

6. THUNG SONG

EXECUTIVE SUMMARY

PART I - GENERAL

THE STUDY AREA

The Municipality of Thung Song, which is one of the centers in the Nakhon Si Thammarat Province, is situated on the southeastern coast in the southern region of Thailand. Mainly engaged in commerce, as the distribution center of raw materials, especially rubber and rice, Thung Song lies about 710 km south of Bangkok and 60 km northwest of Nakhon Si Thammarat.

Thung Song is situated on the flat terrace upstream of the Tao Loa River flowing southward. Several small streams originating from the mountains northeast of Thung Song flow into the neighboring area and then join the Tao Loa River.

Na Bon, which is known as the rubber industry town, is 14 km northeast of Thung Song and is supplied with water by the same municipal system in Thung Song.

Annual rainfall in Thung Song averages 2,400 mm while average annual pan evaporation level is about 1,400 mm. Mean monthly temperature varies from 28.7°C in April to 25.9°C in December.

In Amphoe Thung Song, the agricultural sector provides most of the job opportunities. Of the total agricultural area of 400 sq. km in Amphoe, rubber plantations occupy about 250 sq. km., with the rest dominated by paddy fields. In 1987, a total of 1,087 people are gainfully employed in 121 establishments in the industrial sector. A more significant number of people are employed in 776 commercial and business establishments dominated by grocery stores and restaurants.

Thung Song is a junction of many land transportation routes. Route 41 and Route 403 meet in the area, with Route 41 leading northwards to Surat Thani and Chumphon, where it joins Route 4 leading to Bangkok. Also, the railways divert from Thung Song in three directions: to the north, leading to Bangkok; to the east, leading Nakhon Si Thammarat and to Hat Hai; and to the south leading to Trang and the Andaman Sea.

WATER SOURCE

The present water source in Thung Song is mainly the Khlong Poek, which flows 2.0 km east of the Municipality. The existing intake point of the waterworks is located 1.5 km downstream of the confluence of two streams, the Khlong Poek and the Khlong Nam Tok Yong. Several concrete bricks are placed in the stream so that raw water can be fed into the sedimentation basin. The catchment area has a relatively flat terrace where rubber and paddy rice are planted.

Shallow wells are often utilized by private houses as the study area is situated on the colluvium of the small streams. Most of the wells are hand-dug with brick lining and with a depth of from 3 to 5 meters.

Monthly rainfall data were recorded at six gauging stations in Amphoe Thung Song, Ron Phibun, Chaweng, Lan Saka, Nakhon Si Thammarat and Kri Rat Nikom. Climatology data on the study area are available at Nakhon Si Thamma-

rat.

Two hydrological stations at Lan Saka and Muang, Nakhin Si Thammarat, were selected for hydrological analysis because these have similar runoff patterns and catchment conditions.

Several methods such as specific runoff and hydrological models were used for estimating the available amount of water at the existing water source at the Khlong Tam Tok Yong.

Probability analyses showed that the minimum flow at the existing intake point is 0.75 MCM/mo in the return period of 1/10. Availability of water at the source is considered sufficient for water demand even up to the target year of 2011.

The study also considered several alternative water sources in order to meet future water demand and secure stable water supply. These include the construction of a concrete weir with a gate at the present intake point, diversion from the Khlong Tha Long, construction of a multi-purpose dam upstream of the Khlong Wang Hip, and groundwater development.

EXISTING WATER SUPPLY SYSTEM

The waterworks for the municipality of Thung Song, which was founded in 1961, initially had a treatment plant with a capacity of 40 cu.m./h, treating raw water from a canal flowing into Thung Song. In 1969, a new treatment plant with a capacity of 160 cu.m./h was constructed some 3.5 km away from the old treatment plant which was soon abandoned due to the deterioration of water quality. The new treatment plant has, for its source, surface water from the Tha Phae River which originates from the Yong Waterfall. The capacity of the treatment plant increased to 240 cu.m./h in February 1988 with the completion of improvement works on the plant.

The treatment process consists of chemical flocculation, sedimentation, rapid filtration and chlorination. The treated water is stored in two clear water reservoirs with a total capacity of 2,000 cu.m. and is distributed directly by means of pumps.

The distribution system of the waterworks covers the center of the town and extends to the prison by direct pumping from the water treatment plant. Na Bon, which is located about 14 km north of Thung Song, has a distribution system consisting of a receiving tank and pipeline with a total length of 2,500 m.

The number of connections increased from 2,799 in 1980 to 3,196 in 1984 and 3,799 in 1987. Although all the house connections are metered, several meters are found to be defective or have measuring errors.

The operational condition obtaining in the Thung Song waterworks is fairly stable. Although the treatment capacity is doubled from March 1988 with the modification of the sedimentation basin and rapid sand filters, no significant change is found in the quality of treated water to date.

About 93 percent of the water produced for sale is distributed in Thung Song while the rest is sent to Na Bon.

The annual water production and sales from 1980 to 1987 are shown in the following table.

Annual Water Production and Sales

Year	Water Production (cu.m/y)	Water Sales (cu.m/y)	No. of Conn.	Consump. per Conn. (cu.m/d)
1980	1,367,406	1,138,162	2,799	1.111
1981	1,437,426	1,114,069	2,926	1.043
1982	1,623,228	1,336,872	3,024	1.211
1983	1,643,726	1,339,385	3,126	1.174
1984	1,773,604	1,397,133	3,196	1.194
1985	1,924,233	1,331,805	3,368	1.083
1986	1,976,185	1,193,847	3,549	0.922
1987	1,704,450	1,253,329	3,799	0.904

POPULATION AND WATER DEMAND

The total future population in the study area was placed at 44,417 in 1991, 47,358 in 1996, 49,940 in 2001, 53,242 in 2006 and 57,203 in 2011. Future population was calculated based on the following assumptions:

- a. In the municipality, the natural growth rate will decrease from the present level of 5% to 1.5% in 2001 and will remain in that level. The net out-migration will decrease from the recent level of 4% to zero in 2008.
- b. The neighboring tambons will have a growth rate equal to that of the municipality.

The existing service area of the waterworks consists of the municipality of Thung song and the Sanitary District of Na Bon in Amphoe Na Bon.

Past and present population served was estimated from the number of members per household and the number of connections. In 1980, out of 2,799 connections, population served was placed at 15,656. In 1983, there were 3,126 connections and 12,382 people served while in 1987, the figures are 3,799 and 14,607.

The future population served was calculated by service area density as shown in the following table.

Future Served Population

Year	Thung Song		Na Bon	Total	Average Service Ratio (%)
	Mun.	Fringe Area			
1991	15,195 (21,707)	503 (5,033)	1,965 (3,930)	17,663 (30,670)	57.6
1996	16,197 (22,187)	1,182 (5,140)	2,359 (4,289)	19,738 (31,616)	62.4
2001	17,330 (23,106)	1,872 (5,349)	2,788 (4,647)	21,990 (33,102)	66.4
2006	19,122 (24,516)	2,723 (5,672)	3,254 (5,006)	25,099 (35,194)	71.3
2011	21,101 (26,376)	3,659 (6,099)	3,756 (5,365)	28,516 (37,840)	75.4

Upper : Served population in the service area

Lower : Total population in the service area

Future water demand is calculated from the water consumption, unaccounted-for water ratio and peak factor as summarized in the following table.

Daily Average and Maximum Water Demand

(Unit : cu.m/d)

Category	1987	1991	1996	2001	2006	2011
Domestic	2,013	2,947	3,402	3,905	4,614	5,408
Gov'l/Inst'l	1,154	1,717	1,767	1,843	1,951	2,087
Commercial	186	307	316	331	352	378
Industrial	51	70	78	86	98	112
Others	35	47	52	57	66	75
Sub-Total	3,439	5,088	5,615	6,222	7,081	8,060
Unaccounted-for Water Ratio (%)	26.5	25	23	22	21	20
Unaccounted-for Water	1,238	1,696	1,677	1,755	1,882	2,015
Daily Average	4,677	6,784	7,292	7,977	8,963	10,075
Peak Factor		1.30	1.30	1.30	1.30	1.30
Daily Maximum		8,819	9,480	10,370	11,652	13,098

DESIGN CRITERIA

The design criteria for the treatment system and pipeline was established on the various design standards employed in Thailand and other countries, taking into consideration the project site and the raw water quality.

The design criteria is summarized as follows:

1. Water loss - intake loss is 10 %; treatment loss is 8 %
2. Pipeline - velocity is a maximum of 3.0 m/s and a minimum of 0.3 m/s. Pipe material is steel for 400 mm diameter pipes or larger and A/C for 300 mm or smaller.
3. Treatment Plant - a) receiving well: treatment time is 1.5 min.; b) mixing tank: mechanical flush mixer; c) filter: rapid sand filtration; d) clear water reservoir: 8.0 hour retention time.
4. Distribution facilities - Minimum service pressure is planned at 1.0 kg/cm² for hourly maximum flow.

BASIS OF COST ESTIMATE

The construction of the facilities to be built is calculated based on 1989 prices.

- a) Pipelines - by linear meter for transmission and distribution pipes
- b) Water treatment plant - PWA's data for the unit cost is used for the civil structures of the treatment plant. For the mechanical works, major items are counted individually. The cost of the electrical works are calculated by the percentage to the mechanical works.

The cost estimates are separated into foreign and local cost portions as shown here:

Item	Foreign Currency	Local Currency
Pipeline	(%)	(%)
A/C pipes	30	70
Steel pipes	80	20
Structural/Architectural	30	70
Mechanical Works	80	20
Electrical Works	80	20
Land Acquisition	0	100

Operation and maintenance costs, based on 1989 prices, consist of energy, chemical, manning, replacement and repair costs. Costs of the PWA's head office and the regional office allocated for this waterworks are also calculated and added in the financial study.

Part 2 - DEVELOPMENT PLAN

DEFINITION AND EVALUATION OF ALTERNATIVES

Water source development plan calls for the construction of a fixed concrete weir with a gate by 1993 for the purpose of securing stable intake and draining of deposited sediment during flood seasons. In the interim, stone blocks or concrete blocks should be temporarily placed at the present intake point to raise the intake water level.

The expansion of the treatment plant at the present site is recommended since the raw water source is sufficient and the existing raw water intake is planned to be used through the future.

The distribution system, in order to respond to water demand in 2011, was considered in optimizing the systems capacity. Since the present design is not even sufficient to meet the planned water demand in 1990, increase of the transmission capacity is inevitable. To achieve this, an additional pipeline is recommended to be installed.

IMPLEMENTATION PLAN

The implementation plan of the total project will involve the construction of a treatment facilities which will be carried out in one phase. It is assumed that the distribution pipelines will be constructed in two years.

The water demand, treatment capacity, and implementation schedule is shown in Figure S-1.

ORGANIZATION OF WATERWORKS

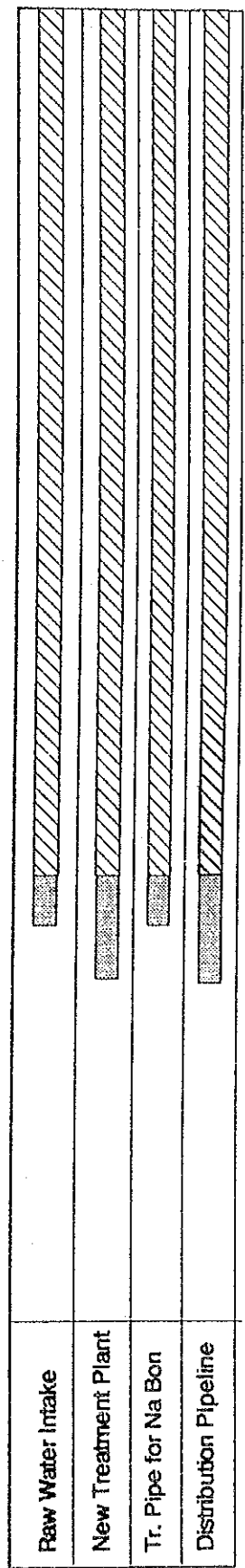
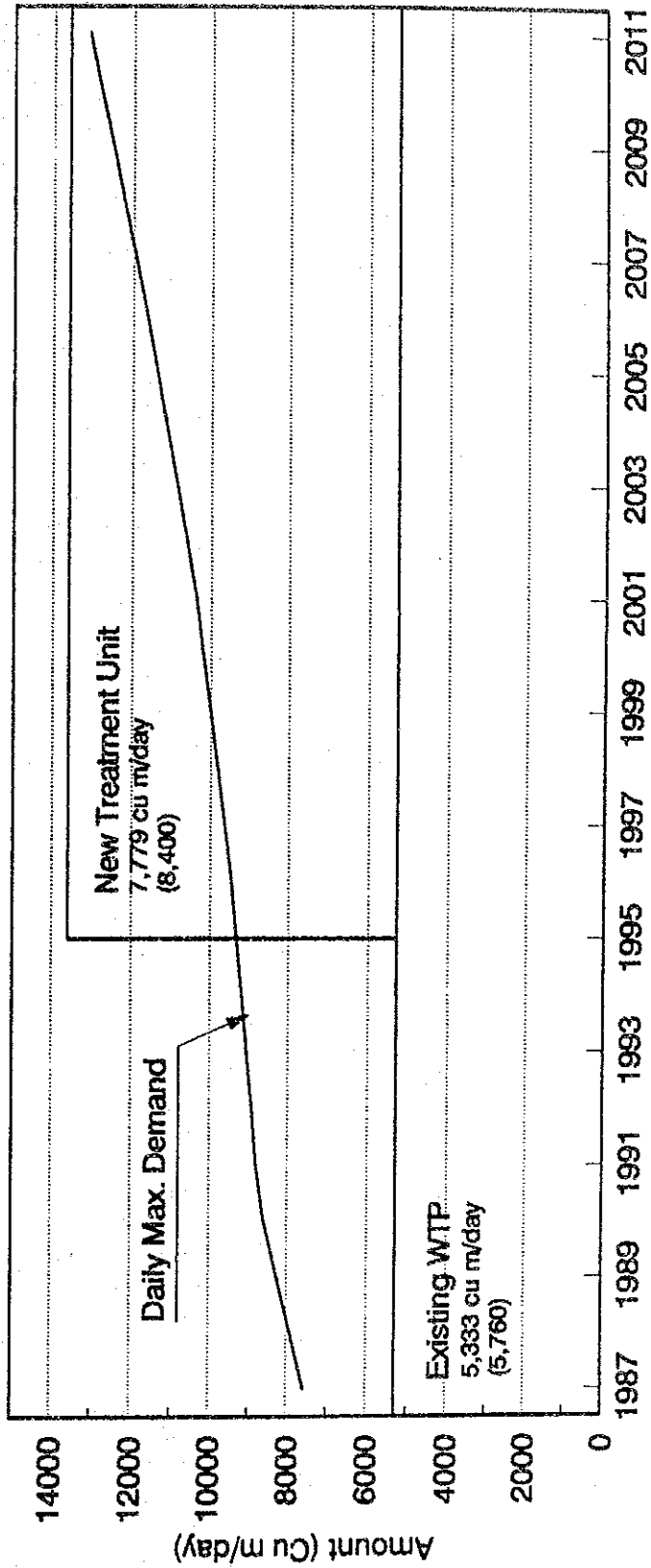
The proposed organization is based on the existing functional chart of the waterworks and will consist of the following:

- a. Administrative Section -- this will be responsible for the administrative and financial operations of the waterworks to include meter reading and preparation of bills, collection of water bills and management of documents and records.
- b. Water Production Section -- this will be responsible for the operation and maintenance of the water treatment plants and raw water intake, including the transmission pipeline system.
- c. Service Section -- this will be responsible for setting and repair of house connections.

PROJECT COST ESTIMATES

(1) Construction Cost

The construction cost of the proposed water supply system was calculated for each component of the facility. The following table shows a summary of the construction costs based on 1989 prices:



Water Treatment Plant Capacity
 7,779 cu m/day : Net Treatment Capacity
 (8,400) : Design Capacity (incl. Treatment loss)

Construction
 Operation

FIGURE S-1
 Implementation Plan

Summary of the Construction Cost

(unit : Baht 1000)

Item	Total Value	Foreign Currency Portion	Local Currency Portion
1.Raw Water Intake	1,954	586	1,368
2.Treatment Plant	28,609	10,952	17,657
3.Transmission Pipeline for Na Bon	15,170	4,551	10,619
4.Distribution Pipeline	11,642	3,493	8,149
Sub Total	57,375	19,582	37,793
5.Land Cost	0	0	0
Total	57,375	19,582	37,793

(2) Operation and Maintenance Cost

Operation and maintenance cost is calculated from the water demand in each year, and consists of energy, chemical, manning, repair, and replacement costs.

Summary of Operation and Maintenance Cost

(unit : Baht 1000)

Year	Energy Cost	Chemical Cost	Manning Cost	Repair Cost	Replace-ment	Total
1990	975	131	2,446			3,552
1991	982	135	2,568			3,685
1992	987	137	2,697			3,821
1993	993	140	2,831			3,964
1994	999	142	2,973			4,114
1995	1,000	145	3,122			4,266
1996	1,014	147	3,414	25		4,601
1997	1,028	150	3,728	25		4,932
1998	1,042	153	4,216	25		5,436
1999	1,137	156	4,427	25		5,745
2000	1,208	159	4,648	25		6,040
2001	1,224	162	4,880	25		6,292
2002	1,245	166	5,124	25		6,561
2003	1,266	171	5,573	25		7,035
2004	1,288	175	5,852	25		7,340
2005	1,310	180	6,356	25		7,871
2006	1,332	184	6,674	25		8,215
2007	1,356	189	7,475	25		9,045
2008	1,381	194	8,094	25		9,694
2009	1,405	199	8,498	25		10,128
2010	1,507	204	8,923	25		10,660
2011	1,534	210	9,653	25		11,422

Financial StudyProject Cost Estimates

Total Project cost is estimated at 19,180,000 Baht, with a foreign exchange requirement of 6,176,000 Baht and local cost component of 13,004,000 Baht. The breakdown of cost estimates is as follows (in thousand Bahts):

	Foreign Portion	Local Portion	TOTAL
a. Construction Cost	19,583	37,792	57,375
b. Engineering Cost			
Design, 8% of (a)	1,724	3,325	5,049
Supervision, 4% of (a)	862	1,663	2,525
TOTAL	22,169	42,780	64,949

Financing Plan

The total foreign cost and 9.501 million Baht of local cost (approximately 50% of project cost) is recommended to be financed from bilateral loan, the remaining 16.640 million Baht of local cost to be equally financed from domestic loan and PWA equity.

Cash Flow Analysis

Inflows consist of government capital contribution for interest payment of domestic loan, foreign and local loan based on recommended financing scheme, water sales, connection fees, service charges, and other income including revenues from sales of materials collected fines and about 2% of water sales. Water sales were projected using the current tariff structure until year 2020. Outflows consist of project expenditure, amortization based on recommended financing scheme, O&M, and connection expenses (50% connection fees).

Results of cash flow analysis show net surpluses throughout the project life, except for 1994. Cumulative cash surpluses for years 2011 and 2020 are estimated at 34.754 million Baht and 35.539 million Baht, respectively.

The results may suggest the simple financial feasibility of this project. It is projected that the unit cost of water would stand at 5.46 Baht per cubic meter in year 2011 and average unit water cost from 1990 to 2020 is 5.69 Baht with the implementation of the project. These rates are almost equal to the third level of PWA's present water tariff structure.

JICA