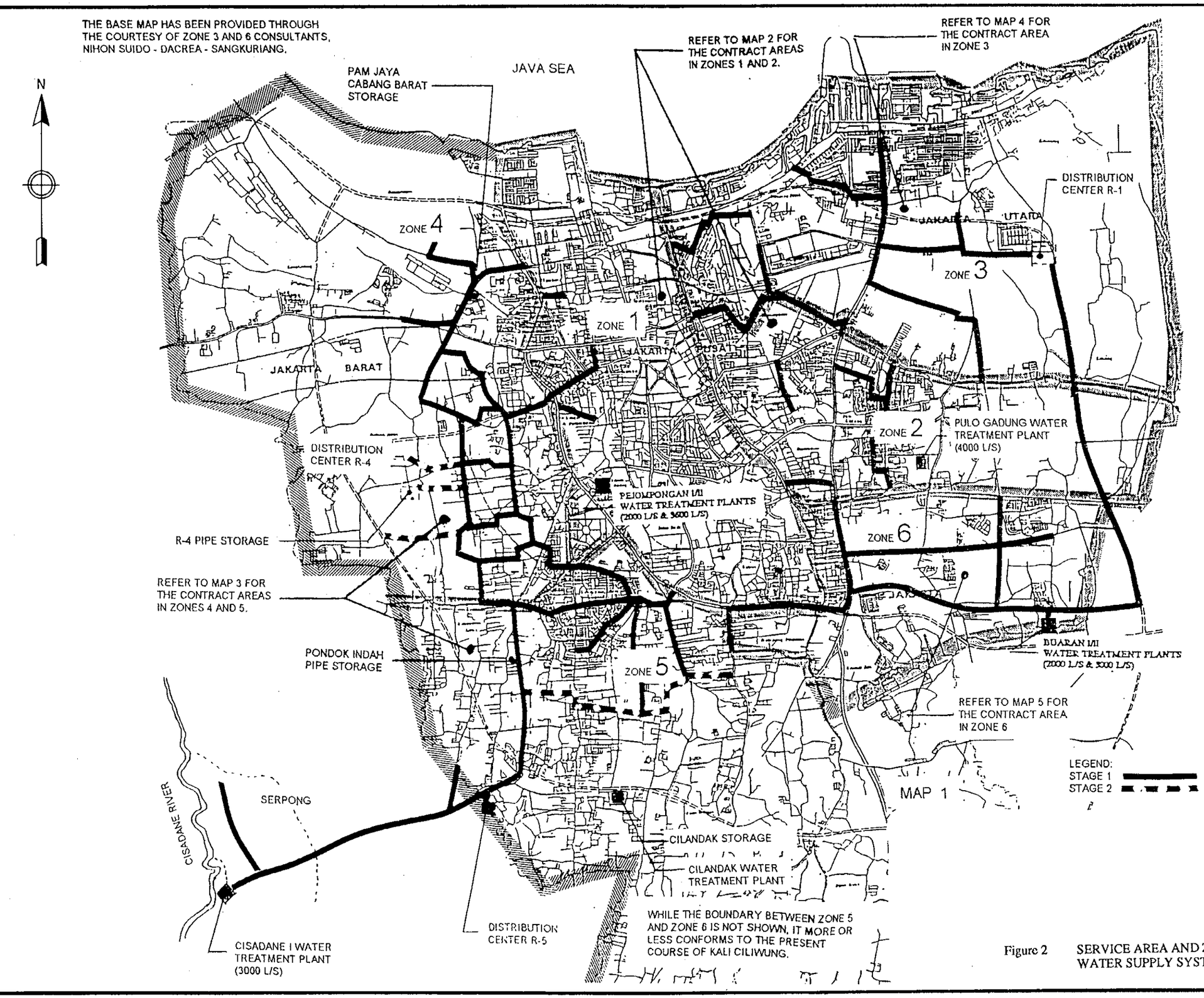


Figure 2 SERVICE AREA AND ZONE OF THE PAM JAYA WATER SUPPLY SYSTEM

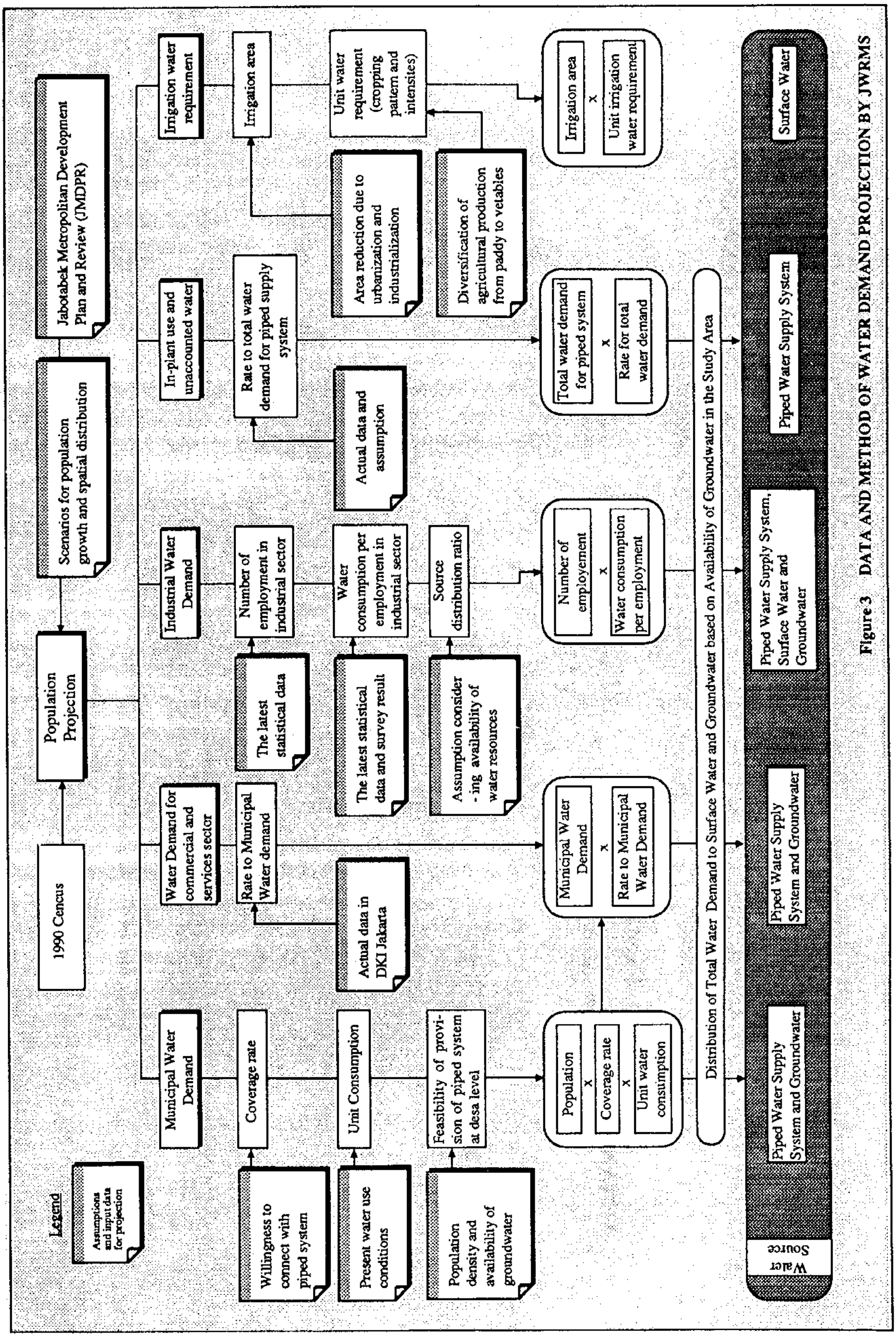
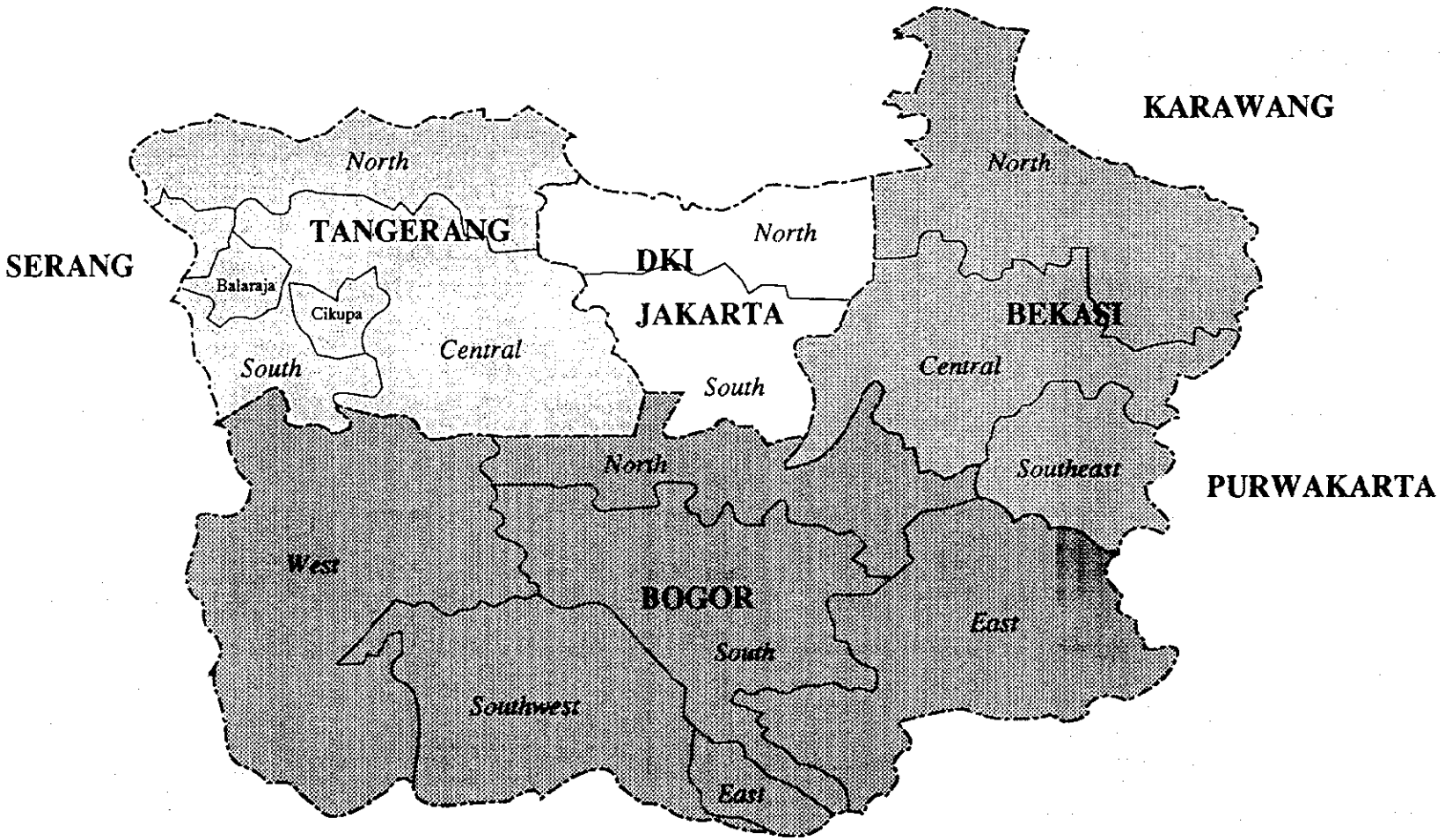


Figure 3 DATA AND METHOD OF WATER DEMAND PROJECTION BY JWRMS



Source: Jabotabek Water Resources Management Study

Figure 4 DEMAND ZONES IN JABOTABEK AREA

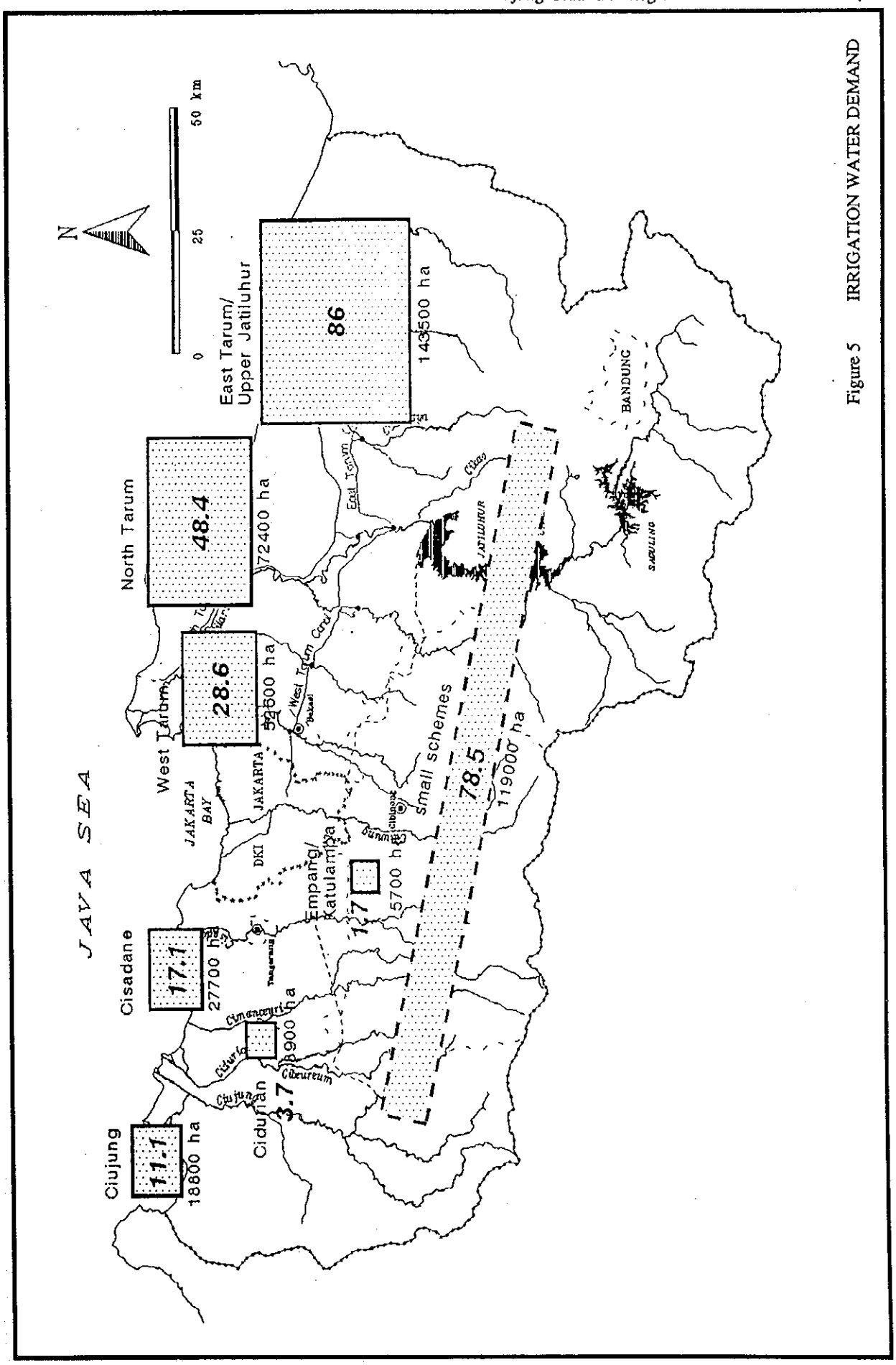


Figure 5 IRRIGATION WATER DEMAND

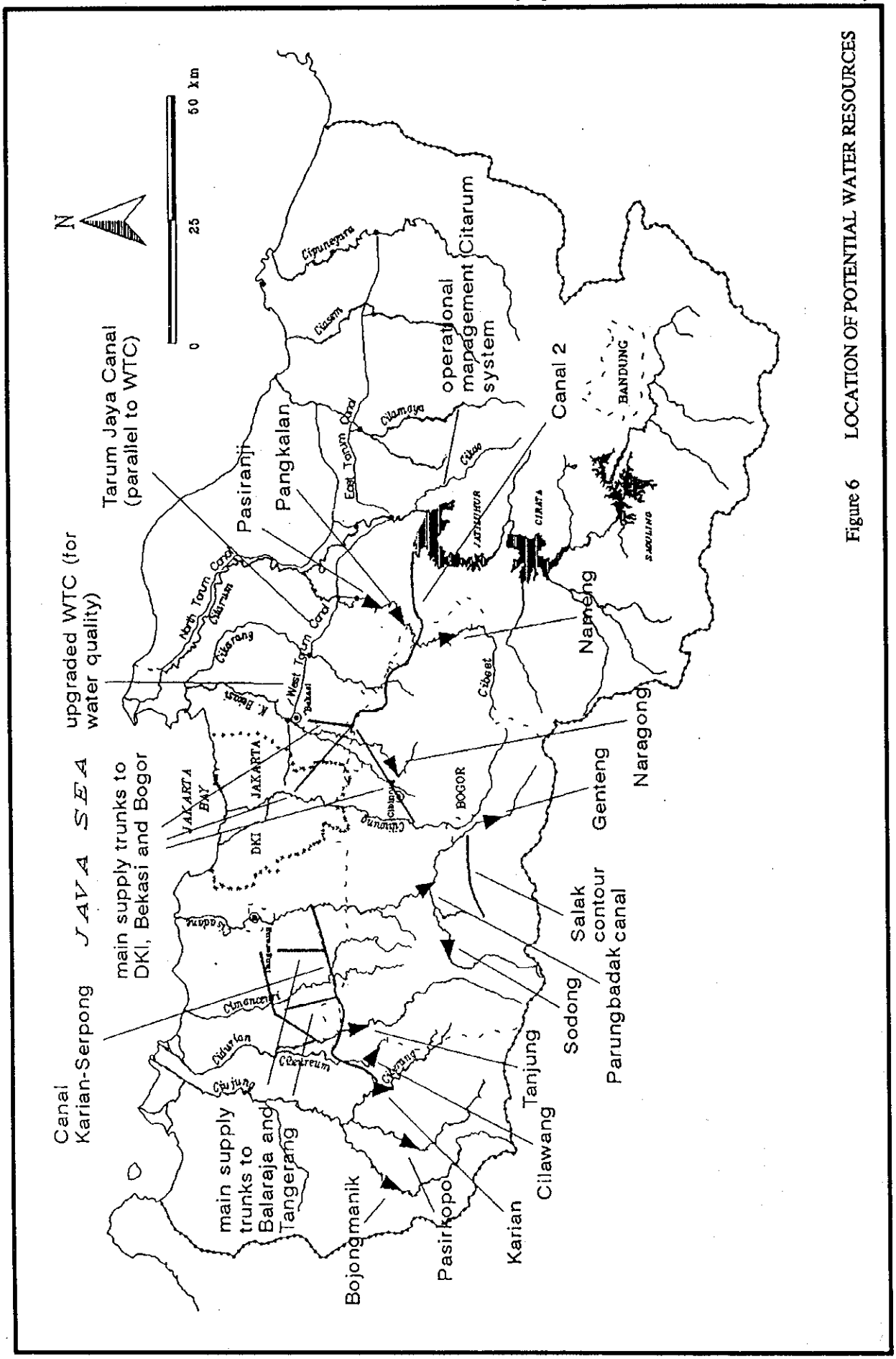
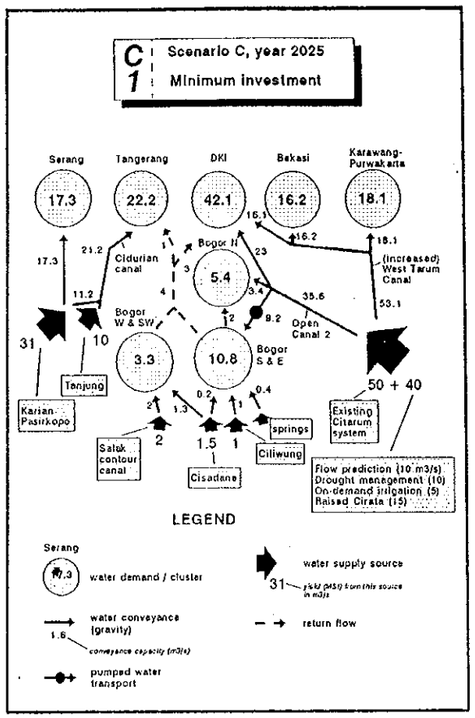
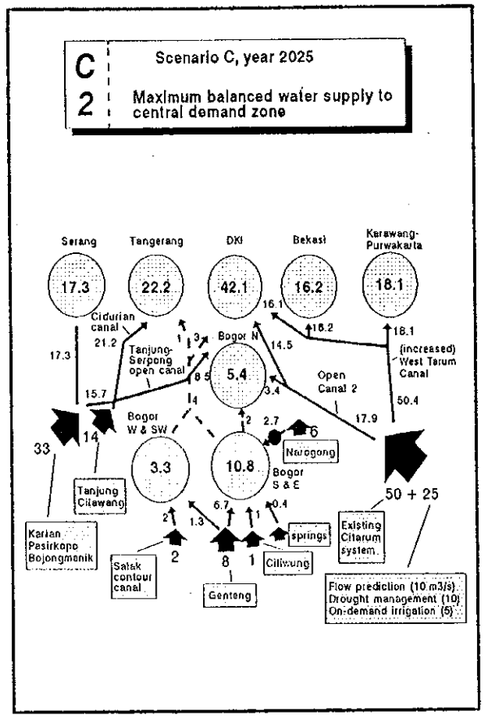
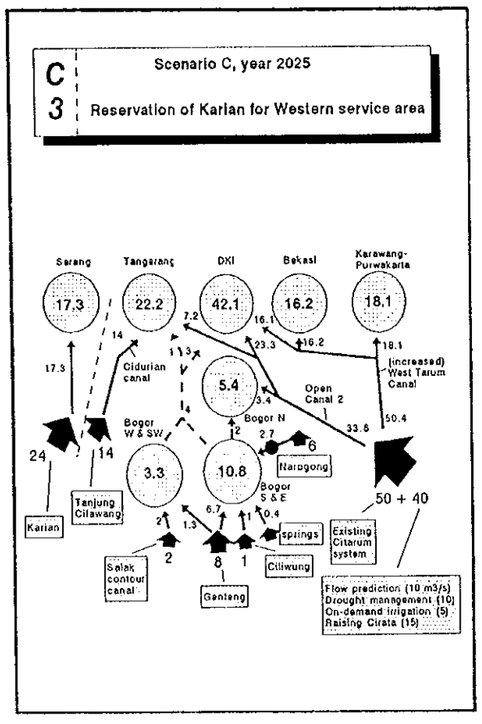
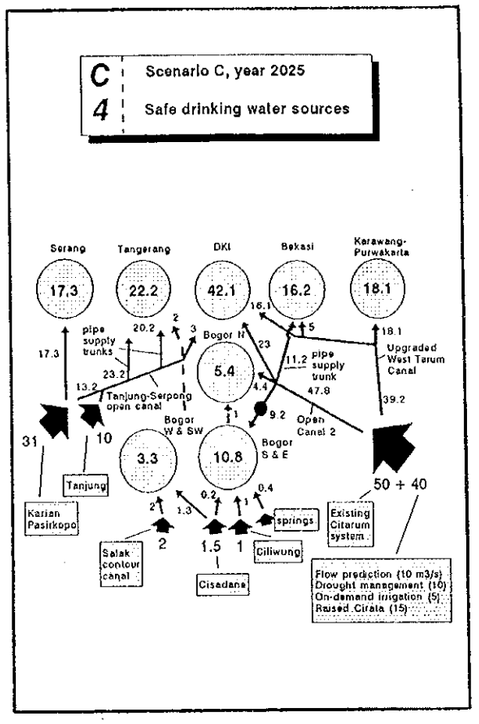


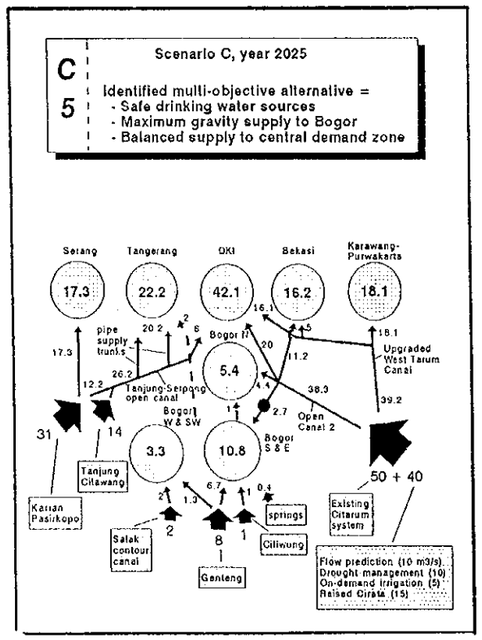
Figure 6 LOCATION OF POTENTIAL WATER RESOURCES

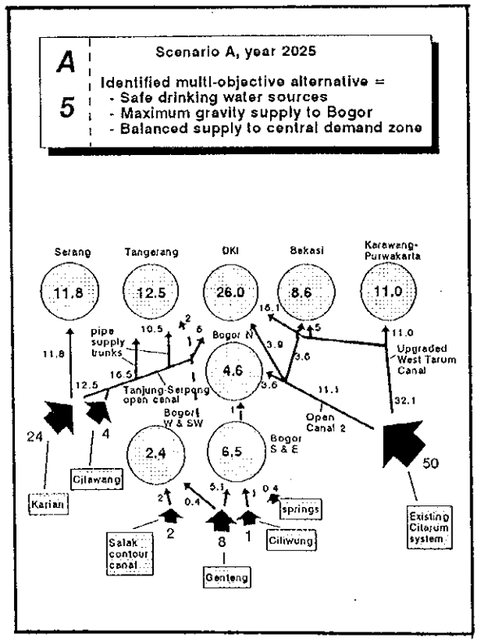












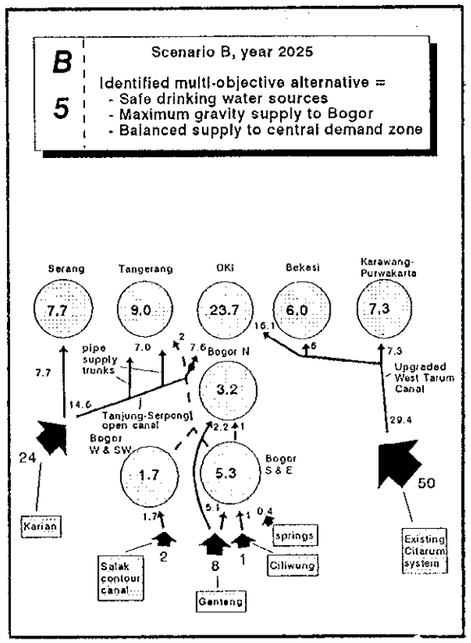


Figure 7 ALTERNATIVE WATER RESOURCES DEVELOPMENT PLANS

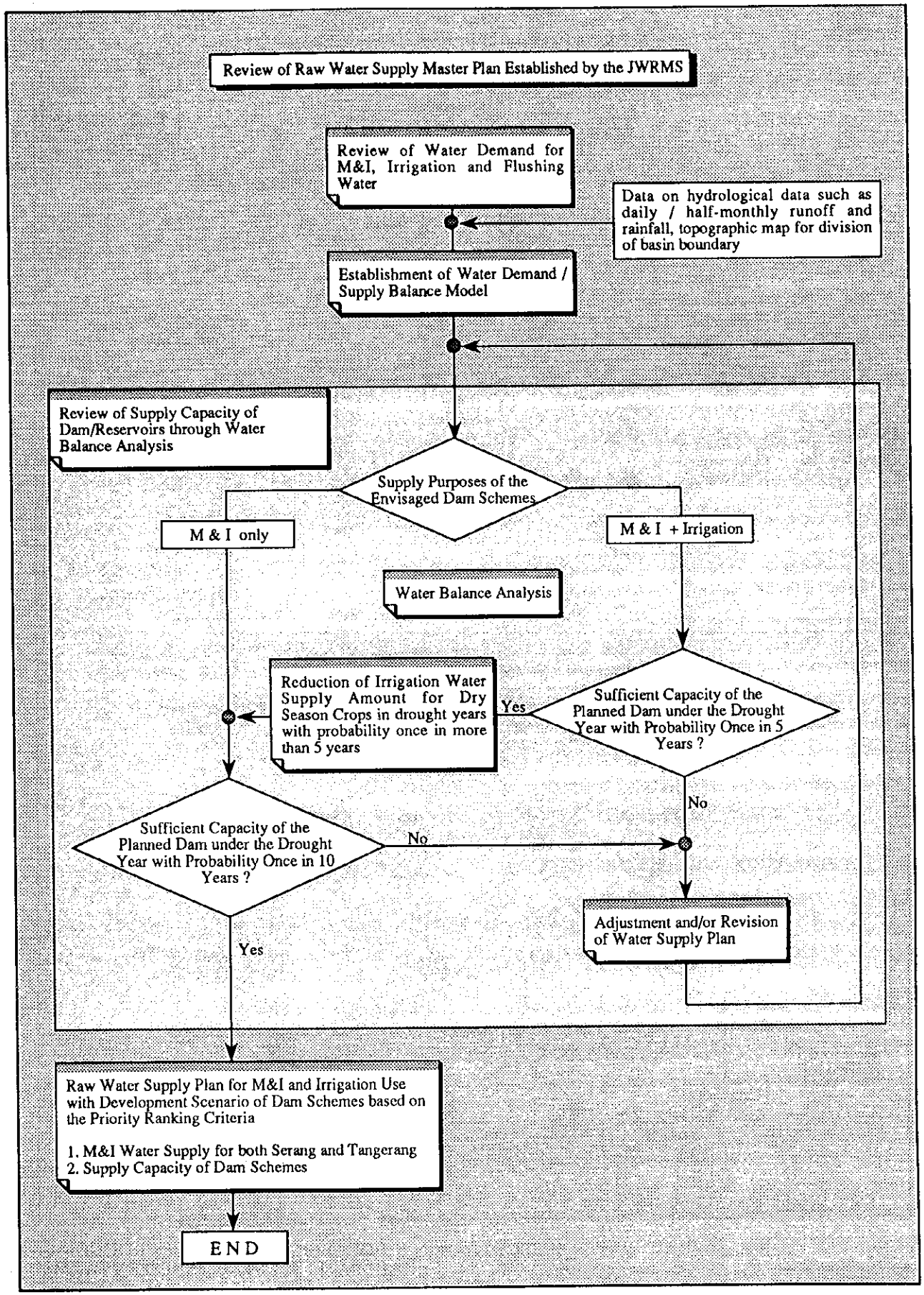
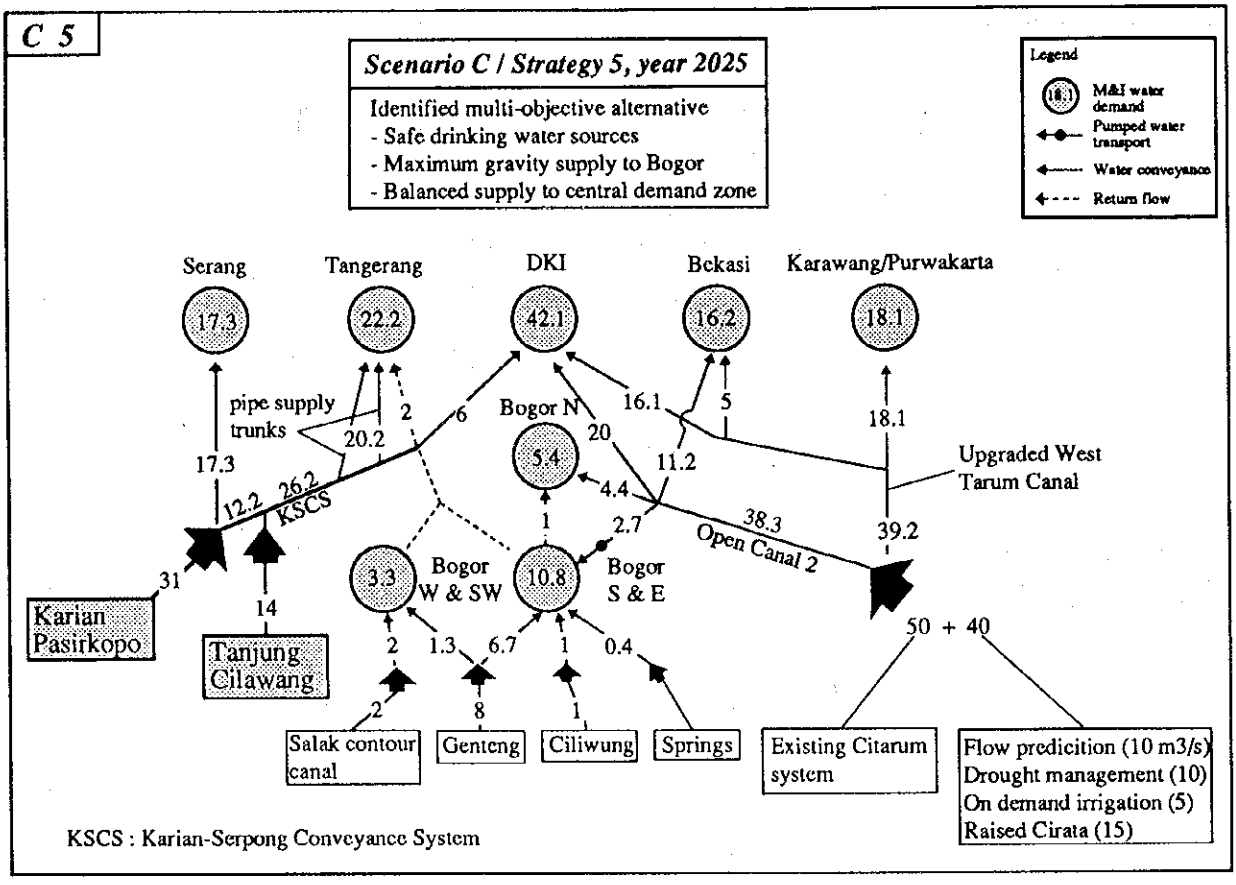


Figure 8 PROCEDURES FOR REVIEW OF RAW WATER SUPPLY MASTER PLAN ESTABLISHED BY JWRMS



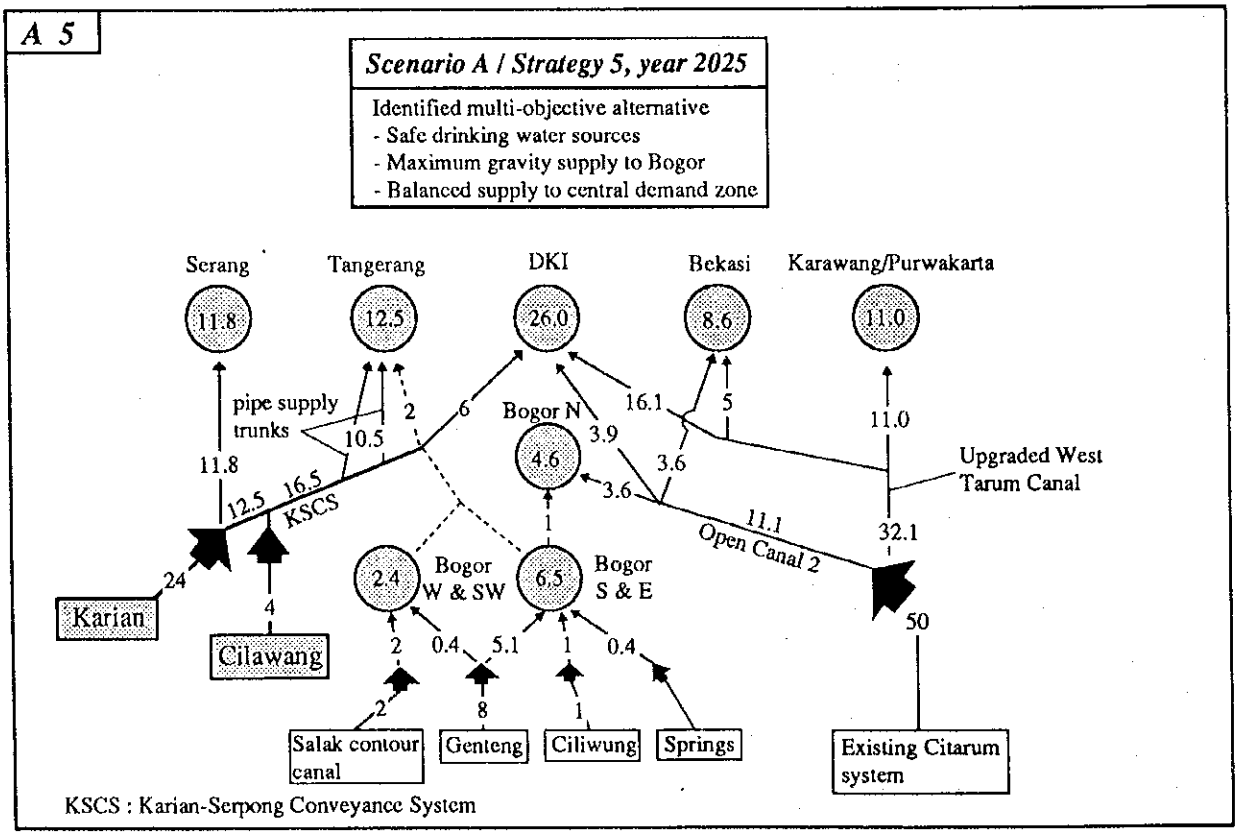


Figure 9 RAW WATER SUPPLY PLAN IN JABOTABEK AREA AND SURROUNDING KABUPATENS, ESTABLISHED BY JWRMS

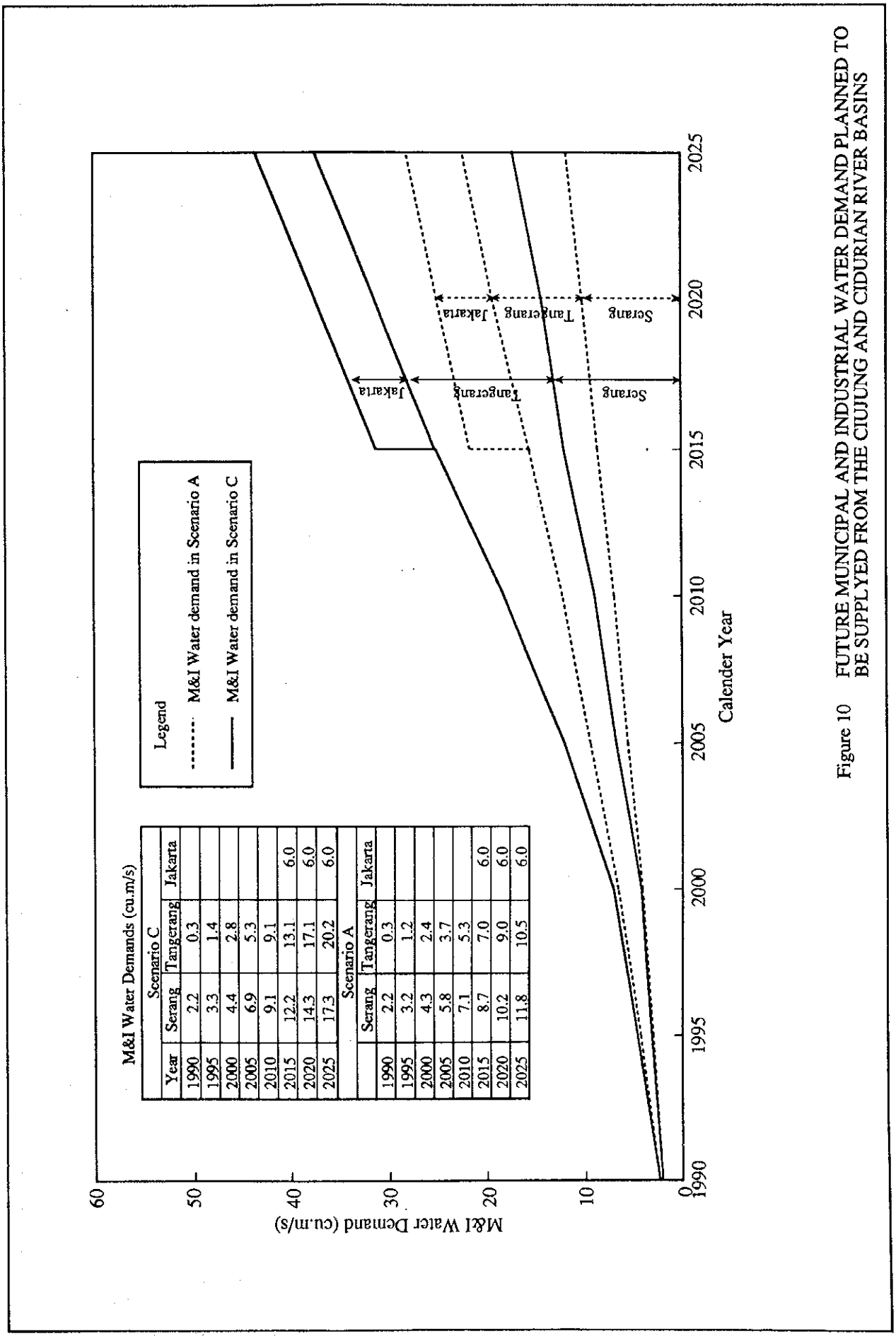
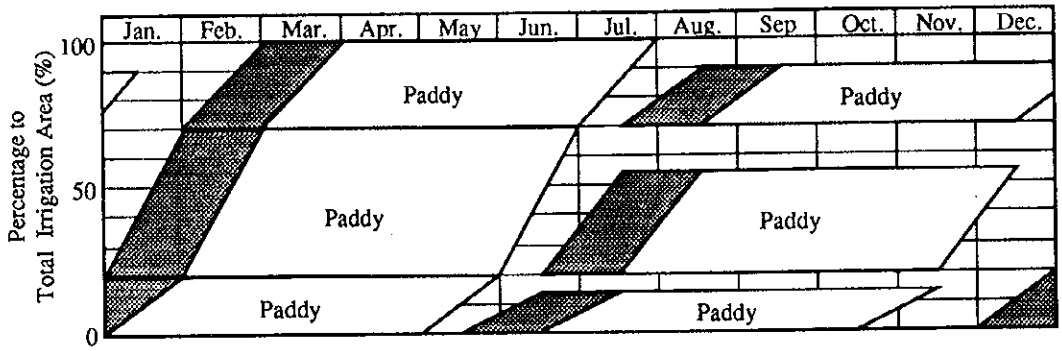


Figure 10 FUTURE MUNICIPAL AND INDUSTRIAL WATER DEMAND PLANNED TO BE SUPPLYED FROM THE CIUJUNG AND CIDURIAN RIVER BASINS

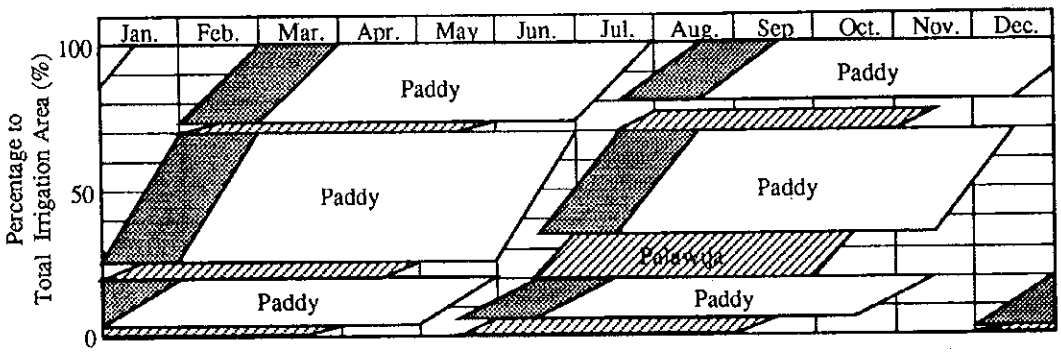
Present Condition

Irrigation area (ha) : 22,988
Average intensity : 168 %



Scenario A

Irrigation area (ha) : 18,862
Average intensity : 168 + 29 = 197 %



Scenario C

Irrigation area (ha) : 18,862 ha
Average intensity : 168 + 55 = 223 %

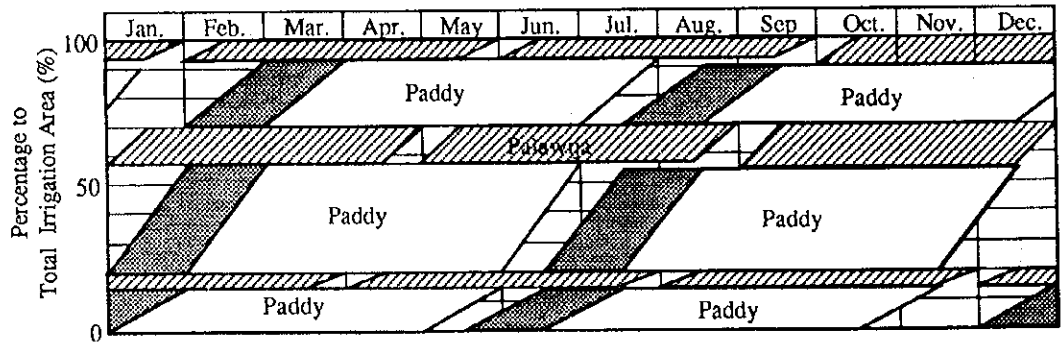
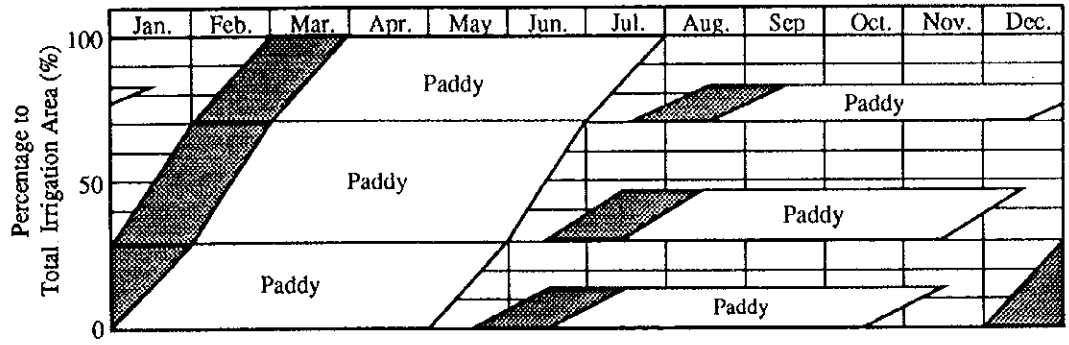


Figure 11 TYPICAL CROPPING PATTERNS FOR SCENARIOS IN CIUJUNG IRRIGATION AREA

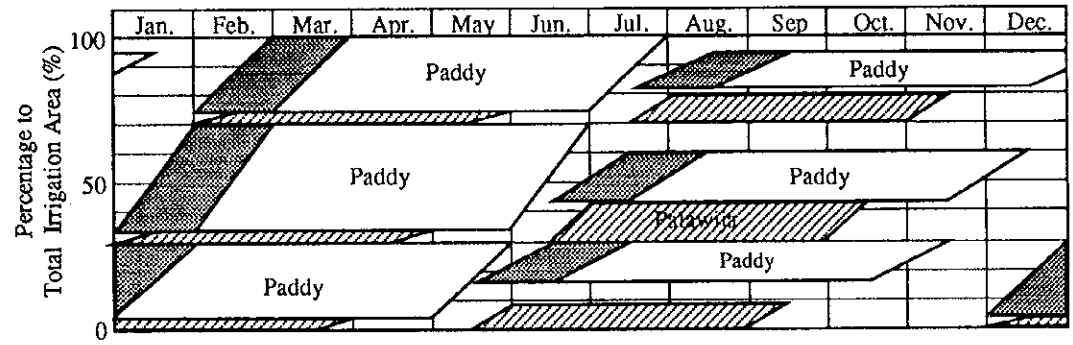
Present Condition

Irrigation area (ha) : 10,805
Average intensity : 142 %



Scenario A

Irrigation area (ha) : 9,312
Average intensity : 142 + 29 = 171 %



Scenario C

Irrigation area (ha) : 8,873 ha
Average intensity : 142 + 55 = 197 %

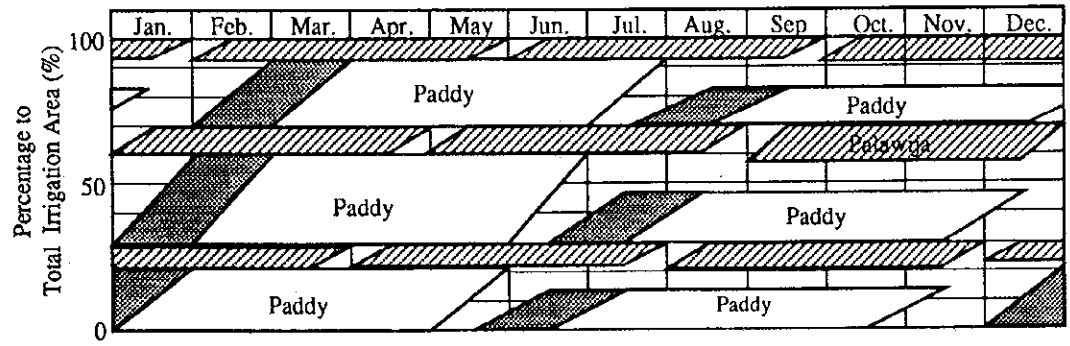


Figure 12 TYPICAL CROPPING PATTERNS FOR SCENARIOS IN CIDURIAN-RANCASUMUR IRRIGATION AREA

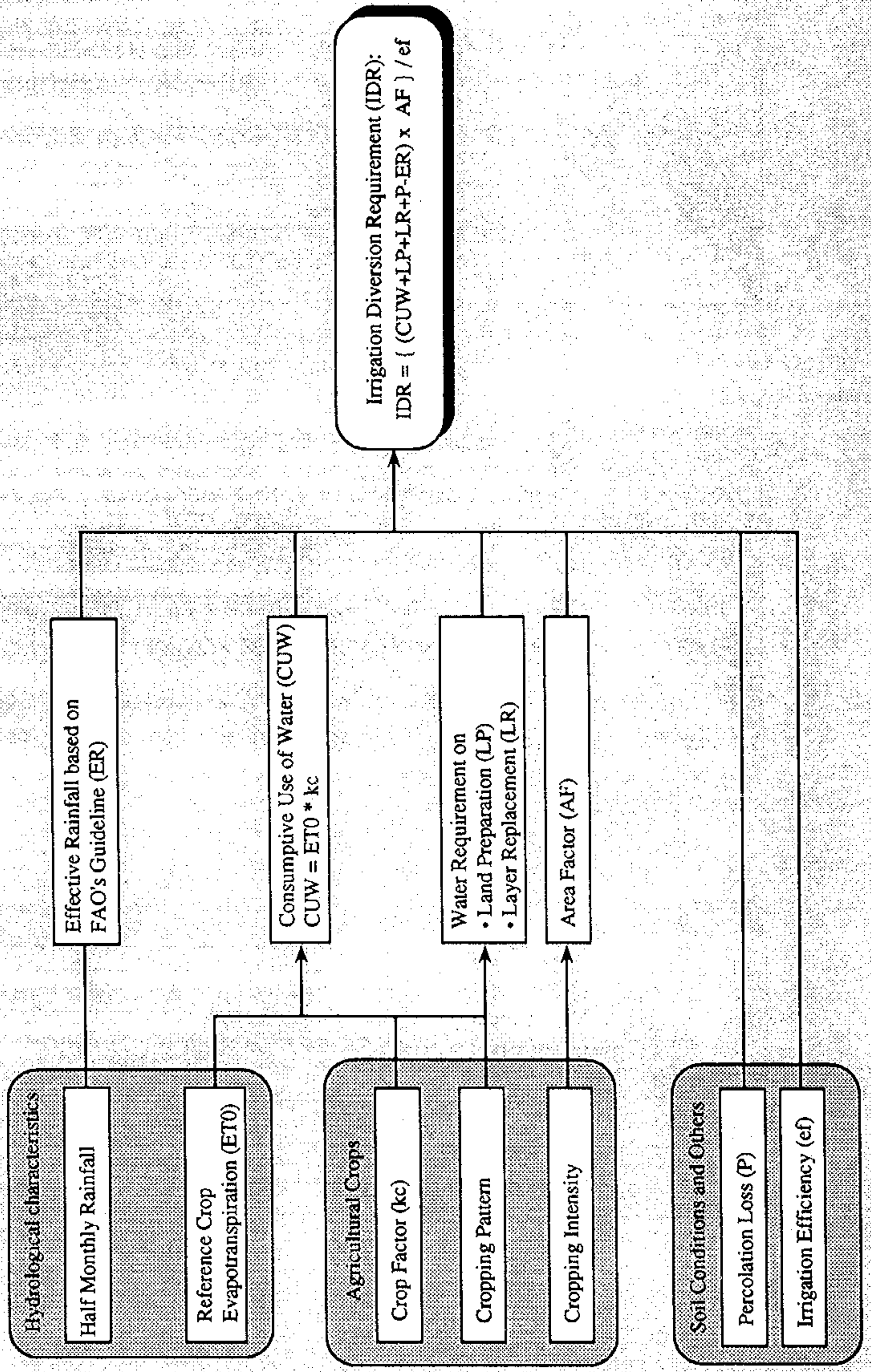


Figure 13 PROCEDURES FOR ESTIMATING IRRIGATION WATER REQUIREMENT

Main Features of Dams	Karian	Pasir Kopo	Cilawang	Tanjung
(1) River basin	Cibeurang	Cisumut	Cibeureum	Cidurian
(2) Catchment area (km2)	288.0	172.0	93.0	280.0
(3) Dam crest elevation (El.m)	72.5	-	81.0	60.5
(4) Dam height (m)	60.5	-	36.0	35.5
(5) High water level	67.5	90.5/100.5	76.5	56.5
(6) Low water level	46.0	80.0	66.5	50.0
(7) Gross storage volume (million m3)	306.0	-	82.0	237.0
(8) Effective storage volume (million m3)	219.0	44.5/112.6	62.0	120.0

Note :
Figures of Pasir Kopo dam in high water level and effective storage volume show those in the scenarios A and C.

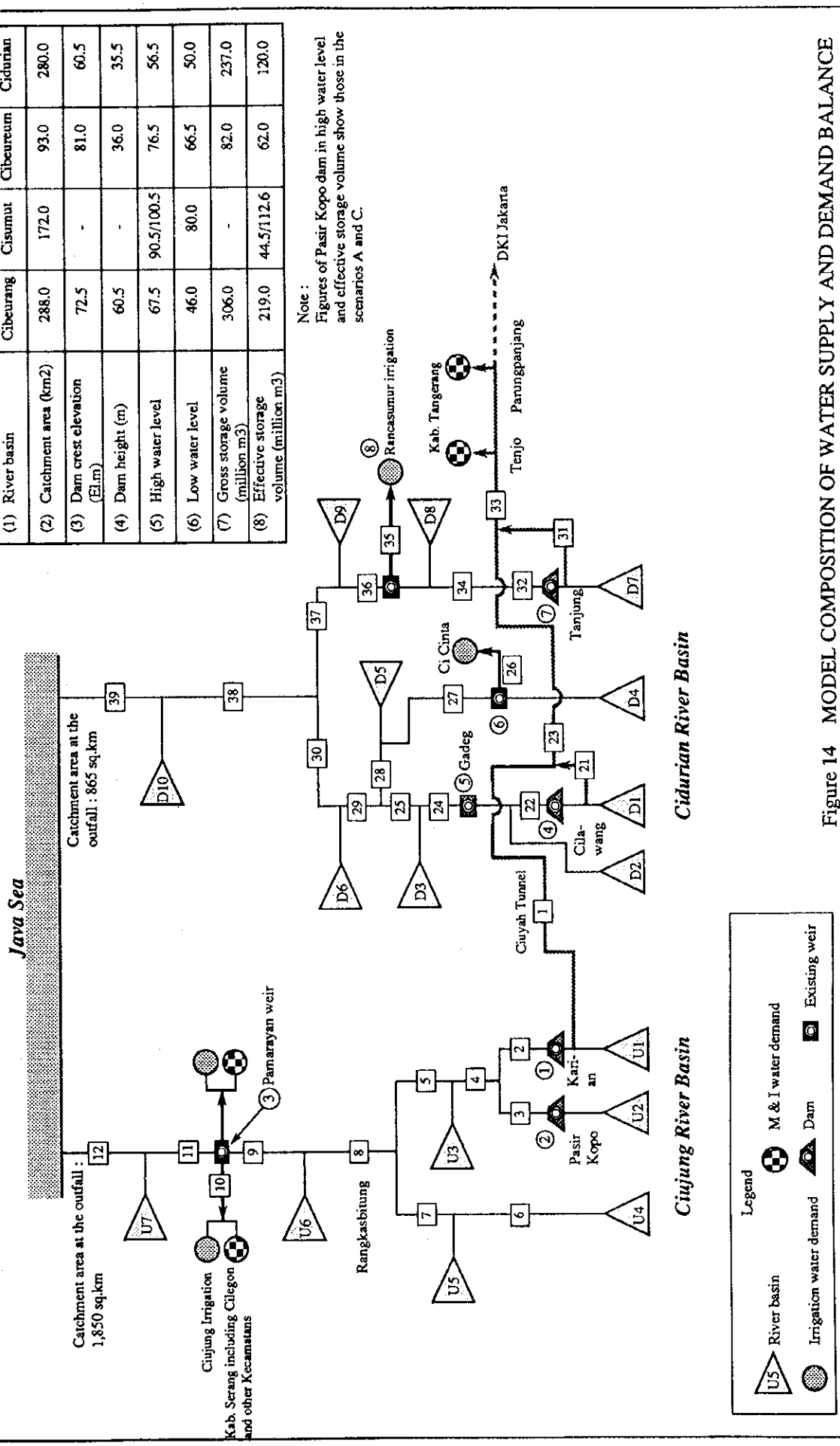


Figure 14 MODEL COMPOSITION OF WATER SUPPLY AND DEMAND BALANCE

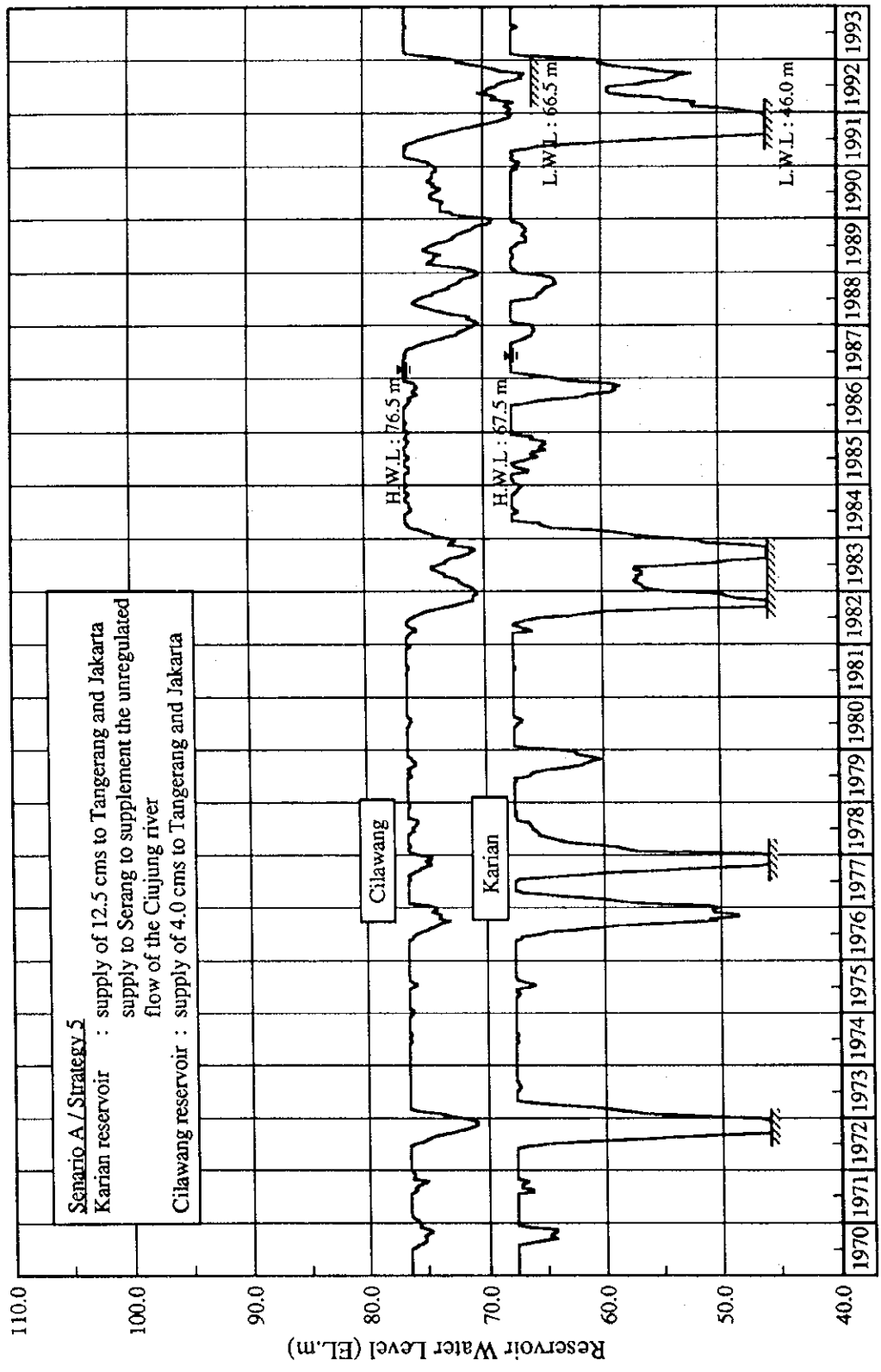
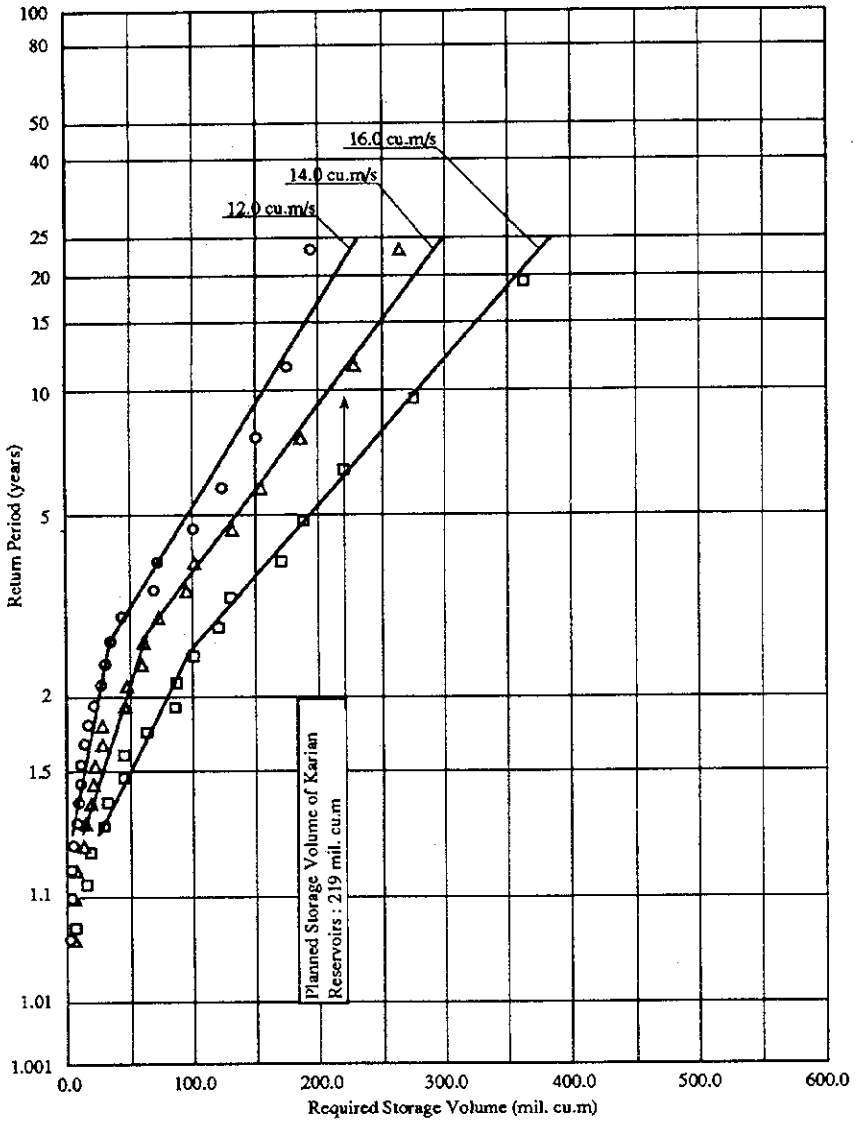
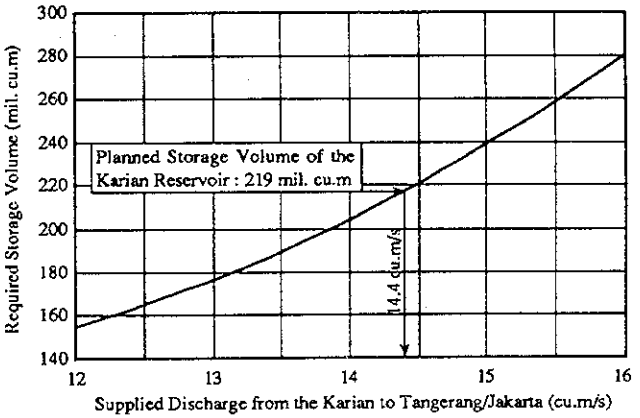


Figure 15 SIMULATED RESERVOIR WATER LEVEL HYDROGRAPHS IN SCENARIO A AND STRATEGY 5





Note :
Figures show M&I water supply amount from Karian to Tangerang/Jakarta without M&I and irrigation water supply to Serang, assuming that the Pasir Kopo fully supplies water to Serang.

Figure 16 FREQUENCY CURVE FOR REQUIRED STORAGE VOLUME FOR KARIAN RESERVOIR FOR TANGERANG/ JAKARTA WATER SUPPLY UNDER DROUGHT CONDITION WITH 10 YEARS RETURN PERIOD

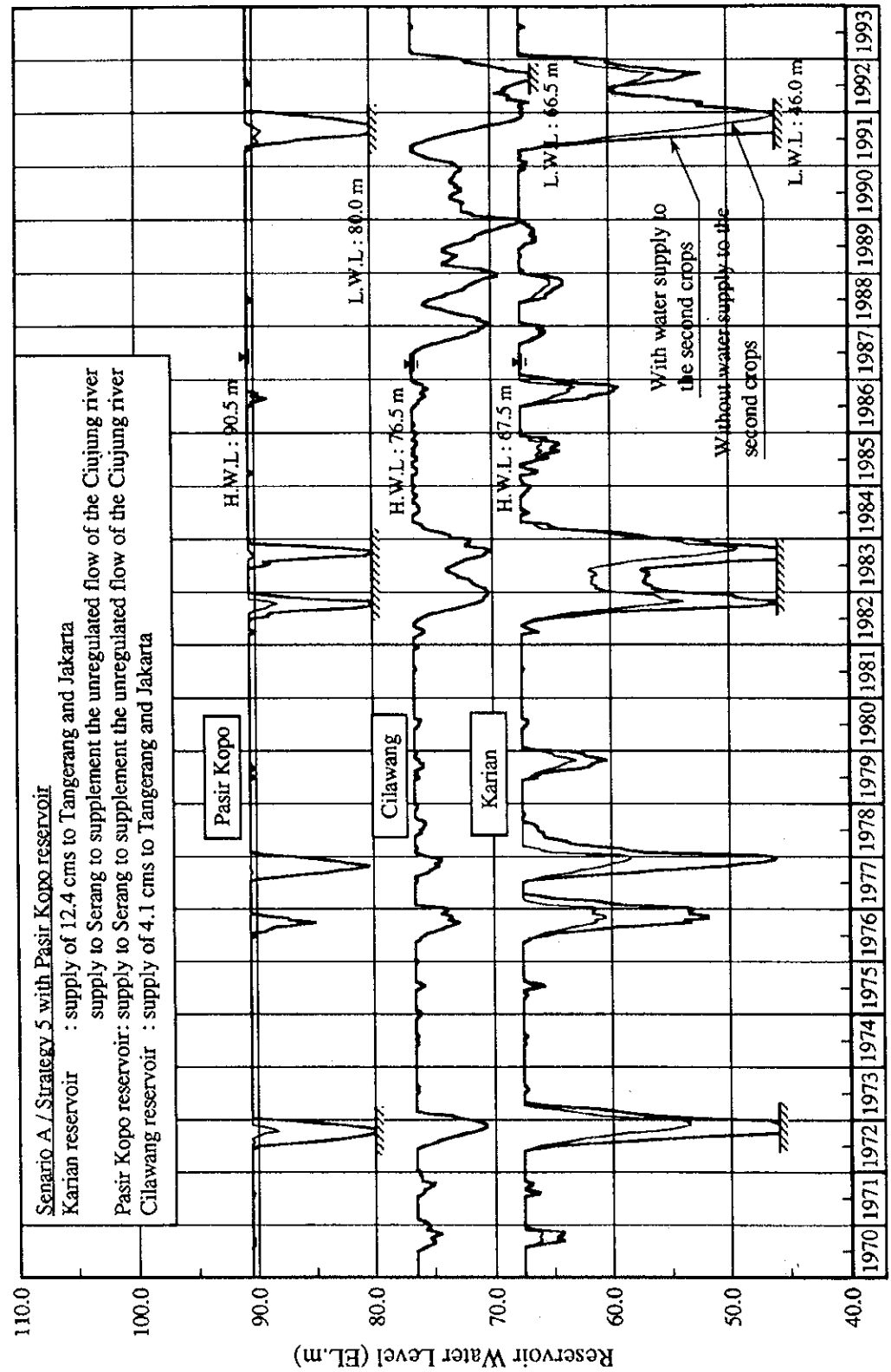


Figure 17 SIMULATED RESERVOIR WATER LEVEL HYDROGRAPHS IN SCENARIO A AND STRATEGY 5 WIYH PASIR KOPO DAM SCHEME

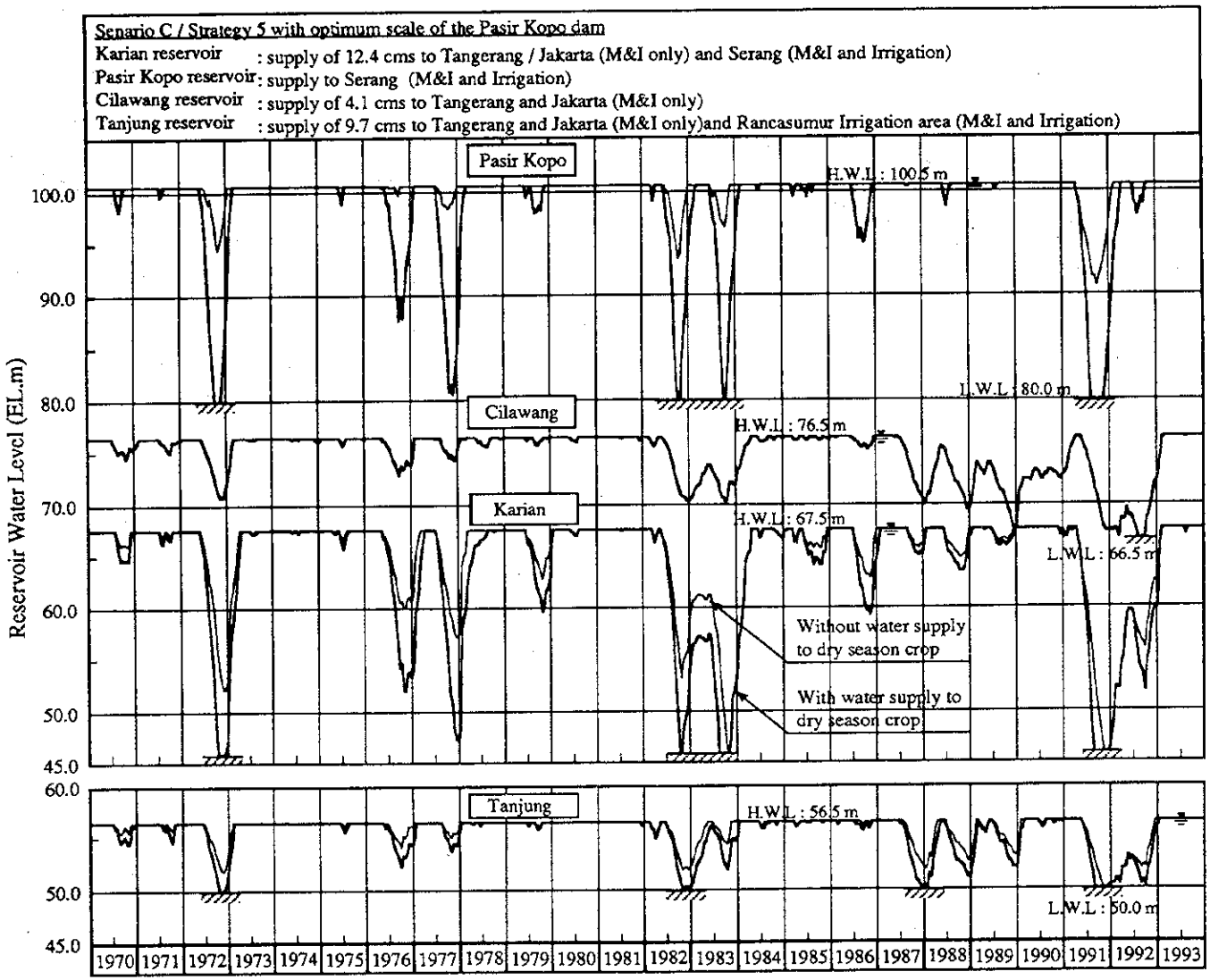
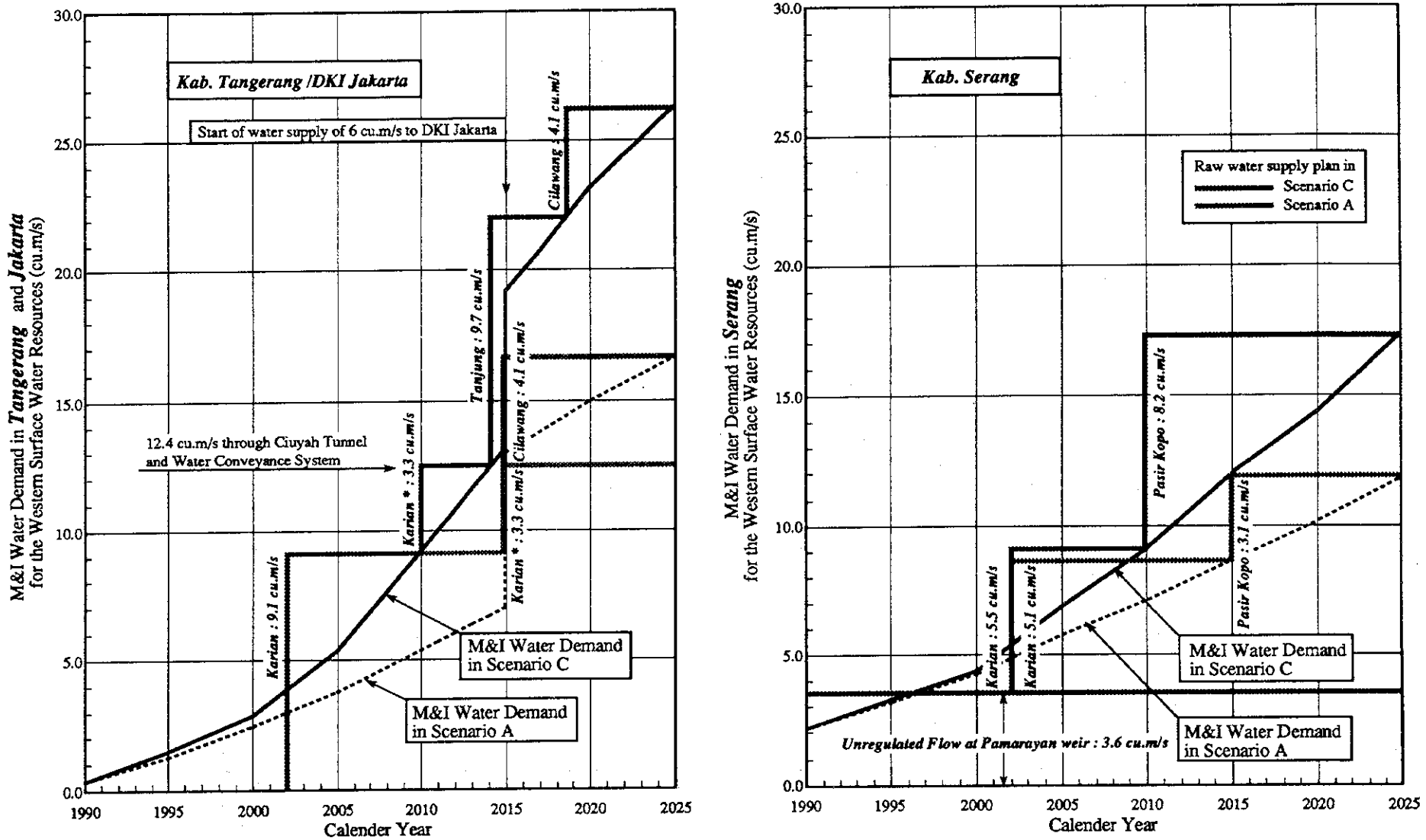


Figure 18 SIMULATED RESERVOIR WATER LEVEL HYDROGRAPHS IN SCENARIO C AND STRATEGY 5 WITH OPTIMUM SCALE OF THE PASIR KOPO DAM SCHEME



Note : Karian with a symbol of " *" means incremental discharge from the Karian dam to Karian-Serpong Conveyance System and decrease of water supply amount for Serang. The decreased discharge is planned to be replaced by the Pasir Kopo dam.

Figure 19 RAW WATER SUPPLY PLAN FOR MUNICIPAL AND INDUSTRIAL USE IN SERANG, TANGERANG AND DKI JAKARTA

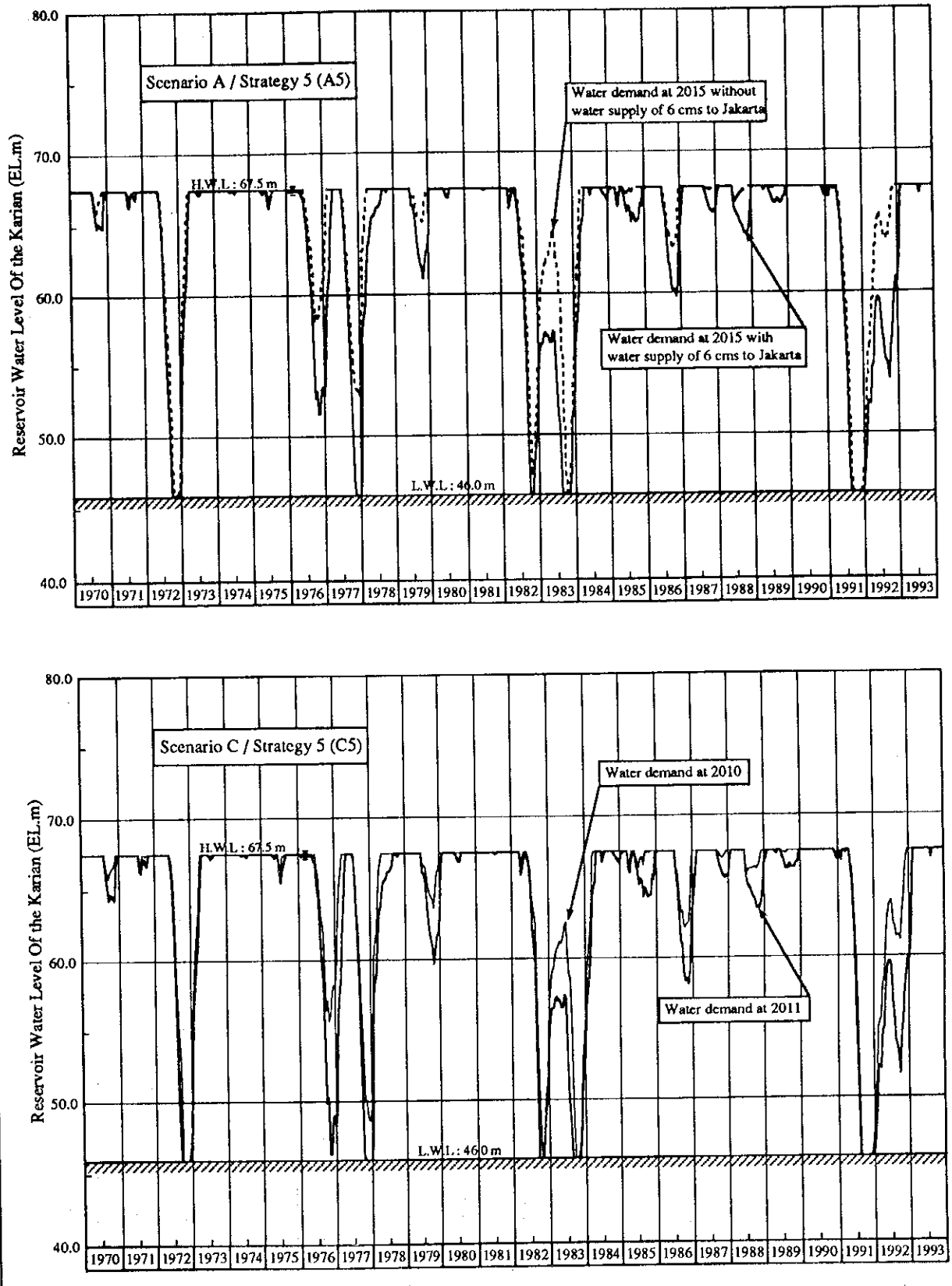
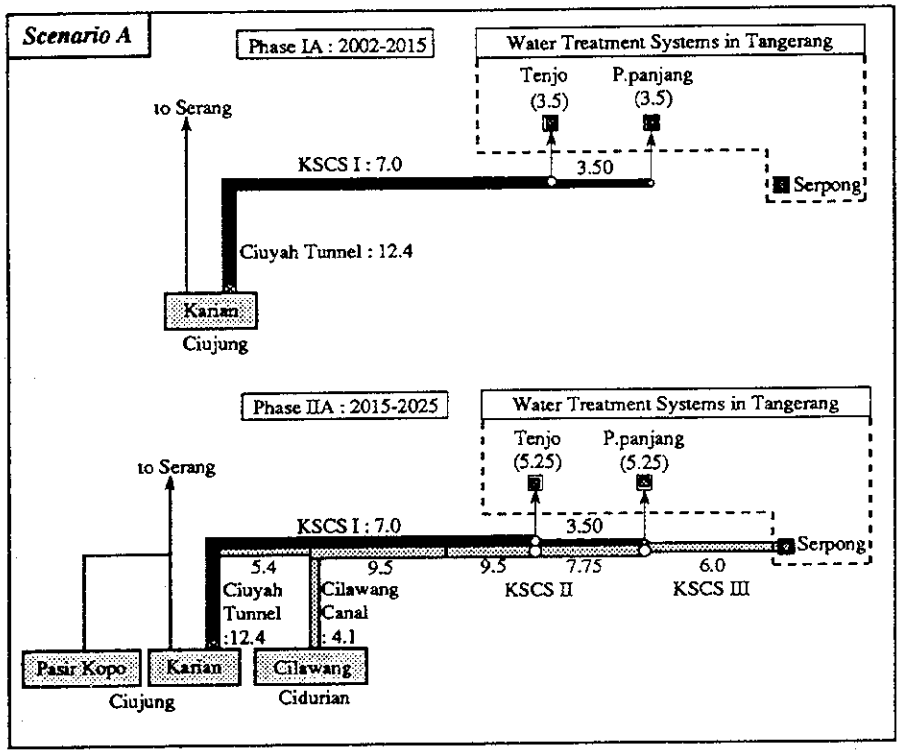
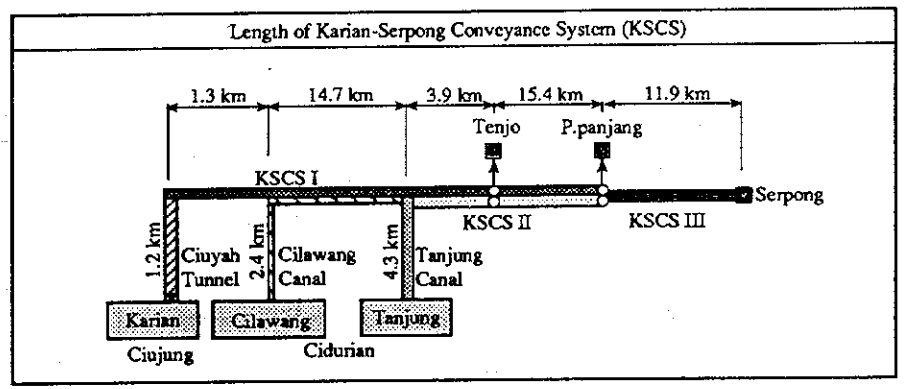


Figure 20 RESERVOIR WATER LEVEL OF THE KARIAN FOR WATER DEMAND IN THE TIME HORISON





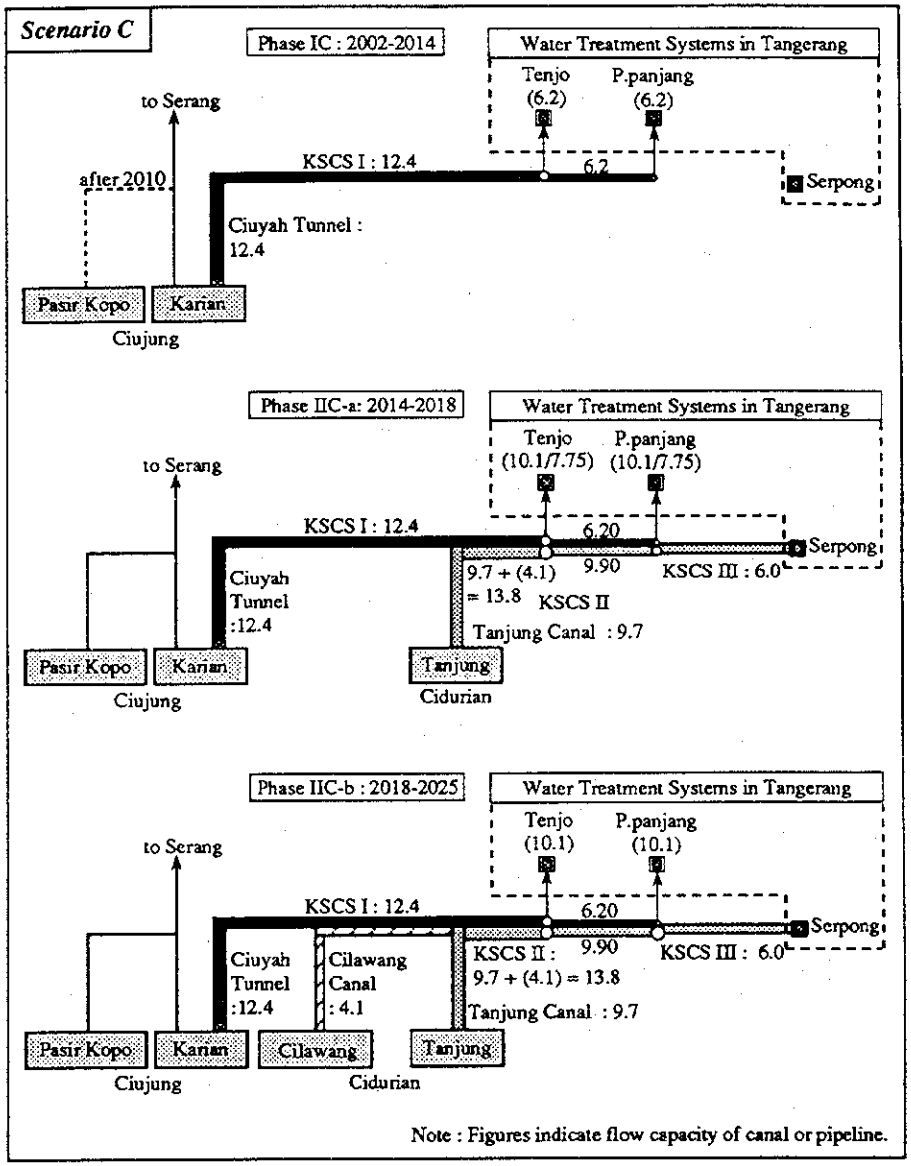
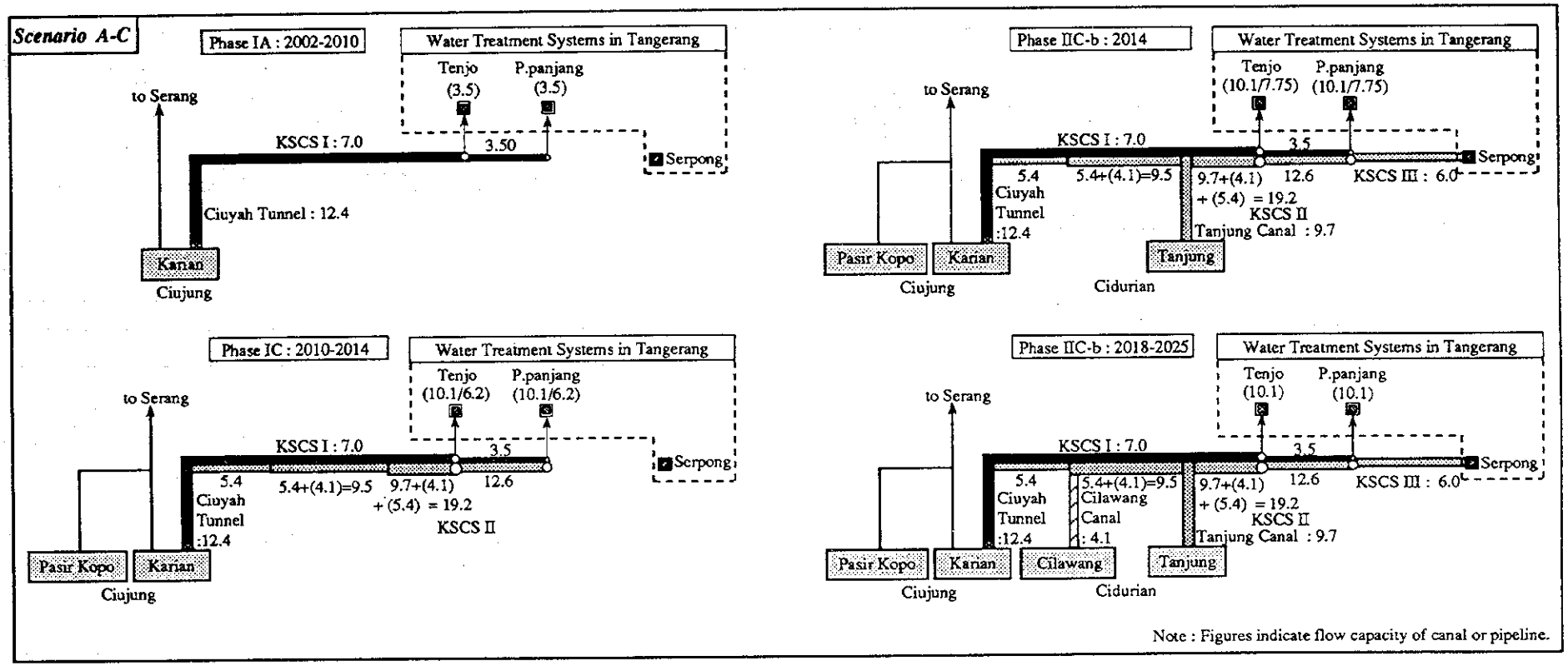


Figure 21 FLOW CAPACITY OF KSCS IN PAHSING DEVELOPMENT (1/2)



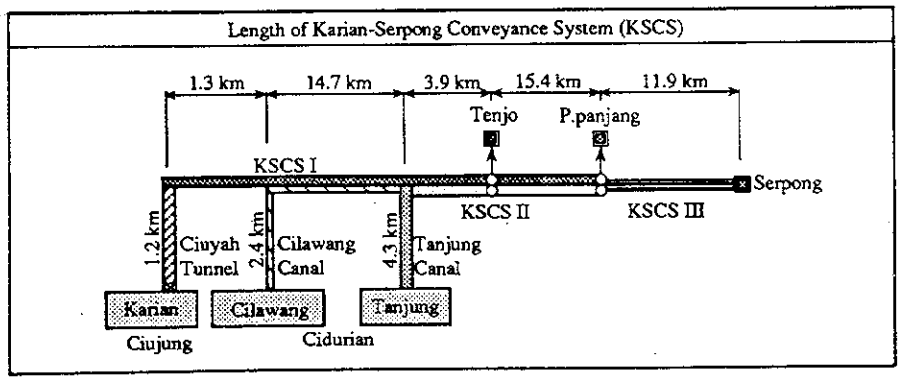


Figure 22 FLOW CAPACITY OF KSCS IN PAHSING DEVELOPMENT (2/2)

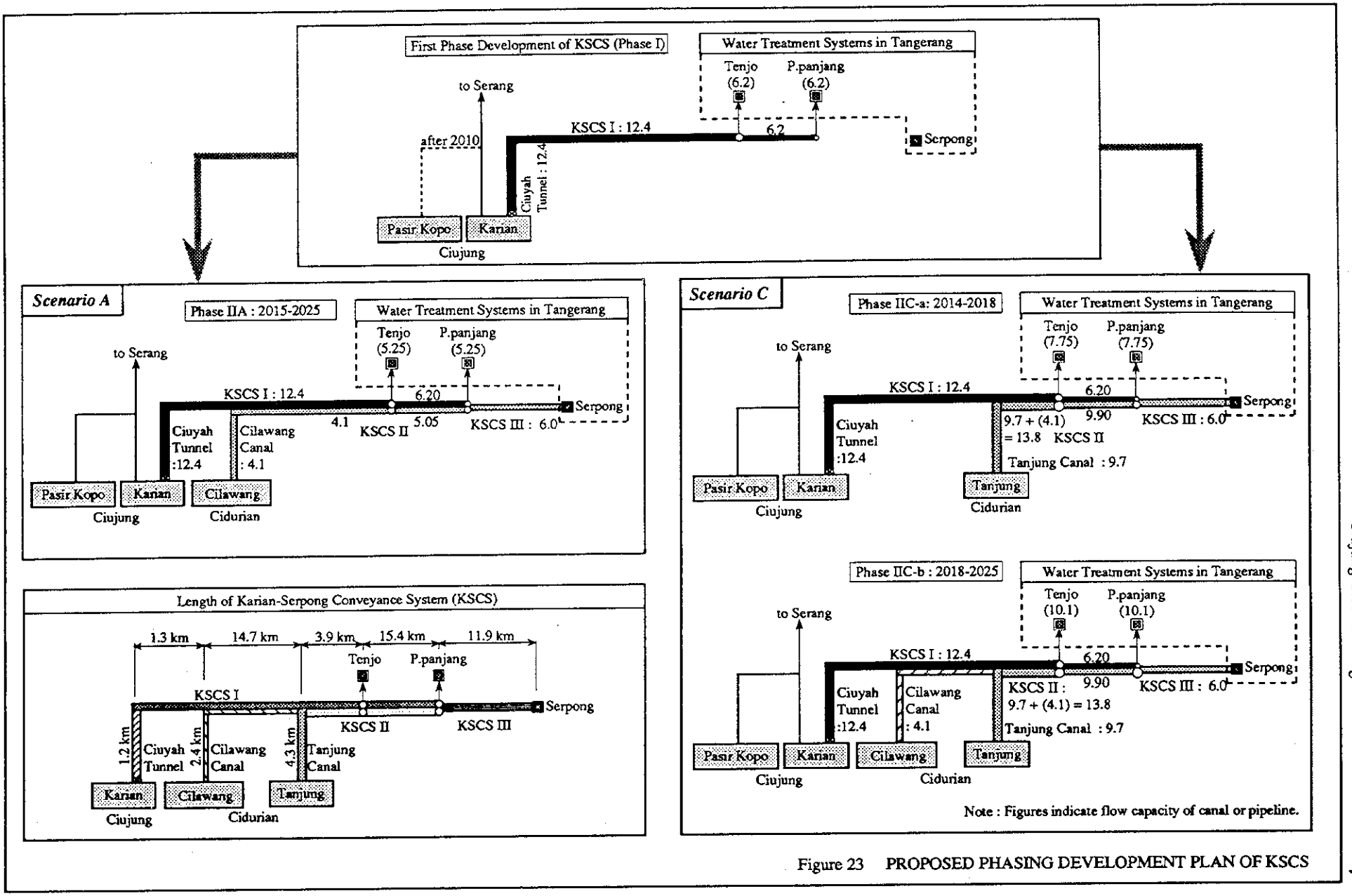


Figure 23 PROPOSED PHASING DEVELOPMENT PLAN OF KSCS

ANNEX 4

PRELIMINARY DESIGN AND ENVIRONMENTAL INVESTIGATION OF PASIR KOPO DAM

THE STUDY ON CIUJUNG-CIDURIAN INTEGRATED WATER RESOURCES

Annex 4 : Preliminary Design and Environmental Investigation of Pasir Kopo Dam

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1. BACKGROUND OF THE SCHEME

The Pasir Kopo dam was identified in the master plan study on the north Banten water resources development, 1983, JICA. The master plan concluded that the priority for the agricultural development and flood control in the study area was not given to the Pasir Kopo dam scheme through screening among the many identified dam schemes in the study area.

Recently, the Jabotabek Water Resources Management Study (JWRMS) reviewed the necessity of the dam scheme focusing on the municipal and industrial (M&I) water supply in order to support the rapid economic development in the north Banten and Jabotabek area. The JWRMS concluded that the Pasir Kopo dam will be necessary in case that the M&I water demands in the study area increase with a high rate due to rapid economic development and diversification of the main water sources for M&I water supply from the groundwater to the surface water as expected in the scenario C.

Based on the conclusion of the JWRMS, the Study reviewed on the scale of the Pasir Kopo dam as stated in Annex 3 : Water Resources Study. As a result, the Pasir Kopo reservoir with the following effective storage volume is proposed to be provided to meet the M&I water demands in Serang during the time horizon till 2025 in both the scenarios A and C:

Effective Storage Volume ($mil.m^3$)	
Scenario A	Scenario C
44.5	112.6

Regarding the Pasir Kopo dam scheme, its construction cost has been estimated by means of the mathematical approach using relationship between dam volume and total construction cost derived from data on the past similar projects in Indonesia.

Preliminary design for the Pasir Kopo, therefore, aims at updating the construction cost based on design of major facilities and preliminary geological and environmental investigation on reconnaissance basis.

2. GEOLOGICAL CONDITION OF THE DAMSITE

Geological condition for dam foundation, possibility of land slide near the damsite and potential quarry sites was investigated through site reconnaissance and analysis for available data by the dam engineers and geotechnical engineers of the JICA study team and DGWRD.

The geology at the damsite consists of the alluvial deposits of Holocene and the tuffaceous sedimentary rock in the Pliocene to Miocene. The foundation of dam structure is expected to be lied on the tuffaceous sedimentary rock. Assuming the similar characteristics as the

foundation of the Karian damsite, which also consists of the tuffaceous sedimentary rock, a dam with a height of 60 m to 70 m is possible to be constructed thereat. The topography formed by landslips with a small scale is found out on both the river bank sides of the damsite, which is needed to be removed at the construction works. A fault line may run in parallel with the meandering river course downstream of 200 m from the damsite.

There are potential quarry sites consisting of Andesite formed by the surface intrusion in the western direction of the damsite within a distance of around 15 km as shown in Figure 1. These potential quarry sites are located at the mountains of the Ungkal Munding, Gublegan, Galabek, Karimun, Lisoeng and Kantong. Among these potential sites, the Genung Ungkal Munding is proposed as a quarry site because of sufficient quality and quantity of the rock material and good accessibility to the sites connected by the existing paved road.

3. PRELIMINARY DESIGN OF STRUCTURES

3.1 Relationship between Storage Volume and Reservoir Water Level

Relationship between reservoir water level, surface area and storage volume was reviewed by using all the available topographic maps with a scale of 1: 50,000 and 1: 5,000 as illustrated in Figure 2. The normal high water levels with the aforesaid required storage volume and sedimentation volume of 38 million m^3 for 100 years are estimated as follows:

Features		Scenario A	Scenario C
Gross Storage	(million m^3)	82.5	150.6
Effective Storage	(million m^3)	44.5	112.6
Sedimentation Volume	(million m^3)	38.0	38.0
Normal High Water Level	(m)	90.5	100.5
Riverbed elevation	(EL.m)	47.0	47.0

3.2 Main Dam and Spillway

3.2.1 Crest elevation of dam and spillway capacity

Crest elevation of the Pasir Kopo dam was decided at that giving the least cost through cost comparison assuming several spillway capacities based on flood routine analysis. In the analysis, overflow spillway type with a side channel was selected taking into account the small catchment area of 172 km^2 and short duration of rising time of discharge hydrograph for the probable maximum flood (PMF) with the peak discharge of 3,300 m^3/s. Layout of the spillway is determined at the left bank based on the consideration that the left bank of the damsite is expected to require smaller excavation works than those of the right bank side which has rather steep slope of river bank with a height of 70 m.

In order to design overflow length of the spillway, relationship between overflow length and construction costs for dam and spillway and land acquisition cost was examined as follows:

Scenario	Overflow Length (m)	Spillway Capacity (m^3/s)	Dam Crest Elevation (EL.m)	Construction Cost (Rp. billion)			
				Main Dam	Spillway	Land Acquisition	Total
A	50	1,220	98.5	18.9	8.2	37.4	64.5
	75	1,470	98.0	18.0	9.2	36.3	63.5
	100	1,630	97.5	17.4	10.1	35.6	
	125	1,760	97.0	17.0	11.0	34.9	62.9
	150	1,870	96.5	16.6	12.0	34.4	63.1
C	50	990	108.0	30.9	7.5	50.9	89.3
	75	1,180	107.5	30.0	8.4	49.9	88.3
	100	1,320	107.0	29.4	9.2	49.1	87.7
	125	1,430	106.5	28.9	10.0	48.6	87.5
	150	1,520	106.0	28.7	10.8	48.3	87.8

In the above table, dam crest elevation was derived at the flood water level simulated by the flood routing for PMF and freeboard of 2.0 m against wave induced by wind and protection layer with thickness of 0.5 m for core zone.

Through the comparative study mentioned above, the overflow length of 125 m giving the least cost was adopted for design of spillway structure, and the dam crest elevation was set at EL.97.0 m in the scenario A and EL. 106.5 m in the scenario C.

3.2.2 Main dam

Main dam was designed as center core rockfill type with five (5) zones; core, fine and coarse filter, rock and riprap zones, referring to the design of the Karian dam. Since there are no engineering data on foundation of the damsite, under the assumption that the foundation condition is similar to that at the Karian damsite, foundation treatment by providing blanket and curtain grout was planned to be provided. Also, the dam slopes at the upstream and downstream sides were set at 1:3.0 and 1:2.5 respectively, referring to design slopes of the proposed Karian dam. The estimated embankment volume for the main dam is given as follows:

Zone	Embankment Volume (m^3)	Embankment Volume (m^3)	Material
Core	55,600	88,800	Earth, Sand and Gravel
Fine filter	34,500	54,000	Sand and Gravel
Coarse filter	24,200	38,000	Sand and Gravel
Rock	272,600	473,900	Andesite
Riprap	33,700	46,300	Andesite
Total	420,600	701,000	-

General layout plan and typical section of the Pasir Kopo dam for the scenarios A and C are shown in Figures 3 to 6.

3.2.3 Spillway

The general layout plan of the spillway is shown in Figures 3 and 4, and profile and cross section are given in Figure 7. As shown in the figure, the spillway facility is comprised of an overflow weir, side channel, chute and hydraulic jump stilling basin.

The capacity of over flow weir was designed at 1,760 m^3/s in the scenario A and 1,430 m^3/s in the scenario C against the PMF of 3,300 m^3/s taking into account retardation effect of the reservoir estimated through flood routing analysis. These flood discharges will safely flow down through the side channel with a width of 25 m and a channel gradient of 1:25 and the connection channel with a control weir of 2 m height. The bed slope of spillway chute was designed at 1:3 in consideration of topographic condition. The hydraulic jump stilling basin was planned against the flood discharge 610 m^3/s with an excess probability once in 100 years, and the length of apron, height of end-sill and side wall were designed at 50 m, 6 m and 20 m, respectively.

3.3 River Diversion

The river diversion tunnel was planned to be laid out in the right bank side and designed to safely pass the flood discharge of 400 m^3/s with excess probability once in 20 years. One lane of diversion tunnel with a diameter of 6.0 m in the scenario A and 5.8 m in the scenario C was designed as shown in Figure 8.

Crest elevation of coffer dam was determined at the maximum elevation not to cross the filter zone. As a result, the crest elevation was set at EL. 70 m in the scenario A and EL. 75 m in the scenario C as shown in Figure 5.

3.4 River Outlet Facilities

Two (2) kinds of river outlet facilities were planned to be provided; one for normal water supply to Serang, the other for emergency outlet to draw down the reservoir water level for dam safety. The former outlet capacity was set at 18 m^3/s in the scenario A and 24 m^3/s in the scenario C through water demand and supply balance analysis. The capacity of emergency outlet was determined at 70 m^3/s in the scenario A and 165 m^3/s in the scenario C, which is able to draw down the reservoir water level from the high water level to low water level during ten (10) days at the time of annual average inflow.

In the scenario A, the intake pipeline with a diameter of 1.7 m for normal water supply was designed along the spillway on the left bank in consideration of higher construction cost of intake tower and tunnel in case of using diversion tunnel. While, the emergency outlet consisting of a steel pipeline with a diameter of 2.2 m and a hollow jet valve with a diameter of 2 m was planned to be provided by using diversion tunnel with a diameter of 6 m.

In the scenario C, the intake tower and tunnel with a diameter of 3.5 m and emergency outlet were planned to be connected with the diversion tunnel.

Figures 9 and 10 show the intake tower and typical cross section of the intake tunnel.

3.5 Main Features of the Pasir Kopo Dam

The main features are given as follows:

Main Features		Scenario A	Scenario C
1. Catchment area	(km^2)	172.0	172.0
2. Dam Structure			
Dam crest elevation	(EL.m)	97.0	106.5
Dam type		Center Core Rockfill	Center Core Rockfill
Dam height	(m)	52.0	61.5
Dam embankment slope : Upstream		1:3.0	1:3.0
Downstream		1:2.5	1:2.5
Embankment volume	(m^3)	420,600	701,000
3. Reservoir			
Flood water level	(EL.m)	94.2	103.7
Normal high water level	(EL.m)	90.5	100.5
Low water level	(EL.m)	80.0	80.0
Reservoir Area	(km^2)	6.4	9.2
Gross Storage	(million m^3)	82.5	150.6
Effective Storage	(million m^3)	44.5	112.6
Sedimentation Volume	(million m^3)	38.0	38.0
4. Spillway			
Type		Ungated	Ungated
Length of overflow section	(m)	125.0	125.0
Width of chute way	(m)	25.0	25.0
Total length	(m)	358.9	379.9
Design flood discharge	(m^3/s)		
• Scale of design flood		PMF	PMF
• Inflow		3,300	3,300
• Outflow		1,760	1,430
5. River Diversion			
Probability of design flood		1/20	1/20
Design discharge	(m^3/s)	400	400
Diameter of diversion tunnel	(m)	6.0	5.8
Slope of diversion tunnel		1:128	1:150
6. Intake structure			
Intake discharge	(m^3/s)	18.0	24.0
Intake gate			
Diameter of steel pipe	(m)	1.7	3.5
Diameter of valve	(m)	1.5	1.6
7. Emergency outlet			
Maximum discharge	(m3/s)	35.0	129.0
Emergency gate			
Diameter of steel pipe	(m)	2.2	3.5
Diameter of valve	(m)	2.0	3.0

4. PRELIMINARY ENVIRONMENTAL INVESTIGATION

4.1 Natural Environment

4.1.1 Physio-chemical environment

The area subject to be submerged by the Pasir Kopo Dam is located in a basin with a size of approximately 4 km width from the east to the west and 3 km from the north to the south. The Cisimeut river flows through the center of the basin from the southeast to the northwest, meandering along the course of the river.

The altitude of the basin is ranging from EL. 45 m at the river bed of the dam axis to EL. 115 m at the western edge of the basin. An average altitude of the hills surrounding the basin is from 180 m to 220 m above the sea level. The mountain range located at the eastern side of the basin is about EL. 500 m.

Both sides of the river course are the alluvial plain where rice filed has been extensively developed. Vegetables, coconuts and other agricultural commodities for self consumption and trade are also grown extensively.

4.1.2 Vegetation

Since the Pasir Kopo basin has been developed mainly for estate during the colonial period and afterwards become rice field and the settlement area, natural vegetation there has been eliminated in the most of the areas. Where there is no human activities, the vegetation has already been replaced by the secondary growth of trees and scrub within the lower portion of the basin. The upper part with relatively steep slope has been the remnant of old estate crops planted during the colonial period after the World War II. They are, however, being made by use of the local residents for primary or secondary income. The estate crops are mainly clove, rubber, coconut and oil palm. Thus, mixture of these crop tree species with secondary growth dominates the upper part of the slope of the Pasir Kopo basin.

4.1.3 Wildlife

The wildlife in the Pasir Kopo basin has already been highly disturbed by the past development works on agriculture. No sign of significant or endangered species has been traced in the project area. There is no record in the village or kecamatan offices on the existence of any significant or endangered wildlife species.

4.2 Socio-economic Environment

4.2.1 Agricultural activities

Land in the Pasir Kopo reservoir area has been utilized mainly for production of paddy, rubber, durian and clove as shown in Figure 11 and agricultural activities thereat is relatively prosperous for the following reasons:

1) relatively wide and flat topography,
2) rich water source,
3) existence of a motorable road network which enables the farmers to move their commodities to the nearest consumption center, and
4) old estate areas fragmented for small holders.

An preliminary interview survey by the JICA study team indicated that 47.5 % of the total interviewed local residents own separate portions of land to which they can move out when their present residential area will be submerged by the Project. It is a sign of which people in the Pasir Kopo area are relatively wealthy comparing to other areas in Kabupaten Lebak. This is due mainly to the high agricultural potentiality of wide and flat area available in the Pasir Kopo basin.

4.2.2 Population to be affected by the project

Table 1 shows the number of households affected by the Project and Table 2 gives the socio-economic data in the affected administration areas on the desa basis. Total number of households subject to relocation would be 1,781 in case of the scenario C and 846 in the scenario A assuming the high water level of the reservoir at EL. 104 m and 94.5 m, respectively.

Total population was estimated at about 8,020 in the scenario C and 3,810 in the scenario A by multiplying the aforesaid households with the average family size of 4.5 persons.

4.2.3 Interview survey for resettlers

A preliminary interview survey was carried out by the study team against 183 households, about 10 % of households subject to relocation in the scenario C. Out of 183 households, residents of 89.1% replied that they will agree to move out from the present residential areas. Among the residents of 89.1%, 53,4 % wants to move out to their own land areas available outside the reservoir area while 2.5% will move to their relative's place.

The result of interview survey shown in the Table 2 can be interpreted as follows:

(1) 49.7 % of the local residents can move out to their own land or relative's place,

(2) 21.9 % of the local residents rely on the government relocation program,
(3) 16.4 % of the local residents will look for privately available land upon compensation paid to them,
(4) 1.1 % of the local residents do not have any idea, otherwise will take up the option of transmigration program,
(5) 90.1% of the local residents are not interested in changing their present occupation, mainly those of related to agriculture, and
(6) 9.9% of the local residents want to change their present occupation.

4.2.4 Indigenous minority people

There is a group of minority people known as "Baduy" living in Kecamatan Kanekes, Kabupaten Lebak and the area is located at the south of the Pasir Kopo reservoir area. They are known to be one of the Sundanese tribes who lived on the coastal areas of Western Java before the advent of Islamic religion to Indonesia. Their direct ancestor is believed to be the Hindu Kingdom of Pajajaran thriving before 15th century.

As they rejected the Islamic religion in the 15th century, they had to move out to the isolated mountainous region to the south of Pajajaran Kingdom. Since then, the "Baduy" people have stayed independently from any regulations of the Government, maintaining and preserving their own value system and the way of life.

The "Baduy" can be divided into two classes of people: one is called the "Inner Baduy" that consists of three families and still maintains their own value system in which they reject to possess any artificial goods affected by the modern culture; the other is called the "Outer Baduy" who are allowed to own modern goods. The present day economic activities of both of the "Inner Baduy" and "Outer Baduy" are based on the mixture of agriculture and trading. Hunting and gathering occupies small portion of their life style at the moment. Their cultivation technology is in the primitive stage comparing to that of the people living in the surrounding areas.

Since 1976, the Department of Social Affairs has made effort to modernize the "Outer Baduy" people and has began developing their resettlement areas around the Pasir Kopo basin as shown in Table 4. At the time, the population of the "Baduy" was 4,057, although a different source recorded that their population was 4,574 in 1983. This might be the indication that the population of "Baduy' is on the increase. On the other hand, a group of people would move in and out of the territory.

There are two separate sites designated for the relocation areas of the "Baduy". One is located in the area directly to the northeast of Pasir Kopo Dam on the right bank of Cisimeut river. The area has been divided into several villages since the program began in 1977 in order to provide well-planned resettlement areas for the "Baduy" people as well as for the

local residents. The other site is in the area to the southwest of the reservoir area. The name of the village is Kompol as shown in Figure 12.

In relation to the Pasir Kopo Dam, a portion of agricultural area and the housing area owned by the "Baduy" people resettled to the aforesaid areas may be affected by the construction of access road to the dam site, although this will depend on the alignment of the access road. Further, a part of the main body of dam and its ancillary buildings may also affect the agricultural area, which is the area of former rubber estate where rubber sap is still collected by the "Baduy" people and the local residents for a small cash income.

The resettlement area of Kompol will not be affected by the reservoir. However, agricultural areas, which are developed by the "Baduy" villagers as well as the local residents in the lower part of Kompol along the small tributary of Cisimeut river, may be submerged in case that the Pasir Kopo dam scheme is constructed to meet requirements in the scenario C.

There is a plan to move 100 families or more of the "Baduy" people into Kompol area during the period of 1995-1996 and a similar program is going on in Desa Jalpang Mulya located the north of the dam site. Depending on the performance of the present social development project conducted by the Ministry of Social Affairs, a considerable number of the "Baduy" resettlement areas may be created in and around the reservoir areas of Pasir Kopo Dam for the next 10 to 20 years. Therefore, very close liaison with the Department of Social Affairs for further development of the "Baduy" resettlement areas is vital for the successful planning of the Pasir Kopo dam scheme as this is a sensitive issue at the moment and would probably remain so in the future.

4.3 Land Acquisition and Compensation

4.3.1 Potential resettlement area

A candidate for resettlement area for residents in the Pasir Kopo reservoir area was identified at the governmental estate of PT.P11 located on the right and left banks of the Cisemut, the private estate of PBS Pasir Kopo, and/or small nucleus estate distributed along the downstream reaches from the damsite in the Cisemut river through preliminary reconnaissance by the study as shown in Figure 13. The total potential resettlement area was estimated at 4,100 ha.

4.3.2 Land acquisition and compensation cost

Land acquisition and compensation cost was estimated by assuming that 66.1 % of households will move to their own land or find out relocation area by themselves after receiving monetary compensation and that 33.9 % of households will relocate their houses to the resettlement area to be prepared by GOI.

Land compensation area was derived by using the rate of each land use category for the total area in Table 2 and summarized as follows:

(unit : ha)

Land Use Category	Scenario A	Scenario C
Rice field	224.0	322.0
a) Irrigated	68.2	98.1
b) Rainfed	3.4	4.9
c) Dry land	2.2	3.2
Estate	102.4	147.2
Upland crop	224.0	322.0
Settlement area	57.6	82.8
Others	32.0	46.0
Total	640.0	920.0

As for area division into monetary compensation and relocation to the resttlement area, the same rate of housesholds was applied for estimate of cost.

Unit prices for houses and land area by cateegory were established based on the data from the regional government (PEMDA), regional development agency (BAPPEDA), Cipta Karya and tax office (NJOP) in Tangerang, Bogor and Lebak.

Based on the above assumptions, land acquisition and compensation cost was estimated as given Tables 5 and 6 for both scenarios A and C. The total land acquisition and compensation cost were estimated at Rp. 20,137 million for the scenario A and Rp. 33,579 million for the scenario C.

TABLES

Table 1 AFFECTED AREAS BY PASIR KOPO DAM

(1) Flood water level at EL.104.0 m

Kabupaten	Kecamatan	Desa	Kampung	No. of Household
Lebak	Leuwidamar	Sangkanwangi	Batang	150
			Bunter	30
			Rancamalang	280
			Kompol	142
			Kadukesur	8
			Leuwipesing	20
			Daruwas	10
		Margawangi	Kaleker	43
			Babakan Hilir	80
			Kamancing	56
			Sawah	27
		Cisimeut	Lambur	65
			Cibunut	120
			Bantarnaga	300
			Cimuntur	120
			Cipeuyah	30
		Nayagati	Karag	170
			Babakan Giran	130
			Total	1,781

(2) Flood water level at EL.94.5 m

Kabupaten	Kecamatan	Desa	Kampung	No. of Household
Lebak	Leuwidamar	Sangkanwangi	Batang	150
			Bunter	30
			Rancamalang	280
			Kompol	142
			Kadukesur	8
			Leuwipesing	20
			Daruwas	10
		Margawangi	Kaleker	43
			Babakan Hilir	80
			Kamancing	56
			Sawah	27
			Total	846

Table 2 SOCIO-ECONOMIC DATA IN THE PASIR KOPO AREA

Socio-economic Data	Desa				Total or Average
	Sangkanwangi	Cisimeut	Margawangi	Nayagati	
I. Land Use Condition (ha)					
(1) Land area	305.0	2,093.9	853.5	1,500.0	4,752.4
(2) Housing area	40.0	275.0	45.0	85.0	445.0
(3) Rice field					
• Technical	80.0	150.0	269.0	0.0	499.0
• Non-technical	32.0	0.0	50.0	0.0	82.0
• Rainfed	13.0	824.0	50.0	170.0	1,057.0
Sub-total	125.0	974.0	369.0	170.0	1,638.0
(4) Estate					
• Government	0.0	0.0	0.0	0.0	0.0
• Private	30.0	100.0	125.0	485.0	740.0
Sub-total	30.0	100.0	125.0	485.0	740.0
(5) Upland crop	108.5	710.0	288.0	550.0	1,656.5
(6) Government forest	0.0	0.0	0.0	0.0	0.0
(7) Wet land	0.0	0.0	0.0	0.0	0.0
(8) Bush	0.0	32.0	10.0	0.0	42.0
(9) Fish pond	0.0	0.0	5.0	30.0	35.0
(10) Live stock	0.0	0.0	8.0	0.0	8.0
(11) Others	1.5	2.9	3.5	180.0	187.9
II. Distribution of Occupation (person)					
(1) Total population	2,014	6,210	1,414	3,662	13,300
(2) Total household	466	1,286	329	856	2,937
(3) Population density	157	293	174	244	868
(4) Occupation					
Agriculture					
• Rice	217	1,236	227	432	2,112
• Upland crop	417	1,087	179	339	2,022
• Estate crop	131	595	144	0	870
• Livestock	97	0	0	0	97
Cottage industry	5	0	19	21	45
Services / trading	91	1,250	103	63	1,507
(5) Total working population	958	4,168	672	855	6,653

Table 3 RESULT OF INTERVIEW SURVEY IN THE PASIR KOPO AREA

Questions	No. of Households	% to Answered	% to Total
(1) Total No.of Household Expected to Relocate	1,781	-	-
(2) Total No.of Household Interviewed	183	10.3%	-
(3) About the Project			
• Agree	179	97.8%	97.8%
• Not Agree	4	2.2%	2.2%
• No Answer	0	0.0%	0.0%
Total	183	100.0%	100.0%
(4) Relocation			
• Agree to Move	163	89.1%	89.1%
• Not Agree to Move	12	6.6%	6.6%
• No Answer	8	4.4%	4.4%
Total	170	100.0%	100.0%
(5) Do you have a place to move to?			
• To Relative's Place	4	2.5%	2.2%
• To My Friend's	0	0.0%	0.0%
• Find a Private Land	30	18.4%	16.4%
• To My Own Land	87	53.4%	47.5%
• To Gov. Place	40	24.5%	21.9%
• Others	2	1.2%	1.1%
Total	163	100.0%	89.1%
(6) If you rely on the govt. land for relocation, where is your desireable place ?			
• Near-by Village	28	70.0%	15.3%
• Within Kecamatan	0	0.0%	0.0%
• Within Kabupaten	8	20.0%	4.4%
• Within Java Island	3	7.5%	1.6%
• Transmigration	1	2.5%	0.5%
Total	40	100.0%	21.9%
(7) Why you do not move ?			
• Not agree	0	0.0%	0.0%
• Nothing	5	41.7%	2.7%
• Others	7	58.3%	3.8%
Total	12	100.0%	6.6%
(8) If you have to find the same job, is it easy ?			
• Easy	117	80.1%	63.9%
• Not easy	28	19.2%	15.3%
• Too difficult	1	0.7%	0.5%
Total	146	100.0%	79.8%
(9) If you moved, do you change your job ?			
• Agriculture	2	11.8%	1.1%
• Fisherman	0	0.0%	0.0%
• Rearing Livestock	0	0.0%	0.0%
• Factory worker	0	0.0%	0.0%
• Start Own Business	11	64.7%	6.0%
• Government Job	0	0.0%	0.0%
• Office worker	0	0.0%	0.0%
• Others	4	23.5%	2.2%
Total	17	100.0%	9.3%

Table 4 BADUY RESETTLEMENT AREAS AROUND PASIR KOPO DAM

a) Actual number of families in residence in 1993

Year	Stage	Village	No. of households			Remarks
			Local Family	Baduy Family	Total	
1981	I	Leuwidamar	60	24	80	Later sub-divided into
	II	Leuwidamar	19	20	39	Cipangar 1 & 2
1982	II	Kopo 1	-	36	36	
	III	Kopo 1	-	32	32	
1982	III	Kopo 2	-	38	38	
	IV	Kopo 2	-	75	75	
1991	V	Sukatani	-	38	38	
1992	VI	Kompol	30	107	137	
			109	370	475	

b) Original relocation program planned by the Ministry of Social Affairs

Year	Village	No.of Baduy Family
1977	Leuwidamar	80
1978	Leuwidamar	75
1979	Kopo 1	70
1980	Kopo 1	75
1986	Kanekes	50
1986	Kompol	50
1990	Kopo 2	50
1992	Kompol	25
1993	Kompol	25
	Total	500

Table 5 LAND ACQUISITION AND COMPENSATION COST FOR PASIR KOPO DAM SCHEME IN SCENARIO A

	Cost Items	Unit	Quantity	Unit Price (Rp.)	Amount (Rp.)
A.	**House compensation**				
	I. Buildings				
	1) Monetary compensation	sq.m	42,500	120,000	5,100,000,000
	2) Housing cost to be handled to resettlers to resettlement area	sq.m	21,796	120,000	2,615,520,000
	Total of Item I.		64,296		7,715,520,000
	II. Housing plot				
	1) Monetary compensation	sq.m	380,736	2,800	1,066,060,800
	2) Land cost for resettlment area	sq.m	195,264	1,350	263,606,400
	Total of Item II.		576,000		1,329,667,200
	Total of Item A.				9,045,187,200
B.	**Land compensation**				
	I. Monetary Compensation				
	1) Agricultural land				
	a) Irrigated land	sq.m	450,802	1,150	518,422,300
	b) Rainfed	sq.m	74,032	790	58,485,280
	c) Non-irrigated	sq.m	958,450	790	757,175,500
	2) Estate	sq.m	674,220	1,350	910,197,000
	3) Upland crop	sq.m	1,480,640	790	1,169,705,600
	4) Others	sq.m	320,000	790	252,800,000
	Total of Item I.		3,958,144		3,666,785,680
	II. Land cost for resettlment area				
	1) Agricultural land				
	a) Irrigated land	sq.m	231,198	1,350	312,117,300
	b) Rainfed	sq.m	37,968	1,350	51,256,800
	c) Non-irrigated	sq.m	491,550	1,350	663,592,500
	2) Estate	sq.m	345,780	1,350	466,803,000
	3) Upland crop	sq.m	759,360	1,350	1,025,136,000
	4) Others	sq.m	-	-	-
	Total of Item II.		1,865,856		2,518,905,600
	Total of Item B.				6,185,691,280
C.	**Preparation of resettlement area**				
	I. Construction of public facilities				
	1) Administration office	nos.	1	47,228,000	47,228,000
	2) Education facilities				
	a) Primary school	nos.	7	132,750,000	929,250,000
	b) Junior high school	nos.	2	190,800,000	381,600,000
	3) Park	places	2	1,620,000	3,240,000
	4) Clinic	nos.	5	46,620,000	233,100,000
	5) Mosque	nos.	5	18,338,000	91,690,000
	6) Market place	places	5	109,350,000	546,750,000
	Total of Item I.				2,232,858,000
	II. Other public facilities in the resettlement area				
	1) Infra-structures	sq.m	2,441,856	1,000	2,441,856,000
	2) Facilities for agricultural activities	sq.m	1,865,856	100	186,585,600
	Total of Item II.				2,628,441,600
	Total of Item C.				4,861,299,600
D.	**Others**				
	I. Large tree	pieces	1,269	12,000	15,228,000
	II. Small tree	pieces	3,807	8,000	30,456,000
	Total of Item D.				45,684,000
	Grand Total				20,137,862,080

Table 6 LAND ACQUISITION AND COMPENSATION COST FOR PASIR KOPO DAM SCHEME IN SCENARIO C

	Cost Items	Unit	Quantity	Unit Price (Rp.)	Amount (Rp.)
A.	**House compensation**				
	I. Buildings				
	1) Monetary compensation	sq.m	89,470	120,000	10,736,400,000
	2) Housing cost to be handled to resettlers to resettlement area	sq.m	45,886	120,000	5,506,320,000
	Total of Item I.		135,356		16,242,720,000
	II. Housing plot				
	1) Monetary compensation	sq.m	801,526	2,800	2,244,272,800
	2) Land cost for resettlment area	sq.m	411,070	1,350	554,944,500
	Total of Item II.		1,212,596		2,799,217,300
	Total of Item A.				19,041,937,300
B.	**Land compensation**				
	I. Monetary Compensation				
	1) Agricultural land				
	a) Irrigated land	sq.m	648,441	1,150	745,707,150
	b) Rainfed	sq.m	106,421	790	84,072,590
	c) Non-irrigated	sq.m	1,374,880	790	1,086,155,200
	2) Estate	sq.m	971,670	1,350	1,311,754,500
	3) Upland crop	sq.m	2,128,420	790	-
	4) Others	sq.m	460,000	790	363,400,000
	Total of Item I.		5,689,832		3,591,089,440
	II. Land cost for resettlment area				
	1) Agricultural land				
	a) Irrigated land	sq.m	332,559	1,350	448,954,650
	b) Rainfed	sq.m	54,579	1,350	73,681,650
	c) Non-irrigated	sq.m	705,120	1,350	951,912,000
	2) Estate	sq.m	498,330	1,350	-
	3) Upland crop	sq.m	1,091,580	1,350	-
	4) Others	sq.m	-	-	-
	Total of Item II.		2,682,168		1,474,548,300
	Total of Item B.				5,065,637,740
C.	**Preparation of resettlement area**				
	I. Construction of public facilities				
	1) Administration office	nos.	2	47,228,000	94,456,000
	2) Education facilities				
	a) Primary school	nos.	15	132,750,000	2,256,750,000
	b) Junior high school	nos.	3	190,800,000	763,200,000
	3) Park	places	3	1,620,000	6,480,000
	4) Clinic	nos.	10	46,620,000	559,440,000
	5) Mosque	nos.	10	18,338,000	220,056,000
	6) Market place	places	10	109,350,000	1,312,200,000
	Total of Item I.				5,212,582,000
	II. Other public facilities in the resettlement area				
	1) Infra-structures	sq.m	3,894,764	1,000	3,894,764,000
	2) Facilities for agricultural activities	sq.m	2,682,168	100	268,216,800
	Total of Item II.				4,162,980,800
	Total of Item C.				9,375,562,800
D.	**Others**				
	I. Large tree	pieces	2,672	12,000	32,064,000
	II. Small tree	pieces	8,015	8,000	64,120,000
	Total of Item D.				96,184,000
	Grand Total				33,579,321,840

FIGURES

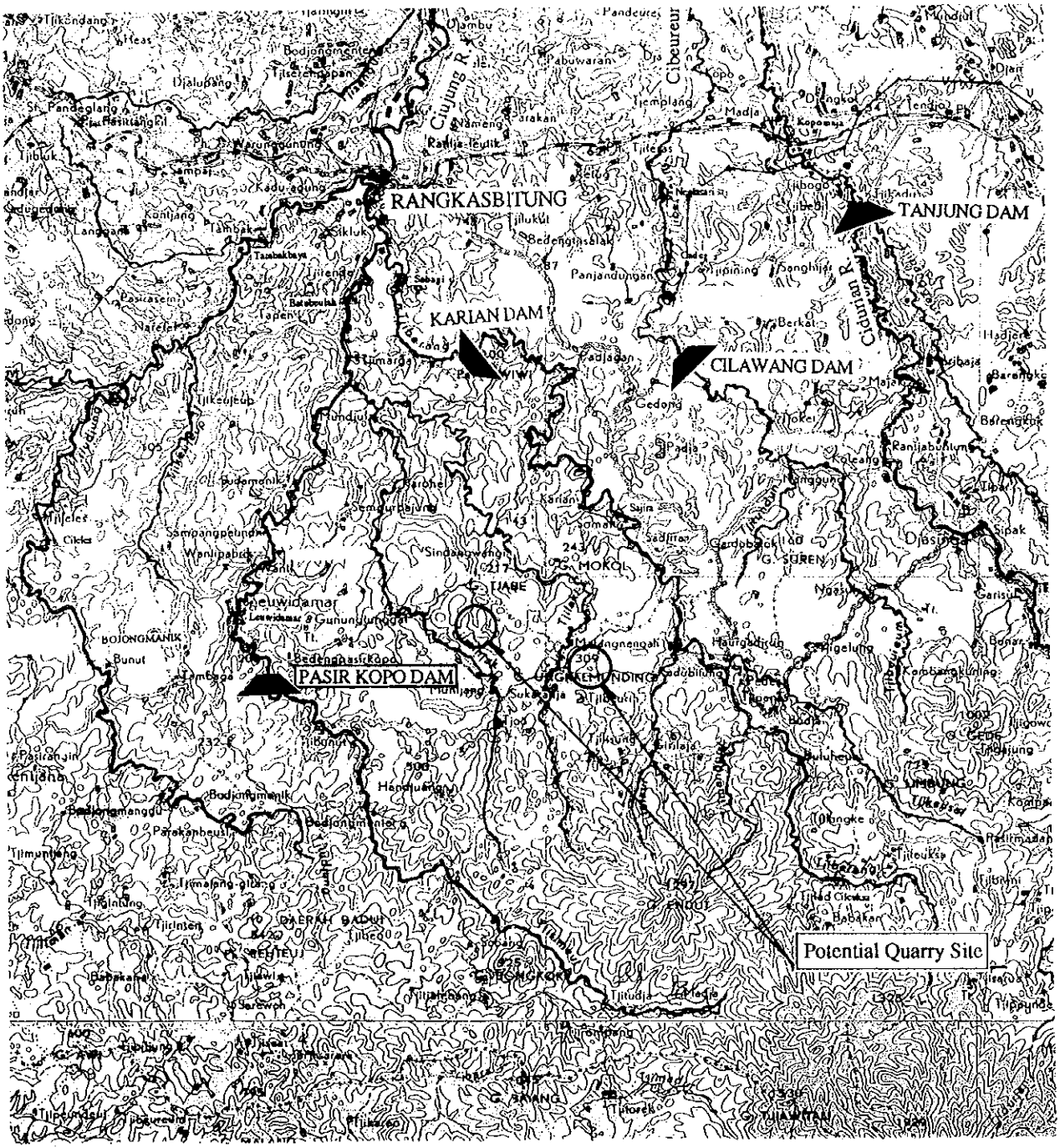
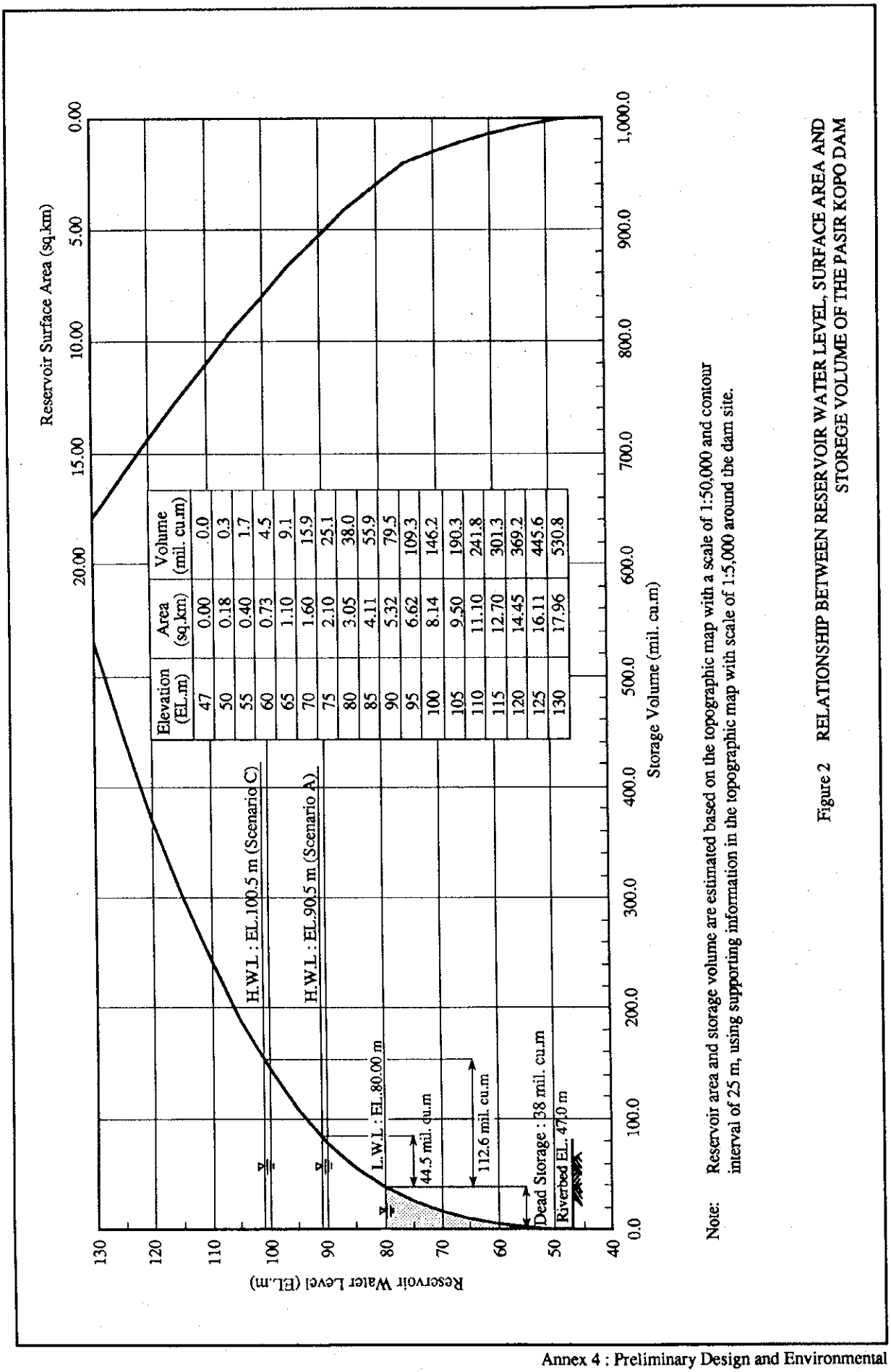


Figure 1 POTENTIAL QUARRY SITES FOR THE PASIR KOPO DAM



Elevation (EL.m)	Area (sq.km)	Volume (mil. cu.m)
47	0.00	0.0
50	0.18	0.3
55	0.40	1.7
60	0.73	4.5
65	1.10	9.1
70	1.60	15.9
75	2.10	25.1
80	3.05	38.0
85	4.11	55.9
90	5.32	79.5
95	6.62	109.3
100	8.14	146.2
105	9.50	190.3
110	11.10	241.8
115	12.70	301.3
120	14.45	369.2
125	16.11	445.6
130	17.96	530.8

Figure 2 RELATIONSHIP BETWEEN RESERVOIR WATER LEVEL, SURFACE AREA AND STOREGE VOLUME OF THE PASIR KOPO DAM

Note: Reservoir area and storage volume are estimated based on the topographic map with a scale of 1:50,000 and contour interval of 25 m, using supporting information in the topographic map with scale of 1:5,000 around the dam site.

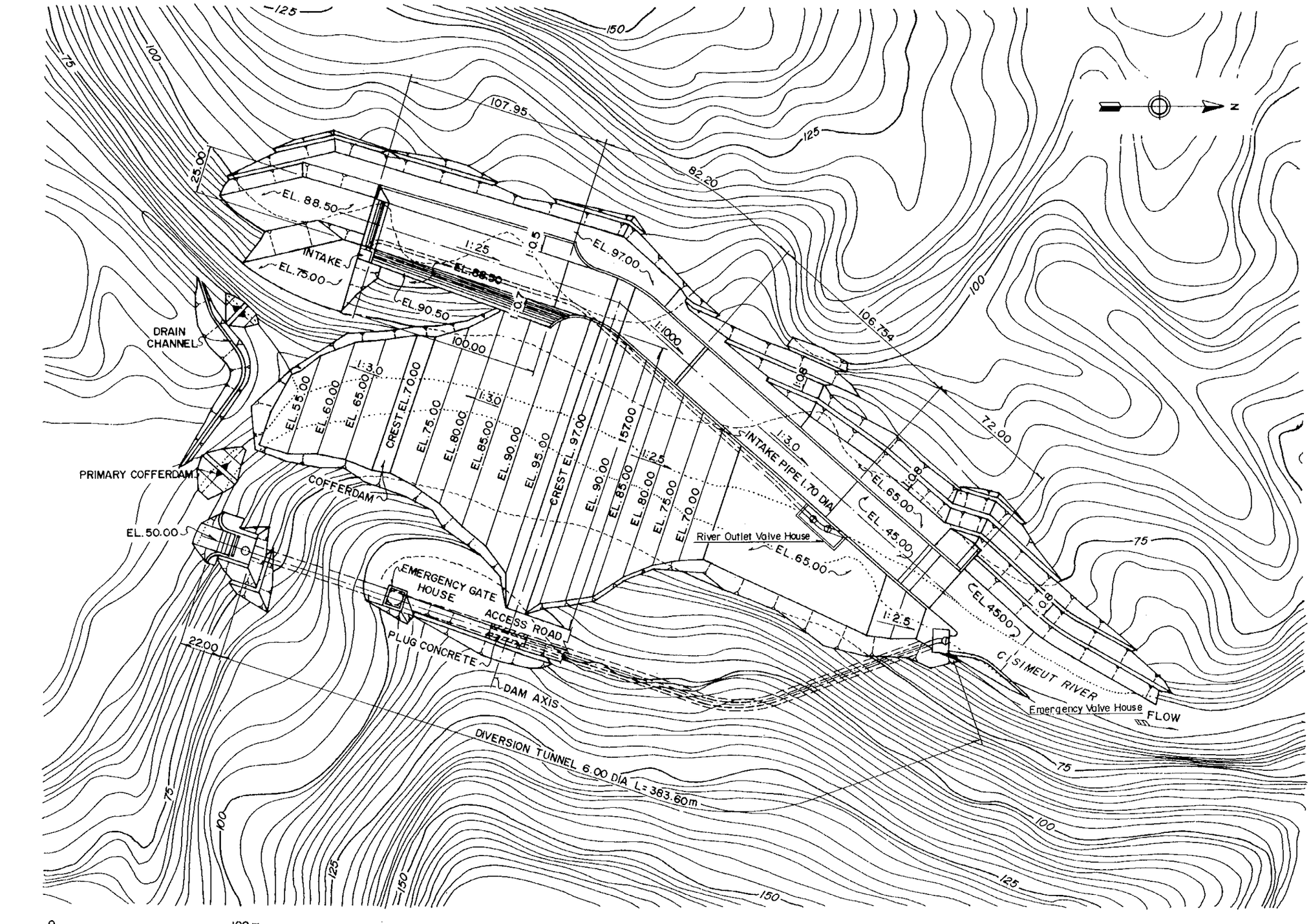
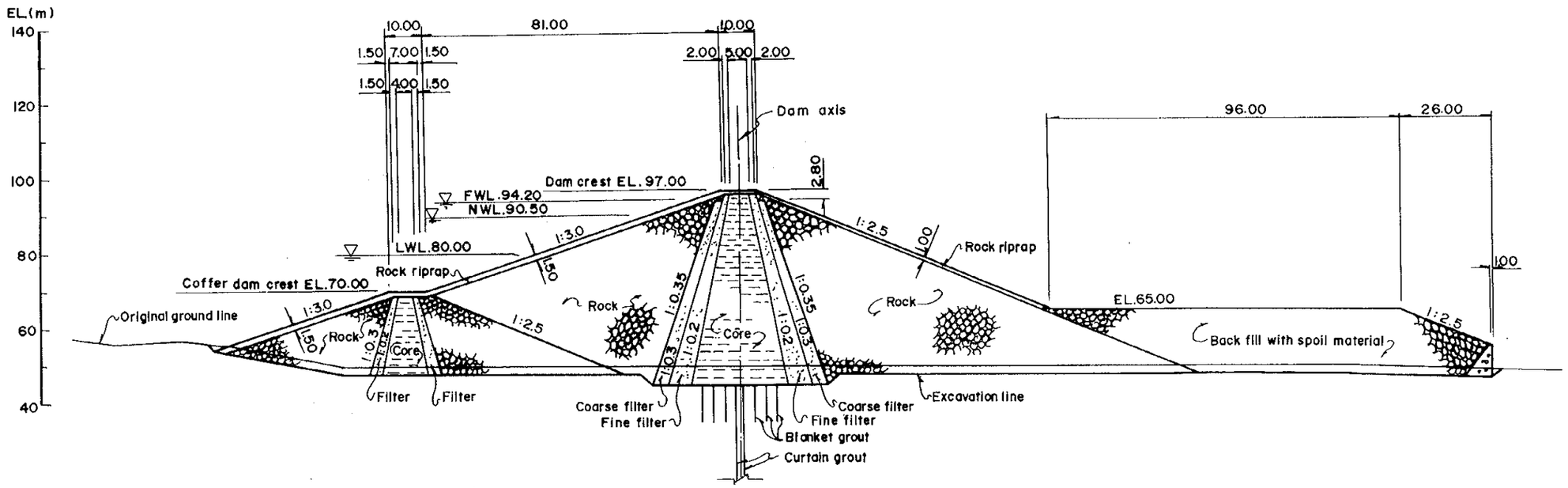
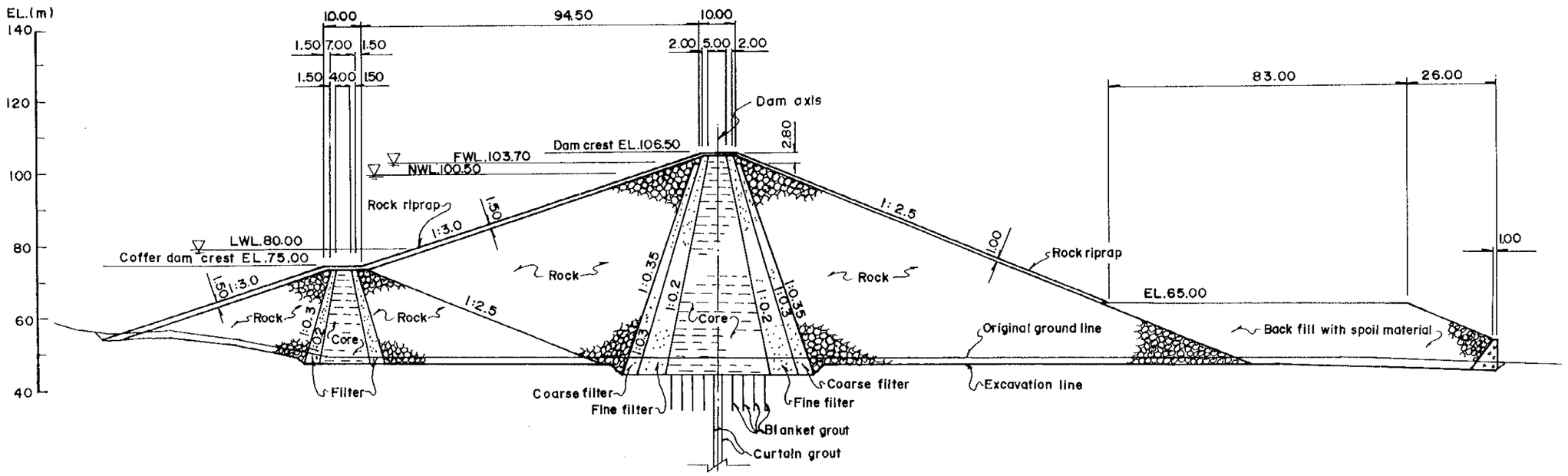


Figure 3 GENERAL LAYOUT PLAN OF PASIR KOPO DAM IN THE SCENARIO A

Figure 4 GENERAL LAYOUT PLAN OF PASIR KOPO DAM IN THE SCENARIO C



TYPICAL CROSS SECTION IN THE SCENARIO A



TYPICAL CROSS SECTION IN THE SCENARIO C

Figure 5 TYPICAL CROSS SECTION OF PASIR KOPO DAM IN THE SCENARIOS A AND C

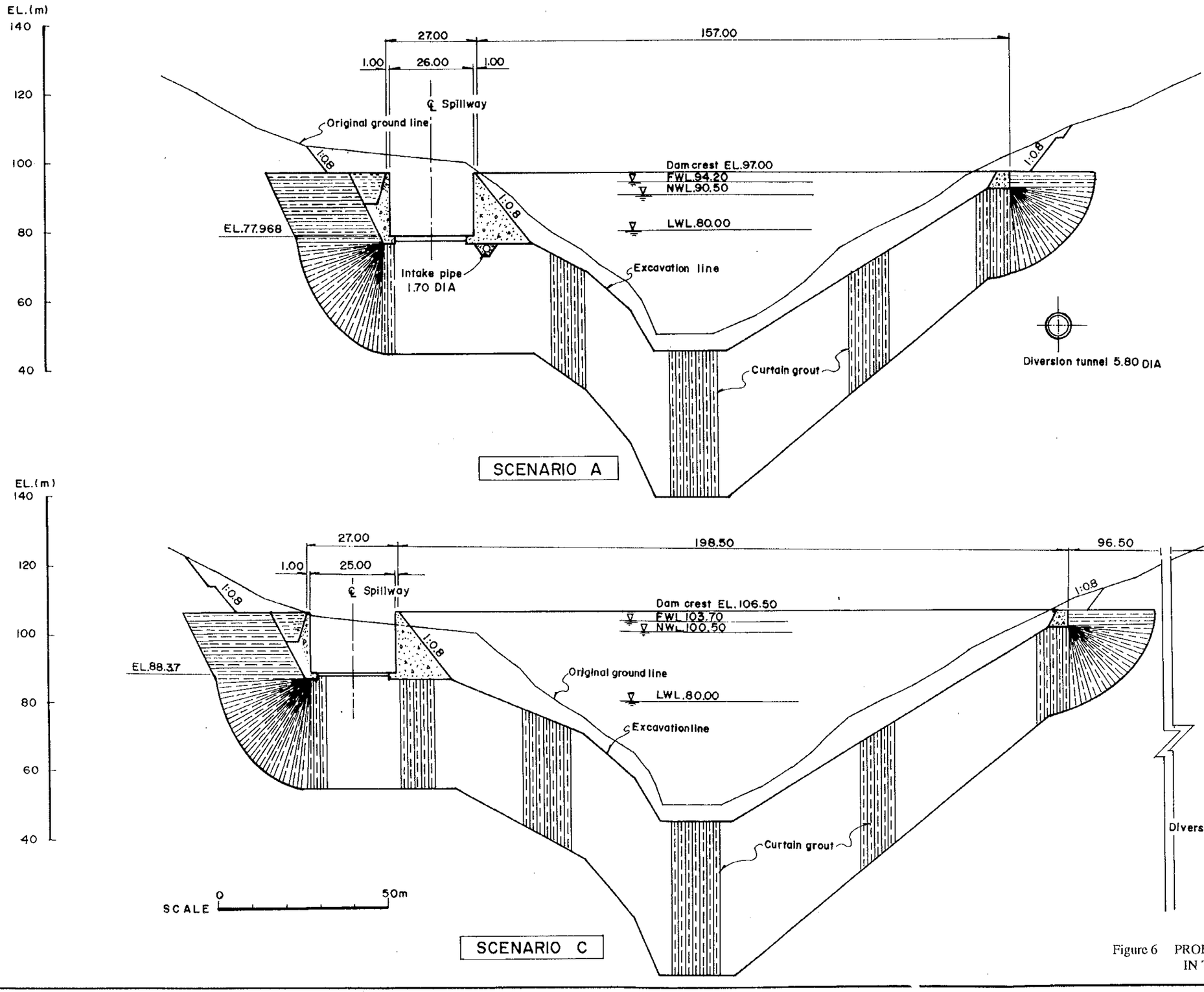
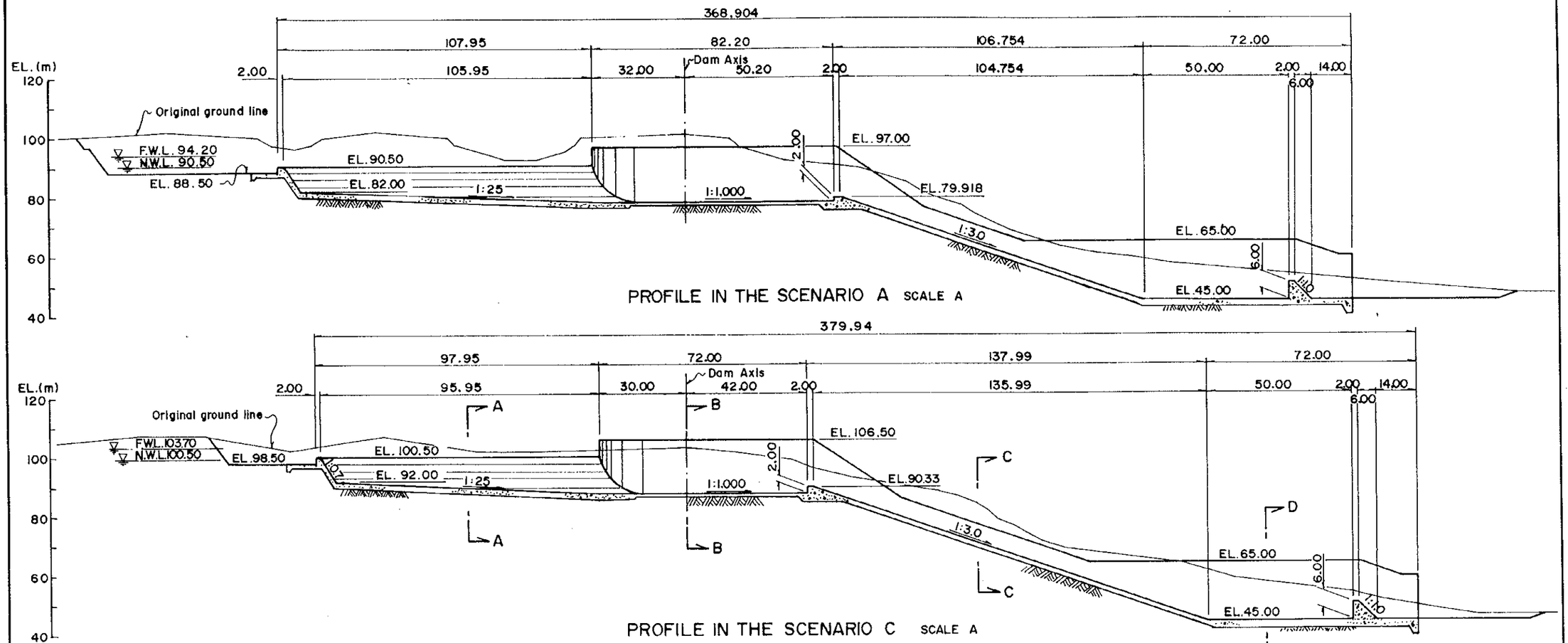
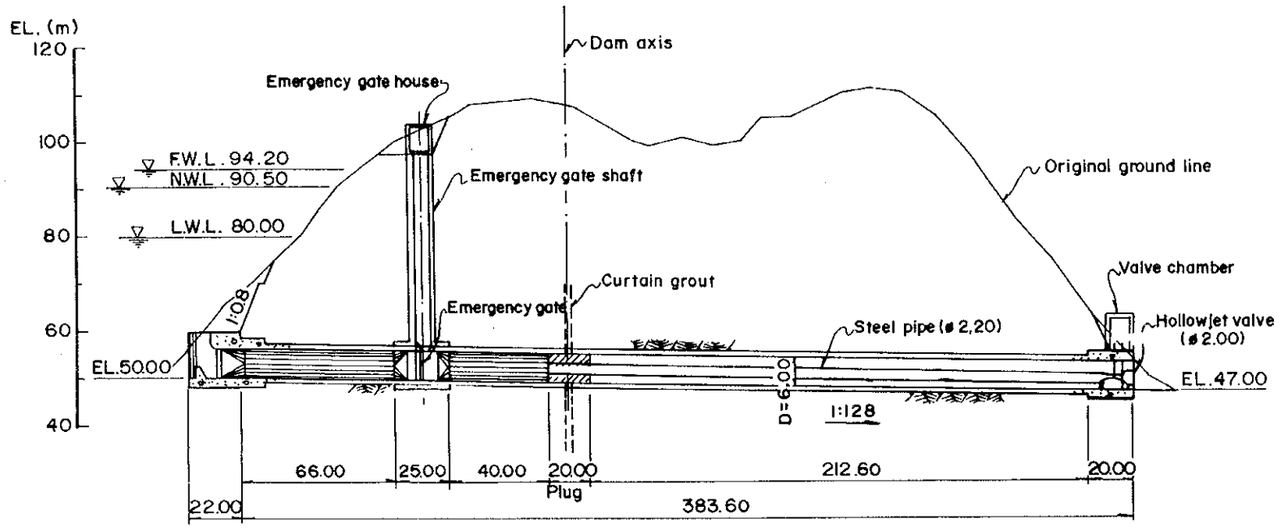


Figure 6 PROFILE OF PASIR KOPO DAM IN THE SCENARIOS A AND C

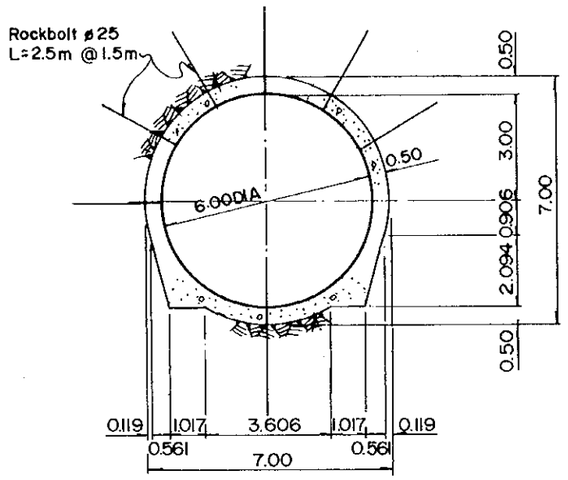


	SCENARIO A	SCENARIO C
HA.1	15.00~19.00	14.50~ 18.10
HA.2	8.50~12.50	8.50 ~ 12.10
HB	19.00~19.082	18.10 ~ 18.172

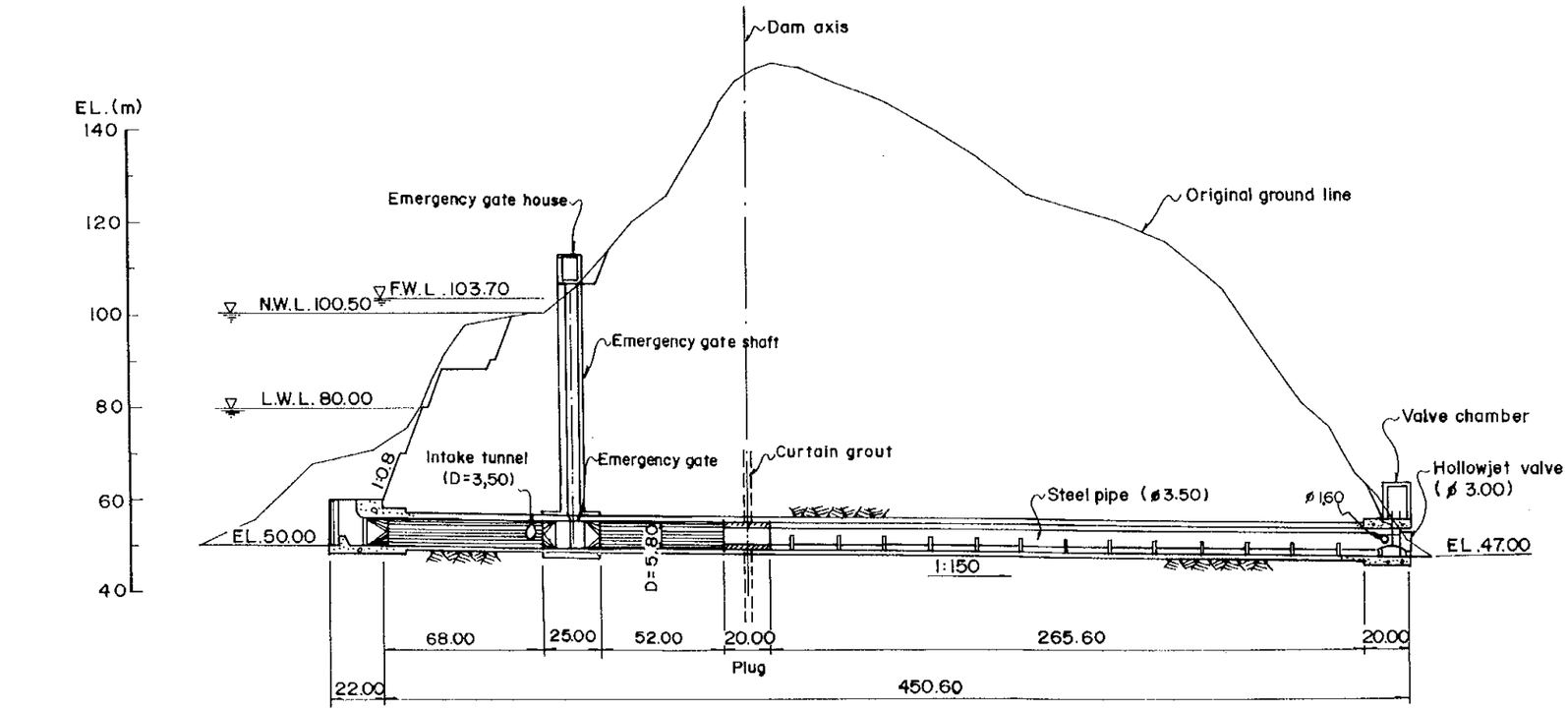
Figure 7 SPILLWAY OF PASIR KOPO DAM IN THE SCENARIOS A AND C



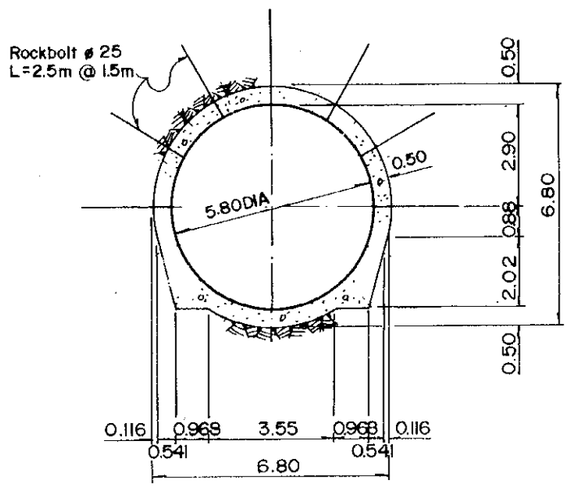
PROFILE IN THE SCENARIO A SCALE A



TYPICAL SECTION IN THE SCENARIO A
SCALE B

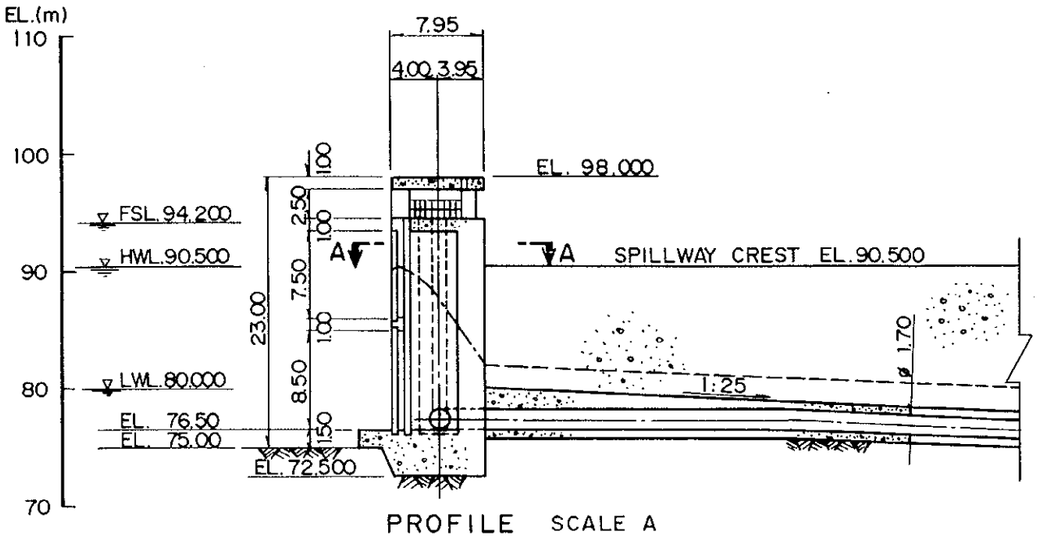


PROFILE IN THE SCENARIO C SCALE A

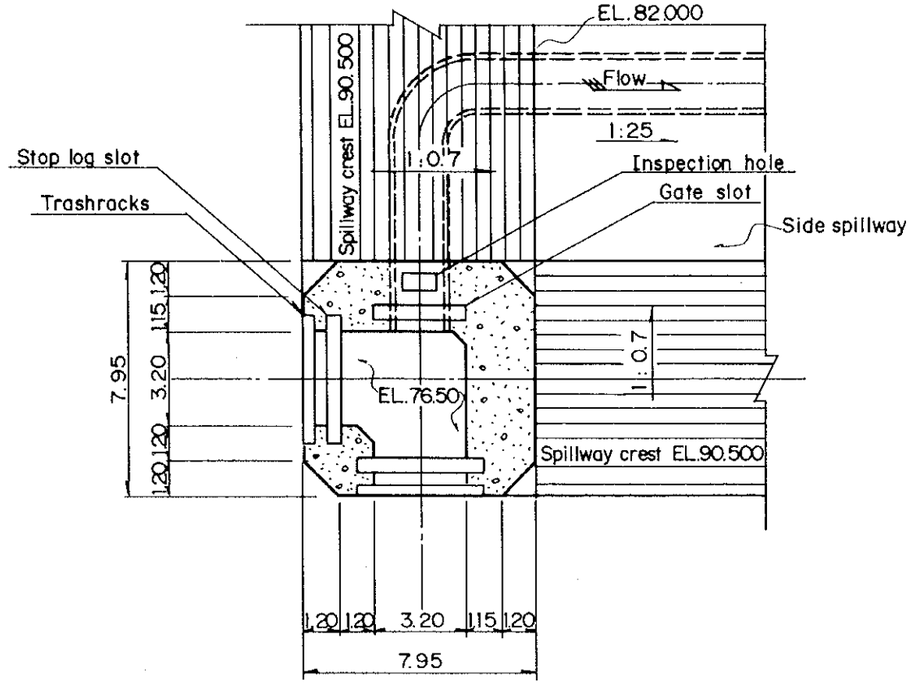


TYPICAL SECTION IN THE SCENARIO C
SCALE B

Figure 8 DIVERSION TUNNEL OF PASIR KOPO DAM IN THE SCENARIOS A AND C

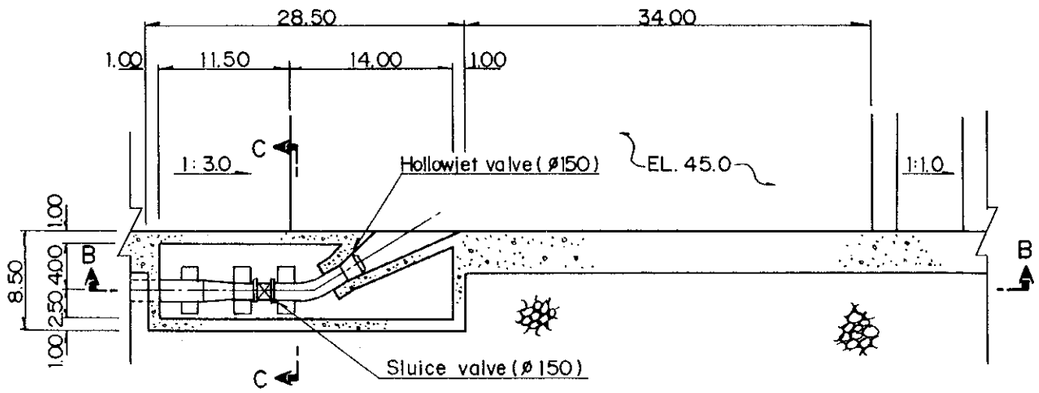


PROFILE SCALE A



SECTION A – A SCALE B

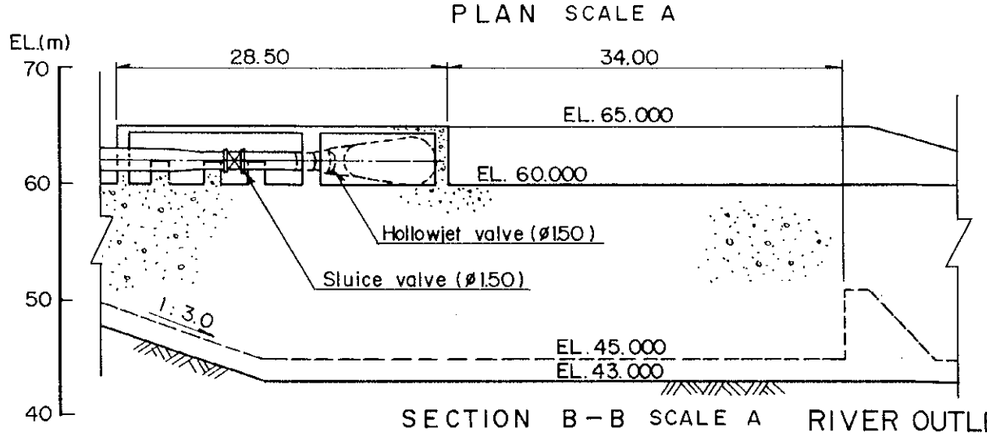
INTAKE TOWER



PLAN SCALE A

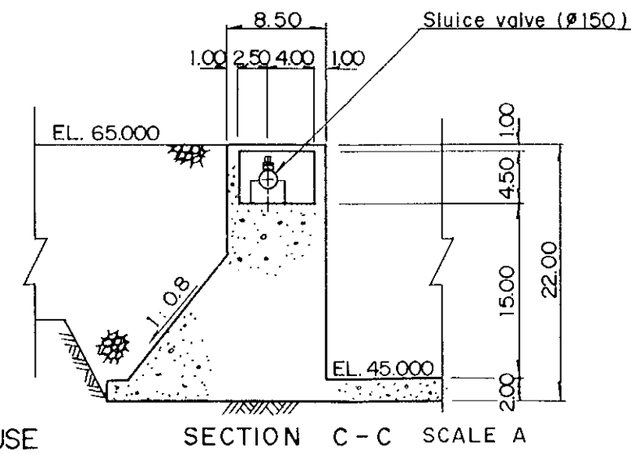
SCALE A 0 10 20m

SCALE B 0 10m



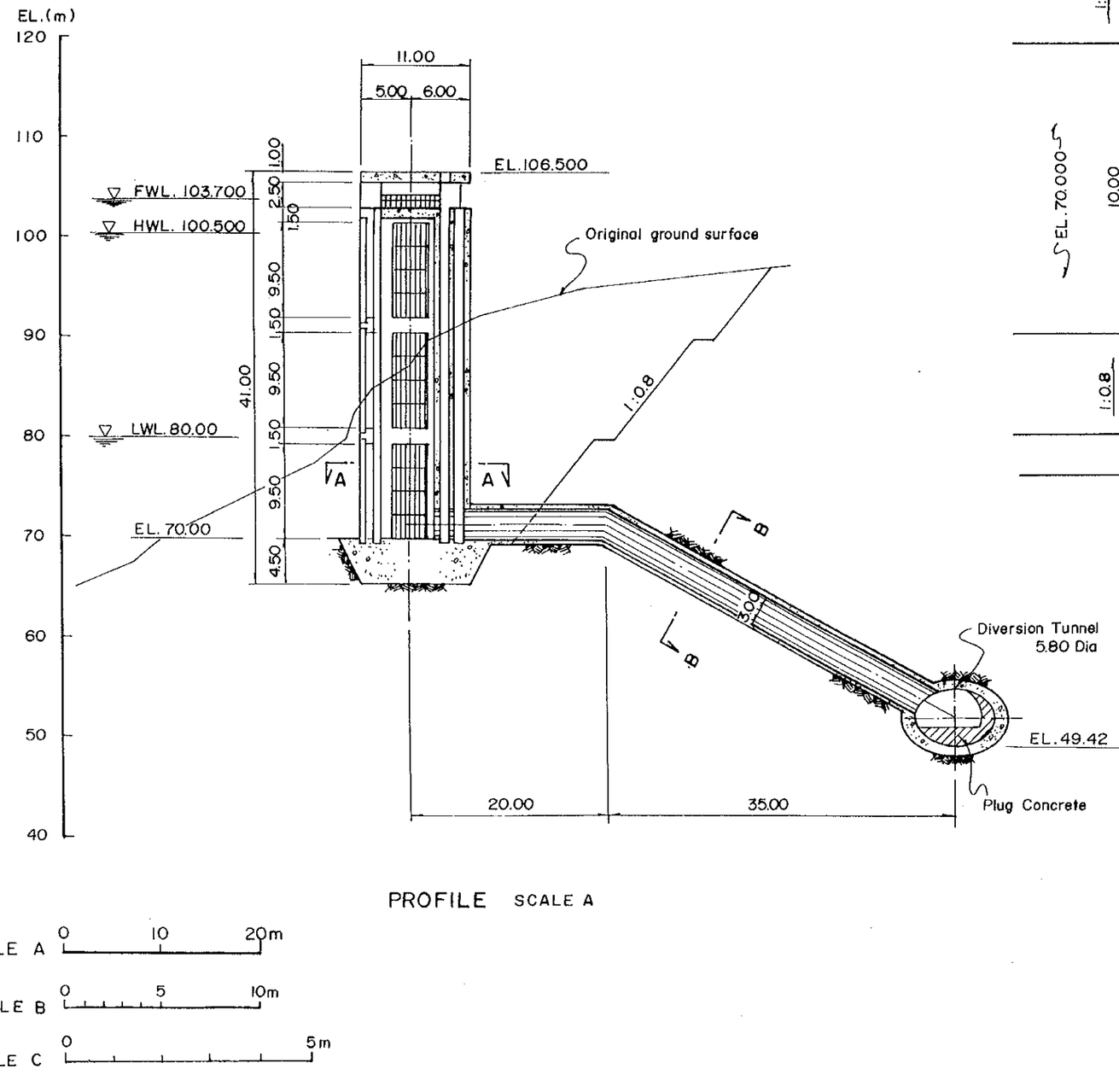
SECTION B – B SCALE A

RIVER OUTLET VALVE HOUSE

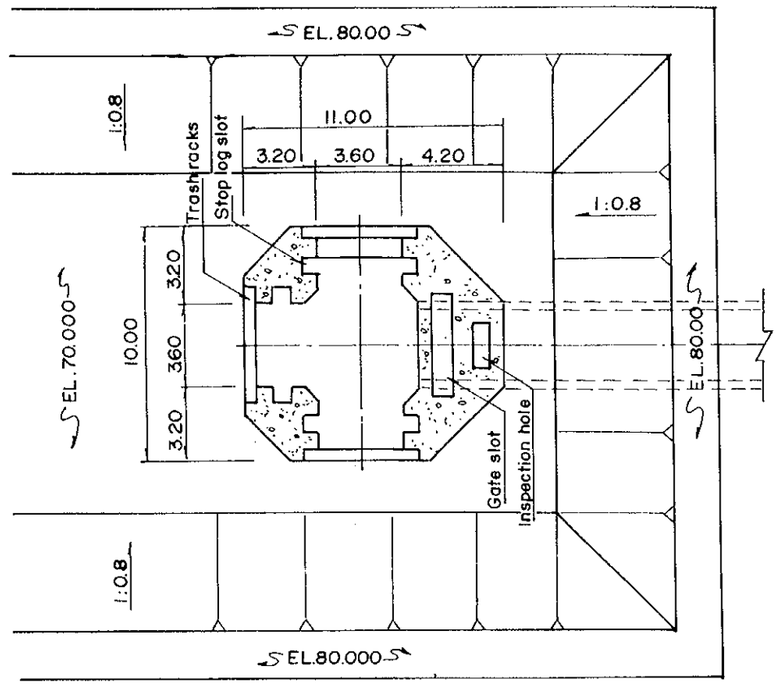


SECTION C – C SCALE A

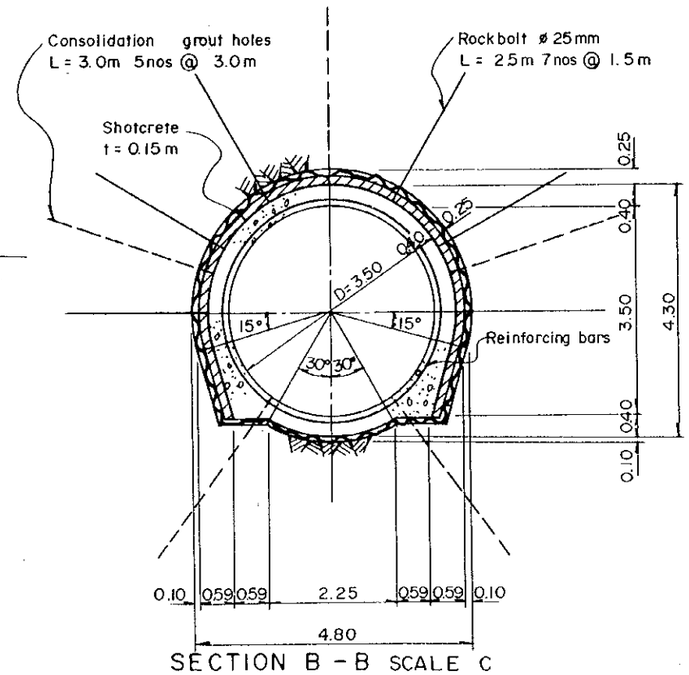
Figure 9 INTAKE STRUCTURE AND VALVE HOUSE OF PASIR KOPO DAM IN THE SCENARIO A



PROFILE SCALE A



SECTION A-A SCALE B



SECTION B - B SCALE C

SCALE A 0 10 20m

SCALE B 0 5 10m

SCALE C 0 5m

Figure 10 INTAKE STRUCTURE OF PASIR KOPO DAM IN THE SCENARIO C

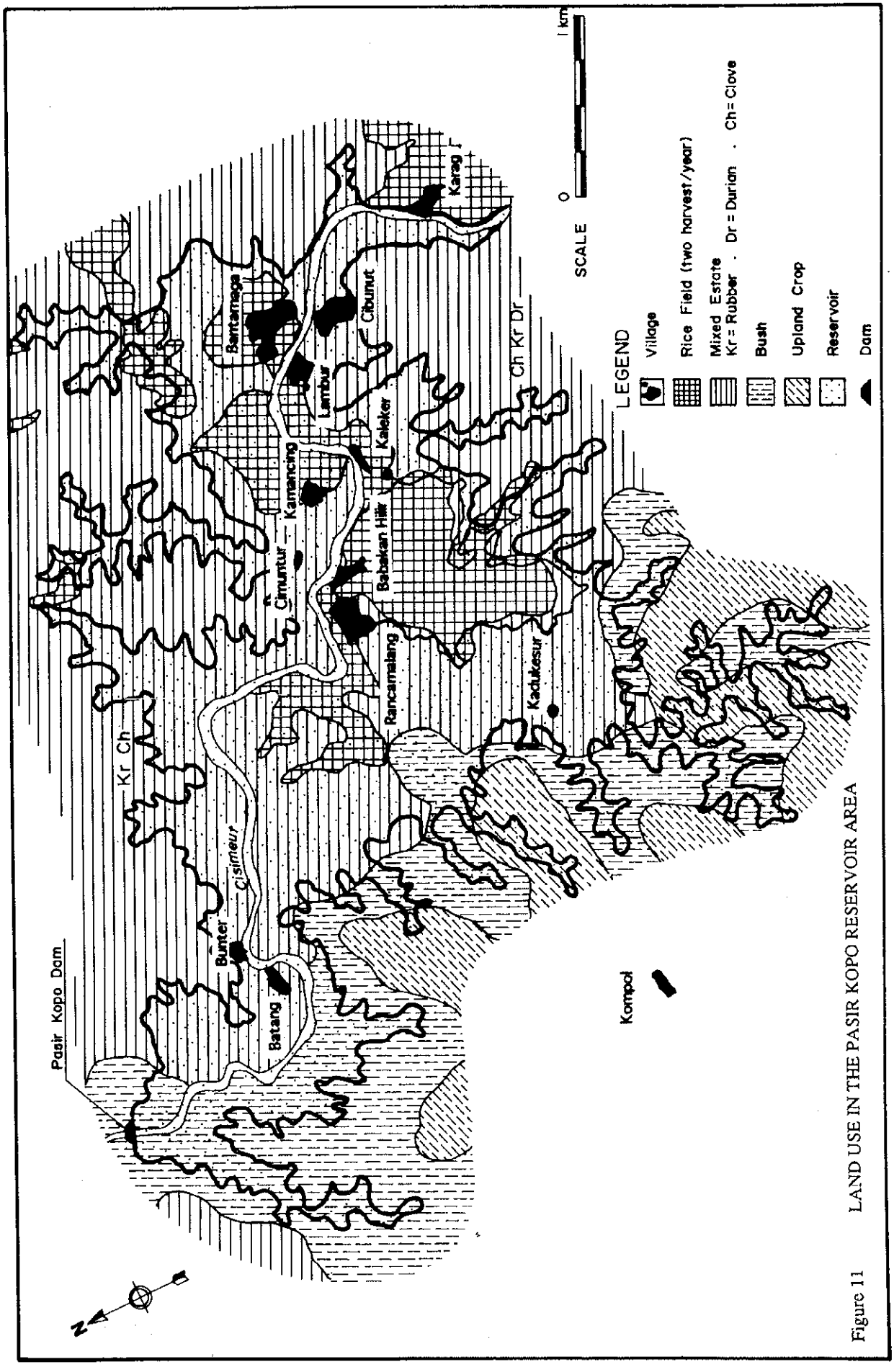


Figure 11 LAND USE IN THE PASIR KOPO RESERVOIR AREA

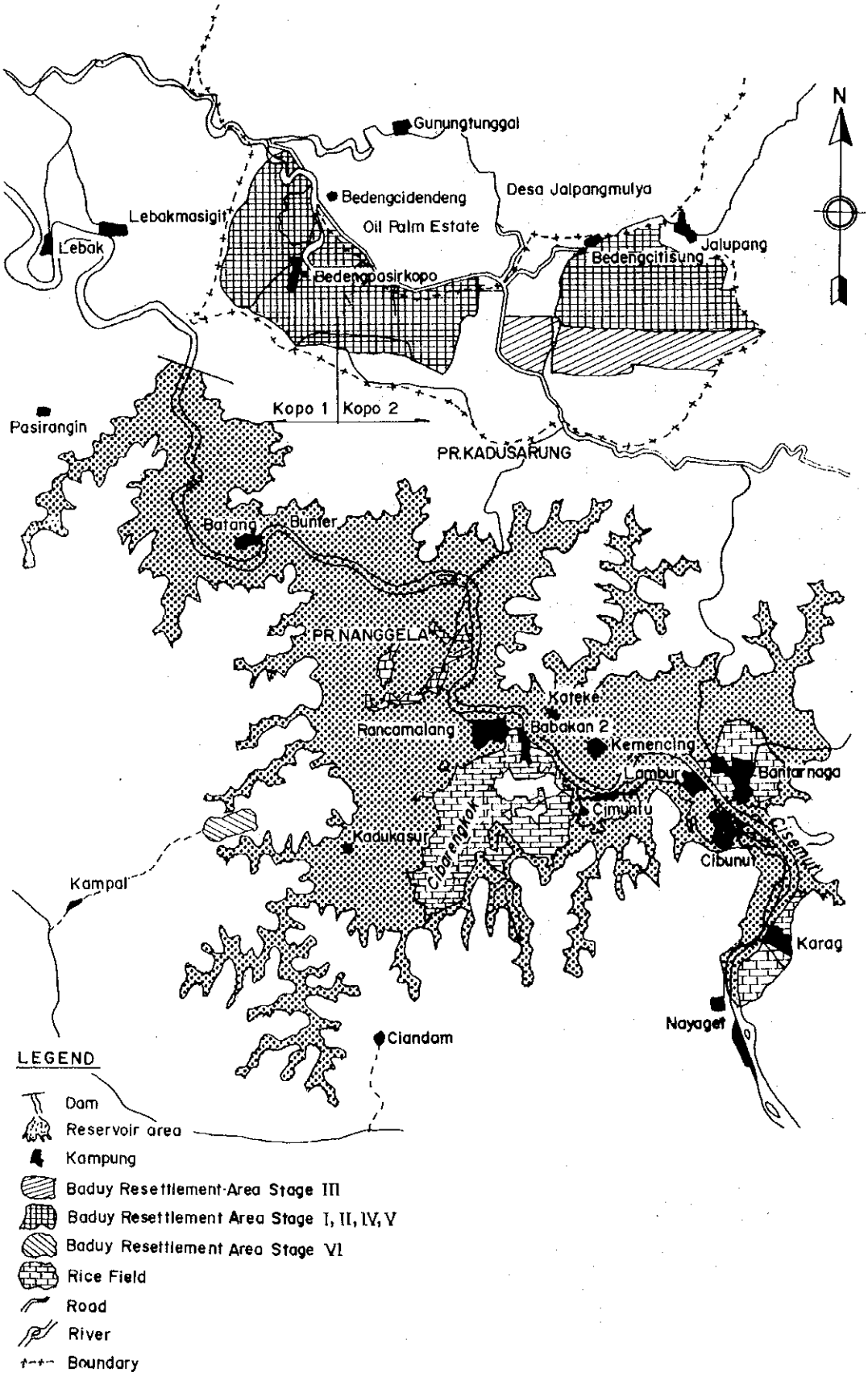


Figure 12 BADUY RESETTLEMENT AREA IN THE PASIR KOPO AREA

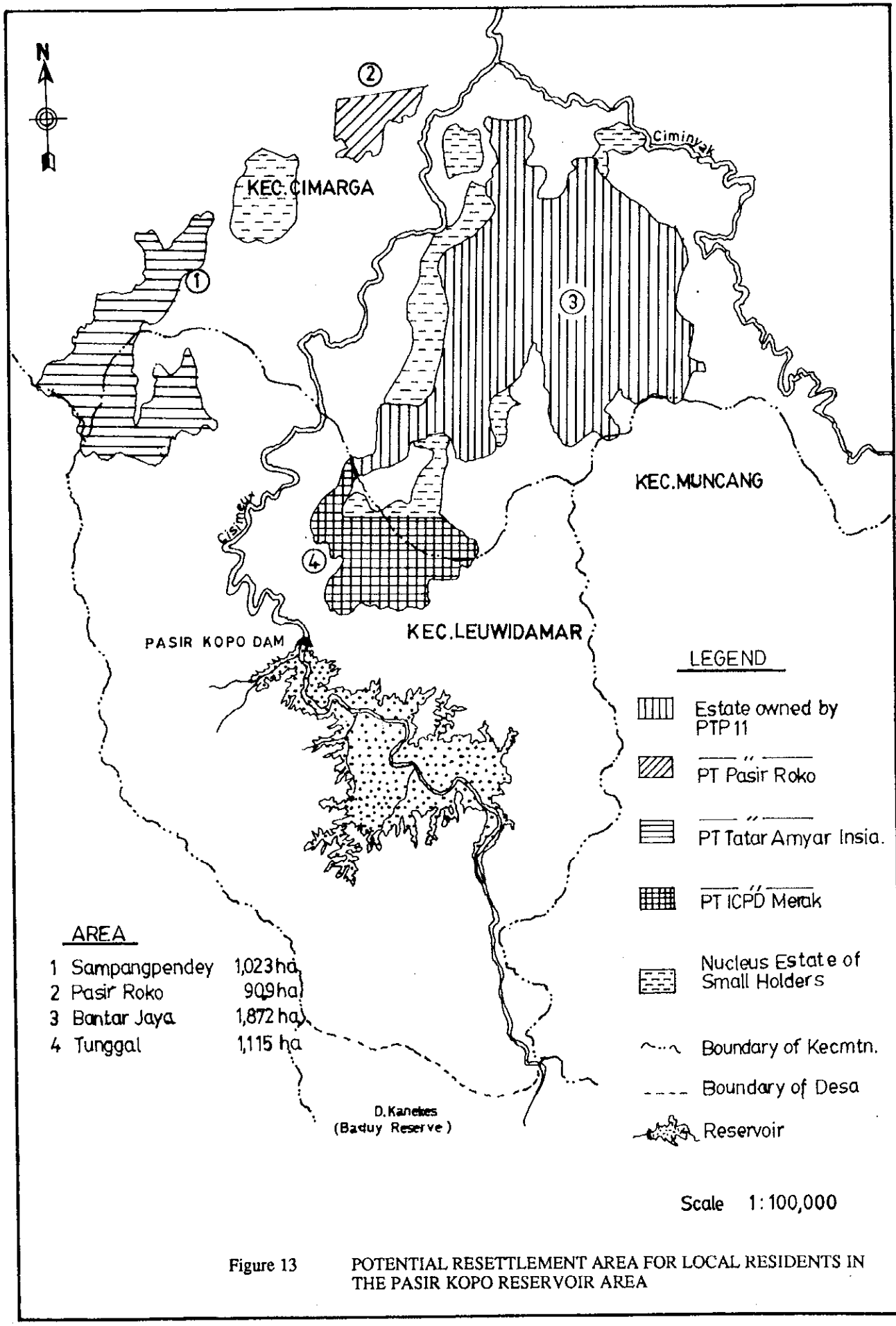


Figure 13 POTENTIAL RESETTLEMENT AREA FOR LOCAL RESIDENTS IN THE PASIR KOPO RESERVOIR AREA

ANNEX 5

TOPOGRAPHIC SURVEY FOR KARIAN-SERPONG CONVEYANCE SYSTEM

THE STUDY
ON
CIUJUNG-CIDURIAN INTEGRATED WATER RESOURCES

Annex 5 : Topographic Survey for Karian-Serpong Conveyance System

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List of Figures

1. INTRODUCTION

The topographic survey undertaken by the study on the Ciujung-Cidurian integrated water resources is comprised of the aerial photogrammetric mapping with a scale of 1:5,000 and a mapping area of 250 km^2 and topographic survey at the major structure sites of nineteen (19) locations with a scale of 1:500 and a total area of 17 ha along the route of the Karian-Serpong water conveyance system (KSCS).

The aerial photogrammetric mapping were carried out during a period from the beginning of May, 1993 to the end of January 1994 by Indonesian contractor, PT. EXSA International Co. Ltd., on a contract basis under supervision of the JICA Study Team. Also, the topographic survey at the major structures sites was executed by the aforesaid contractor for three (3) months from the beginning of June 1994 to the middle of August, 1994 under the same procedure as the aerial photogrammetric mapping.

The survey area located in West Java Province is illustrated in Figures 1 and 2.

2. DATA COLLECTION AND THEIR REVIEW

Prior to the topographic survey, the following existing topographic maps, photographs and relevant data were collected and reviewed:

a)	Topographic map with a scale of 1:50,000	:	Survey Department, DGWRD
b)	Topographic map with a scale of 1:25,000	:	Survey Department, DGWRD
c)	Topographic map with a scale of 1:10,000	:	Bina Program, DGWRD
d)	Topographic map with a scale of 5,000	:	Bina Program, DGWRD
e)	Photographs with a scale of 1:50,000	:	Bina Program, DGWRD
f)	Data on the existing benchmarks in the study area	:	Survey Department, DGWRD

Among the available maps, the topographic maps with a scale of 1:50,000 and 1:25,000 cover all the area. While, other topographic maps were produced by the previous studies and projects executed by the DGWRD and their covering areas are indicated in Figure 3.

3. TOPOGRAPHIC SURVEY WORKS

3.1 Aerial Photogrammetric Survey

3.1.1 Survey works and equipment utilized

Aerial photogrammetric survey mainly consists of; a) aerial photography, b) ground control survey with Grobal Positioning System (GPS) survey and leveling work, c) field verification, d) aerial triangulation, e) restitution, and f) scribing works. For carrying out these works, the following equipment was utilized:

No.	Description	Specification	Quantity (nos.)
1.	Aircraft	C-402/PK-DCJ	1
2.	Aerial Camera	RC-10	1
3.	GPS Survey	Trimble 4000 ST	3
4.	Automatic Level	Wild Nak2	3
		Sokkisha B2	2
5.	Pricking Devise	Wild PUG IV	1
6.	Model Coordinate Measurement	Stecometer C	1
7.	Computer	IBM PC. AT Compatible	2
8.	Stereo Plotter	Wild A8 and Zeiss Topocart B	3

3.1.2 Aerial photography

(1) Photo-signal and monumentation

Targets with three (3) wings illustrated in Figure 4 were set up at twenty (20) locations in the survey area before commencement of aerial-photo shooting in order to identify actual location of the ground control points in a photograph. Among the targets, concrete pillar were newly established at fifteen (15) points for the ground control survey using GPS and at other 5 locations the wing targets were set up on the existing control points. However, since it was identified through first field investigation that these five (5) existing points were missing or damaged, three ones located in the middle of project area were used only for a purpose of elevation control after repair, and two ones in the eastern and western sides were renewed as new control points. Figure 5 shows locations of the ground control points set up by the monumentation work.

(2) Shooting

Aerial-photograph shooting was started on 3rd August in 1993 immediately after getting permission for security clearance from the Indonesian armed forces (PUSSURTA ABRI). The work was completed on 15th August 1993. A date of successful shooting and numbers of photograph sheets taken are given as below and flight index map is shown Figure 6.

Flight Date	Run No.	Counter No. (Registration No.)	No. of photograph sheets
Aug. 6	3C	5119 - 5124 (1- 6)	6
Aug. 10	3B	5305 - 5314 (1-10)	10
Aug. 10	4	5335 - 5359 (1-25)	25
Aug. 10	5	5375 - 5364 (1-12)	12
Aug. 11	2	5473 - 5488 (1-16)	16
Aug. 11	1	5426 - 5441 (1-16)	16
Aug. 15	3A	5612 - 5624 (1-13)	13
Total	7 courses		98

The above aerial photographs taken with a scale of 1:20,000 covers an area of 400 km^2 with an overlapping rate of 60% + 5% in the forward and 30% + 10% in the lateral.

(3) Annotation of aerial photograph

Processed negative aerial photographs were annotated with roll number, name of project, ownership, date of photography, scale of photograph, strip number and photo number.

(4) Uncontrolled mosaic

Uncontrolled photo-mosaic with a scale of 1:10,000 was produced at the middle of September 1993 by means of photo blow-up, assembling, annotation and duplication in order to grasp the present land use condition along the route of water conveyance system.

The uncontrolled mosaic produced consists of 14 sheets with a sheet has a size of 75 cm x 50 cm.

3.1.3 Ground control survey

The ground control survey was performed in order to obtain coordinates of the ground control points by using Global Positioning System (GPS) and the elevation by leveling. For the aerial triangulation, several control points were pricked on the aerial photographs with a scale of 1:10,000 enlarged.

(1) GPS survey

To determine coordinates of the ground control points set up, the GPS survey was carried out by receiving data from five (5) satellites at each control point in differential mode for around 1 hour per point.

In the GPS survey, the GPS network shown in Figure 7 was established by forming triangle linking the ground control points and the respective triangle configuration was connected to the master station with a base line of less than 20 km in length. Datum point for the GPS survey was based on the existing Doppler point of D. 1011 with station code number of 50

which has the following topographic characteristics. The maximum closure error was within 24.81 ppm in the GPS survey.

Description	Topographic Information
Ellipsoid Datum	WGS-84/ID-74
Latitude	06° 05' 13.369"
Longitude	106° 31' 2.157"
Elevation (ELL)	0.000 m (ANT)
Elevation (ELL)	63.688 m (B.M)
Elevation (MSL)	0.000 m (B.M)
U.T.M - Coordinate	a : 6378160
	f : 1/298.247
Zone	48
Central Meridian	105
Coordinate : East	667908.057
North	9326935.004

Table 1 shows the obtained coordinates of the ground control points by the GPS survey.

(2) Leveling

Leveling was carried out based on the existing TTG (national vertical control network) bench mark. The leveling routes were arranged to connect all the GPS points. At an interval of one (1) km, spot elevation was pricked on the enlarged aerial photographs.

The reference points used for calculation of elevation are TTG 285 and TTG 370 with an elevation of 28.121 m and 87.417 m, respectively. The locations of these reference points are shown in Figure 5 as well as those of the ground control points.

3.1.4 Field verification

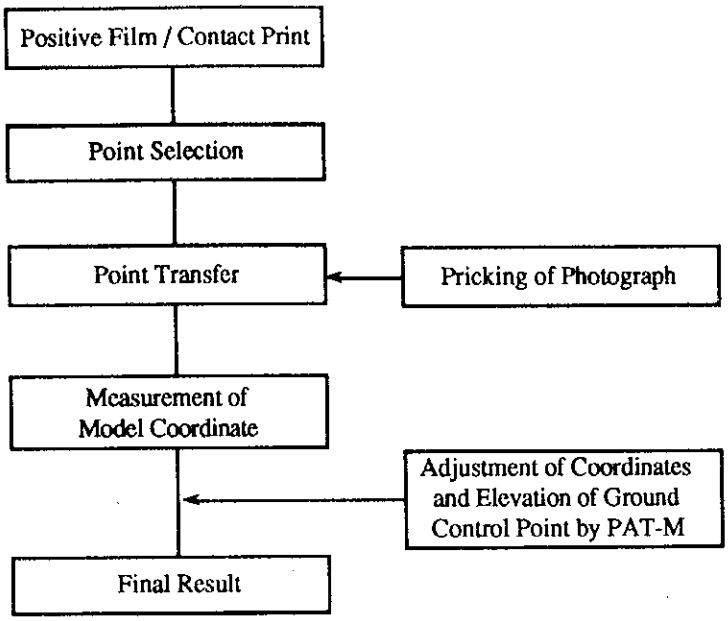
Field verification was done by the enlarged aerial photos 4 times. All objects on the photographs were verified in accordance with the map symbols. Uninterpretable objects were also notated, including bridges, railways, roads, rivers, irrigation canals, vegetation, cemetery, etc.

All necessary data, such as name of kecamatans, kabupatens and cities including their boundaries were identified and plotted on the aerial photograph with a scale of 1:10,000.

3.1.5 Mapping work

(1) Aerial triangulation

Aerial triangulation was executed by independent analytical model based on the ground control points based on the work flow diagram shown as follows:



Point selection and the numbering were done on the aerial photographs with a scale of 1: 20,000 by using a mirror stereoscope. The selected points on one diapositive film were transferred to other overlapping diapositive film by using Wild PUG.IV instrument. Coordinates of the selected points were measured by using a Stecometer C. Aerial triangulation was finally adjusted by using PAT-M.PC program.

(2) Restitution

Based on the result of aerial triangulation, the photogrammetric line map with a scale of 1:5,000 was produced by using Zeiss Topocart B and two (2) Wild A.8 Stereo Plotter.

All detailed topographical information such as houses, buildings, roads, rivers, farms, factories, railways etc. were plotted on stable polyester base as well as spot heights at the main top of the mountains, main fork of roads, mouth of a valley, many change of slopes, lowest point of depression etc.

The contour lines were plotted at 5 meters interval, and half interval contour line of 2.5 m were supplemented according to topography there.

(3) Editing

Based on plotted manuscript, editing work was carried out using the result of field verification to complete pencil manuscript map. All necessary data were transferred from the photographs to manuscript.

(4) Drawing

The 80 cm x 60 cm size of polyester bases were used to trace the manuscript maps obtained from photogrammetric restitution at the scale 1:5,000. The final map sheets contains the grid crosses at interval of 10 cm, marginal information, coordinates etc. The index map of the produced topographic maps with thirty one (31) sheets is shown in Figure 8. The produced topographic maps are compiled into the Data Book (Volume IV).

3.2 Topographic Survey at the Major Structure Sites along the Karian Serpong Conveyance System

3.2.1 Survey sites

The topographic survey was commenced at the end of May 1994 by entrusting a local survey firm, PT. EXSA International, under supervision of the topographic survey experts of JICA study team and DGWRD based on the technical specifications prepared by the JICA study team, and completed at the middle of August 1994. The topographic maps with a scale of 1: 500 were produced for the proposed crossing structure sites such as aqueduct, syphon and box culvert, etc. at the existing rivers, roads and railways. The locations of the survey areas with the following mapping areas are illustrated in Figure 2 and the produced topographic maps are compiled into the Data Book (Volume IV):

No.	Location	Symbol in the Figure	Description	Mapping Area (ha)
1.	Kp. Ciherang, Ds. Maja	RD-1	Road crossing	0.5
2.	Kp. Babakan, Ds. Cikasungka	RD-2	Road crossing	0.5
3.	Kp. Kadepes, Ds. Bantar Panjang	RD-3	Road crossing	0.5
4.	Kp. Kademango, Ds. Cibogo	RD-4	Road crossing	0.5
5.	Kp. Nambo, Ds. Serpong	RD-5	Road crossing	0.5
6.	Kp. Cilacap, Ds. Cidadap		Cibeureum River	1.0
7.	Kp. Pasirceri, Ds. Mekarsari	RV-2	Cipanggang River	0.5
8.	Kp. Rabab, Ds. Pasirkembang	RV-3	Ciruruh River	0.5
9.	Kp. Ciherang, Ds. Maja	RV-4	Cicinta River	1.0
10.	Kp. Saporem, Ds. Sanghyang	RV-5	Cidurian River	2.0
11.	Kp. Pasirceri, Ds. Cikasungka	RV-6	Cikasunga River	0.5
12.	Kp. Barat, Ds. Daru	RV-7	Payaheum River	0.5
13.	Kp. Bandung, Ds. Daru	RV-8	Cicalengka River	0.5
14.	Kp. Leles, Ds. Jagabita	RV-9	Cimatuk	1.0
15.	Kp. Cibunar, Ds. Cibunar	RV-10	Cibunar River	1.0
16.	Kp. Lebak Talun, Ds. Parung Panjang	RV-11	Cimanceuri River	2.0
17.	Kp. Nambo, Ds. Serpong	RV-12	Cisadane River	2.5
18.	Kp. Cibayana, Ds. Cikasungka	RW-1	Railway	0.8
19.	Kp. Kalipey, Ds. Jatak	RW-2	Railway	0.7
			Total	17.0

3.2.2 Traverse survey

Traverse survey was carried out by using an electric distance measurement (EDM) theodolite in order to investigate coordinates by using the ground control points established for the

photogrammetric mapping. To carry out the survey with high accuracy, four (4) additional ground control points with wooden pegs were set up at all the aforesaid nineteen (19) locations in traverse survey and a concrete type stake was provided for one among four (4) points at each location. The locations of the ground control points utilized for the topographic survey are shown in Figure 5 and their coordinates are given in Table 1. Length and accuracy of the traverse-survey are as follows:

	Route	Length (km)	Accuracy
1	GPS02 - GPS05	8.2	1/34,000
2	GPS05 - GPS07	6.3	1/16,000
3	GPS07 - GPS09	9.0	1/12,000
4	GPS09 - GPS10	10.7	1/17,000
5	GPS11 - GPS13	11.1	1/19,000
6	GPS14 - GPS15	11.2	1/30,000
	Total	56.5	-

3.2.3 Leveling

Leveling survey was carried out to determine the elevation of the aforesaid four (4) supplementary ground control points. The datum elevation for leveling was set at the same one as the photogrammetric mapping work. The leveling survey using an automatic level was also started from and closed to the bench marks established during the aforesaid photogrammetric mapping work with closure error within an allowance derived by multiplying plus/minus 50 mm with square root of one way leveling distance in km. Results of leveling works are as follows:

Route	Length (km)	Error (mm)	Allowance in Specification (mm)
1	3.0	- 1	86
2	3.1	+ 1	88
3		- 20	150
4	2.5	- 1	79
5	4.5	+ 5	106
6	8.5	+ 35	145
7	2.5	- 2	79
8	4.0	- 12	100
9	3.0	- 7	86
10	6.5	- 14	127
11	5.0	- 13	111
Total	51.6	-	-

3.2.4 Mapping work

Spot leveling using the EDM theodolite was made to supplement contour lines by adequately selecting position and density of spot elevations in order to present the terrain conditions with high accuracy.

Based on the data and information acquired in the field, plotting work was made for producing a map with a scale of 1: 500 and contour line intervals of one (1) meter and half (0.5) meter subsidiary lines taking into account the flat topography at the sites with plotting accuracy within 0.5 mm on the map.

4. PRODUCED SURVEY MATERIAL

The following survey material was produced through photogrammetric mapping and topographic survey along the route of Karian-Serpong conveyance system.

No.	Description	Quantity
I. Photogrammetric Mapping		
1.	Signalization and monumentation description	1 set
2.	Aerial Photography	
	a) Original negative film	1 set
	b) Diapositive film	1 set
	c) Contact print	2 sets
	d) Enlarged prints	1 set
	e) Original flight index map	1 set
	f) Blue copy of flight index map	3 sets
	g) Flight records and weekly progress reports	1 set
3.	Uncontrolled Mosaic	
	a) Original uncontrolled mosaic	1 set
	b) Copy of uncontrolled mosaic	3 sets
4.	Control Point Survey	
	a) Observation data and calculation note	1 set
	b) Index map	1 set
5.	Leveling	
	a) Field note and computation note	1 set
	b) Index map	1 set
6.	Field Verification	
	a) Field verification results on four times enlarged photos	1 set
	b) Other data and materials collected	1 set
7.	Aerial Triangulation	
	a) Observation and computation output	1 set
	b) Original index map	1 set
	c) Copies	3 sets
8.	Editing	
	a) Original manuscript	1 set
	b) Other materials, and field completion data if any	1 set
9.	Drawings	
	a) Original topographic map	31 sheets
	b) Duplicate of topographic map	31 sheets
	c) Blue copies of topographic map	3 sets
10.	Final report	1 set
II.	**Topographic Survey at Major Structure Sites**	
10.	Drawings	
	a) Original topographic map	14 sheets
	b) Duplicate of topographic map	14 sheets
	c) Blue print of topographic map	5 sets
11.	Field notes and calculation sheets	1 set
12.	Description of monuments	1 set
13.	Final report	1 set

TABLES

Table 1 COORDINATE AND ELEVATION OF GROUND CONTROL POINTS

Ground Cotrol Point	Coordinates (m) North	Coordinates (m) East	Elevation (EL.m)
I. Set-up by photogrammetic mapping			
1. GPS-1	9,291,020.659	643,615.265	64.141
2. GPS-2	9,293,330.703	647,020.314	79.325
3. GPS-3	9,287,253.631	647,414.773	128.941
4. GPS-4	9,290,482.284	653,009.741	104.042
5. GPS-5	9,295,800.883	650,886.586	57.390
6. GPS-6	9,303,565.047	649,776.808	35.236
7. GPS-7	9,299,448.942	655,243.408	25.429
8. GPS-8	9,296,698.935	658,440.781	31.369
9. GPS-9	9,302,204.686	660,135.036	50.968
10. GPS-10	9,302,672.651	668,733.993	42.667
11. GPS-11	9,297,085.670	668,822.012	48.607
12. GPS-12	9,303,300.568	675,749.750	42.430
13. GPS-13	9,297,499.078	674,514.836	54.050
14. GPS-14	9,303,037.555	683,894.551	41.381
15. GPS-15	9,297,787.510	685,050.526	60.713
II. Set-up by topographic survey for major structure sites			
1. RV-01	9,291,738.378	648,873.318	50.660
2. RV-02	9,294,111.651	650,798.299	40.074
3. RV-03	9,297,827.616	651,689.115	44.084
4. RV-04	9,298,331.329	654,592.810	38.176
5. RV-05	9,298,557.330	655,847.755	29.252
6. RV-06	9,299,026.201	656,565.616	26.691
7. RV-07	9,300,723.346	664,109.520	37.767
8. RV-07	9,300,723.346	664,109.520	37.767
9. RV-08	9,300,816.433	664,953.009	40.854
10. RV-09	9,298,576.931	669,222.033	33.181
11. RV-10	9,298,772.283	671,261.031	36.055
12. RV-11	9,299,103.791	674,173.648	51.349
13. RV-12	9,301,036.954	683,494.918	40.602
14. RD-01	9,298,375.764	654,974.409	54.041
15. RD-02	9,299,067.039	656,334.677	35.041
16. RD-03	9,301,996.613	660,078.876	45.158
17. RD-04	9,300,194.788	681,307.796	49.069
18. RD-05	9,300,606.390	683,967.522	46.104
19. RW-01	9,300,182.995	658,485.041	52.589
20. RW-02	9,298,888.961	675,459.017	50.032

Note: All ground control points have been established with concrete for future use.

FIGURES

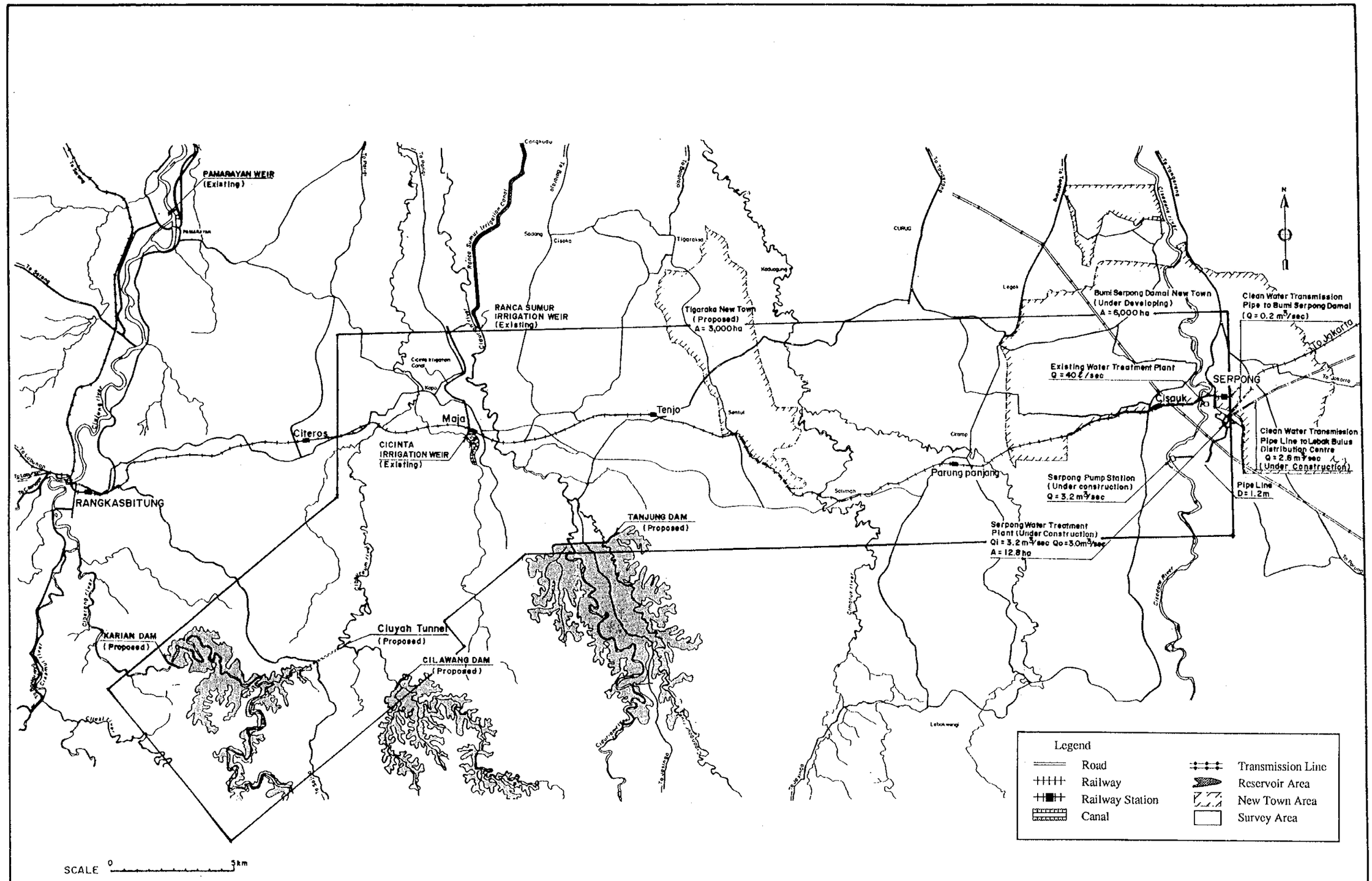


Figure 1 SURVEY AREA FOR PHOTOGRAMMETRIC MAPPING

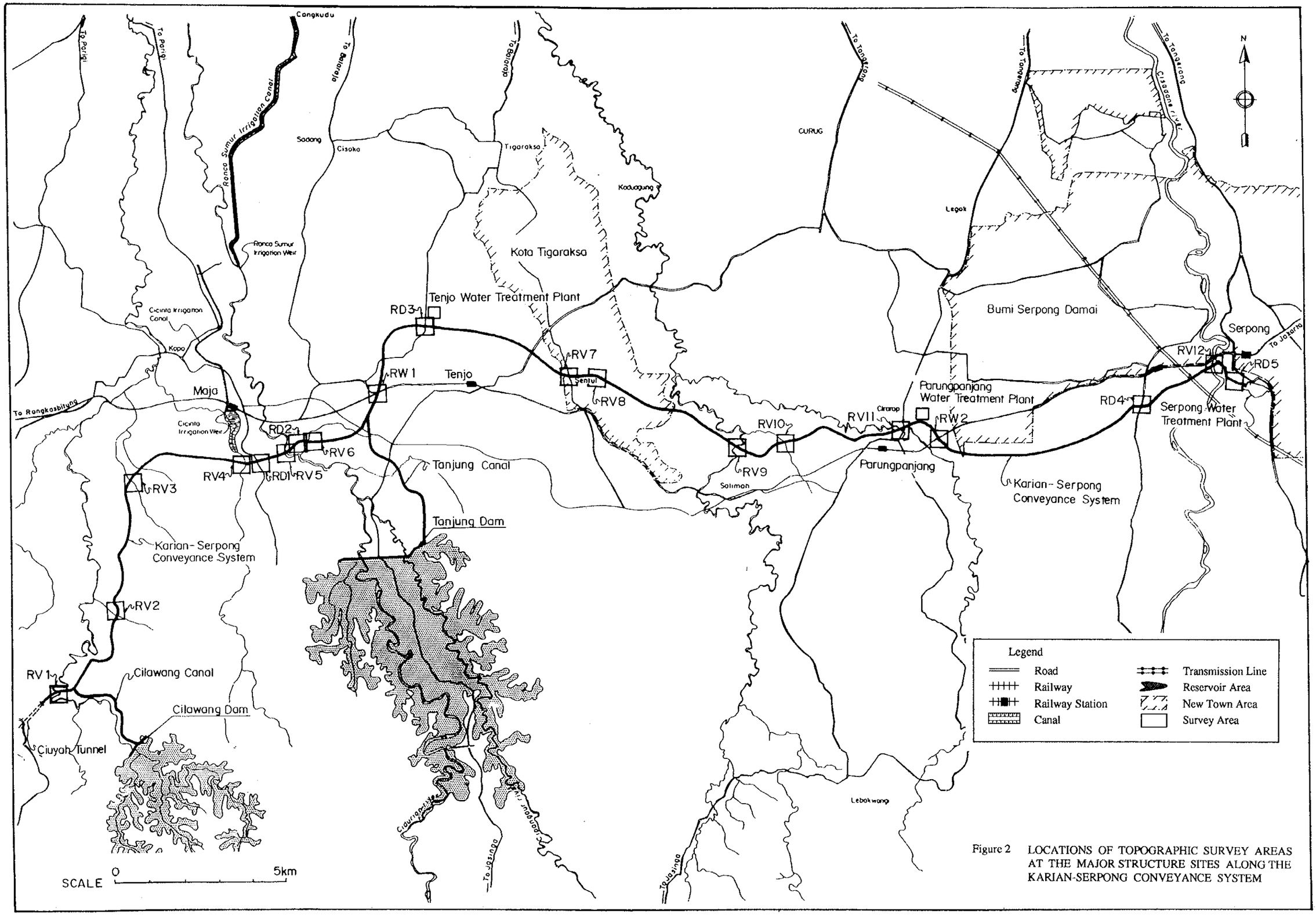


Figure 2 LOCATIONS OF TOPOGRAPHIC SURVEY AREAS AT THE MAJOR STRUCTURE SITES ALONG THE KARIAN-SERPONG CONVEYANCE SYSTEM

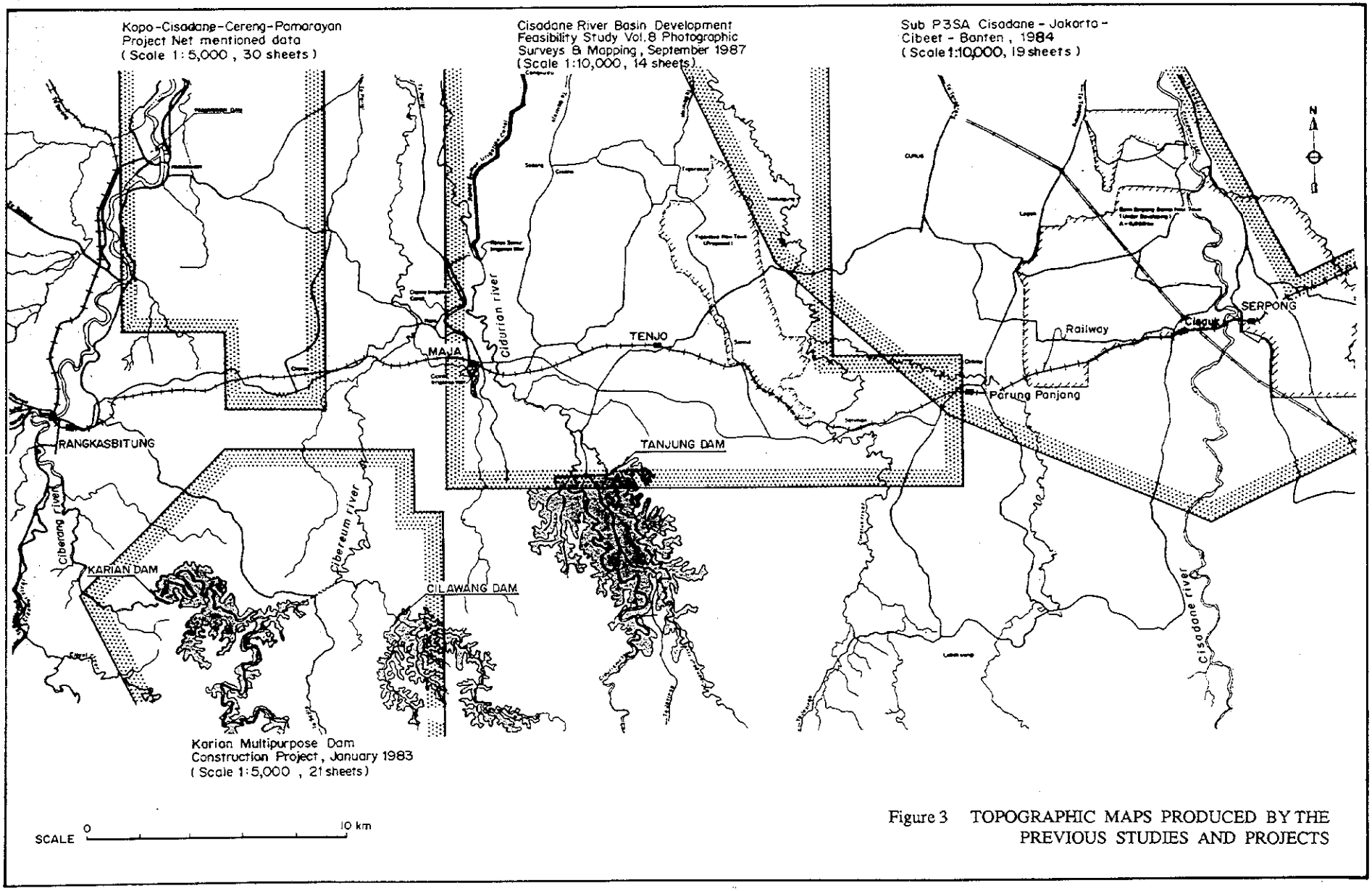
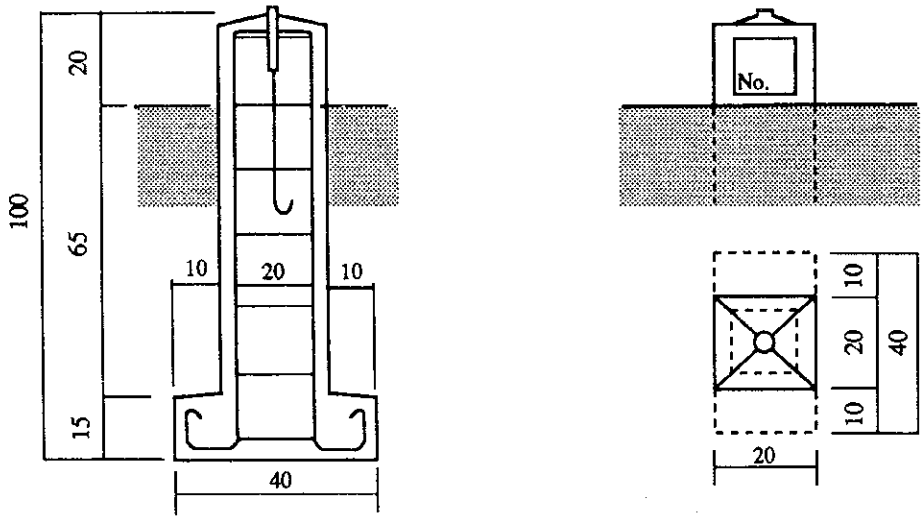


Figure 3 TOPOGRAPHIC MAPS PRODUCED BY THE PREVIOUS STUDIES AND PROJECTS



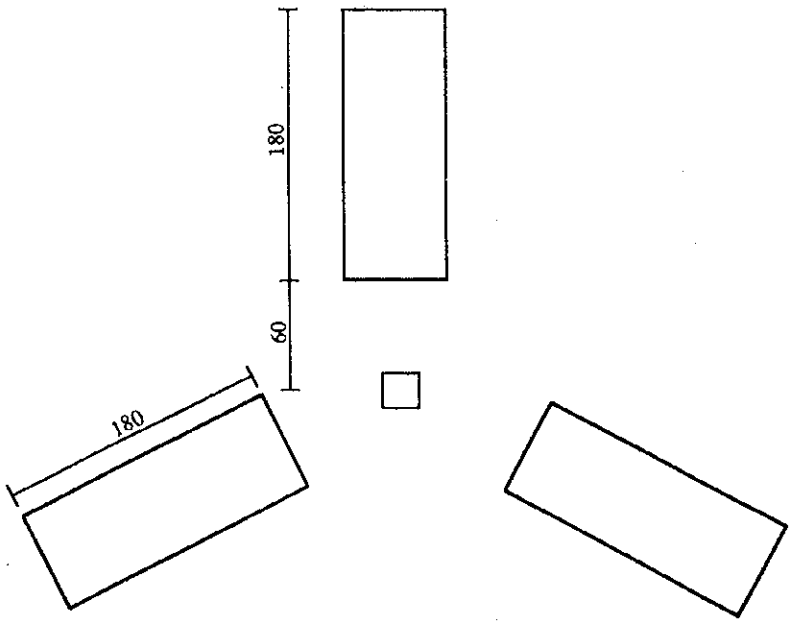


Figure 4 MONUMENT CONSTUCTED AT GROUND CONTROL POINTS BY THE STUDY