The above comparative study was worked out for the first phase work. The second phase will be basically implemented by the same natures as the first phase. However standby pumps, raw water basin and other joint use facilities will be installed in the first phase.

5.3.4 Design of Structures

The features of the proposed are completely shown in Table 22.

(1) Intake

The intake is selected at the head of the South Main Irrigation Canal and is composed of approach channel, pumping well, pump station and electric station as shown in Fig. 26.

The pump well will be constructed in full capacity in the first phase. It has a capacity of 92 m^3 between HWL 31.6 m and LWL 28.6 m and is 3.0m in width and 12.0m in length.

The pumping station and electric stations are 78 m^2 and 85 m^2 respectively in terms of floor area. The pumping station is accommodating three units of horizontal double section volute pump of which one unit is the standby and the other one unit will be installed in the second phase. The features of pump and motor are as follows.

Design Discharge	
1st phase	: 15.3 m^3/min./unit
2nd phase	: 15.3 m^3/min./unit
Gross head	: 30 m
Dia. of delivery pipe	: 200 mm
Motor capacity	: 110 kW

A diesel generator with 100 kVA output will be provided in the electric station for emergency use.

(2) Pipeline

The inside diameter of pipe is ø600 mm and its wall thickness is 6 mm. The pipeline is installed in two rows, one row of which will be initiated. It is aligned along the national highways and embeded deep into firm foundation.
The pipeline is divided into four reaches as follows.

Reach	Design Discharge		Length	Dia of Pipe	
	1st Phase (m^3/s)	2nd Phase (m^3/s)	(km)	1st Phase (mm)	2nd Phase (mm)
Intake-5.0 km point	0.26	0.26	5	600	600
5.0 km point-Ban Suan Phak	0.25	0.25	14	600	600
Ban Suan Phak-31.8 km point	0.24	0.24	13	600	600
31.8 km point-Raw water basin	0.23	0.23	24	600	600

The longitudinal profile and typical cross section of the pipeline is shown in Fig. 27.

(3) Booster Pump Station

As shown in Fig. 27, two booster pump stations will be constructed. The one is located at Ban Suan Phak and the other at Ban Yat Noen. The booster pump station comprises receiving well, pump well, pump station and electric station as shown in Fig. 28. Features of the stations are as follows.

Description	Unit	Ban Suan Phak	Ban Yot Noen
Receiving Well			
Capacity	m^3	141	141
HWL	El.m	23.0	38.0
LWL	El.m	20.0	35.0
Dimension, L x B	m	9.4x5.0	9.4x5.0

to be cont'd

Description	Unit	Ban Suan Phak	Ban Yot Noen
Pump Well			
Capacity	m^3	879	879
HWL	El.m	21.8	36.8
LWL	El.m	18.8	33.8
Dimension, L x B	m	24.2x12.1	24.2x12.1
Pump			
Design discharge	m^3/min.	14.5	13.6
Gross head	m	55	50
Dia. of delivery pipe	mm	200	200
Motor capacity	kW	190	160
Nos. of installation	nos	3	3
Pump Station	m^2	78	78
Electric Station	m^2	85	85

Type of pumps is the same as the intake pump. Two units including one standby will be installed in the initial stage.

Each pump station will be provided with a diesel generator of 100 kVA capacity for emergency use.

(4) Raw Water Basin

Raw water basin will be constructed at two locations. A small raw water basin is proposed to be constructed close to Ban Suan Phak booster pump station to facilitate the water diversion to Phanat Nikhom. The other raw water basin is situated at the end of the pipeline. The features of the raw water basins are as follows.

Description	Unit	Raw Water Basin	
		Ban Suan Phak	Khao Choeng Thian
Capacity	m^3	180	4,200
HWL	El.m	23.0	62.0
LWL	El.m	20.0	59.0
Dimension, L x B	m	10.0 x 6.0	40.0 x 35.0

Fig. 29 shows the preliminary design of the raw water basin.

(5) Other Appurtenant Structures

One way surge tank is proposed at about 4 km point from the intake to solve water hammer. It capacity is provisionally estimated to be 80 m^3/s.

Butterfly valve will be installed at intervals of one to three km. Air valve and blow-off will also be installed in convex section and concave section respectively. Fig. 30 shows the appurtenant facilities.

(6) Electricity Supply

The electricity supply for intake and booster pump stations will be made available from PEA. It may be supplied by 22 kV and stepped down to 3kV/380V/220V.

5.4 Preliminary Design of Nong Pla Lai System

5.4.1 Design Discharge

The Nong Pla Lai system supplies a raw water to Nong Kho reservoir from Nong Pla Lai reservoir. It will be realized in two phases in accordance with growth of water demand. The design discharge is determined taking into account the plant factor as tabulated below.

Description	Year			
	1986	1991	1996	2001
Annual water diversion ($10^6 m^3$)	-	4.9	14.2	31.3
System capacity (m^3/s)				
1st phase	-	0.65	0.65	0.65
2nd phase	-	-	0.65	0.65

5.4.2 Route Alignment

In the long-term water supply plan, the Neong Pla Lai system is directly connected to the Nong Kho reservoir. The water supply to Pattaya area is planned by means of extension of Nong Kho conveyance system. This alignment is shown in Fig. 31 and is temporarily called as Alternative A.

The water supply to Pattaya area, however, may possibly be attained directly from Nong Pla Lai system by installing the branch pipeline line as shown in Fig. 32. In this case Nong Kho system between Laem Chabang and Nong Kho dam is unnecessary. This route alignment plan is herein named as Alternative B.

A tentative layout design was carried out for both alternatives for comparison of construction cost. Table 23 shows the features of each alternative. The estimated construction cost is shown in Table 24 and is summarized below.

(Unit: ฿10^6)

Systems	Alternative A	Alternative B
Nong Pla Lai	909.4	814.2
Nong Kho (4-2)	398.6	334.2
Nong Kho (4-3)	113.5	-
Nong Pla Lai, branch	-	111.7
Total	1,421.5	1,260.1

In view of investment requirement, Alternative A has the advantage of Alternative B. As well the Alternative A runs through the proposed development area where a large number of water consumers are expected to be concentrated. Having regard to such circumstances, Alternative A is proposed as a route of Nong Pla Lai system.

The intake is located at the outlet of the river outlet in Nong Pla Lai dam. The pipeline runs along the rural road and tends to ascend toward Rout 331. The highest elevation is approximately EL. 110 m, which is about 80 m higher than intake water level and also 50 m higher than delivery water level. Thus upstream half is designed in pressure flow with a booster pump station while the lower half is designed in gravity flow.

5.4.3 Selection of Optimum System

The same method as employed in the preceding sub-section 5.3.3 is adopted herein.

For the upstream reach, four different combinations of pump and pipe size are considered to be eligible. The head tank is selected at Bang Khao Khayai and its high water and low water levels are pre-determined at El. 118.0 m and El. 115.0 m respectively. The intake water level is determined referring to the Phase I Study. Four alternatives are illustrated in Fig. 33.

The principal features and construction cost of the respective alternative are shown in Tables 25 and 26 respectively. The O & M cost and replacement cost are also estimated as presented in Table 27. A relationship between pipe size, annual equivalent cost and O & M cost is developed as indicated in Table 27 and Fig. 34.

As the result, Alternative 2 is selected as the most economical system among four alternatives. The inside diameter of pipe is ø900 mm and a booster station with 1,450 kW capacity is installed in between the intake and the head tank. The hydraulic properties was worked out for the selected plan as shown in Fig. 35.

The lower reach between the head tank and the Nong Kho dam is designed in gravity flow by harnessing the head of about 50 m. Minimum diameter of pipe is justified to be most economical as demonstrated in Table 28. It is ø800 mm in inside diameter.

5.4.4 Design of Structures

Table 30 shows the features of the proposed works.

(1) Intake

The intake is selected at the outlet of the river outlet of Nong Pla Lai dam and is composed of pump well, pump station and electric station as shown in Fig. 36. According to the Phase I Study, the river outlet has been designed for the maximum discharge of 14.0 m^3/s. The maximum release is however only 10.0 m^3/s. Thus the domestic and industrial water demand of 1.29 m^3/s can be sufficiently obtainable through the river outlet.

The pump well is designed with a 3-m drawdown between HWL 27.8 m and LWL 24.8 m and has a storage capacity of 288 m^3, sufficient for 3 minutes of retention time. The well water level is determined in relation to the river outlet design presented in the Phase I Study.

Five units of horizontal double suction volute pump will be installed, of which three units including one standby will be fixed in the initial stage. The characteristics of pump are as follows.

Design Discharge
- 1st Phase : 19.5 m^3/min./unit
- 2nd Phase : 19.5 m^3/min./unit

Gross Head : 85 m

Dia of Delivery Pipe: 400 mm

Motor Capacity : 390 kW

The pumping and electric stations have floor areas of 168 m^2 and 98 m^2 respectively. An emergency generator with 100 kVA capacity will be installed in the electric station.

(2) Pipeline

The inside diameters of pipe is already decided at ø900 mm for the upstream reach and at ø800 mm for the downstream reach from the economic point of view. Required wall thickness is 7.9 mm. The pipeline is divided into 3 reached by reasons of hydraulic design.

Reach	Design Discharge (m^3/s)	Length (km)	Dia. of Pipe (mm)
Intake-Booster P/S	1.29	11	900
Booster P/S-Head Tank	1.29	22	900
Head Tank-Nong Kho dam	1.29	20	800

The longitudinal profile and typical cross section of pipeline is shown in Fig. 37. Water conveyed through the pipeline is directly flown into Nong Kho reservoir.

(3) Booster Pump Station

The booster pump station is selected at Ban Thap Thong from the topographic and hydraulic viewpoints. The components of the station are receiving well, pump well, pump station and electric station as shown in Fig. 38. The features of the station are as follows.

Receiving Well	
Capacity	298 m^3
HWL	El. 93 m
LWL	El. 90 m
Dimension, L x B	12.4 m x 8.0 m
Pump Well	
Capacity	2,327 m^3
HWL	El. 91.7 m
LWL	El. 88.7 m
Dimension, L x B	28.0 m x 27.7 m
Pump	
Design discharge	19.4 m^3/min
Gross head	65 m
Dia of delivery pipe	350 mm
Motor capacity	290 kW
No. of unit	5
Pump Station	168 m^2
Electric Station	91 m^2
Diesel Generation	100 kVA

Out of five units of pump, three units including a standby will be set up in the first phase.

(4) Head Tank

The head tank is located at the highest position along the selected route so that static head between the tank and the Nong Kho dam can be efficiently utilized. It will be constructed with a full scale in the first phase. Brief features are as follows.

HWL	El. 118.0 m
LWL	El. 115.0 m
Storage capacity.	2,352 m^3

Fig. 39 shows the preliminary design of the head tank.

(5) Other Appurtenant Structures

One way surge tanks will be required at 3, 7 and 17 km points respectively. Their capacities are estimated to be 16, 4 and 6 m^3 respectively.

Supersonic flow meters with ø900 mm will be installed in each pipeline at intake, booster pump station and terminal point.

Butterfly valves, air valves and blow-offs will be provided in an appropriate location, according to topographic conditions.

(6) Electricity Supply

The electricity supply to the intake facilities and the Booster pump station will be made available from PEA.

6. COST ESTIMATE

6.1 Investment Cost

6.1.1 Basic Condition

The investment cost was estimated based on the 1982 price level. The cost comprises direct cost, compensation and land acquisition cost, administration cost of executive agency, engineering services and physical and price contingencies. The followings are the basic conditions for the direct cost estimate.

(1) The currency exchange rates were assumed;

US$1 = Baht 23 = Japanese Yen 240

(2) The construction works will be executed by contractors selected through international competitive bidding.

(3) Unit price of each work item included direct cost such as personnel and labour expenses, material costs and operation and depreciation costs of construction equipment. The unit price is divided into foreign currency portion and local currency portion in accordance with the following classification.

Foreign Currency Portion

- Depreciation cost of constructional plant and equipment,
- Large gate and valve,
- Electrical equipment,
- Hydro-mechanical equipment,
- Steel pipe and valve,

Local Currency Portion

- Labour wages,
- Sand, gravel, timber, board,
- Fuel, oil, lubricant,
- Cement,
- Reinforcement steel bars,
- Inland transportation cost.

(4) The contractor's overhead and profit were estimated in accordance with the Government's guideline issued in July 30, 1982.

(5) Income taxes to be levied by the Government is also included in the cost estimate.

(6) Import tax and duty on the equipment, plants and materials imported by contractors were not taken into account.

The compensation and land acquisition cost is referred to the result of the compensation survey, which was directly conducted by RID in 1982.

The administration cost of the executive agency was assumed to be 4% of the direct cost. The cost of engineering services was estimated to be 8% of the direct cost. The physical contingency is assumed to be 15% of the sum of the direct cost, compensation and land acquisition cost, administration cost of the executive agency and cost of engineering services. The price contingency was estimated assuming broadly a price escalation of 10% per annum for the local currency portion and of 8% per annum for the foreign currency portion.

6.1.2 Investment Cost

The investment cost estimate is presented in Table 29 and 30 and is summarized as follows.

(Unit: ฿10^6)

Development Phase	Khlong Luang System			Nong Pla Lai System		
	F/C	L/C	Total	F/C	L/C	Total
Phase I	388.3	170.6	558.9	585.8	248.3	834.1
Phase II	483.1	146.8	629.9	767.2	276.0	1,043.2
Total	871.4	317.4	1,188.8	1,353.0	524.3	1,877.3

The disbursement schedule of the investment cost is prepared as shown in Tables 31 and 32, referring to the implementation schedules. The economic construction cost is obtained by subtracting the transfer payment such as compensation cost, tax, price contingency etc. and is shown in Tables 33 and 34.

6.2 Operation and Maintenance Cost

The operation and maintenance cost is assumed to be 0.5% of the initial investment. In addition electric charge was added as a part of O & M cost and was calculated at a rate of ฿1.19 kWh. The estimated O & M cost are as follows.

(Unit: ฿ 10^6)

Year	Khlong Luang System			Nong Pla Lai System		
	O & M cost	Electric charge	Total	O & M cost	Electric charge	Total
1986	–	–	–	–	–	–
1991	3.0	1.1	4.1	3.5	4.4	7.9
1996	5.6	5.2	10.8	6.7	12.8	19.5
2001	5.6	9.6	15.2	6.7	28.3	35.0

6.3 Replacement Cost

Some facilities and equipment need to be replaced periodically Economic life and replacement cost are estimated as follows.

(Unit: ฿ 10^6)

Facilities and Equipment	Economic Life (year)	Water Conveyance System			
		Khlong Luang		Nong Pla Lai	
		Phase I	Phase II	Phase I	Phase II
Hydro-mechanical equipment	16	10.2	4.7	15.8	9.0
Electrical equipment	16	27.9	6.0	27.6	6.0
Pipeline	40	184.8	184.6	306.8	306.9

6.4 Construction Schedule

The construction schedule is prepared as shown in Figs. 40 and 41.

7. DOMESTIC AND INDUSTRIAL WATER SUPPLY BENEFIT

7.1 Unit Water Supply Benefit

Domestic and industrial water supply benefit is derived from the cost of alternative facilities with the single purpose of supplying domestic and industrial water. Alternative facilities include the dams which are assumed to be located at the same location as the proposed damsties and the water conveyance systems which are proposed in the present study.

The benefit is evaluated at Khao Choeng Thian which is the terminal point of the proposed Khlong Luang water conveyance system for Khlong Luang Dam Scheme. Benefit of the Khlong Yai Dam Scheme is evaluated at Nong Kho reservoir which is the terminal point of proposed Nong Pla Lai water conveyance system for water supply to Chon Buri - Pattaya area and at the Nong Pla Lai Dam for water supply to Map Ta Phut - Sattahip area.

Unit D&I water supply benefit is obtained by the following formula.

$$\sum_{n=1}^{n} \frac{C_1(n) + C_2(n)}{(1+i)^n} = \sum_{n=1}^{n} \frac{\alpha \cdot S_n}{(1+i)^n}$$

where, $C_1(n)$; construction cost of alternative facilities (฿10^6)

$C_2(n)$; OM&R cost of alternative facilities (฿10^6)

α; unit D&I water supply benefit (฿/m^3)

S_n; water supply volume (10^6 m^3/year)

i; discount rate, which is the same rate as the internal rate of return

Parameters in the formula are presented in the Table 35 and unit D&I water supply benefit is shown below.

Discount Rate (%)	Unit Benefit (฿/ m^3)			
	Khlong Luang	Khlong Yai		
		Total	Chon Buri-Pattaya	Map Ta Phut -Sattahip
8.0	-	10.35	7.97	2.38
10.0	12.69	13.14	10.14	3.00
12.0	15.88	16.36	12.69	3.67
14.0	19.51	20.01	15.63	4.38
16.0	23.57	24.09	18.97	5.12
18.0	28.07	-	-	-

7.2 Domestic and Industrial Water Supply Benefit

Total D&I water supply benefit is obtained by multiplying the unit benefit by annual water supply volume. Annual water supply by each five year period is as show below and total D&I water supply benefit by different discount rate is presented in table 35.

Year	Khlong Luang	Khlong Yai	
		Chon Buri Pattaya	Map Ta Phut -Sattahip
1991	4.1	4.9	43.2
1996	10.9	14.2	48.2
2001	17.8	31.3	53.5

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4. STUDY ON EASTERN SEABOARD BASIC INDUSTRIES AND DEEP-SEA PORT DEVELOPMENT: SECRETARIAT OFFICE, EASTERN SEABOARD BASIC INDUSTRIES DEVELOPMENT SUB-COMMITTEE, THAILAND, APR. 1981

5. THE FIFTH FIVE YEAR PLAN B.E. 2525 - 2529: PWWA

6. DESIGN CRITERIA FOR WATER WORKS FACILITIES: JAPAN WATER WORKS ASSOCIATION, 1978

TABLES

Table 1 EXISTING WATER WORKS

Water Works Location	Zone No.	Service Area Area	Zone No.	Plant Capacity (m^3/day)	Commissioning in Service	Water Source
1. Large Scale Water Works						
Chon Buri		M. Chon Buri	2	24,000	1973	Bang Phra reservoir
		A. Muang	2	24,000	1977	
		T. Si Racha	4	48,000		
		SD. Saen Suk	2			
		SD. Bang Phra	3			
Ban Bung	1	SD. Ban Bung	1	480	-	Ma Pai stream & Chang Nam pond
		A. Ban Bung	1			
Phanat Nikhom	1	M. Phanat Nikhom	1	960	1968	Sarika stream
		A. Phanat Nikhom	1	1,200	1978	
				2,160		
Naklua-Pattaya		M. Pattaya	5	1,920	-	
		A. Muang	5	24,000	1979	Map Prachan reservoir
				25,920		
Rayong	10	M. Rayong	10	960	-	Tha Si Phet Lake and Rayong river at Ban Khai
		A. Muang	5	1,920	1967	
				4,800	1974	
				7,680		
2. Rural Water Works						
Nong Kakha		Nong Kakha	1	240		Pondage
Phan Thong		Phan Thong	1	720		Irrigation canal
Ao Udom		Ao Udom	4	1,200		Pondage
Tha Bun Mi		Tha Bun Mi	1	720		
Ban Soet		Ban Soet	1	480		Small stream
Ban Khai		Ban Khai	10	480		Ban Khai irri. canal
Ban Chang		Ban Chang	8	1,200		Pondage
Pluak Daeng		Pluak Daeng	10	240		Small stream

Data Source : PWWA

Table 2 HISTORICAL WATER SUPPLY AND USE BY LARGE WATER WORKS

Description	Water Works	1977	1978	1979	1980	1981	Average growth rate
1. Total Quantity of Water Supplied (10^3m^3/yr)	Chon Buri	5,085	9,025	7,426	12,077	14,626	0.302
	Ban Bung	122	105	116	91	115	-0.015
	Phanat Nikhom	346	403	219	253	368	0.016
	Naklua-Pattaya	259	302	323	294	916	0.371
	Rayong	1,254	1,525	1,810	1,761	2,078	0.135
	Total	7,066	11,360	9,894	14,476	18,103	0.265
2. Total Quantity of Water Metered (10^3m^3/yr)	Chon Buri	4,951	5,318	5,569	4,988	6,495	0.070
	Ban Bung	102	92	82	57	94	-0.021
	Phanat Nikhom	294	310	154	183	291	-0.003
	Naklua-Pattaya	194	205	267	261	733	0.394
	Rayong	1,103	1,323	1,440	1,480	1,611	0.099
	Total	6,644	7,248	7,512	6,969	9,224	0.085
3. Population in Service Area (10^3)	Chon Buri	149.1	154.4	154.9	169.4	173.4	0.038
	Ban Bung	6.2	6.2	6.6	6.7	6.2	0.000
	Phanat Nikhom	13.1	13.3	13.3	15.2	13.8	0.013
	Naklua-Pattaya	23.0	29.7	31.8	34.9	36.5	0.122
	Rayong	26.8	27.1	27.5	31.1	37.8	0.090
	Total	218.2	230.7	234.1	257.3	267.7	0.052
4. Nos. of Consumers (household)	Chon Buri	12,115	13,073	13,872	14,801	15,569	0.065
	Ban Bung	374	409	432	443	459	0.053
	Phanat Nikhom	1,007	1,027	1,079	1,134	1,270	0.060
	Naklua-Pattaya	734	798	886	966	1,342	0.163
	Rayong	2,605	2,773	2,988	3,180	3,376	0.067
	Total	16,835	18,080	19,257	20,524	22,016	0.069
5. Served Population (10^3)	Chon Buri	(72.7)	(78.4)	(83.2)	(88.8)	(93.4)	0.065
	Ban Bung	(2.2)	(2.5)	(2.6)	(2.7)	(2.7)	0.053
	Phanat Nikhom	(6.0)	(6.2)	(6.5)	(6.8)	(7.6)	0.060
	Naklua-Pattaya	-	-	-	-	-	-
	Rayong	16.7	16.9	17.8	(19.1)	(20.3)	0.050
	Total	97.6	104.0	110.1	117.4	124.0	0.062
6. Pipe Water Supply per Capita (l/d)	Chon Buri	191.6	315.2	244.4	372.5	429.0	0.223
	Ban Bung	148.8	117.6	122.8	94.0	113.8	-0.069
	Phanat Nikhom	156.7	179.1	92.8	102.0	132.2	-0.043
	Naklua-Pattaya	-	-	-	-	-	-
	Rayong	206.1	247.0	278.7	252.8	281.1	0.081
	Average/1	191.1	291.3	238.2	331.0	379.7	0.187
7. Pipe Water Use per Capita (l/d)	Chon Buri	186.6	185.8	183.3	153.9	190.5	0.005
	Ban Bung	125.1	102.4	87.0	58.7	93.5	-0.076
	Phanat Nikhom	133.2	137.7	65.0	73.8	104.8	-0.062
	Naklua-Pattaya	-	-	-	-	-	-
	Rayong	181.3	214.2	221.8	212.2	217.9	0.035
	Average/1	181.0	185.6	180.3	156.6	187.5	0.009
8. Service Factor (%)	Chon Buri	48.8	50.8	53.7	52.4	53.9	0.025
	Ban Bung	36.2	39.5	39.2	39.7	44.1	0.051
	Phanat Nikhom	46.0	46.5	48.6	44.8	55.2	0.047
	Naklua-Pattaya	-	-	-	-	-	-
	Rayong	67.3	62.5	64.7	61.4	53.6	-0.059
	Average	50.0	51.7	54.4	52.8	53.6	0.018
9. Ratio of water supply loss (%)	Chon Buri	2.6	41.1	25.0	58.7	55.6	1.150
	Ban Bung	16.0	12.9	29.1	37.5	17.8	0.027
	Phanat Nikhom	15.0	23.1	30.0	27.5	20.7	0.084
	Naklua-Pattaya	25.0	32.0	17.2	11.5	19.9	-0.059
	Rayong	12.0	13.3	20.4	16.0	22.5	0.170
	Average	14.1	24.5	24.3	30.2	27.3	0.180

Note : Figures in parentheses are estimted assuming that each household accommodates a family of six.

/1 : Excluding the figure of Na Klua-Pattaya water works.

Table 3 WATER ABSTRACTION FROM RESERVOIRS FOR MANUFACTURING USE

Reservoir		Water Users		Water Abstraction ($10^3 m^3$)				
Name	Zone	Name	Zone	1977	1978	1979	1980	1981
1. Ban Bung	1	Chon Buri Sugar Mill	1	985	692	2,214	1,572	3,648
		TFV Co.,	1	125	88	53	57	50
		Sura Town Plywood	1	148	115	84	48	35
		Sub-total		1,258	895	2,351	1,677	3,733
2. Bang Phra	3	Thai Tapioca Fact.	3	263	263	263	264	262
		Sri Maharaj Plywood	4	84	81	106	127	122
		Thai Oil	4	1,050	993	1,116	955	1,226
		EGAT/1	1	-	-	-	-	-
		Sub-total		1,397	1,337	1,485	1,346	1,610
3. Map Prachan	5	Tapioca Fact./2	5	-	-	-	-	-
		Total		2,655	2,232	3,836	3,023	5,343

/1 : Thermal-power generation, to be completed in 1982

/2 : To be completed in 1982

Data Source : RID

Table 4 MONTHLY WATER SUPPLY AND FLUCTUATION RATIO IN 1981

Month	Chon Buri		Rayong		Ban Bung	
	Water Supply	Fluctuation ratio	Water Supply	Fluctuation ratio	Water Supply	Fluctuation ratio
	($10^3 m^3$)		($10^3 m^3$)		($10^3 m^3$)	
January	1,262	1.04	173	1.00	9.9	1.04
February	936	0.77	146	0.84	9.6	1.01
March	1,267	1.04	192	1.11	10.2	1.07
April	1,221	1.00	188	1.09	10.3	1.08
May	1,293	1.06	192	1.11	8.7	0.92
June	1,208	0.99	176	1.02	8.6	0.91
July	1,249	1.02	183	1.06	10.3	1.08
August	1,288	1.06	179	1.03	9.6	1.01
September	1,213	1.00	146	0.84	9.2	0.97
October	1,171	0.96	164	0.95	8.9	0.94
November	1,238	1.02	163	0.94	9.3	0.98
December	1,279	1.05	175	1.01	9.7	1.02
Average	1,219	1.00	173	1.00	9.5	1.00

Table 5 DOH STANDARD FOR POTABLE WATER

Item	Unit	Highest desirable level	Maximum permissible level
pH	-	7.0-8.5	6.5-9.2
Colour, Pt-Co scale	Units	5	50
Turbidity, Silica scale	Units	5	25
Total solids	mg/l	500	1,500
Hardness (as $CaCO_3$)	mg/l	100	500
Calcium (as Ca)	mg/l	75	200
Magnesium (as Mg)	mg/l	30/1	150
Iron (Total as Fe)	mg/l	0.1	1.0
Manganese (as Mn)	mg/l	0.05	0.5
Copper (as Cu)	mg/l	0.05	1.5
Zinc (as Zn)	mg/l	5	15
Lead (as Pb)	mg/l	-	0.1
Chromium (Total as Cr)	mg/l	-	0.05
Cadmium (as Cd)	mg/l	-	0.01
Sulfate (as SO_4)	mg/l	200	400
Chloride (as Cl)	mg/l	200	600
Fluoride (as F)	mg/l	0.6-0.8/2	-
Nitrate (as N)	mg/l	-	10
Coliform bacteria 37 °C 48 hrs.	(MPN/100 ml)	less than 2	-

/1 : Not more than 30 mg/l if there are 250 mg/l of sulfate; if there is less sulfate, magnesium up to 150 mg/l may be allowed.

/2 : Annual average of maximum daily air temperature 26.3-32.6 °C

Source : DOH

Table 6 DOH STANDARD FOR WATER SOURCE

Item		Standard
Colour, Pt-Co scale	Units	300
Dissolved solids	mg/l	1,500
Iron (as Fe)	mg/l	50
Manganese (as Mn)	mg/l	5
Copper (as Cu)	mg/l	1.5
Zinc (as Zn)	mg/l	1.5
Lead (as Pb)	mg/l	0.05
Chromium, hexavalent (as Cr)	mg/l	0.05
Fluoride (as F)	mg/l	1.5
Ammonia (as NH_3)	mg/l	0.5
Total Nitrogen (as N)	mg/l	1
Nitrate (as N)	mg/l	10
Biochemical Oxygen Demand	mg/l	6
Chemical Oxygen Demand	mg/l	10

Bacteriological Standards

Classification	Coliform bacteria /1 (MPN/100 ml)
I. Bacterial quality applicable to disinfection treatment only	0-50
II. Bacterial quality requiring conventional methods of treatment (coagulation, filtration, disinfection)	50-5000
III. Heavy pollution requiring extensive types of treatment	5000-50000
IV. Very heavy pollution, unacceptable unless special treatments designed for such water are used : source to be used only when unavoidable	greater than 50000

/1 : When more than 40% of the number of coliform bacteria represented by the MPN Index are found to be of the faecal coliform group, the water source should be considered to fall into the next higher category with respect to the treatment required.

Source : DOH

Table 7 REVENUES AND EXPENDITURES OF PWWA IN 1980 AND 1981 FISCAL YEARS

(Unit: ฿ 10^3)

Fiscal Year	By Water Works				Whole PWWA
	Chon Buri	Phanat Nikhom	Ban Bung	Naklua -Pattaya	
1980					
Revenue	11,513.1	463.2	139.5	634.2	261,238.8
Expenditure	14,911.8	1,281.5	786.1	830.2	391,815.7
Balance	-3,398.7	-818.3	-646.6	-196.0	-130,576.9
1981					
Revenue	18,877.8	261.5	1,005.2	2,773.0	362,301.5
Expenditure	21,663.6	1,579.7	1,028.0	2,384.7	500,480.6
Balance	-2,785.8	-1,318.2	-22.8	388.3	-138,179.1

Data Source: PWWA

Table 8 WATER CONVEYANCE CALCULATION FOR 2001, ALTERNATIVE I

(Unit: 10^6 m^3/year)

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Pakong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	0	-	-6.6	6.6	(B. Pakong P/S)		
1	2.1	5.8	0	60.1	1.9	69.9	0.7	P. Nikhom W.W.	0	-	68.8	0	68.8	79.8	Khlong Luang	+11.0	12.4	Khlong Luang	11.0	Khlong Luang
							0.1	N. Kakha W.W.												
							0.2	P. Thong W.W.												
							0.1	B. Soet W.W.												
1-1	0.4	0	4.3	0	0.4	5.1	0.1	B. Bung W.W.	0.3	Private	4.7	0	4.7	11.7	New Ban Bung	+7.0	4.0	(Private)	7.0	Ban Bung (2-1)
																	7.3	Ban Bung (2-1)		
2	23.3	0.1	0	15.4	0	38.8	0	-	0	-	38.8	0	38.8	-	-	-38.8	15.4	(Irri. Canal)		
																	5.4	(Bang Phra W.W.)		
																	11.0	Khlong Luang		
																	7.0	Ban Bung (2-1)		
3	0	0.3	2.3	0	8.0	10.6	0	-	0	-	10.6	0	10.6	34.7	(Bang Phra)	+24.1	2.3	(Private)	15.4	(Irri. Canal)
																	8.9	Nong Kho (4-1)	6.6	(B. Pakong P/S)
																			5.4	(Bang Phra W.W.)
																			5.6	(Bang Phra W.W.)
4	18.5	1.2	27.8	0	3.2	50.7	0	-	0	-	50.7	19.6	31.1	12.6	(Nong Kho)	-18.5	18.4	Bang Lamung	8.9	Nong Kho (4-1)
																	31.8	Nong Kho (4-2)	9.5	Nong Kho (4-3)
																	5.6	(Bang Phra W.W.)		
																	31.3	Nong Pla Lai		
5	15.2	0.3	0.7	0	2.5	18.7	0	-	0	-	18.7	0	18.7	9.2	(Map Prachon)	-9.5	8.7	(Pattaya W.W.)		
																	9.5	Nong Kho (4-3)		
6	1.0	0.1	0	0	0	1.1	0	-	0	-	1.1	1.0	0.1	0	-	-0.1	1.0	Huai Yai		
7	2.9	2.0	3.9	0	0	8.8	0	-	0	-	8.8	0	8.8	0	-	-8.8	8.8	Dok Krai		
8	1.1	0	0	0	0	1.1	0.4	Ban Chang W.W.	0	-	0.7	0	0.7	0	-	-0.7	9.5	Dok Krai	8.8	Dok Krai
9	4.0	0.2	41.3	0	0	45.5	0	-	0.2	Private	45.3	0	45.3	0	-	-45.3	1.3	(Private)	9.5	Dok Irai
																	53.5	(Dok Krai P.)		
10	9.7	3.3	1.6	140.9	12.0	167.5	0	-	0	-	167.5	31.8	135.7	56.8	(Dok Krai)	+86.0	7.4	Ban Khai	53.5	(Dok Krai P.)
														102.5	(Nong Pla Lai)		2.3	(Rayong W.W.)	31.3	Nong Pla Lai
														62.4	Khlong Yai		1.6	(Private)	1.3	(Private)
10-1	0	0	0	30.6	10.5	41.1	0	-	0	-	41.1	0	41.1	41.3	K. Thap Ma	+0.2				
Total	78.2	13.3	88.5	247.0	38.5	465.5	1.6	-	0.5	-	463.4	52.4	411.0	411.0		0	271.0		173.5	

Note: DU: Domestic, urban area
DR: Domestic, rural area
I: Industrial
A: Irrigation
M: River maintenance flow

Remarks: (1) Facilities in bracket are existing

Table 9 WATER CONVEYANCE CALCULATION FOR 2001, ALTERNATIVE II

(Unit: 10^6 m^3/year)

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Kong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	-	-	-6.6	6.6	(B. Pakong P/S)		
1	2.1	5.8	0	60.1	1.9	69.9	0.7	P. Nikhom W.W.	0	-	68.8	0	68.8	79.8	Khlong Luang	+11.0	12.4	Khlong Luang	8.5	Khlong Luang
							0.1	N. Kakha W.W.											2.5	Ban Bung (2-2)
							0.2	P. Thong W.W.												
							0.1	B. Soet W.W.												
1-1	0.4	0	4.3	0	0.4	5.1	0.1	B. Bung W.W.	0.3	Private	4.7	0	4.7	2.2	(Ban Bung)	-2.5	4.0	(Private)		
																	2.5	Ban Bung (2-2)		
2	23.3	0.1	0	15.4	0	38.8	0	-	0	-	38.8	0	38.8	0	-	-38.8	15.4	(Irri. Canal)		
																	11.3	(Bang Phra W.W.)		
																	8.5	Khlong Luang		
																	3.6	Bang Phao		
3	0	0.3	2.3	0	8.0	10.6	0	-	0	-	10.6	0	10.6	34.7	(Bang Phra)	+24.1	2.3	(Private)	15.4	(Irri. Canal)
																	18.4	Nong Kho (4-1)	6.6	(B. Pakong P/S)
																			11.3	(Bang Phra W.W.)
																			5.6	(Bang Phra W.W.)
																			3.6	Huai Yai
4	18.5	1.2	27.8	0	3.2	50.7	0	-	0	-	50.7	16.2	34.5	12.6	(Nong Kho)	-5.9	22.3	Nong Kho (4-2)	18.4	Nong Kho (4-1)
														16.0	Huai Bung		5.6	(Bong Phra W.W.)	9.5	Nong Kho (4-5)
																	15.0	Bang Lamung		
																	3.4	Nong Kho (4-4)		
																	31.3	Nong Pla Lai		
5	15.2	0.3	0.7	0	2.5	18.7	0	-	0	-	18.7	0	18.7	9.2	(Map Prdchan)	-9.5	8.7	(Pattaya W.W.)		
																	9.5	Nong Kho (4-5)		
6	1.0	0.1	0	0	0	1.1	0	-	0	-	1.1	1.0	0.1	0	-	-0.1	1.0	Huai Yai		
7	2.9	2.0	3.9	0	0	8.8	0	-	0	-	8.8	0	8.8	0	-	-8.8	8.8	Dok Krai		
8	1.1	0	0	0	0	1.1	0.4	Ban Chang W.W.	0	-	0.7	0	0.7	0	-	-0.7	9.5	Dok Krai	8.8	Dok Krai
9	4.0	0.2	41.3	0	0	45.5	0	-	0.2	Private	45.3	0	45.3	0	-	-45.3	53.5	(Dok Krai P.)	9.5	Dok Krai
																	1.3	(Private)		
10	9.7	3.3	1.6	140.9	12.0	167.5	0	-	0	-	167.5	31.8	135.7	56.8	(Dok Krai)	+86.0	7.4	Ban Khai	31.3	Nong Pla Lai
														102.5	(Nong Pla Lai)		2.3	(Rayong W.W.)	1.3	Private
														62.4	Khlong Yai		1.6	(Private)	53.5	(Dok Krai P.)
10-1	0	0	0	30.6	10.5	41.1	0	-	0	-	41.1	0	41.1	41.3	K. Thap Ma	+0.2	-	-	-	-
Total	78.2	13.3	88.5	247.0	38.5	465.5	1.6	-	0.5	-	463.4	49.0	414.4	417.5		+3.1	266.2		185.8	

Table 10 WATER CONVEYANCE CALCULATION FOR 2001, ALTERNATIVE III

(Unit: 10^6 m^3/year)

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Kong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	0	-	-6.6	6.6	(B. Pakong P/S)		
1	2.1	5.8	0	60.1	1.9	69.9	0.7	P. Nikhom W.W.	0	-	68.8	0	68.8	79.8	Khlong Luang	+11.0	12.4	Khlong Luang	11.0	Khlong Luang
							0.1	N. Kakha W.W.												
							0.2	P. Thong W.W.												
							0.1	B. Soet W.W.												
1-1	0.4	0	4.3	0	0.4	5.1	0.1	B. Bung W.W.	0.3	Private	4.7	0	4.7	11.7	New Ban Bung	+7.0	4.0	(Private)	7.0	Ban Bung (2-1)
																	7.3	Ban Bung (2-1)		
2	23.3	0.1	0	15.4	0	38.8	0	-	0	-	38.8	0	38.8	0	-	-38.8	15.4	(Irri. Canal)		
																	5.4	(Bang Phra W.W.)		
																	11.0	Khlong Luang		
																	7.0	Ban Bung (2-1)		
3	0	0.3	2.3	0	8.0	10.6	0	-	0	-	10.6	0	10.6	34.7	(Bang Phra)	+24.1	2.3	(Private)	15.4	(Irri. Canal)
																	9.4	Nong Kho (4-1)	5.4	(Bang Phra W.W.)
																			6.1	(Bang Phra W.W.)
																			6.6	(Bang Pakong P/S)
4	18.5	1.2	27.8	0	3.2	50.7	0	-	0	-	50.7	14.2	36.5	12.6	(Nong Kho)	-0.1	6.1	(Bang Phra W.W.)	9.4	Nong Kho (S-1)
														16.0	Huai Rung		13.0	Bang Lamung		
														7.8	H. Takhian Tia		15.0	Nong Kha (4-4)		
																	7.3	Nong Kho (4-6)		
																	4.9	Nong Kho (4-7)		
5	15.2	0.3	0.7	0	2.5	18.7	0	-	0	-	18.7	0	18.7	5.2	K. Na Klua	-4.3	8.7	(Pattaya W.W.)	4.9	Nong Kho (4-7)
														9.2	(Map Prachon)		9.5	Nong Ko (4-8)		
6	1.0	0.1	0	0	0	1.1	0	-	0	-	1.1	1.0	0.1	15.6	-	+15.5	1.0	Huai Yai		
7	2.9	2.0	3.9	0	0	8.8	0	-	0	-	8.8	0	8.8	0	-	-8.8	8.8	Dok Krai		
8	1.1	0	0	0	0	1.1	0.4	Ban Chang W.W.	0	-	0.7	0	0.7	0	-	-0.7	9.5	Dok Krai	8.8	Dok Krai
9	4.0	0.2	41.3	0	0	45.5	0	-	0.2	Private	45.3	0	45.3	0	-	-45.3	53.5	(Dok Krai P.)	9.5	Dok Krai
																	1.3	(Private)		
10	9.7	3.3	1.6	140.9	12.0	167.5	0	-	0	-	167.5	31.8	135.7	56.8	(Dok Krai)	+54.7	7.4	Ban Khai	1.3	(Private)
														102.5	(Nong Pla Lai)		2.3	(Rayong W.W.)	53.5	(Dok Krai P.)
														31.1	Khlong Yai		1.6	(Private)		
10-1	0	0	0	30.6	10.5	41.1	0	-	0	-	41.1	0	41.1	41.3	K. Thap Ma	+0.2	-	-	-	-
Total	78.2	13.3	88.5	247.0	38.5	465.5	1.6	-	0.5	-	463.4	47.0	416.4	424.3	-	+7.9	230.7		138.9	

Table 11 WATER CONVEYANCE CALCULATION FOR 2001, ALTERNATIVE IV

(Unit: 10^6 m^3/year)

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Kong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	0	-	-6.6	6.6	(B. Pakong P/S)		
1	2.1	5.8	0	60.1	1.9	69.9	0.7	P. Nikhom W.W.	0	-	68.8	0	68.8	62.0	K. Luang dam	-6.8	1.4	Ban Bung (2-2)		
							0.1	N. Kakha W.W.												
							0.2	P. Thong W.W.												
							0.1	B. Soet W.W.												
1-1	0.4	0	4.3	0	0.4	5.1	0.1	B. Bung W.W.	0.3	Private	4.7	0	4.7	11.7	New Ban Bung	+7.0	4.0	(Private)	1.4	Ban Bung (2-2)
																	1.7	Ban Bung (2-2)		
2	23.3	0.1	0	15.4	0	38.8	0	-	0	-	38.8	0	38.8	0	-	-38.8	15.4	(Irri. Canal)		
																	11.3	(Bang Phra W.W.)		
																	12.1	Huai Yai		
3	0	0.3	2.3	0	8.0	10.6	0	-	0	-	10.6	0	10.6	34.7	(Bang Phra)	+24.1	2.3	(Private)	12.1	Huai Yai
																	26.9	Nong Kho (4-1)	15.4	(Irri. Canal)
																			11.3	(Bang Phra W.W.)
																			5.6	(Bang Phra W.W.)
																			6.6	(B. Pakong P/S)
4	18.5	1.2	27.8	0	3.2	50.7	0	-	0	-	50.7	14.2	36.5	12.6	Nong Kho	-0.1	13.8	Nong Kho (4-2)	26.9	Nong Kho (4-1)
														16.0	Huai Bung		13.0	Bang Lamung	2.2	Nong Kho (4-5)
														7.8	H. Takhian Tia		11.9	Nong Kho (4-4)	7.3	Nong Kho (4-9)
																	31.3	Nong Pla Lai		
																	5.6	(Bang Phra W.W.)		
5	15.2	0.3	0.7	0	2.5	18.7	0	-	0	-	18.7	0	18.7	9.2	(Map Prochon)	-9.5	2.2	Nong Kho (4-5)		
																	7.3	Nong Kho (4-9)		
																	8.7	(Pattaya W.W.)		
6	1.0	0.1	0	0	0	1.1	0	-	0	-	1.1	1.0	0.1	0	-	-0.1	1.0	Huai Yai		
7	2.9	2.0	3.9	0	0	8.8	0	-	0	-	8.8	0	8.8	0	-	-8.8	8.8	Dok Krai		
8	1.1	0	0	0	0	1.1	0.4	Ban Chong W.W.	0	-	0.7	0	0.7	0	-	-0.7	9.5	Dok Krai	8.8	Dok Krai
9	4.0	0.2	41.3	0	0	45.5	0	-	0.2	Private	45.3	0	45.3	0	-	-45.3	53.5	(Dok Krai P.)	9.5	Dok Krai
																	1.3	(Private)		
10	9.7	3.3	1.6	140.9	12.0	167.5	0	-	0	-	167.5	31.8	135.7	56.8	(Dok Krai)	+86.0	7.4	Ban Khai	1.3	(Private)
														102.5	(Nong Pla Lai		2.3	(Rayong W.W.)	53.5	(Dok Krai P.)
														62.4	Khlong Yai		1.6	(Private)	31.3	Nong Pla Lai
10-1	0	0	0	30.6	10.5	41.1	0	-	0	-	41.1	0	41.1	41.3	K. Thap Ma	+0.2	-	-	-	-
Total	78.2	13.3	88.5	247.0	38.5	465.5	1.6	-	0.5	-	463.4	47.0	416.4	417.0		+0.6	260.9		193.2	

Table 12 WATER CONVEYANCE SYSTEMS BY WATER SUPPLY ALTERNATIVE

Water Supply Alternative	Water Conveyance System	Annual Water Conveyance ($10^6 m^3/yr$)	Pipeline			Intake		Booster Pump Station		Location of Receiving Facilities
			Dia (mm)	Length (km)	Row (nos)	Location	Capacity (kWxunit)	Location	Capacity (kWxunit)	
I.	Khlong Luang	12.4	500	19	2	K. Luang dam	160 x 3			B. Suan Phak
		11.7	600	23	2			B. Suan Phak	170 x 3	
		11.0	600	14	2			B. Yot Noen	140 x 3	K. Choeng Thian
	Ban Bung (2-1)	7.3	600	26	1	New Ban Bung dam	120 x 2			
		7.0	700	14	1			B. Yot Noen	180 x 2	K. Choeng Thian
	Nong Kho (4-1)	8.9	600	1	1	Nong Kho dam	120 x 2			B. Phra dam
	Nong Kho (4-2)	31.8	900	21	2	Nong Kho dam	140 x 5			B. Nong Kabok
	Nong Kho (4-3)	9.5	700	22	1			B. Nong Kabok	270 x 2	Map Prachan dam
	Bank Lamung	18.4	900	10	1	Huai Kong Dai	320 x 3			B. Nong Kabok
	Nong Pla Lai	31.3	900	37	2	Nong Pla Lai dam	310 x 5	B. Thap Thong	290 x 5	
		31.3	900	19	2					Nong Kho dam
	Huai Yai	1.0	300	1	1	Huai Yai	20 x 2			B. Huai Yai
	Dok Krai	9.5	600	9	1			Map Ta Phut	250 x 2	B. Krok Tabaek
		8.8	700	14	1					Sattahip
	Ban Khai	7.4	600	16	1	B. Khai weir	90 x 2			Rayong
II.	Khlong Luang	12.4	500	19	2	K. Luang dam	160 x 3			B. Suan Phak
		11.7	600	23	2			B. Suan Phak	170 x 3	
		11.0	500	14	2			B. Yot Noen	140 x 2	K. Choeng Thian
	Ban Bung (2-2)	2.2	500	26	1			B. Yot Noen	100 x 2	B. Bung dam
	Bang Phra	3.6	600	19	1	Bang Phra dam	140 x 2			K. Choeng Thian
	Nong Kho (4-1)	18.4	800	1	1	Nong Kho dam	100 x 3			B. Phra dam
	Nong Kho (4-2)	22.3	800	21	2	Nong Kho dam	100 x 4			B. Nong Kabok
	Nong Kho (4-4)	3.4	500	10	1	Huai Bung	70 x 2			B. Nong Kabok
	Nong Kho (4-5)	9.5	700	12	1	Huai Bung	270 x 2			Map Prachan dam
	Bang Lamung	15.0	900	10	1	Huai Kong Dai	320 x 3			B. Nong Kabok
	Nong Pla Lai	31.3	900	37	2	Nong Pla Lai dam	310 x 5	B. Thap Thong	290 x 5	
		31.3	900	19	2					Nong Kho dam
	Huai Yai	1.0	300	1	1	Huai Yai	20 x 2			B. Huai Yai
	Dok Krai	9.5	600	9	1			Map Ta Phut	250 x 2	B. Krok Tabaek
		8.8	700	14	1					Sattahip
	Ban Khai	7.4	600	16	1	B. Khai weir	90 x 2			Rayong
III.	Khlong Luang	12.4	500	19	2	K. Luang dam	160 x 3			B. Suan Phak
		11.7	600	23	2			B. Suan Phak	170 x 3	
		11.0	600	14	2			B. Yot Noen	140 x 3	K. Choeng Thian
	Ban Bung (2-1)	7.3	600	26	1	New Ban Bung dam	120 x 2			
		7.0	700	14	1			B. Yot Noen	180 x 2	K. Choeng
	Nong Kho (4-1)	9.4	600	1	1	Nong Kho dam	120 x 2			B. Phra dam
	Nong Kho (4-4)	15.0	900	10	1	Huai Bung dam	170 x 3			B. Nong Kabok
	Nong Kho (4-6)	7.3	600	5	1	Huai Takhian Thia	200 x 2			B. Nong Kabok
	Nong Kho (4-7)	4.9	600	9	1	Khlong Na Klua	110 x 2			
		12.2	800	3	1					
		27.2	1,200	5	1					B. Nong Kabok
	Nong Kho (4-8)	10.6	700	25	1	Huai Yai	290 x 2			Map Prachan dam
	Bang Lamung	13.0	900	10	1	Huai Kong Dai	320 x 3			Ban Nong Kabok
	Dok Krai	9.5	600	9	1			Map Ta Phut	250 x 2	B. Krok Tabaek
		8.8	700	14	1					Sattahip
	Ban Khai	7.4	600	16	1	B. Khai weir	90 x 2			Rayong
IV.	Ban Bung (2-1)	1.7	600	26	1	New Ban Bung dam	120 x 2			
		1.4	400	10	1					Ban Suan Phak
		0.7	350	13	1			Ban Suan Phak	20 x 2	
		0.4	250	14	1					Tha Bun Mi
	Bang Phra	12.1	800	19	1	Bang Phra dam	200 x 3			Khao Choeng Thian
	Nong Kho (4-1)	26.9	900	1	1	Nong Kho dam	100 x 4			Bang Phra dam
	Nong Kho (4-2)	13.8	900	21	2	Nong Kho dam	150 x 3			B. Nong Kabok
	Nong Kho (4-4)	11.9	700	10	1	Huai Bung	170 x 3			B. Nong Kabok
	Nong Kho (4-5)	2.2	500	9	1	Huai Bung	60 x 2			
		9.5	700	13	1					Map Prachan dam
	Nong Kho (4-9)	7.3	600	5	1	Huai Thakian Tia				Map Prachan dam
	Bang Lamung	15.0	900	10	1	Huai Kong Dai	320 x 3			B. Nong Kabok
	Nong Pla Lai	31.3	900	37	2	Nong Pla Lai	310 x 5	Ban Thap Thong	290 x 5	
				19	2					Nong Kho dam
	Huai Yai	1.0	300	1	1	Huai Yai	20 x 2			B. Huai Yai
	Dok Krai	9.5	600	9	1			Map Ta Phut	250 x 2	B. Krok Tabaek
		8.8	700	14	1					Sattahip
	Ban Khai	7.4	600	16	1	B. Khai weir	90 x 2			Rayong

Table 13 ROUGH COST ESTIMATE OF WATER CONVEYANCE SYSTEM (1/2)

(Unit: ฿ 10^6)

Water Conveyance Systems	Pre-paratory Works	Direct Const. Cost	Compen-sation	Admn. & Engineer. Services	Contin-gency	Interest During Construct.	Total
WATER SUPPLY ALTERNATIVE I							
Khlong Luang	51.6	517.5	0.9	68.4	127.7	122.6	888.7
Ban Bung (2-1)	22.9	230.5	0.3	30.4	56.8	27.3	368.2
Nong Kho (4-1)	6.9	69.6	0	9.2	17.1	8.2	111.0
Nong Kho (4-2)	35.9	358.9	1.1	47.5	88.7	42.6	574.7
Nong Kho (4-3)	11.4	114.6	0	15.1	28.2	13.5	182.8
Bang Lamung	14.8	149.4	0.1	19.7	36.8	17.7	238.5
Nong Pla Lai	100.8	1,008.5	0.2	133.1	248.5	238.6	1,729.7
Huai Yai	4.4	44.5	0.3	5.9	11.0	5.3	71.4
Dok Krai	13.4	134.6	0.1	17.8	33.2	15.9	215.0
Ban Khai	12.1	121.4	0.1	16.0	29.9	14.4	193.9
Total	274.2	2,749.5	3.1	363.1	677.9	506.1	4,573.9
WATER SUPPLY ALTERNATIVE II							
Khlong Luang	49.2	492.9	0.7	65.1	121.6	116.7	846.2
Ban Bung (2-2)	9.7	97.1	0.1	12.8	23.9	11.5	155.1
Bang Phra	13.3	133.2	0.2	17.6	32.9	15.8	213.0
Nong Kho (4-1)	7.8	78.3	0	10.3	19.3	9.3	125.0
Nong Kho (4-2)	33.1	330.0	1.1	43.7	81.5	39.1	528.5
Nong Kho (4-4)	8.4	84.7	0	11.2	20.9	10.0	135.2
Nong Kho (4-5)	6.9	69.0	0	9.1	17.0	8.2	110.2
Bang Lamung	14.8	149.4	0.1	19.7	36.8	17.7	238.5
Nong Pla Lai	100.8	1,008.5	0.2	133.1	248.5	238.6	1,729.7
Huai Yai	4.4	44.5	0.3	5.9	11.0	5.3	71.4
Dok Krai	13.4	134.6	0.1	17.8	33.2	15.9	215.0
Ban Khai	12.1	121.4	0.1	16.0	29.9	14.4	193.9
Total	273.9	2,743.6	2.9	362.3	676.5	502.5	4,561.7

Table 13 ROUGH COST ESTIMATE OF WATER CONVEYANCE SYSTEM (2/2)

(Unit: ฿ 10^6)

Water Conveyance Systems	Pre-paratory Works	Direct Const. Cost	Compen-sation	Admn. & Engineer. Services	Contin-gency	Interest During Construct.	Total
WATER SUPPLY ALTERNATIVE III							
Khlong Luang	51.6	517.5	0.9	68.4	127.7	122.6	888.7
Ban Bung (2-1)	22.9	230.5	0.3	30.4	56.8	27.3	368.2
Nong Kho (4-1)	6.9	69.6	0	9.2	17.1	8.2	111.0
Nong Kho (4-4)	10.1	101.9	0	13.4	25.1	12.0	162.5
Nong Kho (4-6)	7.0	70.5	0	9.3	17.4	8.3	112.5
Nong Kho (4-7)	19.9	199.4	1.1	26.4	49.4	23.7	319.9
Nong Kho (4-8)	16.9	169.2	0	22.4	41.6	20.1	270.2
Bang Lamung	14.8	149.4	0.1	19.7	36.8	17.7	238.5
Dok Krai	13.4	134.6	0.1	17.8	33.2	15.9	215.0
Ban Khai	12.1	121.4	0.1	16.0	29.9	14.4	193.9
Total	175.6	1,764.0	2.6	233.0	435.0	270.2	2,880.4
WATER SUPPLY ALTERNATIVE IV							
Ban Bung (2-1)	19.1	190.8	0.6	25.3	47.2	45.3	328.3
Bang Phra	21.6	216.7	0.1	28.6	53.4	25.6	346.0
Nong Kho (4-1)	8.3	83.6	0	11.0	20.6	9.9	133.4
Nong Kho (4-2)	20.0	199.6	1.1	26.5	49.5	23.7	320.4
Nong Kho (4-4)	10.7	107.2	0	14.1	26.4	12.7	171.1
Nong Kho (4-5)	9.1	91.5	0	12.1	22.5	10.8	146.0
Nong Kho (4-9)	6.9	69.5	0	9.2	17.1	8.2	110.9
Bang Lamung	14.8	149.4	0.1	19.7	36.8	17.7	238.5
Huai Yai	4.4	44.5	0.3	5.9	11.0	5.3	71.4
Nong Pla Lai	100.8	1,008.5	0.2	133.1	248.5	238.6	1,729.7
Dok Krai	13.4	134.6	0.1	17.8	33.2	15.9	215.0
Ban Ihai	12.1	121.4	0.1	16.0	29.9	14.4	193.9
Total	241.2	2,417.3	2.6	319.3	596.1	428.1	4,004.6

Table 14 WATER CONVEYANCE CALCULATION FOR 1986

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Pakong	0	0	3.3	0	0	3.3	0	-	0	-	3.3	0	3.3	0	-	-3.3	3.3	(B. Pakong P/S)		
1	1.2	1.8	0	0	1.9	4.9	0.7 0.1 0.2 0.1	P. Nikhom W.W. N. Kokha W.W. P. Thong W.W. B. Soet W.W.	0	-	3.8	3.5	0.3	0	-	-0.3				
1-1	0.2	0	4.3	0	0.4	4.9	0.1	B. Bung W.W.	0.3	Private	4.5	0	4.5	11.7	New Bang Bung	+7.2	4.0 7.2	(Private) Bung Bung (2-1)	7.1	Ban Bung (2-1)
2	12.4	0.1	0	15.4	0	27.9	0	-	0	-	27.9	0	27.9	0	-	-27.9	15.4 5.4 7.1	(Irri. Canal) (Bang Phra W.W.) Ban Bung (2-1)		
3	0	0.1	2.3	0	8.0	10.4	0	-	0	-	10.4	0	10.4	34.7	(Bang Phra)	+24.3	2.3 5.4	(Private) Nong Kho (4-1)	15.4 3.3 5.4 5.6	(Irri. Canal) (Bang Pakong P/S) (Bang Phra W.W.) (Bang Phra W.W.)
4	4.8	0.3	7.5	0	3.2	15.8	0	-	0	-	15.8	8.8	7.0	12.6	(Nong Kho)	+5.6	5.6 4.0 2.7	(Bang Phra W.W.) Nong Kho (4-2) Bang Lamung	5.4	Nong Kho (4-1)
5	4.3	0.1	0.7	0	2.5	7.6	0	-	0	-	7.6	0	7.6	9.2	(Map Prachon)	+1.6	5.0	(Pattaya W.W.)		
6	0.4	0	0	0	0	0.4	0	-	0	-	0.4	0.4	0	0	-	0	0.4	Huai Yai		
7	1.0	0.6	3.9	0	0	5.5	0	-	0	-	5.5	0	5.5	0	-	-5.5	5.5	Dok Krai		
8	0.7	0	0	0	0	0.7	0.4	Ban Chang W.W.	0	-	0.4	0	0.3	0	-	-0.3	5.8	Dok Krai	5.5	Dok Krai
9	0.8	0.1	33.0	0	0	33.9	0	-	0.2	Private	33.7	0	33.7	0	-	-33.7	38.2 1.3	(Dok Krai P.) (Private)	5.8	Dok Krai
10	3.3	0.9	1.6	140.9	12.0	158.7	0	-	0	-	158.7	38.2	120.5	56.8 102.5	(Dok Krai) (Nong Pla Lai)	+38.8	2.3 1.6 1.0	(Rayong W.W.) (Private) Ban Khai	38.2 1.3	(Dok Krai P.) (Private)
10-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	29.1	4.0	56.6	156.3	28.0	274.0	1.6	-	0.5	-	272.0	50.9	221.0	227.5	-	+6.5	116.6	-	93.0	-

Table 15 WATER CONVEYANCE CALCULATION FOR 1991

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Pakong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	0	-	-6.6	6.6	(Bang Pakong P/S)		
1	1.7	3.1	0	60.1	1.9	66.8	0.7 0.1 0.2 0.1	P. Nikhom W.W. N. Kakha W.W. P. Thong W.W. B. Soet W.W.	0	-	65.7	0	65.7	79.8	Khlong Luang	+14.1	1.4	Khlong Luang	0.4	Khlong Luang
1-1	0.3	0	4.3	0	0.4	5.0	0.1	Ban Bung W.W.	0.3	Private	4.6	0	4.6	11.7	New Ban Bung	+7.1	4.0 7.3	(Private) Ban Bung (2-1)	7.0	San Bung (2-1)
2	12.7	0.1	0	15.4	0	28.2	0	-	0	-	28.2	0	28.2	0	-	-28.2	15.4 0.4 7.0 5.4	(Irri. Canal) Khlong Luang Ban Bung (2-1) (Bang Phra W.W.)		
3	0	0.2	2.3	0	8.0	10.5	0	-	0	-	10.5	0	10.5	34.7	(Bang Phra)	+24.2	2.3 8.8	(Private) Nong Kho(4-1)	6.6 5.4 15.4 5.6	(Bang Pakong P/S) (Bang Phra W.W.) (Irri. Canal) (Bang Phra W.W.)
4	6.4	0.7	16.0	0	3.2	26.3	0	-	0	-	26.3	14.0	12.3	12.6	(Nong Kho)	+0.3	5.6 13.3 5.5 4.9	(Bang Phra W.W.) Bang Lamung Nong Kho (4-2) Nong Pla Lai	2.0 8.8	Nong Kho (4-3) Nong Kho (4-1)
5	7.8	0.2	0.7	0	2.5	11.2	0	-	0	-	11.2	0	11.2	9.2	(Map Prachon)	-2.0	2.0 8.5	Nong Kho (4-3) (Pattaya W.W.)		
6	0.8	0	0	0	0	0.8	0	-	0	-	0.8	0.8	0	0	-	0	0.8	Huai Yai		
7	1.9	1.0	3.9	0	0	6.8	0	-	0	-	6.8	0	6.8	0	-	-6.8	6.8	Dok Krai		
8	0.9	0	0	0	0	0.9	0.4	Ban Chang W.W.	0	-	0.5	0	0.5	0	-	-0.5	7.3	Dok Krai	6.8	Dok Krai
9	1.5	0.1	35.8	0	0	37.4	0	-	0.2	Private	37.2	0	37.2	0	-	-37.2	1.3 43.2	(Private) (Dok Krai P)	7.3	Dok Krai
10	4.3	1.7	1.6	140.9	12.0	160.5	0	-	0	-	160.5	31.8	128.7	56.8 102.5 62.4	(Dok Krai) (Nong Pla Lai) Khlang Yai	+93.0	2.3 1.6 2.0	(Rayong W.W.) (Private) Ban Krai	1.3 4.9 43.2	(Private) Nong Pla Lai (Dok Krai P.)
10-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	38.3	7.1	71.2	216.4	28.0	361.0	1.6	-	0.5	-	358.9	46.6	312.3	369.7		+57.4	156.3		114.7	

Table 16 WATER CONVEYANCE CALCULATION FOR 1996

Zone	Water Demand						Available Local Flow				Water Withdrawal	Natural Run-off	Water Deficit	Water Supply by Dams		Balance	Water Conveyance in and to Zone		Water Conveyance to outside Zone	
							Surface Water		Grand Water											
	DU	DR	I	A	M	Total	Q'ty	Facilities	Q'ty	Facilities				Q'ty	Facilities		Q'ty	Facilities	Q'ty	Facilities
B. Pakong	0	0	6.6	0	0	6.6	0	-	0	-	6.6	0	6.6	0	-	-6.6	6.6	(Bang Pakong P/S)		
1	1.9	4.6	0	60.1	1.9	68.5	0.7 0.1 0.2 0.1	P. Nikhom W.W. N. Kakha W.W. P. Thong W.W. B. Soet W.W.	0	-	67.4	0	67.4	79.8	Khlong Luang	+12.4	6.7	Khlong Luang	5.5	Khlong Luang
1-1	0.4	0	4.3	0	0.4	5.1	0.1	S. Bung W.W.	0.3	Private	4.7	0	4.7	11.7	New Ban Bung	+7.0	4.0 7.3	Private Ban Bung (4-1)	7.0	Ban Bung (4-1)
2	17.8	0.1	0	15.4	0	33.3	0	-	0	-	33.3	0	33.3	0	-	-33.3	15.4 5.4 5.5 7.0	(Irri. Canal) (Bang Phra W.W.) Khlong Luang Ban Bung (4-1)		
3	0	0.3	2.3	0	8.0	10.6	0	-	0	-	10.6	0	10.6	34.7	(Bang Phra)	+24.1	2.3 8.9	(Private) Nong Kho (4-1)	6.6 5.4 15.4 5.6	(Bang Pakong P/S) (Bang Phra W.W.) (Irri. Canal) (Bang Phra W.W.)
4	11.4	1.0	19.5	0	3.2	35.1	0	-	0	-	35.1	16.8	18.3	12.6	(Nong Kho)	-5.7	5.6 15.8 14.7 14.2	(Bang Phra W.W.) Bang Lamung Nong Kho (4-2) Nong Pla Lai	8.9 5.2	Nong Kho (4-1) NongKho (4-3)
5	10.9	0.3	0.7	0	2.5	14.4	0	-	0	-	14.4	0	14.4	9.2	(Map Prachan)	-5.2	8.7 5.2	(Pattaya W.W.) Nong Kho (4-3)		
6	0.9	0.1	0	0	0	1.0	0	-	0	-	1.0	0.9	0.1	0	-	-0.1	0.9	Huai Yai		
7	2.4	1.5	3.9	0	0	7.8	0	-	0	-	7.8	0	7.8	0	-	-7.8	7.8	Dok Krai		
8	1.0	0	0	0	0	1.0	0.4	Ban Chang	0	-	0.6	0	0.6	0	-	-0.6	8.4	Dok Krai	7.8	Dok Krai
9	2.6	0.2	38.5	0	0	41.3	0	-	0.2	Private	41.1	0	41.1	0	-	-41.1	1.3 48.2	(Private) (Dok Krai P.)	8.4	Dok Krai
10	6.8	2.5	1.6	140.9	12.0	163.8	0	-	0	-	163.8	31.8	132.0	56.8 102.5 62.4	(Dok Krai) (Nong Pla Lai) Khlong Yai	+89.7	2.3 1.6 4.5	(Rayong W.W.) Private Ban Khai	1.3 14.2 48.2	(Private) Nong Pla Lai (Dok Krai P.)
10-1	0	0	0	30.6	10.5	41.1	0	-	0	-	41.1	0	41.1	41.3	K. Thap Ma	+0.2	-	-	-	-
Total	56.1	10.6	77.4	247.0	38.5	429.6	1.6		0.5		427.5	49.5	378.0	411.0		+33.0	208.3		139.5	

Table 17 DEVELOPMENT PROGRAMME OF WATER CONVEYANCE SYSTEMS (1/3)

Water Conveyance Systems	1986	1991	1996
Khlong Luang System		System Capacity: 8.1 x $10^6 m^3$/yr Intake Facilities: Pump, 160kW x 2 units at Khlong Luang dam Boosting Pump: 170kW x 2 units at Ban Suan Phak, 140kW x 2 units at Ban Yot Noen Pipeline: ø500mm x 19km x 1 row, Khlong Luang dam - B. Suan Phak, ø600mm x 37km x 1 row, B. Suan Phak - K. Choeang Thian Receiving Facilities: B. Suan Phak & K. Choeang Thian	System Capacity: 8.0 x $10^6 m^3$/yr Intake Facilities: Pump, 160kW x 1 unit at Khlong Luang dam Boosting Pump: 170kW x 1 unit at Ban Suan Phak, 140kW x 1 unit at Ban Not Noen Pipeline: ø500mm x 19km x 1 row, Khlong Luang dam - B. Suan Phak, ø600mm x 37km x 1 row, B. Suan Phak - K. Choeang Thian
Ban Bung (2-1) System	System Capacity: 9.5 x $10^6 m^3$/yr Intake Facilities: Pump, 120kW x 2 units at New Ban Bung dam Boosting Pump: 180kW x 2 units at Ban Not Yoen Pipeline: ø600mm x 26km x 1 row, Ban Bung dam - B. Not Yoen, ø700mm x 14 km x 1 row, B. Not Yoen - K. Choeang Thiang Receiving Facilities: Khao Choeang Thiang		
Nong Kho (4-1) System	System Capacity: 11.6 x $10^6 m^3$/yr Intake Facilities: Pump, 120kW x 2 units at Nong Kho dam Pipeline: ø600mm x 1km x 1 row, Nong Kho dam - Bang Phra dam		
Nong Kho (4-2) System	System Capacity: 20.6 x $10^6 m^3$/yr Intake Facilities: Pump, 140kW x 3 units at Nong Kho dam Pipeline: ø900mm x 21km x 1 row, Nong Kho dam - Ban Nong Krabok Receiving Facilities: Bang Nong Krabok		System Capacity: 20.6 x $10^6 m^3$/yr Intake Pump: Pump, 140kW x 2 units at Nong Kho dam Pipeline: ø900mm x 21km x 1 row, Nong Kho dam - Ban Nong Krabok

Table 17 DEVELOPMENT PROGRAMME OF WATER CONVEYANCE SYSTEMS (2/3)

Water Conveyance Systems	1986	1991	1996
Nong Kho (4-3) System		System Capacity: 12.3 x $10^6 m^3$/yr Boosting Pump: 270kW x 2 units at Ban Nong Krabok Pipeline: ø700mm x 22km x 1 row, B. Nong Krabok - Map Prachan dam Receiving Facilities: Map Prachan dam	
Bang Lamung System	System Capacity: 23.9 x $10^6 m^3$/yr Intake Facilities: Pump, 320kW x 3 units at Huai Kon Dai Pipeline: ø900mm x 10km x 1 row, H. Kon Dai - B. Nong Krabok		
Nong Pla Lai System		System Capacity: 20.3 x $10^6 m^3$/yr Intake Facilities: Pump, 310kW x 3 units at Nong Pla Lai dam Boosting Pump: 290kW x 3 units at Ban Thap Thong Pipeline: ø900mm x 56km x 1 row, Nong Pla Lai dam - Nong Kho dam Head Tank: Ban Khao Khayai Receiving Facilities: Nong Kho dam	System Capacity: 20.3 x $10^6 m^3$/yr Intake Facilities: Pump, 310km x 2 units at Nong Pla Lai dam Boosting Pump: 290kW x 2 units at Ban Thap Thong Pipeline: ø900mm x 56km x 1 row, Nong Pla Lai dam - Nong Kho dam
Huai Yai System	System Capacity: 1.3 x $10^6 m^3$/yr Intake Facilities: Pump, 20kW x 2 units at Huai Yai Pipeline: ø300mm x 1 km x 1 row, Huai Yai - Ban Huai Yai Receiving Facilities: Ban Huai Yai		

Table 17 DEVELOPMENT PROGRAMME OF WATER CONVEYANCE SYSTEMS (3/3)

Water Conveyance Systems	1986	1991	1996
Dok Krai System	System Capacity: 9.5 x $10^6 m^3$/yr Boosting Pump: 250kW x 2 units at Map Ta Phut Pipeline: ø700mm x 14km x 1 row, Map Ta Phut - Ban Krak Taback ø600mm x 9km x 1 row, Ban Krok Taback - Khao Won Receiving Facilities: Ban Krok Taback and Khao Won		
Ban Khai System	System Capacity: 9.6 x $10^6 m^3$/yr Intake Facilities: Pump, 160kW x 2 units at Ban Khai Pipeline: ø600mm x 16km x 1 row, Ban Khai - Rayong Receiving Facilities: Rayong		

Table 18 INVESTMENT REQUIREMENTS BY 5-YEAR PERIODS

(Unit: ฿ 10^6)

Description	Row Water Conveyance Systems										Total
	Khlong Luang	Ban Bung (2-1)	Nong Kho (4-1)	Nong Kho (4-2)	Nong Kho (4-3)	Bang Lamung	Nong Pla Lai	Huai Yai	Dok Krai	Ban Khai	
1982 - 1986											
1. Preparatory Works	-	22.9	6.9	19.3	-	14.8	-	4.4	13.4	12.1	93.8
2. Direct Construction Cost	-	230.5	69.6	193.3	-	149.4	-	44.5	134.6	121.4	943.3
3. Compensation	-	0.3	-	1.1	-	0.1	-	0.3	0.1	0.1	2.0
4. Administration and Engineering Services	-	30.4	9.2	25.6	-	19.7	-	5.9	17.8	16.0	124.6
5. Contingency	-	56.8	17.1	47.9	-	36.8	-	11.0	33.2	29.9	232.7
6. Interest during Construction	-	27.3	8.2	23.0	-	17.7	-	5.3	15.9	14.4	111.8
Total	-	368.2	111.0	310.2	-	238.5	-	71.4	215.0	193.9	1,508.2
1987 - 1991											
1. Preparatory Works	31.1	-	-	-	11.4	-	55.2	-	-	-	97.7
2. Direct Construction Cost	311.6	-	-	-	114.6	-	552.2	-	-	-	978.4
3. Compensation	0.9	-	-	-	-	-	0.2	-	-	-	1.1
4. Administration and Engineering Services	41.2	-	-	-	15.1	-	72.9	-	-	-	129.2
5. Contingency	77.0	-	-	-	28.2	-	136.1	-	-	-	241.3
6. Interest during Construction	73.9	-	-	-	13.5	-	130.7	-	-	-	218.1
Total	535.7	-	-	-	182.8	-	947.3	-	-	-	1,665.8
1992 - 1996											
1. Preparatory Works	20.5	-	-	16.6	-	-	45.6	-	-	-	82.7
2. Direct Construction Cost	205.9	-	-	165.6	-	-	456.3	-	-	-	827.8
3. Compensation	-	-	-	-	-	-	-	-	-	-	
4. Administration and Engineering Services	27.2	-	-	21.9	-	-	60.2	-	-	-	109.3
5. Contingency	50.7	-	-	40.8	-	-	112.4	-	-	-	203.9
6. Interest during Construction	48.7	-	-	19.6	-	-	107.9	-	-	-	176.2
Total	353.0	-	-	264.5	-	-	782.4	-	-	-	1,399.9
Grand Total	888.7	368.2	111.0	574.7	182.8	238.5	1,729.7	71.4	215.0	193.9	4,573.9

Table 19 PRINCIPAL FEATURES BY ALTERNATIVES, KHLONG LUANG WATER CONVEYANCE SYSTEM

Facilities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Intake Facilities				
Pump Well	108 m^3 x 1 unit	108 m^3 x 1 unit	108 m^3 x 1 unit	108 m^3 x 1 unit
Intake Pump & Motor	15.6 m^3/min x 55 m x 180 kW x 2 units	15.6 m^3/min x 30 m x 110 kW x 2 units	15.6 m^3/min x 45 m x 150 kW x 2 units	15.6 m^3/min x 60 m x 190 kW x 2 units
Electrical Equipment	650 kVA x 1 unit	400 kVA x 1 unit	550 kVA x 1 unit	650 kVA x 1 unit
Pipeline	D500 x 56 km, t = 6 mm	D600 x 56 km, t = 6 mm	D700 x 56 km, t = 6 mm	D800 x 56 km, t = 7.9 mm
Booster Pump Station (1)				
Receiving Well	141 m^3 x 1 unit	141 m^3 x 1 unit	141 m^3 x 1 unit	-
Pump Well	878 m^3 x 1 unit	878 m^3 x 1 unit	878 m^3 x 1 unit	
Booster Pump & Motor	15.0 m^3/min x 70 m x 220 kW x 2 units	14.46 m^3/min x 55 m x 190 kW x 2 units	13.8 m^3/min x 45m x 130 kW x 2 units	
Electrical Equipment	750 kVA x 1 unit	600 kVA x 1 unit	500 kVA x 1 unit	
Booster Pump Station (2)				
Receiving Well	141 m^3 x 1 unit	141 m^3 x 1 unit	-	-
Pump Well	878 m^3 x 1 unit	878 m^3 x 1 unit		
Booster Pump & Motor	13.8 m^3/min x 70 m x 200 kW x 2 units	13.59 m^3/min x 50 m x 160 kW x 2 units		
Electrical Equipment	700 kVA x 1 unit	500 kVA x 1 unit		
Booster Pump Station (3)				
Receiving Well	141 m^3 x 1 unit	-	-	-
Pump Well	878 m^3 x 1 unit			
Booster Pump & Motor	13.8 m^3/min x 40 m x 120 kW x 2 units			
Electrical Equipment	500 kVA x 1 unit			
Booster Pump Station (4)				
Receiving Well	141 m^3 x 1 unit	-	-	-
Pump Well	878 m^3 x 1 unit			
Booster Pump & Motor	13.8 m^3/min x 50 m x 140 kW x 2 units			
Electrical Equipment	550 kVA x 1 unit			
Raw Water Basin	4,200 m^3 x 1 unit 180 m^3 x 1 unit	4,200 m^3 x 1 unit 180 m^3 x 1 unit	4,200 m^3 x 1 unit 180 m^3 x 1 unit	4,200 m^3 x 1 unit 180 m^3 x 1 unit

Table 20 CONSTRUCTION COST BY ALTERNATIVE, KHLONG LUANG WATER CONVEYANCE SYSTEM

(Unit: 10^6)

Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Preparatory Works	21.5	20.0	22.7	28.7
Civil Works	31.2	21.3	16.4	11.4
Mechanical Works	137.9	156.4	189.9	265.2
Electrical Works	55.1	22.3	21.0	15.5
Contractor's Overhead	8.6	7.7	8.8	11.2
Contractor's Profit	16.0	14.3	16.3	20.9
Tax	8.4	7.5	8.5	10.9
Sub-total	278.7	249.5	283.6	363.8
Land Acquisition & Compensation	0.3	0.3	0.3	0.3
Engineering Services	22.3	20.0	22.7	29.1
Administration Cost of Executive Agency				
- Administration Cost	11.2	10.0	11.4	14.6
- Commission to PEA	19.5	11.7	7.8	3.9
Physical Contingency	49.8	43.7	48.9	61.8
Total	381.8	335.2	374.7	473.5

Table 21 ANNUAL COST BY ALTERNATIVE, KHLONG LUANG WATER CONVEYANCE SYSTEM

	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
(1)	O&M Cost (฿10^6/year)				
	O&M Cost	3.2	3.0	3.0	3.5
	Power Cost	8.9	4.8	2.9	1.9
	Total	12.1	7.8	5.9	5.4
(2)	Replacement Cost (฿10^6)				
	Mechanical equipment & Electrical equipment				
	1st Replacement	86.9	38.1	33.5	25.1
	2nd Replacement	86.9	38.1	33.5	25.1
	Pipeline	152.9	184.9	229.7	324.4
	Total	326.7	261.1	296.7	374.6
	Salvage Value	150.8	168.0	205.8	285.9
(3)	Annual Equivalent Cost (฿10^6)				
	Construction Cost	24.2	21.3	23.8	30.1
	O&M Cost	3.2	3.0	3.0	3.5
	Power Cost	8.9	4.8	2.9	1.9
	Replacement Cost	2.0	1.0	0.9	0.9
	Total	38.3	30.1	30.6	36.4

Table 22 FEATURES OF PROPOSED KHLONG LUANG WATER CONVEYANCE SYSTEM (1/2)

Description	Phase I	Phase II
(1) Intake Facilities		
Location	Khlong Luang dam, south main canal	
Pump Well		
Effective storage capacity	108 m^3	
HWL	El. 34.4 m	
LWL	El. 31.4 m	
Dimension, L x B x H	12.0m x 3.0m x 4.4m	
Pump		
Design discharge	15.3 m^3/min	15.3 m^3/min
Design head	30 m	30 m
Motor capacity	110 kW	110 kW
Type of pump	Horizontal double suction volute pump	Horizontal double suction volute pump
Nos. of unit	2 units	1 unit
Electric Facilities		
Receiving panel	22 kV x 400kVA x 1 unit	
Control panel	3 kV/380V x 2 units	3 kV/380V x 1 unit
Diesel generator	100 kVA x 1 unit	
Pump & Electric Station		
Dimension, L x B	25.0m x 6.5m	
Flow Meter	600mm x 1 unit	600mm x 1 unit
(2) Pipeline		
Reach (1)	Intake - 5.0km point	Intake - 5.0km point
Design discharge	0.26 m^3/s	0.26 m^3/s
Inside diameter of pipe	600 mm	600 mm
Type of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	6.0 mm	6.0 mm
Length	5,000 m	5,000 m
One way surge tank	80m^3 x 1 unit	
Butterfly valve	600mm x 2 units	600mm x 2 units
Blow-off	600mm x 200mm x 2 units	600mm x 200mm x 2 units
Air valve	600mm x 100mm x 3 units	600mm x 100mm x 3 units
Reach (2)	5.0km point - Ban Suan Phak	5.0km point - Ban Suan Phak
Design discharge	0.25 m^3/s	0.25 m^3/s
Inside diameter of pipe	600 mm	600 mm
Type of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	6.0 mm	6.0 mm
Length	14,000 m	14,000 m
Butterfly valve	600mm x 7 units	600mm x 7 units
Blow-off	600mm x 200mm x 7 units	600mm x 200mm x 7 units
Air valve	600mm x 100mm x 8 units	600mm x 100mm x 8 units
Reach (3)	Ban Suan Phak - 31.8km point	Ban Suan Phak - 31.8km point
Design discharge	0.24 m^3/s	0.24 m^3/s
Inside diameter of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	6.0 mm	6.0 mm
Length	13,000 m	13,000 m
Butterfly valve	600mm x 6 units	600mm x 6 units
Blow-off	600mm x 200mm x 6 units	600mm x 200mm x 6 units
Air valve	600mm x 100mm x 6 units	600mm x 100mm x 6 units
Reach (4)	31.8km point - Raw water basin	31.8km point - Raw water basin
Design discharge	0.23 m^3/s	0.23 m^3/s
Inside diameter of pipe	600 mm	600 mm
Wall thickness	6.0 mm	6.0 mm
Length	24,000 m	24,000 m
Butterfly	600mm x 12 units	600mm x 12 units
Blow-off	600mm x 200mm x 12 units	600mm x 200mm x 12 units
Air valve	600mm x 100mm x 14 units	600mm x 100mm x 14 units
(3) Booster Pump Station No. 1		
Location	Ban Suan Phak	
Receiving Well		
Effective storage capacity	141 m^3	
HWL	El. 23.0 m	
LWL	El. 20.0 m	
Dimension, L x B x H	9.4m x 5.0m x 4.3m	

Table 22 FEATURES OF PROPOSED KHLONG LUANG WATER CONVEYANCE SYSTEM (2/2)

Description	Phase I	Phase II
(3) (cont'd)		
Pumping Well		
Effective storage capacity	878 m^3	
HWL	El. 21.8 m	
LWL	El. 18.8 m	
Dimension, L x B x H	12.1m x 24.2m x 4.3m	
Pump		
Design discharge	14.5 m^3/min	14.5 m^3/min
Design head	55 m	55 m
Motor capacity	190 kW	190 kW
Type of pump	Horizontal double suction volute pump	Horizontal double suction volute pump
Nos. of unit	2 units	1 unit
Electric Facilities		
Receiving panel	22kV x 600kVA x 1 unit	
Control panel	3kV/380V x 2 units	3kV/380V x 1 unit
Diesel generator	100kVA x 1 unit	
Flow Meter	600mm x 1 unit	600mm x 1 unit
Pump & Electric Station		
Dimension, L x B	25.0m x 6.5m	
(4) Booster Pump Station No. 2		
Location	Ban Yot Noen	
Receiving Well		
Effective storage capacity	141 m^3	
HWL	El. 38.0 m	
LWL	El. 35.0 m	
Dimension, L x B x H	12.1m x 24.2m x 4.3m	
Pumping Well		
Effective storage capacity	878 m^3	
HWL	El. 36.8 m	
LWL	El. 33.8 m	
Dimension, L x B x H	12.1m x 24.2m x 4.3m	
Pump		
Design discharge	13.6 m^3/min	13.6 m^3/min
Design head	50 m	50 m
Motor capacity	160 kW	160 kW
Type of pump	Horizontal double suction volute pump	Horizontal double suction volute pump
Nos. of unit	2 untis	1 unit
Electric Facilities		
Receiving panel	22kV x 500kVA x 1 unit	
Control panel	3kV/380V x 2 units	3kV/380V x 2 units
Diesel generator	100kVA x 1 unit	
Flow Meter	600mm x 1 unit	600mm x 1 unit
(5) Raw Water Basin No. 1		
Location	Ban Suan Phak	
Effective storage capacity	180 m^3	
HWL	El. 23.0 m	
LWL	El. 20.0 m	
Dimension, L x B x H	10.0m x 6.0m x 3.6m	
(6) Raw Water Basin No. 2		
Location	Khao Choeng Thian	
Effective storage capacity	4,200 m^3	
HWL	El. 62.0 m	
LWL	El. 59.0 m	
Dimension, L x B x H	40.0m x 35.0m x 3.6m	

Table 23 FEATURES OF NONG PLA LAI AND NONG KHO SYSTEM FOR COST COMPARISON

Description	Unit	Alternative A			Alternative B		
		(1)	(2)	(3)	(1)	(2)	(4)
1. Annual Water Supply	$10^6 m^3$	31.3	31.8	9.5	31.3 -21.8	22.3	9.5
2. Intake							
Discharge rate	m^3/sec,	1.29	1.31	-	1.29 -0.90	0.92	-
Gross head	m	85	35	-	85	35	-
Pump capacity	m^3/min x kW	19.35 x390	19.65 x1.40	-	19.35 x390	13.79 x100	-
No. of unit	unit	5	5	-	5	5	-
3. Booster Pump Station							
Discharge rate	m^3/sec	1.29	-	0.39	1.29	-	0.39
Gross head	m	65	-	55	65	-	85
Pump capacity	m^3/min x kW	19.35 x290	-	11.70 x140	19.35 x290	-	11.7 x210
No. of unit	unit	5	-	2	5	-	3
4. Head Tank							
Capacity	m^3	2,330	-	-	1,620	1,410	-
5. Pipeline							
Dia.	mm	900,800	900	700	900,700	800	500 -800
Length	km	33,20	21	18	33,20	21	19
No. of row		2,2	2	1	2,2	2	1
6. Raw Water Basin	m^3	-	18,860	4,320	-	10,220	-

Note, (1) : Nong Pla Lai System, Nong Pla Lai - Nong Kho

(2) : Nong Kho (4-2) System, Nong Kho - Laem Chabang

(3) : Nong Kho (4-3) System, Laem Chabang - Pattaya

(4) : Nong Pla Lai Branch, Ban Phak Ruam - Map Prachan

Table 24 CONSTRUCTION COST OF ALTERNATIVES FOR ROUTE ALIGNMENT

(Unit: ฿ 10^6)

Description	Alternative A			Alternative B		
	Pipe-line (1)	Pipe-line (2)	Pipe-line (3)	Pipe-line (1)	Pipe-line (2)	Pipe-line (4)
Preparatory Works	55.7	24.7	6.7	49.8	20.7	6.6
Civil Works	19.2	34.9	9.2	18.0	19.9	5.1
Mechanical Works	511.4	207.2	53.9	453.4	183.2	55.2
Electrical Works	26.8	5.2	4.1	26.8	4.0	5.7
Contractor's Overhead	21.5	9.5	3.0	19.2	8.0	2.9
Contractor's Profit	39.9	17.6	5.2	35.6	14.8	5.1
Tax	20.9	9.2	2.5	18.6	7.7	2.5
Sub-total	695.4	308.3	84.6	621.4	258.3	83.1
Land Acquisition & Compensation	0.3	1.1	-	0.3	1.1	0.1
Engineering Services	55.6	24.8	6.8	49.7	20.8	6.7
Administration Cost of Executive Agency						
- Administration Cost	27.8	12.4	3.4	24.9	10.4	3.3
- Commission to PEA	11.7	-	3.9	11.7	-	3.9
Physical Contingency	118.6	52.9	14.8	106.2	43.6	14.6
Total	909.4	398.6	113.5	814.2	334.2	111.7

Note: Pipeline (1): Nong Pla Lai - Nong Kho dam
Pipeline (2): Nong Kho dam - Laem Chabang
Pipeline (3): Laem Chabang - Pattaya
Pipeline (4): Ban Phak Ruam - Map Prachan dam

Tabel 25 PRINCIPAL FEATURES BY ALTERNATIVES NONG PLA LAI WATER CONVEYANCE SYSTEM

Facilities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
(1) Upstream Reach				
Intake Facilities				
Pump Well	$288m^3$ x 1 unit	$288m^3$ x 1 unit	$288m^3$ x 1 unit	$288m^3$ x 1 unit
Intake Pump & Motor	$19.5m^3$/min x 65m x 260kW x 3 unit	$19.5m^3$/min x 85m x 390kW x 3 unit	$19.5m^3$/min x 80m x 370kW x 3 unit	$19.5m^3$/min x 75m x 350kW x 3 unit
Electrical Equipment	1,550kVA x 1 unit	2,250kVA x 1 unit	2,150kVA x 1 unit	2,000kVA x 1 unit
Pipeline	D800 x 33km x 1 row	D900 x 33km x 1 row	D1,000 x 33km x 1 row	D1,200 x 33km x 1 row
Booster Pump Station No. 1				
Receiving Well	$298m^3$ x 1 unit	$298m^3$ x 1 ujit	$298m^3$ x 1 unit	$298m^3$ x 1 unit
Pump Well	$2,327m^3$ x 1 unit	$2,327m^3$ x 1 unit	$2,327m^3$ x 1 unit	$2,327m^3$ x 1 unit
Booster Pump & Motor	$19.5m^3$/min x 80m x 320kW x 3 unit	$19.5m^3$/min x 65m x 290kW x 3 unit	$19.5m^3$/min x 55m x 250kW x 3 unit	$19.5m^3$/min x 45m x 200kW x 3 unit
Electrical Equipment	1,850kVA x 1 unit	1,700kVA x 1 unit	1,500kVA x 1 unit	1,200kVA x 1 unit
Booster Pump Station No. 2				
Receiving Well	$298m^3$ x 1 unit	-	-	-
Pump Well	$2,327m^3$ x 1 unit	-	-	-
Booster Pump & Motor	$19.5m^3$/min x 50m x 210kW x 3 unit	-	-	-
Electrical Equipment	1,300kVA x 1 unit	-	-	-
Head Tank	$2,352m^3$ x 1 unit	$2,352m^3$ x 1 unit	$2,352m^3$ x 1 unit	$2,352m^2$ x 1 unit
(2) Downstream Reach				
Pipeline	D800 x 20km x 1 row	D900 x 20km x 1 row	-	-

Table 26 CONSTRUCTION COST BY ALTERNATIVE,
NONG PLA LAI WATER CONVEYANCE SYSTEM

(Unit: ฿10^6)

Description	Upstream Reach				Downstream Reach	
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 1	Alternative 2
Preparatory Works	22.5	21.4	26.7	35.3	8.6	9.6
Civil Works	28.1	19.2	19.3	19.2	-	-
Mechanical Works	165.7	172.4	231.1	315.0	86.0	96.6
Electrical Works	34.5	22.1	24.7	21.3	-	-
Contractor's Overhead	8.7	8.2	10.6	13.7	3.3	3.7
Contractor's Profit	16.3	15.3	19.6	25.4	6.1	6.9
Tax	8.5	8.0	10.3	13.3	3.2	3.6
Sub-total	284.3	266.6	342.3	443.2	107.2	120.4
Land Acquisition & Compensation	0.3	0.3	0.3	0.3	-	-
Engineering Services	22.8	21.3	27.4	35.5	8.6	9.6
Administration Cost of Execution Agency						
- Administration Cost	11.4	10.7	13.7	17.7	4.3	4.8
- Commission to PEA	15.6	11.7	11.7	11.7	-	-
Physical Contingency	50.2	46.6	59.3	76.3	18.0	20.2
Total	384.6	357.2	454.7	584.7	138.1	155.0

Table 27 ANNUAL COST BY ALTERNATIVE,
LONG PLA LAI WATER CONVEYANCE SYSTEM

	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
(1)	O&M Cost (฿10^6/year)				
	O&M Cost	3.0	3.5	3.3	3.8
	Power Cost	16.4	14.1	12.9	11.4
	Total	19.4	17.6	16.2	15.2
(2)	Replacement Cost (฿10^6)				
	Mechanical equipment & Electrical equipment				
	1st Replacement	72.8	43.2	53.0	46.5
	2nd Replacement	72.8	43.2	53.0	46.5
	Pipeline	176.5	199.4	265.3	372.7
	Total	322.1	285.8	371.3	465.7
	Salvage Value	168.2	175.2	240.8	332.3
(3)	Annual Equivalent Cost (฿10^6)				
	Construction Cost	24.4	22.7	28.9	37.2
	O&M Cost	3.0	3.5	3.3	3.8
	Power Cost	16.4	14.1	12.9	11.4
	Replacement Cost	1.6	1.1	1.4	1.3
	Total	45.4	41.4	46.5	53.7

Table 28 FEATURES OF PROPOSED NONG PLA LAI WATER CONVEYANCE SYSTEM (1/2)

Description	Phase I	Phase II
(1) Intake Facilities		
Location	Nong Pla Lai dam, Irrigation canal	
Pump Well		
Effective storage capacity	288 m^3	
HWL	El. 27.8 m	
LWL	El. 24.8 m	
Dimension, L x B x H	24.0m x 4.0m x 4.4m	
Pump		
Design discharge	19.4 m^3/min	19.4 m^3/min
Design head	85 m	85 m
Motor capacity	390 kW	390 kW
Type of pump	Horizontal double suction volute pump	Horizontal double suction volute pump
Nos. of unit	3 units	2 units
Electric Facilities		
Receiving panel	22kV x 2,250kVA x 1 unit	
Control panel	3kV/380V x 3 units	3kV/380V x 2 units
Diesel generator	100kVA x 1 unit	
Flow Meter	900mm x 1 unit	900mm x 1 unit
(2) Pipeline		
Reach (1)	Intake - Booster pump station	Intake - Booster pump station
Design discharge	1.29 m^3/s	1.29 m^3/s
Inside diameter of pipe	900 mm	900 mm
Type of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	7.9 mm	7.9 mm
Length	11,000 m	11,000 m
One way surge tank No. 1	16m^3 x 1 unit	16m^3 x 1 unit
One way surge tank No. 2	4 m^3 x 1 unit	4 m^3 x 1 unit
Butterfly valve	900mm x 5 units	900mm x 5 units
Blow-off	900mm x 250mm x 5 units	900mm x 250mm x 5 units
Air valve	900mm x 100mm x 7 units	900mm x 100mm x 7 units
Reach (2)	Booster pump station - Head tank	Booster pump station - Head tank
Design discharge	1.29 m^3/s	1.29 m^3/s
Inside diameter of pipe	900 mm	900 mm
Type of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	7.9 mm	7.9 mm
Length	22,000 m	22,000 m
One way surge tank No. 3	60m^3 x 1 unit	
Butterfly valve	900mm x 10 units	900mm x 10 units
Blow-off	900mm x 250mm x 10 units	900mm x 250mm x 10 units
Air valve	900mm x 100mm x 15 units	900mm x 100mm x 15 units
Reach (3)		
Disign discharge	1.29 m^3/s	1.29 m^3/s
Inside diameter of pipe	800 mm	800 mm
Type of pipe	Coating steel pipe	Coating steel pipe
Wall thickness	7.9 mm	7.9 mm
Length	20,000 m	20,000 m
Butterfly valve	800mm x 9 units	800mm x 9 units
Blow-off	800mm x 9 units	800mm x 9 units
Air valve	800mm x 11 units	800mm x 11 units
(3) Booster Pump Station		
Location	Ban Thap Thong	
Receiving Well		
Effective storage capacity	298 m^3	
HWL	El. 93.0 m	
LWL	El. 90.0 m	
Dimension, L x B x H	12.4m x 8.0m x 4.3m	
Pumping Well		
Effective storage capacity	2,327 m^3	
HWL	El. 91.7 m	
LWL	El. 88.7 m	
Dimension, L x B x H	27.7m x 28.0m x 4.4m	

Table 28 FEATURES OF PROPOSED NONG PLA LAI WATER CONVEYANCE SYSTEM (2/2)

Description	Phase I	Phase II
(3) (cont'd)		
Pump		
Design discharge	19.4 m^3/min	19.4 m^3/min
Design head	65 m	65 m
Motor capacity	290 kW	290 kW
Type of pump	Horizontal double suction volute pump	Horizontal double suction volute pump
Nos. of unit	3 units	2 units
Electric Facilities		
Receiving panel	22kV x 1,700kVA x 1 unit	
Control panel	3kV/380V x 3 units	3kV/380V x 2 units
Diesel generator	100kVA x 1 unit	
Flow meter	900mm x 1 unit	900mm x 1 unit
Pump & Electric Station		
Dimension, L x B	37.0m x 7.0m	
(4) Head Tank		
Location	Ban Khao Khayai	
Effective storage capacity	2,352 m^3	
HWL	El. 118.0 m	
LWL	El. 115.0 m	
Dimension, L x B x H	28.0m x 28.0m x 4.3m	

Table 29 INVESTMENT COST OF KHLONG LUANG SYSTEM

(Unit: ฿10^3)

Description	Total	Foreign Currency	Local Currency
Phase I			
1. Preparatory Work	20,000	16,140	3,860
2. Civil Works	21,350	3,650	17,700
3. Mechanical Works	156,380	135,680	20,700
4. Electrical Works	22,280	22,070	210
Contractor's Overhead	7,700	6,210	1,490
Contractor's Profit	14,300	11,540	2,760
Tax	7,480	-	7,480
Sub-total	249,490	195,290	54,200
Land Acquisition & Compensation	300	-	300
Engineering Services	19,970	13,970	6,000
Administration Cost of Executive Agency			
- Administration Cost	9,980	-	9,980
- Commission to PEA	11,700	-	11,700
Physical Contingency	43,710	31,390	12,320
Price Contingency	223,700	147,620	76,080
Total	558,850	388,270	170,580
Phase II			
1. Preparatory Work	15,660	13,590	2,070
2. Civil Works	-	-	-
3. Mechanical Works	151,930	131,280	20,650
4. Electrical Works	4,710	4,650	60
Contractor's Overhead	6,030	5,230	800
Contractor's Profit	11,200	9,720	1,480
Tax	5,860	-	5,860
Sub-total	195,390	164,470	30,920
Land Acquisition & Compensation	-	-	-
Engineering Services	15,630	10,940	4,690
Administration Cost of Executive Agency			
- Administration Cost	7,820	-	7,820
- Commission to PEA	-	-	-
Physical Contingency	32,830	26,310	6,520
Price Contingency	378,310	281,430	96,880
Total	629,980	483,150	146,830
Grand Total	1,188,830	871,420	317,410

Table 30 INVESTMENT COST OF NONG PLA LAI SYSTEM

(Unit: ฿10^3)

Description	Total	Foreign Currency	Local Currency
Phase I			
1. Preparatory Work	29,960	24,100	5,860
2. Civil Works	19,230	3,200	16,030
3. Mechanical Works	258,390	215,980	42,410
4. Electrical Works	22,060	21,870	190
Contractor's Overhead	11,540	9,280	2,260
Contractor's Profit	21,210	17,230	4,190
Tax	11,210	-	11,210
Sub-total	373,810	291,660	82,150
Land Acquisition & Compensation	300	-	300
Engineering Services	29,910	20,940	8,970
Administration Cost of Executive Agency			
- Administration Cost	14,960	-	14,960
- Commission to PEA	11,700	-	11,700
Physical Contingency	64,600	46,890	17,710
Sub-total	495,280	359,490	135,790
Price Contingency	338,870	226,350	112,520
Total	834,150	585,840	248,310
Phase II			
1. Preparatory Work	25,780	21,540	4,240
2. Civil Works	-	-	-
3. Mechanical Works	253,040	210,690	42,350
4. Electrical Works	4,710	4,660	50
Contractor's Overhead	18,430	15,400	3,030
Contractor's Profit	9,920	8,290	1,630
Tax	9,640	-	9,640
Sub-total	321,520	260,580	60,940
Land Acquisition & Compensation	-	-	-
Engineering Services	25,730	18,010	7,720
Administration Cost of Executive Agency			
- Administration Cost	12,860	-	12,860
- Commission to PEA	-	-	-
Physical Contingency	54,020	41,790	12,230
Sub-total	414,130	320,380	93,750
Price Contingency	629,080	446,840	182,240
Total	1,043,210	767,220	275,990
Grand Total	1,877,360	1,353,060	524,300

Table 31 DISBURSEMENT SCHEDULE OF INVESTMENT COST, KHLONG LUANG SYSTEM (1/2)

(Unit: ฿ 10^3)

Description	Summary			1987		1988		1989		1990		1991	
	Total	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency
Phase I													
Preparatory Works	20,000	16,140	3,860	-	-	3,550	850	5,330	1,270	5,330	1,270	1,930	470
Civil Works	21,350	3,650	17,700	-	-	800	3,890	1,200	5,840	1,200	5,840	450	2,130
Mechanical Works	156,380	135,680	20,700	-	-	29,840	4,550	44,770	6,830	44,770	6,830	16,300	2,490
Electrical Works	22,280	22,070	210	-	-	4,850	50	7,280	70	7,280	70	2,660	20
Contractor's Overhead	7,700	6,210	1,490	-	-	1,370	330	2,050	490	2,050	490	740	180
Contractor's Profit	14,300	11,540	2,760	-	-	2,550	610	3,820	910	3,820	910	1,350	330
Tax	7,480	-	7,480	-	-	-	1,640	-	2,470	-	2,470	-	900
Sub-total	249,490	195,290	54,200	-	-	42,960	11,920	64,450	17,880	64,450	17,880	23,430	6,520
Land Acquisition Compensation	300	-	300	-	-	-	300	-	-	-	-	-	-
Engineering Services	19,970	13,970	6,000	3,360	1,440	3,070	1,320	3,070	1,320	3,070	1,320	1,400	600
Administration Cost of Executive Agency													
- Administration Cost	9,980	-	-	-	240	-	2,230	-	3,160	-	3,160	-	1,190
- Commission to PEA	11,700	-	-	-	280	-	2,620	-	3,720	-	3,720	-	1,360
Physical Contingency	43,710	31,390	12,320	500	290	6,900	2,760	10,130	3,910	10,130	3,910	3,730	1,450
Price Contingency	223,700	147,620	76,080	1,390	1,040	24,850	12,910	45,570	23,140	55,430	28,460	20,380	10,530
Total	558,850	388,270	170,580	5,250	3,290	77,780	34,060	123,220	53,130	133,080	58,450	48,940	21,650

Table 31 DISBURSEMENT SCHEDULE OF INVESTMENT COST, KHLONG LUANG SYSTEM (2/2)

(Unit: ฿ 10^3)

Description	Summary			1992		1993		1994		1995		199	
	Total	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency
Phase II													
Preparatory Works	15,660	13,590	2,070	-	-	2,990	460	4,480	680	4,480	680	1,640	250
Civil Works	-	-	-	-	-	-	-	-	-	-	-	-	-
Mechanical Works	151,930	131,280	20,650	-	-	28,880	4,550	43,320	6,810	43,320	6,810	15,760	2,480
Electrical Works	4,710	4,650	60	-	-	1,020	10	1,530	20	1,530	20	570	10
Contractor's Overhead	6,030	5,230	800	-	-	1,150	180	1,730	260	1,730	260	620	100
Contractor's Profit	11,200	9,720	1,480	-	-	2,140	330	3,220	490	3,220	490	1,140	170
Tax	5,860	-	5,860	-	-	-	1,280	-	1,940	-	1,940	-	700
Sub-total	195,390	164,470	30,920	-	-	36,180	6,810	54,280	10,200	54,280	10,200	19,730	3,710
Land Acquisition Compensation	-	-	-	-	-	-	-	-	-	-	-	-	-
Engineering Services	15,630	10,940	4,690	2,620	1,130	2,410	1,030	2,410	1,030	2,410	1,030	1,090	470
Administration Cost of Executive Agency	7,820	-	7,820	-	250	-	1,720	-	2,460	-	2,470	-	920
Physical Contingency	32,830	26,310	6,520	390	210	5,790	1,430	8,500	2,060	8,500	2,060	3,130	760
Price Contingency	378,310	286,430	96,880	3,020	2,140	51,430	17,500	86,810	29,190	98,970	33,680	41,200	14,370
Total	629,980	483,150	146,830	6,030	3,730	95,810	28,490	152,000	44,940	164,160	49,440	65,150	20,230

Table 32 DISBURSEMENT SCHEDULE OF INVESTMENT COST, NONG PLA LAI SYSTEM (1/2)

(Unit: ฿ 10^3)

Description	Summary			1987		1988		1989		1990		1991	
	Total	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency
Phase I													
Preparatory Works	29,960	24,100	5,860	-	-	5,300	1,290	7,950	1,930	7,950	1,930	2,900	710
Civil Works	19,230	3,200	16,030	-	-	700	3,530	1,060	5,290	1,060	5,290	380	1,920
Mechanical Works	258,390	215,980	42,410	-	-	47,520	9,330	71,270	14,000	71,270	14,000	25,920	5,080
Electrical Works	22,060	21,870	190	-	-	4,810	40	7,220	60	7,220	60	2,620	30
Contractor's Overhead	11,540	9,280	2,260	-	-	2,040	500	3,060	750	3,060	750	1,120	260
Contractor's Profit	21,420	17,230	4,190	-	-	3,790	920	5,690	1,380	5,690	1,380	2,060	510
Tax	11,210	-	11,210	-	-	-	2,460	-	3,700	-	3,700	-	1,350
Sub-total	373,810	291,660	82,150	-	-	64,160	18,070	96,250	27,110	96,250	27,110	35,000	9,860
Land Acquisition Compensation	300	-	300	-	-	-	300	-	-	-	-	-	-
Engineering Services	29,910	20,940	8,970	5,010	2,150	4,620	1,970	4,610	1,970	4,610	1,970	2,090	900
Administration Cost of Executive Agency													
- Administration Cost	14,960	-	-	-	350	-	3,310	-	4,760	-	4,760	-	1,780
- Commission to PEA	11,700	-	-	-	280	-	2,620	-	3,720	-	3,720	-	1,360
Physical Contingency	64,600	46,890	17,710	750	420	10,320	3,940	15,130	5,630	15,130	5,630	5,560	2,090
Price Contingency	338,870	226,350	112,520	2,080	1,480	37,120	18,450	68,070	33,330	82,790	40,980	36,290	18,280
Total	834,150	585,840	248,310	7,840	4,680	116,220	48,670	184,060	76,520	198,780	84,170	78,940	34,270

Table 32 DISBURSEMENT SCHEDULE OF INVESTMENT COST, NONG PLA LAI SYSTEM (2/2)

(Unit: ฿ 10^3)

Description	Summary			1992		1993		1994		1995		1996	
	Total	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency	Foreign Currency	Local Currency
Phase II													
Preparatory Work	25,780	21,540	4,240	-	-	4,740	930	7,110	1,400	7,110	1,400	2,580	510
Civil Works	-	-	-	-	-	-	-	-	-	-	-	-	-
Mechanical Works	253,040	210,690	42,350	-	-	46,350	9,320	69,530	13,980	69,530	13,980	25,280	5,070
Electrical Works	4,710	4,660	50	-	-	1,030	-	1,540	20	1,540	20	550	10
Contractor's Overhead	18,430	15,400	3,030	-	-	3,390	670	5,080	1,000	5,080	1,000	1,850	360
Contractor's Profit	9,920	8,290	1,630	-	-	1,820	360	2,730	540	2,730	540	1,010	190
Tax	9,640	-	9,640	-	-	-	2,130	-	3,170	-	3,170	-	1,170
Sub-total	321,520	260,580	60,940	-	-	57,330	13,410	85,990	20,110	85,990	20,110	31,270	7,310
Land Acquisition Compensation	-	-	-	-	-	-	-	-	-	-	-	-	-
Engineering Services	25,730	18,010	7,720	4,330	1,850	3,960	1,700	3,960	1,700	3,960	1,700	1,800	770
Administration Cost of Executive Agency	12,860	-	12,860	-	340	-	2,830	-	4,090	-	4,090	-	1,510
Physical Contingency	54,020	41,790	12,230	660	340	9,190	2,690	13,490	3,880	13,490	3,880	4,960	1,440
Price Contingency	629,080	446,840	182,240	4,970	3,440	81,680	32,870	137,750	55,180	157,040	63,680	65,400	27,070
Total	1,043,210	767,220	275,990	9,960	5,970	152,160	53,500	241,190	84,960	260,480	93,460	103,430	38,100

Table 33 ECONOMIC CONSTRUCTION COST, KHLONG LUANG SYSTEM

(Unit: ฿10^3)

Description	Phase I			Phase II		
	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency
Preparatory Work	19,420	16,140	3,280	15,350	13,590	1,760
Civil Works	18,690	3,650	15,040	-	-	-
Mechanical Works	153,270	135,680	17,590	148,830	131,280	17,550
Electrical Works	22,250	22,070	180	4,700	4,650	50
Contractor's Overhead	7,470	6,210	1,260	10,980	9,720	1,260
Contractor's Profit	13,890	11,540	2,350	5,910	5,230	680
Tax	-	-	-	-	-	-
Sub-total	234,990	195,290	39,700	185,770	164,470	21,300
Land Acquisition & Compensation	-	-	-	-	-	-
Engineering Services	19,070	13,970	5,100	14,930	10,940	3,990
Administration Cost of Executive Agency	9,400	-	9,400	7,430	-	7,430
Physical Contingency	39,520	31,390	8,130	31,210	26,310	4,900
Total	302,980	240,650	62,330	239,340	201,720	37,620

Table 34 ECONOMIC CONSTRUCTION COST, NONG PLA LAI SYSTEM

(Unit: ฿10^3)

Description	Phase I			Phase II		
	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency
Preparatory Work	29,080	24,100	4,980	25,140	21,540	3,600
Civil Works	16,830	3,200	13,630	-	-	-
Mechanical Works	252,030	215,980	36,050	246,690	210,690	36,000
Electrical Works	22,030	21,870	160	4,710	4,660	50
Contractor's Overhead	11,200	9,280	1,920	9,680	8,290	1,390
Contractor's Profit	20,790	17,230	3,560	17,980	15,400	2,580
Tax	-	-	-	-	-	-
Sub-total	351,960	291,660	60,300	304,200	260,580	43,620
Land Acquisition & Compensation	-	-	-	-	-	-
Engineering Services	28,570	20,940	7,630	24,570	18,010	6,560
Administration Cost of Executive Agency	14,080	-	14,080	12,170	-	12,170
Physical Contingency	59,190	46,890	12,300	51,140	41,790	9,350
Total	453,800	359,490	94,310	392,080	320,380	71,700

Table 35(1) DOMESTIC AND INDUSTRIAL WATER SUPPLY BENEFIT

(Khlong Luang)

(Unit: ฿10^6)

Discount Rate (%)	1991	1996	2001
10	52.0	138.3	225.9
12	65.1	173.1	282.7
14	80.0	212.7	347.3
16	96.6	256.9	419.5
18	115.1	306.0	499.6

Table 35(2) DOMESTIC AND INDUSTRIAL WATER SUPPLY BENEFIT

(Khlong Yai)

(Unit: ฿10^6)

Discount Rate (%)	1991		1996		2001	
	Chon Buri -Pattaya	Map Ta Phut -Sattahip	Chon Buri -Pattaya	Map Ta Phut -Sattahip	Chon Buri -Pattaya	Map Ta Phut -Sattahip
8.0	39.1	102.8	113.2	114.7	249.5	127.3
10.0	49.7	129.6	144.0	144.6	317.4	160.5
12.0	62.2	158.5	180.2	176.9	397.2	196.3
14.0	76.6	189.2	221.9	211.1	489.2	234.3
16.0	93.0	221.2	269.4	246.8	593.8	273.9