CHAPTER 9 ORGANIZATION AND FINANCE

9.1 Organization and Financial Status

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CHAPTER 9

CHAPTER 9 ORGANIZATION AND FINANCE

9.1 Organization and Financial Status

9.1.1 Organization of PWA

PWA is a state enterprise with staff members totaling in 5,111 in February 1986 (Head Office - 841, Regional Offices - 592 and Waterworks - 3,678), supervised by the Board of Directors under the Ministry of Interior. The organization chart showing the lines of administration is illustrated in Fig-9.1.

For operating and maintaining 183 urban waterworks and providing technical guidance to 675 rural waterworks across the country, PWA owns 10 Regional Offices which directly supervise these urban waterworks and assist rural waterworks in technical aspects. The survey area waterworks in this report, Pattaya, is supervised by Regional Office No. 1, which is organized as illustrated in Fig-9.2.

9.1.2. Organization of Regional Office

Regional Office No. 1, which is supervising Pattaya Waterworks, is organized in the same manner as other regional offices and consists of the following 9 sections.

1) Personnel & Clerical Section, which is responsible for personnel administration of the waterworks under its control, including the training of waterworks personnel.

2) Finance & Accounting Section, which takes charge of finance and accounts of the water works under its control, inclusive of debiting and crediting of their bank accounts.

3) Procurement and Stores Section, which takes charge of procuring and storing materials and supplies necessary for operating the water facilities of the waterworks under its control.

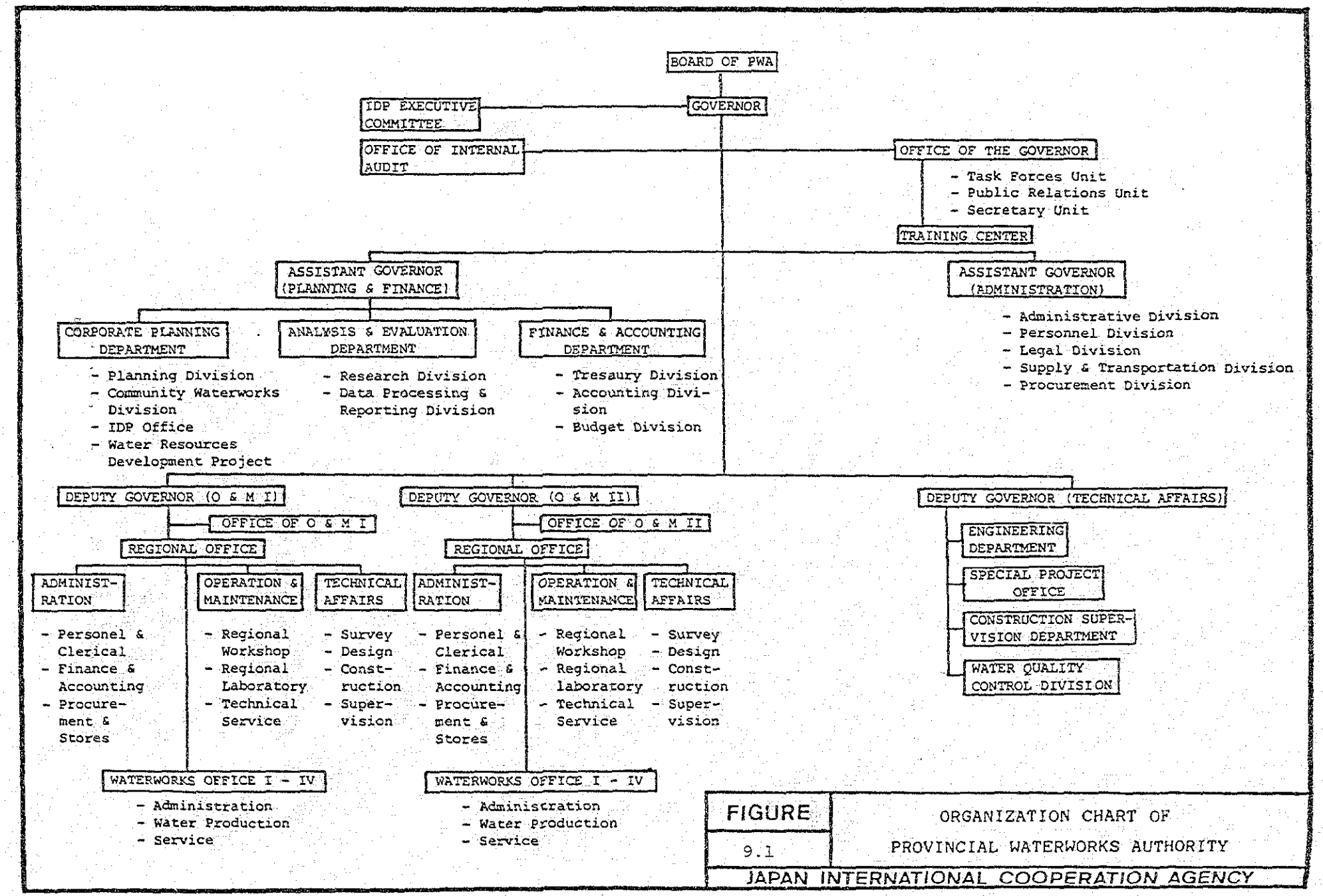
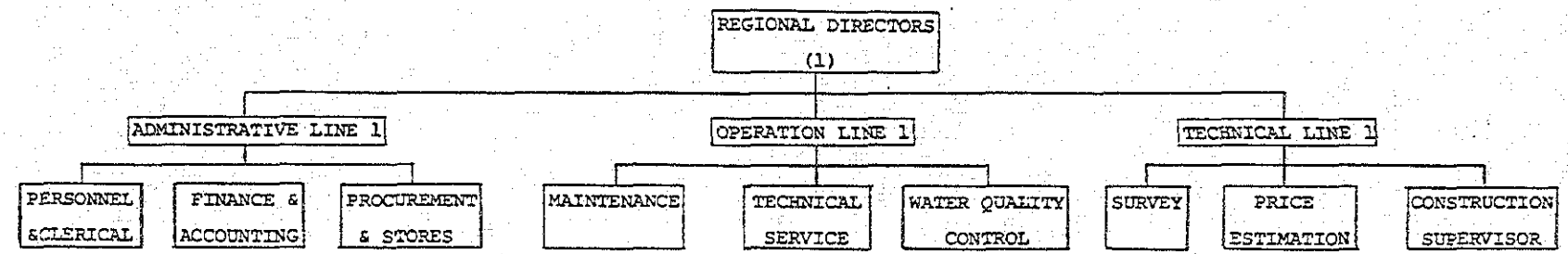


FIGURE 9.1 ORGANIZATION CHART OF PROVINCIAL WATERWORKS AUTHORITY

JAPAN INTERNATIONAL COOPERATION AGENCY



CHIEF	1	CHIEF	1	CHIEF	1	CHIEF	1	CHIEF	1	CHIEF	1	CHIEF	1	CHIEF	1
CLERK	3	FINANCE &		STORE -				MECHANIC	2	SCIENTIST	1	TEC-		TECHNICIAN	4	TECHNICIAN	2
TYPIST	3	ACCOUNT	5	KEEPER	4	ELECTRICIAN	3					NICIAN	4		
DRIVER	3			LABOUR	1	MACHANIC	7								
JANITOR	2					SKILL LABOUR	3								
SECURITY-			6		6		14		3		2		5		5		3
STAFF	2														
LABOUR	2														
	16														

PERSONNEL IN LINE	64
TECHNICIAN *	2
MECHANIC *	1
TOTAL	67

* NOT IN LINE

FIGURE 9.2 REGIONAL OFFICE I CHONBURI

JAPAN INTERNATIONAL COOPERATION AGENCY

4) Maintenance Section, which takes charge of giving guidance and instruction how to conduct operation and maintenance of the facilities of the waterworks under its control.

5) Technical Service Section, which provides preliminary survey of projected waterworks schemes for both urban and rural waterworks under its jurisdiction.

6) Water Quality Control Section, which is responsible for conducting quality test of raw water in the area under its control to check if the water meet the standards set by PWA.

7) Survey Section, which is responsible for providing Head Office with information concerning rural waterworks and planning of new projects of water supply under its jurisdiction.

8) Price Estimation Section, which is responsible for estimating cost of expansion and rehabilitation of water supply systems both for urban and rural waterworks under its jurisdiction and preparing documents and drawings for tender bidding, etc.

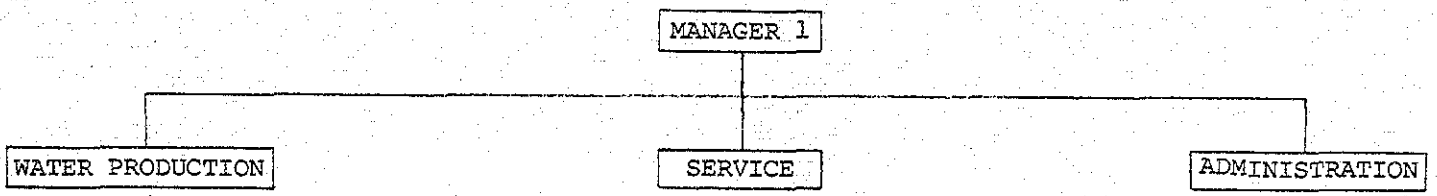
9) Construction Supervision Section, which is responsible for supervising the construction and rehabilitation of water supply facilities mentioned in 8) above.

9.1.3 Organization of Waterworks

The proto type organization of PWA waterworks, after which Pattaya Waterworks is modeled, consist of the following 3 sections, as illustrated in Fig-9.3.

1) Water Production Section, which is responsible for operation and maintenance of water production facilities.

2) Service Section, which provides services of setting and repairing house connections.



WATER PRODUCTION	
CHIEF	1
PRODUCTION STAFF	7
	8

SERVICE	
CHIEF	1
TECHNICIAN	1
SERVICING STAFF	6
LABOUR	1
	9

ADMINISTRATION	
CHIEF	1
FINANCE & A/C	5
METER READER &	1
BILL COLLECTOR	4
CLERK	4
TYPIST	1
STORE KEEPER	1
DRIVER	1
JANITOR	1
SECURITY STAFF	1
	20

TOTAL 38

FIGURE 9.3 PATTAYA WATERWORKS

JAPAN INTERNATIONAL COOPERATION AGENCY

3) Administration Section, which takes charge of meter-reading and bill-collection, book-keeping of customers accounts, financing, record-keeping of waterworks income and expenditure, and other administrative matters.

9.1.4 Financial Status of PWA

It is the established policy of the Thai government that the state enterprises including PWA should become self-financing, and thanks to its continue effort to reduce operation expenses, the net income of PWA before depreciation and investment cost has turned to surplus since 1983 and that after depreciation turned to surplus in 1985, as shown in Table-9.1. This means that PWA achieved the first of the five steps towards the self-financing target as illustrated in Figs-9.4 to 9.5 in 1983 and the 2nd in 1985.

PWA is making a effort to achieve better business, and revisions have been made in their accounting system. These revisions are of course welcome from long term view points, but these revisions break the continuity of financial records and are making analysis of time series difficult. Despite such inadequancy of study data, the financial statements shown in Tables-9.1 and 9.2 show that the operating ratio of PWA has greatly improved from 95.6 % in 1983 to 68.9 % in 1985 and demonstrated its effort to reduce operating cost.

PWA thus has come to the stage where revenue more than off-sets its operating expenses, but it still depends upon Government subsidies and financial assistance from abroad for capital investment which is indispensable for the Authority to perform its primary objective of serving water of adequate quantity and quality to the population of the entire country except the Bangkok Metropolitan Area. It is noted that almost half of the population are still using unsafe water.

Table-9.1 PROVINCIAL WATERWORKS AUTHORITY
INCOME STATEMENT
1983 - 1986

Unit: Mil. Baht

	1983	1984	1985	1986(Budget)
Revenue				
Water sales (net)	626.48	647.53	967.14	1,229.08
Service charge		52.74	54.50	57.15
Connection income	72.93	118.35	149.11	146.79
Other income	28.57	66.28	137.24	50.00
Total revenue	727.98	884.90	1,307.99	1,483.02
Operation expenses				
Salaries & Wages	304.74	325.81	351.12	384.44
Temporary wages	0.40	1.23	0.84	2.12
Remunerations	56.32	55.78	61.56	69.90
Chemicals	33.19	43.27	35.52	44.04
Material & Maintenance	48.21	35.27	39.67	66.28
Oil & fuel	22.36	15.69	14.50	18.41
Office supplies		9.84	6.65	10.64
Hire & service	2.31	12.55	52.08	54.35
Other operating expense	59.80	38.40	27.04	55.27
Public Utilities	2.23	18.23	6.77	21.71
Electricity	153.36	167.47	167.29	177.03
Interest & bank charge	13.03	22.99	66.57	104.56
Connection cost		46.27	71.56	85.68
Miscellaneous		0.37	0.56	20.00
Total expenses	695.95	793.17	901.73	1,114.43
Gross proftit	32.03	91.73	406.26	368.59
Bad debt	0.01	0.72	0.09	1.00
Rural w/w expenses		1.49	1.03	1.50
Other expenses	13.68	-12.25	66.71	9.85
Profit (loss) before depriciation & amortization	18.34	101.77	338.43	356.24
Depriciation & amortization	136.32	149.14	174.58	200.44
Net profit (loss)	-117.98	-47.37	163.85	155.80

Note: 1. For 1983, material and maintenance includes office supplies.
2. Income statement is not approved by the auditor.

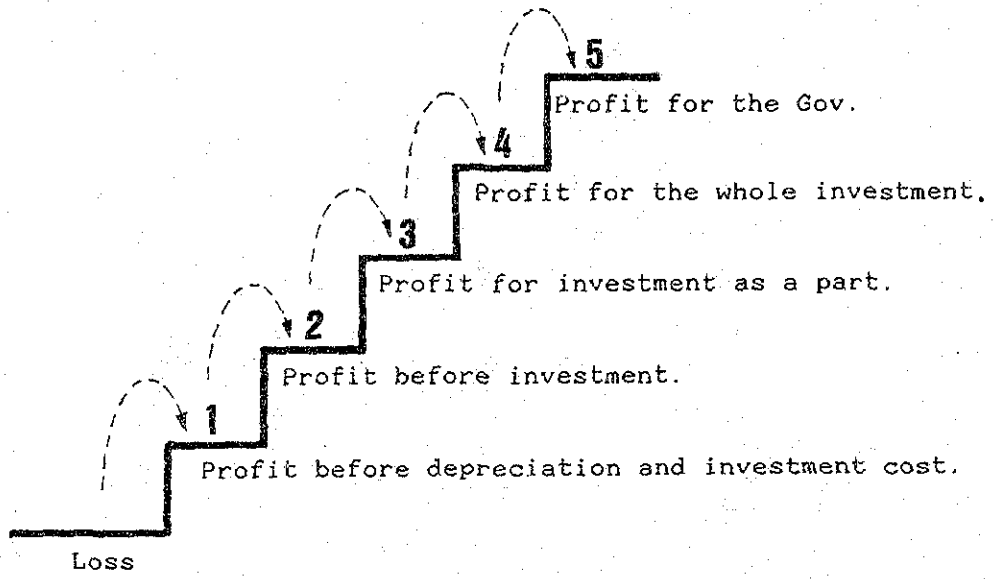


FIGURE	5 STEPS FOR ACHIEVEMENT OF SELF-FINANCING BY STATE ENTERPRISES
9.4	

JAPAN INTERNATIONAL COOPERATION AGENCY

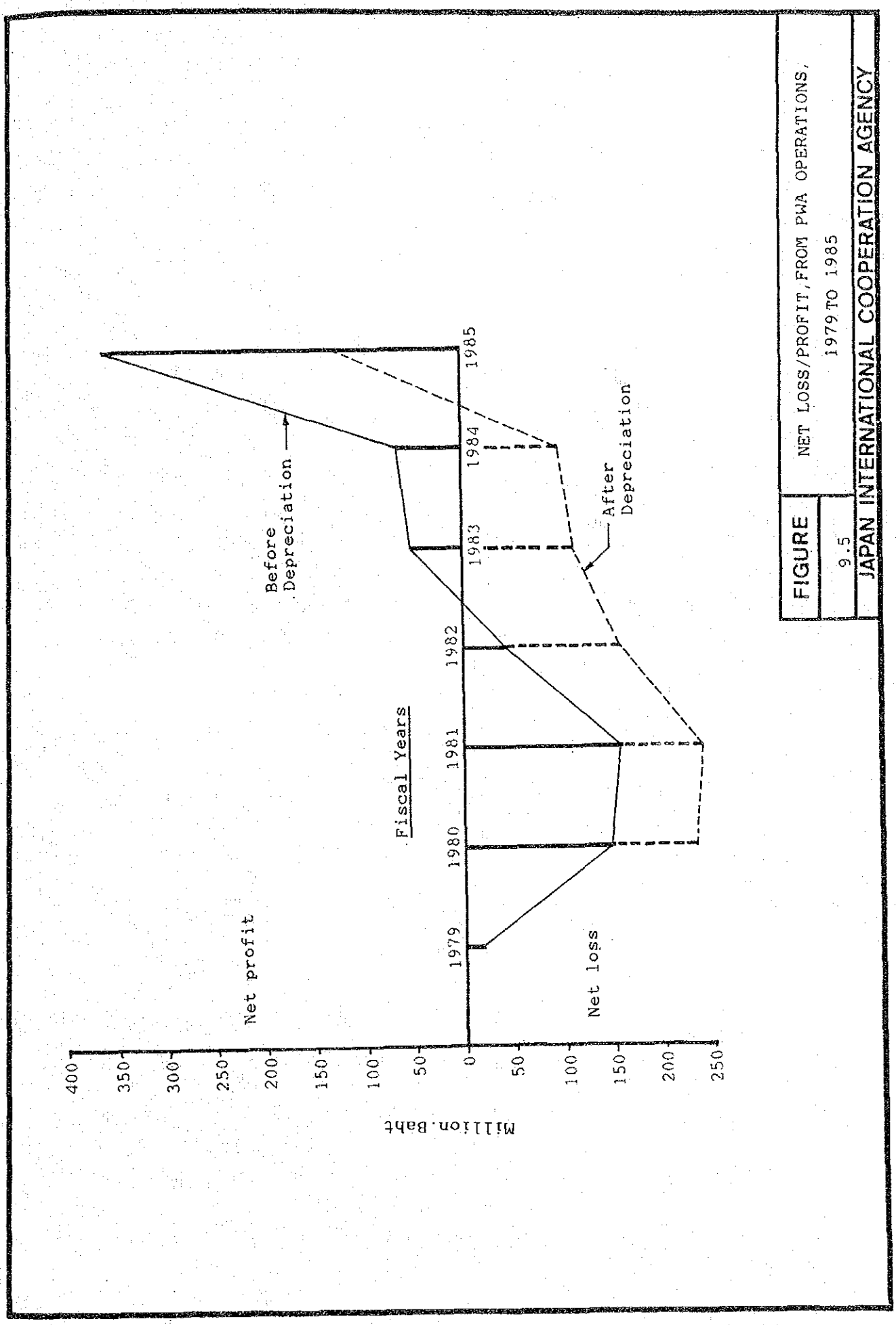


FIGURE 9.5

NET LOSS/PROFIT, FROM PWA OPERATIONS, 1979 TO 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

Table-9.2 Provincial Waterworks Authority
Balance Sheet
At the End of September 1983, 1984 and 1985

Unit: Mil. Baht

Assets	1983	1984	1985	Liabilities and Equity	1983	1984	1985
Current asset				Current liabilities			
Cash in hand and at bank	385.80	824.11	1,243.67	Accounts payable	0.97	9.43	14.76
Accounts receivable (net)	122.31	155.89	160.81	Accrued electricity charge	324.42	298.99	318.15
Advances	2.56	5.64	10.27	Accrued interest	3.73	10.95	19.75
Interest receivable	8.52	31.71	42.74	Other accrued expenses	23.50	5.59	9.51
Inventories	152.60	168.82	161.73	Customers deposits	25.72	31.24	38.10
Work in progress	1.81	3.36	7.90	Employees' deposits	4.96	5.51	6.03
Other current assets	1.55	2.30	2.58	Connection fees received in advance	17.61	36.12	31.11
				Current portion of long term debt	2.87	5.54	42.36
				Other current liabilities	14.63	12.83	14.40
Total current assets	675.15	1,191.83	1,629.70	Total current liabilities	418.41	416.20	494.17
Fixed assets				Long term debt	164.61	513.09	641.26
Land	21.96	34.75	43.46				
Building and construction	1,452.07	1598.93	1907.97				
Equipment	497.77	568.94	594.70				
Sub total	1,971.80	2,202.62	2,546.13				
Less accumulated depreciation and amortization	-334.01	-449.46	-590.35				
Fixed asset (net)	1,637.79	1,753.16	1,955.78	Total liabilities	583.02	929.29	1,135.43
Construction in progress	173.69	258.50	350.18	Equities			
				Capital	2,147.50	2,147.50	2,147.50
Other asset				Government subsidy	1,512.09	1,775.50	2,071.08
Construction advances	20.00	40.17	23.86	Other subsidy	1.91	109.78	109.99
Right of possesion over Government property (net)	957.86	924.17	890.48	Capital surplus (net)	43.20	73.61	90.00
				Capital surplus from donations	-2.04	0.71	0.71
				Total	3,702.66	4,107.10	4,419.28
				Profit (loss) at beginning	-703.21	-821.19	-868.56
				Profit (loss) for the year	-117.98	-47.37	163.85
				Profit (loss) at the end	-821.19	-868.56	-704.71
				Total equities	2,881.47	3,238.54	3,714.57
Total assets	3,464.49	4,167.83	4,850.00	Total liabilities & equuitie	3,464.49	4,167.83	4,850.00

9.1.5 Financial Status of Pattaya Waterworks

All the revenues of waterworks, including Pattaya Waterworks, are transferred, through Regional Offices, to PWA Head Office and all the necessary expenses of the waterworks for their administration, operation and maintenance are allocated by PWA Head Office annually. The capital investment procedures for the waterworks, covering all phases of planning, designing and construction, are executed at the responsibility and on account of PWA Head Office.

The waterworks including Pattaya Waterworks, thus have no autonomy in financing. Their revenue and expenditure accounts, as shown in the accounts of Pattaya Waterworks illustrated in Table-9.3 do not reflect such items as debt service, depreciation cost and shares of PWA Head Office and Regional Offices to be borne by the waterworks concerned. Their accounts do not present such financial picture of the waterworks concerned as will be required for the feasibility study of the projects. The above revenue and expenditure accounts of Pattaya Waterworks for example registered a net surplus of 40,895.5 million Baht for fiscal 1985, i.e., 83.28 % of gross revenue.

In order to grasp the real picture of the financial status of the waterworks, those activities of PWA Head Office conducted for the waterworks concerned must be taken into consideration, as will be discussed in Chapter 14, "FINANCIAL AND ECONOMIC ANALYSIS" in the process of feasibility study.

9.2 Current Project Viewed from the Sixth Sector Five-Year Economic and Social Development Program

PWA is preparing the sector's draft five-year planning which will be integrated into the Sixth National Five-Year Economic and Social Development Program, as summarized in Tables-9.4 to 9.8. The current project for Pattaya Waterworks together with the three other projects for Chiangmai, Ubon-Warin and Suphanburi Waterworks, now being studied with a grant by the Japan International Cooperation Agency, which altogether constitute a package project named the Provincial Water Supply Projects in the Kingdom of Thailand, will form a part of the Five-Year Program.

Table-9.3 REVENUE AND EXPENDITURE OF PATTAYA WATERWORKS (FOR PAST TWO YEARS)

Unit: Baht

	1984	1985
Water Production (x1,000 m3)	6,590,375	7,582,445
Water Sales (x1,000 m3)	5,910,626	6,432,018
No. of Connections	4,239	5,269
REVENUE:		
Water Sales	27,699,886	43,624,269
Service Charge	728,472	868,935
Connection Fee	1,953,875	4,470,493
Others	206,984	142,093
Total	30,589,217	49,105,790
EXPENDITURE:		
Personnel Expenses	2,165,225	2,605,638
Chemicals	800,524	671,830
Material & Maintenance	250,909	163,481
Oil & Fuel	46,792	267,354
Office Supplies	42,791	50,606
Hire & Service	46,187	118,675
Electricity	1,618,874	2,444,507
Connection Cost	851,657	1,806,768
Others	453,797	76,432
Total	6,276,756	8,205,291
REVENUE/EXPENDITURE	4.87	5.98

Table-9.4 SUMMARY OF ECONOMIC TARGETS IN SIXTH ECONOMIC & SOCIAL DEVELOPMENT PROGRAM (PWA)

PLAN	INVESTMENT COSTS (MIL. BAHT)	AVERAGE INVESTMENT COST/ SERVED POPULATION (BAHT/ PERSON)	INCREASED WATER PRODUCTION AT END OF PROJECT PERIOD (MIL. M3/YR)	WATER SOLD AT END OF PROJECT PERIOD			REMARKS
				INCREASED WATER SALES (MIL. M3/ YEAR)	TARIFF RATE (BAHT/ M3)	INCREASED INCOME (MIL. BAHT/ YEAR)	
1. Water Supply Expansion Program	5,988.077	2,181	31.212	23.409	6.79	158.977	- Increased Water Production, Increased Water Sales and Increased Income calculated from the increased amounts for 1987 - 1991 (5 years)
2. Take Over Water Supply Program	243.000	648	4.599	3.449	6.79	23.419	
3. Immediate Improvement Program	165.830	880	2.488	1.866	6.79	12.670	
4. Water Resource Development Program	133.920	137					- No. of Served Population calculated from the figures at the end of project periods (10 years)
5. Rural Water Supply Expansion Construction Program	667.500	890	(1.84)			(5.52)	- Nos. of waterworks in ( ) are those not operated by PWA.
6. Master Plan and Feasibility Study Program	152.201			(1.38)	(4.0)		The figures in ( ) are therefore do not add up to total.
TOTAL	7,350.528	4,736	38.299	28.724	6.79	195.066	

Table-9.5 YEARLY PROJECT TARGETS (SOCIAL) ACCORDING TO 6TH ECONOMIC & SOCIAL DEVELOPMENT PROGRAM (PWA)

PLAN	No. of Communities Alleviated of Water Supply Problems (fiscal year)						No. of People Covered (fiscal year)					
	1987	1988	1989	1990	1991	TOTAL	1987	1988	1989	1990	1991	TOTAL
1. Water Supply Expansion Program	12	7	12	8	10	49	637,400	306,800	936,000	631,100	233,800	2,745,100
2. Take Over Water Supply Program	15	15	15	15	15	75	75,000	75,000	75,000	75,000	75,000	375,000
3. Immediate Improvement Program	16	9	0	0	0	25	117,539	70,891	0	0	0	188,430
4. Water Resource Development Program	8	9	9	9	9	44	198,764	229,802	141,976	162,093	241,351	973,986
5. Rural Water Supply Expansion Construction Program	30	30	30	30	30	150	150,000	150,000	150,000	150,000	150,000	750,000
6. Master Plan and Feasibility Study Program	12	4	8	8	7	39	0	0	0	0	0	0
TOTAL	93	74	74	70	71	382	1,178,703	832,493	1,302,976	1,018,193	700,151	5,032,516

Table-9.6 SUMMARY OF SOCIAL TARGETS
IN
THE 6TH ECONOMIC AND SOCIAL
DEVELOPMENT PLAN
(PWA)

PLAN	NO. OF COMMUNITIES ALLEVIATED OF WATER SUPPLY PROBLEMS	NO. OF POPULATION TO BE COVERED AT THE END OF PROJECT (10 YEARS)	PER YEAR INCREASE IN WATER SALES (MIL. M3)
1. Water Supply Expansion Program	49	2,745,100	23.409
2. Take Over Water Supply Progra	75	375,000	3.449
3. Immediate Improvement Program	25	188,430	1.866
4. Water Resource Development Pr	44	973,986	
5. Rural Water Supply Expansion Construction Program	150	750,000	(1.38)
6. Master Plan and Feasiblity Study Program	39		
T O T A L	382	5,032,516	28.724

Table-9.7 SUMMARY OF EXPENDITURE
IN
THE 6TH ECONOMIC AND SOCIAL
DEVELOPMENT PROGRAM
ON A YEARLY BASIS
(PWA)

TYPE OF PROJECT INVESTMENT	1987	1988	1989	1990	1991	TOTAL
1. Project investment (Mill Baht)						
1.1 Water Supply Expansion Program	862.073	802.915	1,609.999	1,655.836	1,057.254	
1.2 Take Over Water Supply Program	48.600	48.600	48.600	48.600	48.600	
1.3 Immediate Improvement Program	106.130	59.700				
1.4 Water Resource Development Program	20.500	29.200	28.820	31.200	24.200	
1.5 Rural Water Supply Expansion and Construction Program	115.500	124.500	133.500	142.500	151.500	
1.6 Master Plan and Feasiblity Study Program	125.554	24.347	0.800	0.800	0.700	
Sub.total	1,278.357	1,089.262	1,821.719	1,878.936	1,282.254	7,350.528
2. unproject Investment (Mill Baht)						
2.1 Expansion of Service Area						
2.2 Central Durable Articles Procurement						
2.3 Other reserves						
Sub total	111.161	94.718	158.409	163.385	111.500	639.173
TOTAL	1,389.518	1,183.980	1,980.128	2,042.321	1,393.754	7,989.701

Table-9.8 SUMMARY OF INVESTMENT EXPENDITURE
IN
THE 6TH ECONOMIC AND SOCIAL
DEVELOPMENT PROGRAM
CATEGORIZED BY SOURCE OF FUND
(PWA)

TYPE OF PROJECT INVESTMENT	Government Budgets (Mil. Baht)	PWA INCOME (Mil. Baht)	Loans		Grants* (Baht)	Local Budgets (Budget)	Total	Remarks
			Local	Foreign				
1. Project investment (Mil. Baht)								
1.1 Water Supply Expansion Program	2,614.376	87.581		3,286.120			5,988.077	
1.2 Take Over Water Supply Program	119.000			124.000			243.000	-Source of Finance:GTZ
1.3 Immediate Improvement Program	58.050			107.780			165.830	-Worldbank & Local Budget
1.4 Water Resource Development Program		133.920						
1.5 Rural Water Supply Expansion and Construction Program	467.250					200.250	667.500	
1.6 Master Plan and Feasibility Study Program		24.784			127.417		152.201	* Grants (JICA & GTZ)
Sub total	3,258.676	246.285	0.000	3,517.900	127.417	200.250	7,350.528	
2. Unproject Investment (Mil. Baht)								
2.1 Expansion of Service Area								
2.2 Central Durable Article Procurement		639.173					639.173	-8% of Total Investment Cost
2.3 Other reserves								
	3,258.676	885.458	0.000	3,517.900	127.417	200.250	7,989.701	

This chapter tries to evaluate the importance of the aforesaid package of JICA projects from the view point of the draft Sixth Sector Five-Year Economic and Social Development Program, on the top of that for the current project for Pattaya Waterworks, the reason being that the weight of the former is considered to be more significant than that for the latter.

The projects under the Five-Year Program number 382 and the estimated cost for these projects amounts to 7,350.50 million Baht (1 Baht = 6 Yen as of September 1986). Of these projects, expansion projects such as the current one for Pattaya, as shown in Table-9.9, amount to 5,988 million Baht, 80 % of the total. The current project for Pattaya, whose investment cost totals 380.8 million Baht, assumes the weight of 6.4 % of the total expansion projects under the Five-Year Program. (The combined total cost of the JICA package project covering Chiangmai, Ubon-Warin and Suphanburi as well as Pattaya shares 16.2 % of the total cost for the expansion projects under the Program.)

Pattaya will be one of the 49 communities to be alleviated of water supply problems by the mentioned Five-Year Program. The number of people who will be covered by the current project for Pattaya up to 2000, the target year of Stage 1 of the project, as shown in Table-9.9, is estimated at 37,400, which is about 1.4 % of the number of people to be covered by the expansion projects under the Five-Year Program, i.e., 2,745,100, although both figures are not directly comparable because of differences in the periods of comparison. (The combined total of people covered by the JICA package project is estimated to be 150,010, 5.5 % of those covered by the Five-Year Program.)

The per-year increase in water sales to be brought about by the current Project for Pattaya in the 5 years from 1992 when the current project implementation will be completed, is estimated at 2,300,000 cu m, which is about 9.8 % of the corresponding figure to be achieved by the Five-Year Program. (The combined total of said per-year increase of water sales by the JICA package project for the four cities will be 10,133,000 cu m, i.e., 43.3 % of the corresponding figure for the Five-Year Program.)

The above comparison of the targets of the Five-Year Program and JICA projects reveals that the latter places more weight on sales increases than the number of people to be benefited. This difference may be partly attri-

Table-9.9 Targets of Five-Year Program
and JICA Projects Compared

	No.of Communities Covered	Investment Cost (Mil. Baht)	Ratio to Five-Year Program	No.of People Covered	Ratio to Five-Year Program	Increase in Annual Water Sales (Mil. M3)	Ratio to Five-Year Program
Water Supply Expansion Projects Under Five-Year Program	49	5988.077	100.00%	2,745,100	100.00%	23.409	100.00%
JICA Provincial Water Supply Projects for Four Cities	4	971.937	16.23%	150,010	5.46%	10.133	43.29%
Chiangmai	1	309.535	5.17%	52,210	1.90%	4.033	17.23%
Pattaya	1	380.830	6.36%	37,400	1.36%	2.300	9.83%
Ubon-Warin	1	219.197	3.66%	52,200	1.90%	3.362	14.36%
Suphanburi	1	62.375	1.04%	8,200	0.30%	0.438	1.87%

butable to the fact that the JICA projects cover such large cities as Chiangmai, Ubon and Warin as well as such tourist spots as Pattaya where per-capita consumption of water is expected considerably higher than small communities. In addition it is to be noted that approximately 40 % of water consumption in Pattaya and 10 % in Chiangmai are directed to consumption by tourists whose number is not counted as served population.

Of the four municipalities under the JICA study, Pattaya together with Chiangmai are believed to have prospective futures to be leading spots of tourism in Thailand on which the Government of Thailand is placing importance as a means of encouraging labor employment and earning foreign exchange. Chiangmai is also a renown tourist town and assumes the importance as the 2nd largest city in Thailand. Ubon and Warin, if combined together, assume the status of the 3rd largest. Suphanburi, which is a municipality important as an ancient cultural resort and a commercial center for its vicinities, is suffering from serious water shortage and troubles caused by the aged facilities.

PWA has achieved a sounder financial position to earn net surplus after depreciation since 1985, having put forward to a second step to self-financing and is now making efforts to be affordable to finance its capital investment with its own internal cash generation. It is regarded in this connection that soft loans from OECF may help PWA achieve its long-cherished desire of self-financing of capital investment without Government subsidies. The above factors doubtless justify the Provincial Water Supply Project under the current JICA study as a top priority project, thus viewed from the Sixth Five-Year Economic and Social Development Program of PWA.

9.3 Financing of the Project

The possible main fund sources for PWA capital investment are considered to consist of (1) internal generation, (2) government subsidies, and (3) foreign and domestic loans. As for the 2nd category of sources, government subsidies, PWA has recently been notified by NESDB that no Government budget will be allocated to PWA for its capital investment projects as for fiscal year 1986. The Board however indicated a possibility that such budget allocation may be resumed from 1987 though at a low level, if the government budgetary tightness turns to ease. General predictions are

however that current financial stringency will not ease so soon.

As a consequence, financing of the current project have to depend upon other two sources, (1) cash generation or net earnings of PWA and foreign and domestic loans. In view of the fact that loans should be repaid with interest in the long run, the bulk of loans available finally depends upon the ability of PWA in internal cash generation. Analysis in this respect will also be furthered in Chapter 14.

In this study, the possibility of financing part of the local portions of capital investment by foreign loans, OECF loans in this case, will be examined in view of the prevailing stringency in the local money market.

CHAPTER 10

CHAPTER 10 SCOPE OF PROJECT FOR FEASIBILITY STUDY

Of the three phases of works proposed in Chapter 7, two phases, Stage I Rehabilitation and Modification and Stage I Expansion Works, are planned for Stage I implementation as shown in the Implementation Schedule in Chapter 8.

These two phases of works shall be studied as of their technical, financial and economic feasibility, accordingly.

The outline of the Feasibility Study project in tabulated below:

No.	Item		Description
1.	Service Area	:	2,700 ha (as shown in Fig-6.2)
2.	Target Year	:	A.D. 2000
3.	Served Population	:	59,800 people (in 2000)
4.	Max-Day Demand	:	48,900 cu m/d (in 2000)
5.	Project Works		
	a) Rehabilitation and Modifications Works		
		:	Intake and raw water transmission pipeline
		:	Pattaya-Na Klua Treatment Plant
		:	Distribution pipelines
	b) Expansion Works		
		:	Thung Sukla Treatment Plant (Capacity 20,100 cu m/d)
		:	Clear water transmission pipelines (ϕ600-ϕ500 x 11km) + (ϕ400 x 13km)
		:	Rong Po Distribution Pump Station
		:	Distribution Pipelines (ϕ600-ϕ100 x 78km)

PART THREE
FEASIBILITY STUDY

CHAPTER 11 SERVED POPULATION AND WATER DEMAND

CHAPTER 12 PRELIMINARY DESIGN

CHAPTER 13 PROJECT IMPLEMENTATION AND COST ESTIMATES

CHAPTER 14 FINANCIAL AND ECONOMIC ANALYSIS

PART THREE

CHAPTER 11 SERVED POPULATION AND WATER DEMAND

11.1 Introduction

11.2 Served Population

11.3 Water Demand

CHAPTER 11

CHAPTER 11 SERVED POPULATION AND WATER DEMAND

11.1 Introduction

In Chapter 6, the served population and water demand were forecast in every fifth year up to 2010 for the Development Plan. In this chapter, forecast is made yearly up to 2000 for Feasibility Study.

In making yearly forecast, new concepts were introduced as follows:

1) When the supply service is apparently improved after completion of the planned works, accumulated implicit water demand will surface and result in a concentrated increase in application for the service.

2) As the waterworks' resources are limited, meeting such increased application satisfactorily will be difficult.

Though the influence of other factors was considered, the above two factors were thought to be principal.

These factors, however, were found not so influential as to change the Development plan. These factors are considered to bring some bearings on financial forecast in the feasibility study.

11.2 Served Population

In this section, yearly served population was forecasted on the basis of the forecast made in Development Plan, and also, such factors as demand explication mentioned in the former section were taken into consideration.

Table-11.1 shows future yearly served population together with total population, which was utilized as an imputation factor for projecting yearly water demand.

Table-11.1 TOTAL AND SERVED POPULATION

YEAR	TOTAL POPULATION	SERVICE RATIO (%)	SERVED POPULATION
1985	58,700	34.0	20,000
1986	61,000	36.8	22,400
1987	63,200	39.7	25,100
1988	65,500	42.5	27,800
1989	67,700	45.2	30,600
1990	69,900	48.0	33,600
1991	72,100	50.8	36,600
1992	74,400	54.6	40,600
1993	76,600	57.5	44,000
1994	78,800	59.8	47,100
1995	81,000	61.0	49,400
1996	83,200	62.1	51,700
1997	85,400	63.1	53,900
1998	87,600	63.9	56,000
1999	89,800	64.5	57,900
2000	92,000	65.0	59,800

11.3 Water Demand

Total water consumption, and average and maximum water demand are shown in Table-11.2.

Total water consumption was forecast from such factors as served population, per capita water consumption, consumption by each category, and tourism water consumption, as described in Chapter 6. This water consumption is used for financial analysis as basic data on water quantity.

For the calculation of average-day water demand, the unaccounted-for water ratio was assumed at 15 % constant to year 2000.

Maximum day water demand was calculated, with a peak factor of 1.4 for tourism water consumption and 1.25 for other water consumption.

Table-11.2 TOTAL WATER CONSUMPTION AND AVERAGE AND MAXIMUM DAY DEMAND

YEAR	TOTAL WATER CONSUMPTION (cu m/d)	AVERAGE-DAY DEMAND (cu m/d)	MAXIMUM-DAY DEMAND (cu m/d)
1985	13,800	16,200	21,500
1986	15,100	17,800	23,700
1987	16,500	19,400	26,000
1988	17,900	21,100	28,200
1989	19,500	22,900	30,500
1990	21,100	24,800	32,700
1991	22,400	26,400	34,900
1992	23,900	28,100	36,800
1993	25,400	29,900	39,000
1994	26,700	31,400	41,100
1995	27,900	32,800	43,000
1996	28,700	33,800	44,100
1997	29,600	34,800	45,400
1998	30,300	35,600	46,600
1999	31,100	36,600	47,900
2000	31,900	37,500	48,900

CHAPTER 12 PRELIMINARY DESIGN

12.1 Design Criteria
12.1.1 Peak Factors
12.1.2 Water Loss in Production
12.1.3 Treatment Plant
12.1.4 Service Pressure
12.1.5 Pipelines

12.2 Rehabilitation and Modification Works
12.2.1 Intake and Raw Water Transmission Pipeline
12.2.2 Water Treatment Facilities
12.2.3 Distribution Pipeline

12.3 Expansion Works
12.3.1 General
12.3.2 Outline of Proposed Water Supply Facilities

12.4 Operations and Management Plan

CHAPTER 12

CHAPTER 12 PRELIMINARY DESIGN

In Chapter 7, the water supply system proposed for the Stage I, including rehabilitation and modification of the existing system and the expansion works, was described. This chapter intends to make the preliminary design of the involved works. The criteria is discussed in 12.1, in 12.2 and 12.3 the applications of the criteria to the rehabilitation and modification works and the expansion works are described. In 12.4, fundamental requirements of operation and maintenance of the completed facilities are described.

12.1 Design Criteria

The design criteria mentioned herein were concluded after discussion with PWA and studying the PWA design criteria and the concepts widely accepted in waterworks field. They are applied to the preliminary design of the project, and detailed in Appendix 6.

12.1.1 Peak Factors

No peak factors have been established as criteria, and the table below shows the peak factors planned for Pattaya.

Peak Factor by Day (Max Day/Ave Day)	Peak Factor by Hour (Max Hour/Ave Hour)
1.30	1.20

(Note) Ave Hour = 1/24 Max Day

Different peak factors by day were estimated for each of the domestic and tourism demands and the listed figure is the average. Using the peak factors, the average day demand, maximum day demand and maximum hour demand were calculated.

Each type of the demands is for different use as described below:

Average Day Demand : financial and economic study
Maximum Day Demand : production facility design
Maximum Hour Demand: distribution facility design

12.1.2 Water Loss in Production

Water loss is counted in designing production facilities. They are assumed to be:

Treatment Plant : 8 % including filter washing and other in-plant consumption

12.1.3 Treatment Plant

The treatment plant must be equipped with such facilities as necessary to produce treated water enough in quantity and quality.

Treated water must conform to the Drinking Water Quality Standards of PWA.

Details of the design criteria for treatment plant and the Drinking Water Quality Standards of PWA are stipulated in Appendix 6.

12.1.4 Service Pressure

The minimum service pressure in the maximum hour flow is set at 1.0 kg/sq cm for general application, except for rural areas where 0.7 - 0.8 kg/sq cm can be tolerated.

12.1.5 Pipelines

1) Pipe Material

In selecting pipe material, conditions such as strength against internal and external loads, suitability to ground conditions, workability in existing conditions and influence on water quality must be considered.

Asbestos cement pipes, anti-corrosion coated when necessary, are to be used preferably for economic reasons. For cases requiring pipe strength such as road crossing works and the like, ductile cast iron pipes are to be employed.

2) Pipe Size

Pipe size is to be selected pursuant to flow requirements. In this preliminary design, the fire-fighting flow is not surcharged on the maximum hour flow.

3) Appurtenances

Necessary appurtenances such as valves, drain valves, air release valves, hydrants are installed at necessary and appropriate places.

12.2 Rehabilitation and Modification Works

The rehabilitation and modification works are intended to provide needed improvements of the existing facilities for possible capacity increase of the Pattaya-Na Klua Treatment Plant which could be accomplished with minimal engineering and capital investment. (For details, refer to Appendix 8.)

The Pattaya-Na Klua Treatment Plant is originally designed with 24,000 cu m/d (1,000 cu m/h) capacity on the PWA Standardized design basis. The plant was investigated for its potencial capacity, whether the existing facilities could be upgraded with minimum capital investment. As the result of the study, it was found that approximately 40 % increase of the

production capacity was reasonable, or the total capacity was reasonably increased to 33,600 cu m/d, considering both the design criteria and the hydraulic conditions.

The planned works are described in the following sections:

12.2.1 Intake and Raw Water Transmission Pipeline

1) Relocation of intake pump

The 400 cu m/h intake pump installed outside the pump house in March 1986 should be relocated into the pump house of the intake tower for long-term use and easy maintenance.

2) Replacement and installation of flow meters and recorders

Flow meters and recorders should be installed for recording daily intake amount and determination of chemical feeding rates. For installation of the additional raw water intake pump, a flow meter and a recorder should be installed for the 250 mm diameter raw water transmission main. Replacement will be needed for a flow meter and a recorder of the 700 mm diameter raw water transmission main due to malfunctioning. These new flow meters should be of differential pressure type.

12.2.2 Water Treatment Facilities

1) Installation of additional chemical feeding equipment

For increase of production capacity, additional chemical feeding equipment should be installed. A chemical storage house will be also constructed, since the existing chemical building will become undersized due to installation of additional pumps.

- Alum feeding pump with piping, valves and flowmeter 1 unit
- Lime feeding pump with piping, valves and flowmeter 1 unit
- Chemical storage house 1

2) Replacement of level gauges and Water Meter

Defective float type water level gauges (field readout type) will be replaced for the clear water reservoir and the elevated tank. Malfunctioning flow meter and recorder for treated water will be replaced for recording daily production.

3) Provision of chlorine gas container scale

A set of chlorine gas container scale will be provided for precise timing of replacement of gas container to secure continuous disinfection as well as reading consumption.

4) Replacement or washing of filter media and repair of underdrain

Filter sand of 390 sq m or 8 filter beds in total will be replaced or thoroughly washed to undertake sufficient filtration. In addition, the underdrain of all filters should be repaired.

5) Purchase of filter sand washer

A movable filter sand washer is proposed for purchase, and washing of filter sand should be practiced to provide clean sand for make-up and/or replacement.

12.2.3 Distribution Pipeline

1) Replacement

Obsolete pipes and defected ones are proposed for replacement.

Following pipes are also requested by the Waterworks for replacement:

- Pipes installed under rain sewers if found hampering smooth maintenance service; and
- Pipes buried in a drive way which is subject to heavy traffic.

Such replacement is summarized below:

Diameter (mm)	Length (m)
200	380
150	3,090
100	1,760
Total	5,230

In addition to the replacement above, installation of 400 mm diameter distribution main of 6,700 m from the Pattaya-Na Klua Treatment Plant to Sukumvit Highway will be required to reinforce the existing 600 mm diameter main. Refer to Appendix 8 for details.

2) Purchase of leak detection equipment and implementation of leakage control program

Following equipment will be purchased for the program:

- Leak detector
- Electric sound detector, and
- Pipe locator

A leakage control program as described in Appendix 11 is proposed for implementation.

12.3 Expansion Works

12.3.1 General

The proposed major facilities for the Stage I Expansion Works are summarized in this section. The planned water supply system for 2000 is shown in the general plan of Fig-12.1 and schematically presented in Fig-12.2. The major facilities proposed for the Stage I are tabulated in Table-12.1 and the details are referred to Appendix 8.

The projected year 2000 water demand of 48,900 cu m/d will be satisfied by productions of the following two treatment plants:

Pattaya-Na Klua Treatment Plant	28,800 cu m/d
Proposed Thung Sukla Treatment Plant	20,100 cu m/d
T o t a l	48,900 cu m/d

12.3.2 Outline of Proposed Water Supply Facilities

1) Source

The proposed source for the present project should be the Nong Kho Reservoir, of which 21,700 cu m/d water is diverted at the Laem Chabang Receiving Well to the proposed treatment plant through the proposed 700 mm raw water transmission pipeline of 400 m length. The Nong Kho Reservoir and the Laem Chabang Receiving Well are implemented by the Public Works Department under the Nong Kho-Laem Chabang Water Pipeline Project.

2) Treatment Plant

The proposed treatment plant (hereinafter referred to as the "Thung Sukla Treatment Plant" after the name of the propose plant site) is sited near the Laem Chabang Receiving Well. The treatment plant will incorporate unit processes and operations as shown on Fig-12.3. The layout of the proposed plant is presented on Fig-12.4.

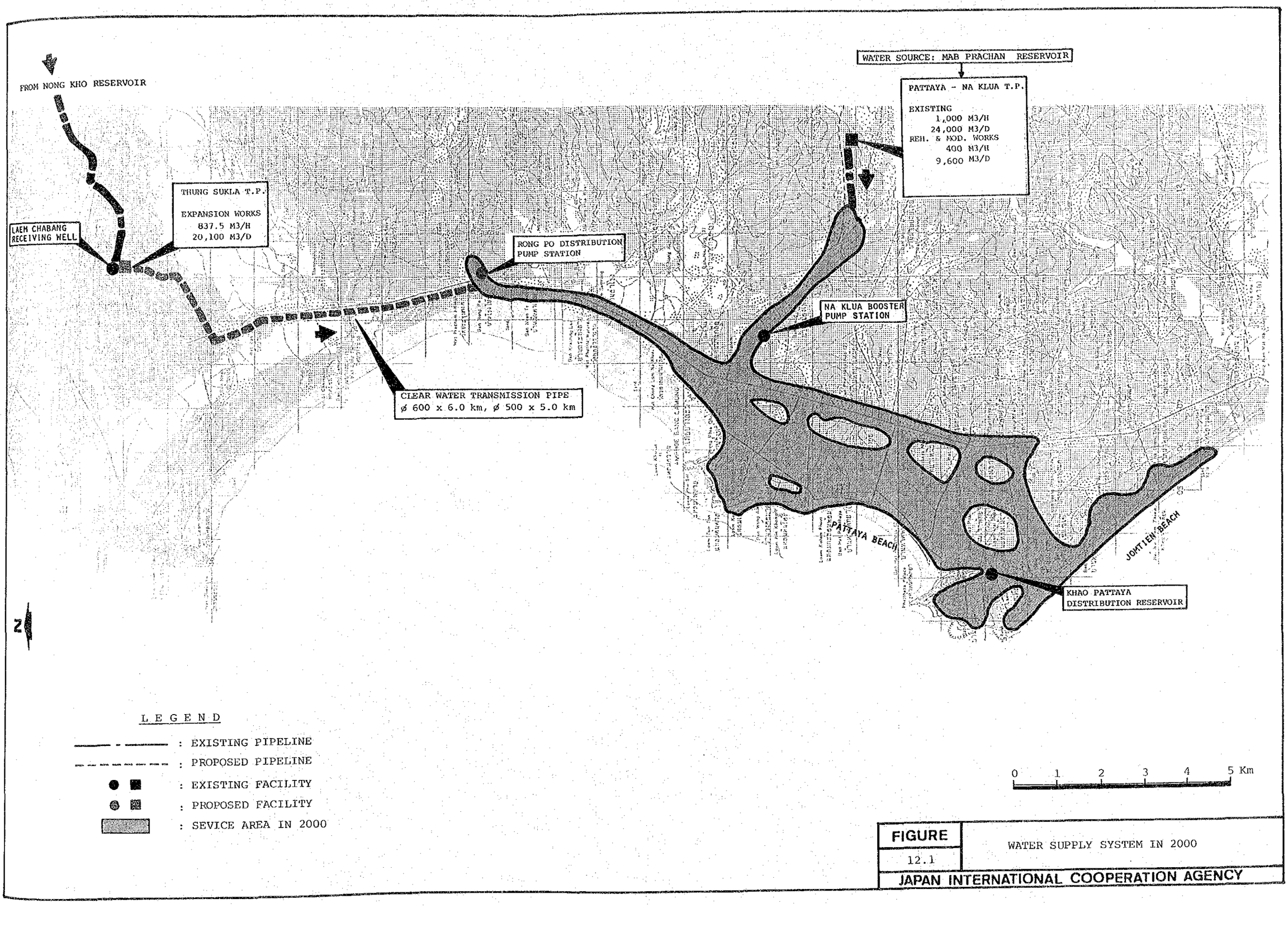


FIGURE	WATER SUPPLY SYSTEM IN 2000
12.1	

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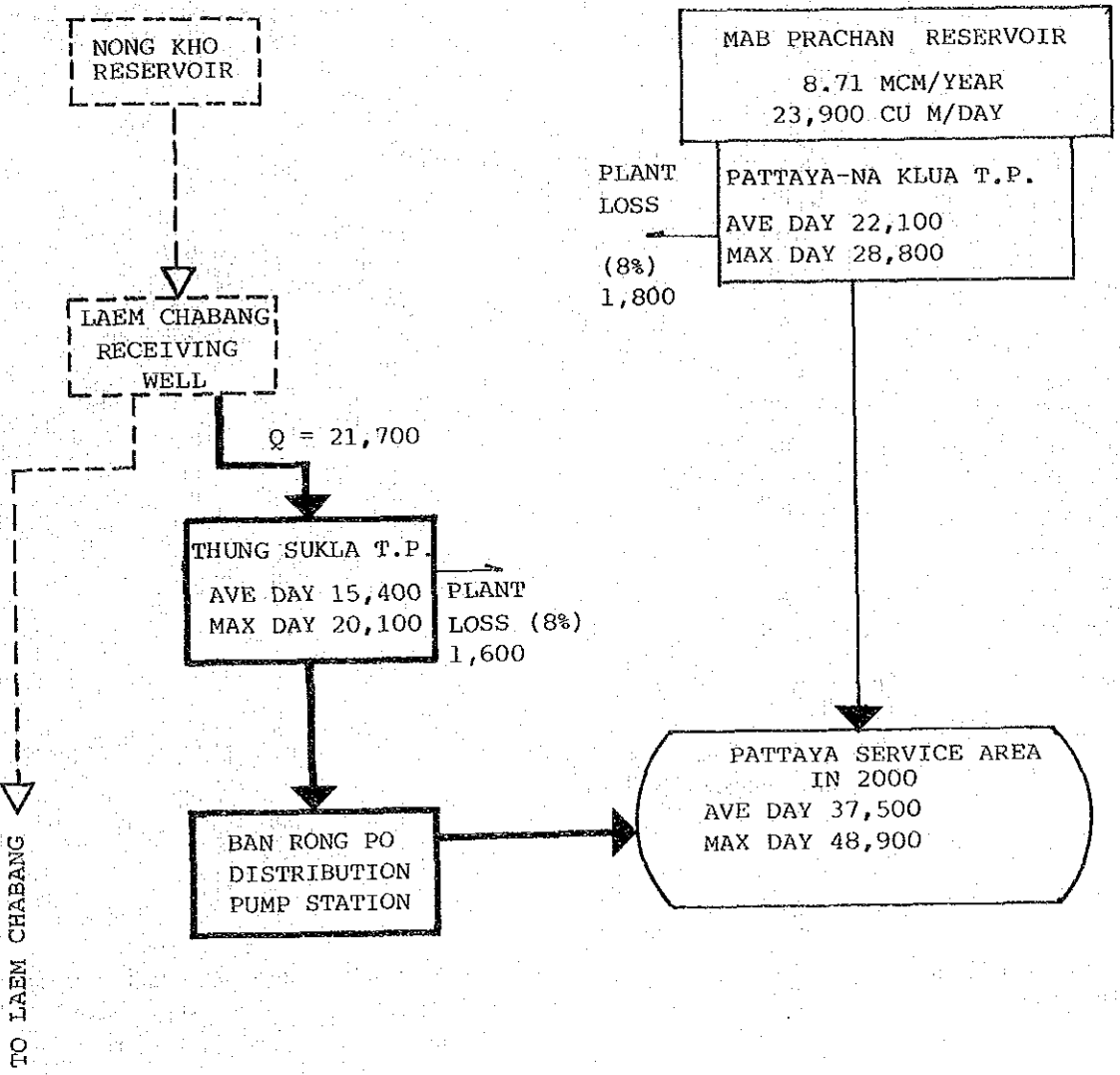


LEGEND

: NONG KHO - LAEM CHABANG WATER PIPELINE PROJECT

: PROPOSED FACILITIES

: EXISTING FACILITIES

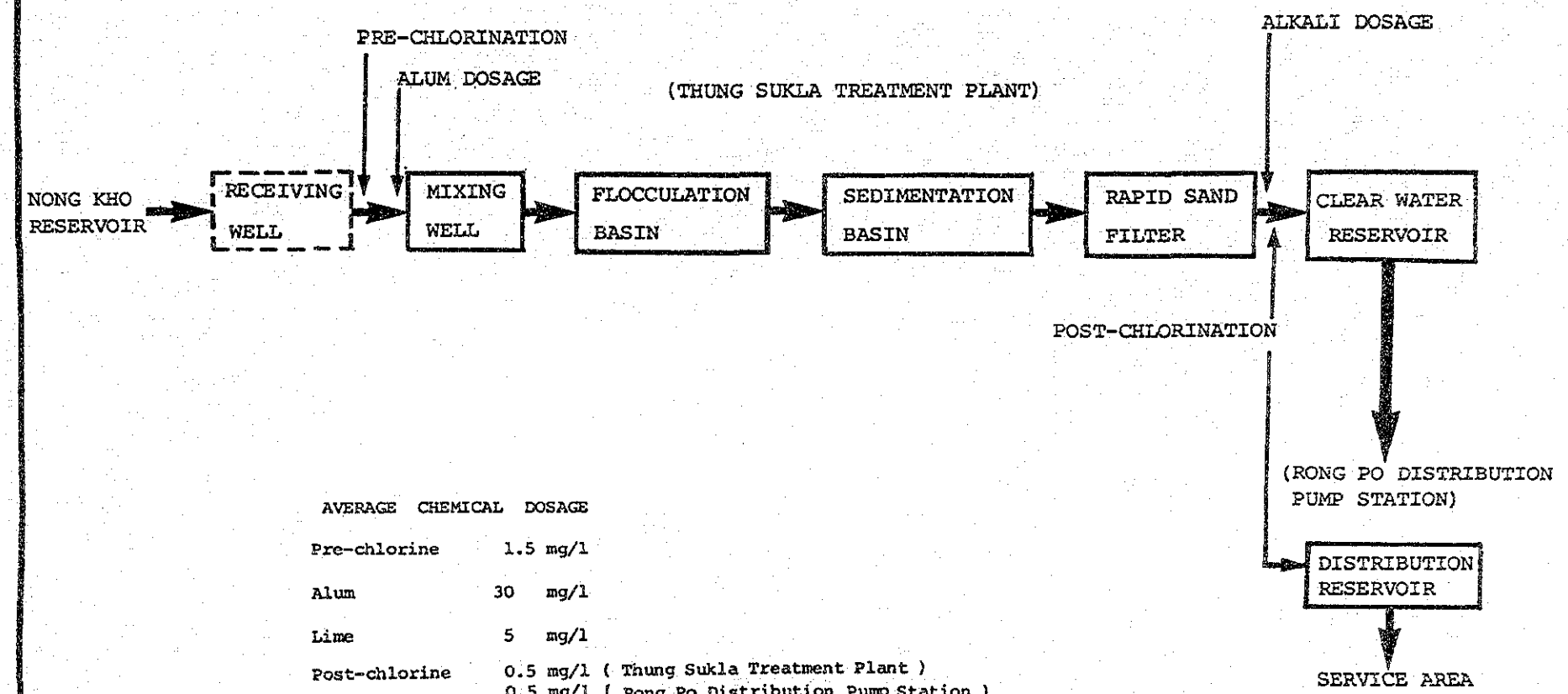
UNIT : cu m/day

FIGURE	SCHEMATIC DIAGRAM OF WATER SUPPLY SYSTEM IN 2000
12.2	

JAPAN INTERNATIONAL COOPERATION AGENCY

Table-12.1 MAJOR FACILITIES IN EXPANSION WORKS

Category	Item	No.	Unit	Description
1) Raw Water Transmission Pipeline	Laem Chabang Receiving Well to Thung Sukla T.P.			
	Dia. 700 mm	400	L.M.	
2) Thung Sukla Treatment Plant (20,100 cu m/day)	Flush mixing well	1	well	hydraulic mixing by ajustable cone type
	Flocculation basin	2	basins	hydraulic mixing by baffled channel
	Sedimentation basin	2	basins	one direction horizontal flow
	Rapid sand filter	6	beds	declining rate filtration
	Clear water reservoir	2	reservoirs	
	Elevated tank	1	tank	
	Waestwater basin	2	basins	
	Sludge lagoon	2,000	sq m	
	Chemical feeding facility	1	L.S.	
	- Alum			
	- Lime			
	- Pre and Post chlorination			
	Instrumentation	1	L.S.	
	Power Substation	1	L.S.	
	Buildings	1	L.S.	
	- Administration			
	- Chemical			
	- Staff houses			
	- Warehouse			
3) Clear Water Transmission Pipeline	Thung Sukla T.P. to Rong Po Distribution Pump Station			
	Dia.600 mm	6,000	L.M.	
	Dia.500 mm	5,000	L.M.	
	Na Klua Booster Pump Station to Khao Pattaya Distribution Reservoir			
	Dia.400 mm	13,000	L.M.	
	Booster pump	1	pump	Q 1.5 cu m/min x H 55 m
4) Rong Po Distribution Pump Station	Distribution reservoir	2	reservoir	v = 5,000 cu m (D.T. 6 hours)
	Distribution pump	2	pumps	Q 11.2 cu m/min x H 45 m
		2	pumps	Q 5.6 cu m/min x H 45 m
	Chlorination facilities	1	L.S.	
	Power substation	1	L.S.	
	Staff house	1	L.S.	
5) Distribution Pipeline	Dia. 600 mm	4,200	L.M.	
	Dia. 500 mm	1,800	L.M.	
	Dia. 400 mm	7,400	L.M.	
	Dia. 300 mm	15,750	L.M.	
	Dia. 200 mm	1,000	L.M.	
	Dia. 150 mm	11,000	L.M.	
	Dia. 100 mm	37,200	L.M.	
6) Land Acquisition	Thung Sukla Treatment Plant	30,000	sq m	
	Rong Po Distribution Pump Station	4,900	sq m	



AVERAGE CHEMICAL DOSAGE

Pre-chlorine	1.5 mg/l	
Alum	30 mg/l	
Lime	5 mg/l	
Post-chlorine	0.5 mg/l	(Thung Sukla Treatment Plant)
	0.5 mg/l	(Rong Po Distribution Pump Station)

FIGURE 12.3 TREATMENT PROCESS OF THUNG SUKLA TREATMENT PLANT

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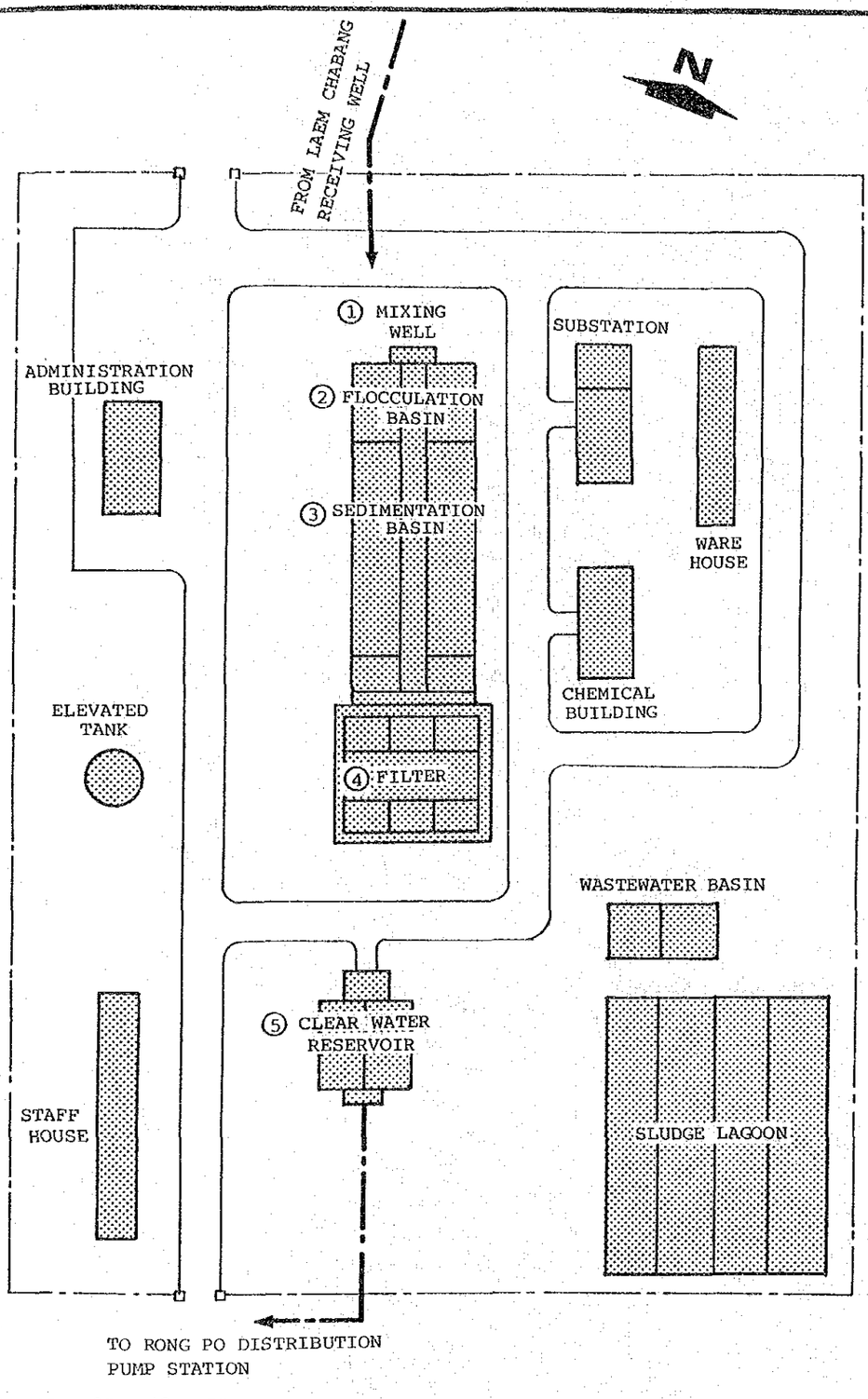
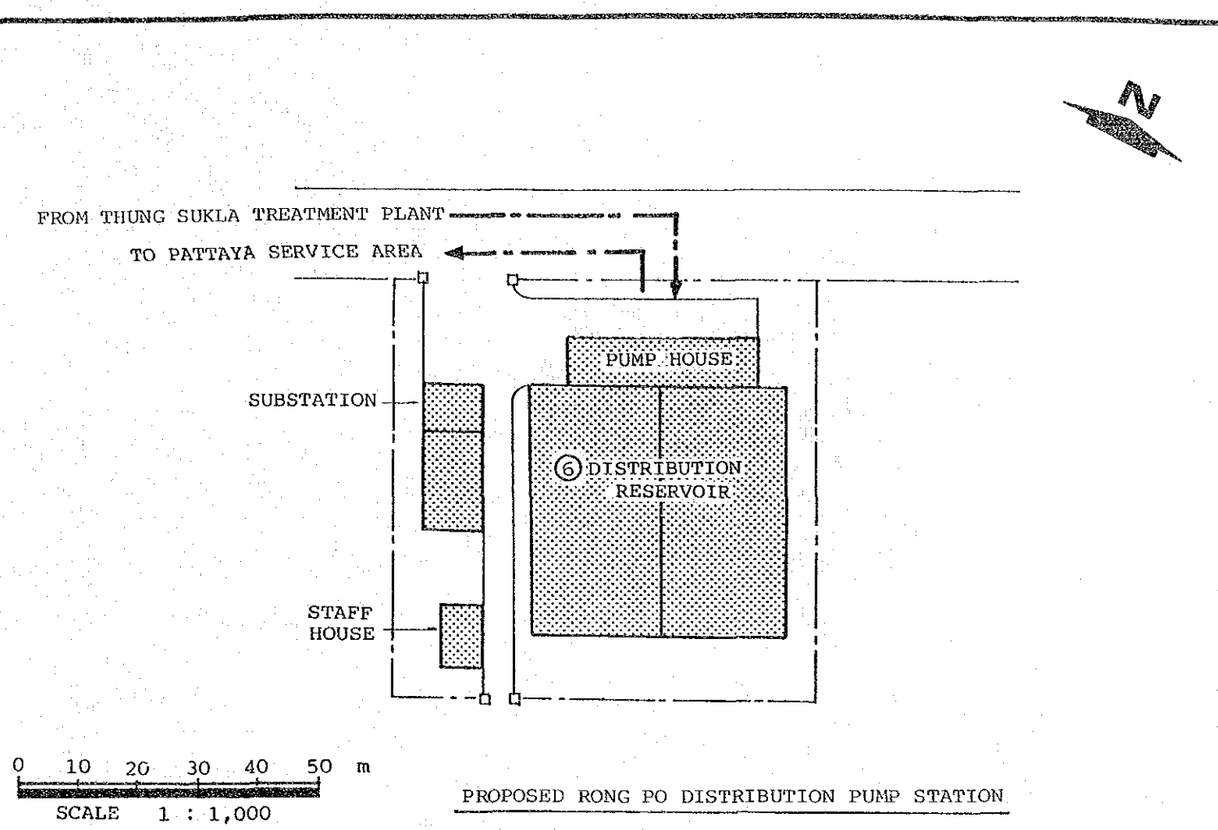


PROPOSED THUNG SUKLA TREATMENT PLANT



PROPOSED RONG PO DISTRIBUTION PUMP STATION

PROPOSED FACILITIES (20,100 CU M/DAY)

① MIXING WELL
- 1 WELL
- V=3.4 CU M
- D.T.=14 SEC

② FLOCCULATION BASIN
- 2 BASINS
- V=260 CU M/BASIN
- D.T.=34 MIN

③ SEDIMENTATION BASIN
- 2 BASINS
- V=960 CU M/BASIN
- D.T.=2.1 HR

④ FILTER
- 6 BEDS
- A=33 SQ M/BED
- F.R.=5.4 M/HR IN AVERAGE

⑤ CLEAR WATER RESERVOIR
- 2 RESERVOIRS
- V=450 CU M/RESERVOIR

⑥ DISTRIBUTION RESERVOIR
- 2 RESERVOIRS
- V=2,500 CU M/RESERVOIR
- D.T.=6 HR

⑦ ELEVATED TANK
- V = 250 CU M

NOTE: D.T.=DETENTION TIME
F.R.=FILTRATION RATE

FIGURE	GENERAL LAYOUT OF TREATMENT PLANT AND DISTRIBUTION PUMP STATION
12.4	

JAPAN INTERNATIONAL COOPERATION AGENCY

3) Clear Water Transmission Pipeline

The pipeline transmits clear water from the clear water reservoir of the plant to the distribution pump station at Ban Rong Po by gravity. A pipeline combining a 600 mm diameter main of 6,000 m length and a 500 mm diameter main of 5,000 m length will be used for supplying 20,100 cu m/d water as the maximum day demand.

4) Rong Po Distribution Pump Station

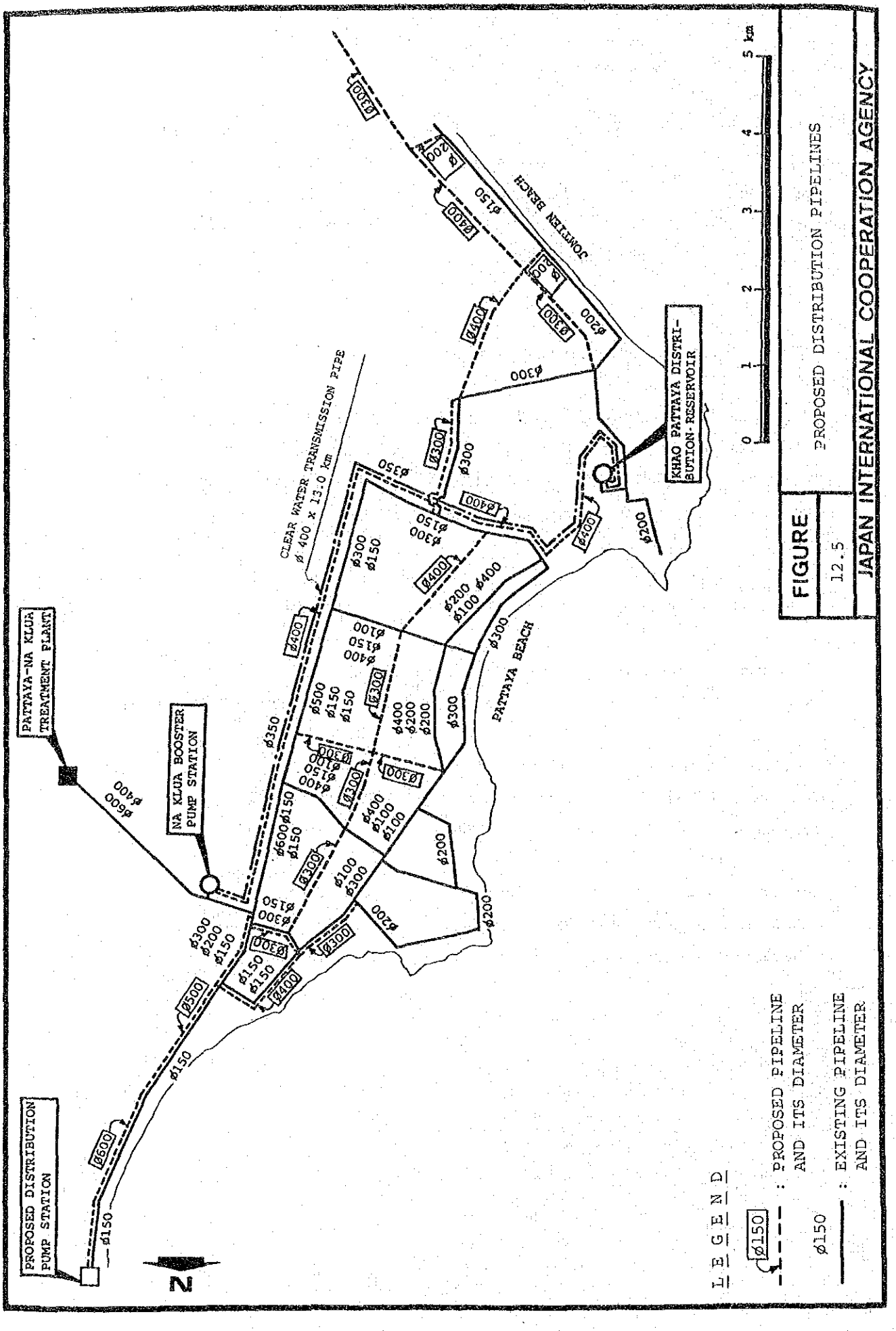
The proposed distribution pump station is composed of a reservoir, distribution pump facilities and chlorination facilities. The chlorination facilities is proposed to replenish chlorine to be consumed in the transmission pipeline after the disinfection at the plant.

5) Distribution Pipelines

The proposed Stage I Expansion Works for the distribution system includes installation of 78,350 m distribution mains in total as shown on Fig-12.5.

Based on the computer-aided distribution network analysis, distribution pipelines are sized to serve peak hour flows with sufficient service pressures.

Service connections will be installed by the Waterworks within daily routine as applications for connection are filed. More than 6,000 connections are expected to be installed by the target year of 2000.


PROPOSED DISTRIBUTION PUMP STATION
PATTAYA-NA KLUA TREATMENT PLANT
NA KLUA BOOSTER PUMP STATION
CLEAR WATER TRANSMISSION PIPE
ø 400 x 13.0 km
JOMTIEN BEACH
PATTAYA BEACH
KHAO PATTAYA DISTRI-BUTION-RESERVOIR
N
0 1 2 3 4 5 km
LEGEND
ø150 : PROPOSED PIPELINE AND ITS DIAMETER
ø150 : EXISTING PIPELINE AND ITS DIAMETER
FIGURE 12.5 PROPOSED DISTRIBUTION PIPELINES
JAPAN INTERNATIONAL COOPERATION AGENCY

12.4 Operations and Management Plan

For enabling the Thung Sukla Treatment Plant and the Pattaya-Na Klua Treatment Plant to supply safe and sufficient water to consumers at their best condition, the plant must be attended by appropriate maintenance and operation. To operate the whole system in good order, the following procedures should be followed in the two Plants and the Pattaya Waterworks Office at the Na Klua Booster Pump Station.

- Treatment Plants

  (1) To gauge and control water flow in the systems for required volume of water to meet demand,

  (2) To control water quality by testing water and by dosing and stockpiling chemicals,

  (3) To maintain the treatment facilities in proper conditions,

- Waterworks Office

  (4) To control and manage the whole systems in accordance with the information obtained from the operation room at each respective treatment plant, and

  (5) To organize a leakage survey team in the Waterworks for the purpose of reducing water leakage.

In order to apply the requirements mentioned above to their future operation and maintenance, such increases in the number of personnel as suggested in Table-12.2 will be needed. The resultant increases in the operation and maintenance cost are given in Chapter 13.

As the flow from the Pattaya-Na Klua Treatment Plant is driven by gravity and can save electricity cost, its operation and maintenance cost is projected to be approximately 30% less than that for the Thung Sukla Treatment Plant which has to depend upon pumping in driving its flow.

Water demand is expected to increase gradually up to 2000 when the production capacity of the two treatment plants reaches their peak. It is recommended therefore that the Pattaya-Na Klua Treatment Plant lead production and the Thung Sukla Treatment Plant make up for supply deficits. On such exceptional occasions as the level of water in the Mab Prachan Reservoir reduces substantially, however, the latter should lead production.

Table-12.2 STAFF REQUIREMENT FOR PATTAYA WATERWORKS

Description	Grade	1986	1990	1995	2000
1) Manager	8	1	1	1	1
2) Water Production Section					
- Chief	7	1	1	1	1
- Mechanic/Scientist	5	0	0	1	1
- Production Staff	4	7	7	9	9
- Janitor	3	0	0	1	1
- Electrician	3	0	0	1	1
3) Service Section					
- Chief	7	1	1	1	1
- Technician	6	1	1	2	2
- Servicing Staff	5	6	9	14	16
- Skilled Labor	6	0	1	1	1
- Labor	3	1	2	2	3
- Driver	3	1	1	2	2
4) Administration Section					
- Chief	7	1	1	1	1
- Clerk	6	4	4	6	6
- Finance & A/C	6	5	8	11	14
- Storage Keeper	4	1	1	2	2
- Labor	3	1	1	1	1
- Bill Collector	5	3	5	7	8
- Meter Reader	4	3	5	7	8
- Security Staff	4	2	2	3	3
T O T A L		39	51	74	82

CHAPTER 13 PROJECT IMPLEMENTATION AND COST ESTIMATES

13.1 Labor, Material, Equipment and Machinery

13.1.1 Labor

13.1.2 Materials

13.1.3 Equipment and Machinery

13.2 Procurement and Financing

13.2.1 Procurement Procedures of PWA

13.2.2 Project Financing

13.3 Implementation Schedule

13.4 Cost Estimates and Disbursement Schedule

13.4.1 Cost Estimates for Rehabilitation and Modification Works

13.4.2 Cost Estimates for Expansion Works

13.4.3 Cost Estimates for Operation and Maintenance

13.4.4 Disbursement Schedule

CHAPTER 13

CHAPTER 13 PROJECT IMPLEMENTATION AND COST ESTIMATES

In this chapter, availability of labor, material, equipment and machinery necessitated for construction is studied.

Related to it, the procurement procedures of PWA is reviewed and the principal matters of financing the project is discussed.

Following the above, the implementation schedule is proposed and the cost estimation is presented.

13.1 Labor, Material, Equipment and Machinery

13.1.1 Labor

A good number of qualified workers can be mobilized in the project area, enough to meet the civil and architectural needs for the implementation of the project. The mobilization may be facilitated by the climate of the labor market of the project area where supply generally exceeds demand.

The qualification of levels of skill in various trades has not been institutionalized and each laborer differs in skill. General contractors are trying to maintain the level of workmanship, by employing skilled workers on a permanent basis and/or sub-contracting the part of work to contractors which are specialized in particular fields.

13.1.2 Materials

1) Standards of Construction Materials

The following two standards are adopted and practiced by PWA:

General Construction Standard
Pipe and Fitting Standard

The pipe and fitting standards have been based mainly on the standards of the American Water Works Association (AWWA). Regarding matters unspecified

therein and/or un-specified details, PWA makes its own specifications.

On the part of manufacturers, materials based on their own standards, as well as on AWWA, JWWA, B.S. (British Standards) and DIN (German Standards) have been prepared and supplied to PWA.

2) Construction Materials

Materials used in construction by waterworks are roughly divided into a) general construction materials and b) waterworks related construction materials.

a) General Construction Materials

Natural products like natural gravel, sand, clay and timber are available in the area, although crush/sieved stone is gradually taking the place of natural gravel for concrete aggregate.

Such local products as steel bars, cement, bricks, concrete precast products, ready mixed concrete, window sashes, doors and furniture are easily available.

As for scaffolding and staging, steel materials have taken the place of wooden ones since the beginning of 1980s. Staging of bamboo and wooden plates is still popular in the countryside.

Wooden forms are popular in the construction field.

b) Waterworks Related Construction Materials

Machines specifically used in water treatment, like chemicals dosing pumps, chlorinator and others are mostly imported.

Asbestos cement pipes up to 600 mm in diameter are available. Cast iron valves and pipe fittings are made by a few local factories. One of the largest is capable of making

1,500 mm sized valves.

A few makers are manufacturing service meters by importing major components and assembling them in domestically made casings.

Two to three firms are producing alum, and PWA is now being supplied by a national enterprise. Chlorine gas is produced by an unknown number of companies which have sufficient supply capacity.

13.1.3 Equipment and Machinery

Small construction machinery like concrete pushcarts, concrete mixers, drainage pumps for civil works, etc., and motors and engines for them have been manufactured locally. Large construction machinery for general and special uses are imported. Both of the local and foreign made, after-sale service is taken care by the local agents.

Lease service of construction machinery has been undertaken by about ten firms. Almost all kinds of construction machinery can be available on a rental base. Rental conditions are flexible.

Machinery for general uses are owned by large contractors and some of them have their own repair workshops and motor pools.

13.2 Procurement and Financing

13.2.1 Procurement Procedures of PWA

Procurement of goods and construction works is generally made on a contract basis. Except for small scale and urgently necessary goods or works, PWA depends on open tendering rather than direct appointment.

The following criteria have been set on the level of order agencies:

Individual Waterworks	: less than 50,000 Baht
PWA Regional Office	: from 50,000 to 500,000 Baht
PWA Head Office	: more than 500,000 Baht

The below procedures are taken from planning to tendering and awarding contracts:

Planning is made by Planning Division of Corporate Planning Department. On the basis of the plan, Project Preparation Division of Engineering Department prepares detail designs and plans of goods procurement.

Costs of goods procurement and construction works are estimated jointly by Project Preparation Division and Cost Estimation Division and tendering is made based on such estimated costs.

Tendering is managed by two committees of PWA. One committee is responsible for checking the consistency with the specified conditions and opening the proposed tender prices. Tendering Committee is responsible, then, for evaluating the proposed tenders and finalizing them.

Both committees are formed by the PWA directors and higher ranked senior staff. After decision making, the contract is officially finalized between PWA and the contractor/supplier.

Generally adopted is open tendering. In case of big projects, prequalification is applied prior to open tendering. Tendering by the specified bidders and awarding by direct-appointment is seldom practiced except special cases.

Announcement of open tenders is made public in Bidding News, weekly editions of the Thai Construction Association publication, Construction Business News (monthly publication), other Thai papers, and English ones in case of international tendering.

When the method of announcement is conditioned with the loan/grant

agreement, the terms and conditions of the loan will be followed.

The present procedures of procurement of PWA are well routinized and applying them to the project will be reasonable and justifiable.

13.2.2 Project Financing

Implementation of the project assumes that the fund will be made available from foreign financial sources such as the OECF Loans. Therefore, if the fund is provided by other types of leading agencies on the terms and conditions different from said loans, the schedule may be adjusted so as to meet these terms and conditions.

The Stage I Works consist of two components, the Rehabilitation and Modification Works to be undertaken at the early phase of the Stage, and to be followed by the Expansion Works which constitute major component of the Stage I Works.

The Stage I Works are planned to be financed by the following two kinds of loans. The First loan which consists of the following components:

a) Engineering service loan for detailed design for the whole Stage I Works

b) Project loan for the Rehabilitation and Modification Works

c) Engineering service loan for the construction supervision services for the above Rehabilitation and Modification Works

The Second loan which consists of the followings:

a) Project loan for the construction of Stage I Expansion Works

b) Engineering service loan for construction supervision services for the above works

Implementation delineates the time schedule for the above loan procedure, together with detailed design and construction to be followed.

The following is the schedule covering (1) the Rehabilitation and Modification and (2) Stage I Expansion:

Rehabilitation and Modification Works	: July 1988 - June 1989 (1 year)
Expansion Works	: January 1990 - December 1991 (2 years)

13.3 Implementation Schedule

As the construction of the water supply system is one of the important public works, it is imperative that a reliable construction work be ensured within the shortest period practical. In view of these, the construction works under the Stage I should adopt the common construction methods widely practiced in Thailand, so that the steady construction works are easily undertaken and the period can be shortened.

The timing of the implementation of Stage I Works which are composed of Rehabilitation and Modification Works and Expansion Works is set as follows:

The timing of executing the rehabilitation/modification is flexible, although earlier execution is preferable. The works are planned to be completed in 1989 prior to the commencement of the expansion works.

The expansion works to meet the demand in 2000 are scheduled to be completed at end of 1991.

The design period for the rehabilitation/modification works is estimated at about 4 month, judging from the work volume.

As the facilities included in the expansion works are diversified in nature, the design period of 15 months is planned.

Loan application for the project will be made in two steps presumably.

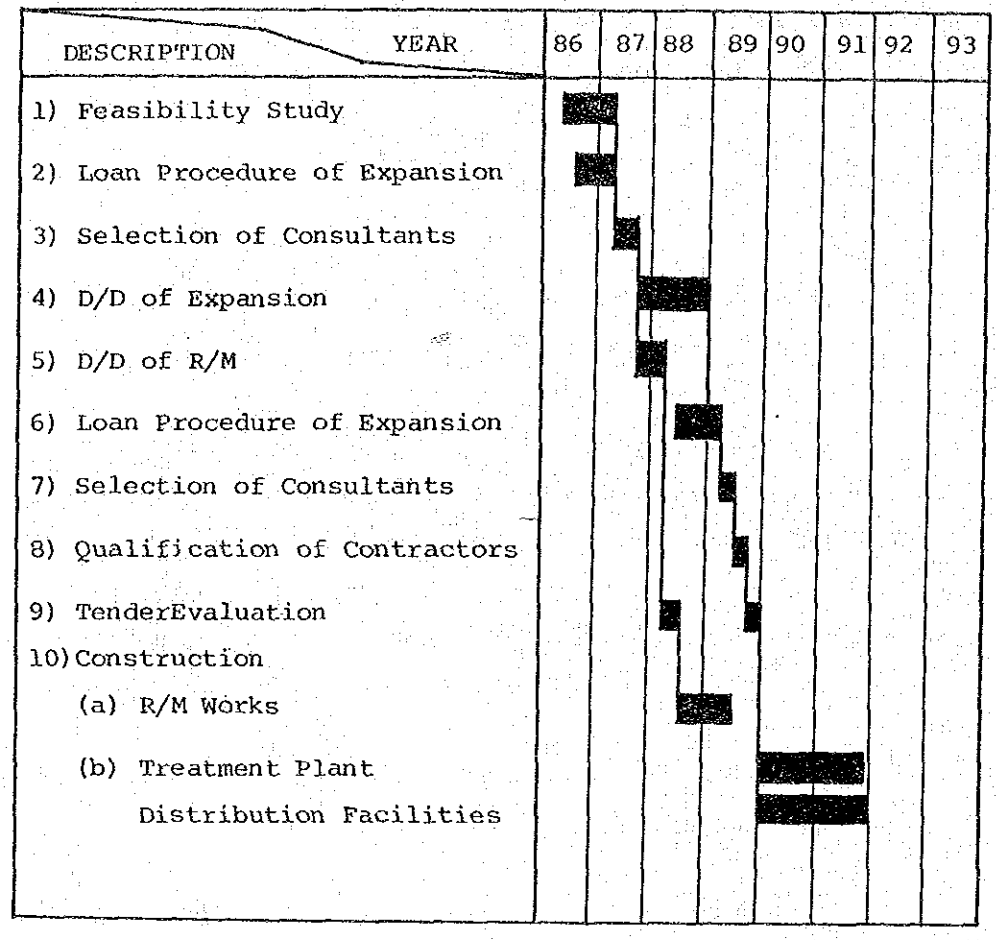
The first step loan is planned to cover the engineering service, design of both of the rehabilitation/modification and expansion works and supervision of the former, and the implementation of rehabilitation/modification.

The second step loan is for the implementation of the expansion works, inclusive of supervision by consultants.

The construction period planned for the rehabilitation/modification works is estimated on 1 year, including safety margin.

As for the expansion works, the planned 2 years are rather tight, when the involved works are considered. A detailed execution plan will be needed in the later stage.

The above mentioned conditions were taken into account in preparing the implementation schedule, shown in Fig-13.1.



NOTE : D/D Detailed Design
R/M Rehabilitation and Modification

FIGURE	IMPLEMENTATION SCHEDULE
13.1	

JAPAN INTERNATIONAL COOPERATION AGENCY

13.4 Cost Estimates and Disbursement Schedule

13.4.1 Cost Estimates for Rehabilitation and Modification Works

The methods of cost estimation and cost-allocation of foreign/local currency, described in detail in Appendix 9 were applied herewith.

Table-13.1 shows the summary of the estimated cost of rehabilitation and modification works resulted by the estimation and allocation.

Table-13.1 ESTIMATED COST OF REHABILITATION AND MODIFICATION WORKS

(Unit : 1,000 ฿)

	F/C	L/C	Total
1. Land Acquisition	-	-	-
2. Intake and Raw Water Transmission Pipeline	435	165	600
3. Pattaya-Na Klua Treatment Plant	3,792	1,158	4,950
4. Distribution Pipeline	12,270	7,880	20,150
Total	16,497	9,203	25,700

13.4.2 Cost Estimates for Expansion Works

Table-13.2 shows the summary of the estimated cost of expansion works resulted by the estimation and allocation, and the details are referred to Appendix 9.

Table-13.2 ESTIMATED COST OF EXPANSION WORKS

(Unit : 1,000 ฿)

	F/C	L/C	Total
1. Land Acquisition	-	2,100	2,100
2. Raw Water Transmission Pipeline	1,500	1,000	2,500
3. Thung Sukla Treatment Plant	34,914	17,986	52,900
4. Clear Water Transmission Pipeline	48,435	32,065	80,500
5. Rong Po Distribution Pump Station	12,900	5,900	18,800
6. Distribution Pipeline	56,340	37,560	93,900
Total	154,089	96,611	250,700

13.4.3 Cost Estimates for Operation and Maintenance

Operation and maintenance cost is classified as stated below, the items are:

1) Personnel Cost

The personnel cost is estimated as follows:

Organization and staff arrangement will continue to keep the present form, even if managerial practice and efficiency in functioning may need improvement in future.

Corresponding to increased supply of water resulting from the rehabilitation/modification and expansion works, work volume of operation/ maintenance/service will increase accordingly.

Every section in the waterworks, to meet increased work volume, will have to be staffed by additional personnel gradually. The number of personnel from 1986 to 2000 was assumed considering the work volume.

Personnel cost are calculated on the basis of the number of personnel classified by position and function multiplied by the salary grades of the PWA, according to their functions and positions as shown in Table-12.3. In case one grade is divided into several salary levels, the medium level is used as a base of calculation. The basic level of personnel expenses is assumed to increase at 7 % per annum, inclusive of price escalations, following the pattern in recent years.

2) Electricity and Fuel Cost

The electricity rate is divided into two portions. The first one, fixed on the basis of the total electric equipments' rated capacity (@ ฿95/kW), is paid monthly. The second one is charged on the basis of actual consumption measured by periodical meter readings (@ ฿1.36/kWA).

In this report, estimation is made by a simplified method, on the following assumptions:

Electricity:

(a) The present electricity cost consisting of the both portions mentioned above and fuel cost of each waterworks is converted to unit cost (per cubic meter of produced water).
(b) Unit cost will be subject to price escalation of 3.3 % per annum
(c) Annual electricity cost is calculated from the planned yearly water production volume multiplied by unit cost.
(d) In case the two treatment plants in the area are not in full operation, the priority of operation is given to the plant with cheaper unit electricity cost, so that the combined total electricity cost may be minimized.

Fuel:

Fuel cost is assumed to increase in the same proportion with electricity charges.

3) Chemical Cost

Considering the future water quality and planned treatment process, chemical dosage was forecast in the previous chapter, on an average basis.

Unit cost of chemicals per cubic meter of produced water is calculated on the basis of the present average price and the quoted chemical dosage. The unit prices employed herein are as follows:

Alum	฿ 3.8/kg
Lime	฿ 1.5/kg
Chlorine	฿12.0/kg

The unit cost is assumed to increase at 3.3 % per annum from 1986 to 2000.

Chemicals cost in a particular year is calculated based on the planned water volume and unit cost for the year.

4) Connection Work Cost

Connection cost is an expense to connect service pipe to consumers' service meters from the distribution pipe.

The number of connections is estimated from the served population and average number of household members per family in a respective year.

Average unit connection cost is estimated on the basis of the accounting records of the actual expenses spent for connection works, with escalation at 3.3 % per annum from 1986 to 2000.

Connection cost in a respective year is calculated on the basis of yearly

increase in the connection number and the above average unit cost per connection work.

5) Raw Water Cost

In estimating cost of raw water from the Nong Kho-Laem Chabang Pipeline, this report adopts the charge of 1.50 Baht per m3 preliminarily calculated by JICA's Feasibility Study on Nong Kho-Laem Chabang Project. This rate of charge is considered to be immoderate compared with the prevailing RID raw water charge of 0.5 Baht per m3. PWA is therefore recommended to negotiate with the Agent concerned for a more moderate rate of raw water charge.

The price escalation of the raw water cost is assumed 3.3 % per annum from 1986 to 2000.

6) Other Cost

This item includes costs for repair works, office expenses and other miscellaneous costs. Data in 1985 show that these costs amount to about 5 % of total expenditure including personnel, power and other costs stated in the preceding sections.

For better maintenance of the facilities, particularly to keep the unaccounted ratio at a lowest possible level, repair costs and material costs are expected to increase. The ratio of other expenses to the total cost is, therefore, projected to increase gradually. Estimation of this item was therefore made along this line.

7) Operation and Maintenance Summarized

All of the operation and maintenance costs estimated in the preceding sections are summarized and tabulated as shown below in Table-13.3.

Table-13.3 OPERATION AND MAINTENANCE COST

(Unit : 1,000 ฿)

Item	1986	1990	1995	2000
Personnel Cost	2,782	4,661	9,264	14,399
Electricity & Fuel Cost	2,983	4,733	7,300	9,777
Chemical Cost	897	1,422	2,213	2,976
Connection Cost	1,074	1,630	1,410	1,270
Raw Water Cost	0	0	8,414	14,280
Other	406	656	1,069	1,513
Total	8,142	13,102	29,670	44,214

13.4.4 Disbursement Schedule

The project will be commenced in 1987 and completed in 1991. Disbursement by each year will be made as stated in Table-13.4, which is based on the Implementation Schedule.

The cost described in the Table of the Schedule is denoted in 1986 price.

The employed exchange rate is : US $1.00 = ฿26.12

Table-13.4 PROJECT COST AND DISBURSEMENT SCHEDULE

Unit : x 1,000 Baht

ITEM	Total Cost	BREAK DOWN			1987			1988			1989			1990			1991		
		FC	LC		FC	LC		FC	LC		FC	LC		FC	LC		FC	LC	
			Material Cost	Labor Cost		Material Cost	Labor Cost		Material Cost	Labor Cost		Material Cost	Labor Cost		Material Cost	Labor Cost		Material Cost	Labor Cost
				Skilled Unskilled			Skilled Unskilled			Skilled Unskilled			Skilled Unskilled			Skilled Unskilled			Skilled Unskilled
A. Rehab. & Modification																			
1) Reinforcement Work	17,500	10,500	1,750	2,450 2,800	0	0	0 0	4,200	700	980 1,120	6,300	1,050	1,470 1,680	0	0	0 0	0	0	0 0
2) Chemical D. System	600	510	30	42 18	0	0	0 0	510	30	42 18	0	0	0 0	0	0	0 0	0	0	0 0
3) Instrumentation	1,300	1,105	65	91 39	0	0	0 0	1,105	65	91 39	0	0	0 0	0	0	0 0	0	0	0 0
4) Repair of Filters	2,700	1,782	324	324 270	0	0	0 0	1,782	324	324 270	0	0	0 0	0	0	0 0	0	0	0 0
5) Dist. Pipe Repair	2,500	1,500	250	350 400	0	0	0 0	600	100	140 160	900	150	210 240	0	0	0 0	0	0	0 0
6) Procurement of Equip. & Machinery	1,100	1,100	0	0 0	0	0	0 0	1,100	0	0 0	0	0	0 0	0	0	0 0	0	0	0 0
- Total of A -	25,700	16,497	2,419	3,257 3,527	0	0	0 0	9,297	1,219	1,577 1,607	7,200	1,200	1,680 1,920	0	0	0 0	0	0	0 0
B. Expansion																			
1. Land Acquisition	2,100	0	2,100	0 0	0	0	0 0	0	0	0 0	0	2,100	0 0	0	0	0 0	0	0	0 0
2. Construction	248,600	154,089	26,018	32,867 35,626	0	0	0 0	0	0	0 0	0	0	0 0	61,636	10,407	13,147 14,256	92,453	15,611	19,720 21,376
1) R. Water Trans. Pipeline	2,500	1,500	250	350 400	0	0	0 0	0	0	0 0	0	0	0 0	600	100	140 160	900	150	210 240
2) Treatment Plant	52,900	34,914	6,348	6,348 5,290	0	0	0 0	0	0	0 0	0	0	0 0	13,966	2,539	2,539 2,116	28,948	3,809	3,809 3,174
3) C/W Trans Pipeline	45,800	27,480	4,580	6,412 7,328	0	0	0 0	0	0	0 0	0	0	0 0	10,992	1,832	2,565 2,931	16,488	2,748	3,847 4,397
4) Dist. Facilities	147,400	90,195	14,840	19,757 22,608	0	0	0 0	0	0	0 0	0	0	0 0	36,078	5,936	7,903 9,043	54,117	8,904	11,854 13,565
a. Dist. Reservoir	10,000	6,300	1,100	1,200 1,400	0	0	0 0	0	0	0 0	0	0	0 0	2,520	440	480 560	3,780	660	720 840
b. Dist. Pump	8,800	6,600	880	616 704	0	0	0 0	0	0	0 0	0	0	0 0	2,640	352	246 282	3,960	528	370 422
c. Naklua B. Station	900	675	90	63 72	0	0	0 0	0	0	0 0	0	0	0 0	270	36	25 29	405	54	38 43
d. Pipelines	127,700	76,620	12,770	17,878 20,432	0	0	0 0	0	0	0 0	0	0	0 0	30,648	5,108	7,151 8,173	45,972	7,662	10,727 12,259
- Total of B -	250,700	154,089	28,118	32,867 35,626	0	0	0 0	0	0	0 0	0	2,100	0 0	61,636	10,407	13,147 14,250	92,453	15,611	19,720 21,376
- Total of A+B -	276,400	170,586	30,537	36,124 39,153	0	0	0 0	9,297	1,219	1,577 1,607	7,200	3,300	1,680 1,920	61,636	10,407	13,147 14,250	92,453	15,611	19,720 21,376
C. Engineering Services																			
1. Detail Design	14,300	8,580	0	5,720 0	1,115	0	744 0	6,950	0	4,633 0	515	0	343 0	0	0	0 0	0	0	0 0
2. Field Survey and Soil Investigation	1,600	960	0	640 0	960	0	640 0	0	0	0 0	0	0	0 0	0	0	0 0	0	0	0 0
3. Supervision	14,500	8,700	0	5,800 0	0	0	0 0	0	0	0 0	1,218	0	812 0	3,741	0	2,494 0	3,741	0	2,494 0
- Total of C -	30,400	18,240	0	12,160 0	2,075	0	1,384 0	6,950	0	4,633 0	1,733	0	1,155 0	3,741	0	2,494 0	3,741	0	2,494 0
- Total of A+B+C -	306,800	188,826	30,537	48,284 39,153	2,075	0	1,384 0	16,247	1,219	6,210 1,607	8,933	3,300	2,835 1,920	65,377	10,407	15,641 14,250	96,194	15,611	22,214 21,376
D. Administration Cost	3,068	1,888	305	483 392	21	0	14 0	162	12	62 16	89	33	28 19	654	104	156 143	962	156	222 214
- Total of A+B+C+D -	309,868	190,714	30,842	48,767 39,545	2,096	0	1,397 0	16,409	1,231	6,272 1,623	9,022	3,333	2,864 1,939	66,030	10,511	15,797 14,393	97,156	15,767	22,436 21,589
E. Physical Contingencies,7%	21,691	13,350	2,159	3,414 2,768	147	0	98 0	1,149	86	439 114	632	233	200 136	4,622	736	1,106 1,088	6,801	1,104	1,571 1,511
- Total of A+B+C+D+E -	331,559	204,064	33,001	52,181 42,313	2,243	0	1,495 0	17,558	1,317	6,711 1,737	9,654	3,566	3,064 2,075	70,652	11,247	16,903 15,400	103,957	16,871	24,007 23,101
F. Price Contingencies, 3.3% per annum	49,272	30,361	4,986	7,388 6,536	74	0	49 0	1,178	88	450 117	988	365	313 212	9,798	1,560	2,344 2,136	18,323	2,974	4,231 4,072
- Total of A+B+C+D+E+F - (Total Project Cost)	380,830	234,425	37,988	59,569 48,849	2,317	0	1,545 0	18,736	1,406	7,162 1,853	10,641	3,931	3,377 2,287	80,451	12,807	19,247 17,536	122,280	19,844	28,238 27,172
G. Total of Year					3,861			29,156			20,237			130,041			197,535		

Note: 1) Figures of items A to E are expressed at 1986 prices.
2) Figures of items F and G are expressed at current prices.

CHAPTER 14 FINANCIAL AND ECONOMIC ANALYSIS

14.1 Financial Analysis

- 14.1.1 Financing For Proposed Project
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14.2 Economic Analysis

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CHAPTER 14

CHAPTER 14 FINANCIAL AND ECONOMIC ANALYSIS

14.1 FINANCIAL ANALYSIS

14.1.1 Financing For Proposed Project

This chapter verifies the financial feasibility of the proposed project on the assumptions that capital investment will be disbursed and financed as shown in Table-14.1.

1) The above disbursements will be grouped into two phases, (1) rehabilitation and modification and (2) expansion.

2) The foreign portions and part of local portions will be financed by a foreign financial institution such as OECF (Overseas Economic Cooperation Fund of Japan) and the terms and conditions of loans will be the same as the prevailing ones, i.e.,

a.	Interest Rate	:	3.5% per annum
b.	Maturity	:	25 years, with a grace period of 7 years

3) The part of local portions which will be financed with foreign loans is calculated to meet the recent practices of the loans.

4) The rest of local portions, i.e., 20% of the total project cost, will be financed by the Krung Thai Bank Ltd. The terms and conditions of loans will be the same as the prevailing ones, i.e.,

a.	Interest Rate	:	13.0% per annum
b.	Maturity	:	10 years, with a grace period of 3 years

Table-14.1 PROJECT COST, DISBURSEMENT SCHEDULE AND SOURCES OF FUND
[PATTAYA WATERWORKS]

a. PROJECT COST AND DISBURSEMENT SCHEDULE

YEAR	FORRIGN PORTION	LOCAL PORTION	TOTAL
1987	2,317	1,544	3,861
1988	18,736	10,420	29,156
1989	10,641	9,596	20,237
1990	80,451	49,590	130,041
1991	122,280	75,255	197,535
TOTAL	234,425	146,405	380,830

b. SOURCES OF FUND

YEAR	OECF LOAN	LOCAL LOAN	TOTAL
1987	3,089	772	3,861
1988	23,325	5,831	29,156
1989	16,190	4,047	20,237
1990	104,033	26,008	130,041
1991	158,028	39,507	197,535
TOTAL	304,664	76,166	380,830

Note: Disbursement amounts are forecast at current prices.

5) Analysis is made to verify that debt service and the increase in operation and maintenance expenses resulting from the implementation of the proposed project, as forecast in Section 14.1.4 following, can be absorbed by an increase in revenue.

14.1.2 Approach to Financial Analysis

Like other waterworks of PWA, the Pattaya Waterworks is wholly under the control of PWA Head Office in budgetary and financial aspects. All the revenues of these waterworks are, as a rule, transferred to PWA Head Office and all the necessary expenses of the waterworks inclusive of those for their administration, operation and maintenance are allocated by the PWA Head Office annually. The financing of their capital investment, if any, including the implementation of the project under this study, is also planned and executed at the responsibility and on the accounts of PWA Head Office.

In view of the above, this report verifies the financial feasibility by the following methods, instead of the analysis of income statements and balance sheets, which is only meaningful for entities that have full or semi-autonomy in their financial management.

Method I : Cash Flow Analysis

In this analysis, the following are projected:

(a) Revenue collection from the waterworks.
(b) Operation and Maintenance expenses allocation to the waterworks from PWA Head Office.
(c) Share of Head and Regional Office Overhead Expenses.
(d) Debt service relating to the waterworks.
(e) Net cash flow surplus
(f) Unit cost of water after debt service

and check if the amount of item I.(a) above can cover the necessary amounts for items I.(b), I.(c) and I.(d).

Method II : Fixed Assets and Rate of Return Analysis

The following items are projected:

(a) Fixed Assets in Operation.
(b) Depreciation of Fixed Assets.
(c) Total Cost after Depreciation and Interest.
(d) Unit Cost after Depreciation and Interest.
(e) Rate of Return = Surplus after Depreciation and Interest / Fixed Assets in Operation.

and with these figures, the rate of return from the operation of the waterworks is projected. This rate of return will provide one of the criteria for the financial feasibility of the project and also give an assessment of the suitability of the proposed water tariff schedule.

Method III : Financial Internal Rate of Return Analysis (FIRR)

A discount rate at which the net present worth revenue of the project equals zero will be calculated as a factor to verify the financial feasibility of the project.

14.1.3 Financial Performance of the Waterworks

Table-14.2 following shows the annual revenues and expenditures of Pattaya Waterworks on a cash-flow basis for 1984 and 1985. Reflecting the recent up-ward revision of the water tariff schedule executed from 1984 to 1985, the revenues of the waterworks mainly consisting of water sales increased remarkably to improve the revenue-expenditure ratio, from 4.87 in 1984 to 5.98.

Table-14.2 REVENUE AND EXPENDITURE OF PATTAYA WATERWORKS (BAHT) (FOR PAST TWO YEARS)

	1984	1985
Water Production (x1,000 m3)	6,590,375	7,582,445
Water Sales (x1,000 m3)	5,910,626	6,432,018
No. of Connections	4,239	5,269
REVENUE:		
Water Sales	27,699,886	43,624,269
Service Charge	728,472	868,935
Connection Fee	1,953,875	4,470,493
Others	206,984	142,093
Total	30,589,217	49,105,790
EXPENDITURE:		
Personnel Expenses	2,165,225	2,605,638
Chemicals	800,524	671,830
Material & Maintenance	250,909	163,481
Oil & Fuel	46,792	267,354
Office Supplies	42,791	50,606
Hire & Service	46,187	118,675
Electricity	1,618,874	2,444,507
Connection Cost	851,657	1,806,768
Others	453,797	76,432
Total	6,276,756	8,205,291
REVENUE/EXPENDITURE	4.87	5.98

14.1.4 Cash-Flow Analysis

The Cash-Flow Analysis is summarized in Table-14.3 following. The items comprised in the table and the assumptions used for forecasting their future estimates are given below.

1) Operating Revenue

The Operating Revenue is classified as follows :

Water Sales

Water Sales are estimated in the table as:
products of Projected Water Sales Volumes (shown as item (C) in the table) multiplied by the Average Water Tariff (shown as item (E)).

a. Average Water Tariff

The average water tariff for 1986 shown in the table is calculated as the average of the water tariffs collected by the waterworks during the six months ending March 1986.

In view of the past performance and the political and social climate of Thailand where frequent revision of public charges is difficult, this report forecasts cash flow on the assumption that the water tariffs will be increased every three years at the rate of 3.3% per annum, same as the rate of price escalation used in this study. As shown in Appendix 10, Tables-10.2 and -10.3, sensitivity studies were made in this report to forecast cash flows on the assumptions that (1) water tariffs will be increased every year at the rate of 3.3 % and (2) water tariffs will remain unchanged up to the target year 2000. Also for the purpose of constant price analysis such as FIRR, EIRR and AIC calculations, a cash flow table at 1986 constant price is prepared as shown in Appendix 10, Table-10.1.

Table-14.3 CASH FLOW PROJECTED (x 1,000 Baht) AT CURRENT PRICE. (PATTAYA WATERWORKS)

Description	Text Ref.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
(A) Water Production (x1000 m3)		6,484	7,085	7,686	8,374	9,061	9,619	10,263	10,907	11,465	11,981	12,324	12,711	13,011	13,355	13,698
(B) Unaccounted for Water (%)		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
(C) Water Sales (x1000 m3)		5,512	6,023	6,534	7,118	7,702	8,176	8,724	9,271	9,746	10,184	10,476	10,804	11,060	11,352	11,644
(D) No. of Connections		5,930	6,640	7,414	8,203	9,084	9,895	10,941	11,856	12,694	13,342	13,925	14,498	15,038	15,542	16,038
(E) Average Water Tariff (Baht/m3)##		8.36	8.36	8.36	9.22	9.22	9.22	10.16	10.16	10.16	11.20	11.20	11.20	12.34	12.34	12.34
1. Operating Revenue:																
1.1 Water Sales		46,076	50,348	54,620	65,590	70,971	75,344	88,613	94,175	98,995	114,027	117,296	120,974	136,504	140,108	143,712
1.2 Connection Fees		2,657	2,854	3,112	3,496	3,904	3,594	5,110	4,470	4,094	3,489	3,139	3,085	3,205	2,991	2,944
1.3 Service Charges		756	847	945	1,153	1,277	1,391	1,695	1,837	1,966	2,278	2,378	2,476	2,831	2,925	3,019
1.4 Other Revenue		227	248	269	322	349	368	437	460	481	549	563	580	653	669	686
Total 1.		49,716	54,297	58,946	70,561	76,501	80,696	95,855	100,941	105,536	120,343	123,376	127,115	143,193	146,694	150,361
2. Expenses:																
2.1 Operation & Maintenance																
- Personnel Cost		2,782	3,093	3,614	3,970	4,661	5,943	6,851	7,565	8,347	9,264	10,078	10,914	12,247	13,254	14,398
- Electricity & Fuel Cost		2,983	3,359	3,774	4,231	4,733	5,122	5,705	6,255	6,775	7,300	7,764	8,250	8,712	9,245	9,777
- Chemical Cost		897	1,009	1,134	1,271	1,422	1,564	1,719	1,890	2,051	2,213	2,356	2,505	2,647	2,812	2,976
- Connection Cost		1,074	1,192	1,342	1,413	1,630	1,550	2,065	1,866	1,765	1,410	1,311	1,331	1,295	1,249	1,270
- Raw Water Cost		0	0	0	0	0	0	4,252	5,702	7,062	8,414	9,461	10,658	11,739	12,975	14,280
- Other Cost		406	455	519	573	656	748	863	929	1,002	1,069	1,140	1,221	1,323	1,412	1,513
Sub-total 2.1		8,142	9,108	10,383	11,459	13,103	14,927	21,454	24,207	27,003	29,670	32,109	34,888	37,964	40,948	44,214
2.2 Share of Head & Regional Office Overhead Expenses		6,404	6,994	7,593	9,089	9,855	10,395	12,348	13,003	13,595	15,502	15,893	16,375	18,446	18,897	19,369
2.3 Debt Service		0	104	996	2,329	6,218	13,987	21,691	30,852	31,804	30,307	28,810	40,350	38,541	36,732	25,563
Total 2.		14,546	16,206	18,972	22,877	29,175	39,309	55,493	68,062	72,402	75,479	76,812	91,613	94,950	96,576	89,147
3. Net Cash Flow Surplus:																
3.1 Annual		35,170	38,090	39,973	47,683	47,326	41,388	40,362	32,880	33,134	44,864	46,564	35,502	48,242	50,118	51,214
3.2 Cumulative		35,170	73,260	113,233	160,917	208,243	249,631	289,993	322,872	356,006	400,870	447,434	482,936	531,179	581,296	642,510
4. Unit Cost of Water after Debt Service (Baht/m3)#		2.45	2.50	2.69	2.99	3.51	4.49	5.88	6.85	6.97	7.02	6.97	8.07	8.18	8.13	7.32

Note: # [(Total 2.) x {(1.1 Water Sales) / (Total 1.)}] / (3. Water Sales m3)

Based upon the assumption that the water tariff increases every 3 years at the rate of 3.3 % per annum.

b. PWA Water Tariff Schedule

Water tariffs are collected by water meters, with the exception of negligible direct sale fees. Shown below is the existing water tariff schedule, compared with the one which was in force prior to the revision in 1984.

Table-14.4 WATER TARIFF SCHEDULE

Consumption (cubic meters/ month)	Existing Tariff (B/cubic meter)	Previous Tariff (B/cubic meter)
1-10	3.75	2.00
11-20	4.50	2.50
21-50	6.00	3.00
51-80	7.00	4.00
81-100	7.50	4.50
101-300	8.00	5.00
301 and above	8.50	5.50

Connection Fees and Service Charges

These fees and charges are of the nature which cover actual expenses to be borne by the users for connection work. PWA accounts these fees as revenue sources and they actually form a significant part of its revenue.

In this study, these fees and charges are forecast on the basis of future demand projection with charge rates to be revised every three years at the rate of 3.3 % per annum as in the case of water tariffs. As a sensitivity study, forecasts are made on the assumptions of (1) every year upward revision of 3.3 % and (2) no changes in charge rates, as given in Appendix 10, Tables-10.2 and -10.3.

Connection fees

Connection fees are estimated in the table as:
products of annual increases multiplied by the 1985 average fee per connection work with price adjustments.
Existing PWA Connection Fees:

The minimum connection fee is set at 2,050 Baht for 1/2" ϕ pipe with a length of 10 meters. Based on the records for the past three years, average connection fees for households are assumed at 3,566 Baht and for those for industrial and other large scale consumers at 6,985 Baht. The additional fee can add substantially to the total cost of a connection - for example a new 1/2" connection 30 meters from the main pipe could cost over double that for an equivalent connection 10 meters from the main. The additional fees are not charged according to a fixed scale, but instead are levied by PWA on an ad hoc basis, using standard unit costs for the labor and material required.

Table-14.5 Existing Connection Fees

Size of Connection	Basic Connection Fee (for connections less than 10 meters from main pipe) - Baht/connection -
1/2"	2,050
3/4"	2,750
1"	3,750
1 1/2"	6,690
2"	9,575
2 1/2"	13,075
3"	15,495
4"	21,455
6"	30,025

Service Charges

Service charges are estimated in the table as:
a product of the number of connections multiplied by the 1985 average charges per connection with price adjustments.

Existing PWA Service Charges:

Service charges are levied on consumers according to the size of their connection, as shown Table-14.6 below.

Table-14.6 Service Charges

Size of Connection	Monthly Service Charge (Baht)
1/2"	10
3/4"	15
1"	30
1 1/2"	60
2"	100
2 1/2"	120
3"	160
4" and above	200

Other Revenue

This item is estimated in the table as:
a portion equal to the ratio of the other revenue to the 1985 combined total of water sales, connection fees and service charges, with price adjustments.

2) Expenses

With the expansion of water supply facilities, water production is planned under the current project to be increased approximately 2 times more than the present level. With production expanded, the scale of operation and maintenance and other expenses are expected to increase. This report forecasts expenses in the following manner.

Operation & Maintenance

This item is shown in the table classified as follows:

a. Personnel Cost
b. Electricity & Fuel Cost
c. Chemical Cost
d. Connection Cost
e. Raw water Cost
f. Other Cost

The method of estimation employed in forecasting operation and maintenance expenses are delineated in Chapter 13.

As shown in table-14.2, the Revenue and Expenditure Account of Pattaya Waterworks lists only operation and maintenance expenses as expenditure items and do not reflect the following items which are important in financial feasibility analysis:

(1) share of the overhead expenses of the Head Office and Regional Office No. 1 which controls Pattaya Waterworks,
(2) depreciation of the fixed assets of the waterworks,
(3) debt service expenses payable by Head Office, if any, in relation to the capital investment in the waterworks.

The cash flow table of this study lists them as follows.

Share of Head & Regional Office Overhead Expenses

The formula shown in Table-14.7 is the existing accounting method applied to the allocation of Head and Regional Office overhead expenses to be shared by Pattaya Waterworks.

As discussed in Section 14.3, this formula is considered unfair to small sized waterworks or those waterworks whose surplus position is not favorable.

The formula is, as you see in Table-14.7, divided into two portions:

(1) The portion applicable to one-third of Head and Regional Office overhead expenses. The share of this portion is allocated to each waterworks equal in amount regardless of their sizes of water sales. The amount of this portion to each waterworks for 1985 was 451,133 Baht which was equal to 5.5 % of total expenses of Pattaya waterworks, but the corresponding percentages for small waterworks are generally far larger. Even for such medium sized waterworks as Suphanburi said percentage was 8.1 % for 1985.

(2) The portion applicable to the rest two-thirds. The share of this portion is calculated by sales scales of waterworks, regardless of their earning positions. This makes the share practically uncollectable when respective waterworks make deficits or fail to make surpluses enough to pay share amounts.

In view of the above, it is recommended that the allocation of shares be made in one lot without partitioning it into two portions and the calculation of shares be based on net surpluses rather than on sales scales, as illustrated by a trial formula suggested in Appendix 10, Table-10.4.

The recommended formula may support cross-subsidies among waterworks, with those earning more to pay more and those earning less or making losses to pay less or nothing. Under the new formula,

Table-14.7 SHARE ALLOCATION OF HEAD AND REGIONAL OFFICE EXPENSES (PATTAYA WATERWO

1985 Cost Share Allocation

1. Head Office Expenses

a) Per Waterworks Portion (1/3)

Baht 159,272,735 x (1/3) / (No. of Waterworks in PWA) = Baht 285,435

b) WW/PWA-Total Consumption Portion (2/3)

Baht 159,272,735 x (2/3) x (WW% of PWA Total) = Baht 4,786,822

2. Regional Office Expenses

a) Per Waterworks Portion (1/3)

Baht 6,959,334 x (1/3) / (No. of Waterworks in Region) = Baht 165,698

b) WW/Region-Total Consumption Portion (2/3)

Baht 6,959,334 x (2/3) x (WW% of Regional Total) = Baht 1,087,727

TOTAL SHARE OF HEAD AND REGIONAL OFFICE OVERHEAD EXPENSES = Baht 6,325,683

therefore, waterworks with large earnings would have to be allocated larger shares than under the existing PWA formula. Pattaya waterworks for example would have had to pay 10.2 million Baht in 1985, 61.3 % larger than the share under the existing formula.

This report however tries to forecast future share allocations by the existing formula, but also tries to make forecasts, as a sensitivity study, by the new formula suggested above as shown in Appendix 10, both with price escalation of 3.3 % per year, in both cases.

Debt Service

Debt service payment as forecast in Table-14.8 is considered as a factor which usually restricts the cash flow of an entity which has gone through a large scale of capital investment. With such foreign assistance as OECF loans for the total foreign currency portion and part of the local currency portion, as referred to in Section 14.1.1, financing of the project will be substantially improved.

3) Net Cash Flow Surplus

Annual and Cumulative

As shown in Table-14.3, the annual cash flow surpluses throughout the project period are projected to cover (1) operation and maintenance expenses, (2) the waterworks' share of Head and Regional Office overhead expenses calculated either by the existing PWA formula or by a new formula suggested above, and (3) PWA's debt service arising from the proposed project, with annual cumulative surpluses spiraling to register 642.5 million Baht in 2000 or 4.3 times as much as the annual gross revenue (150.3 million Baht) of the year.

As a sensitivity analysis, cash flow forecasts are also made on the assumption that, instead of the OECF loan, a foreign loan

(PATTAYA WATERWORKS)

Table-14.8 DEBT SERVICE PROJECTED

Year	FOREIGN CURRENCY PORTION (in 1,000 Baht) Interest : 3.5% per annum									LOCAL CURRENCY PORTION (in 1,000 Baht) Interest : 13.0 % per annum									TOTAL DEBT SERVICE
	Rehabil. and Modif.	Stage 1 Expan.	Loans Outstanding Beginning	Loans Outstanding Ending	Interest Payments 1st year	Interest Payments Later year	Principal Repayment Rehab. & Mod.	Principal Repayment Expansion	Debt Service Sub-total	Year	Rehabil. and Modif.	Stage 1 Expan.	Loans Outstanding Beginning	Loans Outstanding Ending	Interest Payments 1st year	Interest Payments Later year	Principal Repayment Rehab. & Mod.	Principal Repayment Expansion	Debt Service Sub-total	
1987	3,089		0	3,089	54	0	0	0	54	1987	772		0	772	50	0	0	0	50	104
1988	23,325		3,089	26,414	408	108	0	0	516	1988	5,831		772	6,603	379	100	0	0	479	996
1989	16,190		26,414	42,604	283	924	0	0	1,208	1989	4,047		6,603	10,650	263	858	0	0	1,121	2,329
1990		104,033	42,604	146,637	1,821	1,491	0	0	3,312	1990		26,008	10,650	35,137	0	1,385	1,521	0	2,906	6,218
1991		158,028	146,637	304,665	2,755	5,132	0	0	7,898	1991		39,507	35,137	73,122	0	4,568	1,521	0	6,089	13,987
1992			304,665	304,665	0	10,663	0	0	10,663	1992			73,122	71,601	0	9,506	1,521	0	11,027	21,691
1993			304,665	304,665	0	10,663	0	0	10,663	1993			71,601	60,720	0	9,308	1,521	9,359	20,189	30,852
1994			304,665	302,298	0	10,663	2,367	0	12,930	1994			60,720	49,839	0	7,894	1,521	9,359	18,774	31,804
1995			302,298	299,931	0	10,580	2,367	0	12,947	1995			49,839	38,959	0	6,479	1,521	9,359	17,360	30,307
1996			299,931	297,564	0	10,498	2,367	0	12,864	1996			38,959	28,078	0	5,065	1,521	9,359	15,945	28,810
1997			297,564	280,639	0	10,415	2,367	14,559	27,341	1997			28,078	18,719	0	3,650	0	9,359	13,009	40,350
1998			280,639	263,713	0	9,822	2,367	14,559	26,748	1998			18,719	9,359	0	2,433	0	9,359	11,793	38,541
1999			263,713	246,787	0	9,230	2,367	14,559	26,156	1999			9,359	0	0	1,217	0	9,359	10,576	36,732
2000			246,787	229,861	0	8,638	2,367	14,559	25,563	2000										25,563
2001			229,861	212,935	0	8,045	2,367	14,559	24,971	2001										24,971
2002			212,935	196,009	0	7,453	2,367	14,559	24,379	2002										24,379
2003			196,009	179,084	0	6,860	2,367	14,559	23,786	2003										23,786
2004			179,084	162,158	0	6,268	2,367	14,559	23,194	2004										23,194
2005			162,158	145,232	0	5,676	2,367	14,559	22,601	2005										22,601
2006			145,232	128,306	0	5,083	2,367	14,559	22,009	2006										22,009
2007			128,306	111,380	0	4,491	2,367	14,559	21,417	2007										21,417
2008			111,380	94,454	0	3,898	2,367	14,559	20,824	2008										20,824
2009			94,454	77,529	0	3,306	2,367	14,559	20,232	2009										20,232
2010			77,529	60,603	0	2,713	2,367	14,559	19,639	2010										19,639
2011			60,603	43,677	0	2,121	2,367	14,559	19,047	2011										19,047
2012			43,677	29,118	0	1,529	0	14,559	16,088	2012										16,088
2013			29,118	14,559	0	1,019	0	14,559	15,578	2013										15,578
2014			14,559	0	0	510	0	14,559	15,069	2014										15,069

whose lending rate is 8.5 % per annum is applied to finance 80 % of the total project investment. The result of this study reveals, as shown in Appendix 10, Tables-10.9 and -10.10, that both annual and cumulative revenue-expenditure balances throughout the project period will record positive figures, indicating a financial feasibility of the project even with such financing.

4) Unit Cost of Water after Debt Service

This Unit Cost on a cash flow basis may be compared with the unit cost after depreciation and interest on an income flow basis shown in Table-14.9. As shown in Table-14.3, the unit cost after debt service which will register 2.45 Baht/m3 in 1986 or equal to 29.3 % of the then prevailing average water tariff (8.36 Baht), is projected to stand at 7.32 Baht in 2000 or 59.3 % of the comparable water tariff (12.34 Baht).

14.1.5 Fixed Assets, Unit Cost after Depreciation and Rate of Return Analysis

1) Fixed Assets

Fixed Assets (excluding land) in this analysis are expressed in the following terms:

(a) Accumulative Fixed Assets = Accumulative Fixed Assets of previous year + completion amount of construction work, transferred from "Work in Progress".

(b) Accumulative Depreciation = Accumulative Depreciation of previous year + depreciation of current year. Depreciation is applied by a straight line method, with the service life of fixed assets assumed to be 30 years.

(c) Net Fixed Assets = (a) - (b) above.

(d) Work in Progress = Accumulative capital investment - accumulative capital construction completed (no price escalation applied during construction).

(e) TOTAL (Total fixed assets excluding land) = (c) + (d) above.

(f) Total Cost before Depreciation and Interest = Operation and Maintenance Cost (see Table-10.2 of Appendix 10) + Share of Head & Regional Office Overhead Expenses (see same Table).

As shown in Table-14.9, Net Fixed Assets in Operation which is projected to stand at 88,509 thousand Baht in 1987, or 178 % of then Total Revenue (49,716 thousand Baht, see Table-10.2 of Appendix 10) will register 452,034 thousand Baht in 1993 the year after completion of construction, or 4.3 times as large as then Total Revenue 104,272 thousand Baht (see the same Table), but will reduce to 446,164 thousand Baht in 2000, or 278 % of then Total Revenue (160,448 thousand Baht, see the same Table), in reflection of both accumulative depreciation and increases in revenue resulting from the expansion of production facilities. The improvement of the above revenue - fixed assets ratio is reflected in the rate of return mentioned below.

2) Cost after Depreciation and Interest

This analysis shows production cost after depreciation in the following terms:

(g) Total Cost after Depreciation but before Interest = (f) + depreciation for current year (accumulative depreciation for current year - that for previous year).

(h) Total Cost after Depreciation and Interest = (g) + interest payable for current year (see Table-14.8).

(i) Unit Cost of Water after Depreciation and Interest = (h) / Water Sales (x 1,000 m3) (see (C) of Table-10.2 of Appendix 10).

The figures of Total Cost after Depreciation and Interest shown in Table-14.9 do not differ so much from those of Total Cost after Debt Service

Table-14.9 FIXED ASSETS, UNIT COST AFTER DEPRECIATION AND RATE OF RETURN

[PATTAYA WATERWORKS] x 1,000 BAHT

ITEM	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fixed Assets														
Accumulative Fixed Assets	117,584	121,465	129,326	162,631	188,112	323,323	529,591	547,068	565,121	583,770	603,034	622,934	643,491	664,726
Less Accumulative Depreciation	29,076	33,125	37,436	42,857	49,127	59,904	77,558	95,793	114,630	134,089	154,191	174,955	196,405	218,562
Net Fixed Assets in Operation	88,509	88,340	91,890	119,774	138,985	263,419	452,034	451,274	450,490	449,680	448,844	447,979	447,086	446,164
Work in Progress	3,853	32,890	49,151	149,118	324,602	195,598	0	0	0	0	0	0	0	0
TOTAL	92,362	121,230	141,041	268,892	463,587	459,017	452,034	451,274	450,490	449,680	448,844	447,979	447,086	446,164
Total Cost before Depreciation and Interest**	16,333	18,486	20,548	23,282	26,019	33,789	37,652	41,501	45,153	48,556	52,341	56,368	60,479	64,855
Total Cost after Depreciation but before Interest		22,535	24,859	28,703	32,290	44,567	55,305	59,736	63,991	68,015	72,443	77,133	81,928	87,013
Total Cost after Depreciation and Interest		23,531	27,188	33,400	44,755	64,736	75,276	78,293	81,050	83,577	86,507	89,389	92,375	95,650
Unit Cost of Water (Baht/m3) after depreciation and Interest*		3.60	3.82	4.34	5.47	7.42	8.12	8.03	7.96	7.98	8.01	8.08	8.14	8.21
Average Rate Base		88,424	90,115	105,832	129,379	201,202	357,726	451,654	450,882	450,085	449,262	448,411	447,533	446,625
Surplus after Depreciation and Interest		39,370	43,372	45,626	41,355	31,119	28,996	34,323	39,293	43,870	49,136	53,804	59,160	64,798
Rate of Return after Completion of Construction						15%	8%	8%	9%	10%	11%	12%	13%	15%

Note: * [{(Total Cost after Depreciation and Debt Service) of this Table} x {(1.1 Water Sales)/(1. Operating Revenue) of Cash Flow Table}]/[{(C) Water Sales (x 1000 m3)} of Cash Flow Table]

shown in Table-10.2 of Appendix 10.

	1993	1998
Total Cost after Depreciation and Interest (Table-14.9, x 1,000 Baht)	75,272	89,389
Total Cost after Debt Service (Table-10.2 of Appendix 10, x 1,000 Baht)	68,504	94,909

This is due partly to the low interest rate (3.5 % per annum) of the foreign loan applicable to this project.

The figures of Unit Cost after Depreciation and Interest are compared with those of Unit Cost after Debt Service as follows:

		1993	1998
i)	After Depreciation and Interest (Table-14.9)	8.12 Baht	8.08 Baht
ii)	After Debt Service (Table-10.2 of Appendix 10)	6.89 Baht	8.18 Baht

This comparison shows that depreciation decreases yearly, while annual debt service amount reaches its peak in 1997 and 1998 (see Table-14.8).

3) Rate of Return after Completion of Construction

This item is calculated in this analysis as follows:

(j) Average Rate Base = (Fixed Assets in Operation for current year + Fixed Assets in Operation for previous year) / 2.

(k) Surplus after Depreciation and Interest = Total Revenue (see Table-10.2 of Appendix 10) - (h).

(l) Rate of Return after Completion of Construction = (k) / (j).

The Rate of return which is forecast to stand at 15 % in 1992 will register to 15 % again in 2000 after dropping to 7 % in 1993. This indicates a favorable earning position of the waterworks even after the large capital

investment under current project.

14.1.6 Financial Internal Rate of Return

Table-14.10 represents the tabulation and calculation of the Financial Internal Rate of Return for Pattaya Waterworks on an incremental basis resulting from investment in the expansion project of the waterworks, utilizing a discount rate that equates costs with benefits which produces a figure of 5.56 %. This discount rate exceeds compound interest rate of loans by OECF and local loans (OECF loans 3.5 % x 0.8 + local loans 13 % x 0.2 = 5.4 %) but is less than that (8.5 x 0.8 + 13 % x 0.2 = 9.4 %) by another foreign loan and local loan referred to in 14.1.4, 3) above. It it is to be noted in this connection that this rate of return refers only to incremental earnings of the newly invested capital and if the earnings from the formerly invested capital are combined, Pattaya Waterworks can afford to pay back debt service arrising from foreign loans even with a lending rate of 8.5 % per annum as revealed by the afore-mentioned cash flow analysis (see Appendix 10, Table-10.10 for example).

Another factor to be noted in this connection is that financial forecast was made on an assumption of a very high rate chargeable to the raw water from the Nong Kho-Laem Chabang Pipeline System. The rate applied to this study was 1.5 Baht per cubic meter, a highest one considerable under the present conditions. It is therefore recommended that PWA will make all the efforts to negotiate for a lowest possible rate with other Authorities concerned.

14.1.7 Financial Feasibility

The results of the analysis mentioned above throughout Section 14.1, demonstrate the financial feasibility of the project, particularly in view of the terms and conditions of loans considered available for the project.

Table-14.10 FINANCIAL INTERNAL RATE OF RETURN (FIRR)

(PATTAYA WATERWORKS) x 1,000 BAHT

YEAR	TOTAL WATER REVENUE	CAPITAL INVESTMENT COST	OPERATING COSTS & H.R.O.*	1986 PRICE NET REVENUE	NET BENEFITS DISCOUNTED AT 5 % (0.05)	NET BENEFITS DISCOUNTED AT 6 % (0.06)
1987	0	3,738	0	-3,738	-3,560	-3,527
1988	0	- 27,323	0	-27,323	-24,783	-24,318
1989	14,296	18,359	3,715	-7,778	-6,719	-6,530
1990	19,685	114,203	5,335	-99,853	-82,149	-79,093
1991	23,491	167,935	6,716	-151,160	-118,438	-112,956
1992	29,172		12,143	17,029	12,708	12,005
1993	33,358		14,055	19,303	13,718	12,838
1994	37,140		15,805	21,335	14,440	13,386
1995	40,134		17,202	22,931	14,782	13,573
1996	42,398		18,252	24,146	14,824	13,483
1997	45,190		19,508	25,682	15,015	13,529
1998	47,272		20,652	26,620	14,823	13,229
1999	49,643		21,741	27,902	14,797	13,081
2000	52,149		22,896	29,253	14,775	12,939
2001	52,149		22,896	29,253	14,071	12,206
2002	52,149		22,896	29,253	13,401	11,515
2003	52,149		22,896	29,253	12,763	10,864
2004	52,149		22,896	29,253	12,155	10,249
2005	52,149		22,896	29,253	11,577	9,669
2006	52,149		22,896	29,253	11,025	9,121
Salvage		-157,518		157,518	59,367	22,375
TOTALS	746,819	174,041	315,392	257,386	28,592	-22,362

Note: * Share Allocation of Head and Regional Office Overhead Expenses (calculated by the existing PWA formula).

FIRR= 5+(6-5)x28,592/(28,592+22,362)
= 5.56%

14.1.8 Summary of Sensitivity Study Results

The results of sensitivity studies are summarized, for your reference, as follows:

1) Cash flow analysis (in terms of accumulative surplus in 2000)

Unit: 1,000 Baht

a. Main Report (see Table-14.3) 642,510
Tariff change: every three years
Share allocation PWA method
Foreign loan: interest rate at 3.5 % p.a.

b. Sensitivity Study A (Share allocation: PWA formula)
a) Tariff change: every year (Appendix 10, Table-10.2) 687,561
b) Tariff change: no change (Appendix 10, Table-10.3) 371,858

c. Sensitivity Study B (Share allocation: new formula)
a) Tariff change: every year (Appendix 10, Table-10.6) 564,683
b) Tariff Change: every 3 years (App. 10, Table-10.7) 523,716
c) Tariff change: no change (App. 10, Table-10.8) 277,600

d. Sensitivity Study C (Foreign loan: at 8.5 % p.a., and tariff change: every 3 years) (App.10, Table-10.10) 504,848

2) Fixed Assets, Unit Cost after Depreciation and Interest, and Rate of Return Analysis

a. Main Report (see Table-14.9)

Unit cost of water in 2000	8.21 Baht
Annual surplus in 2000	54,798 thousand Baht
Rate of return in 2000	15 %

b. Sensitivity Study (share allocation: new formula, see Table-10.11 of APP.10)

Unit cost of water in 2000	9.30 Baht
Annual surplus in 2000	52,126 thousand Baht
Rate of return in 2000	12 %

3) Financial Internal Rate of Return

a. Main Report (share allocation: PWA formula, see Table-14.10) 5.56 %

b. Sensitivity Study (share allocation: new formula, see Table-10.12 of App.10) 3.97 %

14.2 Economic Analysis

This analysis purports the economic justification of the project by comparing the net creation of benefits to the net increase in costs.

In this analysis, benefits and costs are considered from the national interest standpoint. Costs are converted to economic costs to reflect alternative uses of resources by the nation, and benefits include effects of the projects upon water users and upon the community in which the improvement occurs.

Benefits and costs in this analysis are valued in the present national value of money, currently at approximately 10%, for the purpose of discounting benefits and costs.

In this analysis, economic justification is considered to be proved if benefits exceed costs at the present national value.

14.2.1 Economic Benefits

The main socio-economic benefits which will be brought about by the implementation of the Pattaya Water Supply Expansion Project as proposed in the current feasibility study are summarized as follows.

1) Water Volume Benefits

The increases to be brought about by the project in total water production, served population and per capita and total water consumption are summarized in Chapter 2. Also water pressures will be substantially increased and the existing chronic water shortages will be eliminated.

2) Water Quality Effects

The questionnaire market survey which the study team conducted in January, 1986 reveals that the majority of Pattaya residents are not satisfied with the present quality of water supplied, as shown in Appendix 5.

3) Fire Loss Reduction

Table-14.11 shows that the damages in Pattaya caused by fire losses in the past three years amounted to considerable amounts.

As the water supply service will dramatically improve and expand the fire fighting capabilities of the area. This will protect property values especially in the central business districts where a major conflagration has the greatest potential. With reduced fire loss, personal injury and loss of human lives will be markedly reduced.

4) Effects on Health, Sanitation and Aesthetics

Table-14.12 following shows that Pattaya is still not free from water-borne diseases such as Typhoid, Dysentery, Diarrhea and Food Poisoning.

The current project upon implementation will be a positive step in reducing such water-borne diseases. Improvement of sanitation and beautification will also contribute to further development of these areas.

5) Increase in Property Values

With the improvement of the sanitary environment and fire protection, property values throughout the city, particularly in the areas where water supply will be improved or extended by the project, will show an increase.

6) Direct and Indirect Impacts on Local and National Economies

Direct employment of people and procurement of materials during the planning, construction and operational periods of the project will produce excellent economic repercussions on the regional economies, which will in turn impact the national economy as a whole.

Table-14.11 FIRE LOSSES IN PATTAYA

YEAR / DESCRIPTION	1981 NUMBER	1981 AMOUNT OF DAMAGE (BAHT)	1982 NUMBER	1982 AMOUNT OF DAMAGE (BAHT)	1983 NUMBER	1983 AMOUNT OF DAMAGE (BAHT)	1984 NUMBER	1984 AMOUNT OF DAMAGE (BAHT)	1985 NUMBER	1985 AMOUNT OF DAMAGE (BAHT)
HOUSE	14	1,489,000	18	1,995,150	16	38,550	11	102,550	8	450,000
BUILDING	0	0	4	7,110,000	4	55,000	3	2,001,700	2	400,000
CAR	2	31,000	1	350,000	0	0	4	78,500	0	0
BOAT	0	0	0	0	1	9,000	0	0		
GRASS	44		32		92		43		43	
TOTAL	60	1,520,000	55	9,455,150	113	102,550	61	2,182,750	53	850,000

SOUCE : PATTAYA FIRE STATION, JUNE 1986

Table-14.12 NO. OF PATIENTS IN BANG LAMUNG DISTRICT

ITEM	1982	1983	1984	1985	1986 (Jan.-May)
Population of Jurisdictional Area	-	-	43,257	39,203	42,341
Causes of Morbiditiy (No.)					
Cholera	-	-	-	-	-
Typhoid	-	32	14	22	6
Dysentery	40	108	44	48	21
Diarrhoea	191	156	956	1,083	584
Food Poisoning	13	67	47	112	93
Population in Bang Lamung	-	85,345	83,119	59,394	73,671
Birth (No.)	1,298	710	-	419	1,473
Death (No.)	369	212	-	211	-
Birth in/ Jurisdictional Area	-	-	-	804	-
Death in/ Jurisdictional Area	-	-	-	220	-

Source : Bang Lamung Sanitary Office, 20 June 1986.
Note : 1. Jurisdictional Area covers the jurisdiction of Pattaya Waterworks.
2. Jurisdictional Area includes the suburbs of Bang Lamung Disctict.

14.2.2 Economic Costs

This analysis considered (1) project costs, (2) replacement costs, and (3) operating and maintenance costs. These economic costs are based on the values used in the Financial Analysis adjusted to convert them into economic costs.

1) Project Costs

In determining project costs, this analysis used adjustments for two items only, where the market price mechanism does not function properly. The adjusted prices or so-called "shadow prices" used in this analysis are those employed by OECF and international lending institutions.

a. Prices of Skilled and Unskilled Labor

In this study, the opportunity cost of unskilled labor or its potential in other employment is valued at 0.38 of its estimated cost for the project.

Skilled labor, on the other hand, is valued at a factor of 0.73.

b. Foreign Exchange

In view of the comparatively free foreign exchange practices in Thailand, no shadow prices are applied in this analysis.

c. Interest and Hidden Taxes

Interest is not included since this is a financial rather than economic cost. Local hidden taxes, subsidies and duties, which we assumed to amount 20.9% of local costs, are also removed as they consist only of inter-sectorial transfers of funds from the view point of national economy. This type of reduction is also applied to raw water fees payable to Nong Kho-Laem Chabang Pipeline, as nearly 20 % of the fees considered to be kind of commissions to be earned by RID, a sectorial transfer viewed from the national economy as a whole.

2) Operation and Maintenance Cost

This study considers the operation and maintenance costs pertaining to the proposed project only, excluding those of the present system. The operation and maintenance costs are so-called "annual costs" which include personnel, electricity & fuel, chemical, connection, raw water and other miscellaneous expenses.

3) Replacement Cost and Salvage Value

This analysis also considers the present value of all those facilities, equipment and other items included in the Project with a service life of less than 30 years to be replaced during the 30 years period from 1987 to 2006.

The replacement costs or costs incurred in order to replace mechanical equipment and others that have exceeded their life expectancy are considered part of the economic cost. They are however not shown in the EIRR Table as most of these mechanical equipment having a service life of 15 years will be required to be replaced after 2006, the terminal year of the Table.

The economic cost of the project is expressed as :

"Adjusted (shadow priced) project cost" + "Operating and maintenance cost" + "Replacement cost" - "Salvage Value". The percentage of salvage value is measured on the basis of the remaining service life of the facilities invested in the proposed project in the year of 2006.

14.2.3 Economic Justification

To verify a synthetic measure of the economic justification of the projects, the following two analyses are given in this study.

1) Cost Benefit Ratio

As shown Table-14.13, the ratios of present-value economic benefits to economic cost of the proposed projects for Pattaya calculated in the methods previously outlined are 2.23 at 1986 price and 1.08 at present value discounted at 10% per annum. This is greater than 1 : 1, which demonstrates the economic viability of the projects. The actual benefits of the projects are considered to be greater than the Cost-Benefit ratios calculated, the reason being that non-quantifiable indirect benefits are not incorporated into this analysis.

2) Economic Internal Rate of Return

The economic internal rate of return (EIRR) of the project is the rate at which the present value of the quantifiable benefits equals the present value of the economic cost of the proposed project.

This study uses as the measure of economic benefits the prevailing average water tariff which is considered to be the lowest economic benefits of water supply.

Table-14.14 shows economic internal rates of return (EIRR) for Pattaya at 11.43 %, exceeding 10% which is considered as the prevailing opportunity cost of capital in Thailand.

In view of the difficulty of quantifying the economic benefits delineated in Section 14.2.1 above, this study also tried to show as for reference the EIRR based on the Average Incremental Cost (AIC) which the World Bank and WHO recommend as a proxy for economic benefits or a long run marginal cost of water as shown in Appendix 10, Table-10.17. The EIRR based on the AIC is calculated at 11.22 %.

The above analysis demonstrates the economic justification of the project.

Table-14.13 ECONOMIC BENEFITS VS COSTS (INCREMENTAL)

(PATTAYA WATERWORKS) x 1,000 BAHT

YEAR	AT 1986 PRICE		DISCOUNTED AT 10% PER ANNUM	
	BENEFITS	COSTS	BENEFITS	COSTS
1987	0	3,334	0	3,031
1988	0	24,159	0	19,966
1989	14,487	17,877	10,884	13,431
1990	19,755	101,154	13,493	69,090
1991	24,030	147,903	14,921	91,836
1992	28,974	7,771	16,355	4,387
1993	33,908	8,995	17,400	4,616
1994	38,193	10,115	17,817	4,719
1995	42,143	11,010	17,873	4,669
1996	44,777	11,681	17,264	4,504
1997	47,736	12,485	16,731	4,376
1998	50,045	13,217	15,946	4,211
1999	52,679	13,914	15,259	4,031
2000	55,313	14,653	14,566	3,859
2001	55,313	14,653	13,242	3,508
2002	55,313	14,653	12,038	3,189
2003	55,313	14,653	10,943	2,899
2004	55,313	14,653	9,949	2,635
2005	55,313	14,653	9,044	2,396
2006	55,313	14,653	8,222	2,178
Salvage		-135,018		-20,070
TOTAL	783,921	351,172	251,946	233,462
	BENEFITS/COS = 2.232		BENEFITS/COS = 1.079	

Table-14.14 ECONOMIC INTERNAL RATE OF RETURN (EIRR)

(PATTAYA WATERWORKS) x 1,000 BAHT

YEAR	TOTAL ECONOMIC BENEFITS * AT 1986 PRICE	TOTAL CAPITAL INVESTMENT AT 1986 PRICE	OPERATING COSTS & H.R.O.** AT 1986 PRICE	NET BENEFITS AT 1986 PRICE	CONVERTED ECONOMIC VALUE				NET BENEFITS	
					TOTAL ECONOMIC BENEFITS	TOTAL CAPITAL INVESTMENT	OPERATING COSTS & H.R.O.*	NET BENEFITS	DISCOUNTED AT 11%	DISCOUNTED AT 12%
1987	0	3,738	0	-3,738	0	3,334	0	-3,334	-3,004	-2,977
1988	0	27,323	0	-27,323	0	24,159	0	-24,159	-19,608	-19,260
1989	14,487	18,359	2,972	-6,844	14,487	15,500	2,377	-3,390	-2,479	-2,413
1990	19,755	114,203	4,268	-98,716	19,755	97,740	3,414	-81,400	-53,620	-51,731
1991	24,030	167,935	5,373	-149,278	24,030	143,605	4,298	-123,873	-73,512	-70,289
1992	28,974		9,714	19,260	28,974		7,771	21,202	11,336	10,742
1993	33,908		11,244	22,664	33,908		8,995	24,913	11,999	11,269
1994	38,193		12,644	25,549	38,193		10,115	28,077	12,184	11,340
1995	42,143		13,762	28,382	42,143		11,010	31,134	12,171	11,227
1996	44,777		14,601	30,176	44,777		11,681	33,096	11,656	10,656
1997	47,736		15,607	32,129	47,736		12,485	35,251	11,184	10,134
1998	50,045		16,521	33,524	50,045		13,217	36,828	10,527	9,453
1999	52,679		17,393	35,286	52,679		13,914	38,765	9,983	8,884
2000	55,313		18,316	36,997	55,313		14,653	40,660	9,433	8,320
2001	55,313		18,316	36,997	55,313		14,653	40,660	8,498	7,428
2002	55,313		18,316	36,997	55,313		14,653	40,660	7,656	6,633
2003	55,313		18,316	36,997	55,313		14,653	40,660	6,897	5,922
2004	55,313		18,316	36,997	55,313		14,653	40,660	6,214	5,287
2005	55,313		18,316	36,997	55,313		14,653	40,660	5,598	4,721
2006	55,313		18,316	36,997	55,313		14,653	40,660	5,043	4,215
Salvage		-157,518		157,518		-135,018		135,018	16,747	13,997
TOTAL				357,567				432,749	4,902	-6,442

Note : * Average water tariff in 1986 used as benefits. (8.36 Baht)

** Share Allocation of Head and Regional Office Overhead Expenses.

EIRR = 11+(12-11)x4,902/(4,902+6,442)

= 11.432%

14.2.4 Summary of Sensitivity Study Results

The results of sensitivity studies are summarized ,for your references, as follows:

1) Main Report (share allocation: PWA formula)

a. Economic Benefit vs Cost (see Table-14.13)

i) at 1986 price	2.23 : 1
ii) discounted at 10 % p.a.	1.08 : 1

b. Average incremental cost (see Table-10.13 of App.10) 8.92 Baht

c. Economic internal rate of return

i) prevailing tariff as unit of benefit (Table-14.14)	11.4 %
ii) AIC as unit of benefit (Table-10.17 of App.10)	11.2 %

2) Sensitivity Study (share allocation: new formula)

a. Economic Benefit vs Costs (see Table-10.15 of APP.10)

i) at 1986 price	2.23 : 1
ii) discounted at 10 % p.a.	1.08 : 1

b. Average incremental cost (see Table-10.14 of App.10) 9.47 Baht

c. Economic internal rate of return

i) prevailing tariff used as unit of benefit (see Table-10.16 of App.10)	10.5 %
ii) AIC used as unit of benefit (see Table-10.18 of App.10)	11.5 %

14.3 Future Water Tariff Considerations

14.3.1 General

As discussed below, this chapter makes the following suggestions for successful implementation of the project as well as effective post-implementation operation and maintenance of the improved water supply system proposed in this feasibility study.

1) periodical upward revisions, every three-year revisions for example, to cover price escalations.
2) consideration for lower tariff burdens for users of lower income brackets.
3) study of an appropriate level of connection fees and such other factors as cost of drilling a new well in connection with the willingness of potential new consumers in the project area.
4) consideration for alleviating the burden of share of PWA Head and Regional Office overhead expenses allocable to small-sized waterworks.

14.3.2 Present Level of Water Tariffs

1) The average water tariff level

The average water tariff charged both to domestic and other large scale consumers in Pattaya for the six months starting October 1985, the first month after the recent water tariff revision which took place from November 1984, was 8.36 Baht/m3.

Thanks to the recent across-the-board tariff revision which took place from November 1984 to October 1985, Pattaya Waterworks is predicted to produce annual net surpluses up to the target year of the current feasibility study, 2000, even if the prevailing water tariff level is kept unchanged as forecast in Appendix 10, Table-10.3.

As forecast in table-14.3, this water tariff level will be more than three times higher than projected unit cost of water in 1987, and will still exceed unit cost of water by 119.18 % in 2000.

2) Ability and Willingness to Pay

As shown in Table-14.15, the average household income per month of all households who replied to the questionnaire survey conducted at Pattaya in January 1986 is estimated at 4,281 Baht. If the criteria of 3 % of average household income which OECF and other international lending institutions recommend is applied, the limit of ability to pay by Pattaya dwellers is estimated at the 6.1 Baht/m3 which is lower than the prevailing average water tariff level of Pattaya by 37.0 %. If we take into account of the fact that major part of water consumption is shared by hotels and other large consumers, this phenomenon does not necessarily mean that the prevailing average water tariff for domestic households exceeds their maximum payable amount.

The expressed average willingness-to-pay amount of those households willing to connect is calculated, as shown in Table-14.16, at 4.9 Baht/m3 which is lower than the prevailing average water tariff charged to Pattaya consumers. This survey result may partly indicate kind of reactions of consumers against the recent water tariff revision by PWA and may partly be attributed to the fact that the majority of repliers consisted of domestic households belonging to lower income brackets. It is also recognized that the willing-to-pay amount stated in a questionnaire survey always reflects the psychology of purchasers to pay as little as possible.

The prevailing water tariff level is thus found high enough to cover operation and maintenance expenses of the waterworks and also from the view point of the ability to pay of Pattaya dwellers.

Looking into the distribution of income among the households, 31.7 % of total repliers to the questionnaire survey belong to the household income brackets less than 2,000 Baht/month whose average income is assumed at around 1,300 Baht/month. As these households consist of 4.5 household members, according to the questionnaire survey, and consume water at the rate of 100 lpcd, their maximum payable water rate is estimated at around 2.89 Baht/m3, which is 55.80 % lower than the prevailing PWA water rate of 4.50 Baht/m3 applicable to the mentioned volume of monthly consumption. This suggests a need of special consideration for lower water rates applicable to those households of low income brackets.

Table-14.15 MAXIMUM PAYABLE PRICE FOR WATER IN PATTAYA

The assumed maximum domestic payable price for water to be used for financial and economic analysis was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		156
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.48
(3) AVERAGE HOUSEHOLD INCOME PER MONTH		4,281
(A) LESS THAN 2,000 Baht	31.7%	
(B) 2,000 - 3,000 Baht	30.0%	
(C) 3,000 - 4,500 Baht	16.6%	
(D) 4,500 - 6,000 Baht	9.7%	
(E) 6,000 - 7,500 Baht	3.0%	
(F) 7,500 - 10,000 Baht	3.9%	
(G) 10,000 - 15,000 Baht	2.6%	
(H) 15,000 - 50,000 Baht	2.1%	
(I) OVER 50,000 Baht	0.5%	

(4) MAXIMUM PAYABLE PRICE FOR WATER PER M3
((3)x0.03)/((1)x(2)x30/1000)= 6.1 Baht/m3

Note: 3% of monthly Household income assumed to be the maximum payable amount for water charges. (according to the World Bank guideline.)

SOURCE : QUESTIONNAIRE SURVEY, JANUARY 1986

Table-14.16 WILLING-TO-PAY PRICE FOR WATER IN PATTAYA

The assumed willing-to-pay value of water to be used as a basis of measuring the economic value of water volume benefits was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		156
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		4.48
(3) AVERAGE WILLING-TO-PAY AMOUNT PER MONTH		103.55
(A) Up to 50 Baht	48.7%	
(B) Up to 100 Baht	40.5%	
(C) Up to 200 Baht	9.1%	
(D) Up to 500 Baht	0.9%	
(E) Up to 2,000 Baht	0.8%	

(4) WILLING-TO -PAY PRICE PER M3
(3)/((1)x(2)x30/1000) = 4.9 Baht/m3

It was also found out during the course of questionnaire survey the prevailing high connection fees were working to dampen the willingness of potential new consumers to connect. This was found true particularly when connection charges exceeded the cost of well drilling where water of comparatively good quality was available.

14.3.3 Future Water Tariff Considerations

As forecast in Section 14.1.4, the annual rate revenue-expenditure balance will produce surpluses up to 2000. It is however projected, as shown in Appendix 10, Table-10.3 that if the water tariff level is kept unchanged, annual net surpluses will incline to reduce yearly, i.e., with the surplus of 37,522 thousand Baht for fiscal 1987 decreasing to 15,787 thousand Baht for 1997. This suggests an advisability of raising the water tariffs to cover price escalations. Ideally speaking such revisions should be made as frequently as possible. In view of the past performance and the political and social climate of Thailand, this study recommends periodical revisions of water tariffs with three- to four-year intervals.

Constant regard is required to be paid to the relation between unit cost of water and the prevailing water tariff level. In this connection such accounting items as the share of PWA Head Office and Regional Office overhead expenses, debt service expenses and allocation of depreciation cost, as referred to in Section 14.1.4, are important factors in determining unit cost of water. Complaints are heard about the formula being used in allocating the share of PWA Head Office and Regional Office overhead expenses, which imposes unfairly heavy burden on small sized waterworks, the reason being that per waterworks portions both of Head and Regional Office expenses (one third of their expenses) are allocated to each waterworks regardless of the production scales of waterworks as shown in Table- 14.7. It is therefore suggested that consideration be paid to the alleviation of such share to be allocated to small sized waterworks. In this connection, a tentative formula is suggested in Appendix 10, Table-10.4 as a hint to such consideration.

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