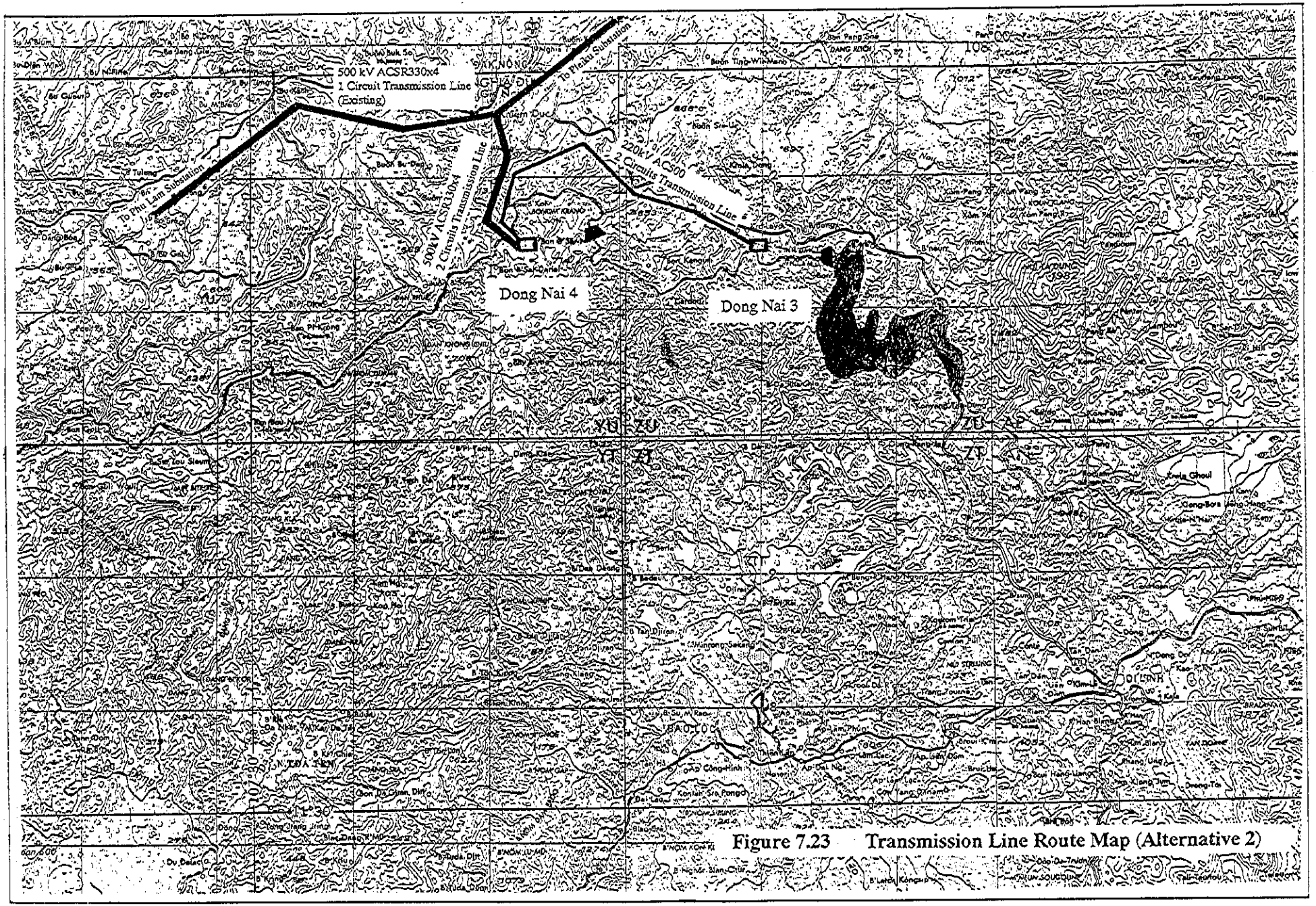

Figure 7.23 Transmission Line Route Map (Alternative 2)

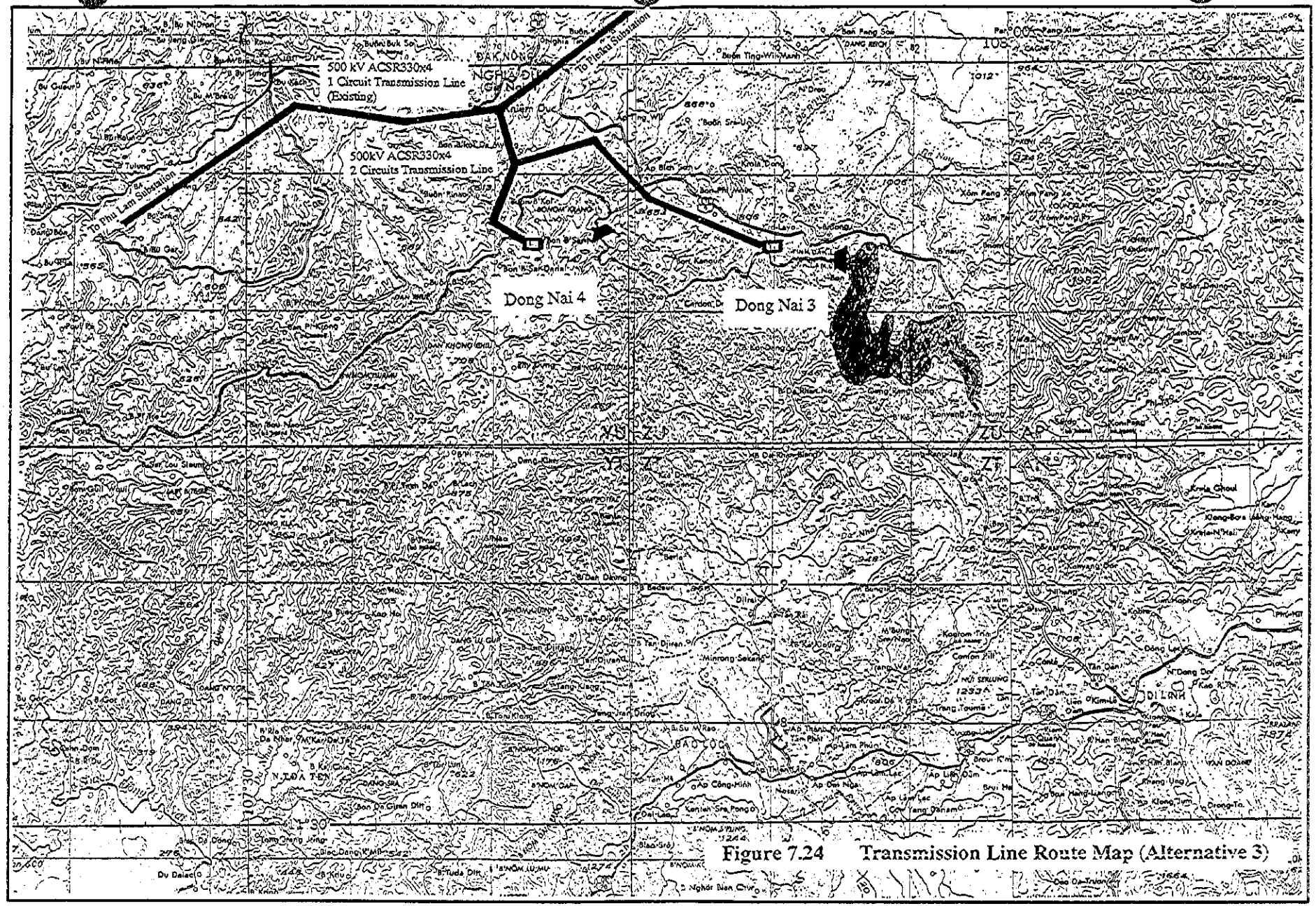

Figure 7.24 Transmission Line Route Map (Alternative 3)

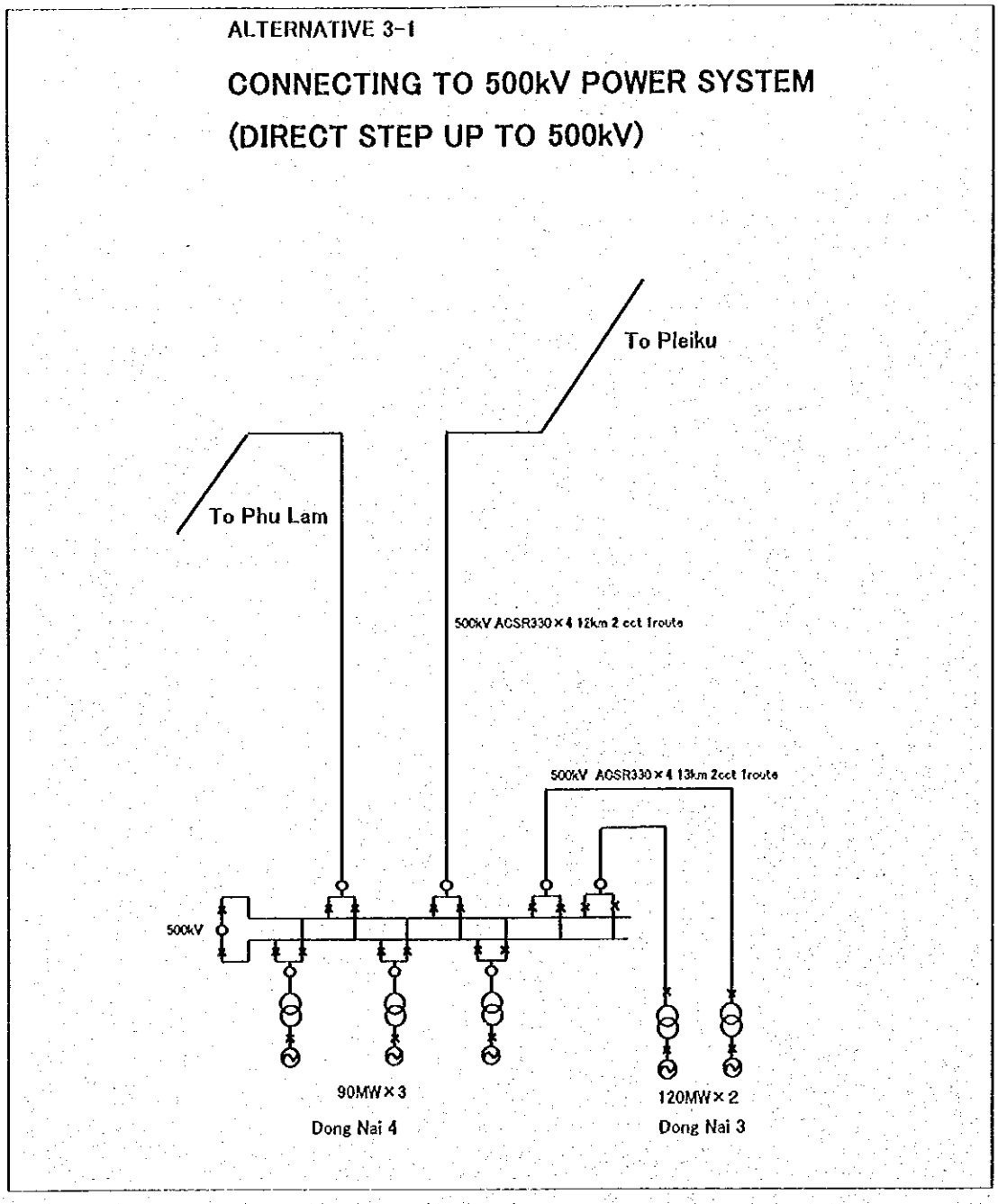

Figure 7.25 Alternative Transmission Method for Dong Nai No.3 and No.4 Combined HPP : Alternative 3-1

CHAPTER 8 CONSTRUCTION PLAN AND COST ESTIMATE

8.1 Construction Plan and Schedule

8.1.1 Conditions and Assumptions

(1) Access to the Site

The Dong Nai No.3 and No.4 combined Hydropower Project is located at the middle reach of the Dong Nai River, approximately 260 km road distance from Ho Chi Minh city by National Roads No.14 and No.28 as summarized below:

Road No.	Route	Distance	Road Surface
National road No.14	Ho Chi Minh - Gia Nghia	220 km	Asphalt concrete
National road No.28	Gia Nghia - No.3 HPP	40 km	Earth

Imported goods required for the construction including construction machinery, generating equipment, and steel materials for metal works will be laded at the port of Ho Chi Minh and transported to the Project site by road without difficulties.

The following access roads are required to be constructed to approach to the site, branching from the National Road No.28 as shown in Figure 8.1:

Access Roads

Project	Route	Distance
No.3 HPP	No.28 - Dam Site	5 km
	No.28 - Powerhouse and Surge Tank	5 km
No.4 HPP	No.28 - Dam Site	8 km
	No.28 - Powerhouse	15 km
	Powerhouse - Surge Tank	2 km

In order to minimize environmental disturbance in the Project area, approach to the No.4 powerhouse is planned to be made from the right bank of the Dong Nai River with about a 70 m long bridge to be constructed near the powerhouse.

In parallel with the access road construction, widening and improvement work of National Road No.28 will be achieved to allow traffic of heavy vehicles during construction.

(2) Meteorological Conditions

(a) Rainfall data

The most useful rainfall data to be used for the construction planning is considered to be those at Bao Loc rainfall gauging station located about 40 km south of the Project site. The average monthly rainfall and rainy days recorded at Bao Loc from 1973 to 1992 are summarized below:

Monthly Rainfall Record at Bao Loc

(Unit : mm)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
49	51	105	196	239	332	338	489	381	229	152	65	2,696

Monthly Rainy Days at Bao Loc

Range (mm)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
0	26.4	23.3	22.9	16.6	12.3	7.4	6.9	5.1	5.8	8.7	18.4	25.1	178.8
0-5	2.4	2.3	4.1	5.6	7.9	7.8	8.8	7.2	7.9	9.6	5.1	3.0	71.7
5-10	0.6	0.7	1.1	1.9	3.1	3.9	5.2	4.1	4.4	3.8	1.6	1.1	31.4
10-20	0.9	0.8	0.9	2.4	3.6	5.3	4.1	5.2	4.8	3.7	2.2	0.8	34.7
20-40	0.4	0.6	1.2	2.2	2.7	3.6	4.7	5.4	5.1	3.4	1.8	0.7	32.0
40 <	0.3	0.3	0.7	1.4	1.3	2.0	1.3	3.9	2.1	1.8	0.9	0.3	16.4

As shown in these tables, the annual rainfall at the Project site is about 2,700 mm with intensive rainfall in the rainy season lasting usually between May and October. The earth works, especially dam embankment work, will be hampered by the intensive rainfall in the rainy season. The core and filter embankment work will be substantially suspended in this period, especially in August and September.

(b) Air temperature

The air temperature does not vary so much throughout a year as indicated in the following annual mean monthly air temperature records at Bao Loc for the period from 1978 to 1991.

Average Air Temperature Record at Bao Loc

(Unit : °C)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
20.1	19.5	22.2	23.0	23.2	22.7	22.2	22.2	22.0	21.8	21.1	19.9

The recorded maximum temperature and minimum temperature are 33.8 °C and 9.5 °C for the same period, respectively.

(c) Hydrological Conditions

The average discharge at the Dong Nai No.3 dam site was estimated through transposition of hydrological data at Ta Lai streamflow gauging station located downstream of the Project site, as shown below:

Estimated Discharge at Dong Nai No.3 Dam Site

(Unit : m^3/sec)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
18.8	12.1	9.2	11.8	23.0	56.8	101.1	169.9	190.5	170.9	70.4	43.4	75.2

Fluctuation of natural discharge is very large through a year, and the period between June and October can be classified as a high flow or flood season. Based on these data, the most adequate timing of river diversion is considered to be December when the non-flood season starts. It is essential to achieve the river diversion at the earliest stage of the non-flood season to allow enough time for embankment work of cofferdam which should be completed before the coming flood season.

On the other hand, reservoir impounding should be started during the flood season to store the ample river flow in the reservoir effectively.

The probable flood with different return periods are given below:

Probable Flood at Dong Nai No.3 Dam Site

Return period (year)	Discharge (m^3/sec)
2	1,238
5	1,813
10	2,208
20	2,585
30	2,801
100	3,717

A 20-year probable flood is adopted as the design flood for the temporary river diversion facilities including diversion tunnels and cofferdams and the safety thereof is confirmed for a check flood of a 30-year return period.

(3) Source of Construction Materials

(a) Rock materials

Two quarry sites were identified during the field investigation in the Project area as detailed in Subsections 3.4.1 and 3.4.2. The rock embankment materials will be obtained from these quarry sites with bench cut blasting operation. The required amount and hauling distance to the dam site are estimated as below:

Rock Materials for Dam Embankment

Project	Rock embankment	Hauling distance
No.3	4,110,000 m^3	3 km
No.4	1,760,000 m^3	10 km
Total	5,870,000 m^3	-

(b) Earth core materials (for No.4 HPP)

The core embankment materials will be obtained from borrow areas on the basalt plateau located in the right bank of the dam site. The requirement and hauling distance to the dam site are estimated as below:

Core Materials for Dam Embankment

Project	Core embankment	Hauling distance
No.3	-	-
No.4	370,000 m^3	3 km
Total	370,000 m^3	-

(c) Concrete aggregate and filter materials

The requirement of concrete aggregate and filter materials for dam embankment is estimated as below:

Concrete Aggregate and Filter Materials

Project	Materials	Unit	Quantity
No.3	Coarse aggregate	ton	570,000
	Fine aggregate	ton	320,000
	Filter materials	m^3	3,000
No.4	Coarse aggregate	ton	540,000
	Fine aggregate	ton	320,000
	Filter materials	m^3	111,000

The coarse aggregate will be produced from quarried rock by crushing plant installed by civil work contractors at the site.

The fine aggregate is also planned to be produced from the quarried rock by crushing plant and sand production facilities including rod mill. The production cost of fine aggregate is estimated as follows:

Production Cost of Fine Aggregate

Activities	Estimated Cost (US$/ton)
Quarry excavation	1.5
Hauling from quarry to the plant (3 km)	1.4
Crushing operation	7.8
Total	10.7

During the site survey period, natural sand deposits were investigated for three different locations, namely Quang Phu, Srepok and Thong Nhat, as detailed in Subsection 3.4.3.

Natural Sand Deposit

Sand Deposit Name	River	Hauling Distance	Cost at Site (estimated)
Quang Phu	Krong Kno	120 km	10.0 US$/ton
Srepok	Srepok	170 km	11.2 US$/ton
Thong Nhat	Dong Nai	150 km	10.7 US$/ton

In this study, use of river sand for concrete and filter materials is discarded for the following reasons, although such option will be subject to the contractor's discretion in

the construction stage:

- The sand production cost is competitive to the estimated natural sand prices as indicated in the above tables. However, the estimated natural sand prices do not include cost for road improvement, road maintenance, adjustment of sand grading and environmental mitigation described hereinafter.
- The hauling road between Quang Phu and the National Road No.28 is unpaved and the existing road condition is not appropriate for travelling of dump trucks. Large-scale improvement works for the hauling road are required for transportation of the sand to the site.
- Hauling route from Thong Nhat includes 30 km section of earth road for which road maintenance work will be required especially in the rainy season.
- According to the sieve test result for Srepok and Quang Phu sand (refer to Table 3.18), retained percentage between 2.5 mm and 5 mm in diameter is as small as 5% or less in general. The test result also shows that grading of sand varies to a considerable extent from place to place within the same deposit area. The adjustment of sand grading would be required at the site by means of screening or blending with crushed sand.
- The sand exploitation is being made by local suppliers at present at these sand deposits and it is unknown that stable supply of good quality sand could be maintained throughout the construction period of the Project.
- Since Thong Nhat sand deposit is located in Cat Tien National Park, large-scale exploitation of sand would not be favorable.

Taking these circumstances into account, use of crushed sand is more economical and reliable at this feasibility study stage.

(d) Other construction materials

Major construction materials such as cement, reinforcement bars and explosives are available from local industries and market. Since the shortage of such construction materials that would hamper smooth construction of the Project has not occurred in recent years, the stable supply of these materials is expected.

(4) Quarry Development

As mentioned in the previous section, rockfill materials and concrete aggregate will be obtained from the quarry site identified for each of the Dong Nai No.3 and No.4 dams. The result of geological investing work shows that the fresh basalt zones in these quarry sites are covered with about 25 m thick overburden. This overburden should be removed by bulldozers or backhoe excavators prior to bench-cut blasting work for fresh rock. The topography and profile of the proposed quarry sites for Dong Nai No. 3 and No.4 are shown in Figures 8.2 and 8.3, respectively. At each quarry site, rock materials of about 10 million m^3 can be obtained from the shaded area in these Figures.

(5) Power Supply for Construction

The peak electric power required for the construction work is estimated at about 3,000 kVA for each of the Dong Nai No.3 and No.4.

This power will be available from 25 MVA Dac Nong substation which is scheduled to be put into operation in year 2000. A 22 kV temporary transmission line is to be constructed from Dac Nong substation to the Project site prior to the commencement of main construction work and the contractors will tap the power from this line through step-down transformers provided by themselves.

(6) Water Supply for Construction

Water supply will be required for construction camp, aggregate plant, concrete plant, boring work and concrete curing work during the construction. The water will be supplied from the Dong Nai River by pumping equipment and necessary piping system to be installed.

(7) Contract Packaging

The construction works will be carried out by various contractors having different expertise. The preparatory works will be executed by local contractors prior to the main construction works. The main construction works will be undertaken by international contractors selected through international competitive bid. The contract packages contemplated at this feasibility study stage are as follows:

(a) Local contract package

- Lot L-1 Access road : Construction of permanent access road between national road No.28 and project sites. (Dong Nai No.3 project : 10 km, Dong Nai No.4 project : 25 km road and 70 m bridge)
- Lot L-2 Base camp : Construction of permanent offices and residential facilities for EVN and consultants.
- Lot L-3 Power supply system : Construction of 22 kV transmission line for construction use.

(b) International contract packages

The separate contract packages are envisaged for each category of the works concerning each of the No.3 and No.4 project. (The suffix of Lot No. represents the project identification.)

- Lot I-1-3/4 Diversion tunnel : Construction of diversion tunnels
- Lot I-2-3/4 Main civil works : Construction of the main civil work structures including rockfill dam, spillway, power intake, headrace tunnel, surge tank, penstock, powerhouse and switchyard.
- Lot I-3-3/4 Hydromechanical works Supply and erection of metal works including spillway gates, intake gates, penstock steel liners and draft tube gates.
- Lot I-4A-3/4 Turbines and auxiliaries: Supply and erection of turbines, inlet valves, O/H travelling cranes and control equipment.
- Lot I-4B-3/4 Generator and auxiliaries :Supply and erection of generators and

control equipment.

- Lot I-4C-3/4 Switchgear equipment : Supply and erection of 500 kV switchgear and transformers.
- Lot I-5-3/4 Transmission line : Supply and erection of 500 kV transmission line

In order to squeeze total construction period by fast-tracking procedure, diversion tunnel work (Lot I-1-3/4) is separated from the main civil work for the river to be diverted earlier. The procurement of Lot I-1 work is scheduled to be made one year ahead of the Lot I-2-3/4 main civil work so that the overall time schedule can be reduced by one year.

8.1.2 Construction Method for Dong Nai No. 3

The construction methods that are planned to be applied to the major construction works of Dong Nai No. 3 are described hereinafter.

(1) River Diversion Work

Temporary river diversion during construction period is planned to be achieved by the diversion tunnel method. To cope with a 30-year probable flood of 2,800 m^3/sec, two diversion tunnels having the following dimensions will be provided on the right bank of the dam site.

Diversion Tunnels for Dong Nai No.3

Diameter	Length	Inlet sill level	Section
11.5 m	880 m	EL. 492	Circular

These diversion tunnels have a enough discharge capacity to release the above flood safely in combination with a cofferdam with a crest elevation of El.519 m.

The tunnels will be driven by the top heading and bottom bench-cut method. The driving rate of 60 m/month is expected to be attained by employing such construction equipment as 3-boom hydraulic drill jumbo, 3 m^3 side dump loader, and 20 ton articulated dump trucks. Since construction of the diversion tunnels is critical path work, tunnel will be excavated from both inlet and outlet portals. Ten months will be required for breakthrough of the diversion tunnels with these arrangements.

Concrete lining work will follow the tunnel driving work. The tunnel wall and crown concrete will be placed at first by 9 m-long circular travelling form to allow concurrent work with excavation work. The monthly progress rate of 90 m (9.0 m long x 10 cycles/month) is expected to be achieved for the concrete lining work. The invert concrete will be placed separately afterward.

After completion of the diversion tunnels, primary cofferdam will be embanked to divert the river flow into the tunnels. The river will be diverted in the beginning of December 2004 after the high flow season will end.

The upstream main cofferdam will be constructed between the primary cofferdam and main dam with rock materials and impervious materials to be spread in the upstream slope of the rock embankment. The cofferdam has the following dimensions:

Cofferdam for Dong Nai No. 3

Height	27 m
Embankment volume	380,000 m^3
Embankment period	5 months

(2) Dam Works

The work quantities of concrete face rockfill dam (CFRD) with 108.5 m high and 4,720,000 m^3 embankment volume are estimated as below:

Work Quantity of Dong Nai No. 3 Dam (CFRD Type)

Work	Quantity
Excavation, common	631,000 m^3
Excavation, rock	162,000 m^3
Embankment, rock	4,105,000 m^3
Embankment, crusher run	171,000 m^3
Embankment, selected small rock	285,000 m^3
Embankment, clay	39,000 m^3
Concrete, plinth	2,600 m^3
Concrete, face slab	47,500 m^3
Blanket grout	17,700 m
Curtain grout	52,600 m

The excavation work for dam foundation and plinth will be commenced immediately after contractor's mobilization and carried out in a downward direction to the riverbed. Following the plinth trench excavation, concrete work will be conducted for plinth of 0.7 m thickness and 4.3 m wide. The foundation grouting work can be carried out from the top of the slab concrete block. About 90% (or 3,7000,000 m^3) of rockfill materials should be obtained from the quarry site described in Clause 8.1.1 (3), since rockfill materials of 400,000 m^3 equivalent to only 10% of the total required volume will be available from excavation from dam foundation, spillway and power intake sites. The rock embankment work will be started in April 2005, following the plinth concrete work in the riverbed. Dam embankment materials hauled by heavy dump trucks will be spread at the dam site by bulldozers and the compaction will be made in the following manner:

Compaction of Embankment Materials

Zone	Compaction Equipment	Layer thickness	Nos. of roller pass
Upstream clay	Tamping roller, 15 ton	0.25 m	8
Crusher run	Plate compactor Vibratory roller, 1 ton	0.4 m	6
Selected rock	Vibratory roller, 1ton	0.8 m	6
Rock	Vibratory roller, 15 ton	1.5 m	6

With the average embankment speed of 250,000 m^3/month, 18 months will be required for the dam embankment work.

After completion of dam embankment work, the face slab concrete will be placed for the entire upstream face of the dam body. The face slab concrete will be placed with about 15 m wide slip form. The mixed concrete delivered to the dam site by agitator trucks will be further conveyed to the placing area through concrete chute. The slip form will be moved by winch with travelling speed of some 1.5 m/hr and the concrete will be continuously placed without making horizontal joint. Employing two (2) sets of concrete form, the required work period is estimated at 12 months for the face slab concrete with a total surface area of 95,000 m^2.

(3) Spillway

The work quantities of spillway work are estimated below:

Work Quantity of Dong Nai No.3 Spillway

Work	Quantity
Excavation, common	1,040,000 m^3
Excavation, rock	260,000 m^3
Concrete	134,500 m^3

The excavation work will be commenced from the headwork area and continued in a downward direction along the chuteway by earthmoving equipment and bench cut blasting work. The excavated slope will be protected by shotcrete, concrete frame works or sod facing according to the actual geological conditions encountered. The concrete work for the headwork and chuteway will be done by various concrete placing equipment including concrete pumps, truck mounted belt conveyer placers and tower cranes. The equipment will be selected according to the following criteria in general:

Working performance of Concrete Equipment

Equipment	Concrete pump truck	Concrete pump, stationary	Conveyer placers	Tower cranes
Max. aggregate size	40 mm	40 mm	80 mm	150 mm
Slump of concrete	12 cm or more	12 cm or more	-	-
Horizontal coverage	20 m	300 m	30 m	75 m
Vertical coverage	30 m	100 m	15 m	100 m

With the average concrete placement volume of 6,000 m^3/month, about a two-year working period will be required for the spillway concrete work.

The installation of three sets of radial gates will be undertaken by Lot I-3-3 contractor following the concrete work in the spillway headworks.

(4) Power Intake

The work quantities of power intake work are estimated below:

Work Quantity of Dong Nai No.3 Power Intake

Work	Quantity
Excavation, common	402,000 m^3
Excavation, rock	140,000 m^3
Excavation, gate shaft	63 m
Concrete	13,500 m^3

A large amount of excavation work will be required at the intake site due to thick coverage of overburden and weathered rock. The excavation work will be carried out with ordinary earthmoving and blasting operation. Since a work adit is proposed to be provided near its inlet of the headrace tunnel, power intake work including gate shaft construction can be done independently without disturbing the tunneling work.

The gate shaft will be excavated by the sinking method with shotcrete and rock bolt supporting. In case that the actual geological condition does not allow this, initial concrete lining will be provided after each round of excavation work. The permanent concrete lining work will be done upward after the shaft excavation by employing prefabricated sliding forms.

(5) Headrace Tunnel

Headrace tunnel is a circular section tunnel of 6,960 m long and 8.4 m finished diameter. The following three work adits will be provided as temporary facilities to facilitate the tunneling work

Work Adits for Dong Nai No.3 Headrace Tunnel

No.	Location	Length
1	Downstream of intake gate shaft	170 m
2	Mid-way of headrace tunnel	540 m
3	Upstream of surge tank	290 m
	Total	1,000 m

Headrace tunnel will be driven by the full-face excavation method in principle employing such construction equipment as 3-boom hydraulic drill jumbo, 3 m^3 side dump loader and 20 ton articulated dump trucks. For some poor geological sections, on the other hand, the top heading and bottom bench-cut method will also be applied.

The average excavation rate of 85 m/month is expected to be attained with these arrangements. In the cycle time analyses, the whole stretch of the tunnel is divided into two sections, namely Section A (with good geological condition) and Section B (with poor geological condition) as shown below:

Progress Rate Estimate for Dong Nai No.3 Headrace Tunnel

Description	Unit	Section A	Section B
Ratio	%	70 %	30 %
Advance per round	m	4.0	1.5
Supporting work		Shotcrete and rock bolt	Steel support
Cycle time			
Drilling and blasting	hr	7.0	4.7
Mucking	hr	4.7	2.2
Supporting and measurement	hr	4.0	5.5
Total cycle time	hr	15.7	12.4
Working hours (2 shift)	hr/day	18	18
Working day	days/month	25	25
Round per day	nos.	1.14	1.44
Daily progress	m/day	4.56	2.16
Monthly progress	m/month	114	54
Average progress	m/month	85	

The tunnel excavation work will be conducted at four faces concurrently, using above work adits.

The concrete lining work will follow the tunnel driving work. The tunnel wall and crown concrete will be placed at first with 12 m-long circular travelling form to allow the concurrent work with excavation work. The monthly progress rate of 120 m/month (12 m x 10 cycles/month) is expected to be achieved for the concrete lining work. Four sets of lining form will be used to deliver mixed concrete by agitator truck through three work adits. Invert concrete will be placed separately after breakthrough of tunnel has been achieved.

(6) Surge Tank and Penstock

Surge tank and penstock tunnel have the following dimensions:

Work	Surge Tank	Penstock
Diameter	20.9 m	6.5 m
Vertical shaft	85 m	-
Horizontal tunnel		
Upper	-	71 m
Lower	-	130 m
Inclined shaft	-	135 m
Total length	85 m	236 m

The surge tank shaft will be excavated by the upward pilot-hole drilling and downward enlargement method. The pilot hole will be drilled either by raise borer or raise climber and this will be left to the contractor's option. The tunnel muck will be hauled outside through the headrace work adit No.3.

Lower penstock tunnel will be excavated from its outlet with the same method and equipment as those employed for headrace tunnel after completion of open excavation in the portal area. Following the tunnel excavation, the inclined shaft will also be driven by upward pilot-hole drilling and downward enlargement method. Installation of penstock steel pipe will be carried out by Lot I-3-3 contractor following the penstock tunnel work and the pipe will be encased with backfill concrete by Lot I-2-3 contractor

(7) Powerhouse

The construction of powerhouse will be started with excavation work on the right bank slope. Following the excavation work, concrete work for powerhouse substructure will be carried out using tower crane and concrete pumps. Draft tubes will be installed by Lot I-4A-3 contractor during the concrete work.

Installation of overhead travelling crane in the powerhouse superstructure is a milestone event for the succeeding installation work of hydropower plants. In the construction program, 18 months are allocated for power plant installation.

(8) Final River Closure and Reservoir Impounding

Final river closure is scheduled to be made at the beginning of October 2007 so as to commence wet test of generating equipment in December of the same year. Installation of intake and spillway gates as well as concrete plug work in headrace work adits should be completed by December 2007 at the latest, taking a rise of reservoir water level into account.

8.1.3 Construction Method for Dong Nai No. 4

The construction methods that are planned to be applied to the major construction works of Dong Nai No. 4 are described here.

(1) River Diversion Work

Concerning the temporary river diversion work of the Dong Nai No.4, the same concept and method as those proposed for the Dong Nai No.3 will be applied. Two lines of diversion tunnels provided on the right bank are a little bit smaller in its diameter and length than that of the Dong Nai No.3 as shown below:

Diversion Tunnels for Dong Nai No.4

Diameter	Length	Inlet sill level	Section
10.9 m	760 m	EL. 353	Circular

These diversion tunnels have a enough discharge capacity to release a 30-year probable flood of 2,800 m^3/s safely in combination with a cofferdam with a crest elevation of El.395 m. The tunnel excavation and concrete work will be carried out in the same manner as that described in Clause 8.1.2 (1).

Concerning the Dong Nai No.4, the integrated cofferdam scheme, in which the upstream primary cofferdam constitutes a part of the Dong Nai No.4 main dam, is adopted in this feasibility-grade design as shown in Figure 7.12. The integrated cofferdam has the

following dimensions:

Integrated Cofferdam for Dong Nai No. 4

Height	42.5 m
Embankment volume	390,000 m^3
Embankment period	5 months

The river diversion will be achieved in the beginning of December 2004 when the high flow season usually ends.

(2) Dam Works

The Dong Nai No.4 dam is designed to be a 96 m high center core rockfill type dam. The work quantities of the Dong Nai No.4 dam were estimated so that the total embankment volume amounts to about 2.24 million m^3 as shown below:

Work Quantity of Dong Nai No. 4 Dam (Center Core Rockfill Type Dam)

Work	Quantity
Excavation, common	255,000 m^3
Excavation, rock	36,000 m^3
Embankment, core	370,000 m^3
Embankment, filter	111,000 m^3
Embankment, rock	1,763,000 m^3
Total embankment volume	2,244,000 m^3
Blanket grout	7,800 m
Curtain grout	25,900 m

The excavation work for dam foundation and core trench will be commenced immediately after contractor's mobilization.

The embankment materials will be obtained from the borrow area and quarry site described in Clause 8.1.1 (3). As for rock embankment, about 25% of rock materials (or 440,000 m^3) can be supplied from foundation excavation of dam, spillway and power intake. The rock embankment work will be started in June 2005, following the foundation excavation in the riverbed. The core and filter embankment can be commenced in December 2005 after blanket and curtain grouting work will be completed in the riverbed area. Dam embankment materials hauled by heavy dump trucks will be spread at the dam site by bulldozers and the compaction will be made in the following manners:

Compaction of Embankment Materials

Zone	Compaction Equipment	Layer thickness (m)	Roller Pass
Core	Tamping roller, 20 ton	0.2	8
Filter	Vibration roller, 8 ton	0.4	6
Rock	Vibration roller, 15 ton	1.0	6

In view of its height and embankment volume, three dry seasons are required for the dam embankment work. Workable days between December 2005 and May 2008 is estimated at about 470 days for the core embankment work and average embankment speed (or height) of core zone is estimated at 20 cm/working day.

(3) Spillway

The work quantities of spillway work on the left bank of the dam site are estimated blow:

Work Quantity of Spillway for Dong Nai No.4

Work	Quantity
Excavation, common	1,268,000 m^3
Excavation, rock	317,000 m^3
Concrete	201,000 m^3

The same construction methods as those described in Clause 8.1.2 (3) will be applied to construction of spillway for the Dong Nai No.4, although it is estimated to require the larger work quantities for both excavation (20% more) and concrete work (50% more), as compared with those of spillway for the Dong Nai No.3. With the average concrete placement volume of 7,500 m^3/month, about a two-year working period will be required to complete the spillway concrete work.

The installation of three sets of radial gates will be carried out by the Lot I-3-4 contractor following the concrete work in the spillway headworks.

(4) Power Intake

The work quantities of power intake work are estimated as follows:

Work Quantity of Dong Nai No.4 Power Intake

Work	Quantity
Excavation, common	148,000 m^3
Excavation, rock	115,000 m^3
Excavation, gate shaft	44.1 m
Concrete	7,750 m^3

The general layout of the Dong Nai No.4 power intake structure is same as that for the Dong Nai No.3. Besides, the same construction method and sequence as those described in Clause 8.2.3 (4) will be applied for open excavation work, shaft driving work and concrete work for the Dong Nai No.4 power intake structure.

(5) Headrace Tunnel

The Dong Nai No.4 headrace tunnel is designed to have a circular section of 8.6 m in inside diameter and 5,320 m in total length. The two work adits will be provided as temporary facilities to facilitate the tunneling work as shown in Figure 7.14.

Work Adits for No.4 Headrace Tunnel

No.	Location	Length
1	Downstream of intake gate shaft	240 m
2	Upstream of surge tank	360 m
	Total	600 m

In view of topographical feature of the tunnel route, construction of intermediate work adit will be very costly and time-consuming, thus only two work adits near its inlet and outlet portals are planned to be provided.

The headrace tunnel will be driven by the full-face excavation method in principle employing such construction equipment as 3-boom hydraulic drill jumbo, 3 m^3 side dump loader and 20 ton articulated dump trucks. The top heading and bottom bench-cut method will be applied in some poor geological sections.

The average excavation rate of 90 m/month is expected to be attained. In the cycle time analyses, the whole stretch of the tunnel is divided into two sections, namely Section A (with good geological condition) and Section B (with poor geological condition) as shown below:

Progress Rate Estimate for Dong Nai No.4 Headrace Tunnel

Description	Unit	Section A	Section B
Ratio	%	80 %	20 %
Advance per round	m	4.0	1.5
Supporting work		Shotcrete and rock bolt	Steel support
Cycle Time			
Drilling and blasting	hr	7.2	4.8
Mucking	hr	4.8	2.3
Supporting and measurement	hr	4.2	5.7
Total cycle time	hr	16.2	12.8
Working hours (2 shift)	hr/day	18	18
Working day	days/month	25	25
Round per day	nos.	1.1	1.4
Daily progress	m/day	4.4	2.1
Monthly progress	m/month	110	52.5
Average progress	m/month	90	

The tunnel excavation work will be conducted at two faces concurrently by using the said work adits.

The concrete lining work will follow the tunnel driving work. The tunnel wall and crown concrete will be placed at first with 12 m-long circular travelling form to allow concurrent work with excavation work. The monthly progress rate of 120 m/month (12 m x 10 cycles/month) is expected to be achieved for the concrete lining work. Two sets of lining form will be used to deliver mixed concrete by agitator truck through two work adits. The invert concrete will be placed separately after wall and crown concrete has

been completed.

(6) Surge Tank and Penstock

Surge tank and penstock tunnel have the following dimensions:

Work	Surge Tank	Penstock
Diameter	17 m	6.7 m
Vertical shaft	69 m	-
Horizontal tunnel		
Upper	-	174 m
Lower	-	215 m
Inclined shaft	-	158 m
Total length	69 m	547 m

The general layout of No.4 surge tank and penstock is same as that of the Dong Nai No.3. Besides, the same construction method and sequence as those described in Clause 8.2.3 (6) will be applied for vertical shaft excavation work, inclined shaft driving work and concrete work for the Dong Nai No.4. Installation of penstock steel pipe will be carried out by the Lot I-3-4 contractor following the penstock tunnel work and the pipe will be encased with concrete by the Lot I-2-4 contractor.

(7) Powerhouse

The construction of powerhouse will be started with excavation work on the left bank slope. Following the excavation work, concrete work for powerhouse substructure will be done with tower crane and concrete pump. Draft tubes will be installed by the Lot I-4A-4 contractor during the concrete work.

Installation of overhead travelling crane in the powerhouse superstructure is a milestone event for the succeeding installation work of hydropower plants. In the construction program, 18 months are allocated for installation work thereof.

(8) Final River Closure and Reservoir Impounding

Final river closure is scheduled to be made in the middle of August 2008 so as to commence the wet test of generating equipment in December of the same year. In order to avoid a rapid rise of the reservoir water level, the outflow from the upstream Dong Nai No. 3 powerhouse should be controlled during impounding period. Installation of intake and spillway gates as well as concrete plug work in headrace work adit should be completed by September 2008 at the latest, taking a rise of the reservoir water level into account.

8.1.4 Construction Schedule

The implementation schedule of the project after completion of this feasibility study in March 2000 is shown in Figure 8.4 in bar chart form. Starting the detailed design in July 2001for both of the Dong Nai No.3 and No.4, power commissioning will be achieved in December 2007 for Dong Nai No.3 after 5 years construction and in December 2008 for Dong Nai No.4 after 6 years construction.

The detailed construction programs for the Dong Nai No. 3 and No.4 Combined HPP are shown in Figures 8.5 and 8.6, respectively. These programs were prepared in full

consideration of required duration of each work activity, appropriate sequence of each work activity, meteorological and hydrological conditions.

The following activities constitute the main critical path in the overall time schedule:

Critical Path Work of Dong Nai No.3 Project

No.	Activity/Event	Timing
1)	Loan request	July 2000
2)	Loan agreement	March 2001
3)	Selection of consultant	April - June 2001
4)	Detailed design and bid document preparation	From July 2001
5)	Procurement procedures - preparatory	From January 2002
6)	Procurement procedures - diversion tunnel	From January 2002
7)	Procurement procedures - civil work	From October 2002
8)	Commencement of work - preparatory works	From July 2002
9)	Commencement of work - diversion tunnel	From January 2003
10)	Commencement of work - civil work	From January 2004
11)	River diversion	December 2004
12)	Dam Construction (from cofferdam)	34 moths
13)	Reservoir impounding	From October 2007
14)	Wet test of generating equipment	December 2007
15)	Commissioning of power plant	End of December 2007

Critical Path Work of Dong Nai No.4 Project

No.	Activity/Event	Timing
1)	Loan request	July 2000
2)	Loan agreement	March 2001
3)	Selection of consultant	April - June 2001
4)	Detailed design and bid document preparation	From July 2001
5)	Procurement procedures - preparatory	From January 2002
6)	Procurement procedures - diversion tunnel	From January 2002
7)	Procurement procedures - civil work	From October 2002
8)	Commencement of work - preparatory works	From July 2002
9)	Commencement of work - diversion tunnel	From January 2003
10)	Commencement of work - civil work	From January 2004
11)	Headrace tunnel construction	54 months
12)	Reservoir impounding	From August 2008
13)	Wet test of generating equipment	December 2008
14)	Commissioning of power plant	End of December 2008

8.2 Cost Estimate

8.2.1 Conditions and Assumptions

The Project cost was estimated for the feasibility-grade design on the following conditions and assumptions:

a) The estimate is made in US dollars (US$) for both foreign and local currency components.

b) The local currency component covers cost of locally available materials including cement, reinforcing bars, fuel, explosives and local labors. The costs of imported machinery for mechanical and electrical works and depreciation of construction equipment are allocated into the foreign currency component.

c) The cost estimate was made at a price level of 1st March 1999 when the field investigation works concerned with the cost survey were carried out. The exchange rate used in the cost estimate is US$ 1.0 = VND 13,870 (=114 J. Yen) which is a market transaction rate on 1 March 1999.

d) The construction work is assumed to be undertaken by competent contractors selected through international competitive bidding (ICB) and local competitive bidding (LCB).

e) The unit prices of the works were determined in reference to prevailing unit cost of labour, construction materials and equipment in principle. The recent bidding data of similar projects in Vietnam and other Asian countries were also reflected in the estimate. The data on labor, materials and equipment that were used in the cost estimate are tabulated in Tables 8.1, 8.2 and 8.3, respectively.

8.2.2 Cost Estimate Method

The following estimate methods were applied for the respective cost categories.

(1) Preparatory Works (Lot L-1 to L-3)

The construction cost of the permanent access road was estimated based on the required road length and unit cost per linear meter (200 US$/m). The cost for EVN base camp was estimated on a lump sum basis in reference to the data from the similar projects in Vietnam.

(2) Civil Works (Lot I-1-3/4 and Lot I-2-3/4)

The construction cost for diversion tunnels and main civil works was estimated by the unit price estimate method. The work quantities and corresponding unit prices are shown in Tables 8.9, 8.10, 8.11 and 8.12. In addition to the direct construction cost, cost for contractor's site installation (covering temporary offices and houses, construction roads, water and power supply system, telecommunication facilities, etc.) is separately allocated in the cost estimate. The rate of such cost is estimated at 10% of direct construction cost, based on actual bid data of Ham Thuan (9%) and Da Mi (10%) hydropower projects.

(3) Gate and Penstock (Lot I-3-3/4)

The unit price estimating method was applied. The weight of steel structures was calculated based on its dimension and design hydraulic pressure. The recent bidding data of the similar works was referred to determine unit price per weight for respective types of structures.

(4) Electrical Works (Lot I-4-3/4 and Lot I-5-3/4)

The lump sum estimate method was applied. The price was estimated based on various factors including design head, discharge, rated capacity, dimensions, unit numbers, estimated weight of machinery and recent bidding data of the similar works.

(5) Engineering Service

The cost for engineering service that comprises costs for detailed design, procurement of works and site supervision was estimated at 7.5 % of the direct construction cost.

(6) Administration Expense

Administration expense of the Project owner (EVN) was estimated at 0.7 % of the direct construction cost.

(7) Land Compensation and Resettlement

Land compensation and resettlement cost was estimated by the unit price estimate method, taking results of the latest environmental survey into account. The breakdown of cost estimate is detailed in Table D15 of Appendix D of Supporting Report.

(8) Tax

Five (5) percent of value added tax (VAT) is allocated in the estimate for the construction work and engineering service.

(9) Contingencies

The contingencies required for the project budgeting comprise i) price contingency to compensate future price escalation and ii) physical contingency to cover changes of physical conditions unforeseeable at this stage.

The price contingency was estimated assuming a price escalation rate at 1.0 % per annum for both foreign and local currency components expressed in US$. The rate of 1.0 % is based on the average GDP deflators in Japan for past ten years (0.8% per annum actually).

The rates of physical contingencies applied to the cost estimate are shown below:

Rates on Physical Contingency

Works	Rate
Preparatory works (L-1 to L-3)	10 %
Diversion tunnel (I-1)	10 %
Main civil work (I-2)	10 %
Electrical and mechanical works (I-3 to I-5)	5 %
Engineering Service	10 %
Administration	10 %
Land compensation and resettlement	10 %

8.2.3 Total Project Cost

The total project cost is estimated at 737.1 million US$ comprising foreign currency component of 423.4 million US$ and local currency component of 313.7 million US$ as summarized below and detailed in Tables 8.4, 8.5 and 8.6:

Estimate of Total Project Cost (1)

(Unit: million US$)

Description	FC	LC	Total
I. Base Cost	368.4	270.4	638.8
Construction Cost	333.4	219.6	553.0
Engineering Service	31.1	10.4	41.5
Administration	0.0	3.9	3.9
Land compensation and resettlement	3.9	6.7	10.6
Tax	0.0	29.8	29.8
II. Contingency	55.0	43.3	98.3
Price contingency	26.0	17.9	43.9
Physical contingency	29.0	25.4	54.4
Total Project Cost	423.4	313.7	737.1

Estimate of Total Project Cost (2)

(Unit: million US$)

Description	No.3	No.4	Total
I. Base Cost	343.9	294.9	638.8
Construction Cost	293.4	259.6	553.0
Engineering Service	22.0	19.5	41.5
Administration	2.1	1.8	3.9
Land compensation and resettlement	10.6	0.0	10.6
Tax	15.8	14.0	29.8
II. Contingency	52.6	45.7	98.3
Price contingency	22.6	21.3	43.9
Physical contingency	30.0	24.4	54.4
Total Project Cost	396.5	340.6	737.1

The breakdown of the estimated costs is shown in the following tables:

a) Preparatory works	: Tables 8.7 and 8.8
b) Diversion tunnels	: Tables 8.9 and 8.10
c) Main civil works	: Tables 8.11 and 8.12
d) Hydromechanical works	: Tables 8.13 and 8.14
e) Electrical work	: Tables 8.15 and 8.16

8.2.4 Annual Disbursement Schedule

The annual disbursement is prepared in accordance with the estimated project cost and the construction time schedule as detailed in Tables 8.17, 8.18, and 8.19 and summarized below:

Summary of Annual Disbursement Schedule

(Unit: million US$)

Year	FC	LC	Total
2001	5.2	2.7	7.9
2002	6.6	11.8	18.4
2003	17.4	26.8	44.2
2004	40.1	42.4	82.5
2005	72.6	62.3	134.9
2006	127.1	76.3	203.4
2007	121.2	72.3	193.5
2008	29.6	18.3	47.9
2009	3.6	0.6	4.2

Table 8.1 Labour Wage

Particular	Unit	LC (VND.)	FC (US$)
Foreman, foreign	m.d.		200
Foreman	m.d.	150,000	
Equipment operator	m.d.	100,000	
Assistant operator	m.d.	50,000	
Driver	m.d.	100,000	
Rigger	m.d.	120,000	
Carpenter	m.d.	100,000	
Concrete worker	m.d.	75,000	
Driller	m.d.	80,000	
Rebar worker	m.d.	80,000	
Skilled labor	m.d.	120,000	
Common labor	m.d.	60,000	

Table 8.2 Unit Price of Major Construction Materials

Material	Unit	LC (VND.)	FC (US$)
Light oil	lit.	3,600	
Gasoline	lit.	4,500	
Electricity	kWh	970	
Portland cement	ton	1,100,000	
AE agent	kg	20,000	
Deformed bar	ton	5,000,000	
Dynamite, in open	kg	25,000	
Dynamite, in tunnel	kg	32,000	
ANFO	kg	10,000	
Electric detonator	no.	60,000	
Timber	cu.m	1,600,000	
Plywood	cu.m	1,600,000	
Metal form	m^2	500,000	
Cross bit, 65 mm	no.		260.0
Drilling rod, 38mm, L=3.0m	no.		360.0
Joint sleeve, 38 mm	no.		80.0
Shank rod, 38 mm	no.		230.0

Table 8.3 Hourly Cost of Construction Equipment

Equipment	Unit	LC (VND)	FC (US$)	Total (US$ equiv.)
Bulldozer, 21 t	hr	429	36.9	45.5
Bulldozer, 32 t	hr	626	50.6	63.1
Bulldozer, 44 t	hr	823	66.5	82.9
Bulldozer, 66 t	hr	1,205	97.3	121.4
Bulldozer, w/ripper, 21 t	hr	486	40.3	50.0
Bulldozer, w/ripper, 32 t	hr	624	50.1	62.6
Bulldozer, w/ripper, 44 t	hr	856	68.8	86.0
Bulldozer, w/ripper, 66 t	hr	1,257	101.1	126.2
Wheel loader, 2.3 m3	hr	252	21.4	26.4
Wheel loader, 2.9 m3	hr	296	25.0	31.0
Wheel loader, 3.5 m3	hr	384	32.6	40.3
Wheel loader, 4 m3	hr	467	39.6	48.9
Wheel loader, 4.5 m3	hr	559	47.4	58.5
Wheel loader, 5.4 m3	hr	848	71.8	88.8
Wheel loader, 11 m3	hr	1,647	139.6	172.5
Backhoe, 0.8 m3	hr	224	21.6	26.1
Backhoe, 1 m3	hr	277	26.7	32.2
Backhoe, 1.2 m3	hr	327	31.6	38.1
Backhoe, 1.5 m3	hr	388	37.5	45.2
Dump truck,11 t	hr	129	9.7	12.2
Dump truck, 20 t	hr	282	22.7	28.3
Dump truck, 32 t	hr	386	30.3	38.1
Dump truck, 46 t	hr	512	40.2	50.5
Dump truck, 60 t	hr	666	52.3	65.6
Crawler drill, air, 180 kg	hr	197	18.6	22.5
Crawler drill, hyd., 150 kg	hr	676	63.8	77.3
Crawler drill, hyd., 180 kg	hr	751	70.9	85.9
Wheel jumbo, 2boom, 150 kg	hr	2,160	172.1	215.3
Wheel jumbo, 3boom, 150 kg	hr	3,078	245.3	306.9
Tamping roller, pull, 13.5-20.7t	hr	131	10.9	13.6
Vibrating roller, 3-5t	hr	131	11.2	13.8
Vibrating roller, 11-12t	hr	415	35.6	43.9
Vibrating roller, 15-18t	hr	586	50.2	61.9
Agitator truck, 3 m3	hr	93	8.0	9.8
Agitator truck, 4.5 m3	hr	135	11.6	14.3
Concrete pumpcar, 60 m3/hr, boom	hr	428	36.4	44.9
Concrete pumpcar, 100 m3/hr, boom	hr	635	54.0	66.7
Sprinkler truck, 10 kl	hr	135	11.4	14.1

Table 8.4 Summary of Project Cost Estimate (Dong Nai No. 3 + No. 4)

Description	F.C. (million US$)	L.C. (million US$)	Total (million US$)
I. Base Cost			
(1) Preparatory Works (LCB)			
L-1 : Access road	0.0	9.4	9.4
L-2 : Base camp	0.0	4.0	4.0
L-3 : Power supply system	0.0	0.6	0.6
Sub-total (1)	0.0	14.0	14.0
(2) Main Construction Works (ICB)			
I-1-3/4 : Diversion Tunnel	22.0	20.2	42.2
I-2-3/4 : Main Civil Works	154.9	162.3	317.2
I-3-3/4 : Hydromechanical Works	35.9	6.4	42.3
I-4-3/4 : Hydroelectrical Works	114.7	12.8	127.5
I-5-3/4 : Transmission Line	5.9	3.9	9.8
Sub-total (2)	333.4	205.6	539.0
Sub-total (1)+(2)	333.4	219.6	553.0
(3) Engineering Service	31.1	10.4	41.5
(4) Administration	0.0	3.9	3.9
(5) Land Compensation and Resettlement	3.9	6.7	10.6
Sub-total (1) to (5)	368.4	240.6	609.0
(6) Tax	0.0	29.8	29.8
Sub-total I (Base cost)	368.4	270.4	638.8
II. Contingency			
Price Contingency	26.0	17.9	43.9
Physical Contingency	29.0	25.4	54.4
Sub-total II (Contingency)	55.0	43.3	98.3
Total Project Cost	423.4	313.7	737.1

Table 8.5 Summary of Project Cost Estimate (Dong Nai No. 3)

Description	F.C. (million US$)	L.C. (million US$)	Total (million US$)
I. Base Cost			
(1) Preparatory Works (LCB)			
L-1 : Access road	0.00	4.00	4.00
L-2 : Base camp	0.00	2.00	2.00
L-3 : Power supply system	0.00	0.50	0.50
Sub-total (1)	0.00	6.50	6.50
(2) Main Construction Works (ICB)			
I-1-3 : Diversion Tunnel	13.00	11.70	24.70
I-2-3 : Main Civil Works	88.80	89.20	178.00
I-3-3 : Hydromechanical Works	18.00	3.20	21.20
I-4-3 : Hydroelectrical Works	52.10	5.80	57.90
I-5-3 : Transmission Line	3.10	2.00	5.10
Sub-total (2)	175.00	111.90	286.90
Sub-total (1)+(2)	175.00	118.40	293.40
(3) Engineering Service	16.50	5.50	22.00
(4) Administration	0.00	2.10	2.10
(5) Land Compensation and Resettlement	3.90	6.70	10.60
Sub-total (1) to (5)	195.40	132.70	328.10
(6) Tax	0.00	15.80	15.80
Sub-total I (Base cost)	195.40	148.50	343.90
II. Contingency			
Price Contingency	13.10	9.50	22.60
Physical Contingency	15.90	14.10	30.00
Sub-total II (Contingency)	29.00	23.60	52.60
Total Project Cost	224.40	172.10	396.50

Table 8.6 Summary of Project Cost Estimate (Dong Nai No. 4)

Description	F.C. (million US$)	L.C. (million US$)	Total (million US$)
I. Base Cost			
(1) Preparatory Works (LCB)			
L-1 : Access road and bridge	0.0	5.4	5.4
L-2 : Base camp	0.0	2.0	2.0
L-3 : Power supply system	0.0	0.1	0.1
Subtotal (1)	0.0	7.5	7.5
(2) Main Construction Works (ICB)			
I-1-4 : Diversion Tunnel	9.0	8.5	17.5
I-2-4 : Main Civil Works	66.1	73.1	139.2
I-3-4 : Hydromechanical Works	17.9	3.2	21.1
I-4-4 : Hydroelectrical Works	62.6	7.0	69.6
I-5-4 : Transmission Line	2.8	1.9	4.7
Subtotal (2)	158.4	93.7	252.1
Subtotal (1)+(2)	158.4	101.2	259.6
(3) Engineering Service	14.6	4.9	19.5
(4) Administration	0.0	1.8	1.8
(5) Land Compensation and Resettlement	0.0	0.0	0.0
Subtotal (1) to (5)	173.0	107.9	280.9
(6) Tax	0.0	14.0	14.0
Subtotal I (Base cost)	173.0	121.9	294.9
II. Contingency			
Price Contingency	12.9	8.4	21.3
Physical Contingency	13.1	11.3	24.4
Subtotal II (Contingency)	26.0	19.7	45.7
Total Project Cost	199.0	141.6	340.6

Table 8.7 Breakdown of Cost Estimate for Preparatory Works (Dong Nai No.3)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
Lot L-1 Access Road					0	4,000	4,000
Access road	km	10	0.0	200,000	0	2,000	2,000
Improvement of Route-20	km	40	0.0	50,000	0	2,000	2,000
Lot L-2 Basecamp							
Base camp	LS				0	2,000	2,000
Lot L-3 Power supply system							
Construction power supply	km	30	0.0	15,000	0	450	450
Total						6,450	6,450

Table 8.8 Breakdown of Cost Estimate for Preparatory Works (Dong Nai No. 4)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
Lot L-1 Access Road					0	5,420	5,420
Access road	km	25	0.0	200,000	0	5,000	5,000
Bridge	m^2	420	0.0	1,000	0	420	420
Lot L-2 Basecamp							
Base camp	LS				0	2,000	2,000
Lot L-3 Power supply system							
Construction power supply	km	8		15,000	0	120	120
Total						7,540	7,540

Table 8.9 Breakdown of Cost Estimate for Divesion tunnel (Dong Nai No. 3)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Site installation		10%			1,185	1,065	2,250
2) River diversion work					11,851	10,648	22,499
Excavation, tunnel	m^3	227,096	26.0	16.0	5,905	3,634	9,538
Tunnel supporting work	LS	25%			1,476	908	2,385
Concrete, lining	m^3	41,287	52.0	73.0	2,303	3,233	5,536
Re-bar	t	1,771	10.0	755.0	18	1,337	1,355
U/S cofferdam,clay	m^3	58,000	2.6	1.7	151	99	249
U/S cofferdam,rock	m^3	322,000	3.8	2.3	1,224	741	1,964
Others (open works, etc.)		7%			775	697	1,472
Total					13,036	11,713	24,749

Table 8.10 Breakdown of Cost Estimate for Divesion tunnel (Dong Nai No. 4)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Site installation		10%			817	773	1,590
2) River diversion work					8,172	7,729	15,901
Excavation, tunnel	m^3	174,521	26.0	16.0	4,538	2,792	7,330
Tunnel supporting work	LS	25%			1,134	698	1,832
Concrete, lining	m^3	35,484	55.0	75.0	1,952	2,661	4,613
Re-bar	t	1,419	10.0	755.0	14	1,072	1,086
Others (open works, etc.)		7%			535	506	1,040
Total					8,990	8,502	17,491

Table 8.11 Breakdown of Cost Estimate for Main Civil Works (Dong Nai No. 3)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Site installation		10.0%			8,076	8,105	16,181
2) Dam					28,556	22,302	50,858
Excavation, common	m^3	631,000	1.7	1.2	1,073	757	1,830
Excavation, rock	m^3	162,000	4.8	2.7	778	437	1,215
Embankment, clay	m^3	39,000	2.6	1.7	101	66	168
Embankment, filter	m^3	2,560	16.6	8.7	42	22	65
Embankment, rock	m^3	4,104,700	3.6	2.2	14,777	9,030	23,807
Embankment, crusher run	m^3	171,000	13.9	7.1	2,377	1,214	3,591
Embankment, selected rock	m^3	285,000	4.9	3.0	1,397	855	2,252
Embankment, random fill	m^3	110,000	1.9	1.1	209	121	330
Concrete, structure	m^3	2,600	30.0	63.0	78	164	242
Concrete, face slab	m^3	47,500	54.0	71.0	2,565	3,373	5,938
Re-bar	t	3,904	10.0	675.0	39	2,635	2,674
Grout work							
Blanket grout	m	7,700	33.0	22.0	254	169	424
Curtain grout	m	52,600	57.0	38.0	2,998	1,999	4,997
Others		7%			1,868	1,459	3,327
3) Spillway					7,532	13,686	21,219
Excavation, common	m^3	1,040,600	1.7	1.2	1,769	1,249	3,018
Excavation, rock	m^3	260,200	4.8	2.7	1,249	703	1,952
Concrete, structure	m^3	124,360	30.0	63.0	3,731	7,835	11,565
Concrete, replaced	m^3	10,140	25.0	48.0	254	487	740
Re-bar	t	3,731	10.0	675.0	37	2,518	2,556
Others		7%			493	895	1,388
4) Power intake					2,490	2,272	4,762
Excavation, common	m^3	402,500	1.7	1.2	684	483	1,167
Excavation, rock	m^3	140,600	4.8	2.7	675	380	1,055
Excavation, tunnel	m^3	4,550	26.0	16.0	118	73	191
Excavation, shaft	m^3	8,600	42.0	28.0	361	241	602
Concrete, structure	m^3	2,000	30.0	63.0	60	126	186
Concrete, tunnel	m^3	1,600	52.0	73.0	83	117	200
Concrete, shaft	m^3	5,510	62.0	79.0	342	435	777
Re-bar, open	t	80	10.0	675.0	1	54	55
Re-bar, tunnel	t	64	10.0	755.0	1	48	49
Re-bar, shaft	t	220	10.0	755.0	2	166	169
Others		7%			163	149	312
5) Headrace tunnel					32,185	31,579	63,764
Excavation, tunnel	m^3	547,044	26.0	16.0	14,223	8,753	22,976
Tunnel supporting work	LS	30%	0.0	0.0	4,267	2,626	6,893
Concrete, lining	m^3	152,470	52.0	73.0	7,928	11,130	19,059
Re-bar	t	6,099	10.0	755.0	61	4,605	4,666
Work adit	m	1,200	3,000.0	2,000.0	3,600	2,400	6,000
Others (portal work, grout work etc.)		7%			2,106	2,066	4,172
6) Surge tank					2,543	2,220	4,763
Excavation, common	m^3	84,200	1.7	1.2	143	101	244
Excavation, rock	m^3	6,200	4.8	2.7	30	17	47
Excavation, shaft	m^3	35,660	42.0	28.0	1,498	998	2,496
Tunnel supporting work	LS	20%	0.0	0.0	300	200	499
Concrete, lining	m^3	6,499	62.0	79.0	403	513	916
Re-bar	t	325	10.0	755.0	3	245	249
Others		7%			166	145	312
7) Penstock					1,243	1,102	2,345
Excavation, tunnel	m^3	14,436	26.0	16.0	375	231	606
Excavation, inclined shaft	m^3	6,519	60.0	40.0	391	261	652
Tunnel supporting work	LS	20%	0.0	0.0	153	98	252
Concrete, backfill	m^3	6,022	40.0	64.0	241	385	626
Re-bar	t	72	10.0	755.0	1	55	55
Others		7%			81	72	153
8) Powerhouse and switch yard					5,996	7,510	13,506
Excavation, common	m^3	98,000	1.7	1.2	167	118	284
Excavation, rock	m^3	350,000	4.8	2.7	1,680	945	2,625
Concrete, structure	m^3	35,000	38.0	72.0	1,330	2,520	3,850
Re-bar	t	2,720	10.0	675.0	27	1,836	1,863
Building and utility works	LS				2,400	1,600	4,000
Others		7%			392	491	884
9) Power outlet					215	383	597
Excavation, common	m^3	3,074	1.7	1.2	5	4	9
Excavation, rock	m^3	7,172	4.8	2.7	34	19	54
Concrete, structure	m^3	4,221	38.0	72.0	160	304	464
Re-bar	t	45	10.0	675.0	0	31	31
Others	LS	7%			14	25	39
Total					**88,835**	**89,160**	**177,995**

Table 8.12 Breakdown of Cost Estimate for Main Civil Works (Dong Nai No. 4)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Site installation		10%			6,012	6,648	12,660
2) Dam					13,810	8,246	22,055
Excavation, common	m^3	255,000	1.8	1.3	459	332	791
Excavation, rock	m^3	36,000	5.2	2.9	187	104	292
Embankment, core	m^3	370,000	2.6	1.7	962	629	1,591
Embankment, filter	m^3	111,000	18.0	9.8	1,998	1,038	3,036
Embankment, rock	m^3	1,763,000	4.3	2.5	7,581	4,408	11,988
Grout work							
Blanket grout	m	7,700	33.0	22.0	254	169	424
Curtain grout	m	25,700	57.0	38.0	1,465	977	2,442
Others		7%			903	539	1,443
3) Spillway					11,044	20,148	31,192
Excavation, common	m^3	1,268,000	1.8	1.3	2,282	1,648	3,931
Excavation, rock	m^3	317,000	5.2	2.9	1,648	919	2,568
Concrete, structure	m^3	181,240	32.0	64.0	5,800	11,599	17,399
Concrete, replaced	m^3	19,860	27.0	50.0	536	993	1,529
Re-bar	t	5,437	10.0	675.0	54	3,670	3,724
Others		7%			722	1,318	2,041
4) Power intake					1,716	1,661	3,378
Excavation, common	m^3	148,000	1.8	1.3	266	192	459
Excavation, rock	m^3	114,800	5.2	2.9	597	333	930
Excavation, tunnel	m^3	2,300	26.0	16.0	60	37	97
Excavation, shaft	m^3	6,540	42.0	28.0	275	183	458
Concrete, structure	m^3	1,780	32.0	64.0	57	114	171
Concrete, tunnel	m^3	1,610	47.0	75.0	76	121	196
Concrete, shaft	m^3	4,360	62.0	79.0	270	344	615
Re-bar, open	t	71	10.0	675.0	1	48	49
Re-bar, tunnel	t	64	10.0	755.0	1	49	49
Re-bar, shaft	t	174	10.0	755.0	2	132	133
Others		7%			112	109	221
5) Headrace tunnel					23,303	24,177	47,480
Excavation, tunnel	m^3	435,200	26.0	16.0	11,315	6,963	18,278
Tunnel supporting work	LS	20%			2,263	1,393	3,656
Concrete, lining	m^3	119,201	47.0	75.0	5,602	8,940	14,543
Re-bar	t	4,768	10.0	755.0	48	3,600	3,648
Work adit	m	850	3000.0	2000.0	2,550	1,700	4,250
Others (portal work, grout work etc.)		7%			1,524	1,582	3,106
6) Surge tank					1,523	1,358	2,882
Excavation, common	m^3	56,600	1.8	1.3	102	74	175
Excavation, rock	m^3	9,800	5.2	2.9	51	28	79
Excavation, shaft	m^3	19,927	42.0	28.0	837	558	1,395
Tunnel supporting work	LS	20%			167	112	279
Concrete, lining	m^3	4,266	62.0	79.0	264	337	601
Re-bar	t	213	10.0	755.0	2	161	163
Others		7%			100	89	189
7) Penstock					1,294	1,137	2,431
Excavation, tunnel	m^3	13,235	26.0	16.0	344	212	556
Excavation, inclined shaft	m^3	7,843	60.0	40.0	471	314	784
Tunnel supporting work	LS	20%			163	105	268
Concrete, backfill	m^3	5,917	39.0	64.0	231	379	609
Re-bar	t	71	10.0	755.0	1	54	54
Others		7%			85	74	159
8) Powerhouse and switch yard					7,193	9,342	16,535
Excavation, common	m^3	420,000	1.8	1.3	756	546	1,302
Excavation, rock	m^3	340,000	5.2	2.9	1,768	986	2,754
Concrete, structure	m^3	44,100	40.0	74.0	1,764	3,263	5,027
Re-bar	t	3,460	10.0	675.0	35	2,336	2,370
Building and utility works	LS				2400	1,600	4,000
Others		7%			471	611	1,082
9) Power outlet					238	412	650
Excavation, common	m^3	3,182	1.8	1.3	6	4	10
Excavation, rock	m^3	7,424	5.2	2.9	39	22	60
Concrete, structure	m^3	4,435	40.0	74.0	177	328	506
Re-bar	t	47	10.0	675.0	0	31	32
Others	LS	7%			16	27	43
Total					**66,132**	**73,131**	**139,263**

Table 8.13 Breakdown of Cost Estimate for Hydromechanical Works (Dong Nai No. 3)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Spillway gates	t	699	6,800.0	1,200.0	4,751	838	5,589
2) Intake gates	t	288	6,800.0	1,200.0	1,958	346	2,304
3) Intake trashrack	t	224	3,400.0	600.0	762	134	896
4) Steel penstock	t	2,580	2,975.0	525.0	7,676	1,355	9,031
5) Draft tube gates	t	288	6,800.0	1,200.0	1,958	346	2,304
6) Others		5%			855	151	1,006
Total					17,960	3,169	21,130

Table 8.14 Breakdown of Cost Estimate for Hydromechanical Works (Dong Nai No. 4)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
1) Spillway gates	t	699	6800.0	1200.0	4,751	838	5,589
2) Intake gates	t	279	6800.0	1200.0	1,894	334	2,229
3) Intake trashrack	t	217	3400.0	600.0	737	130	867
4) Steel penstock	t	2,615	2975.0	525.0	7,779	1,373	9,152
5) Draft tube gates	t	279	6800.0	1200.0	1,894	334	2,229
6) Others		5%			853	150	1,003
Total					17,908	3,160	21,068

Table 8.15 Breakdown of Cost Estimate for Electrical Works (Dong Nai No. 3)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
Lot I-4 Hydroelectrical Works					52,100	5,800	57,900
1) Generating equipment	LS				37,700	4,200	41,900
2) Switchgear equipment	LS				14,400	1,600	16,000
Lot I-5 Transmission Line					3,073	2,049	5,122
1) 220 kV transmission line	km	13	236,400	157,600	3,073	2,049	5,122

Table 8.16 Breakdown of Cost Estimate for Electrical Works (Dong Nai No. 4)

Cost Items	Unit	Quantity	Unit price (US$)		Amount (1000 US$)		
			FC	LC	FC	LC	Total
Lot I-4 Hydroelectrical Works					62,600	7,000	69,600
1) Generating equipment	LS				44,600	5,000	49,600
2) Switchgear equipment	LS				18,000	2,000	20,000
Lot I-5 Transmission Line					2,837	1,891	4,728
1) 220 kV transmission line	km	12	236,400	157,600	2,837	1,891	4,728

Table 8.17 Annual Disbursement Schedule (Dong Nai No. 3 + No. 4)

(Unit : US$ Million)

Description	F.C. (mill. US$)	L.C. (mill. US$)	Total (mill. US$)	Foreign Currency Portion (mill. US$)												Local Currency Portion (mill. US$)											
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
I. Base Cost																											
(1) Preparatory Works (LCB)																											
L-1 : Access road		9.4	9.4															3.8	5.6								9.4
L-2 : Base camp		4.0	4.0															1.6	2.4								4.0
L-3 : Power supply system		0.6	0.6															0.4	0.2								0.6
Sub-total (1)		14.0	14.0															5.7	8.3								14.0
(2) Main Construction Works (ICB)																											
I-1-3/4 : Diversion Tunnel	22.0	20.2	42.2				11.0	11.0							22.0				10.1	10.1							20.2
I-2-3/4 : Main Civil Works	154.9	162.3	317.2					19.9	43.2	46.5	38.7	6.6			154.9					20.7	45.0	48.7	40.6	7.3			162.3
I-3-3/4 : Hydromechanical Works	35.9	6.4	42.3						3.6	14.4	14.4	3.6			35.9							1.6	3.2	1.6			6.4
I-4-3/4 : Hydroelectrical Works	114.7	12.8	127.5						10.4	41.7	46.9	12.5	3.1		114.7							3.0	6.3	3.2	0.4		12.8
I-5-3/4 : Transmission Line	5.9	3.9	9.8							2.5	2.0	1.4			5.9							0.6	2.4	1.0			3.9
Sub-total (2)	333.4	205.6	539.0				11.0	30.9	57.2	105.0	102.0	24.1	3.1		333.4				10.1	20.8	45.0	53.9	52.4	13.0	0.4		205.6
Total (1)+(2)	333.4	219.6	553.0				11.0	30.9	57.2	105.0	102.0	24.1	3.1		333.4			5.7	18.4	30.8	45.0	53.9	52.4	13.0	0.4		219.6
(3) Engineering Service	31.1	10.4	41.5		4.7	4.7	3.1	3.1	5.5	5.5	3.1	1.5			31.1		1.6	1.6	1.0	1.0	1.8	1.8	1.0	0.5			10.4
(4) Administration		3.9	3.9														0.6	0.6	0.4	0.4	0.7	0.7	0.4	0.2			3.9
(5) Land Compensation and resettlement	3.9	6.7	10.6			1.2	1.2	0.8	0.4	0.4					3.9			2.0	2.0	1.3	0.7	0.7					6.7
Sub-total (1) to (5)	368.4	240.6	609.0		4.7	5.8	15.3	34.8	63.1	110.9	105.1	25.6	3.1		368.4		2.1	9.9	21.8	33.6	48.2	57.1	53.8	13.7	0.4		240.6
(6) Tax		29.8	29.8														0.3	0.6	1.7	3.3	5.5	8.3	7.9	2.0	0.2		29.7
Sub-total (base cost)	368.4	270.4	638.8		4.7	5.8	15.3	34.8	63.1	110.9	105.1	25.6	3.1		368.4		2.5	10.5	23.5	36.9	53.7	65.4	61.8	15.6	0.5		270.3
II. Contingency																											
Price Contingency	26.0	17.9	43.8		0.1	0.2	0.6	1.8	3.9	8.0	8.7	2.4	0.3		26.0		0.0	0.3	1.0	1.9	3.3	4.7	5.1	1.5	0.1		17.9
Physical Contingency	29.0	25.4	54.5		0.5	0.6	1.5	3.5	5.6	8.2	7.3	1.7	0.2		29.0		0.2	1.0	2.3	3.6	5.3	6.2	5.5	1.2	0.0		25.4
Sub-total (contingency)	55.0	43.3	98.3		0.6	0.8	2.1	5.3	9.5	16.2	16.1	4.1	0.5		55.0		0.3	1.4	3.3	5.5	8.6	10.9	10.6	2.7	0.1		43.3
Total project cost	423.4	313.7	737.1		5.2	6.6	17.4	40.1	72.6	127.1	121.2	29.6	3.6		423.4		2.7	11.3	26.8	42.4	62.3	76.3	72.3	18.3	0.6		313.7

Table 8.18 Annual Disbursement Schedule (Dong Nai No. 3)

(Unit : US$ Million)

Description	F.C. (mill. US$)	L.C. (mill. US$)	Total (mill. US$)	Foreign Currency Portion (mill. US$)												Local Currency Portion (mill. US$)											
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
I. Base Cost																											
(1) Preparatory Works (LCB)																											
L-1 : Access road		4.0	4.0															1.6	2.4								4.0
L-2 : Base camp		2.0	2.0															0.8	1.2								2.0
L-3 : Power supply system		0.5	0.5															0.3	0.2								0.5
Subtotal (1)		6.5	6.5															2.7	3.8								6.5
(2) Main Construction Works (ICB)																											
I-1-3 : Diversion Tunnel	13.0	11.7	24.7				6.5	6.5							13.0				5.9	5.9							11.7
I-2-3 : Main Civil Works	88.8	89.2	178.0					13.3	26.6	26.6	22.2				88.8					13.4	26.8	26.8	22.3				89.2
I-3-3 : Hydromechanical Works	18.0	3.2	21.2						3.6	9.0	5.4				18.0							1.6	1.6				3.2
I-4-3 : Hydroelectrical Works	52.1	5.8	57.9						10.4	26.1	15.6				52.1							2.3	3.5				5.8
I-5-3 : Transmission Line	3.1	2.0	5.1							2.5	0.6				3.1							0.6	1.4				2.0
Subtotal (2)	175.0	111.9	286.9				6.5	19.8	40.7	64.2	43.9				175.0				5.9	19.2	26.8	31.3	28.8				111.9
Total (1)+(2)	175.0	118.4	293.4				6.5	19.8	40.7	64.2	43.9				175.0			2.7	9.7	19.2	26.8	31.3	28.8				118.4
(3) Engineering Service	16.5	5.5	22.0		2.5	2.5	1.7	1.7	3.3	3.3	1.7				16.5		0.8	0.8	0.6	0.6	1.1	1.1	0.6				5.5
(4) Administration		2.1	2.1														0.3	0.3	0.2	0.2	0.4	0.4	0.2				2.1
(5) Land Compensation and resettlement	3.9	6.7	10.6			1.2	1.2	0.3	0.4	0.4					3.9			2.0	2.0	1.3	0.7	0.7					6.7
Subtotal (1) to (5)	195.4	132.7	328.1		2.5	3.6	9.3	22.3	44.4	67.9	45.5				195.4		1.1	5.9	12.4	21.3	29.0	33.5	29.5				132.7
(7) Tax		15.8	15.8														0.2	0.3	0.9	2.1	3.6	5.0	3.7				15.8
Subtotal (base cost)	195.4	148.5	343.9		2.5	3.6	9.3	22.3	44.4	67.9	45.5				195.4		1.3	6.2	13.3	23.4	32.5	38.5	33.3				148.5
II. Contingency																											
Price Contingency	13.1	9.5	22.6		0.0	0.1	0.4	1.1	2.7	4.9	3.8				13.1		0.0	0.2	0.5	1.2	2.0	2.8	2.8				9.5
Physical Contingency	15.9	14.1	30.0		0.2	0.4	0.9	2.2	3.7	4.9	3.5				15.9		0.1	0.6	1.3	2.3	3.2	3.6	3.0				14.1
Subtotal (contingency)	29.0	23.6	52.6		0.3	0.5	1.3	3.4	6.5	9.8	7.2				28.9		0.2	0.8	1.9	3.5	5.2	6.3	5.7				23.6
Total project cost	224.4	172.1	396.5		2.8	4.1	10.6	25.6	50.8	77.7	52.7				224.3		1.5	6.9	15.2	26.9	37.8	44.8	39.0				172.0

Table 8.19 Annual Disbursement Schedule (Dong Nai No.4)

(Unit : US$ Million)

Description	F.C. (mill. US$)	L.C. (mill. US$)	Total (mill. US$)	Foreign Currency Portion (mill. US$)												Local Currency Portion (mill. US$)											
				2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
I. Base Cost																											
(1) Preparatory Works (LCB)																											
L-1 : Access road		5.4	5.4															2.2	3.2								5.4
L-2 : Base camp		2.0	2.0															0.8	1.2								2.0
L-3 : Power supply system		0.1	0.1															0.1	0.0								0.1
Subtotal (1)		7.5	7.5															3.0	4.5								7.5
(2) Main Construction Works (ICB)																											
I-1-4 : Diversion Tunnel	9.0	8.5	17.5				4.5	4.5							9.0				4.3	4.3							8.5
I-2-4 : Main Civil Works	66.1	73.1	139.2					6.6	16.5	19.8	16.5	6.6			66.1					7.3	18.3	21.9	18.3	7.3			73.1
I-3-4 : Hydromechanical Works	17.9	3.2	21.1							5.4	9.0	3.6			17.9								1.6	1.6			3.2
I-4-4 : Hydroelectrical Works	62.6	7.0	69.6							15.7	31.3	12.5	3.1		62.6							0.7	2.8	3.2	0.4		7.0
I-5-4 : Transmission Line	2.8	1.9	4.7								1.4	1.4			2.8								1.0	1.0			1.9
Subtotal (2)	158.4	93.7	252.1				4.5	11.1	16.5	40.9	58.2	24.1	3.1		158.4				4.3	11.6	18.3	22.6	23.6	13.0	0.4		93.7
Total (1)+(2)	158.4	101.2	259.6				4.5	11.1	16.5	40.9	58.2	24.1	3.1		158.4			3.0	8.7	11.6	18.3	22.6	23.6	13.0	0.4		101.2
(3) Engineering Service	14.6	4.9	19.5		2.2	2.2	1.5	1.5	2.2	2.2	1.5	1.5			14.6		0.7	0.7	0.5	0.5	0.7	0.7	0.5	0.5			4.9
(4) Administration		1.8	1.8														0.3	0.3	0.2	0.2	0.3	0.3	0.2	0.2			1.8
(5) Land Compensation and resettlement																											
Subtotal (1) to (5)	173.0	107.9	280.9		2.2	2.2	6.0	12.6	18.7	43.0	59.6	25.6	3.1		173.0		1.0	4.0	9.4	12.2	19.3	23.6	24.3	13.7	0.4		107.9
(6) Tax		14.0	14.0														0.1	0.3	0.8	1.2	1.9	3.3	4.2	2.0	0.2		14.0
Subtotal (base cost)	173.0	121.9	294.9		2.2	2.2	6.0	12.6	18.7	43.0	59.6	25.6	3.1		173.0		1.2	4.3	10.2	13.5	21.2	27.0	28.5	15.6	0.5		121.9
II. Contingency																											
Price Contingency	12.9	8.4	21.3		0.0	0.1	0.2	0.6	1.2	3.1	4.9	2.4	0.3		12.9		0.0	0.1	0.4	0.7	1.3	1.9	2.4	1.5	0.1		8.4
Physical Contingency	13.1	11.3	24.5		0.2	0.2	0.6	1.3	1.9	3.3	3.9	1.7	0.2		13.1		0.1	0.4	1.0	1.3	2.1	2.6	2.5	1.2	0.0		11.3
Subtotal (contingency)	26.0	19.7	45.8		0.3	0.3	0.8	1.9	3.0	6.4	8.8	4.1	0.5		26.0		0.1	0.6	1.4	2.0	3.4	4.5	4.9	2.7	0.1		19.7
Total project cost	199.0	141.6	340.7		2.5	2.5	6.8	14.5	21.7	49.4	68.5	29.6	3.6		199.0		1.3	4.9	11.6	15.5	24.6	31.5	33.4	18.3	0.6		141.6

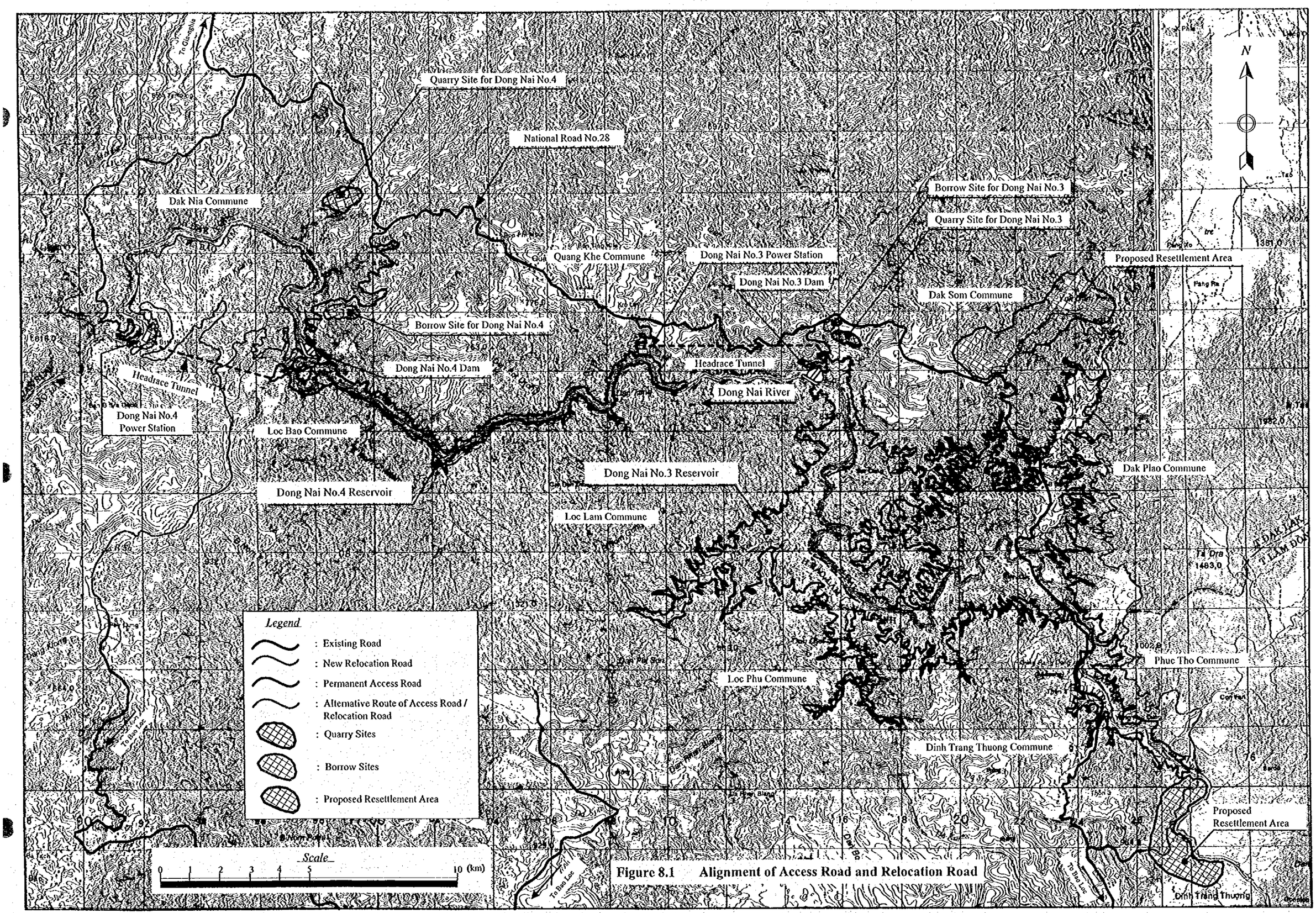

Figure 8.1 Alignment of Access Road and Relocation Road