1) Inlet

The inlet structure which consist of 1400 steel conduit is embedded in the non-overflow concrete dam body and the centre of steel conduit is set at El.2.20 m.

2) Pipe line between dam and valve house for hollow jet valve

The pipe line, 150 m long between the dam toe and the valve house is embedded along the downstream right bank.

3) Valve house

The valve house for the guard valve and hollow jet valve is located at the end of 1400 steel conduit just upstream of existing Krakatau intake weir.

The stored water by the gated weir is released by the guard valve and hollow jet valve.

4) Energy dissipator

The energy dissipator for the outlet is provided at the downstream of hollow jet valve so as to make the stable flow condition into the trap basin.

The size of energy dissipator is designed by 3.5 m wide x 5.5 m depth x 39.4 m length.

The structural components optimized for the Cidanau gated weir is shown in Fig. 4.10.

4.4 Beroeng Diversion Tunnel

1) Diversion tunnel

Based on the results of optimization study,the internal diameter of the diversion tunnel is fixed at 1.50 m. The diversion tunnel is of pressure type. The tunnel length is about 280 m with no slope.

The bottom elevation excavated at both inlet and outlet portals is set at El.36.80 m which corresponds to the river bed in the outlet side because the river bed in the Beroeng river at the inlet portal is about 5 m lower than the river bed of Krenceng

river at the outlet portal.

2) Maximum discharge capacity

The outflow discharge into the diversion tunnel is determined by combination of the overflow water depth and width at the control weir to be provided in front of tunnel satisfying the pressure tunnel flow condition. The water surface level at the inlet portal is set at the elevation adding to the water depth of one (1) diameter of the tunnel above the elevation of tunnel crown at inlet.

El.of tunnel invert at inlet	:	El.37.10 m
El.of tunnel crown at inlet	:	El.38.60 m
El.of crest for control weir	:	El.39.35 m
Width of control weir	:	3 m
Maximum discharge	:	4 m^3/sec
Water level at maximum discharge	:	Wl.40.10 m

3) Intake Weir

The intake weir is provided crossing the Beroeng river,just downstream of tunnel portal. The intake weir consist of non-overflow section and overflow section. The crest elevation of overflow section is set at El.40.10 m which corresponds to the water surface level on the control weir at the maximum discharge, 4 m^3/sec. The discharge beyond 4 m^3/sec is released from the overflow section to the downstream Beroeng.

The crest elevation of non-overflow section is set at El.44.10 m adding to the freeboard, 1.0 m plus the overflow depth, 3.0 m against the 200-year probable flood, 170 m^3/sec above El.40.10 m.

4) Outlet facility

The outlet facilities which consist of 800 Howell-bunger and 2000x2000 outlet gate are provided in the concrete non-overflow section of intake weir so as to release the downstream water requirement such as irrigation and river maintenance flow and to flush the sediment.

The structural components optimized for the Beroeng diversion tunnel are shown in Figs. 4.11 to 4.13.

4.5 Water Conveyance Facilities

4.5.1 Basic Design Criteria

The basic design criteria for the water conveyance facilities is described as below.

1) Study cases

According to the selected schemes as the feasibility study, the following three cases are studied;

Scheme		Name of development	Net safe yield (m^3/sec)
1)	K-1	Heightening of Krenceng dam without diversion	3.05
2)	K-2	Heightening of Krenceng dam with Beroeng diversion	3.11
3)	C-3	Heightening of Krenceng dam with Beroeng diversion and Cidanau gated weir	3.435

2) Design conditions

(1) In principle, the incremental development due to the Project above the design capacity of existing Krakatau water conveyance and treatment facilities is additionally provided for the intake, sand trap basin and Cidanau pump station and the water treatment plant.

(2) The existing water conveyance facility which consists of Cidanau pump station and 27.2 km long pipe line having the conveyance capacity of 2 m^3/sec at the maximum pumping head of 67.1 m is operated so as not to exceed the design capacity of the existing.

(3) The additional pumps to be provided at Cidanau pump station should be designed at the total head of 67.1 m.

(4) In case that the development yield exceeds the existing, full water can not conveyed upto the Krenceng reservoir by using the design head of Cidanau pumps. Therefore, the booster pump station should be provided at the intermediate point, about 14.25 km from the Cidanau pump station so as to convey the water up to the Krenceng reservoir after receiving of water conveyed from the Cidanau pump station.

(5) According to the booster pump station, the surge tank is additionally provided at the place between the booster pump station and Krenceng receiving well.

(6) The existing Krenceng pump station is replaced by the proposed heightening of Krenceng dam.

4.4.2 Intake Facilities

1) Intake

Assuming the flow velocity in the intake of 0.5 m/sec and effective water depth of 1.6 m which are the same as the existing,the additional intake facility is estimated as below.

$$B = Q/v/H \quad (m)$$

where, B : width of intake (m)
v : flow velocity (0.5 m/sec)
H : water depth (1.6 m)

Scheme	Additional discharge (cms)	Width of additional intake, B (m)
K-1	1.05	1.50
K-2	1.11	1.50
C-3	1.435	2.00

2) Sand trap basin

The sand trap basin is added by one lane, 77.6 m length x 6.5 m wide x 1.8 m depth which is same as the dimension of existing trap basin. The settling velocity and flow velocity of the additional sand trap basin is estimated as below.

$$F=Q/As$$
$$V=Q/A$$

where, F : settling velocity (cm/sec)
Q : discharge (m^3/day)
As : surface area of trap basin (77.6 m length x 6.5 m wide)

A : sectional area of flow (6.5 m wide x 1.8 m water depth)

V : flow velocity (m/sec)

	Scheme			Allowable design in Japan 1)
	K-1	K-2	K-3	
Settling velocity (cm/sec)	0.21	0.22	0.28	< 0.3-0.8
Flow velocity (m/sec)	0.09	0.095	0.123	> 0.02-0.07

As seen in the above, the dimension of additional sand trap basin is satisfied for surface area but flow velocity exceeds the allowable one.

The sand trap basin is additionally provided by one lane of the existing one considering the allowance of settling velocity of the existing.

4.5.3 Water Conveyance Facilities

1) Design of conveyance facilities

The existing Cidanau pump station is designed with the discharge of 3000 m^3/hr and the total head, H=67.1 m.

Assuming that the development yield including the existing is conveyed from the Cidanau pump station to the Krenceng reservoir through a 27.2 km long pipe line, the required total head is estimated as below.

$$H = Ha + Hf + alfa \quad (m)$$

where, H : total head (m)

Hf : static head (31.6 m=33 m at Krenceng - 1.4 m at Cidanau)

alfa : residual head (1.0 m)

$$Hf = I*L \quad (m)$$

$$I = 10.666^{-1.85}*D^{-4.87}*Q^{1.85}$$

I : hydraulic gradient

L : length of pipe line (27200 m)

C : velocity coefficient (100)

Q : discharge (m^3/sec)

Scheme	Q (m^3/sec)	Ha (m)	Hf (m)	alfa (m)	H (m)
K-1	3.05	31.6	88.7	1.0	121.3
K-2	3.11	31.6	91.9	1.0	124.8
C-3	3.435	31.6	110.4	1.0	143.0

The results of the mentioned above reveals that;

1) The total head will reach to 120-140 m which corresponds to two times of design head, 67.1 m for the existing pump. This will bring the instability operation due to the difference of capacity between additional and existing pumps and the structural damages for the exist pipe line at the bend and the joint portions although the working stress is lower than the allowable stress.

2) The pumping head due to the development yield including the existing should be designed so as not to exceed the design head of existing pumps and thus available conveyance distance is determined.

3) The booster pump station should be provided at the intermediate point in 27.2 km pipe line so as to convey the water upto the Krenceng reservoir after receiving of water conveyed from the Cidanau pump station.

2) Cidanau pump station

From the check calculation of actual pumping head, the water is conveyed from the Cidanau pump station upto 14.25 km by using the Cidanau pump station (Fig. 4.14).

Scheme	Q (cms)	I (10^{-3})	Ha (m)	Hf (m)	alfa (m)	H (m)
K-1	3.05	3.26	1.0 1]	46.5	1.0	48.5
K-2	3.11	3.38	1.0	48.2	1.0	50.2
C-3	3.435	4.06	1.0	57.9	1.0	59.9

Note: 1] Booster pump station El.2.40 minus Cidanau pump station El.1.40 m

As seen in the above, total head is lower than the design head, 67.1 m.

Pump & motor output

$$P = 0.163*Q*H*(1+k)/eta \quad (kw)$$

where, Q : discharge (m^3/min)
H : total head (m)
eta : Pump efficiency (0.8)
k : allowance (0.25)

Scheme	Q (cms)	H (m)	P (kW)	Unit	Pump output (kW)	Total output (kW)
K-1	1.05	67.1	1078	2	550	1100
K-2	1.11	67.1	1138	2	580	1160
C-3	1.435	67.1	1471	2	740	1480
Existing	2.00	67.1	2050	4 1]	1000 2]	4000

Note: 1] including one standby.
2) Actual capacity of the existing because this pump is designed at 2.5 m^3/sec.

3) Booster pump station

Water is conveyed from the intermediate point upto the Krenceng receiving well, about 12.95 km by the booster pump station.

Scheme	Q (cms)	I (10^{-3})	Ha (m)	Hf (m)	alfa (m)	H (m)
K-1	3.05	3.26	30.6 1]	42.2	1.0	73.8
K-2	3.11	3.38	30.6	43.8	1.0	75.4
C-3	3.435	4.06	30.6	52.6	1.0	84.2

Note: 1] Receiving well El.33.00 minus booster pump station El.2.40 m

In principle,the quantity of booster pump station is required for the purpose of regular operation and one standby so as to avoid trouble due to operation under the high pressure condition.

Scheme	Q (cms)	H (m)	P (kW)	Unit	Pump output (kW)	Total output (kW)
K-1	3.05	73.8	3440	4 1]	1150	4600
K-2	3.11	75.4	3584	4 1]	1200	4800
C-3	3.435	84.2	4420	4 1]	1500	6000

Note: 1] included one standby.

4) Surge tank

The existing one-way surge tank is located at about 4 km point from the Cidanau pump station so as to reflect the pressure wave and protect the pipe line against water hammer overpressures due to pump-trip.

Owing to the addition of booster pump, the surge tank is added to the existing one and provided at the place between the booster pump station and Krenceng receiving well.

4.5.4 Treatment Facilities

The existing water treatment facilities which are designed at 2.0 m^3/sec consist of the high rate coagulation basin,rapid sand filtration, sludge treatment,purified water reservoir and water tower (Fig. 4.15).

1) Krenceng pump station

The storaged water in the Krenceng reservoir is conveyed to the water treatment facilities by using the Krenceng pump station.

Owing to the heightening of Krenceng dam, the Krenceng pump station is replaced. The quantity of pumps is provided for regular operation and one standby in an emergency.

Scheme	Q (cms)	H (m)	P (kW)	Unit	Pump output (kW)	Total output (kW)
K-1	3.05	20 [2]	932	4 [1]	310	1240
K-2	3.11	20	950	4 [1]	320	1280
C-3	3.435	20	1050	4 [1]	350	1400
Existing	2	13	410	5 [1]	110 [4]	550

Note: 1] included one standby.
2] Ha=El.33-LWL.18.5=14.5 m, Hf=3.0 m, alfa=1.0 m
3] Ha = EL.28.2 - LWL.18.0 = 10.2 m, Hf = 2.0 m, alfa = 1.0 m
4] Actual capacity of the existing.

2) Receiving well

The dimension of receiving well is estimated to provide a capacity of 5 minutes storage to meet with the existing capacity.

3) High-rate coagulation basin

The existing facilities consist of three (3) units x 0.7 m^3/sec (= 1,500 m^2 x settling rate 1.6 m/hr/3,600 sec). It includes the chemical feeding and associated equipment. The facility is added by incremental yield due to the project, 3-4 units x 0.5 m^3/sec.

4) Rapid sand filtration

The existing facilities are designed at 0.5 m^3/sec per unit. The facility is added by incremental yield due to the Project, 3-4 units x 0.5 m^3/sec.

5) Purified water reservoir

The existing facility is designed at 7200 m^3 (= 2 m^3/sec x 3600 sec) which corresponds to the capacity-to-supply of purified water in 1 hour.

6) Water tower

The existing water tower is designed by the capacity-to-supply of water in 15 minutes.

7) Sludge treatment

The sludge treatment will be designed according to the existing.

The structural components optimized for the water conveyance and treatment facilities are shown in Figs. 4.16 to 4.20 and Table 4.1.

The principal features for selected development schemes are summarized in Table 4.2.

5. CONSTRUCTION PLAN AND COST ESTIMATE

5.1 Construction Plan and Schedule

5.1.1 General

Structures and facilities necessary for the project are planned and designed as described in the previous Chapter 4. Construction plan and schedule required for implementation of the designed structures and facilities is dealt with in this Chapter.

The study of the construction plan and schedule are carried out for the scheme with principal features as described in Table 4.2 and the required major construction works are summarized as follows:

(1) Heightening of Krenceng dam including spillway facilities
(2) Construction of Beroeng diversion tunnel and intake weir
(3) Construction of Cidanau gated weir including installation of gate and construction of outlet facilities
(4) Extension of Cidanau pump station including construction of intake and sand trap basin.
(5) Construction of Anyer pump station
(6) Extension of water treatment plant including construction of intake facilities

It is assumed that the construction works will be mainly conducted under a contract system of which contractor will be selected through international competitive tender. The selected contractor would apply a modern construction method taking consideration of local conditions, managing proper and sufficient equipment to complete the works on schedule.

Based on the above condition and assumption, the construction plan and schedule is prepared to give an outline of possible construction sequence and method, and construction schedule.

5.1.2 Heightening of Krenceng Dam

The existing Krenceng dam will be heightened by embanking earth material. The embankment volume required for heightening will be 1,281,000 m^3 of which borrow pit will be provided at just upstream area of the Krenceng reservoir.

After the mobilization and preparatory works, the construction will be initiated from the dam foundation excavation including trench cut excavation. Subsequently, grout works will be performed for the dam foundation treatment and the dam embankment works will be followed.

The dam embankment will be carried out during dry season only from May to November annually. Available working day for embankment work is estimated at about 150 days annually, considering that of similar project performed in Indonesia.

The embankment material will be excavated by using bulldozer with ripper, loaded by tractor shovel and hauled by dump truck from the borrow area to dam embankment site. The embankment will be conducted layer by layer by using bulldozer for spreading the material and by using soil compactor for compaction. Water content of the embankment material will be controlled by sprinkling water with water tanker when necessary.

Three dry seasons will be required for the completion of the dam embankment.

In parallel with the dam embankment, spillway construction will be carried out and spillway gates will be installed after the completion of the civil structures of the spillway.

5.1.3 Beroeng Diversion Tunnel

There is a existing road to access from the Krenceng dam site to the just upper part of the tunnel. Prior to the commencement of tunnel construction, the existing road will be improved by levelling and metaling inferior parts of the road.

The tunnel construction will be initiated from portal construction at both inlet and outlet site and subsequently, tunnel will be excavated from both inlet and outlet side.

The tunnel excavation will be conducted by man power, using jack hammers powered by compressed air for drilling of blast holes. Muck car and shovel loader on the rail will be used for hauling excavated materials after blasting.

After the excavation of upstream side, concrete lining will be carried out by using concrete pump and steel sliding form. Concrete will be produced by batcher plant and hauled by agitator truck to a concrete pump installed at portal of tunnel. Concrete lining for downstream side will be followed to that of upstream side with the same method.

After the concrete works, grout works will be performed in the surrounding of the concrete lining.

In parallel with the tunnel construction, intake weir will be constructed. The intake weir construction will be initiated from foundation excavation after the dry season set in. After the completion of foundation excavation, concrete works will be carried out.

5.1.4 Cidanau Gated Weir

The Cidanau gated weir will be constructed at just upstream area of the existing Cidanau intake weir.

The existing approach road branched from the public road to the existing Cidanau pump station and intake will be extended to the construction site. It will be used for access road during the construction.

The construction of gated weir will be initiated from river diversion works which will be carried out by making cofferdam of double steel sheet pile connected with tie rods and filled with earth and sand. The river diversion works will be divided into two stages. The first stage will be carried out for the right side construction, and subsequently the second stage will be performed for the left side construction. Immediately after dry season set in, steel sheet piling will be commenced by steel hammer handled with crawler crane.

After the completion of cofferdam with steel sheet pile, the construction area will be dewatered by using submersible pump and subsequently, foundation excavation will be carried out by using back hoe, bulldozer and dump truck.

After the foundation excavation, concrete works will be performed by using concrete bucket handled with crawler crane. Concrete will be produced by batcher plant installed nearby the dam site on right bank. Agitator truck will be used for transportation of the concrete from the batcher plant to the placement site. Concrete vibrator will be used for compaction of the concrete.

In parallel with the concrete placement of the weir portion, concrete will be placed for pier portion also with the same method.

After the completion of the pier, spillway bridge will be constructed and subsequently, spillway gate will be installed.

After the completion of the works, the cofferdam will be removed finally.

5.1.5 Construction Schedule

After the completion of feasibility study, financial arrangement and selection of engineering consultants will be made for the detail engineering study to implement the project. The detail engineering study will be carried out for about one or two years including survey and investigation works necessary for the detail design and preparation of tender documents required for selection of appropriate contractor.

The selection of contractor will be carried out through international competitive tender with prequalification and then, construction works will be commenced. The construction period is assumed to be three (3) years. Thus, seven (7) years in total will be necessary for the completion of the project after the feasibility study.

Implementation schedule of the project and construction schedule of respective works are shown in Figs. 5.1 to 5.4 (3).

5.2 Cost Estimate

5.2.1 General

Project cost is estimated on the basis of the feasibility design described in previous Chapter 4, and the construction plan and schedule mentioned in the Section 5.1 of Chapter 5.

The project cost to be estimated is composed of as follows:

(1) direct construction cost
(2) Land acquisition and compensation cost
(3) Government administration cost
(4) Engineering service cost
(5) O&M cost
(6) Contingency

The direct construction cost is further subdivided into preparatory works, civil works, hydromechanical works and water transmission works according to their nature of works.

Cost estimate for the project is made with a price level of the end of 1991 and currency exchange rate at the end of 1991 is applied as follows:

¥1 = Rp.15.6
$1 = ¥126 = Rp. 1965.6

The project cost is estimated by dividing into two component of the foreign currency component and a local currency component.

Each currency component includes as follows:

Local currency component (L.C.)
- Labour cost
- Local purchased materials
- Government administration expenses
- Land acquisition and compensation cost
- Engineering service cost for local consultants
- Small gates
- Steel pipes

Foreign currency component (F.C.)
- Construction equipment cost
- Gates and valves
- Purification equipment
- Imported materials
- Engineering service cost for foreign consultants

The local currency component is expressed by Indonesian Rupiah and the foreign currency component by Japanese yen.

5.2.2 Preparatory Works

Cost of preparatory works is estimated by lump sum basis to cover access road, temporary office and quarter, electric supply system, water supply system and other facilities for construction use. Besides, cost of miscellaneous works, such as slope protection, sod facing, weep hole, water stop, backfill, dowel bar, etc., which is not estimated by unit price basis, is also estimated by lump sum basis.

Twenty (20) percent of total direct cost estimated by unit price basis is applied for the cost of preparatory works and miscellaneous works.

5.2.3 Civil Works

Direct construction cost of civil works is estimated principally by adopting the unit price basis that is multiplied by the corresponding work quantity. According to the feasibility design, the work quantity for main work items is calculated.

Based on the conventional construction method, the unit prices for the main work items are computed by using unit cost of labour, material and equipment which were collected in the field as shown in Table 5.1 to 5.3.

The calculated unit price for main work item is summarized in Table 5.4.

5.2.4 Hydro-mechanical Works

Cost of hydro-mechanical works is estimated based on the past tendered record of similar projects and considering the local conditions. The estimated cost includes the cost of engineering, design, material, manufacturing, painting, testing, packing, delivery to the site and installation.

5.2.5 Water Transmission Works

Cost of water transmission works mainly consists of :

(1) Construction cost of Cidanau pump station
(2) Construction cost of Booster pump station
(3) Construction cost of Krenceng pump station
(4) Construction cost of water treatment plant

There are mainly subdivided into civil work cost, building cost and equipment cost including water pump and water treatment equipment.

The cost of civil works is estimated by the unit price basis as described in Subsection 5.2.3, and the cost of building is calculated by applying prevailing unit cost of square meter in Indonesia. The cost of water pump and treatment equipment are estimated on the basis of prevailing purchase cost in Japan.

5.2.6 Land acquisition and compensation cost

The cost of right of way and compensation is estimated for the land, building and other private properties by using prevailing unit cost obtained at field. These costs are counted in local currency portion.

	Item	Unit	Heightening of Krenceng Dam	Cidanau gated weir	Unit price (10^6 Rp/ha) or (10^6Rp/nos.)	Amount of compensation cost (10^6 Rp) Krenceng	Cidanau
1)	Inundated area	ha	183	41			
	- Inundated area to be compensated	ha	58 1)	14 2)			
	- Forest	ha	-	14	2		28
	- Upland paddy field 3)	ha	58	-	11	638	
	- Houses to be resettled in the inundated area	ha	-	-			
2)	Downstream area to be compensated						
	- Upland paddy field 3)	ha	11.05	-	11	121.55	
	- Houses	Nos.	278	-	10	2,780	
	- School	Nos.	1	-	50	50	
	- Mosque	Nos.	4	-	30	120	
	- Office	Nos.	1	-	13	13	
						3,722	28

Note : 1) Show the area between EL. 29.00 and EL. 24.00 because the area below EL. 24.00 is compensated by PT Krakatau Steel.
2) Only private area
3) Include ground-nuts and coconut fields.

5.2.7 Administration Cost

The government administration expenses for the project is estimated by Lump Sum basis at ten (10) percent of the total construction cost. It is expressed in local currency portion.

5.2.8 Engineering Service Cost

The cost of engineering service to be required for the implementation of the project is estimated at fifteen (15) percent of total construction cost for foreign currency portion and five (5) percent of total construction cost for local currency portion. It covers engineering services required for detailed design and construction supervision.

5.2.9 Contingency

The contingency is provided to cope with the unforeseen physical condition and the price escalation due to inflation. The physical contingency is assumed to be ten (10) percent of total cost for both local and foreign currency portion.

The price contingency is estimated for both foreign and local currency by applying annual inflation rates as follows:

	1991	1992 ~ 2000
F.C.	5%	3.7%
L.C.	7.5%	6.0%

Source: DGWRD

5.2.10 Project Cost

The project cost is computed by applying unit price basis for main work items and lump sum basis for other work items as described in previous section.

The details of construction cost are shown in Table 5.5 to 5.7 (2).

5.2.11 Annual Disbursement Schedule

Based on the construction schedule, the construction cost is assumed to be disbursed as shown in Table 5.8 to 5.10.

The project costs are summarized in Table 5.11.

5.3 Organization for Project Implementation

5.3.1 Alternatives for Project Implementation

From view points of execution and finance of the Project, six (6) alternatives of organizations are considered for the Project implementation as shown in Table 5.12.

The organization is mainly divided into two (2) types, Type A and Type B as below.

1) Type A assumes that both new water supply facilities to be implemented through the Project and the existing facilities currently managed by P.T. Krakatau Steel (P.T. KS) should be under a single management body; P.T. KS in the case of Alternative A-1 and PDAM, Serang in the case of Alternative A-2.

2) Type B assumes that the existing water supply facilities should be continuously managed by P.T. KS as at present.

Basic difference of Alternatives B-1 and B-2 is that the construction cost of the Project will be financed by DPU by its budgetary allocation in the case of the former and financed by cost sharing among public and private sectors in the case of the latter.

5.3.2 O&M Plan

After completion of the Project, an organization to execute O&M for the dam, water transmission and water treatment facilities will be required. The organization of O&M will be made in accordance with that of organization for the Project implementation.

6. PROJECT EVALUATION

6.1 General

The Project evaluation which consists of economic and financial analysis are made in this chapter. The benefit brought by the project implementation is composed of incremental net water supply between "with Project" and "without Project".

For the project evaluation,the following basic assumptions are applied;

i) The cost is estimated at a price level of end 1991.
ii) The exchange rate is US$1 = ¥126 = Rp1965.6
iii) The detailed design and construction begins in 1993 and operation commences in 2000.
iv) The project life is taken as 50 years after the commissioning of water supply.
v) The construction cost for the distribution pipeline is excluded.

6.1.1 O&M Costs

The annual O&M costs for the dam and appurtenant structures are 0.5% of the direct cost. Annual O&M costs for water transmission and treatment facilities are taken at 1% of direct cost. The annual O&M costs for the existing facilities are excluded.

Scheme	Annual O&M cost (10^6 Rp)
K-1	747
K-2	773
C-3	1110

6.1.2 Pumping Costs

The annual pumping costs are estimated by the incremental cost between "with Project" and "without Project".

1) Pump capacities to be installed

The pump capacities are as described in Chapter 4.5.3 and 4.5.4. The facilities to be installed are summarized as below.

Scheme	Cidanau pump station (kW)	Booster pump station (kW)	Krenceng pump station (kW)
K-1	1100 2]	3450	930 3]
K-2	1160 2]	3600	960 3]
C-3	1480 2]	4500	1010 3]
Existing	3000	-	440

Note: 1] Excluded the standby.
2] Additional facilities.
3] Replaced facilities.

2) Operation hours

$$Oh = V/Q/3600 \quad (hrs)$$

where, Oh : annual operation hours (hrs)
V : annual water conveyance (m^3)
Q : discharge (m^3/sec)

	Description	Pump station	V 1] ($10^6 m^3$/yr)	Q (cms)	Oh (hrs/yr)
1)	Scheme K-1	Cidanau	83.501	3.05	7604.8
		Booster	83.501	3.05	7604.8
		Krenceng	96.184	3.05	8760
2)	Scheme K-2	Cidanau	77.522	3.11	6924.0
		Booster	77.522	3.11	6924.0
		Krenceng	98.076	3.11	8760
3)	Scheme C-3	Cidanau	87.771	3.435	7097.8
		Booster	87.771	3.435	7097.8
		Krenceng	108.326	3.435	8760

Note: 1] Based on the results of final operation study mentioned in Chapter 3.5.4.

3) Annual electric consumption and annual electric charge

The annual electric consumption is estimated by multiplying the pump capacity and annual operation hours.

The electric charge per kwh is assumed at 84 Rp/kwh according to PLN.

Description		Annual incremental [1] electric consumption (10^6 kwh/yr)	Annual incremental electric charge (10^6 Rp/yr)
Scheme	K-1	38.89	3267.12
	K-2	37.51	3151.16
	C-3	47.78	4014.22

Note: Excluded the annual electric consumption and electric charge due to the existing.

6.1.3 Replacement Cost

The original investment for the water transmission and treatment facilities except civil works is assumed to be incurred for replacement after the life of 25 years. The replacement will be carried out in three years period from 2023 to 2025. The replacement costs for the existing water transmission and treatment facilities are excluded.

Scheme	Total replacement cost (10^6 Rp)
K-1	53064
K-2	54378
C-3	63980

6.2 Economic Analysis

The economic viability of each scheme is evaluated by means of economic internal rate of return (EIRR) and net benefit (B-C), where economic benefit is estimated by willingness-to-pay for water users and economic cost is calculated on the basis of the financial cost by deducting the transfer payment.

6.2.1 Economic Costs

The financial cost expressed in market prices excluding the compensation cost is converted into economic values by applying the conversion factors.

1) Conversion factor

	Item	Conversion factor
1)	Civil works	0.90
2)	Metal works	1.00
3)	Water transmission &treatment works	0.95
4)	Administration	0.95
5)	Engineering services	0.95
6)	O&M	0.85

Source: DGWRD

The financial and economic costs are summarized in Table 6.1 to 6.3.

2) Annual production foregone

Land acquisition cost is excluded from the project economic costs. After completion of the heightening of Krenceng dam, the upland paddy field is submerged. For economic analysis, an opportunity cost of production foregone is evaluated instead of the land acquisition cost.

The annual production foregone is expressed by the net profit which is obtained by the gross income minus the production costs as below.

Description	Planted area (ha)	Yield (kg/ha)	Annual production (ton)	Selling price (Rp/kg)	Annual income (10^6 Rp)	Production cost (Rp/ha)	Annual production cost (10^6 Rp)	Annual net profit (10^6 Rp)
1) Paddy	15	1500	22.5	250	5.625	312,000	4.680	0.945
2) Groundnuts	40	400	16	1200	19.200	142,000	5.680	13.520
3) Coconut	14.05	400	5.62	1000	5.620	100,000	1.405	4.215
	69.05							18.680

6.2.2 Economic Benefits

Economic benefits of the water supply Project is theoretically estimated by means of the willingness-to-pay of the enterprises and residents for the water supply. However, water tariff corresponding to willingness-to-pay is quite difficult to assess, therefore, the actual expenses disbursed by the suppliers is applied instead of willingness-to-pay.

Thus, incremental economic benefit of the project is estimated as follows:

Thus, incremental economic benefit of the project is estimated as follows:

1) Willingness-to-Pay of Manufacturing Enterprises and Residents

Manufacturing enterprises

According to interview survey with manufacturing and other enterprises in the Study Area conducted in this Study during December 1990 through January 1991, and PDAM water tariff, it is found out that the disbursement for one cubic meter of treated water in 1990 was as follows:

Category	Water charge cost (Rp/m^3)
PDAM tariff (industrial use)	700 - 2100
Private supply	
- Krakatau steel company	500
- Desalination plant	3000 - 5000
- Others	2750 - 9000

The PDAM water tariff for the industrial water use in January 1992 lies in the range of Rp 700 - 2100 /m^3 owing to the magnitude of daily water consumption of each enterprise.

The cost of water produced by desalination plants of four manufacture having water supply capacity of about 35 l/sec lies in a range of Rp 3000 - 5000 /m^3.

The water charge of other eight private suppliers, such as PT Peteka and PT GSI having water supply capacity of about 3 l/sec lies in the range of Rp 2750 - 9000 /m^3.

As mentioned in Chapter 2.2, the Krakatau's water transmission and treatment facilities had been established by the own financing of the Government of the Republic of Indonesia in 1978 and their water supply facilities were shifted to the state owned Krakatau Steel Company. Considering the above background, the water tariff 500 Rp/m^3 by Krakatau's water supply facility to Suralaya power station, Cigadeng port, Asahimas and Otsuka chemical companies and so on is deemed not a full-cost-recovery basis, which is only sufficient to meet operation and maintenance expenses for water supply facilities including the distribution pipelines but rather too high as O&M expenses.

As shown above, the water charge/cost ranges from Rp700 to Rp9,000 per m^3 except Kurakatau's water tariff which is not taken into account due to reasons as forementioned.

Enterprises who are paying higher unit charge are those who have located their facilities at relatively later stage and did not have the access to cheaper water, and those who are paying lower charges are "early commers". This implies that all these enterprises are willing to pay even a quite high water charge as they have no access to cheaper water.

Residents

Capacity-to-pay of the residents and commercial enterprises of small scale (shops) could be measured either by PDAM water tariff, or 3% of the household income of the residents which is frequently used by international financing institutes as given below:

Category	Water charge cost (Rp/m^3)		
PDAM tariff(domestic)	0 - 10	m^3/day	175
	11 - 20	m^3/day	275
	21 - 30	m^3/day	375
	> 30	m^3/day	525
3 % of household income *			530

Note : The 3 % of house hold income is calculated based on the data of statistic office of Serang district in 1990 as follow :

1)	Annual regional gross domestic product per capita	(Rp/yr)	1,140,290
2)	Annual regional income per capita (excluding 15 % of indirect tax)	(Rp/yr)	969,246
3)	Average persons per household	(Nos.)	5
4)	Daily water consumption per capita	(l/day)	150
5)	Capability to pay for water charge (3 % of monthly household income)	(Rp/m^3)	* 538

* : = (0.03 x 5 x 969246 / 12) / (5 x 0.15 x 30)

From the view point of household income, it can be said that the residents have the capacity-to-pay up to around 530 Rp/m^3.

2) Economic Benefits

Water use ratio

The water use ratio between the manufacturing enterprises and residents is determined by the water use amount due to the water demand projection mentioned in Chapter 2.3.4 as below.

Water use	Water supply ratio
Domestic water	25.0% of annual supply volume
Industrial water	75.0% of "

Water charge

As mentioned above, water charge for the industrial water use ranges from Rp 700 to Rp 9000/m^3 owing to the suppliers. Among them, PDAM water tariff which lies in the range of Rp 700 - 2100 /m^3 is the lowest one. In this study, willingness-to-pay of manufacturing enterprises is evaluated by the most conservative water charge, PDAM water tariff.

The water charge as the economic benefit for the industrial water is decided at 2100 Rp /m^3 which rate is for daily water consumption of more than 30 m^3/day.

The PDAM's water tariff for domestic water ranges from Rp 175 to Rp 525 with an average of Rp 350. Within the above, the majority of water user will be the residents with water consumption of 0 - 10 m^3/day which costs Rp 175/m^3. From the view point of weighted average, the water charge for the domestic water is conservatively decided at 200 Rp/m^3 which corresponds to the PDAM's water tariff for daily water consumption of about 15 m^3/day. This is much less than 3 % of the household income which is considered as capacity-to-pay of the residents.

The combined willingness-to-pay of manufacturing enterprises and residents is obtained by the weighted ratio of both water use ratio, which comes to 1625 Rp/m^3 (= 0.25x200 + 0.75x2100).

Annual net supply volume

The economic benefits in each year after the operation of water supply in early January of 2000 is obtained by multiplying the combined willingness-to-pay and

annual net water supply volume which means the difference between net supply yield "with Project" and "without Project" considering the loss due to leakage of water supply facilities including the distribution pipelines.

The incremental annual net water supply volume above is calculated by following three conditions ;

Case 1 : 95 % effective of incremental annual net water supply volume
(5 % loss based on Design Criteria in Japanese Industrial Water Institute)

Case 2 : 75 % effective of incremental annual net water supply volume

Case 3 : 60 % effective of incremental annual net water supply volume
(40 % loss based on Jakarta Water Supply Development Project, Mar. 1985, JICA)

Scheme	Net supply yield with Project	Net supply yield without Project	Incremental annual net water supply volume ($10^6 m^3/yr$)*		
	(m^3/sec)	(m^3/sec)	95 %	75 %	60 %
K-1	3.05	1.94	33.254	26.253	21.002
K-2	3.11	1.94	35.052	27.672	22.138
C-3	3.435	1.94	44.789	35.359	28.287

* 365 day x 86400 sec. x effective (%) x net supply yield (with Project - without Project)

3) Economic internal rate of return

The economic cash flow for the scheme is prepared as presented in Table 6.4 to 6.6. From the cash flow data in tables above, the economic internal rate of return (EIRR) and cost-benefit ratio (B/C) are calculated and shown in Table 6.4 to 6.6. B/C calculation is made by the assumption of 12 % discount rate and 50 years evaluation period.

Economic Analysis (Unit : 10^6 Rp)

	Scheme								
	K-1			K-2			C-3		
	Effective Supply Volume (%)			Effective Supply Volume (%)			Effective Supply Volume (%)		
	95	75	60	95	75	60	95	75	60
1)	83868	83868	83868	86403	86403	86403	136891	136891	136891
2)	227359	179494	143595	239648	189196	151357	306218	241751	193401
3)	143490	95625	59727	153245	102793	64954	169327	104860	56510
4)	2.71	2.14	1.71	2.77	2.19	1.75	2.24	1.77	1.41
5)	30.92	25.51	20.95	31.23	25.82	21.26	25.11	20.65	16.92

Note :
1) Capitalized cost (C) *
2) Capitalized benefit (B) *
3) Net benefit value (B-C)
4) Benefit cost ratio (B/C)
5) Internal rate of return (IRR)%
* Capitalized by discount rate of 12 %

It is apparent from the above results that, even by applying the most conservative condition of 60 % incremental annual net water supply volume, EIRR of three schemes is higher than 12 % which is considered as the opportunity cost of capital in Indonesia.

4) Sensitivity analysis

Sensitivity analysis of EIRR is conducted by applying following cases and fixing 60 % incremental annual net water supply volume which is the most conservative condition :

Case 1 : 10 % up for the capital costs
Case 2 : 10 % down for the capital costs
Case 3 : 10 % up for the benefits
Case 4 : 10 % down for the benefits
Case 5 : Combination of Case 1 and 4
Case 6 : Combination of Case 2 and 3

The results of the sensitivity analysis are summarized in Figs. 6.1 to 6.3.

Economical Sensitivity Analysis for Selected Schemes

Case		Scheme					
		K-1		K-2		C-3	
Original		20.95	(100.0)	21.26	(100.0)	16.92	(100.0)
Case	1	19.33	(92.2)	19.63	(92.3)	15.59	(92.1)
	2	22.84	(109.0)	23.17	(108.9)	18.48	(109.2)
	3	22.83	(108.9)	23.15	(108.8)	18.45	(109.0)
	4	18.97	(90.5)	19.29	(90.7)	15.31	(90.5)
	5	17.47	(83.4)	17.77	(83.5)	14.08	(83.2)
	6	24.84	(118.5)	25.17	(118.3)	20.11	(118.8)

6.3 Financial Analysis

The financial viability of each scheme is evaluated by means of financial internal rate of return (FIRR) and net benefit (B-C).

Financial Cost

All the costs are expressed in the form of financial or market prices. Interest during construction is not included.

Annual revenue

Water tariff is same as the economic analysis. The water tariff of domestic use is 200 Rp/m^3 and the industrial use is 2100 Rp/m^3. The annual revenue in each year is obtained by multiplying the water tariff and net incremental water supply volume same as that of the economic analysis.

6.3.1 Financial Cash Flow

The financial cash flow for each scheme is prepared as presented in Table 6.7 to 6.9.

6.3.2 Calculation of FIRR

From the cash flow data in Table 6.7 to 6.9, the financial internal rate of return (FIRR) and cost-benefit ratio (B/C) are calculated and summarized as below.

Financial Analysis (Unit : 10^6 Rp)

	Scheme								
	K-1			K-2			C-3		
	Effective Supply Volume (%)			Effective Supply Volume (%)			Effective Supply Volume (%)		
	95	75	60	95	75	60	95	75	60
1)	92524	92524	92524	95291	95291	95291	148845	148845	148845
2)	227359	179494	143595	239648	189196	151357	306218	241751	193401
3)	134835	86970	51071	144358	93906	56066	157373	92906	44556
4)	2.46	1.94	1.55	2.51	1.99	1.59	2.06	1.62	1.30
5)	27.99	23.03	18.87	28.33	23.37	19.19	23.25	19.06	15.57

Note : 1) Capitalized cost (C) *
2) Capitalized benefit (B) *
3) Net benefit value (B-C)
4) Benefit cost ratio (B/C)
5) Internal rate of return (IRR)%
* Capitalized by discount rate of 12 %

4) Sensitivity analysis

Sensitivity analysis of FIRR is conducted by applying following cases and fixing 60 % incremental annual net water supply volume which is the most conservative condition :

Case 1 : 10 % up for the capital costs
Case 2 : 10 % down for the capital costs
Case 3 : 10 % up for the benefits
Case 4 : 10 % down for the benefits
Case 5 : Combination of Case 1 and 4
Case 6 : Combination of Case 2 and 3

The results of the sensitivity analysis are summarized in Figs. 6.4 to 6.6.

Case	Scheme					
	K-1		K-2		C-3	
Original	18.87	(100.0)	19.19	(100.0)	15.57	(100.0)
Case 1	17.39	(92.1)	17.70	(92.2)	14.33	(92.0)
2	20.60	(109.1)	20.94	(109.1)	17.03	(109.3)
3	20.59	(109.1)	20.92	(108.4)	17.01	(109.2)
4	17.06	(90.4)	17.39	(90.5)	14.07	(90.3)
5	15.69	(83.1)	16.00	(83.3)	12.91	(82.9)
6	22.42	(118.8)	22.77	(118.6)	18.56	(119.1)

6.3.3 Loan Repayability

1) Terms of loans

Loan repayability of the project is examined under the following conditions.

(1) All the foreign currency portions of the investment costs would be financed by a loan from an international financing agency.

(2) All the local currency portions of the investment costs would be financed by a loan from the local financing agency.

(3) The terms of the external loan is assumed as follows:

Interest	:	3.0%
Grace period	:	7 years
Repayment period	:	30 years including the grace period

(4) The terms of the internal loan is assumed as follows:

Interest	:	12 %
Grace period	:	7 years
Repayment period	:	20 years including the grace period

2) Financial statement

(1) Capital costs

The financial cost disbursed during the construction period is escalated by the respective serial year from end 1991 at annual rate of 3.7% for foreign currency portion and 6% for local current portion.

(2) O&M costs

The O&M costs are escalated for respective serial year from end 1991 at annual rate of 6% for local currency portion.

(3) Pumping cost

The pumping cost is escalated for respective serial year from the end of 1991

at annual rate of 4% for local currency portion in accordance with the projection of electric charge estimated by PLN. The electric charge at the end of 1991 is 84 Rp/kwh.

(4) Replacement cost

The replacement cost is escalated for respective serial year from end of 1991 at annual rate of 3.7% for foreign currency portion and 6% for local currency portion.

(5) Water tariff and incremental annual net water supply volume

The water tariff is escalated by respective serial year from the end of 1991 at annual rate of 4% for local currency portion in accordance with the escalation rate of electric charge mentioned above. The water tariff at the end of 1991 is 200 Rp/m^3 for domestic use and 2100 Rp/m^3 for industrial use. The incremental annual net water supply volume is calculated by 60 % effective.

The final statement is prepared on the basis of the conditions assumed above and shown in Table 6.10 to 6.12. As seen in tables above, the accumulated surplus would become positive after the operation starts depending on the loan conditions .

6.3.4 Financial Analysis due to Difference of Organization for Project Implementation

1) Alternatives for financial analysis

As shown in Table 6.13, the financial analysis due to difference of organization for the project implementation is divided into four (4) cases.

Case 1: Financed by Krakatau Steel
(Alternative: A-1)

Case 2: Financed by DPU
(Alternative: A-2-1 and A-2-2)

Case 3: Financed by DPU
(Alternative: B-1-1 and B-1-2)

Case 4: Financed by cost sharing between public and private sectors
(Alternative: B-2)

2) 60 % annual net water supply and its water use ratio

60 % Annual Net Water Supply

Case	Scheme K-1		Scheme K-2		Scheme C-3	
	60 % net Supply yield (m^3/sec)	60 % annual net Supply yield (10^6m^3/yr)	60 % net Supply yield (m^3/sec)	60 % annual net Supply yield (10^6m^3/yr)	60 % net Supply yield (m^3/sec)	60 % annual net Supply yield (10^6m^3/yr)
Case 1	0.666	21.002	0.702	22.138	0.897	28.287
Case 2*	1.830	57.710	1.866	58.846	2.061	64.995
Case 3	0.666	21.002	0.702	22.138	0.897	28.287
Case 4	0.666	21.002	0.702	22.138	0.897	28.287

Note : * included the 60 % net supply yield of existing 1.164 m^3/sec (= 0.60 × 1.94 m^3/sec).

Water Use Ratio for 60 % Annual Net Supply Yield (Unit: 10^6m^3/yr)

Case	Scheme K-1		Scheme K-2		Scheme C-3	
	Domestic Use	Industrial Use	Domestic Use	Industrial Use	Domestic Use	Industrial Use
Case 1	5.250	15.752	5.534	16.603	7.701	21.215
Case 2	14.427	43.283	14.711	44.134	16.248	48.746
Case 3	5.250	15.752	5.534	16.603	7.701	21.215
Case 4	5.250	15.752	5.534	16.603	7.701	21.215

Note : Water use ratio of domestic vs. industrial water : 25 % vs. 75 %

3) Cost allocation

There are a number of cost allocation methods such as "Benefit method", "Justifiable expenditure method", "Alternative expenditure method", "Alternative justifiable expenditure method", "Use of facility method", "Priority of use method" and "Separable-cost remaining-benefit method".

Among them, the separable-cost remaining-benefit method is usually applied. However, some difficulty would arise in estimation of the separable costs.

In this Study, the cost allocation is estimated by "Supply volume ratio method" considering the simplicity or being easily understood and availability of the required data.

According to the water supply volume ratio mentioned in Chapter 6.2.2, the project costs which consist of capital costs, O&M cost, pumping cost and replacement cost are allocated as below. The escalation is excluded.

Item	Allocated cost ratio
Domestic water	0.25
Industrial water	0.75

The allocated costs are summarized as below.

Allocated Costs

(Unit: 10^6 Rp)

Case		Allocated item	Scheme					
			K-1		K-2		C-3	
			Domestic use	Industrial use	Domestic use	Industrial use	Domestic use	Industrial use
Case 1	1)	Investment cost	127513		132745		208829	
	2)	O&M cost	747		773		110	
	3)	Pumping cost	3267		3151		4014	
	4)	Replacement cost	53070		54381		63975	
Case 2	1)	Investment cost	31878 [1]	95635 [2]	33186 [1]	99559 [2]	52207 [1]	156622 [2]
	2)	O&M cost	187	560	193	580	277	832
	3)	Pumping cost [5]	1377	4130	1348	4043	1564	4691
	4)	Replacement cost	13267	39802	13595	40786	15994	47981
Case 3	1)	Investment cost	31878 [1]	95635 [2]	33186 [1]	99559 [2]	52207 [1]	156622 [2]
	2)	O&M cost	187	560	193	580	277	832
	3)	Pumping cost	817	2450	788	2363	1003	3010
	4)	Replacement cost	13267	39802	13595	40786	15994	47981
Case 4	1)	Investment cost	31878 [3]	95635 [4]	33186 [3]	99559 [4]	52207 [3]	156622 [4]
	2)	O&M cost	187	560	193	580	277	832
	3)	Pumping cost	817	2450	788	2363	1003	3010
	4)	Replacement cost	13267	39802	13595	40786	15994	47981

Notes: 1] Financed by DPU but not recovered by water tariff.
2] Financed by DPU but recovered by water tariff.
3] Financed by public sector but not recovered by water tariff.
4] Financed by private sector but recovered by water tariff.
5] Included the existing facilities to be operated after commissioning of Project.

4) Financial cash flow and recovery water tariff

The financial analysis is made by the recovery water tariff which the net benefit

capitalized become zero within the evaluation period.

Evaluation period	:	20 years after commissioning
Discount rate	:	12%

The financial analysis for the above are summarized in Table 6.14 to 6.25.

Recovery Water Tariff

(Unit: Rp/m^3)

Case	Alternative	Execution of Project	Construction Cost	Tariff Policy		Scheme K-1		Scheme K-2		Scheme C-3	
				Domestic Use	Industrial Use	Domestic Use	Industrial Use	Domestic Use	Industrial Use	Domestic Use	Industrial Use
Case 1	A-1	Krakatau Steel	Krakatau Steel	Full Cost Recovery Basis		1122.8		1098.2		1352.3	
Case 2	A-2	DPU	DPU	Allocated O&M Cost Recovery	Allocated Full Cost Recovery	108.4	447.4	104.7	285	113.3	623.0
Case 3	B-1	DPU	DPU	Allocated O&M Cost Recovery	Allocated Full Cost Recovery	191.1	1122.8	177.3	1098.2	181.1	1352.3
Case 4	B-2	DPU	Sharing	O&M Cost Recovery Basis		191.1	191.1	177.3	177.3	181.1	181.1

5) Net income of PDAM

Expenditure

PDAM will pay to the water producer, Krakatau Steel (Case 1), DPU (Case 2 and 3) or public & private sectors (Case 4) the amount of buying cost which corresponds to the recovery water charge produced.

Income

PDAM will collect the water charge which consists of domestic use, 200 Rp/m^3 and industrial use, 2100 Rp/m^3 from the consumer, residents and manufacturing enterprises.

Net income

The net income of PDAM is summarized as below.

(Unit: 10^6 Rp/yr)

Case	Scheme K-1			Scheme K-2			Scheme C-3		
	Expenditure	Income	Net income	Expenditure	Income	Net income	Expenditure	Income	Net income
Case 1	23582	34130	10548	24312	35975	11662	38254	45968	7714
Case 2	20292	93780	72851	21454	95625	74171	32210	105618	73408
Case 3	18690	34130	15440	19215	35975	16759	29971	45968	15997
Case 4	4014	34130	30116	3925	35975	32050	5123	45968	40845

6) Conclusion

As seen in the above, all the cases will make profit even by applying the most conservative condition of 60 % incremental annual net water supply volume.

Among four (4) cases, the project implementation by the organization of Case 2 is most profitable because the income by the existing Krakatau's water supply facilities is included.

7. ENVIRONMENTAL ASSESSMENT

7.1 General

The Cidanau river and the Cibanten river are the principal rivers in the Study Area. On the upstream reaches of the Cidanau river, there is a nature reserve area embracing freshwater swamp, which is called the Rawa Danau.

As the Government of Indonesia had already performed Environmental Information Presentation (PIL) concerning the Cidanau development plan in 1989, the environmental assessment (PIL) in this Study was carried out first on the Cibanten development in 1991. With the progress of the Study, due to the unfavourable geology of the Cidanau dam site and the irrigation water requirement downstream from the Cibanten dam, another investigation was additionally introduced for heightening of the Krenceng reservoir and provision of a gated weir on the lowest downstream reaches of the Cidanau river.

Accordingly, the environmental assessment (PIL) for the heightening of Krenceng dam with Beroeng diversion tunnel and Cidanau gated weir was carried out in December 1991 to January 1992.

The water quality survey was also carried out for the Cidanau river, the Cibanten river and the Krenceng reservoir. Since the water quality survey for dry season had been already performed in 1989 by the Government of Indonesia, the water quality survey in this Study was made during the rainy season in 1991, for the purpose of comparing with dry season data and to have general understanding on the water quality of both rivers.

Both the environmental assessment (PIL) and the water quality survey were carried out based upon the laws and regulations of Indonesia. Their results are described in following pages.

7.2 Environmental Assessment of the Cibanten River Basin

As the study of Environmental Information Presentation (PIL) for the Cidanau development plan was already completed by the Government of Indonesia in 1989, the environmental assessment study of this time was carried out for PIL of the Cibanten development plan.

The result of survey is as shown in the matrix of Table 7.1. In this table, work classifications and environmental items, whose score is 10 or more, may be anticipated to be affected by possible impact due to the dam construction plan.

They will be as follows:

<<Work classifications>>

* Acquisition of land --- A very delicate problem related to existence of inhabitants of the area concerned
* Construction of access road, office, and associated facilities (workers living quarters, etc.)
* Excavation and quarrying of rocks, including blasting, transport, and storage
* Dam construction, including temporary cofferdam, diversion tunnel, main dam, and spillway
* Impounding of dam -- Change from land to aqueous environment

<<Environment items>>

* Landscape -- Artificial structures included into natural landscape
* Culture pattern of inhabitants -- Transition from agricultural to fishery culture
* Relocation of inhabitants -- Relocate to a nearby district or another island
* Health -- Probable infection of respiratory troubles or diseases like malaria via pathogenic insects during a period from land preparation to full impounding
* Society and economy -- Change in the living pattern of surrounding inhabitants, resulting possibly in social change associated with crimes, prostitution, and others

It is noted that no any special species of animals and plants have been confirmed in the area under survey.

7.3 Heightening of Krenceng dam with Beroeng Diversion Tunnel and Cidanau Gated Weir

Environmental assessment in this Study was carried out for PIL of the heightening of Krenceng dam with Beroeng diversion tunnel and Cidanau gated weir.

The results of the survey are as shown in the matrix in Table 7.2. In this table,

group of activities and group of environment, whose score is 8 or more, may be anticipated to be affected by possible impact due to the construction of the Schemes.

a) Important impact of group of activities

1. Activity in the pre construction stage, which may cause important impact is land acquisition activities and resettlement. Land acquisition will cause important impact, because it relates to the future life of people influenced by the project, which may derive difficult problems. Resettlement will also cause important impact, because it may increase the population density, addition of new settlement land,and it may cause impacts on water storage, flora, fauna, land form, economy, health and social relationship.

2. Activity in the construction stage,which may cause important impact are;

   Construction of the supporting facilities such as storehouse, workshop, base camp, etc.

   The heightening of the dam embankment.

3. Activity in the operation stage, which is assumed to cause important impacts are; the raising of the reservoir water level and the reservoir operation.

   The two activities may influence the soil stability,increase the atmospheric moisture,disturb the flora and fauna, change the land use , change the life pattern of the people, influence the settlement and the health. Important positive impact which may cause in this stage are;

   Increase of water supply, which will promote industrialization and provide opportunities for new fields of work.

b) Important impact of group of environment

Group of life environment, which may be influenced by important impact are;

1) Possibility of instability of borrow pits and quarry sites where embankment material are extracted.

2) Resettlement of people due to construction of the dam..

c) As the resettlement of people comes to rather big amount (1403 persons, 311 families), the project has to carry out study on resettlement plan to support the resettlement activities.

From results of above investigation,the resettlement and compensation which may be caused by implementation of the scheme will be as follows;

1) The extent of resettlement and/or compensation due to heightening of Krenceng dam is as shown in Fig. 7.1.

This area includes the area for construction road.

2) The objects to be resettled and/or compensated due to the heightening of Krenceng dam are listed below.

People houses	278
Office building	1
Elementary school	1
Mosque	4
Agricultural land	11.05 ha

People's houses (278 houses) includes 201 own houses and 77 leased or vacant houses. The own houses also include 6 non permanent houses.

7.4 Water Quality Survey in the Project Area

Water quality survey was already carried out in the dry season of 1989 for the Cidanau and the Cibanten rivers. The water quality survey of this time was carried out in the rainy season for the purpose of comparison with the former survey and general understanding of the water quality of both rivers. Water was sampled at eight points as shown in Fig. 7.2.

According to the survey result shown in Table 7.3 (1), both the Cidanau and the Cibanten rivers are appropriate to irrigation and fisheries, but showed the number of colitis germs exceeding the standard level in certain points (that is, the water is unsatisfactory for drinking as it is). These points where the standard level was exceeded were located on the Cidanau river downstream from the Rawa Danau and on the Cibanten river downstream

from Serang. The survey result for the dry season shows that the standard level for drinking was exceeded at all points where analysis of number of colitis germs was made. Concerning nitrogen and phosphorus, T-N of 0.2 mg/l and T-P of 0.02 mg/l, which are some signs to anticipate eutrophication, were exceeded at all points. There arises a concern therefore that eutrophication may occur in the reservoir created by the dam is completed. Consequently, it may be necessary to take some appropriate measures, such as installation of a circulation system within the reservoir, to prevent such eutrophication.

On the other hand, the water quality survey for the Beroeng river was carried out in January 1992 so as to confirm the quality of water to be diverted to the Krenceng reservoir through the proposed Beroeng diversion tunnel.

As shown in Table 7.3 (2), the quality of water in the upstream Beroeng river was generally good.

7.5 Catchment conservation

The present land use in the catchment basin of heightening of Krenceng dam, Cidanau gated weir and Beroeng diversion tunnel is summarized in Table 7.4. This table shows that each catchment basin is almost fully developed for the agricultural purposes such as wet paddy field, upland crop field and plantation. Especially in the Beroeng river basin, 98% of the catchment area is occupied by agricultural fields and only 2% is left as forest. As the forest is quite important to retain water resources, the present land use in some basins can be said to be in critical condition. Therefore,it is proposed to improve or at least preserve the present basin conditions to maintain the development water resources.

From the viewpoint of maintaining water volume and quality,the catchment conservation will be achieved in the manners as follows;

- Forest conservation :
  The forest will retain the slope failure and erosion. Thus the volume of suspended solids which flow into the reservoir will be decreased.

- Prohibiting over-development :
  The over-development will bring rapid runoff in rainy season.

- Water quality control :
  Control of artificial pollutant outflow will protect the reservoir from eutrophication.

There is virtually no comprehensive guide-lines and/or criteria with regards to protection, conservation, and operation of facilities in the catchment area. In the future, they should be established by DPU or DGWRD to keep a steady level of operation and maintenance and for the sake of conservation of the environment.

8. CONCLUSION AND RECOMMENDATIONS

From the results of the feasibility study, the following matters are concluded and recommended ;

(i) The net supply yield of the Krakatau's water supply facilities is originally planned to be 2.0 m^3/sec, but after review of present condition, it is limited to 1.94 m^3/sec, while the present water supply is remaining at about 0.8 m^3/sec.

The water source in and around Cilegon area is dominated by the Krakatau's water supply facilities which occupy about 75 %.

The Krakatau Steel and its surrounding industrial estate are growing and changing rapidly. The water demand in 2005 year in and around Cilegon area excluding Serang is estimated at 3.7 m^3/sec.

(ii) The water charge of suppliers for industrial use ranges from 500 to 9000 Rp/m^3. Krakatau's water charge is 500 Rp/m^3, desalination plants are 3000 to 5000 Rp/m^3, and other private suppliers are 2750 to 9000 Rp/m^3.

On the other hand, domestic water and industrial water by PDAM are 175 to 525 Rp/m^3 and 700 to 2100 Rp/m^3, respectively.

(iii) From the results of project evaluation, it was found out that the Scheme K-1 and K-2 are more feasible than C-3.

By fixing the water charge for domestic use at 200 Rp/m^3 and industrial use at 2100 Rp/m^3, the incremental annual net water supply volume at 95 % and water use ratio between domestic and industrial use at 25 % vs. 75 %, the EIRR of scheme K-1 and K-2 comes to 30.92 % and 31.23 %, respectively.

Even by applying the most conservative condition of 60 % incremental annual net water supply volume, the EIRR of scheme K-1 and K-2 still shows 20.95 % and 21.26 %, respectively.

The EIRR for both schemes K-1 and K-2 are considered much high as for a water supply project. Both schemes are justified to be sufficiently

economical.

(iv) However, in the scheme K-2, the diversion of river flow of Beroeng river to Krenceng reservoir might cause various social effect to the downstream of Beroeng river such as effect to existing water rights, although the irrigation water during the wet season and river maintenance flow during the dry season in its downstream are guaranteed.

From a conservative point of view, the scheme K-1 could be most recommendable within the alternatives.

The K-1 Scheme can supply 3.05 m^3/s in total including the existing water supply capacity of 1.94 m^3/s.

The total project cost is estimated at about 127.5 billion Rupiah (equivalent to 8.2 billion Yen). The total cost covers the construction cost including purification plant and compensation cost for lands and housings but excluding the additional distribution pipelines.

(v) The purpose of this study is to meet with the rapid increase of water demand in the study area aiming for an urgent implementation of the project.

In view of the necessity of the urgent water supply, the K-1 Scheme utilizing the existing facilities of Klakatau Steel has been proposed to be implemented as soon as possible.

By the proposed K-1 Scheme above, the maximum water supply will be 3.05 m^3/s. However, as the water demand in the year 2,005 is forecasted at 3.7 m^3/s, the K-1 Scheme cannot fulfill the water demand sufficiently.

It is therefore herewith recommended to implement urgently further studies and construction of water resources development schemes such as Karian dam, Pasir Kopo dam and Rawa Danau storage dam as other possible scheme besides this Study urgently so as to cope with the water deficit above, and also to cope with the further water demand of the Cilegon industrial estate and its surroundings after the year 2005.

TABLES

Table 1.1 Members of DGWRD, Counterpart, Advisory Committee, JICA and Study Team

	Name	Organization	Position
(1)	Members of DGWRD		
	Ir. Djoko S Sardjono	DGWRD	Director of Planning Directorate
	Ir. Moh. Sidharto	DGWRD	Chief, Sub. Dit. of River Basin Development
	Ir. Budi Santoso/ Ir. Bambang Pramono	DGWRD	Chief of Section II, Sub. Dit. of River Basin
	Drs. Ch. Nasri	DGWRD	Sub. Dit. Kerjasama Lintas Sektoral Dit. Bina Program-Pengairan
	Ir. Soenarto Soendjaja	DGWRD	Kepala Sub Directorat Evaluasi Proyek
	M. Yusuf Kardi M. Sc.	CJCB	Project Manager of P3SA
(2)	Members of Counterpart		
	Ir. Djodi Sukardjo Sugondo, M.Sc	CJCB	Team Leader
	Hary Witanto, Be	CJCB	Dam Planner
	Ir. Agni Handoyoputro, Dipl. HE	CJCB	Hydrologist
	Baihaki Umar, B.Sc	CJCB	Geologist
	Ir. Suprayitno	CJCB	Survey Engineer
	Poniman S.BE	CJCB	Design Engineer
	Yadi Siswadi, M. Sc/Hernawanto, SE	CJCB	Construction Planner
	Anwar Santosa R.BE	CJCB	Environmentalist
	Nugroho P.B.Sc	CJCB	Economist
(3)	Member of Advisory Committee		
	1) Shigeki Matsuura/ Ryohei Kitazume	Ministry of Construction	Chairman
	2) Hitoshi Yoshida	"	Member
	3) Takashi Ikeda	"	Member
(4)	Coordinator of JICA		
	1) Masahiro Kobayashi/Mitsuru Suemori		JICA (Tokyo)
	2) Eiichiro Cho		JICA (Tokyo)
	3) H. Takata/Hagiwara		JICA (Indonesia)
(5)	Members of Study Team		
	1) Tetsuro Okaji		Team Leader
	2) Kazuo Tsuzuki		Dam Planner
	3) Tomeo Ohta/Yasukazu Kobayashi		Hydrologist
	4) Masahiro Hayashi		Geologist
	5) Katsuyuki Aoyagi		Survey Expert
	6) Makoto Ikushima		Design Engineer
	7) Eiichiro Seki		Construction Planner
	8) Takashi Yamazaki		Environmentalist
	9) Masatoshi Akagawa		Project Economist

Table 2.1 Population Distribution by Kecamatan in Kabupaten Serang in 1990

Kecamatan	Area km2	1961	1971	1980	1990 Urban	1990 Rural	1990 Total	Rate per annum (%) 1961-71	Rate per annum (%) 1971-80	Rate per annum (%) 1980-90	Population Density per km2 in 1990
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Anyer	60.25	91,625	72,635	54,377	6,163	21,364	27,528	-2.30	-3.17	-6.58	457
2. Baros	39.35	7,826	15,177	25,417	7,048	24,430	31,478	6.85	5.90	2.16	800
3. Bojonegara	70.65	13,958	25,223	39,639	10,242	35,500	45,742	6.10	5.15	1.44	647
4. Cerenang	54.95	12,639	23,484	37,840	10,053	34,845	44,897	6.39	5.44	1.72	817
5. Cikande	82.68	14,513	28,145	47,133	13,069	45,300	58,369	6.85	5.90	2.16	706
6. Cikeusal	98.98	16,191	31,913	54,229	15,283	52,974	68,256	7.02	6.07	2.33	690
7. Cilegon	42.19	5,648	16,170	38,448	15,738	54,553	70,291	11.09	10.10	6.22	1,666
8. Cinangka	127.81	19,018	29,317	39,931	8,801	30,507	39,308	4.42	3.49	-0.16	308
9. Ciomas	50.54	5,444	11,262	19,987	5,912	20,492	26,403	7.54	6.58	2.82	522
10. Ciruas	37.62	9,054	18,115	31,200	8,925	30,937	39,862	7.18	6.23	2.48	1,060
11. Kasemen	60.83	8,195	18,393	35,133	11,275	39,082	50,357	8.42	7.46	3.67	828
12. Kopo	85.18	18,896	30,902	44,390	10,379	35,978	46,357	5.04	4.11	0.43	544
13. Kragilan	45.63	9,978	19,491	32,856	9,177	31,810	40,987	6.93	5.97	2.24	898
14. Kramatwatu	48.94	6,240	13,493	24,924	7,706	26,711	34,417	8.02	7.06	3.28	703
15. Mancak	94.01	8,684	15,879	25,221	6,594	22,857	29,451	6.22	5.28	1.56	313
16. Pabuaran	77.83	8,851	17,127	28,625	7,919	27,451	35,370	6.82	5.87	2.14	454
17. Padarincing	74.40	21,838	33,405	45,188	9,884	34,259	44,143	4.34	3.41	-0.23	593
18. Pamarayan	73.40	16,435	28,276	42,518	10,460	36,257	46,716	5.58	4.64	0.95	636
19. Petir	92.27	18,161	32,447	50,474	12,894	44,694	57,587	5.98	5.03	1.33	624
20. Pontang	74.31	13,431	22,519	33,083	7,931	27,492	35,423	5.30	4.37	0.69	477
21. Pulomerak	56.34	312,484	217,840	145,268	14,480	50,191	64,671	-3.54	-4.40	-7.77	1,148
22. Serang	90.65	49,357	80,160	114,436	26,574	92,113	118,687	4.97	4.03	0.37	1,309
23. Taktakan	61.51	10,829	19,427	30,333	7,781	26,970	34,751	6.02	5.08	1.37	565
24. Tirtayasa	90.64	335	2,416	13,191	13,595	47,125	60,720	21.84	20.75	16.49	670
25. Waringin Kurung	65.97	8,077	14,193	21,750	5,465	18,943	24,408	5.80	4.86	1.16	370
26. Walantaka	47.89	12,461	21,956	33,731	8,498	29,457	37,955	5.83	4.89	1.19	793
Total	1,804.82	720,168	859,365	1,109,322	271,846	942,292	1,214,134	1.78	2.88	0.91	673

Table 2.2 (1) Actual Result of Operating Hours for 1987

(unit×hr)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1											24	9
2											21	15
3											17	18
4											17	20
5											17	24
6											22	20
7											18	18
8											17	20
9											18	12
10											19	21
11											20	20
12											23	15
13											16	17
14											19	16
15											20	17
16											22	21
17											20	11
18											5	15
19											1	15
20											9	18
21											2	15
22										12	—	16
23										19	3	15
24										18	—	17
25										19	3	16
26										16	8	11
27										19	8	15
28										17	12	16
29										29	6	20
30										36	15	—
31										28		—
A										11	28	29

	Max	Min	Average
Jan.			
Feb.			
Mar.			
Apr.			
May			
June			
July			
Aug.			
Sept.			
Oct.	36	8	20.1
Nov.	24	1	14.4
Dec.	24	9	16.7
1987	36	1	17.1

A : Number of Operating days

Table 2.2 (2) Actual Result of Operating Hours for 1988

(unit×hr)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	—	15	No Data	15	12	17	15	—	19	17	20	21
2	—	20		15	5	13	15	—	18	17	24	22
3	—	6		14	17	18	16	—	18	18	21	21
4	—	15		15	14	17	15	—	15	19	21	17
5	2	19		16	13	17	16	20	19	19	24	12
6	3	14		17	17	17	16	17	15	18	22	—
7	—	14		15	15	9	16	12	17	21	22	—
8	—	15		15	15	17	16	15	15	19	22	—
9	3	20		14	13	17	14	15	15	16	6	—
10	8	10		16	19	17	15	14	17	19	No Data	2
11	—	14		15	18	17	11	19	15	20		22
12	7	16		15	16	16	21	14	15	20		7
13	14	17		17	17	16	20	20	19	20		—
14	20	14		17	14	21	13	19	16	19		14
15	4	4		17	15	16	—	19	9	18		20
16	18	No Data		10	14	19	—	20	—	17		20
17	16		8	14	13	12	—	15	—	17		18
18	20		16	—	15	19	—	18	—	19		21
19	20		18	—	14	14	—	16	—	19		21
20	16		19	6	13	15	—	15	—	20		14
21	5		16	16	13	15	—	17	—	20		24
22	5		17	17	15	16	—	15	—	23	10	18
23	18		13	14	10	16	—	18	—	—	5	21
24	17		17	15	4	16	—	17	—	21	18	24
25	11		18	15	5	17	—	17	—	17	20	19
26	17		16	13	17	17	—	17	—	22	18	20
27	11		16	14	18	17	—	17	—	9	18	24
28	4		13	16	18	13	—	18	—	—	22	21
29	10		36	17	12	20	—	16	—	7	22	6
30	20		14	14	17	—	—	18	16	22	16	14
31	14		18		15		—	18		21		—
A	24	15	15	28	31	29	14	27	16	29	18	25

A : Number of Operating Days

	Max	Min	Average
Jan.	20	2	11.8
Feb.	20	4	14.2
Mar.	36	8	17.0
Apr.	17	6	14.8
May	19	4	14.0
June	21	9	16.2
July	21	11	15.6
Aug.	20	12	16.9
Sept.	19	9	16.1
Oct.	23	7	18.4
Nov.	24	5	18.4
Dec.	24	2	17.7
1988	36	2	15.9

Table 2.2 (3) Actual Result of Operating Hours for 1989

(unit×hr)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	16	No Data	No Data	20	20	20	17	—	—	13	No Data	15
2	17		20	20	16	18	18	—	—	16		12
3	21		20	19	19	18	19	—	—	14		12
4	17		17	3	15	19	20	—	—	17		12
5	18		17	—	16	21	17	—	—	11		12
6	23		21	—	17	20	—	—	12	11		11
7	—		20	—	12	17	—	—	24	12		7
8	—		21	—	13	16	—	—	18	12		9
9	—		19	—	18	18	—	—	23	10		11
10	5		18	—	15	18	—	—	23	12		10
11	12		19	15	17	19	—	—	—	15		13
12	—		27	24	20	19	—	—	—	15		13
13	—		16	24	19	19	—	—	—	14		14
14	—		20	22	17	21	—	—	—	12		13
15	—		19	24	18	17	—	—	—	12		14
16	6		22	18	19	19	—	—	—	12		14
17	13		19	21	21	17	—	—	—	13		11
18	14		19	19	20	17	—	—	—	12		12
19	11	↓	20	18	21	16	—	—	—	19	↓	13
20	17	—	10	19	24	28	—	—	—	28	10	8
21	17	8	21	19	24	19	—	—	—	26	14	14
22	12	18	23	18	20	17	—	—	—	20	12	14
23	14	19	21	17	23	18	—	—	—	No Data	13	
24	4	15	22	20	21	16	—	—	—		11	
25	No Data	23	20	20	22	19	—	—	14		11	
26		15	18	9	22	20	—	—	15		13	
27		17	22	18	18	18	—	—	15		13	
28		20	20	20	18	20	—	—	14		14	
29		19	20	16	20	20	—	—	13		28	
30			22	17	21	19	—	5	16		14	
31	↓		21		21		—	—		↓		
A	17	9	30	24	31	30	5	1	11	22	11	22

	Max	Min	Averaje
Jan.	23	4	13.9
Feb.	23	8	17.1
Mar.	27	10	19.8
Apr.	24	3	18.3
May	24	12	18.9
June	28	16	18.8
July	20	17	18.2
Aug.	5	2	5.0
Sept.	24	12	17.0
Oct.	28	10	14.8
Nov.	28	10	13.9
Dec.	15	7	12.0
1989	28	3	15.6

A : Number of Operating Days

Table 2.2 (4) Actual Result of Operating Hours for 1990

(unit×hr)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					10	12	No Data	No Data	No Data	No Data	No Data	19
2					17	17						18
3					25	10						8
4					22	—						No Data
5				6	23	—						
6				13	18	13						
7				16	19	16						
8				15	18	18						
9				12	22	18						
10				12	18	18						
11				9	19	17						
12					17	18						
13					19	18					↓	
14					17	18					15	
15					20	21					21	
16					13	19					22	
17					16	16					19	↓
18					13	20					20	10
19					13	18					19	20
20					9	19					21	23
21					11	20					21	22
22					12	21					20	18
23					12	18					12	17
24					8	19					14	13
25					11	4					18	No Data
26					12	No Data					16	
27					11						20	
28			5		14						21	
29			8		13						17	
30			11		13	↓			↓		20	
31			5		15		↓	↓		↓		↓
A			4	7	31	23	—	—	—	—	17	10

	Max	Min	Average
Jan.	—	—	—
Feb.	—	—	—
Mar.	11	5	7.3
Apr.	16	6	11.9
May	25	8	15.5
June	21	4	16.9
July	—	—	—
Aug.	—	—	—
Sept.	—	—	—
Oct.	—	—	—
Nov.	22	12	18.6
Dec.	23	8	16.8
1990	25	4	14.5

A : Number of Operating Days

Table 2.2 (5) Actual Result of Operating Hours for 1991

(unit×hr)

	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	4											
2	—											
3	3											
4	15											
5	13											
6	13											
7	12											
8	12											
9	13											
10	12											
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
A	9											

	Max	Min	Average
Jan.	15	3	10.7
Feb			
Mar.			
Apr.			
May			
June			
July			
Aug.			
Sept.			
Oct.			
Nov.			
Dec.			
1991			

A : Number of Operating Days

Table 2.3 Appurtenant and Protective Equipment of Pipeline

Name ot Equipment	Number	Distance(km) from Cidanau Pump Station
Main Stop Valve	2	8.485KM 20.882KM
One Way Surge Tank	1	3.238KM (575m³) (TV)
Draining Device	2	2.028KM 20.882KM
Air Intake & Venting Device	26	−0.170KM 17.584KM
		0.705KM(TP) 18.164KM(TP)
		3.436KM 18.837KM(PB)
		3.750KM(PB) 20.163KM
		5.453KM(TP) 21.750KM(TP)
		7.183KM 22.344KM
		8.549KM(PB) 22.752KM(PB)
		9.495KM 23.236KM(TP)
		12.830KM(PB) 23.808KM
		14.247KM(TR) 24.129KM
		14.894KM 24.726KM
		16.181KM(TP) 25.189KM
		16.836KM 25.458KM

PB : River Crossing Pipe Section

TP : Line Measure Point for Potential

TR : Line Measure Point for Pipe-Electric-Current

TV : Line Connection Measure Point for Potontial

Table 2.4 River Crossing of Pipeline

	Number	Distance(km) from Cidanau Pump Station
Pipe Bridge	5	3.750KM (Span 24.84m)
		8.549KM (Span 25.00m)
		12.830KM (Span 25.00m)
		18.837KM (Span 20.00m)
		22.752KM (Span 8.89m)
Inverted Syphon	18	-0.800KM 14.074KM
		-0.259KM 14.525KM
		2.100KM 15.754KM
		6.017KM 15.950KM
		6.322KM 16.511KM
		7.226KM 16.874KM
		10.025KM 19.350KM
		12.351KM 21.190KM
		12.570KM 21.930KM

Table 2.5 Length and Location of Pipeline Supported by Concrete Saddle

Location	Length
2.600KM —— 2.917KM	317m
9.940KM —— 10.130KM	190m
13.358KM —— 14.198KM	840m
14.400KM —— 14.620KM	220m
15.086KM —— 16.086KM	1,000m
16.876KM —— 17.511KM	635m
18.339KM —— 18.819KM	480m
Total	3,682m

Table 2.6 (1) Operating of the Krenceng Purification Plant (1/3)

Sizing and Design Data

Load on No.I pumping station maximum		9,000 m^3/h
Load on No.II pumping station maximum		7,500 m^3/h
Delivery to Water Treatment	normal	7,200 m^3/h
	max	7,500 m^3/h

Measurements of Structure

Inside length of Chamber	approx	20.65 m
Inside width of Chamber		3.30 m
Depth of Chamber Outlet	max	5.37 m
Width of Overflow Channel	each	1.00 m
Depth of Overflow Channel	each	1.75 m

Design Basis Feb.74 - Jan.75

Average raw water analysis			Drinking Water MDL	Drinking Water MPL
Colour [Pt/co Scale]		44	5	50
Turbidity [ppm SiO_2]		17.4	5	25
PH		7.1	7.0-8.5	6.5-9.2
NH4	[ppm]	0.2	0.5	0.5
Ca	[ppm]	10.2	75	200
Mg	"	3.7	50	150
Fe	"	3.1	0.1	1.0
Mn	"	0.09	0.05	0.5
SO_4	"	11.5	200	400
CL	"	14.5	200	600
Total Solids	"	231	500	1,500
Total hardness	"	41	100	500

Table 2.6 (2) Operating of the Krenceng Purification Plant (2/3)

Design			
Water flow rate for treatment			7,200 m^3/h
Number of Accelator clarifiers			3
Throughflow, each Accelator			
	average		2,400 m^3/h
	max		2,500 m^3/h
Reaction zone			
Diameter			10 m
Height of water level			4.7 m
Primary zone volume			400 m^3
Secondary zone volume			66 m^3
Total reaction time			11 min
Sedimentation and clarification zone			
Diameter of Accelator			45 m
Clarification zone surface area			1,500 m^2
Clarification zone surface load			
	average		1.6 m/hr
	max		1.7 m/hr
Clarification zone volume			3.100 m^3
Detention time			1.3 hr
Sludge consolidation zone			
(2100 m^3)	Sludge zone volume		3.600 m^3
	Thickening time	minimum	0.5 d
		average	4.8 d
(2500 m^3)	Sludge storage time	minimum	0.4 d
		average	4.5 d
Sludge hoppers			
Number of hoppers			4
Volume			2.6 m^3
Sludge accumulation rate	average		7.2 m^3/h
	max		75 m^3/h
Undissolved solids rate	average		144 kg/h
	max		1,500 kg/h
Undissolved solids concentration	average		2 %/wt

Table 2.6 (3) Operating of the Krenceng Purification Plant (3/3)

Sludge cycle

Average sludge accumulation rate	7.2 m^3/h
Sludge hopper drainage frequency	1 x /h
Duration of drainage	2.2 min
Sludge withdraw, each hopper, each drainage	1.8 m^3
Max sludge accumulation rate	75 m^3/hr
Sludge hopper drainange frequency	6 x/h
Duration of drainage	3.8 min
Sludge withdrawn, each hopper, each drainage	3.2 m^3

Total sludge balance, Accelator system

Solids	average	50 ppm
	max	500 ppm
Flow rate		7,200 m^3/hr

Undissolved solids rate

(including Coagulant)	average	432 kg/h
		10,368 kg/day
Sludge Volume	average	21.6 m^3/hr
		518.4 m^3/day
Undissolved solids rate	max	4,320 kg/hr
		103,680 kg/day
Sludge Volume	max	216 m^3/h
		5,184 m^3/d

Source:Collected Data at Krenceng Purification Plant Office

Table 2.7 PDAM Water Tariff (Jan. 1992)

Unit: Rp./m^3

Volume of Water Supplied (m^3)	Category I	Category II	Category III		Category IV	Category V	Category VI
	Non-Commercial	Commercial	A	B	Social	Public Hydrant	Niaga Khusus
1 - 10	175	435	700	875	150	150	1400
11 - 20	275	435	700	875	150	150	1400
21 - 30	375	615	1050	1050	275	150	1400
>30	525	875	1400	2100	360	150	2200

Table 2.8 (1) Industrial Water Use in 1990 by Water Source (Customer Demand)

Area/Factory	Krakatau Steel		Water Supply		Desalination Plant		Deep Well	River	Total (m3/y)	Remarks
	Vol(m3/y)	Price(Rp/m3)	Vol(m3/y)	Price(Rp/m3)	Vol(m3/y)	Cost(Rp/m3)	Vol(m3/y)	Vol(m3/y)		
Bojonegara										
1. P.T. REDECO PETROCIN UTAMA	-	-	*	-	-	-	*	-		15,000 m3/y in total
2. P.T. SULFINDO ADIUSAHA	-	-	-	-	-	-	-	300,000 (Through P.T. Indprin)		
3. P.T. GUNA NUSA UTAMA FABRICATOR (PMDN)	-	-	21,000 P.T. Sumber Alan	5,000	-	-	-	-		
4. SPWI	-	-	10,800 P.T. Guna Sugih Jaya	9,000	-	-	-	-		
5. P.T. SRIWIJAYA RAKUAN SEJATI	-	-	* P.T. Peteka	-	-	-	*	-		13,500 m3/y in total
6. TRANS BAKRIE	-	-	* P.T. ADES	855	-	-	*	-		270m3/y in total
7. CILEGON FABRICATOR	-	-	18,000 P.T. Peteka	6,000	-	-	-	-		
8. P.T. CONTINENTAL CARBON INDONESIA	-	-	-	-	144,000	-	21,600	-		
9. POLICHEM LINDO INC.	-	-	* P.T. GSI	7,000	-	-	*	-		Also rain water storage 45,600m3/y in total
10. P.T. INDOCHLOR PRAKARSA INDUSTRIES (INDPRIN)	-	-	-	-	-	-	-	420,000 Pasauran R.		
Bojonegara Total			49,800		144,000		21,600	720,000	935,400	Only the total of the allocated figures
Polomerak										
Factory										
11. P.T. STATOMER PVC RESIN FACTORY	-	-	12,000	3,500	151,200	5,000	45,000	-		
12. P.T. UNGGUL INDAH CORPORATION	-	-	6,000 (P.T. Gunung Suginjaman)	2,750	-	-	-	-		
13. P.T. PETROKIMIA NUSANTARA INTERINDO	-	-	-	-	136,800	-	-	-		
Sub-Total			18,000		288,000		45,000		351,000	
Power Station										
14. P.L.T.U. SURALAYA	671,600	500	-	-	656,270		-	-		
Port										
15. MERAK PORT AUTHORITY	-	-	8,100	5,000	-	-	-	-		from P.T. Peteka
Sub-total	671,600		8,100		656,270				1,335,970	
Polomerak Total	671,600		26,100		944,270		45,000	0	1,686,970	

Table 2.8 (2) Industrial Water Use in 1990 by Water Source (Customer Demand)

Area/Factory	Krakatau Steel		Water Supply		Desalination Plant		Deep Well	River	Total (m3/y)	Remarks
	Vol(m3/y)	Price(Rp/m3)	Vol(m3/y)	Price(Rp/m3)	Vol(m3/y)	Cost(Rp/m3)	Vol(m3/y)	Vol(m3/y)		
Anyer										
Factory										
16. Polytama Karsa Agung	-	-	-	-	-	-	-	-		Operation is scheduled to be started from Dec. 1993. Water source is not yet determined.
17. P.T. Tri Polita	-	-	(432,000) (P.T. Peteka)	5,000	-	-	-	-		From Dec. 1991
18. Chandra Asli	-	-	(2,160,000) (P.T. Peteka)	5,000	-	-	-	-		From Dec. 1993
19. P.T. SANKYU INDONESIA INTERNATIONAL	*	-	-	-	*	-	-	-		1,500m3/y in total
20. P.T. SATYA RAYA INDAH WOODBASED INDUSTRIES	-	-	-	-	-	-	249,600	86,400		
21. ASAHIMAS SUBENTRA CHEMICAL	1,008,000	500	-	-	-	-	-	-		
22. P.T. LAUTAU OTSUKA CHEMICAL	129,600	500	-	-	-	-	-	-		
Sub-total	1,137,600		0 (2,592,000)				249,600	86,400	1473600 (4,065,600)	
Port										
23. PERUM DELABUHAN II CABANG (Banten Port)	12,059	500	5,274 (P.T. Peteka)		-		-	-		
24. Cigading Port	157,680	500	-	-	-	-	-	-		
Sub-total	169,739		5,274						175,013	
Anyer Total	1,307,339		5,274 (2,597,274)				249,600	86,400	1,648,613 (4,245,887)	
Cilegon										
25. Krakatau Steel	14,736,000									
26. KIEC	1,406,000									
Cilegon Total	16,142,000								16,142,000	
Grand Total	18,120,939		81,174 (2,673,174)		1,088,270		316,200	806,400	20,412,983 (23,004,983)	

Remarks: 1) Comprising factory, port and power station uses.

2) All the figures are for 1990 except 4 factories/industrial estate in Anyer.

3) Data for the following factories are not made available and not included in this table:

- P.T. GPK (existing) --- Anyer
- P.T. Dong Jing (existing) --- Anyer
- P.T. Indotermina (under construction) --- Not located
- P.T. Sterindo Maromer Indonesia (under construction) --- Bojonegara
- P.T. Jasa Ganeba Pura (under construction) --- Bojonegara
- P.T. Multisida Agrolindo (existing)

4) ( ); not in 1990

Table 2.9 Current and Future Average Water Demand (Customer Demand) in the Study Area

Kecamatan	Type of Water Use		1990		1995	2000	2005	2010
Bojonegara								
	Manufacturing	PDAM /1	991		1,655	2,344	3,319	4,700
	Domestic	Fac. /2	11	Urban	265	779	1,103	1,562
			456	Rural	917	2,077	2,941	4,163
	Sub-total		1,458		2,837	5,201	7,364	10,426
Pulo Merak								
	Manufacturing		351		497	704	997	1,411
	Power station		1,328		1,826	2,822	2,822	2,822
	Port		10		12	20	32	51
	Hotel		47		60	97	157	253
	Domestic	PDAM /1		Urban	487	1,102	1,560	2,209
		Fac. /2	300	Rural	1,297	2,937	4,158	5,886
	Sub-total		2,036		4,179	7,682	9,725	12,632
Anyer								
	Manufacturing		1,475		13,074	15,465	16,578	17,772
	Port		173		177	189	208	238
	Hotel		38		49	79	127	205
	Domestic	PDAM /1	11	Urban	1,649	2,967	4,847	6,862
		Fac. /2	618	Rural	390	624	883	1,250
	Sub-total		2,315		15,339	19,323	22,643	26,326
Cilegon								
	Manufacturing		16,142		30,384	49,207	49,207	69,677
	Domestic	PDAM /1	320	Urban	1,267	6,363	9,008	12,753
		Fac. /2		Rural	1,155	1,848	2,616	3,703
	Sub-total		16,462		32,806	57,418	60,831	86,134
Serang								
	Domestic		1,350	Urban	828	1,350	1,374	1,400
				Rural	1,159	1,889	1,924	1,959
	Sub-total		1,350		1,988	3,239	3,298	3,359
Cinangka								
	Domestic		-	Urban	159	253	251	249
				Rural	552	877	870	863
	Hankam		725		725	725	725	725
	Sub-total		725		1,437	1,855	1,846	1,837
Ciomas								
	Domestic		-	Urban	124	228	262	301
				Rural	430	790	908	1,044
	Sub-total		-		554	1,018	1,171	1,345
Kasemen								
	Domestic		-	Urban	77	149	178	213
				Rural	268	515	617	738
	Sub-total		-		345	664	795	952
Kramatwatu								
	Domestic		14	Urban	165	311	365	429
				Rural	573	1,077	1,265	1,487
	Sub-total		14		738	1,388	1,631	1,916
Mancak								
	Domestic		-	Urban	130	225	243	263
				Rural	451	779	842	910
	Sub-total		-		581	1,004	1,085	1,173
Pabwaran								
	Domestic		-	Urban	161	256	318	353
				Rural	557	990	1,101	1,224
	Sub-total		-		718	1,246	1,419	1,577
Pandaringsang								
	Domestic		5	Urban	178	282	279	276
				Rural	618	977	966	955
	Sub-total		5		796	1,259	1,245	1,230
Tektakan								
	Domestic		-	Urban	152	260	279	298
				Rural	527	902	966	1,034
	Sub-total		-		679	1,163	1,244	1,332
Waringukurung								
	Domestic		-	Urban	106	179	190	201
				Rural	366	621	657	696
	Sub-total		-		472	800	847	897
Study Area								
	Manufacturing		18,959		45,610	67,720	70,101	93,560
	Power station		1,328		1,826	2,822	2,822	2,822
	Port		183		189	209	239	289
	Hotel		86		109	176	284	457
	Domestic		3,809		15,733	32,333	41,697	54,008
	Total (CD)		24,364		63,467	103,260	115,143	151,136
	Total (SD)		30,820		80,286	130,623	145,656	191,187

Remarks: 1) Average day demand.
2) Source demand = 1.265 x Customer demand, where 1.265 is the ratio used by P.T. Krakatau Steel.
3) Domestic water demand includes commercial and public water demand.
4) Hankam is a base for the military police.
/1 PDAM supply
/2 Enterprise's supply

Table 2.10 GOI Urban Water Supply Levels of Service Targets for Repelita V

Town Category	BNA Program				
	Metro (1)	Large City (2)	Medium Town (3)	Small Town (4)	IKK Program (5)
Population ('000)	>1,000	500<P<1,000	100<P<500	<100	<P<20
Percent of 1993/94 population to be served	80	80	80	80	80
Domestic demand (l/cap/day)					
Direct house of yard connections	190	170	150	130	100
Public standpipe	30	30	30	30	30
Total					
Allowance for Unaccounted Water (% of total production)	20	20	20	20	20

Table 2.11 Current and Future Population in the Study Area

		1990	1995	2000	2005	2010
PDAM						
Serang						
	Urban	26,574	27,063	27,561	28,068	28,585
	Rural	48,359	49,249	50,155	51,078	52,017
	Total	74,933	76,312	77,716	79,146	80,602
Cilegon						
	Urban	15,738	46,036	125,236	177,298	251,002
	Rural	54,553	54,553	54,553	77,231	109,337
	Total	70,291	100,589	179,789	254,529	360,339
IKK						
Anyer						
	Urban	6,164	69,524	78,164	110,657	156,658
	Rural	21,364	21,364	21,364	30,245	42,818
	Total	27,528	90,888	99,528	140,902	199,476
Bojonegara						
	Urban	10,246	14,505	20,534	29,070	41,155
	Rural	35,496	50,252	71,142	100,716	142,584
	Total	45,742	64,757	91,676	129,786	183,739
Cinangka						
	Urban	8,805	8,736	8,667	8,600	8,532
	Rural	30,503	30,264	30,027	29,791	29,558
	Total	39,308	39,000	38,694	38,391	38,090
Ciomas						
	Urban	5,914	6,798	7,813	8,979	10,321
	Rural	20,489	23,548	27,065	31,108	35,753
	Total	26,403	30,346	34,878	40,087	46,074
Kasemen						
	Urban	3,553	4,232	5,093	6,097	7,300
	Rural	12,309	14,659	17,643	21,123	25,289
	Total	15,862	18,891	22,736	27,220	32,589
Kramatwatu						
	Urban	7,709	9,059	10,646	12,510	14,701
	Rural	26,708	31,385	36,880	43,338	50,927
	Total	34,417	40,444	47,526	55,848	65,628
Mancak						
	Urban	6,597	7,129	7,703	8,324	8,995
	Rural	22,854	24,695	26,686	28,837	31,161
	Total	29,451	31,824	34,389	37,161	40,156
Pabuaran						
	Urban	7,923	8,807	9,790	10,883	12,097
	Rural	27,447	30,511	33,916	37,701	41,909
	Total	35,370	39,318	43,706	48,584	54,006
Padaringcang						
	Urban	9,888	9,773	9,659	9,547	9,436
	Rural	34,255	33,856	33,463	33,073	32,689
	Total	44,143	43,629	43,122	42,620	42,125
Pulomerak						
	Urban	14,486	20,508	29,033	41,102	58,188
	Rural	50,185	71,047	100,582	142,395	201,590
	Total	64,671	91,555	129,615	183,497	259,778
Taktakan						
	Urban	7,784	8,332	8,918	9,545	10,217
	Rural	26,967	28,864	30,894	33,068	35,394
	Total	34,751	37,196	39,812	42,613	45,611
Waringin Kurung						
	Urban	5,467	5,792	6,135	6,499	6,885
	Rural	18,941	20,064	21,255	22,516	23,851
	Total	24,408	25,856	27,390	29,015	30,736
Study Area		567,278	730,605	910,577	1,149,399	1,478,949

Table 2.12 (1) Existing Condition of Daily Rainfall Data

	Station No.	Name	Annual mean Rainfall (mm)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	installed year
PMG	3B	CINANGKA	2143					o	o	o	o	o	o	o	o	o	o	o		o					
	4	PADARINCANG	3325			o	o		o		o	o	o	o	o		o	o		o					1972
	5	MENES	4088			o	o	o	o	o	o	o	o	o	o					o					
	6	LABUHAN	3164				o	o	o	o	o	o	o	o	o	o				o					
	7	PAGELARAN	2862		o	o	o							o	o	o	o	o		o					
	7A	PASIRWARINGIN	3645		o		o		o	o	o			o	o		o								
	9	BOJONGDATAR	3438		o	o	o	o	o	o	o	o	o	o	o		o					o			1951
	14	CILEGON	1756										o	o	o	o	o	o							
	18	CIOMAS	2682				o			o	o	o		o	o			o	o	o					1927
	19	PABUARAN	1947				o				o		o					o	o	o	o	o			1973
	21	MANOALANGI	4510	o				o	o	o	o	o			o										
	22	CIMANUK	2823			o			o		o	o			o										
	23	SERANG	1666				o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o			1946
	24	BAROS	2047	o	o	o	o		o	o	o	o	o	o	o	o	o	o	o	o					1927
	24A	NYAPOH	2023			o	o					o	o	o	o										1957
	24B	PETIR	2024					o	o	o	o	o	o	o	o	o		o		o					1974
	32C	RAGASILU	1832		o	o	o						o	o	o										1952
	37B	CIKADU	2930		o	o	o	o	o	o	o														1951
P3SA		KEPUH	2001										o	o	o	o	o	o	o	o	o	o	o	o	1978
		SERUT	1817																o	o		o	o		1979
		PADARINCANG	2354										o	o	o	o	o	o	o	o	o	o	o	o	1978
		CIKADU											o	o	o	o	o	o	o	o	o	o	o	o	1978

Table 2.12 (2) Existing Condition of Daily Water Level Data

Kubang Baros (Cidanau)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1980	o	o	x	o	x	x	o	x	o	x		o
1981	o	x	o	x	x	o	o	o	o	o	o	o
1982	x	o	o	o	o	o	o	o	o	o	o	o
1983	o	o	x	o	o	x	x	x	x	x	o	o
1984	x	x	o	x	o	o	o	o	o	o	x	x
1985	o	o	o	o	o	o	o	o	o	o	o	o
1986	x	x	o	o	o	o	o	o	o	o	o	o
1987	o	o	o	o	o	o	o	o	o	o	o	o
1988	o	o	o	o	o	o	o	o	o	o	o	o
1989	o	o	x			o	o	o	o	o	o	o
1990	o	o	o	o			x	o	o			o

Serut (Cibanten)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1977						x	o	o	x	x	x	x
1978	o	o	o	o	o	o	o	x	x	x	x	x
1979		x	x	x	o	o	o			x	o	o
1980	x	o	o	o	o	o	o	o	o	o	o	o
1981	o	o	o	o	o	o	o	o	o	o	o	o
1982	o	o	o	o	o	o	o		x	o	o	x
1983	o	o	o	o	o	o	x	x	x	x	x	o
1984	x	o	o	o	o	o	o	o	o	o	o	o
1985	o	o	o	x	o	o	o	o	o	o	x	x
1986	o	o	o	o	o	o	x	o	o	o	o	o
1987	o	o	o	o	o	x	o	o	o	o	o	o
1988	x	o	x		o	o		x	o	o	o	o
1989	o	o	x	o	o	x	x	o	o	o	x	o
1990	o	o	o	o	o	o	x	x	o	x	x	x

o : Available data

x : Not available data

Table 2.13 (1) Five (5)-day Mean Inflow Discharge at Kubang Baros

(Unit: m3/sec)

Year	Period (day)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1980	1st - 5th	8.37	7.08	9.74	4.79	1.76	8.25	3.51	4.71	5.68	1.84	20.19	59.98	11.33
	6th - 10th	8.56	10.88	7.38	3.80	0.39	9.44	6.05	9.63	58.08	1.36	23.76	68.15	17.29
	11th - 15th	8.71	10.77	30.12	13.97	1.89	4.05	6.04	14.70	61.72	5.46	28.82	70.42	21.39
	16th - 20th	8.42	10.88	20.56	10.40	4.10	6.81	10.20	27.59	26.61	13.18	33.29	90.73	21.90
	21st - 25th	8.37	10.93	4.91	7.03	11.51	8.11	5.67	11.37	5.32	14.76	39.33	63.47	15.90
	26th - 31st	6.37	13.60	3.11	4.28	8.94	5.10	4.91	3.80	3.51	17.68	46.04	84.65	16.83
1981	1st - 5th	133.45	39.60	26.28	26.71	13.82	6.05	9.25	17.26	4.68	89.87	9.91	27.46	33.70
	6th - 10th	155.56	46.22	3.76	26.43	9.50	7.93	2.73	6.64	14.01	30.77	8.67	24.97	28.10
	11th - 15th	61.80	30.32	4.86	25.04	6.35	10.95	5.98	4.76	15.22	10.64	52.17	18.53	20.55
	16th - 20th	65.16	22.71	7.90	21.79	9.35	20.42	11.94	3.39	3.53	7.58	146.59	7.39	27.31
	21st - 25th	29.89	4.02	5.02	18.67	6.95	9.27	15.80	8.09	2.44	3.94	55.71	12.44	14.35
	26th - 31st	30.65	39.95	21.11	16.73	1.97	9.08	20.47	9.55	21.16	19.48	20.08	67.70	23.16
1982	1st - 5th	45.92	5.96	19.62	22.41	11.68	5.22	3.02	3.60	1.81	2.71	1.05	2.92	10.49
	6th - 10th	25.03	2.44	68.17	22.85	7.69	8.15	2.74	2.74	1.23	1.20	11.47	0.91	12.89
	11th - 15th	9.39	3.71	27.14	15.51	7.22	5.49	2.67	1.75	1.14	0.78	3.69	4.78	6.94
	16th - 20th	38.97	3.37	36.47	37.14	4.16	5.46	3.84	1.49	0.97	2.06	1.67	5.99	11.80
	21st - 25th	34.02	7.16	52.72	11.64	3.66	4.06	4.74	1.22	2.06	2.01	5.69	6.29	11.27
	26th - 31st	6.56	10.14	14.56	15.99	4.14	2.78	8.55	0.96	2.30	1.13	5.46	15.36	7.33
1983	1st - 5th	14.55	16.97	11.63	10.60	4.44	8.65	17.10	3.07	1.06	0.81	15.21	41.57	12.14
	6th - 10th	15.00	20.20	5.84	9.38	4.36	7.37	10.58	1.46	1.63	0.62	12.26	22.10	9.23
	11th - 15th	13.26	5.57	4.98	8.17	13.11	5.78	5.45	2.58	1.82	0.70	15.82	9.40	7.22
	16th - 20th	23.74	6.06	4.27	9.72	6.61	8.42	7.21	3.19	1.51	0.79	83.88	9.51	13.74
	21st - 25th	43.06	6.70	4.24	8.23	8.66	10.42	5.28	8.45	1.51	5.39	1.38	8.02	9.28
	26th - 31st	24.45	8.91	6.32	10.14	5.57	11.05	6.03	1.89	1.16	11.73	46.98	12.63	12.24
1984	1st - 5th	12.19	15.97	12.62	25.53	12.57	13.39	4.92	5.37	3.58	22.34	3.46	42.91	14.57
	6th - 10th	2.96	26.90	22.95	6.14	22.95	7.46	10.52	4.14	10.73	9.47	5.93	41.27	14.29
	11th - 15th	13.41	12.11	27.83	8.23	33.57	6.73	7.07	3.18	13.45	4.35	10.47	17.05	13.12
	16th - 20th	14.92	8.92	23.09	7.23	12.46	5.61	4.62	3.25	10.83	5.14	10.61	15.06	10.15
	21st - 25th	15.16	6.16	41.02	9.41	8.52	6.70	5.94	3.01	9.41	4.97	7.66	7.15	10.43
	26th - 31st	17.62	16.20	47.29	13.94	22.62	2.99	6.69	3.89	7.47	6.06	8.07	31.05	15.32
1985	1st - 5th	20.38	11.09	12.14	3.94	14.06	4.85	4.41	11.53	2.54	3.75	8.78	31.30	10.73
	6th - 10th	18.01	10.99	39.14	5.09	10.94	4.42	4.47	11.20	2.58	5.72	8.33	26.51	12.28
	11th - 15th	34.76	13.55	30.47	9.81	8.66	5.35	4.94	6.81	9.47	12.09	9.26	8.98	12.85
	16th - 20th	11.89	7.02	10.31	20.24	7.26	6.60	5.28	5.83	7.30	15.53	6.44	4.09	8.98
	21st - 25th	8.09	12.20	6.43	14.83	7.78	6.81	12.80	4.43	5.13	20.24	7.98	3.79	9.21
	26th - 31st	12.50	13.14	4.74	16.34	6.25	6.23	14.10	3.26	4.78	9.69	14.14	3.94	9.09
1986	1st - 5th	14.02	26.41	11.10	22.69	11.78	5.49	2.61	5.63	1.75	7.31	19.71	11.08	11.63
	6th - 10th	45.10	17.15	9.32	22.30	9.09	5.13	2.96	6.74	2.87	4.89	30.55	4.33	13.37
	11th - 15th	47.60	22.67	7.49	17.62	9.10	4.70	4.32	7.97	5.54	8.18	49.61	13.21	16.50
	16th - 20th	24.31	19.35	6.34	16.69	8.72	4.80	2.98	5.25	6.17	8.91	21.40	20.66	12.13
	21st - 25th	50.03	15.99	27.13	10.27	5.54	5.51	2.31	2.68	6.33	5.64	8.77	11.10	12.61
	26th - 31st	47.38	12.75	49.90	8.05	4.90	3.40	4.58	2.14	8.62	14.76	11.36	6.79	14.55
1987	1st - 5th	10.68	16.55	33.76	10.81	20.93	6.41	5.01	2.71	1.13	1.08	1.43	1.81	9.36
	6th - 10th	40.96	26.15	33.71	14.01	16.13	6.51	3.83	1.99	1.05	1.05	2.47	3.10	12.58
	11th - 15th	56.84	23.63	18.14	15.00	18.44	7.08	3.08	2.19	1.05	2.61	5.37	6.79	13.35
	16th - 20th	31.74	18.90	7.88	14.52	15.62	7.04	2.28	1.69	1.05	2.00	4.93	8.46	9.68
	21st - 25th	19.52	39.90	9.72	6.41	8.12	6.41	2.38	1.42	1.05	2.35	3.05	12.25	9.38
	26th - 31st	19.08	41.13	10.07	10.41	7.42	5.66	2.94	1.19	1.05	1.44	1.86	6.80	9.09
1988	1st - 5th	3.10	35.54	14.14	44.38	16.70	6.71	4.32	2.22	1.87	3.08	7.72	31.19	14.25
	6th - 10th	1.66	44.60	23.15	21.81	18.52	12.28	2.95	4.07	2.46	2.48	9.66	20.27	13.66
	11th - 15th	1.82	31.76	14.15	15.69	14.48	13.47	1.96	3.23	3.22	2.42	12.73	28.98	11.99
	16th - 20th	4.52	46.53	13.56	15.58	19.86	11.73	2.31	2.98	2.84	4.32	11.70	54.48	15.87
	21st - 25th	6.98	23.47	15.50	18.05	16.65	9.60	1.99	3.18	2.78	4.87	17.05	26.57	12.22
	26th - 31st	14.84	7.30	20.87	13.11	7.97	6.73	2.06	2.07	2.68	4.62	28.85	13.27	10.36
1989	1st - 5th	9.61	9.13	53.33	7.26	7.26	7.08	2.94	2.48	3.61	2.94	3.60	4.90	9.51
	6th - 10th	7.37	34.08	36.83	7.26	7.26	8.62	5.83	1.66	2.22	2.48	3.09	6.04	10.23
	11th - 15th	6.05	22.36	20.26	7.26	7.26	8.63	9.76	2.10	4.03	2.03	4.78	8.77	8.61
	16th - 20th	7.91	69.43	17.41	7.26	7.26	5.89	11.44	1.34	5.06	1.75	4.50	9.84	12.42
	21st - 25th	8.38	28.61	10.02	7.26	7.26	3.48	8.09	1.51	3.29	1.87	4.97	9.19	7.83
	26th - 31st	6.83	76.75	7.00	7.26	7.26	3.01	4.12	2.28	1.79	4.35	3.76	9.31	11.14
1990	1st - 5th	8.76	42.49	1.69	2.61	2.19	1.93	1.93	2.61	1.84	4.50	7.21	9.74	7.29
	6th - 10th	8.76	26.95	2.12	2.31	1.99	1.93	2.25	2.71	1.66	4.89	7.66	9.44	6.06
	11th - 15th	15.94	20.93	2.44	3.05	1.93	1.93	1.87	2.64	1.63	5.29	8.13	9.44	6.27
	16th - 20th	25.64	11.08	3.50	3.82	1.93	1.93	1.93	2.31	1.63	5.78	8.71	10.16	6.54
	21st - 25th	42.00	2.71	4.20	3.11	1.93	1.93	2.15	1.99	3.49	6.16	9.19	10.31	7.43
	26th - 31st	44.43	1.98	3.82	2.61	1.93	1.93	2.04	1.93	4.24	6.66	9.69	8.95	7.52
Mean		24.74	19.92	17.69	13.04	9.26	6.70	5.68	4.62	6.29	7.52	16.88	20.54	12.74

Table 2.13 (2) Five (5)-day Mean Inflow Discharge at Serut

(Unit: m3/sec)

Year	Period (day)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1980	1st - 5th	1.32	2.12	1.68	0.68	1.24	1.25	0.46	1.34	2.59	1.24	2.02	0.52	1.37
	6th - 10th	2.24	5.43	2.60	0.74	1.07	0.63	0.44	2.11	2.23	1.39	1.14	0.75	1.73
	11th - 15th	3.31	5.56	1.75	3.21	1.23	0.85	0.49	3.21	3.62	1.39	1.43	0.58	2.22
	16th - 20th	3.29	8.80	1.84	1.11	1.19	0.53	0.59	4.26	1.25	0.93	3.55	1.99	2.44
	21st - 25th	3.25	5.23	0.78	1.93	0.82	0.66	0.53	0.58	0.89	1.35	0.85	6.00	1.91
	26th - 31st	3.71	2.62	1.05	1.21	0.57	0.58	0.59	0.47	1.60	1.08	0.71	6.02	1.68
1981	1st - 5th	19.37	4.51	7.43	1.56	2.40	0.73	0.68	1.87	2.07	3.75	1.56	3.48	4.12
	6th - 10th	13.32	3.94	3.75	1.81	1.84	0.65	0.65	1.96	1.93	3.78	3.11	2.23	3.25
	11th - 15th	8.08	5.83	5.76	1.09	2.34	1.39	2.40	1.20	5.33	2.88	4.72	1.89	3.58
	16th - 20th	4.70	5.80	3.63	1.53	3.26	2.28	3.62	1.64	1.29	1.20	11.13	1.89	3.50
	21st - 25th	3.34	5.25	1.89	1.55	1.20	1.00	4.02	1.65	1.15	1.39	1.93	3.81	2.35
	26th - 31st	4.65	14.08	2.91	1.19	0.94	1.33	6.33	1.10	1.76	2.07	5.24	7.28	4.07
1982	1st - 5th	4.39	5.40	3.30	3.11	2.71	2.78	0.91	1.22	0.52	0.71	0.45	0.48	2.17
	6th - 10th	10.11	2.53	4.20	2.57	2.40	2.08	0.74	0.92	0.54	0.50	0.72	0.44	2.31
	11th - 15th	15.90	3.28	6.87	2.42	1.85	1.51	0.74	0.43	0.48	0.48	0.69	0.48	2.93
	16th - 20th	10.23	2.51	6.67	3.90	1.29	1.28	1.88	0.32	0.49	1.12	0.67	0.50	2.57
	21st - 25th	7.28	2.01	4.98	2.57	1.27	0.84	1.94	0.25	0.45	0.55	0.66	0.52	1.94
	26th - 31st	5.20	2.43	3.93	3.72	1.56	1.27	1.90	0.19	0.59	0.47	0.65	1.18	1.92
1983	1st - 5th	2.11	2.45	4.90	2.10	2.83	1.67	1.74	0.24	0.05	0.03	0.46	4.18	1.90
	6th - 10th	1.21	2.48	2.19	3.34	5.21	10.97	0.25	0.18	0.10	0.02	0.89	4.05	2.57
	11th - 15th	0.89	0.63	1.76	0.69	3.22	4.10	0.21	0.15	0.11	0.02	0.09	1.32	1.10
	16th - 20th	1.35	1.54	0.72	1.53	3.16	2.43	0.55	0.15	0.13	0.03	5.28	0.90	1.48
	21st - 25th	3.66	0.94	0.78	6.69	2.00	1.38	0.51	0.30	0.09	0.43	15.51	0.65	2.75
	26th - 31st	0.55	5.00	2.93	5.08	2.58	3.01	0.60	0.11	0.06	0.44	44.25	0.71	5.44
1984	1st - 5th	1.39	5.17	4.24	2.01	5.68	2.26	2.73	0.99	1.28	5.39	1.66	1.18	2.83
	6th - 10th	2.65	3.84	11.43	2.72	4.79	1.88	1.90	0.78	4.39	1.50	0.93	0.97	3.15
	11th - 15th	0.95	4.49	16.00	1.83	2.53	2.42	1.01	1.74	4.56	2.54	0.95	1.65	3.39
	16th - 20th	1.48	9.00	10.44	2.74	1.72	2.34	0.95	1.07	3.08	2.04	2.12	1.33	3.19
	21st - 25th	10.14	8.16	20.10	2.07	2.69	1.58	1.85	0.95	2.07	2.44	1.62	1.12	4.57
	26th - 31st	15.90	6.50	19.07	5.17	2.09	1.13	1.65	1.78	4.75	1.27	0.88	3.64	5.32
1985	1st - 5th	1.27	1.11	1.93	1.21	1.19	0.69	0.79	2.83	0.46	1.30	0.93	3.40	1.43
	6th - 10th	4.61	0.97	4.30	1.70	0.87	0.93	1.57	1.06	0.95	1.19	1.68	1.38	1.77
	11th - 15th	1.30	0.84	1.64	2.79	0.99	0.60	1.91	0.70	0.63	0.81	0.67	0.56	1.12
	16th - 20th	0.99	0.56	1.70	6.49	0.67	0.63	1.94	0.70	0.54	3.83	0.48	0.86	1.62
	21st - 25th	1.37	2.06	0.90	1.99	0.59	2.39	3.02	0.56	0.49	0.78	0.69	1.36	1.35
	26th - 31st	2.20	0.54	1.40	2.06	0.88	0.63	1.01	0.62	1.08	0.74	1.15	1.06	1.11
1986	1st - 5th	0.87	3.81	2.96	3.34	1.15	0.69	1.08	0.53	0.70	2.02	1.17	0.67	1.58
	6th - 10th	9.49	3.11	1.81	2.38	1.75	1.21	1.02	0.60	1.61	1.44	2.25	0.52	2.27
	11th - 15th	3.32	5.44	2.67	3.14	1.90	2.48	3.43	1.74	1.56	0.78	1.89	2.51	2.57
	16th - 20th	4.85	1.91	2.13	1.88	0.93	1.03	1.67	0.76	0.81	0.71	2.79	3.20	1.89
	21st - 25th	13.57	2.57	1.98	1.47	1.22	0.60	0.93	0.53	0.60	0.50	1.18	0.71	2.16
	26th - 31st	8.59	2.83	1.43	2.37	0.96	0.66	1.34	0.76	0.68	2.86	2.11	1.07	2.14
1987	1st - 5th	1.81	1.55	2.85	1.40	2.23	0.96	0.69	0.49	0.45	0.43	0.50	0.48	1.15
	6th - 10th	6.93	4.25	1.61	1.13	2.97	1.13	0.56	0.43	0.43	0.43	1.18	0.54	1.80
	11th - 15th	5.54	1.71	1.23	1.18	2.12	1.51	0.47	0.43	0.45	0.43	0.62	0.77	1.37
	16th - 20th	1.98	2.26	1.06	1.11	1.68	0.89	0.47	0.43	0.55	0.43	0.44	3.20	1.21
	21st - 25th	2.58	1.47	1.44	1.02	0.84	0.89	0.51	0.43	0.44	0.43	0.43	0.70	0.93
	26th - 31st	2.77	8.69	1.52	3.52	0.84	0.75	0.48	0.43	0.43	0.43	0.45	0.43	1.73
1988	1st - 5th	0.43	14.28	0.93	1.82	0.62	0.89	0.93	0.54	0.46	0.43	3.14	0.57	2.09
	6th - 10th	0.82	9.88	0.80	1.10	0.52	0.57	0.63	0.58	0.43	0.43	1.01	0.59	1.45
	11th - 15th	0.83	1.80	0.73	0.81	0.65	0.54	0.39	0.67	0.43	2.48	0.77	4.28	1.20
	16th - 20th	1.31	0.86	0.72	0.80	0.77	0.45	0.49	0.59	0.42	1.57	0.53	1.01	0.79
	21st - 25th	0.91	0.80	0.92	0.95	0.64	0.43	0.40	0.55	0.42	0.74	0.58	0.44	0.65
	26th - 31st	3.78	0.76	0.85	0.68	0.51	0.42	0.42	0.48	0.43	1.75	0.52	0.44	0.92
1989	1st - 5th	0.46	2.45	3.91	0.41	0.23	0.21	0.62	0.70	0.59	0.42	0.42	0.44	0.91
	6th - 10th	0.49	2.45	3.36	0.51	0.18	0.78	0.65	0.90	0.78	0.42	0.42	0.85	0.98
	11th - 15th	0.62	1.03	2.51	0.47	0.12	1.04	0.69	0.68	0.57	0.42	0.43	5.55	1.18
	16th - 20th	0.70	3.03	1.15	0.18	0.14	0.87	0.66	0.70	0.44	0.42	0.49	1.85	0.89
	21st - 25th	1.33	8.54	0.41	0.16	0.20	0.89	0.58	0.62	0.43	0.44	0.43	0.82	1.24
	26th - 31st	0.77	7.27	0.47	0.12	0.19	0.87	0.74	1.40	0.45	0.43	0.45	2.29	1.29
1990	1st - 5th	1.26	3.45	4.49	1.10	1.34	1.43	0.93	0.94	0.69	0.58	0.48	1.68	1.53
	6th - 10th	2.30	2.03	4.83	3.83	1.68	0.78	1.11	1.16	0.81	0.59	0.48	1.16	1.73
	11th - 15th	1.59	1.28	1.59	2.26	3.04	0.73	0.87	0.80	0.52	0.51	0.47	0.90	1.21
	16th - 20th	1.07	1.53	3.41	3.33	1.34	0.94	0.93	0.70	0.44	0.53	0.47	0.76	1.29
	21st - 25th	1.95	0.73	2.35	2.25	0.85	0.84	1.16	1.20	0.47	0.65	0.46	1.52	1.20
	26th - 31st	4.29	1.87	2.26	1.21	3.23	1.10	0.98	0.93	0.54	0.50	0.46	1.84	1.60
Mean		4.01	3.75	3.48	2.03	1.63	1.35	1.20	0.93	1.09	1.14	2.25	1.70	2.05

Table 2.14 (1) Summary of the Laboratory Test for Core Materials (1/2)

Sample number No.		TPK-3:2	TPK-1:2	TPK-1	TPK-2	TPK-2	TPK-3
Borrow pit and depth (m)		(90:10)%	(95:5)%	(-3.00)	(-1.5)	(-3.00)	(-3.00)
PROPERTIES							
Natural water content	W (%)	14.36	17.00	18.40	10.95	25.01	19.64
Specific gravity of soil	Gs	2.496	2.485	2.478	2.593	2.534	2.470
Wet density	γ t (g/cm^3)						
Void ratio	e						
Degree of saturation	s (%)						
GRAIN-SIZE							
Proportion							
Gravel part	(%)	9.0	8.0	29.0	8.0	37.0	22.0
Sand part	(%)	51.0	40.0	35.0	39.0	25.0	47.0
Silt part	(%)	19.0	20.0	22.0	21.0	24.0	16.0
Clay part	(%)	21.0	22.0	14.0	32.0	14.0	15.0
Max. diameter	(mm)	5.0	5.0	38.1	19.1	25.4	25.4
60% diameter D 60	(mm)	0.42	0.38	0.85	0.36	1.50	0.55
10% diameter D 10	(mm)	-	-	-	-	-	-
Uniformity coefficient		-	-	-	-	-	-
Classification		Sandy clay loam	Sandy clay loam	Loam	Clay	Clay loam	Sandy loam
CONSISTENCY							
Liquid limit	L.L. (%)	N.P	N.P	N.P	33.78	N.P	N.P
Plastic limit	P.L. (%)	N.P	N.P	N.P	16.37	N.P	N.P
Plasticity index	P.I.				17.41		
Flow index	F.I.				4.48		
Shrinkage limit					-		
Unified soil classification					CL		
Permeability	K (cm/sec)	5.786x10^{-8}	4.295x10^{-8}	1.286x10^{-7}	3.281x10^{-8}	8.268x10^{-8}	1.441x10-7
Compaction							
Optimum water content	(%)	21.00	24.08	24.50	17.00	27.32	22.60
Max. density γd max.	(g/cm^3)	1.520	1.476	1.416	1.717	1.409	1.520

Table 2.14 (2) Summary of the Laboratory Test for Core Materials (2/2)

Sample number No.		TPK-3:2	TPK-1:2	TPK-1	TPK-2	TPK-2	TPK-3
Borrow pit and depth (m)		(90:10)%	(95:5)%	(-3.00)	(-1.5)	(-3.00)	(-3.00)
SHEARING STRENGTH							
Triaxial compression							
Unconfirmed compression							
Compression Strength	qu (kg/cm^2)						
Sensitivity	St						
Triaxial compression (UU)							
Cohesion C	(kg/cm^2)	0.40	0.62	0.30	0.48	0.74	0.53
Internal friction angle		35°45'	38°58'	33°25'	25°55'	28°22'	34°24'
Triaxial compression (CU)							
Cohesion C	(kg/cm^2)	0.42	0.12	0.40	0.40	0.65	0.42
Internal friction angle		34°48'	20°33'	28°22'	11°19'	26°34'	35°18'
CONSOLIDATION							
Initial void ratio Co		0.729	0.779				0.712
Preconsolidation load Po	(kg/cm^2)	2.6	4.8				3.2
Compression index Cc		0.128	0.119				0.112
Coef. of consolidation Cv	(cm^2/sec)	$7.4x10^{-3}$	$1.0x10^{-2}$				$1.05x10^{-2}$
Coef. of volume comp. mv	(cm^2/g)	$7.4x10^{-6}$	$2.9x10^{-6}$				$3.00x10^{-6}$
Coef. of Permeability K	(cm/sec)	$5.6x10^{-8}$	$3.4x10^{-8}$				$3.40x10^{-8}$

Table 2.15 Summary of the Laboratory Test for Concrete Aggregate

Test Item / Location	Specific Gravity -	Water absorp-tion test (%)	Sound-ness (%)	Abrasion test A (%)	Abrasion test B (%)	Abrasion test C (%)	Abrasion test D (%)	Alkali aggregate reaction -	Sieve Analysis (Pass. %) 100 (mm)	60 (mm)	40 (mm)	30 (mm)	25 (mm)	20 (mm)	15 (mm)	10 (mm)	5 (mm)	F.M. -
Anyer																		
Anyer 1	2.580	3.28	5.2	51.7	43.6	50.0	27.5	Not Injurious	-	94	73	67	59	50	44	34	26	7.21
Anyer 2	2.586	3.27	5.7	47.7	41.9	49.5	26.7	"	-	95	74	68	60	51	45	37	32	7.11
Anyer 3	2.599	3.31	5.7	49.7	41.2	49.2	26.5	"	-	93	71	65	56	45	42	33	29	7.26

Table 2.16 Design Value for Heightening of Krenceng Dam Embankment Materials and Foundation

	Item	Unit	Impervious random	Filter	Rock	Existing Krenceng dam	Foundation (welded tuff)
1)	Specific gravity	t/m^3	2.492	2.768	2.30	-	-
2)	Water content	%	23.9	7.293	6.0	-	-
3)	Void ratio		0.72	0.73	0.40	-	-
4)	Dry density	t/m^3	1.468	1.60	1.643	-	-
5)	Wet density	t/m^3	1.728	1.717	1.742	1.70	
6)	Saturated density	t/m^3	1.857	2.021	1.928	1.80	
7)	Friction angle	degree	26	33	40	20	32
8)	Cohesion	t/m^2	3	0	0	2	5
9)	Permeability	cm/sec	$1x10^{-6}$	$1x10^{-3}$	$1x10^{0}$-10^{-1}	$1x10^{-5}$	$1x10^{-4}$

Table 3.1 Principal Features for Alternative Single Development Schemes

		A-1	A-3	A-6	K-1	K-2	K-3
		Cibanten Dam	Down-stream Cidanau Dam	Cidanau Gated Weir	Heightening of Krenceng Dam without Diversion	Heightening of Krenceng Dam with One Diversion	Heightening of Krenceng Dam with Two Diversions
Reservoir							
Name of river		Cibanten	Cidanau	Cidanau	Krenceng	Krenceng	Krenceng
Catchment area	km^2	73.15	208.25	214.95	13.3	13.3	13.3
Reservoir surface area	km^2	2.1	0.6	0.41	1.8	1.8	1.8
Gross capacity	10^6m^3	21.5	7.11	3.44	14.1	14.1	14.1
Effective capacity	10^6m^3	14.9	2.95	3.44	12.9	12.9	12.9
Development yield	m^3/s	0.45	1.825	1.97	3.10	3.15	3.20
High water level	EL-m	115.0	50.0	21.2	29.0	29.0	29.0
Low water level	EL-m	104.5	44.0	0	18.0	18.0	18.0
Annual rainfall	mm/yr	2,250	3,000	3,000	2,250	2,250	2,250
Mean runoff	m^3/sec	2.0	13.63	14.36	0.43	0.43	0.43
Design peak flood	m^3/sec						
25 yrs		814	346	346	128	128	128
100 yrs		1,033	444	444	171	171	171
1.2 x 200 yrs		1,324	535	535	225	225	225
Dam and Rated Facility							
Diversion Work							
River diversion		Tunnel scheme	Tunnel scheme	Multi-stage diversion	Multi-stage diversion	Multi-stage diversion	Multi-stage diversion
Diversion tunnel, L	m	410	400	-	-	-	-
D	m	5	5	-	-	-	-
Diversion gate	Nos.	1	1	-	-	-	-
Dam		Main dam / Saddle dam					
Type		Rock-fill / Rando m-fill	Rockfill	Gravity	Impervious random-fill	Impervious random-fill	Impervious random-fill
Crest elevation	EL-m	120 / 120	55	24.2	32	32	32
Height (from river bed)	m	45 / 34	35	24.2	16	16	16
Crest length	m	340 / 275	255	299	2,800	2,800	2,800
Embankment/Conc.volume	10^3m^3	947 / 168	474	43	1,281	1,281	1,281
Spillway							
Type		Side overflow	Side overflow	Roller gate	Roller gate	Roller gate	Roller gate
Crest elevation of weir	EL-m	115	50	1.5	24	24	24
Width of weir	m	150	120	61	20	20	20
Gate (wide x height x Nos.)		-	-	17x20x3	8.75x5.5x2	8.75x5.5x2	8.75x5.5x2
Outlet Works							
Intake type		Vertical	Vertical	Horizontal	-	-	-
Steel conduit, L	m	230	285	200	-	-	-
Guard valve	Nos.	1	1	1	-	-	-
Hollow jet valve	Nos.	1	1	1	-	-	-
Diversion Tunnel							
Name of river		-	-	-	-	Beroeng	Beroeng / Anyer
Catchment area at weir	km^2	-	-	-	-	12.1	12.1 / 17.5
Mean runoff	m^3/sec	-	-	-	-	0.39	0.39 / 0.59
Maximum discharge capacity	m^3/sec	-	-	-	-	4.0	4.0 / 4.0
Diverted tunnel, L	m	-	-	-	-	300	300 / 700
D	m	-	-	-	-	1.5	1.5 / 1.5
Water Transmission Facility							
Transmission pipeline, L	km	28.0	Existing	Existing	Existing	Existing	Existing
D	m	0.7	Existing	Existing	Existing	Existing	Existing
Krakatau pump station 2/							
Pump discharge	m^3/s	-	Existing	Existing	1.1	1.19	1.2
Pump head	m	-	Existing	Existing	67.1	67.1	67.1
Additional pump	kW	-	Existing	Existing	1150	1200	1250
Booster pump station 3/							
Pump discharge	m^3/s	-	-	-	3.1	3.15	3.20
Pump head	m	-	-	-	75	76	77
Pump capacity	kW	-	-	-	3550	3650	3750
Krenceng pump station 3/							
Pump discharge	m^3/s	0.45 3/	0.06 3/	0.205 3/	3.1	3.15	3.20
Pump head	m	12.0	12.0	12	20	20	20
Pump capacity	kW						
Connection pipeline 2/, L	m	160	160	160	160	160	160
Water treatment plant 3/	m^3/hr	1,620	220	740	3960	4140	4320

Notes: 1/ means regulated peak outflow at the outlet of Rawa Danau.
2/ Facility replaced due to development scheme
3/ Facility added due to development scheme

Table 3.2 Principal Features for Alternative Combined Development Schemes

Item	Unit	B-1	B-2	B-3	C-1	C-2	C-3	D-1	D-2	D-3
Scheme combined		K-1 & A-1	K-1 & A-3	K-1 & A-6	K-2 & A-1	K-2 & A-3	K-2 & A-6	K-3 & A-1	K-3 & A-3	K-3 & A-6
Development yield	m^3/sec	3.55	3.40	3.435	3.60	3.445	3.49	3.65	3.49	3.54
Reservoir and Dam Facility		Same as corresponding single development scheme								
Transmission Facility										
Transmission pipeline, L	km	28.0			28.0			28.0		
D	m	0.7 & Existing	Existing	Existing	0.7	Existing	Existing	0.7 & Existing	Existing	Existing
Krakatau pump station 1/										
pump discharge	m^3/sec	1.55	1.40	1.435	1.60	1.445	1.49	1.65	1.49	1.54
pump head	m	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1	67.1
Additional pumps	kW	1,130	1,430	1,480	1,180	1,480	1,530	1,230	1,530	1,580
Booster pump station 1/										
Pump discharge	m^3/sec	3.55	3.40	3.435	3.60	3.445	3.49	3.65	3.49	3.54
Pump head	m	65	82	84	66	83.5	85	67.5	85	86
Pump capacity	kW	3,510	4,240	4,380	3,630	4,380	4,520	3,750	4,520	4,650
Krenceng pump station 2/										
pump discharge	m^3/sec	3.55	3.40	3.435	3.60	3.445	3.49	3.65	3.49	3.54
pump head	m	20	20	20	20	20	20	20	20	20
Connection pipeline, L	m	160	160	160	160	160	160	160	160	160
Water treatment plant 1/	m^3/hr	5,580	5,040	5,170	5,760	5,200	5,370	5,950	5,370	5,500

Notes: 1/ Facility added due to development scheme
2/ Facility replaced due to heightening of Krenceng dam

Table 3.3 Economic Cost and Economic Evaluation for Alternative Single Development Schemes

(Unit : Million)

Description	Scheme											
	A-1		A-3		A-6		K-1		K-2		K-3	
	F/C *5	L/C *6	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
1) Direct Const. cost	3,473	62,317	2,345	18,000	2,792	13,529	4,021	27,420	4,147	28,609	4,318	30,334
Dam and related facility	2,780	17,654	2,251	16,865	2,487	10,534	1,545	8,801	1,585	9,336	1,668	10,408
Water transmission facility	693	44,663	94	1,135	305	2,995	2,476	18,619	2,562	19,272	2,650	19,925
2) Land acquisition cost	0	210	0	12	0	28	0	3,722	0	3,722	0	3,722
3) Administration *1	0	6,253	0	1,801	0	1,356	0	3,114	0	3,233	0	3,406
4) Engineering Services *2	521	3,116	352	900	419	676	603	1,371	622	1,430	648	1,517
5) Physical contingency *3	599	10,753	405	3,105	482	2,334	694	4,786	715	4,991	745	5,288
6) Grand Total	4,593	82,649	3,101	23,818	3,692	17,924	5,318	40,413	5,484	41,985	5,710	44,266
(Rp) *4	154,300		72,199		75,520		123,375		127,542		133,348	
7) Economic cost *7	138,681		64,968		67,943		107,688		111,439		116,664	
8) Capitalized cost *8	106,165		48,612		51,116		96,189		98,398		101,167	
9) Capitalized benefit *8	97,024		19,405		50,668		243,637		254,418		265,198	
10) Net benefit	-9,141		-29,208		-448		147,449		156,019		164,031	
11) Benefit cost ratio	0.91		0.40		0.99		2.53		2.59		2.62	
12) Economic internal rate of return (EIRR)	11.16		5.22		11.92		24.02		24.22		24.26	

Note : *1 F/C 0%, LC 10% of 1) + 2)
*2 F/C 15%, L/C 5% of 1)
*3 F/C 15%, L/C 15% of 1) + 3) + 4)
*4 ¥1 = Rp.15.6
*5 F/C: Japanese Yen
*6 L/C: Rupiah
*7 Conversion factor : 0.9 / Excluded land acquisition cost
*8 Capitalized by discount rate of 12%
Excluded Land acquisition cost

Table 3.4 Economic Cost and Economic Evaluation for Alternative Combined Development Schemes

(Unit : Million)

Description	Scheme																	
	B-1		B-2		B-3		C-1		C-2		C-3		D-1		D-2		D-3	
	F/C *5	L/C *6	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
1) Direct Const. cost	7,007	85,977	6,774	48,576	7,097	42,393	7,134	87,165	6,901	49,763	7,224	43,581	7,304	88,889	6,984	50,835	7,384	45,241
Dam and related facility	4,330	26,485	3,796	25,665	4,032	19,335	4,370	27,020	3,836	26,201	4,072	19,870	4,453	28,092	3,919	27,273	4,155	20,942
Water transmission facility	2,677	59,492	2,978	22,910	3,065	23,058	2,764	60,145	3,065	23,562	3,152	23,710	2,851	60,797	3,065	23,562	3,229	24,298
2) Land acquisition cost	0	5,372	0	5,174	0	5,190	0	5,362	0	5,174	0	5,190	0	5,372	0	5,174	0	5,190
3) Administration *1	0	9,135	0	5,375	0	4,758	0	9,253	0	5,494	0	4,877	0	9,426	0	5,601	0	5,043
4) Engineering Services *2	1,051	4,299	1,016	2,429	1,065	2,120	1,070	4,358	1,035	2,488	1,084	2,179	1,096	4,444	1,048	2,542	1,108	2,262
5) Physical contingency *3	1,209	14,912	1,169	8,457	1,224	7,391	1,231	15,116	1,190	8,662	1,246	7,596	1,260	15,414	1,205	8,847	1,274	7,882
6) Grand Total	9,267	119,693	8,959	70,010	9,386	61,852	9,435	121,254	9,127	71,581	9,553	63,422	9,659	123,545	9,236	72,998	9,765	65,618
(Rp) *4	264,259		209,770		208,269		268,436		213,957		212,456		274,231		217,084		217,949	
7) Economic cost *7	232,998		184,137		182,771		236,767		187,905		186,540		241,974		190,720		191,484	
8) Capitalized cost *8	192,065		156,747		153,174		194,290		156,491		155,149		197,046		157,051		157,279	
9) Capitalized benefit *8	330,235		305,286		313,873		336,925		313,873		321,535		343,026		321,535		328,184	
10) Net benefit	138,170		148,539		160,699		142,635		157,382		166,386		145,980		164,484		170,905	
11) Benefit cost ratio	1.72		1.95		2.05		1.73		2.01		2.07		1.74		2.05		2.09	
12) Economic internal rate of return (EIRR)	18.00		19.91		20.60		18.04		20.22		20.64		18.00		20.36		20.58	

Note : *1 F/C 0%, LC 10% of 1) + 2)
*2 F/C 15%, L/C 5% of 1)
*3 F/C 15%, L/C 15% of 1) + 3) + 4)
*4 ¥1 = Rp.15.6
*5 F/C: Japanese Yen
*6 L/C: Rupiah
*7 Conversion factor : 0.9 / Excluded land acquisition cost
*8 Capitalized by discount rate of 12%

Table 3.5 Water Conveyance and Treatment Facilities for Alternative Development Scale of Heightening of Krenceng Dam

	Alternative		
	H-1	H-2	H-3
Required Additional Pump Capacity*	1.10 m^3/s	0.65 m^3/s	0.105 m^3/s
Intake Facilities (Cidanau)			
Intake*	L = 40 m B = 2.0 m H = 2.2 m	L = 40 m B = 1.0 m H = 2.2 m	-
Sand trap basin*	L = 80 m B = 6.5 m H = 3.0 m	L - 80 m B = 4 m H = 3.0 m	-
Water Conveyance Facilities			
Cidanau Pump station*	0.55 m^3/s x 2 units	0.33 m^3/s x 2 units	0.105 m^3/s x 1 unit
Booster pump station*	1.03 m^3/s x 4[1]	0.88 x m^3/s x 4[1]	0.70 m^3/s x 4[1]
Surge tank	2 units	2 units	1 unit
Purification Facilities			
Pump station**	1.03 m^3/s x 4[1]	0.88 m^3/s x 4[1]	0.105 m^3/s x 1
Receiving well**	Replaced	Replaced	Replaced
Water purification plant**	1.10 m^3/s	0.65 m^3/s	0.105 m^3/s

Note: 1] included one standby.
* additional facilities
** replaced facilities

Table 3.6 Water Conveyance and Treatment Facilities for Alternative Development Scale of Cidanau Gated Weir

	Alternative	
	M-1	M-2
Required Additional Pump Capacity*	0.205 m^3/s	0
Intake Facilities (Cidanau)		
Intake*	-	-
Sand trap basin*	-	-
Pump station*	-	-
Conveyance Facilities		
Booster pump station*	-	-
Surge tank	-	-
Purification Facilities		
Pump station*	0.205 m^3/s x 1 unit	0.015 m^3/s x 1 unit
Receiving well	-	-
Water purification plant	0.205 m^3/s	0.015 m^3/s

Note: * additional facilities

Table 4.1 Water Conveyance and Treatment Facilities

	Scheme		
	K-1	K-2	C-3
Intake Facilities (Cidanau)			
Intake			
Width	1.5 m	1.5 m	2.0 m
Depth	2.2 m	2.2 m	2.2 m
Length	40 m	40 m	40 m
Sand trap basin			
Width	6.5 m	6.5 m	6.5 m
Depth	1.8 m	1.8 m	1.8 m
Length	77.6 m	77.6 m	77.6 m
Water Conveyance Facilities			
Cidanau pump station			
Additional capacity	1.05 m^3/s	1.11 m^3/s	1.435 m^3/s
Total head	67.1 m	67.1 m	67.1 m
Flow rate for unit	0.53 m^3/s	0.56 m^3/s	0.72 m^3/s
Number of units	2	2	2
Pump motor output	550 kW/unit	580 kW/unit	740 kW/unit
Booster pump station			
Total capacity	3.05 m^3/s	3.11 m^3/s	3.435 m^3/s
Total head	73.8 m	75.4 m	84.2 m
Flow rate per unit	1.02 m^3/s	1.04 m^3/s	1.15 m^3/s
Number of units	4 units 1]	4 units 1]	4 units 1]
Pump motor output	1,150 kW/unit	1,200 kW/unit	1,500 kW/unit
Surge tank			
Capacity pre unit	915 m^3/s	933 m^3/s	1,010 m^3/s
Number of units	2	2	2
Purification Facilities			
Receiving well			
Well capacity	275 m^3	280 m^3	310 m^3
High-rate coagulation basin			
Treatment capacity	0.7 m^3/s/unit	0.7 m^3/s/unit	0.7 m^3/s/unit
Number of units	2	2	2
Rapid sand filter			
Treatment capacity	0.5 m^3/s/unit	0.5 m^3/s/unit	0.5 m^3/s/unit
Number of units	3	3	4
Purified reservoir			
Capacity	3,800 m^3	4,000 m^3	5,200 m^3
Water tower			
Capacity	950 m^3	1,000 m^3	1,300 m^3
Krenceng pump station			
Total capacity	3.05 m^3/s	3.11 m^3/s	3.435 m^3/s
Total head	20 m	20 m	20 m
Flow rate per unit	1.02 m^3/s	1.04 m^3/s	1.15 m^3/s
Number of units	4 units 1]	4 units 1]	4 units 1]
Power	310 kW/unit	320 kW/unit	350 kW/unit

Note: 1] Included one standby

Table 4.2 Principal Features for Priority Development Schemes

		K-1	K-2	C-3	
		Heightening of Krenceng Dam without Diversion	Heightening of Krenceng Dam with One Diversion	Heightening of Krenceng Dam with One Diversion	Cidanau Gated Weir
Reservoir					
Name of river		Krenceng	Krenceng	Krenceng	Cidanau
Catchment area	km^2	13.3	13.3	13.3	214.95
Reservoir surface area	km^2	1.8	1.8	1.8	0.41
Gross capacity	10^6m^3	14.1	14.1	14.1	3.44
Effective capacity	10^6m^3	12.9	12.9	12.9	3.44
Development yield	m^3/s	3.05	3.11	3.11	0.325
High water level	EL-m	29.0	29.0	29.0	21.2
Low water level	EL-m	18.0	18.0	18.0	0
Annual rainfall	mm/yr	2,250	2,250	2,250	3,000
Mean runoff	m^3/sec	0.43	0.43	0.43	0.43
Design peak flood	m^3/sec				
25 yrs		128	128	128	346 1/
100 yrs		171	171	171	444 1/
1.2 x 200 yrs		225	225	225	535 1/
Dam and Rated Facility					
Diversion Work					
River diversion		Multi-stage diversion	Multi-stage diversion	Multi-stage diversion	Multi-stage diversion
Diversion tunnel, L	m	-	-	-	-
D	m	-	-	-	-
Diversion gate	Nos.	-	-	-	-
Dam					
Type		Impervious random-fill	Impervious random-fill	Impervious random-fill	Gravity
Crest elevation	EL-m	32	32	32	24.2
Height (from river bed)	m	16	16	16	24.2
Crest length	m	2,911	2,911	2,911	299
Embankment/Conc.volume	10^3m^3	1,270	1,270	1,270	43
Spillway					
Type		Roller gate	Roller gate	Roller gate	Roller gate
Crest elevation of weir	EL-m	25	25	25	1.5
Width of weir	m	18	18	18	61
Gate (wide x height x Nos.)		7.75x4.3x2	7.75x4.3x2	7.75x4.3x2	17x20x3
Outlet Works					
Intake type		-	-	-	Horizontal
Steel conduit, L	m	-	-	-	200
Guard valve	Nos.	-	-	-	1
Hollow jet valve	Nos.	-	-	-	1
Diversion Tunnel					
Name of river		-	Beroeng	Beroeng	
Catchment area at weir	km^2	-	12.1	12.1	-
Mean runoff	m^3/sec	-	0.39	0.39	-
Maximum discharge capacity	m^3/sec	-	4.0	4.0	-
Diverted tunnel, L	m	-	280	280	-
D	m	-	1.5	1.5	-
Water Transmission Facility					
Transmission pipeline, L	km	Existing	Existing	Existing	Existing
D	m	Existing	Existing	Existing	Existing
Krakatau pump station 3/					
Pump discharge	m^3/s	1.05	1.11	1.435	
Pump head	m	67.1	67.1	67.1	
Additional pumps	kW	2unitsx550	2unitsx580	2unitsx740	
Booster pump station 3/					
Pump discharge	m^3/s	3.05	3.11	3.435	
Pump head	m	73.8	75.4	84.2	
Pump capacity	kW	4unitsx1150	4unitsx1200	4unitx1500	
Krenceng pump station 2/					
Pump discharge	m^3/s	3.05	3.11	3.435	
Pump head	m	20	20	20	
Pump capacity 4/	kW	4unitsx310	4unisx320	4unitsx350	
Water treatment plant 3/	m^3/hr	5400	5400	7200	

Notes: 1/ means regulated peak outflow at the outlet of Rawa Danau.
2/ Facility replaced due to development scheme
3/ Facility added due to development scheme
4/ Included one standby.

Table 5.1 Labor Cost

		Daily Wage (Rp.)
1.	Foreman	10,000
2.	Common labor	4,500
3.	Skilled labor	7,500
4.	Operation	10,000
5.	Mechanic	7,000
6.	Welder	7,000
7.	Electrician	7,000
8.	Steel worker	6,500
9.	Carpenter	6,500
10.	Maison	6,500
11.	Semi skilled labor	6,500
12.	Assistant operator	6,500
13.	Driver	7,500
14.	Assistant driver	6,000

Table 5.2 Material Cost

No.	Description	Unit	Price (Rp.)
1.	Cement	t	140,000
2	Reinforcement steel bar	t	1,000,000
3.	Aggregate, fine	cu.m	27,500
4.	Aggregate, coarse	cu.m	30,000
5.	Masonry stone	cu.m	20,000
6.	Structure steel	t	1,400,000
7.	Sheet pile, Type II	m	57,000
8.	Gasoline	lit.	550
9.	Diesel oil	lit.	350
10.	Wood	cu.m	650,000

Table 5.3 Hourly Cost of Construction Equipment

No.	Description		Hourly Cost (¥)
1.	Bulldozer,	30 t	7,525
2.	Bulldozer,	21 t	5,311
3.	Bulldozer,	21 t w/ripper	5,590
4.	Bulldozer,	15 t	3,290
5.	Back hoe,	0.6 m^3	3,161
6.	Tractor shovel,	3.2 m^3	3,805
7.	Tractor shovel,	2.0 m^3	5,483
8.	Wheel loader,	2.1 m^3	3,075
9.	Dump Truck,	11 t	1,978
10.	Dump truck,	8 t	1,398
11.	Truck crane,	20 t	4,617
12.	Crawler crane,	40 t	7,999
13.	Crawler crane,	25 t	4,902
14.	Motor grader,	3.1 m	2,322
15.	Vibration roller,	8 t	5,117
16.	Soil compactor,	20 t	6,708
17.	Vibration pile driver,	45 kW	15,958
18.	Diesel pile hammer,	3.5 t	19,390
19.	Truck mixer,	3.2 m^3	1,254
20.	Concrete pump,	45 m^3/h	2,850
21.	Concrete bucket,	1.5 m^3	398
22.	Diesel generator,	125 kVA	937
23.	Welder,	300 A	40
24	Crawler drill		1,147
25.	Leg hammer,	30 kg	369
26.	Air compressor,	17.0 m^3/min.	1,398
27.	Aggregate plant,	60 t/h	19,350
28.	Batcher plant,	1 m^3	12,900
29.	Batcher plat,	0.5 m^3	8,600
30.	Bar bender		63

Table 5.4 List of Unit Price

Description			Unit	F.C. (¥)	L.C (Rp.)	Total Equivalent to US$
A.	Excavation	(1) Common	(m^3)	276	1,651	3.03
		(2) Weathers rock	(m^3)	339	1,398	3.40
		(3) Rock	(m^3)	962	3,475	9.40
		(4) Tunnel	(m^3)	8,744	105,122	122.85
B.	Embankment	(1) Random	(m^3)	441	1,144	4.08
		(2) Filter	(m^3)	2,285	5,756	21.06
		(3) Rip lap	(m^3)	1,514	5,964	15.05
C.	Concrete	(1) Dam	(m^3)	5,052	118,708	100.47
		(2) Structure	(m^3)	13,442	132,187	173.90
		(3) Tunnel	(m^3)	13,488	155,546	186.14
D.	Reinforcement steel bar		(t)	5,292	1,460,955	785.10
E.	Piling	(1) Steel sheet pile	(t)	131,583	36,915	1,062.87
		(2) Steel pipe pile 300ø	(t)	184,518	18,358	1,473.47
		(3) Steel pipe pile 600ø	(t)	173,818	9,437	1,384.03

Table 5.5 Breakdown of Construction Costs for Scheme K-1

	DESCRIPTION		Unit	Q'ty	UNIT PRICE Fc Yen	UNIT PRICE Lc Rp	AMOUNT Fc Yen	AMOUNT Lc Rp
1	PREPARATORY WORKS							
	(20% of 2+3)						302,465,656	1,488,312,990
2	DIVERTED TUNNEL						0	0
	2 1 Coffering work						0	0
	Coffering	Exca.	m3		276	1,651	0	0
		Embank	m3		441	1,144	0	0
	2 2 Intake Weir						0	0
	Excavation	Common	m3		276	1,651	0	0
		Wea.rock	m3		339	1,398	0	0
		Rock	m3		962	3,475	0	0
	Concrete		m3		5,052	118,708	0	0
	Rein bar		t		5,292	1,460,955	0	0
	2 3 Inlet&outlet						0	0
	Excavation	Common	m3		276	1,651	0	0
		Wea.rock	m3		339	1,398	0	0
		Rock	m3		962	3,475	0	0
	Concrete		m3		13,442	132,187	0	0
	Rein bar		t		5,292	1,460,955	0	0
	2 4 Diversion tunnel						0	0
	Excavation		m3		8,744	105,122	0	0
	Lining conc.		m3		13,488	155,546	0	0
	Plug conc.		m3		13,488	155,546	0	0
	Grouting		t		6,500	90,000	0	0
	Rein bar		t		5,292	1,460,955	0	0
	2 5 Metal Work							
	Trash rack		Ls		800,000	0	0	0
	Guard gate,0.8x0.8		Ls		6,000,000	0	0	0
	Guard gate,2x2		Ls		12,000,000	0	0	0
	Outlet gate,800		Ls		16,000,000	0	0	0
	Outlet gate,2x2		Ls		10,000,000	0	0	0
	Steel conduit,800		Ls		1,040,000	0	0	0
	Steel conduit,2000		Ls		4,000,000	0	0	0
3	HEIGHTENING OF KRENCENG DAM						0	0
	3 1 Main dam						0	0
	Excavation	Common	m3	145,222	276	1,651	40,081,272	239,761,522
		Wea.rock	m3	96,814	339	1,398	32,819,946	135,345,972
		Rock	m3	0	962	3,475	0	0
	Embankment	Core	m3	1,057,882	605	2,359	640,018,610	2,495,543,638
		Filter	m3	144,661	2,285	5,756	330,550,385	832,668,716
		Random	m3	0	441	1,144	0	0
		Rock	m3	63,684	1,514	5,964	96,417,376	379,811,376
	Grouting	Blanket	t	3,881	6,500	90,000	25,226,500	349,290,000
		Curtain	t	4,109	6,500	90,000	26,708,500	369,810,000
	3 2 SPILLWAY						0	0
	1) Approach wall& weir						0	0
	Excavation	Common	m3	13,786	276	1,651	3,804,936	22,760,686
		Wea.rock	m3	20,679	339	1,398	7,010,181	28,909,242
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	12,297	13,442	132,187	165,296,274	1,625,503,539
	Rein bar		t	246	5,292	1,460,955	1,301,514	359,307,273
	2) Chuteway & basin						0	0
	Excavation	Common	m3	5,463	276	1,651	1,507,788	9,019,413
		Wea.rock	m3	8,195	339	1,398	2,778,105	11,456,610
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	3,568	13,442	132,187	47,961,056	471,643,216
	Rein bar		t	71	5,292	1,460,955	377,637	104,253,749
	Grouting	Consoli.	t	72	6,500	90,000	468,000	6,480,000
	3 3 METAL WORK						0	0
	Spillway gate		Ls	1	90,000,000	0	90,000,000	0
	Hollow jet valve		Ls					
	SUB TOTAL						1,814,793,937	8,929,877,942
4	WATER SUPPLY PIPE LINE						0	0
	4 1 Excavation		m3		276	1,651	0	0
	4 2 Backfill		m3		244	1,717	0	0
	4 3 Add.pump station		Ls	1	1,036,000,000	6,926,400,000	1,036,000,000	6,926,400,000
	4 4 Add.purificationplant		Ls	1	1,345,400,000	8,994,960,000	1,345,400,000	8,994,960,000
	4 5 Add.pipe line		Ls	0		1,540,000,000	0	0
	4 6 Add.intake&surge tank		Ls	1	50,780,000	1,848,530,000	50,780,000	1,848,530,000
	4 7 Receiving well		Ls	1	6,300,000	229,320,000	6,300,000	229,320,000
	SUB TOTAL						2,438,480,000	17,999,210,000
	TOTAL						4,253,273,937	26,929,087,942
	DIRECT CONST. COST						4,253,273,937	26,929,087,942
	LAND ACQUISITION COST						0	3,721,750,000
	ADMINISTRATION(FC0%,LC10%)						0	3,065,083,794
	ENGINEERING SERVICES(FC15%,LC5%)						637,991,091	1,346,454,397
	PHYSICAL CONTINGENCY(15%)						733,689,754	4,701,093,920
							0	0
	GRAND TOTAL						5,624,954,781	39,763,470,053

Table 5.6 Breakdown of Construction Costs for Scheme K-2

	DESCRIPTION		Unit	Q'ty	UNIT PRICE Fc Yen	UNIT PRICE Lc Rp	AMOUNT Fc Yen	AMOUNT Lc Rp
1	PREPARATORY WORKS						321,700,370	1,629,905,652
	(20% of 2+3)						0	0
2	DIVERTED TUNNEL						0	0
2 1	Coffering work							
	Coffering	Exca.	m3	1,000	276	1,651	276,000	1,651,000
		Embank	m3	1,000	441	1,144	441,000	1,144,000
2 2	Intake Weir						0	0
	Excavation	Common	m3	405	276	1,651	111,780	668,655
		Wea.rock	m3	405	339	1,398	137,295	566,190
		Rock	m3	203	962	3,475	195,286	705,425
	Concrete		m3	2,382	5,052	118,708	12,033,864	282,762,456
	Rein bar		t	12	5,292	1,460,955	63,028	17,399,974
2 3	Inlet&outlet						0	0
	Excavation	Common	m3	500	276	1,651	138,000	825,500
		Wea.rock	m3	500	339	1,398	169,500	699,000
		Rock	m3	250	962	3,475	240,500	868,750
	Concrete		m3	1,245	13,442	132,187	16,735,290	164,572,815
	Rein bar		t	25	5,292	1,460,955	131,771	36,377,780
2 4	Diversion tunnel						0	0
	Excavation		m3	970	8,744	105,122	8,481,680	101,968,340
	Lining conc.		m3	475	13,488	155,546	6,406,800	73,884,350
	Plug conc.		m3		13,488	155,546	0	0
	Grouting		t	111	6,500	90,000	721,500	9,990,000
	Rein bar		t	10	5,292	1,460,955	50,274	13,879,073
2 5	Metal Work							
	Trash rack		Ls	1	800,000	0	800,000	0
	Guard gate,0.8x0.8		Ls	1	6,000,000	0	6,000,000	0
	Guard gate,2x2		Ls	1	12,000,000	0	12,000,000	0
	Outlet gate,800		Ls	1	16,000,000	0	16,000,000	0
	Outlet gate,2x2		Ls	1	10,000,000	0	10,000,000	0
	Steel conduit,800		Ls	1	1,040,000	0	1,040,000	0
	Steel conduit,2000		Ls	1	4,000,000	0	4,000,000	0
3	HEIGHTENING OF KRENCENG DAM						0	0
3 1	Main dam						0	0
	Excavation	Common	m3	145,222	276	1,651	40,081,272	239,761,522
		Wea.rock	m3	96,814	339	1,398	32,819,946	135,345,972
		Rock	m3	0	962	3,475	0	0
	Embankment	Core	m3	1,057,882	605	2,359	640,018,610	2,495,543,638
		Filter	m3	144,661	2,285	5,756	330,550,385	832,658,716
		Random	m3	0	441	1,144	0	0
		Rock	m3	63,684	1,514	5,964	96,417,576	379,811,376
	Grouting	Blanket	t	3,881	6,500	90,000	25,226,500	349,290,000
		Curtain	t	4,109	6,500	90,000	26,708,500	369,810,000
3 2	SPILLWAY						0	0
1)	Approach wall& weir						0	0
	Excavation	Common	m3	13,786	276	1,651	3,804,936	22,760,686
		Wea.rock	m3	20,679	339	1,398	7,010,181	28,909,242
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	12,297	13,442	132,187	165,296,274	1,625,503,539
	Rein bar		t	246	5,292	1,460,955	1,301,514	359,307,273
2)	Chuteway & basin						0	0
	Excavation	Common	m3	5,463	276	1,651	1,507,788	9,019,413
		Wea.rock	m3	8,195	339	1,398	2,778,105	11,456,610
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	3,568	13,442	132,187	47,961,056	471,643,216
	Rein bar		t	71	5,292	1,460,955	377,637	104,253,749
	Grouting	Consoli.	t	72	6,500	90,000	468,000	6,480,000
3 3	METAL WORK						0	0
	Spillway gate		Ls	1	90,000,000	0	90,000,000	0
	Hollow jet valve		Ls					
	SUB TOTAL						1,930,202,218	9,779,433,910
4	WATER SUPPLY PIPE LINE						0	0
4 1	Excavation		m3		276	1,651	0	0
4 2	Backfill		m3		244	1,717	0	0
4 3	Add.pump station		Ls	1	1,073,100,000	7,174,440,000	1,073,100,000	7,174,440,000
4 4	Add.purificationplant		Ls	1	1,367,100,000	9,140,040,000	1,367,100,000	9,140,040,000
4 5	Add.pipe line		Ls	0		1,540,000,000	0	0
4 6	Add.intake&surge tank		Ls	1	50,780,000	1,848,530,000	50,780,000	1,848,530,000
4 7	Receiving well		Ls	1	6,300,000	229,320,000	6,300,000	229,320,000
	SUB TOTAL						2,497,280,000	18,392,330,000
	TOTAL						4,427,482,218	28,171,763,910
	DIRECT CONST. COST						4,427,482,218	28,171,763,910
	LAND ACQUISITION COST						0	3,721,750,000
	ADMINISTRATION(FC0%,LC10%)						0	3,189,351,391
	ENGINEERING SERVICES(FC15%,LC5%)						664,122,333	1,408,588,196
	PHYSICAL CONTINGENCY(15%)						763,740,683	4,915,455,525
							0	0
	GRAND TOTAL						5,855,345,233	41,406,909,021

Table 5.7 (1) Breakdown of Construction Costs for Scheme C-3 (1/2)

	DESCRIPTION		Unit	Q'ty	UNIT PRICE Fc Yen	UNIT PRICE Lc Rp	AMOUNT Fc Yen	AMOUNT Lc Rp
1	PREPARATORY WORKS							
	(20% of 2+3+4+5)						420,658,474	1,385,996,665
2	DIVERSION WORKS						0	0
2 1	Coffering work						0	0
	Sheet pile&bracing		t	159	131,583	36,915	20,921,697	5,869,485
3	DAM						0	0
3 1	Main dam						0	0
	Excavation	Common	m3	10,662	276	1,651	2,942,712	17,602,962
		Wea.rock	m3	8,530	339	1,398	2,891,670	11,924,940
		Rock	m3	2,132	962	3,475	2,050,984	7,408,700
	Concrete		m3	23,519	5,052	90,000	118,817,988	2,116,710,000
	Grouting	Consoli.	t	219	6,500	90,000	1,423,500	19,710,000
		Curtain	t	352	6,500	90,000	2,288,000	31,680,000
4	SPILLWAY						0	0
4 1	Dental work						0	0
	Excavation	Common	m3	22,389	276	1,651	6,179,364	36,964,239
		Wea.rock	m3		339	1,398	0	0
		Rock	m3		962	3,475	0	0
	Concrete		m3	8,379	5,052	118,708	42,330,708	994,654,332
4 2	Weir &pier						0	0
	Excavation	Common	m3		276	1,651	0	0
		Wea.rock	m3	1,169	339	1,398	396,291	1,634,262
		Rock	m3	500	962	3,475	481,000	1,737,500
	Concrete		m3	10,761	13,442	132,187	144,649,362	1,422,464,307
	Rein bar		t	538	5,292	1,460,955	2,847,361	786,066,838
	Grouting	Consoli.	t	126	6,500	90,000	819,000	11,340,000
		Curtain	t	180	6,500	90,000	1,170,000	16,200,000
4 3	Hoist &bridge						0	0
	Concrete		m3	2,871	13,442	132,187	38,591,982	379,508,877
	Rein bar		t	144	5,292	1,460,955	759,667	209,720,090
4 4	Energy dissipator						0	0
	Excavation	Common	m3	3,503	276	1,651	966,828	5,783,453
		Wea.rock	m3	2,802	339	1,398	949,878	3,917,196
		Rock	m3	700	962	3,475	673,400	2,432,500
	Concrete		m3	1,745	13,442	132,187	23,456,290	230,666,315
	Rein bar		t	35	5,292	1,460,955	184,691	50,987,330
5	METAL WORK						0	0
5 1	Roller gate		Ls	1	1,620,000,000		1,620,000,000	0
5 2	Steel conduit		Ls	1		565,000,000	0	565,000,000
5 3	Hollow jet	valve	Ls	1	45,000,000		45,000,000	0
5 4	Guard valve		Ls	1	22,500,000		22,500,000	0
	SUB TOTAL						2,523,950,846	8,315,979,991
6	WATER SUPPLY PIPE LINE						0	0
	Excavation		m3	0	383	2,176	0	0
	Backfill		m3	0	244	1,717	0	0
	Add.pump station		Ls	0	248,500,000	1,661,400,000	0	0
	Add.purification plant		Ls	0	258,300,000	1,726,920,000	0	0
	Add.pipe line		Ls	0			0	0
	Add.intake&surge tank		Ls	0			0	0
	SUB TOTAL						0	0
	TOTAL						2,523,950,846	8,315,979,991
							0	0
	DIRECT CONST. COST						2,523,950,846	8,315,979,991
	LAND ACQUISITION COST						0	28,000,000
	ADMINISTRATION(FC0%,LC10%)						0	834,397,999
	ENGINEERING SERVICES(FC15%,LC5%)						378,592,627	415,799,000
	PHYSICAL CONTINGENCY(15%)						435,381,521	1,434,926,548
							0	0
	GRAND TOTAL						3,337,924,994	11,029,103,538

Table 5.7 (2) Breakdown of Construction Costs for Scheme C-3 (2/2)

	DESCRIPTION		Unit	Q'ty	UNIT PRICE Fc Yen	UNIT PRICE Lc Rp	AMOUNT Fc Yen	AMOUNT Lc Rp
1	PREPARATORY WORKS							
	(20% of 2+3)						321,700,370	1,629,905,652
2	DIVERTED TUNNEL						0	0
							0	0
2 1	Coffering work							
	Coffering	Exca.	m3	1,000	276	1,651	276,000	1,651,000
		Embank	m3	1,000	441	1,144	441,000	1,144,000
							0	0
2 2	Intake Weir							
	Excavation	Common	m3	405	276	1,651	111,780	668,655
		Wea.rock	m3	405	339	1,398	137,295	566,190
		Rock	m3	203	962	3,475	195,286	705,425
	Concrete		m3	2,382	5,052	118,708	12,033,864	282,762,456
	Rein bar		t	12	5,292	1,460,955	63,028	17,399,974
							0	0
2 3	Inlet&outlet							
	Excavation	Common	m3	500	276	1,651	138,000	825,500
		Wea.rock	m3	500	339	1,398	169,500	699,000
		Rock	m3	250	962	3,475	240,500	868,750
	Concrete		m3	1,245	13,442	132,187	16,735,290	164,572,815
	Rein bar		t	25	5,292	1,460,955	131,771	36,377,780
							0	0
2 4	Diversion tunnel							
	Excavation		m3	970	8,744	105,122	8,481,680	101,968,340
	Lining conc.		m3	475	13,488	155,546	6,406,800	73,884,350
	Plug conc.		m3		13,488	155,546	0	0
	Grouting		t	111	6,500	90,000	721,500	9,990,000
	Rein bar		t	10	5,292	1,460,955	50,274	13,879,073
2 5	Metal Work							
	Trash rack		Ls	1	800,000	0	800,000	0
	Guard gate,0.8x0.8		Ls	1	6,000,000	0	6,000,000	0
	Guard gate,2x2		Ls	1	12,000,000	0	12,000,000	0
	Outlet gate,800		Ls	1	16,000,000	0	16,000,000	0
	Outlet gate,2x2		Ls	1	10,000,000	0	10,000,000	0
	Steel conduit,800		Ls	1	1,040,000	0	1,040,000	0
	Steel conduit,2000		Ls	1	4,000,000	0	4,000,000	0
							0	0
3	HEIGHTENING OF KRENCENG DAM						0	0
3 1	Main dam							
	Excavation	Common	m3	145,222	276	1,651	40,081,272	239,761,522
		Wea.rock	m3	96,814	339	1,398	32,819,946	135,345,972
		Rock	m3	0	962	3,475	0	0
	Embankment	Core	m3	1,057,882	605	2,359	640,018,610	2,495,543,638
		Filter	m3	144,661	2,285	5,756	330,550,385	832,668,716
		Random	m3	0	441	1,144	0	0
		Rock	m3	63,684	1,514	5,964	96,417,576	379,811,376
	Grouting	Blanket	t	3,881	6,500	90,000	25,226,500	349,290,000
		Curtain	t	4,109	6,500	90,000	26,708,500	369,810,000
							0	0
3 2	SPILLWAY						0	0
1)	Approach wall& weir							
	Excavation	Common	m3	13,786	276	1,651	3,804,936	22,760,686
		Wea.rock	m3	20,679	339	1,398	7,010,181	28,909,242
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	12,297	13,442	132,187	165,296,274	1,625,503,539
	Rein bar		t	246	5,292	1,460,955	1,301,514	359,307,273
							0	0
2)	Chuteway & basin							
	Excavation	Common	m3	5,463	276	1,651	1,507,788	9,019,413
		Wea.rock	m3	8,195	339	1,398	2,778,105	11,456,610
		Rock	m3	0	962	3,475	0	0
	Concrete		m3	3,568	13,442	132,187	47,961,056	471,643,216
	Rein bar		t	71	5,292	1,460,955	377,637	104,253,749
	Grouting	Consoli.	t	72	6,500	90,000	468,000	6,480,000
							0	0
3 3	METAL WORK							
	Spillway gate		Ls	1	90,000,000	0	90,000,000	0
	Hollow jet valve		Ls					
	SUB TOTAL						1,930,202,218	9,779,433,910
4	WATER SUPPLY PIPE LINE						0	0
4 1	Excavation		m3		276	1,651	0	0
4 2	Backfill		m3		244	1,717	0	0
4 3	Add.pump station		Ls	1	1,227,800,000	8,208,720,000	1,227,800,000	8,208,720,000
4 4	Add.purificationplant		Ls	1	1,642,900,000	10,983,960,000	1,642,900,000	10,983,960,000
4 5	Add.pipe line		Ls	0		1,540,000,000	0	0
4 6	Add.intake&surge tank		Ls	1	54,460,000	1,982,410,000	54,460,000	1,982,410,000
4 7	Receiving well		Ls	1	6,900,000	251,160,000	6,900,000	251,160,000
	SUB TOTAL						2,932,060,000	21,426,250,000
	TOTAL						4,862,262,218	31,205,683,910
	DIRECT CONST. COST						4,862,262,218	31,205,683,910
	LAND ACQUISITION COST						0	3,721,750,000
	ADMINISTRATION(FC0%,LC10%)						0	3,492,743,391
	ENGINEERING SERVICES(FC15%,LC5%)						729,339,333	1,560,284,196
	PHYSICAL CONTINGENCY(15%)						838,740,233	5,438,806,725
							0	0
	GRAND TOTAL						6,430,341,783	45,419,268,221

Table 5.8 Disbursement Schedule for K-1

(Unit : Million)

DESCRIPTION	1993		1994		1995		1996		1997		1998		1999		TOTAL		
	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Equivalent (Rp)
1. PREPARATORY WORK							242	1,191	60	298					302	1,488	6,207
2. DIVERSION TUNNEL																	
Civil Work									0	0	0	0			0	0	0
Metal Work											0	0	0	0	0	0	0
3. HEIGHTENING OF KRENCENG DAM																	
Civil Work									461	3,195	641	3,134	320	1,112	1,422	7,442	29,630
Metal Work											45	0	45	0	90	0	
4. WATER SUPPLY PIPE LINE																	
Civil Work											57	2,078	0	0	57	2,078	2,968
Metal Work											595	3,980	1,786	11,941	2,381	15,921	53,071
Total of (1 - 4)	0	0	0	0	0	0	242	1,191	522	3,492	1,338	9,193	2,151	13,053	4,253	26,929	93,280
5. LAND ACQUISITION COST					0	3,722									0	3,722	3,722
6. ADMINISTRATION	0	307	0	613	0	307	0	153	0	613	0	613	0	460	0	3,065	3,065
7. ENGINEERING SERVICES	64	135	128	269	64	135	32	67	128	269	128	269	96	202	638	1,346	11,299
Total of (1 - 7)	64	441	128	882	64	4,163	274	1,411	649	4,375	1,466	10,075	2,247	13,715	4,891	35,062	111,366
8. PHYSICAL CONTINGENCY	10	66	19	132	10	66	41	212	97	656	220	1,511	337	2,057	734	4,701	16,147
Total of (1 - 8)	73	507	147	1,015	73	4,229	315	1,623	747	5,031	1,686	11,586	2,584	15,772	5,625	39,763	127,513
9. PRICE ESCALATION	6	63	17	194	11	1,110	63	549	182	2,106	488	5,835	872	9,366	1,638	19,223	44,780
Grand Total	79	570	164	1,208	85	5,339	378	2,172	929	7,137	2,174	17,421	3,455	25,139	7,263	58,986	172,293

Table 5.9 Disbursement Schedule for K-2

(Unit : Million)

DESCRIPTION	1993		1994		1995		1996		1997		1998		1999		TOTAL		
	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Equivalent (Rp)
1. PREPARATORY WORK							257	1,304	64	326					322	1,630	6,648
2. DIVERSION TUNNEL																	
Civil Work									28	403	19	305			46	708	1,431
Metal Work											25	0	25	0	50	0	778
3. HEIGHTENING OF KRENCENG DAM																	
Civil Work									461	3,195	641	3,134	320	1,112	1,422	7,442	29,630
Metal Work											45	0	45	0	90	0	
4. WATER SUPPLY PIPE LINE																	
Civil Work											57	2,078	0	0	57	2,078	2,968
Metal Work											610	4,079	1,830	12,236	2,440	16,314	54,382
Total of (1 - 4)	0	0	0	0	0	0	257	1,304	553	3,924	1,397	9,596	2,220	13,348	4,427	28,172	97,240
5. LAND ACQUISITION COST					0	3,722									0	3,722	3,722
6. ADMINISTRATION	0	319	0	638	0	319	0	159	0	638	0	638	0	478	0	3,189	3,189
7. ENGINEERING SERVICES	66	141	133	282	66	141	33	70	133	282	133	282	100	211	664	1,409	11,769
Total of (1 - 7)	66	460	133	920	66	4,182	291	1,534	686	4,843	1,529	10,515	2,320	14,038	5,092	36,491	115,920
8. PHYSICAL CONTINGENCY	10	69	20	138	10	69	44	230	103	726	229	1,577	348	2,106	764	4,915	16,830
Total of (1 - 8)	76	529	153	1,058	76	4,251	334	1,764	789	5,570	1,759	12,093	2,668	16,144	5,855	41,407	132,750
9. PRICE ESCALATION	6	65	18	202	12	1,116	67	597	192	2,331	509	6,090	900	9,587	1,703	19,988	46,559
Grand Total	82	594	170	1,260	88	5,366	401	2,360	981	7,901	2,268	18,183	3,568	25,731	7,559	61,395	179,309

Table 5.10 Disbursement Schedule for C-3

(Unit : Million)

DESCRIPTION	1993		1994		1995		1996		1997		1998		1999		TOTAL		
	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Fc (Yen)	Lc (Rp)	Equivalent (Rp)
1. PREPARATORY WORK							594	2,413	148	603					742	3,016	14,597
2. DIVERSION TUNNEL																	
Civil Work									28	403	19	305			46	708	1,431
Metal Work											25	0	25	0	50	0	778
3. HEIGHTENING OF KRENCENG DAM																	
Civil Work									461	3,195	641	3,134	320	1,112	1,422	7,442	29,630
Metal Work											45	0	45	0	90	0	
4. CIDANAU GATED WEIR																	
Civil Work									227	3,230	189	3,135			416	6,365	12,851
Metal Work											844	283	844	283	1,688	565	
5. WATER SUPPLY PIPE LINE																	
Civil Work											61	2,234	0	0	61	2,234	3,191
Metal Work											2,871	19,193	0	0	2,871	19,193	63,976
Total of (1 - 4)	0	0	0	0	0	0	594	2,413	865	7,431	4,694	28,283	1,234	1,395	7,386	39,522	154,747
6. LAND ACQUISITION COST					0	3,750									0	3,750	3,750
7. ADMINISTRATION(FC0%,LC10%)	0	433	0	865	0	433	0	216	0	865	0	865	0	649	0	4,327	4,327
8. ENGINEERING SERVICES(FC15%,LC5%)	111	198	222	395	111	198	55	99	222	395	222	395	166	296	1,108	1,976	19,260
Total of (1 - 7)	111	630	222	1,261	111	4,380	649	2,728	1,086	8,692	4,916	29,544	1,400	2,340	8,494	49,575	182,083
9. PHYSICAL CONTINGENCY(15%)	17	95	33	189	17	95	97	409	163	1,304	737	4,432	210	351	1,274	6,874	26,750
Total of (1 - 8)	127	725	255	1,450	127	4,475	747	3,137	1,249	9,995	5,653	33,975	1,610	2,691	9,768	56,448	208,833
10. PRICE ESCALATION	10	90	29	277	20	1,174	149	1,061	304	4,183	1,637	17,111	543	1,598	2,692	25,495	67,489
Grand Total	137	814	284	1,727	147	5,649	895	4,198	1,553	14,179	7,290	51,086	2,153	4,290	12,460	81,943	276,322

Table 5.11 Summary of Project Costs for Priority Schemes

(Unit: Million)

DESCRIPTION	Scheme K-1 Fc (Yen)	K-1 Lc (Rp)	K-2 Fc (Yen)	K-2 Lc (Rp)	C-3 Fc (Yen)	C-3 Lc (Rp)
1. PREPARATORY WORK	302	1,488	322	1,630	742	3,016
2. DIVERSION TUNNEL						
Civil Work	0	0	46	708	46	708
Metal Work	0	0	50	0	50	0
3. HEIGHTENING OF KRENCENG DAM						
Civil Work	1,422	7,442	1,422	7,442	1,422	7,442
Metal Work	90	0	90	0	90	0
4. CIDANAU GATED WEIR						
Civil Work	-	-	-	-	416	6,365
Metal Work	-	-	-	-	1,688	565
5. WATER SUPPLY PIPE LINE						
Civil Work	57	2,078	57	2,078	61	2,234
Metal Work	2,381	15,921	2,440	16,314	2,871	19,193
Total of (1 - 5)	4,253	26,929	4,427	28,172	7,386	39,522
6. LAND ACQUISITION COST	0	3,722	0	3,722	0	3,750
7. ADMINISTRATION(FC0%,LC10%)	0	3,065	0	3,189	0	4,327
8. ENGINEERING SERVICES(FC15%,LC5%)	638	1,346	664	1,409	1,108	1,976
Total of (1 - 8)	4,891	35,062	5,092	36,491	8,494	49,575
9. PHYSICAL CONTINGENCY(15%)	734	4,701	764	4,915	1,274	6,874
Grand Total	5,625	39,763	5,855	41,407	9,768	56,448

Table 5.12 Alternative of Organization for Project Implementation of Cidanau-Cibanten Water Resources Development Scheme

Type of Management	Alternative	Execution of Project	O & M		Construction cost of Project 2]	O & M Cost		Collection		Revenue	
			Exclusive facilities	Common		Exclusive facilities	Common	Existing	Project	Existing	Project
Single	A-1	KS	KS		KS	KS		KS Sell treated to PDAM 1]			
	A-2										
	A-2-1	DPU	PDAM		DPU (BUDGET)	PDAM		PDAM		PDAM	
	A-2-2	DPU	PDAM		DPU (Loan)	PDAM		PDAM		PDAM	
DUAL	B-1										
	B-1-1	DPU	KS, PDAM	PDAM	DPU (Budget)	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM
	B-1-2	DPU	KS, PDAM	PDAM	DPU (Loan)	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM
	B-2	DPU	KS, PDAM	PDAM	Sharing	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM

Remarks, 1] Except KS's own use.
2] Including replacement cost.

Table 6.1 Financial and Economic Costs for Scheme K-1

(Unit: Million)

DESCRIPTION	Financial Cost		Conversion Factor	Economic Cost	
	Fc (Yen)	Lc (Rp)		Fc (Yen)	Lc (Rp)
1. PREPARATORY WORK	302	1,488	0.90	272	1,339
2. DIVERSION TUNNEL					
Civil Work	0	0	0.90	0	0
Metal Work	0	0	1.00	0	0
3. HEIGHTENING OF KRENCENG DAM					
Civil Work	1,422	7,442	0.90	1,280	6,697
Metal Work	90	0	1.00	90	0
4. WATER SUPPLY PIPE LINE					
Civil Work	57	2,078	0.90	51	1,870
Metal Work	2,381	15,921	0.95	2,262	15,125
Total of (1 - 4)	4,253	26,929		3,956	25,032
5. LAND ACQUISITION COST	0	3,722	0.00	0	0
6. ADMINISTRATION(FC0%,LC10%)	0	3,065	0.95	0	2,912
7. ENGINEERING SERVICES(FC15%,LC5%)	638	1,346	0.95	606	1,279
Total of (1 - 7)	4,891	35,062		4,562	29,223
8. PHYSICAL CONTINGENCY(15%)	734	4,701	0.90	660	4,231
Grand Total	5,625	39,763		5,222	33,454

Table 6.2 Financial and Economic Costs for Scheme K-2

(Unit: Million)

DESCRIPTION	Financial Cost		Conversion Factor	Economic Cost	
	Fc (Yen)	Lc (Rp)		Fc (Yen)	Lc (Rp)
1. PREPARATORY WORK	322	1,630	0.90	290	1,467
2. DIVERSION TUNNEL					
Civil Work	46	708	0.90	42	637
Metal Work	50	0	1.00	50	0
3. HEIGHTENING OF KRENCENG DAM					
Civil Work	1,422	7,442	0.90	1,280	6,697
Metal Work	90	0	1.00	90	0
4. WATER SUPPLY PIPE LINE					
Civil Work	57	2,078	0.90	51	1,870
Metal Work	2,440	16,314	0.95	2,318	15,499
Total of (1 - 4)	4,427	28,172		4,121	26,170
5. LAND ACQUISITION COST	0	3,722	0.00	0	0
6. ADMINISTRATION(FC0%,LC10%)	0	3,189	0.95	0	3,030
7. ENGINEERING SERVICES(FC15%,LC5%)	664	1,409	0.95	631	1,338
Total of (1 - 7)	5,092	36,491		4,752	30,538
8. PHYSICAL CONTINGENCY(15%)	764	4,915	0.90	687	4,424
Grand Total	5,855	41,407		5,439	34,962

Table 6.3 Financial and Economic Costs for Scheme C-3

(Unit: Million)

DESCRIPTION	Financial Cost		Conversion Factor	Economic Cost	
	Fc (Yen)	Lc (Rp)		Fc (Yen)	Lc (Rp)
1. PREPARATORY WORK	742	3,016	0.90	668	2,714
2. DIVERSION TUNNEL					
Civil Work	46	708	0.90	42	637
Metal Work	50	0	1.00	50	0
3. HEIGHTENING OF KRENCENG DAM					
Civil Work	1,422	7,442	0.90	1,280	6,697
Metal Work	90	0	1.00	90	0
4. CIDANAU GATED WEIR					
Civil Work	416	6,365	0.90	374	5,728
Metal Work	1,688	565	1.00	1,688	565
5. WATER SUPPLY PIPE LINE					
Civil Work	61	2,234	0.90	55	2,010
Metal Work	2,871	19,193	0.95	2,727	18,233
Total of (1 - 5)	7,386	39,522		6,974	36,586
6. LAND ACQUISITION COST	0	3,750	0.00	0	0
7. ADMINISTRATION(FC0%,LC10%)	0	4,327	0.95	0	4,111
8. ENGINEERING SERVICES(FC15%,LC5%)	1,108	1,976	0.95	1,053	1,877
Total of (1 - 8)	8,494	49,575		8,026	42,574
9. PHYSICAL CONTINGENCY(15%)	1,274	6,874	0.90	1,147	6,186
Grand Total	9,768	56,448		9,173	48,760

Table 6.4 Economic Analysis for Scheme K-1

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,559			1,559		-1,559	1,559	0
2	1994	3,117			3,117		-3,117	2,783	0
3	1995	1,559			1,559		-1,559	1,242	0
4	1996	5,918			5,918		-5,918	4,213	0
5	1997	15,156			15,156		-15,156	9,632	0
6	1998	34,975			34,975		-34,975	19,846	0
7	1999	52,641			52,641		-52,641	26,669	0
8	2000		635	3,267	3,902	34,130	30,228	1,765	15,439
9	2001		635	3,267	3,902	34,130	30,228	1,576	13,784
10	2002		635	3,267	3,902	34,130	30,228	1,407	12,308
11	2003		635	3,267	3,902	34,130	30,228	1,256	10,989
12	2004		635	3,267	3,902	34,130	30,228	1,122	9,812
13	2005		635	3,267	3,902	34,130	30,228	1,001	8,760
14	2006		635	3,267	3,902	34,130	30,228	894	7,822
15	2007		635	3,267	3,902	34,130	30,228	798	6,984
16	2008		635	3,267	3,902	34,130	30,228	713	6,235
17	2009		635	3,267	3,902	34,130	30,228	636	5,567
18	2010		635	3,267	3,902	34,130	30,228	568	4,971
19	2011		635	3,267	3,902	34,130	30,228	507	4,438
20	2012		635	3,267	3,902	34,130	30,228	453	3,963
21	2013		635	3,267	3,902	34,130	30,228	404	3,538
22	2014		635	3,267	3,902	34,130	30,228	361	3,159
23	2015		635	3,267	3,902	34,130	30,228	322	2,821
24	2016		635	3,267	3,902	34,130	30,228	288	2,518
25	2017		635	3,267	3,902	34,130	30,228	257	2,249
26	2018		635	3,267	3,902	34,130	30,228	230	2,008
27	2019		635	3,267	3,902	34,130	30,228	205	1,793
28	2020		635	3,267	3,902	34,130	30,228	183	1,600
29	2021		635	3,267	3,902	34,130	30,228	163	1,429
30	2022		635	3,267	3,902	34,130	30,228	146	1,276
31	2023	16,806	635	3,267	20,708	34,130	13,422	691	1,139
32	2024	16,806	635	3,267	20,708	34,130	13,422	617	1,017
33	2025	16,806	635	3,267	20,708	34,130	13,422	551	908
34	2026		635	3,267	3,902	34,130	30,228	93	811
35	2027		635	3,267	3,902	34,130	30,228	83	724
36	2028		635	3,267	3,902	34,130	30,228	74	646
37	2029		635	3,267	3,902	34,130	30,228	66	577
38	2030		635	3,267	3,902	34,130	30,228	59	515
39	2031		635	3,267	3,902	34,130	30,228	53	460
40	2032		635	3,267	3,902	34,130	30,228	47	411
41	2033		635	3,267	3,902	34,130	30,228	42	367
42	2034		635	3,267	3,902	34,130	30,228	37	327
43	2035		635	3,267	3,902	34,130	30,228	33	292
44	2036		635	3,267	3,902	34,130	30,228	30	261
45	2037		635	3,267	3,902	34,130	30,228	27	233
46	2038		635	3,267	3,902	34,130	30,228	24	208
47	2039		635	3,267	3,902	34,130	30,228	21	186
48	2040		635	3,267	3,902	34,130	30,228	19	166
49	2041		635	3,267	3,902	34,130	30,228	17	148
50	2042		635	3,267	3,902	34,130	30,228	15	132
51	2043		635	3,267	3,902	34,130	30,228	14	118
52	2044		635	3,267	3,902	34,130	30,228	12	105
53	2045		635	3,267	3,902	34,130	30,228	11	94
54	2046		635	3,267	3,902	34,130	30,228	10	84
55	2047		635	3,267	3,902	34,130	30,228	9	75
56	2048		635	3,267	3,902	34,130	30,228	8	67
57	2049		635	3,267	3,902	34,130	30,228	7	60
							Total	83,868	143,595
								B-C	59,727
								B/C	1.71
								EIRR	20.95 %

Discount Rate	12 %
Water Tariff	1625 Rp/m3
Domestic Use	200 Rp/m3
Industrial Use	2100 Rp/m3

Table 6.5 Economic Analysis for Scheme K-2

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,623			1,623		-1,623	1,623	0
2	1994	3,246			3,246		-3,246	2,898	0
3	1995	1,623			1,623		-1,623	1,294	0
4	1996	6,316			6,316		-6,316	4,496	0
5	1997	16,240			16,240		-16,240	10,321	0
6	1998	36,517			36,517		-36,517	20,721	0
7	1999	54,245			54,245		-54,245	27,482	0
8	2000		657	3,151	3,808	35,975	32,167	1,723	16,273
9	2001		657	3,151	3,808	35,975	32,167	1,538	14,530
10	2002		657	3,151	3,808	35,975	32,167	1,373	12,973
11	2003		657	3,151	3,808	35,975	32,167	1,226	11,583
12	2004		657	3,151	3,808	35,975	32,167	1,095	10,342
13	2005		657	3,151	3,808	35,975	32,167	977	9,234
14	2006		657	3,151	3,808	35,975	32,167	873	8,244
15	2007		657	3,151	3,808	35,975	32,167	779	7,361
16	2008		657	3,151	3,808	35,975	32,167	696	6,572
17	2009		657	3,151	3,808	35,975	32,167	621	5,868
18	2010		657	3,151	3,808	35,975	32,167	555	5,240
19	2011		657	3,151	3,808	35,975	32,167	495	4,678
20	2012		657	3,151	3,808	35,975	32,167	442	4,177
21	2013		657	3,151	3,808	35,975	32,167	395	3,729
22	2014		657	3,151	3,808	35,975	32,167	352	3,330
23	2015		657	3,151	3,808	35,975	32,167	315	2,973
24	2016		657	3,151	3,808	35,975	32,167	281	2,654
25	2017		657	3,151	3,808	35,975	32,167	251	2,370
26	2018		657	3,151	3,808	35,975	32,167	224	2,116
27	2019		657	3,151	3,808	35,975	32,167	200	1,889
28	2020		657	3,151	3,808	35,975	32,167	179	1,687
29	2021		657	3,151	3,808	35,975	32,167	159	1,506
30	2022		657	3,151	3,808	35,975	32,167	142	1,345
31	2023	17,221	657	3,151	21,029	35,975	14,946	702	1,201
32	2024	17,221	657	3,151	21,029	35,975	14,946	627	1,072
33	2025	17,221	657	3,151	21,029	35,975	14,946	560	957
34	2026		657	3,151	3,808	35,975	32,167	90	855
35	2027		657	3,151	3,808	35,975	32,167	81	763
36	2028		657	3,151	3,808	35,975	32,167	72	681
37	2029		657	3,151	3,808	35,975	32,167	64	608
38	2030		657	3,151	3,808	35,975	32,167	57	543
39	2031		657	3,151	3,808	35,975	32,167	51	485
40	2032		657	3,151	3,808	35,975	32,167	46	433
41	2033		657	3,151	3,808	35,975	32,167	41	387
42	2034		657	3,151	3,808	35,975	32,167	37	345
43	2035		657	3,151	3,808	35,975	32,167	33	308
44	2036		657	3,151	3,808	35,975	32,167	29	275
45	2037		657	3,151	3,808	35,975	32,167	26	246
46	2038		657	3,151	3,808	35,975	32,167	23	219
47	2039		657	3,151	3,808	35,975	32,167	21	196
48	2040		657	3,151	3,808	35,975	32,167	19	175
49	2041		657	3,151	3,808	35,975	32,167	17	156
50	2042		657	3,151	3,808	35,975	32,167	15	139
51	2043		657	3,151	3,808	35,975	32,167	13	124
52	2044		657	3,151	3,808	35,975	32,167	12	111
53	2045		657	3,151	3,808	35,975	32,167	11	99
54	2046		657	3,151	3,808	35,975	32,167	9	89
55	2047		657	3,151	3,808	35,975	32,167	8	79
56	2048		657	3,151	3,808	35,975	32,167	7	71
57	2049		657	3,151	3,808	35,975	32,167	7	63
							Total	86,403	151,357
								B-C	64,954
								B/C	1.75
								EIRR	21.26 %

Discount Rate	12 %
Water Tariff	1625 Rp/m3
Domestic Use	200 Rp/m3
Industrial Use	2100 Rp/m3

Table 6.6 Economic Analysis for Scheme C-3

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	2,559			2,559		-2,559	2,559	0
2	1994	5,118			5,118		-5,118	4,570	0
3	1995	2,559			2,559		-2,559	2,040	0
4	1996	13,366			13,366		-13,366	9,513	0
5	1997	26,541			26,541		-26,541	16,868	0
6	1998	114,833			114,833		-114,833	65,159	0
7	1999	26,656			26,656		-26,656	13,505	0
8	2000		943	4,014	4,957	45,968	41,010	2,242	20,793
9	2001		943	4,014	4,957	45,968	41,010	2,002	18,566
10	2002		943	4,014	4,957	45,968	41,010	1,788	16,576
11	2003		943	4,014	4,957	45,968	41,010	1,596	14,800
12	2004		943	4,014	4,957	45,968	41,010	1,425	13,215
13	2005		943	4,014	4,957	45,968	41,010	1,272	11,799
14	2006		943	4,014	4,957	45,968	41,010	1,136	10,535
15	2007		943	4,014	4,957	45,968	41,010	1,014	9,406
16	2008		943	4,014	4,957	45,968	41,010	906	8,398
17	2009		943	4,014	4,957	45,968	41,010	809	7,498
18	2010		943	4,014	4,957	45,968	41,010	722	6,695
19	2011		943	4,014	4,957	45,968	41,010	645	5,978
20	2012		943	4,014	4,957	45,968	41,010	576	5,337
21	2013		943	4,014	4,957	45,968	41,010	514	4,765
22	2014		943	4,014	4,957	45,968	41,010	459	4,255
23	2015		943	4,014	4,957	45,968	41,010	410	3,799
24	2016		943	4,014	4,957	45,968	41,010	366	3,392
25	2017		943	4,014	4,957	45,968	41,010	327	3,028
26	2018		943	4,014	4,957	45,968	41,010	292	2,704
27	2019		943	4,014	4,957	45,968	41,010	260	2,414
28	2020		943	4,014	4,957	45,968	41,010	232	2,156
29	2021		943	4,014	4,957	45,968	41,010	208	1,925
30	2022		943	4,014	4,957	45,968	41,010	185	1,718
31	2023	20,259	943	4,014	25,216	45,968	20,751	842	1,534
32	2024	20,259	943	4,014	25,216	45,968	20,751	751	1,370
33	2025	20,259	943	4,014	25,216	45,968	20,751	671	1,223
34	2026		943	4,014	4,957	45,968	41,010	118	1,092
35	2027		943	4,014	4,957	45,968	41,010	105	975
36	2028		943	4,014	4,957	45,968	41,010	94	871
37	2029		943	4,014	4,957	45,968	41,010	84	777
38	2030		943	4,014	4,957	45,968	41,010	75	694
39	2031		943	4,014	4,957	45,968	41,010	67	620
40	2032		943	4,014	4,957	45,968	41,010	60	553
41	2033		943	4,014	4,957	45,968	41,010	53	494
42	2034		943	4,014	4,957	45,968	41,010	48	441
43	2035		943	4,014	4,957	45,968	41,010	42	394
44	2036		943	4,014	4,957	45,968	41,010	38	352
45	2037		943	4,014	4,957	45,968	41,010	34	314
46	2038		943	4,014	4,957	45,968	41,010	30	280
47	2039		943	4,014	4,957	45,968	41,010	27	250
48	2040		943	4,014	4,957	45,968	41,010	24	223
49	2041		943	4,014	4,957	45,968	41,010	22	200
50	2042		943	4,014	4,957	45,968	41,010	19	178
51	2043		943	4,014	4,957	45,968	41,010	17	159
52	2044		943	4,014	4,957	45,968	41,010	15	142
53	2045		943	4,014	4,957	45,968	41,010	14	127
54	2046		943	4,014	4,957	45,968	41,010	12	113
55	2047		943	4,014	4,957	45,968	41,010	11	101
56	2048		943	4,014	4,957	45,968	41,010	10	90
57	2049		943	4,014	4,957	45,968	41,010	9	81
							Total	136,891	193,401
								B-C	56,510
								B/C	1.41
								EIRR	16.92 %

Discount Rate	12 %
Water Tariff	1625 Rp/m3
Domestic Use	200 Rp/m3
Industrial Use	2100 Rp/m3

Table 6.7 Financial Analysis for Scheme K-1

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,652			1,652		-1,652	1,652	0
2	1994	3,304			3,304		-3,304	2,950	0
3	1995	5,374			5,374		-5,374	4,284	0
4	1996	6,536			6,536		-6,536	4,652	0
5	1997	16,681			16,681		-16,681	10,601	0
6	1998	37,886			37,886		-37,886	21,498	0
7	1999	56,081			56,081		-56,081	28,412	0
8	2000		747	3,267	4,014	34,130	30,116	1,816	15,439
9	2001		747	3,267	4,014	34,130	30,116	1,621	13,784
10	2002		747	3,267	4,014	34,130	30,116	1,447	12,308
11	2003		747	3,267	4,014	34,130	30,116	1,292	10,989
12	2004		747	3,267	4,014	34,130	30,116	1,154	9,812
13	2005		747	3,267	4,014	34,130	30,116	1,030	8,760
14	2006		747	3,267	4,014	34,130	30,116	920	7,822
15	2007		747	3,267	4,014	34,130	30,116	821	6,984
16	2008		747	3,267	4,014	34,130	30,116	733	6,235
17	2009		747	3,267	4,014	34,130	30,116	655	5,567
18	2010		747	3,267	4,014	34,130	30,116	585	4,971
19	2011		747	3,267	4,014	34,130	30,116	522	4,438
20	2012		747	3,267	4,014	34,130	30,116	466	3,963
21	2013		747	3,267	4,014	34,130	30,116	416	3,538
22	2014		747	3,267	4,014	34,130	30,116	372	3,159
23	2015		747	3,267	4,014	34,130	30,116	332	2,821
24	2016		747	3,267	4,014	34,130	30,116	296	2,518
25	2017		747	3,267	4,014	34,130	30,116	264	2,249
26	2018		747	3,267	4,014	34,130	30,116	236	2,008
27	2019		747	3,267	4,014	34,130	30,116	211	1,793
28	2020		747	3,267	4,014	34,130	30,116	188	1,600
29	2021		747	3,267	4,014	34,130	30,116	168	1,429
30	2022		747	3,267	4,014	34,130	30,116	150	1,276
31	2023	17,690	747	3,267	21,704	34,130	12,426	724	1,139
32	2024	17,690	747	3,267	21,704	34,130	12,426	647	1,017
33	2025	17,690	747	3,267	21,704	34,130	12,426	578	908
34	2026		747	3,267	4,014	34,130	30,116	95	811
35	2027		747	3,267	4,014	34,130	30,116	85	724
36	2028		747	3,267	4,014	34,130	30,116	76	646
37	2029		747	3,267	4,014	34,130	30,116	68	577
38	2030		747	3,267	4,014	34,130	30,116	61	515
39	2031		747	3,267	4,014	34,130	30,116	54	460
40	2032		747	3,267	4,014	34,130	30,116	48	411
41	2033		747	3,267	4,014	34,130	30,116	43	367
42	2034		747	3,267	4,014	34,130	30,116	39	327
43	2035		747	3,267	4,014	34,130	30,116	34	292
44	2036		747	3,267	4,014	34,130	30,116	31	261
45	2037		747	3,267	4,014	34,130	30,116	27	233
46	2038		747	3,267	4,014	34,130	30,116	24	208
47	2039		747	3,267	4,014	34,130	30,116	22	186
48	2040		747	3,267	4,014	34,130	30,116	20	166
49	2041		747	3,267	4,014	34,130	30,116	17	148
50	2042		747	3,267	4,014	34,130	30,116	16	132
51	2043		747	3,267	4,014	34,130	30,116	14	118
52	2044		747	3,267	4,014	34,130	30,116	12	105
53	2045		747	3,267	4,014	34,130	30,116	11	94
54	2046		747	3,267	4,014	34,130	30,116	10	84
55	2047		747	3,267	4,014	34,130	30,116	9	75
56	2048		747	3,267	4,014	34,130	30,116	8	67
57	2049		747	3,267	4,014	34,130	30,116	7	60
							Total	92,524	143,595
								B-C	51,071
								B/C	1.55
								FIRR	18.87 %

Discount Rate	12 %
Water Tariff	1625 Rp/m3
Domestic Use	200 Rp/m3
Industrial Use	2100 Rp/m3

Table 6.8 Financial Analysis for Scheme K-2

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,720			1,720		-1,720	1,720	0
2	1994	3,440			3,440		-3,440	3,072	0
3	1995	5,442			5,442		-5,442	4,338	0
4	1996	6,977			6,977		-6,977	4,966	0
5	1997	17,879			17,879		-17,879	11,362	0
6	1998	39,532			39,532		-39,532	22,431	0
7	1999	57,761			57,761		-57,761	29,263	0
8	2000		773	3,151	3,924	35,975	32,051	1,775	16,273
9	2001		773	3,151	3,924	35,975	32,051	1,585	14,530
10	2002		773	3,151	3,924	35,975	32,051	1,415	12,973
11	2003		773	3,151	3,924	35,975	32,051	1,263	11,583
12	2004		773	3,151	3,924	35,975	32,051	1,128	10,342
13	2005		773	3,151	3,924	35,975	32,051	1,007	9,234
14	2006		773	3,151	3,924	35,975	32,051	899	8,244
15	2007		773	3,151	3,924	35,975	32,051	803	7,361
16	2008		773	3,151	3,924	35,975	32,051	717	6,572
17	2009		773	3,151	3,924	35,975	32,051	640	5,868
18	2010		773	3,151	3,924	35,975	32,051	572	5,240
19	2011		773	3,151	3,924	35,975	32,051	510	4,678
20	2012		773	3,151	3,924	35,975	32,051	456	4,177
21	2013		773	3,151	3,924	35,975	32,051	407	3,729
22	2014		773	3,151	3,924	35,975	32,051	363	3,330
23	2015		773	3,151	3,924	35,975	32,051	324	2,973
24	2016		773	3,151	3,924	35,975	32,051	290	2,654
25	2017		773	3,151	3,924	35,975	32,051	259	2,370
26	2018		773	3,151	3,924	35,975	32,051	231	2,116
27	2019		773	3,151	3,924	35,975	32,051	206	1,889
28	2020		773	3,151	3,924	35,975	32,051	184	1,687
29	2021		773	3,151	3,924	35,975	32,051	164	1,506
30	2022		773	3,151	3,924	35,975	32,051	147	1,345
31	2023	18,127	773	3,151	22,051	35,975	13,923	736	1,201
32	2024	18,127	773	3,151	22,051	35,975	13,923	657	1,072
33	2025	18,127	773	3,151	22,051	35,975	13,923	587	957
34	2026		773	3,151	3,924	35,975	32,051	93	855
35	2027		773	3,151	3,924	35,975	32,051	83	763
36	2028		773	3,151	3,924	35,975	32,051	74	681
37	2029		773	3,151	3,924	35,975	32,051	66	608
38	2030		773	3,151	3,924	35,975	32,051	59	543
39	2031		773	3,151	3,924	35,975	32,051	53	485
40	2032		773	3,151	3,924	35,975	32,051	47	433
41	2033		773	3,151	3,924	35,975	32,051	42	387
42	2034		773	3,151	3,924	35,975	32,051	38	345
43	2035		773	3,151	3,924	35,975	32,051	34	308
44	2036		773	3,151	3,924	35,975	32,051	30	275
45	2037		773	3,151	3,924	35,975	32,051	27	246
46	2038		773	3,151	3,924	35,975	32,051	24	219
47	2039		773	3,151	3,924	35,975	32,051	21	196
48	2040		773	3,151	3,924	35,975	32,051	19	175
49	2041		773	3,151	3,924	35,975	32,051	17	156
50	2042		773	3,151	3,924	35,975	32,051	15	139
51	2043		773	3,151	3,924	35,975	32,051	14	124
52	2044		773	3,151	3,924	35,975	32,051	12	111
53	2045		773	3,151	3,924	35,975	32,051	11	99
54	2046		773	3,151	3,924	35,975	32,051	10	89
55	2047		773	3,151	3,924	35,975	32,051	9	79
56	2048		773	3,151	3,924	35,975	32,051	8	71
57	2049		773	3,151	3,924	35,975	32,051	7	63
							Total	95,291	151,357
								B-C	56,066
Discount Rate		12 %						B/C	1.59
Water Tariff		1625 Rp/m3						FIRR	19.19 %
Domestic Use		200 Rp/m3							
Industrial Use		2100 Rp/m3							

Table 6.9 Financial Analysis for Scheme C-3

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value Cost	Present Value Benefit
1	1993	2,713			2,713		-2,713	2,713	0
2	1994	5,425			5,425		-5,425	4,844	0
3	1995	6,462			6,462		-6,462	5,152	0
4	1996	14,785			14,785		-14,785	10,524	0
5	1997	29,481			29,481		-29,481	18,736	0
6	1998	122,161			122,161		-122,161	69,317	0
7	1999	27,807			27,807		-27,807	14,088	0
8	2000		1,110	4,014	5,124	45,968	40,844	2,318	20,793
9	2001		1,110	4,014	5,124	45,968	40,844	2,069	18,566
10	2002		1,110	4,014	5,124	45,968	40,844	1,848	16,576
11	2003		1,110	4,014	5,124	45,968	40,844	1,650	14,800
12	2004		1,110	4,014	5,124	45,968	40,844	1,473	13,215
13	2005		1,110	4,014	5,124	45,968	40,844	1,315	11,799
14	2006		1,110	4,014	5,124	45,968	40,844	1,174	10,535
15	2007		1,110	4,014	5,124	45,968	40,844	1,048	9,406
16	2008		1,110	4,014	5,124	45,968	40,844	936	8,398
17	2009		1,110	4,014	5,124	45,968	40,844	836	7,498
18	2010		1,110	4,014	5,124	45,968	40,844	746	6,695
19	2011		1,110	4,014	5,124	45,968	40,844	666	5,978
20	2012		1,110	4,014	5,124	45,968	40,844	595	5,337
21	2013		1,110	4,014	5,124	45,968	40,844	531	4,765
22	2014		1,110	4,014	5,124	45,968	40,844	474	4,255
23	2015		1,110	4,014	5,124	45,968	40,844	423	3,799
24	2016		1,110	4,014	5,124	45,968	40,844	378	3,392
25	2017		1,110	4,014	5,124	45,968	40,844	338	3,028
26	2018		1,110	4,014	5,124	45,968	40,844	301	2,704
27	2019		1,110	4,014	5,124	45,968	40,844	269	2,414
28	2020		1,110	4,014	5,124	45,968	40,844	240	2,156
29	2021		1,110	4,014	5,124	45,968	40,844	215	1,925
30	2022		1,110	4,014	5,124	45,968	40,844	192	1,718
31	2023	21,325	1,110	4,014	26,449	45,968	19,519	883	1,534
32	2024	21,325	1,110	4,014	26,449	45,968	19,519	788	1,370
33	2025	21,325	1,110	4,014	26,449	45,968	19,519	704	1,223
34	2026		1,110	4,014	5,124	45,968	40,844	122	1,092
35	2027		1,110	4,014	5,124	45,968	40,844	109	975
36	2028		1,110	4,014	5,124	45,968	40,844	97	871
37	2029		1,110	4,014	5,124	45,968	40,844	87	777
38	2030		1,110	4,014	5,124	45,968	40,844	77	694
39	2031		1,110	4,014	5,124	45,968	40,844	69	620
40	2032		1,110	4,014	5,124	45,968	40,844	62	553
41	2033		1,110	4,014	5,124	45,968	40,844	55	494
42	2034		1,110	4,014	5,124	45,968	40,844	49	441
43	2035		1,110	4,014	5,124	45,968	40,844	44	394
44	2036		1,110	4,014	5,124	45,968	40,844	39	352
45	2037		1,110	4,014	5,124	45,968	40,844	35	314
46	2038		1,110	4,014	5,124	45,968	40,844	31	280
47	2039		1,110	4,014	5,124	45,968	40,844	28	250
48	2040		1,110	4,014	5,124	45,968	40,844	25	223
49	2041		1,110	4,014	5,124	45,968	40,844	22	200
50	2042		1,110	4,014	5,124	45,968	40,844	20	178
51	2043		1,110	4,014	5,124	45,968	40,844	18	159
52	2044		1,110	4,014	5,124	45,968	40,844	16	142
53	2045		1,110	4,014	5,124	45,968	40,844	14	127
54	2046		1,110	4,014	5,124	45,968	40,844	13	113
55	2047		1,110	4,014	5,124	45,968	40,844	11	101
56	2048		1,110	4,014	5,124	45,968	40,844	10	90
57	2049		1,110	4,014	5,124	45,968	40,844	9	81
							Total	148,845	193,401
								B-C	44,556
								B/C	1.30
								FIRR	15.57 %

Discount Rate	12 %
Water Tariff	1625 Rp/m3
Domestic Use	200 Rp/m3
Industrial Use	2100 Rp/m3

Table 6.10 Loan Repayability for Scheme K-1

(Unit : Million Rp)

No.	Year	Project Cost		Revenue		O & M	Pumping	Net	Repayment (Fc)		Repayment (Lc)		Total	Surplus	Accumlated
		Fc (Rp)	Lc (Rp)	Domestic Use	Industrial Use	Cost	Cost	Income	Capital (Rp)	Interest (Rp)	Capital (Rp)	Interest (Rp)	Repayment	or Deficit	Surplus or Deficit
1	1993	1,231	570					0		37		68	105	(105)	-105
2	1994	2,553	1,208					0		114		213	327	(327)	-432
3	1995	1,324	5,339					0		153		854	1,007	(1,007)	-1,440
4	1996	5,892	2,172					0		330		1,115	1,445	(1,445)	-2,884
5	1997	14,487	7,137					0		765		1,971	2,736	(2,736)	-5,620
6	1998	33,916	17,421					0		1,782		4,062	5,844	(5,844)	-11,464
7	1999	53,905	25,139					0		3,399		7,078	10,478	(10,478)	-21,941
8	2000			1,495	47,083	1,261	4,650	42,666	3,491	3,399	2,104	7,078	16,073	26,593	4,652
9	2001			1,554	48,966	1,337	4,836	44,347	3,596	3,294	2,357	6,826	16,073	28,274	32,926
10	2002			1,617	50,925	1,417	5,030	46,094	3,704	3,187	2,640	6,543	16,073	30,022	62,948
11	2003			1,681	52,962	1,502	5,231	47,910	3,815	3,075	2,957	6,226	16,073	31,837	94,784
12	2004			1,749	55,080	1,592	5,440	49,796	3,929	2,961	3,311	5,871	16,073	33,723	128,508
13	2005			1,819	57,283	1,688	5,658	51,756	4,047	2,843	3,709	5,474	16,073	35,683	164,191
14	2006			1,891	59,575	1,789	5,884	53,793	4,168	2,722	4,154	5,029	16,073	37,720	201,911
15	2007			1,967	61,958	1,897	6,119	55,909	4,293	2,597	4,652	4,531	16,073	39,836	241,747
16	2008			2,046	64,436	2,010	6,364	58,107	4,422	2,468	5,211	3,972	16,073	42,034	283,781
17	2009			2,127	67,013	2,131	6,619	60,391	4,555	2,335	5,836	3,347	16,073	44,318	328,099
18	2010			2,213	69,694	2,259	6,883	62,764	4,692	2,199	6,536	2,647	16,073	46,691	374,790
19	2011			2,301	72,482	2,394	7,159	65,230	4,832	2,058	7,320	1,862	16,073	49,157	423,947
20	2012			2,393	75,381	2,538	7,445	67,791	4,977	1,913	8,199	984	16,073	51,718	475,665
21	2013			2,489	78,396	2,690	7,743	70,452	5,127	1,764	0	0	6,890	63,561	539,226
22	2014			2,588	81,532	2,852	8,053	73,216	5,280	1,610	0	0	6,890	66,326	605,552
23	2015			2,692	84,793	3,023	8,375	76,088	5,439	1,451	0	0	6,890	69,197	674,749
24	2016			2,800	88,185	3,204	8,710	79,071	5,602	1,288	0	0	6,890	72,180	746,930
25	2017			2,912	91,712	3,397	9,058	82,169	5,770	1,120	0	0	6,890	75,279	822,209
26	2018			3,028	95,381	3,600	9,420	85,388	5,943	947	0	0	6,890	78,498	900,707
27	2019			3,149	99,196	3,816	9,797	88,732	6,121	769	0	0	6,890	81,842	982,548
28	2020			3,275	103,164	4,045	10,189	92,205	6,305	585	0	0	6,890	85,314	1,067,863
29	2021			3,406	107,291	4,288	10,597	95,812	6,494	396	0	0	6,890	88,922	1,156,784
30	2022			3,542	111,582	4,545	11,020	99,559	6,689	201	0	0	6,890	92,668	1,249,453
31	2023			3,684	116,045	4,818	11,461	103,450	0	0	0	0	0	103,450	1,352,902
	Total	113,307	58,986												

	Fc	Lc
Interest Rate	: 3 %	12 %
Repayment Period	: 30 Year	20 Year
Grsce Period	: 7 Year	7 Year

Water Tariff
Domestic Use : 200 Rp /m3
Industrial Use : 2100 Rp /m3

Table 6.11 Loan Repayability for Scheme K-2

(Unit : Million Rp)

No.	Year	Project Cost		Revenue		O & M	Pumping	Net	Repayment (Fc)		Repayment (Lc)		Total	Surplus	Accumulated
		Fc (Rp)	Lc (Rp)	Domestic Use	Industrial Use	Cost	Cost	Income	Capital (Rp)	Interest (Rp)	Capital (Rp)	Interest (Rp)	Repayment	or Deficit	Surplus or Deficit
1	1993	1,281	594					0		38		71	110	(110)	-110
2	1994	2,657	1,260					0		118		222	341	(341)	-450
3	1995	1,378	5,366					0		159		866	1,026	(1,026)	-1,476
4	1996	6,251	2,360					0		347		1,150	1,497	(1,497)	-2,973
5	1997	15,307	7,901					0		806		2,098	2,904	(2,904)	-5,877
6	1998	35,385	18,183					0		1,868		4,280	6,147	(6,147)	-12,024
7	1999	55,654	25,731					0		3,537		7,367	10,905	(10,905)	-22,929
8	2000			1,575	49,628	1,306	4,485	45,412	3,633	3,537	2,190	7,367	16,728	28,684	5,755
9	2001			1,639	51,613	1,384	4,664	47,203	3,742	3,428	2,453	7,105	16,728	30,474	36,229
10	2002			1,704	53,677	1,467	4,851	49,063	3,854	3,316	2,748	6,810	16,728	32,335	68,564
11	2003			1,772	55,824	1,555	5,045	50,996	3,970	3,201	3,077	6,480	16,728	34,268	102,833
12	2004			1,843	58,057	1,649	5,247	53,005	4,089	3,081	3,447	6,111	16,728	36,277	139,109
13	2005			1,917	60,380	1,748	5,457	55,092	4,212	2,959	3,860	5,698	16,728	38,364	177,473
14	2006			1,993	62,795	1,852	5,675	57,261	4,338	2,832	4,323	5,234	16,728	40,533	218,006
15	2007			2,073	65,307	1,964	5,902	59,514	4,468	2,702	4,842	4,716	16,728	42,786	260,792
16	2008			2,156	67,919	2,081	6,138	61,856	4,602	2,568	5,423	4,134	16,728	45,127	305,920
17	2009			2,242	70,636	2,206	6,384	64,288	4,740	2,430	6,074	3,484	16,728	47,560	353,480
18	2010			2,332	73,461	2,339	6,639	66,816	4,882	2,288	6,803	2,755	16,728	50,087	403,567
19	2011			2,425	76,400	2,479	6,905	69,441	5,029	2,142	7,619	1,938	16,728	52,713	456,281
20	2012			2,522	79,456	2,628	7,181	72,170	5,180	1,991	8,534	1,024	16,728	55,441	511,722
21	2013			2,623	82,634	2,785	7,468	75,004	5,335	1,835	0	0	7,170	67,833	579,555
22	2014			2,728	85,939	2,952	7,767	77,948	5,495	1,675	0	0	7,170	70,778	650,333
23	2015			2,837	89,377	3,130	8,077	81,007	5,660	1,510	0	0	7,170	73,837	724,170
24	2016			2,951	92,952	3,317	8,400	84,185	5,830	1,341	0	0	7,170	77,014	801,184
25	2017			3,069	96,670	3,516	8,736	87,486	6,005	1,166	0	0	7,170	80,315	881,500
26	2018			3,192	100,537	3,727	9,086	90,915	6,185	986	0	0	7,170	83,744	965,244
27	2019			3,319	104,558	3,951	9,449	94,477	6,370	800	0	0	7,170	87,307	1,052,551
28	2020			3,452	108,740	4,188	9,827	98,177	6,561	609	0	0	7,170	91,007	1,143,557
29	2021			3,590	113,090	4,439	10,220	102,020	6,758	412	0	0	7,170	94,850	1,238,407
30	2022			3,734	117,614	4,706	10,629	106,012	6,961	209	0	0	7,170	98,842	1,337,249
31	2023			3,883	122,318	4,988	11,054	110,159	0	0	0	0	0	110,158	1,447,407
	Total	117,914	61,395												

	Fc	Lc
Water Tariff		
Domestic Use	: 200 Rp /m3	
Industrial Use	: 2100 Rp /m3	
Interest Rate	: 3 %	12 %
Repayment Period	: 30 Year	20 Year
Grsce Period	: 7 Year	7 Year

Table 6.12 Loan Repayability for Scheme C-3

(Unit : Million Rp)

No.	Year	Project Cost		Revenue		O & M Cost	Pumping Cost	Net Income	Repayment (Fc)		Repayment (Lc)		Total Repayment	Surplus or Deficit	Accumulated Surplus or Deficit
		Fc (Rp)	Lc (Rp)	Domestic Use	Industrial Use				Capital (Rp)	Interest (Rp)	Capital (Rp)	Interest (Rp)			
1	1993	2,137	814					0		64		98	162	(162)	-162
2	1994	4,433	1,727					0		197		305	502	(502)	-664
3	1995	2,299	5,649					0		266		983	1,249	(1,249)	-1,913
4	1996	13,969	4,198					0		685		1,487	2,172	(2,172)	-4,085
5	1997	24,231	14,179					0		1,412		3,188	4,600	(4,600)	-8,685
6	1998	113,724	51,086					0		4,824		9,318	14,142	(14,142)	-22,827
7	1999	33,587	4,290					0		5,831		9,833	15,665	(15,665)	-38,491
8	2000			2,013	63,413	1,875	5,713	57,838	5,989	5,831	2,923	9,833	24,577	33,261	-5,230
9	2001			2,094	65,950	1,987	5,942	60,114	6,169	5,652	3,274	9,482	24,577	35,537	30,307
10	2002			2,177	68,588	2,106	6,180	62,479	6,354	5,467	3,667	9,089	24,577	37,902	68,209
11	2003			2,264	71,331	2,233	6,427	64,936	6,545	5,276	4,107	8,649	24,577	40,359	108,568
12	2004			2,355	74,184	2,367	6,684	67,489	6,741	5,080	4,600	8,156	24,577	42,912	151,479
13	2005			2,449	77,152	2,509	6,951	70,141	6,943	4,877	5,152	7,604	24,577	45,564	197,043
14	2006			2,547	80,238	2,659	7,229	72,897	7,151	4,669	5,770	6,986	24,577	48,319	245,363
15	2007			2,649	83,447	2,819	7,519	75,759	7,366	4,455	6,463	6,294	24,577	51,182	296,545
16	2008			2,755	86,785	2,988	7,819	78,733	7,587	4,234	7,238	5,518	24,577	54,156	350,701
17	2009			2,865	90,257	3,167	8,132	81,823	7,815	4,006	8,107	4,650	24,577	57,246	407,947
18	2010			2,980	93,867	3,357	8,457	85,032	8,049	3,772	9,080	3,677	24,577	60,455	468,402
19	2011			3,099	97,622	3,559	8,796	88,367	8,290	3,530	10,169	2,587	24,577	63,789	532,191
20	2012			3,223	101,527	3,772	9,147	91,830	8,539	3,281	11,390	1,367	24,577	67,253	599,444
21	2013			3,352	105,588	3,998	9,513	95,428	8,795	3,025	0	0	11,821	83,607	683,051
22	2014			3,486	109,811	4,238	9,894	99,165	9,059	2,761	0	0	11,821	87,344	770,396
23	2015			3,626	114,204	4,493	10,290	103,047	9,331	2,490	0	0	11,821	91,226	861,622
24	2016			3,771	118,772	4,762	10,701	107,079	9,611	2,210	0	0	11,821	95,258	956,880
25	2017			3,921	123,523	5,048	11,129	111,267	9,899	1,921	0	0	11,821	99,446	1,056,327
26	2018			4,078	128,464	5,351	11,574	115,617	10,196	1,624	0	0	11,821	103,796	1,160,122
27	2019			4,241	133,602	5,672	12,037	120,134	10,502	1,318	0	0	11,821	108,314	1,268,436
28	2020			4,411	138,946	6,012	12,519	124,826	10,817	1,003	0	0	11,821	113,005	1,381,441
29	2021			4,587	144,504	6,373	13,020	129,699	11,142	679	0	0	11,821	117,878	1,499,320
30	2022			4,771	150,284	6,755	13,541	134,759	11,476	345	0	0	11,821	122,939	1,622,259
31	2023			4,962	156,295	7,160	14,082	140,015	0	0	0	0	0	140,014	1,762,273
	Total	194,379	81,943												

	Fc	Lc
Interest Rate	: 3 %	12 %
Repayment Period	: 30 Year	20 Year
Grsce Period	: 7 Year	7 Year

Water Tariff
Domestic Use : 200 Rp /m3
Industrial Use : 2100 Rp /m3

Table 6.13 Financial Analysis due to Difference of Organization for Project Implementation

Case	Alternative	Execution of Project	O & M		Construction cost of Project 2]	O & M Cost		Collection		Revenue		Tariff policy (Project)	FinancialAnalysis
			Exclusive facilities	Common		Exclusive facilities	Common	Existing	Project	Existing	Project		
Case 1	A-1	KS	KS		KS	KS		KS Sell treated to PDAM 1]				Selling price is full cost-recovery basis.	Whether KS can get fair return 3] or not. Whether industrial water charge is cheaper than desalination plant water cost.
Case 2	A-2												
	A-2-1	DPU	PDAM		DPU (BUDGET)	PDAM		PDAM		PDAM		Full Cost recovery for industrial water. O&M Cost recovery for domestic water.	Whether industrial water charge is cheaper than desalination plant water cost. Whether domestic water charge is within capacity to-pay of households.
	A-2-2	DPU	PDAM		DPU (Loan)	PDAM		PDAM		PDAM		do	do Loan repayability will be checked.
Case 3	B-1												
	B-1-1	DPU	KS, PDAM	PDAM	DPU (Budget)	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM	Full Cost recovery for industrial water. O & M Cost recovery for domestic water.	Whether industrial water charge is cheaper than desalination plant water cost. Whether domestic water charge is within capacity to-pay of households.
	B-1-2	DPU	KS, PDAM	PDAM	DPU (Loan)	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM	do	do Loan repayability will be checked.
Case 4	B-2	DPU	KS, PDAM	PDAM	Sharing	KS, PDAM	Sharing PDAM & KS	KS	PDAM	KS	PDAM	O & M Cost recovery basis both for industrial and domestic uses	To check the domestic water charge is within capacity-to-pay of households.

Remarks, 1] Except KS's own use.
2] Including replacement cost.
3] Not at a loss.

Table 6.14 Financial Analysis for Scheme K-1 by Case 1

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,652			1,652		-1,652	1,652	0
2	1994	3,304			3,304		-3,304	2,950	0
3	1995	5,374			5,374		-5,374	4,284	0
4	1996	6,536			6,536		-6,536	4,652	0
5	1997	16,681			16,681		-16,681	10,601	0
6	1998	37,886			37,886		-37,886	21,498	0
7	1999	56,081			56,081		-56,081	28,412	0
8	2000		747	3,267	4,014	23,581	19,568	1,816	10,667
9	2001		747	3,267	4,014	23,581	19,568	1,621	9,524
10	2002		747	3,267	4,014	23,581	19,568	1,447	8,504
11	2003		747	3,267	4,014	23,581	19,568	1,292	7,593
12	2004		747	3,267	4,014	23,581	19,568	1,154	6,779
13	2005		747	3,267	4,014	23,581	19,568	1,030	6,053
14	2006		747	3,267	4,014	23,581	19,568	920	5,404
15	2007		747	3,267	4,014	23,581	19,568	821	4,825
16	2008		747	3,267	4,014	23,581	19,568	733	4,308
17	2009		747	3,267	4,014	23,581	19,568	655	3,847
18	2010		747	3,267	4,014	23,581	19,568	585	3,434
19	2011		747	3,267	4,014	23,581	19,568	522	3,066
20	2012		747	3,267	4,014	23,581	19,568	466	2,738
21	2013		747	3,267	4,014	23,581	19,568	416	2,445
22	2014		747	3,267	4,014	23,581	19,568	372	2,183
23	2015		747	3,267	4,014	23,581	19,568	332	1,949
24	2016		747	3,267	4,014	23,581	19,568	296	1,740
25	2017		747	3,267	4,014	23,581	19,568	264	1,554
26	2018		747	3,267	4,014	23,581	19,568	236	1,387
27	2019		747	3,267	4,014	23,581	19,568	211	1,239
							Total	89,237	89,237
								B-C	0
								B/C	1.00

Note: Water tariff is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 1,122.8 Rp

Table 6.15 Financial Analysis for Scheme K-2 by Case 1

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,720			1,720		-1,720	1,720	0
2	1994	3,440			3,440		-3,440	3,072	0
3	1995	5,442			5,442		-5,442	4,338	0
4	1996	6,977			6,977		-6,977	4,966	0
5	1997	17,879			17,879		-17,879	11,362	0
6	1998	39,532			39,532		-39,532	22,431	0
7	1999	57,761			57,761		-57,761	29,263	0
8	2000		773	3,151	3,924	24,312	20,388	1,775	10,998
9	2001		773	3,151	3,924	24,312	20,388	1,585	9,819
10	2002		773	3,151	3,924	24,312	20,388	1,415	8,767
11	2003		773	3,151	3,924	24,312	20,388	1,263	7,828
12	2004		773	3,151	3,924	24,312	20,388	1,128	6,989
13	2005		773	3,151	3,924	24,312	20,388	1,007	6,240
14	2006		773	3,151	3,924	24,312	20,388	899	5,572
15	2007		773	3,151	3,924	24,312	20,388	803	4,975
16	2008		773	3,151	3,924	24,312	20,388	717	4,442
17	2009		773	3,151	3,924	24,312	20,388	640	3,966
18	2010		773	3,151	3,924	24,312	20,388	572	3,541
19	2011		773	3,151	3,924	24,312	20,388	510	3,162
20	2012		773	3,151	3,924	24,312	20,388	456	2,823
21	2013		773	3,151	3,924	24,312	20,388	407	2,520
22	2014		773	3,151	3,924	24,312	20,388	363	2,250
23	2015		773	3,151	3,924	24,312	20,388	324	2,009
24	2016		773	3,151	3,924	24,312	20,388	290	1,794
25	2017		773	3,151	3,924	24,312	20,388	259	1,602
26	2018		773	3,151	3,924	24,312	20,388	231	1,430
27	2019		773	3,151	3,924	24,312	20,388	206	1,277
							Total	92,003	92,003
								B-C	0
								B/C	1.00

Note: Water tariff is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 1,098.2 Rp

Table 6.16 Financial Analysis for Scheme C-3 by Case 1

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	2,713			2,713		-2,713	2,713	0
2	1994	5,425			5,425		-5,425	4,844	0
3	1995	6,462			6,462		-6,462	5,152	0
4	1996	14,785			14,785		-14,785	10,524	0
5	1997	29,481			29,481		-29,481	18,736	0
6	1998	122,161			122,161		-122,161	69,317	0
7	1999	27,807			27,807		-27,807	14,088	0
8	2000		1,110	4,014	5,124	38,254	33,130	2,318	17,304
9	2001		1,110	4,014	5,124	38,254	33,130	2,069	15,450
10	2002		1,110	4,014	5,124	38,254	33,130	1,848	13,795
11	2003		1,110	4,014	5,124	38,254	33,130	1,650	12,317
12	2004		1,110	4,014	5,124	38,254	33,130	1,473	10,997
13	2005		1,110	4,014	5,124	38,254	33,130	1,315	9,819
14	2006		1,110	4,014	5,124	38,254	33,130	1,174	8,767
15	2007		1,110	4,014	5,124	38,254	33,130	1,048	7,827
16	2008		1,110	4,014	5,124	38,254	33,130	936	6,989
17	2009		1,110	4,014	5,124	38,254	33,130	836	6,240
18	2010		1,110	4,014	5,124	38,254	33,130	746	5,571
19	2011		1,110	4,014	5,124	38,254	33,130	666	4,975
20	2012		1,110	4,014	5,124	38,254	33,130	595	4,442
21	2013		1,110	4,014	5,124	38,254	33,130	531	3,966
22	2014		1,110	4,014	5,124	38,254	33,130	474	3,541
23	2015		1,110	4,014	5,124	38,254	33,130	423	3,161
24	2016		1,110	4,014	5,124	38,254	33,130	378	2,823
25	2017		1,110	4,014	5,124	38,254	33,130	338	2,520
26	2018		1,110	4,014	5,124	38,254	33,130	301	2,250
27	2019		1,110	4,014	5,124	38,254	33,130	269	2,009
							Total	144,762	144,762
								B-C	0
								B/C	1.00

Note: Water tariff is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 1,352.3 Rp

Table 6.17 (1) Financial Analysis for Scheme K-1 by Case 2 (Domestic Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	0			0		0	0	0
2	1994	0			0		0	0	0
3	1995	0			0		0	0	0
4	1996	0			0		0	0	0
5	1997	0			0		0	0	0
6	1998	0			0		0	0	0
7	1999	0			0		0	0	0
8	2000		187	1,377	1,563	1,563	0	707	707
9	2001		187	1,377	1,563	1,563	0	631	631
10	2002		187	1,377	1,563	1,563	0	564	564
11	2003		187	1,377	1,563	1,563	0	503	503
12	2004		187	1,377	1,563	1,563	0	449	449
13	2005		187	1,377	1,563	1,563	0	401	401
14	2006		187	1,377	1,563	1,563	0	358	358
15	2007		187	1,377	1,563	1,563	0	320	320
16	2008		187	1,377	1,563	1,563	0	286	286
17	2009		187	1,377	1,563	1,563	0	255	255
18	2010		187	1,377	1,563	1,563	0	228	228
19	2011		187	1,377	1,563	1,563	0	203	203
20	2012		187	1,377	1,563	1,563	0	182	182
21	2013		187	1,377	1,563	1,563	0	162	162
22	2014		187	1,377	1,563	1,563	0	145	145
23	2015		187	1,377	1,563	1,563	0	129	129
24	2016		187	1,377	1,563	1,563	0	115	115
25	2017		187	1,377	1,563	1,563	0	103	103
26	2018		187	1,377	1,563	1,563	0	92	92
27	2019		187	1,377	1,563	1,563	0	82	82
							Total	5,916	5,916
								B-C	0
								B/C	1.00

Note: Water tariff for domestic use is O&M cost recovery basis including O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 108.4 Rp

Table 6.17 (2) Financial Analysis for Scheme K-1 by Case 2 (Industrial Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,239			1,239		-1,239	1,239	0
2	1994	2,478			2,478		-2,478	2,212	0
3	1995	4,030			4,030		-4,030	3,213	0
4	1996	4,902			4,902		-4,902	3,489	0
5	1997	12,510			12,510		-12,510	7,951	0
6	1998	28,414			28,414		-28,414	16,123	0
7	1999	42,061			42,061		-42,061	21,309	0
8	2000		560	4,130	4,690	19,366	14,676	2,122	8,760
9	2001		560	4,130	4,690	19,366	14,676	1,894	7,822
10	2002		560	4,130	4,690	19,366	14,676	1,691	6,984
11	2003		560	4,130	4,690	19,366	14,676	1,510	6,235
12	2004		560	4,130	4,690	19,366	14,676	1,348	5,567
13	2005		560	4,130	4,690	19,366	14,676	1,204	4,971
14	2006		560	4,130	4,690	19,366	14,676	1,075	4,438
15	2007		560	4,130	4,690	19,366	14,676	960	3,963
16	2008		560	4,130	4,690	19,366	14,676	857	3,538
17	2009		560	4,130	4,690	19,366	14,676	765	3,159
18	2010		560	4,130	4,690	19,366	14,676	683	2,821
19	2011		560	4,130	4,690	19,366	14,676	610	2,518
20	2012		560	4,130	4,690	19,366	14,676	545	2,249
21	2013		560	4,130	4,690	19,366	14,676	486	2,008
22	2014		560	4,130	4,690	19,366	14,676	434	1,792
23	2015		560	4,130	4,690	19,366	14,676	388	1,600
24	2016		560	4,130	4,690	19,366	14,676	346	1,429
25	2017		560	4,130	4,690	19,366	14,676	309	1,276
26	2018		560	4,130	4,690	19,366	14,676	276	1,139
27	2019		560	4,130	4,690	19,366	14,676	246	1,017
							Total	73,285	73,285
								B-C	0
								B/C	1.00

Note: Water tariff for industrial use is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 447.4 Rp

Table 6.18 (1) Financial Analysis for Scheme K-2 by Case 2 (Domestic Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	0			0		0	0	0
2	1994	0			0		0	0	0
3	1995	0			0		0	0	0
4	1996	0			0		0	0	0
5	1997	0			0		0	0	0
6	1998	0			0		0	0	0
7	1999	0			0		0	0	0
8	2000		193	1,348	1,541	1,541	0	697	697
9	2001		193	1,348	1,541	1,541	0	622	622
10	2002		193	1,348	1,541	1,541	0	556	556
11	2003		193	1,348	1,541	1,541	0	496	496
12	2004		193	1,348	1,541	1,541	0	443	443
13	2005		193	1,348	1,541	1,541	0	396	396
14	2006		193	1,348	1,541	1,541	0	353	353
15	2007		193	1,348	1,541	1,541	0	315	315
16	2008		193	1,348	1,541	1,541	0	282	282
17	2009		193	1,348	1,541	1,541	0	251	251
18	2010		193	1,348	1,541	1,541	0	224	224
19	2011		193	1,348	1,541	1,541	0	200	200
20	2012		193	1,348	1,541	1,541	0	179	179
21	2013		193	1,348	1,541	1,541	0	160	160
22	2014		193	1,348	1,541	1,541	0	143	143
23	2015		193	1,348	1,541	1,541	0	127	127
24	2016		193	1,348	1,541	1,541	0	114	114
25	2017		193	1,348	1,541	1,541	0	102	102
26	2018		193	1,348	1,541	1,541	0	91	91
27	2019		193	1,348	1,541	1,541	0	81	81
							Total	5,831	5,831
								B-C	0
								B/C	1.00

Note: Water tariff for domestic use is O&M cost recovery basis including O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 104.7 Rp

Table 6.18 (2) Financial Analysis for Scheme K-2 by Case 2 (Industrial Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,290			1,290		-1,290	1,290	0
2	1994	2,580			2,580		-2,580	2,304	0
3	1995	4,081			4,081		-4,081	3,254	0
4	1996	5,232			5,232		-5,232	3,724	0
5	1997	13,409			13,409		-13,409	8,522	0
6	1998	29,649			29,649		-29,649	16,824	0
7	1999	43,320			43,320		-43,320	21,947	0
8	2000		580	4,043	4,623	19,914	15,291	2,091	9,008
9	2001		580	4,043	4,623	19,914	15,291	1,867	8,043
10	2002		580	4,043	4,623	19,914	15,291	1,667	7,181
11	2003		580	4,043	4,623	19,914	15,291	1,488	6,412
12	2004		580	4,043	4,623	19,914	15,291	1,329	5,725
13	2005		580	4,043	4,623	19,914	15,291	1,187	5,111
14	2006		580	4,043	4,623	19,914	15,291	1,059	4,564
15	2007		580	4,043	4,623	19,914	15,291	946	4,075
16	2008		580	4,043	4,623	19,914	15,291	845	3,638
17	2009		580	4,043	4,623	19,914	15,291	754	3,248
18	2010		580	4,043	4,623	19,914	15,291	673	2,900
19	2011		580	4,043	4,623	19,914	15,291	601	2,590
20	2012		580	4,043	4,623	19,914	15,291	537	2,312
21	2013		580	4,043	4,623	19,914	15,291	479	2,064
22	2014		580	4,043	4,623	19,914	15,291	428	1,843
23	2015		580	4,043	4,623	19,914	15,291	382	1,646
24	2016		580	4,043	4,623	19,914	15,291	341	1,469
25	2017		580	4,043	4,623	19,914	15,291	305	1,312
26	2018		580	4,043	4,623	19,914	15,291	272	1,171
27	2019		580	4,043	4,623	19,914	15,291	243	1,046
							Total	75,359	75,359
								B-C	0
								B/C	1.00

Note: Water tariff for industrial use is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 451.2 Rp

Table 6.19 (1) Financial Analysis for Scheme C-3 by Case 2 (Domestic Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	0			0		0	0	0
2	1994	0			0		0	0	0
3	1995	0			0		0	0	0
4	1996	0			0		0	0	0
5	1997	0			0		0	0	0
6	1998	0			0		0	0	0
7	1999	0			0		0	0	0
8	2000		277	1,564	1,841	1,841	0	833	833
9	2001		277	1,564	1,841	1,841	0	744	744
10	2002		277	1,564	1,841	1,841	0	664	664
11	2003		277	1,564	1,841	1,841	0	593	593
12	2004		277	1,564	1,841	1,841	0	529	529
13	2005		277	1,564	1,841	1,841	0	473	473
14	2006		277	1,564	1,841	1,841	0	422	422
15	2007		277	1,564	1,841	1,841	0	377	377
16	2008		277	1,564	1,841	1,841	0	336	336
17	2009		277	1,564	1,841	1,841	0	300	300
18	2010		277	1,564	1,841	1,841	0	268	268
19	2011		277	1,564	1,841	1,841	0	239	239
20	2012		277	1,564	1,841	1,841	0	214	214
21	2013		277	1,564	1,841	1,841	0	191	191
22	2014		277	1,564	1,841	1,841	0	170	170
23	2015		277	1,564	1,841	1,841	0	152	152
24	2016		277	1,564	1,841	1,841	0	136	136
25	2017		277	1,564	1,841	1,841	0	121	121
26	2018		277	1,564	1,841	1,841	0	108	108
27	2019		277	1,564	1,841	1,841	0	97	97
							Total	6,967	6,967
								B-C	0
								B/C	1.00

Note: Water tariff for domestic use is O&M cost recovery basis including O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 113.3 Rp

Table 6.19 (2) Financial Analysis for Scheme C-3 by Case 2 (Industrial Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	2,034			2,034		-2,034	2,034	0
2	1994	4,069			4,069		-4,069	3,633	0
3	1995	4,847			4,847		-4,847	3,864	0
4	1996	11,089			11,089		-11,089	7,893	0
5	1997	22,111			22,111		-22,111	14,052	0
6	1998	91,621			91,621		-91,621	51,988	0
7	1999	20,855			20,855		-20,855	10,566	0
8	2000		832	4,691	5,523	30,371	24,848	2,499	13,738
9	2001		832	4,691	5,523	30,371	24,848	2,231	12,266
10	2002		832	4,691	5,523	30,371	24,848	1,992	10,952
11	2003		832	4,691	5,523	30,371	24,848	1,778	9,779
12	2004		832	4,691	5,523	30,371	24,848	1,588	8,731
13	2005		832	4,691	5,523	30,371	24,848	1,418	7,795
14	2006		832	4,691	5,523	30,371	24,848	1,266	6,960
15	2007		832	4,691	5,523	30,371	24,848	1,130	6,214
16	2008		832	4,691	5,523	30,371	24,848	1,009	5,549
17	2009		832	4,691	5,523	30,371	24,848	901	4,954
18	2010		832	4,691	5,523	30,371	24,848	804	4,423
19	2011		832	4,691	5,523	30,371	24,848	718	3,949
20	2012		832	4,691	5,523	30,371	24,848	641	3,526
21	2013		832	4,691	5,523	30,371	24,848	573	3,148
22	2014		832	4,691	5,523	30,371	24,848	511	2,811
23	2015		832	4,691	5,523	30,371	24,848	456	2,510
24	2016		832	4,691	5,523	30,371	24,848	408	2,241
25	2017		832	4,691	5,523	30,371	24,848	364	2,001
26	2018		832	4,691	5,523	30,371	24,848	325	1,787
27	2019		832	4,691	5,523	30,371	24,848	290	1,595
							Total	114,931	114,931
								B-C	0
								B/C	1.00

Note: Water tariff for industrial use is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 623.0 Rp

Table 6.20 (1) Financial Analysis for Scheme K-1 by Case 3 (Domestic Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	0			0		0	0	0
2	1994	0			0		0	0	0
3	1995	0			0		0	0	0
4	1996	0			0		0	0	0
5	1997	0			0		0	0	0
6	1998	0			0		0	0	0
7	1999	0			0		0	0	0
8	2000		187	817	1,003	1,003	0	454	454
9	2001		187	817	1,003	1,003	0	405	405
10	2002		187	817	1,003	1,003	0	362	362
11	2003		187	817	1,003	1,003	0	323	323
12	2004		187	817	1,003	1,003	0	288	288
13	2005		187	817	1,003	1,003	0	258	258
14	2006		187	817	1,003	1,003	0	230	230
15	2007		187	817	1,003	1,003	0	205	205
16	2008		187	817	1,003	1,003	0	183	183
17	2009		187	817	1,003	1,003	0	164	164
18	2010		187	817	1,003	1,003	0	146	146
19	2011		187	817	1,003	1,003	0	130	130
20	2012		187	817	1,003	1,003	0	117	117
21	2013		187	817	1,003	1,003	0	104	104
22	2014		187	817	1,003	1,003	0	93	93
23	2015		187	817	1,003	1,003	0	83	83
24	2016		187	817	1,003	1,003	0	74	74
25	2017		187	817	1,003	1,003	0	66	66
26	2018		187	817	1,003	1,003	0	59	59
27	2019		187	817	1,003	1,003	0	53	53
							Total	3,797	3,797
								B-C	0
								B/C	1.00

Note: Water tariff for domestic use is O&M cost recovery basis including O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 191.1 Rp

Table 6.20 (2) Financial Analysis for Scheme K-1 by Case 3 (Industrial Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	1,239			1,239		-1,239	1,239	0
2	1994	2,478			2,478		-2,478	2,212	0
3	1995	4,030			4,030		-4,030	3,213	0
4	1996	4,902			4,902		-4,902	3,489	0
5	1997	12,510			12,510		-12,510	7,951	0
6	1998	28,414			28,414		-28,414	16,123	0
7	1999	42,061			42,061		-42,061	21,309	0
8	2000		560	2,450	3,010	17,686	14,676	1,362	8,000
9	2001		560	2,450	3,010	17,686	14,676	1,216	7,143
10	2002		560	2,450	3,010	17,686	14,676	1,086	6,378
11	2003		560	2,450	3,010	17,686	14,676	969	5,694
12	2004		560	2,450	3,010	17,686	14,676	865	5,084
13	2005		560	2,450	3,010	17,686	14,676	773	4,540
14	2006		560	2,450	3,010	17,686	14,676	690	4,053
15	2007		560	2,450	3,010	17,686	14,676	616	3,619
16	2008		560	2,450	3,010	17,686	14,676	550	3,231
17	2009		560	2,450	3,010	17,686	14,676	491	2,885
18	2010		560	2,450	3,010	17,686	14,676	438	2,576
19	2011		560	2,450	3,010	17,686	14,676	391	2,300
20	2012		560	2,450	3,010	17,686	14,676	350	2,053
21	2013		560	2,450	3,010	17,686	14,676	312	1,833
22	2014		560	2,450	3,010	17,686	14,676	279	1,637
23	2015		560	2,450	3,010	17,686	14,676	249	1,462
24	2016		560	2,450	3,010	17,686	14,676	222	1,305
25	2017		560	2,450	3,010	17,686	14,676	198	1,165
26	2018		560	2,450	3,010	17,686	14,676	177	1,040
27	2019		560	2,450	3,010	17,686	14,676	158	929
							Total	66,928	66,928
								B-C	0
								B/C	1.00

Note: Water tariff for industrial use is full cost recovery basis including investment cost, O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 1,122.8 Rp

Table 6.21 (1) Financial Analysis for Scheme K-2 by Case 3 (Domestic Use)

(Unit : Million Rp)

No.	Year	Project Cost	O & M Cost	Pumping Cost	Total Cost	Benefit	Net Benefit	Present Value	
								Cost	Benefit
1	1993	0			0		0	0	0
2	1994	0			0		0	0	0
3	1995	0			0		0	0	0
4	1996	0			0		0	0	0
5	1997	0			0		0	0	0
6	1998	0			0		0	0	0
7	1999	0			0		0	0	0
8	2000		193	788	981	981	0	444	444
9	2001		193	788	981	981	0	396	396
10	2002		193	788	981	981	0	354	354
11	2003		193	788	981	981	0	316	316
12	2004		193	788	981	981	0	282	282
13	2005		193	788	981	981	0	252	252
14	2006		193	788	981	981	0	225	225
15	2007		193	788	981	981	0	201	201
16	2008		193	788	981	981	0	179	179
17	2009		193	788	981	981	0	160	160
18	2010		193	788	981	981	0	143	143
19	2011		193	788	981	981	0	128	128
20	2012		193	788	981	981	0	114	114
21	2013		193	788	981	981	0	102	102
22	2014		193	788	981	981	0	91	91
23	2015		193	788	981	981	0	81	81
24	2016		193	788	981	981	0	72	72
25	2017		193	788	981	981	0	65	65
26	2018		193	788	981	981	0	58	58
27	2019		193	788	981	981	0	52	52
							Total	3,712	3,712
								B-C	0
								B/C	1.00

Note: Water tariff for domestic use is O&M cost recovery basis including O&M cost and pumping cost.

Discount Rate 12 %

Water tariff 177.3 Rp