APPENDIX A-4-4

Questionnaire Survey for Factories

APPENDIX A-4-4 QUESTIONNAIRE SURVEY IN PATUM THANI AND PRACHATIPAT (INDUSTRIAL)

1 Objective

The door-to-door questionnaire survey was conducted to obtain the basic information on the factories' production conditions, water use patterns, responses to the municipal system and/or their own water sources and willingness for house-connection supply, and covered the area served or unserved by the municipal water supply system aside from that for residents.

2 Survey Area

Four (4) areas were selected for the questionnaire survey taking into account the location of factories as shown in Figure A1-2-1. All areas are at present fully or partially served by the municipal system or by the private water supply system.

3 Survey Item

The form used for the questionnaire survey was originally written by Thai and included the following items.

1. General

    1.1 Name of Company
    1.2 Address
    1.3 Type of Factory
    1.4 Annual Production
    1.5 No. of Present Employees
    1.6 Area of Factory

2. Water Consumption by Usage

    2.1 Washing
    2.2 Cooling
    2.3 Raw Materials
    2.4 Boiling
    2.5 Re-use
    2.6 Others

3. Wastewater Treatment Facility

4. Type of Water Supply

5. Conditions in case of Municipal system

    5.1 Pressure
    5.2 Quantity

6. Other Sources than Municipal System

   6.1 Type of Source
   6.2 Conditions in case of Groundwater

7. Potability

8. Water Quality

   8.1 Municipal System (Color, Smell and Turbidity)
   8.2 Other Sources (Color, Smell and Turbidity)

9. Willingness to Connect to the Municipal System

10. Willingness to Pay for Connection Fee

11. Willingness to Pay for Water Charge

4 Survey Method

The college students were employed as interviewers and engaged in the questionnaire survey after the guidance by the PWA Head Office staff. The survey was conducted to 11, 9, 21 and 15 factories in Ban Klang, Lad Lum Kaeo, the Nava Nakorn Industrial Estate and the FAC-GO Industrial Estate, respectively on September 13, 14 and 17, 1988 under the superintendence of the PWA Head Office staff.

5 Survey Results

The results of the questionnaire survey are summarized in Table A1-5-3.

1) General

A various type of factories such as food processing, chemical products, metal fabrication, machinery, textiles, construction materials, wooden products and others were in operation in the particular areas.

The average number of employees per factory was 165 persons and almost factories in Lad Lum Kaeo and FAC-GO were small with less than 100 employees

Area Name	No. of Employees							
	<50	>50 <100	>100 <200	>200 <500	>500 <1000	>1000	Un-known	Total
Ban Klang	1	4	1	3	1	-	1	11
Lad Lum Kaeo	3	3	3	-	-	-	-	9
Nava Nakhorn	1	6	8	5	-	1	-	21
FAC-GO	10	3	-	-	-	-	2	15
Total	15	16	12	8	1	1	3	56

The average area of factory was approximately 112,100 sq m, however excluding four (4) factories with an area of more than 100,000 sq m, it was 13,700 sq m.

Area Name	Area of Factory (thousand sq m)							
	<2	>2 <5	>5 <10	>10 <50	>50 <100	>100	Un-known	Total
Ban Klang	-	1	1	3	2	1	3	11
Lad Lum Kaeo	-	2	-	3	-	2	2	9
Nava Nakorn	1	3	6	7	-	1	3	21
FAC-GO	6	2	-	-	-	-	7	15
Total	7	8	7	13	2	4	15	56

2) Water Consumption by Usage

Only 6 out of 56 factories gave the breakdown of water consumption by usage. It suggests that it is difficult understand the actual status of water use in the factory.

3) Wastewater Treatment Facility

50.0%, or 28 out of 56 factories had their own wastewater treatment facilities, especially in Ban Klang and the Nava Nakorn Industrial Estate. However, in case of Nava

Nakorn, it may mean that they used the wastewater treatment facilities operated by the Nava Nakorn Co., Ltd, managing the Nava Nakorn Industrial Estate.

4) Type of Water Supply

There was some confusion in the questionnaire survey at the Nava Nakorn Industrial Estate. The factories in this area are at present supplied water by the Nava Nakorn Co., Ltd. of which the water sources are two deep wells. However, some factories answered that they used the municipal system and the others answered that they used the other source managed by the Nava Nakorn Co., Ltd. Such confusions are derived from the difference in interpretation and both the answers are same. Accordingly to distinguish the PWA municipal system from that of Nava Nakorn Co., Ltd, the answer that they used the municipal system were categorized in the other source.

23.2% used the municipal system only, 66.1% other sources than the municipal system and the remaining 10.7% the combination system of the municipal system and other sources.

In other sources, 51.1% or 22 out of 43 other sources were the groundwater only, 23.3% the rain/river water only and the remaining 25.6% the combined water source as shown below.

Area Name	Ban Klang	Lad Lum Kaeo	Nava Nakorn	FAC-GO	Total
Municipal System Only	2	-	-	11	13
Plus Rain/River	1	1	-	3	5
Plus Water Vendor	-	-	-	1	1
Well Only	3	3	16	-	22
Plus Pond/Reservoir	-	-	2	-	2
Plus Water Vendor	-	-	3	-	3
Rain/River Only	5	5	-	-	10
Total	11	9	21	15	56

Though enough information was not obtained from the questionnaire survey, factories in Ban Klang and Lat Lum Kaeo had deep wells with depths ranging between 200 and 400 m.

5) Conditions of Municipal System

Ban Klang and lat Lum Kaeo is supplied water by the PWA Patum Thani Waterworks, while FAC-GO by the PWA Prachatipat Waterworks. The number of users of the municipal system was a few in the former area. In the latter area, the most users had complaints of low pressure, insufficient water, color, smell and turbidity.

6) Conditions of Other Sources

16.3% had a complaint of color, 20.9% of smell and 30.2% of turbidity. Among other sources, the water source for the Nava Nakorn Industrial Estate was comparatively blessed with water quality and only some users had complaints of low pressure, smell and turbidity.

7) Potability

14.3% used its water source for drinking and 17.9% for drinking and not-drinking. However, 60.7% used it for not drinking.

8) Willingness to Connect

The rates of the willingness-to-connect were high in all areas exclusive of FAC-GO already served. 75.0% was willing to connect to the municipal system in Ban Klong, 50.0% in Lat Lum Kaeo and 52.4% in Nava Nakorn in which 42.9% was unknown. Those factories wanted that the connection fee would be less than 5,000 Baht (47.6%) and the water charge less than 10,000 Baht (61.9%), although 38.1% was unknown in both.

Table A1-5-3 Summary of Questionnaire Survey in Patum Thani and Prachatipat (Industry)

AREA / ITEM	Ban Klang	Lad Lum Kaeo	Nava Nakorn	FAC-GO	Total	Rate (%)
No. of Samples	11	9	21	15	56	-
1.General						
1.1 Name of Factory						
1.2 Address						
1.3 Type of Factory						
1.3.1 Food Processing						
1.3.2 Chemical Product						
1.3.3 Metal Fabrication						
1.3.4 Electrical Appliance Parts						
1.3.5 Machinery (Transportation)						
(Others)						
1.3.6 Medical Equipment						
1.3.7 Precision Equipment						
1.3.8 Optical Equipment						
1.3.9 Textiles						
1.3.10 Construction Material						
1.3.11 Wooden Product						
1.3.12 Others						
1.4 Annual Production (mil. Baht)						
Present						
1991						
2001						
2011						
1.5 No. of Employees	2632	776	4908	428	8744	
(No. of Samples)	10	9	21	13	53	
(Average)	263	86	234	33	165	
1.6 Area of Factory (sq m)	437600	558400	1375200	16620	2387820	
(No. of Samples)	8	7	18	8	41	
(Average)	54700	79771	171900	2078	58240	
2. Water Consumption (cu m/mo)						
2.1 Washing	12	13	-	54	79	
2.2 Cooling	-	-	-	-	-	
2.3 Materials	-	43	-	50	93	
2.4 Boiling	-	10	-	-	10	
2.5 Re-use	30	-	-	-	30	
2.6 Others	37	-	-	-	37	
Total	79	66	-	104	249	
(No. of Samples)	1	2		2	5	
3. Wastewater Treatment Facility						
Yes	8	4	13	3	28	50.0
No	2	5	7	12	26	46.4
Unknown	1	-	1	-	2	3.6
4. Type of Water Supply						
Municipal System	2	-	-	11	13	23.2
Combined	1	1	-	4	6	10.7
Other Sources	8	8	21	-	37	66.1

Table A1-5-3 Summary of Questionnaire Survey in Patum Thani and Prachatipat (Industry) (Cont'd)

AREA / ITEM	Ban Klang	Lad Lum Kaeo	Nava Nakorn	FAC-GO	Total	Rate (%)
5. Municipal System						
Pressure						
Low	3	1	-	12	19	65.5
High	-	-	-	1	6	20.7
Unknown	-	-	-	2	4	13.8
Quantity						
Sufficient	1	-	-	6	16	55.2
Not sufficient	2	-	-	9	12	41.4
Unknown	-	1	-	-	1	3.4
6. Other Sources						
Rain/River	6	6		3	15	
Pond/Reservoir			2		2	
Water Vendor			3	1	4	
Groundwater	3	3	21		14	
7. Potability						
Drinking	1	2	3	2	8	14.3
Not drinking	7	3	12	12	34	60.7
Both	2	2	5	1	10	17.9
Unknown	1	2	1	-	4	7.1
8. Water Quality						
8.1 Municipal System						
8.1.1 Color						
Yes	1	1	-	4	6	31.6
No	2	-	-	7	9	47.4
Unknown	-	-	-	4	4	21.0
8.1.2 Smell						
Yes	1	1	-	5	7	36.8
No	1	-	-	5	6	31.6
Unknown	1	-	-	5	6	31.6
8.1.3 Turbidity						
Yes	1	-	-	7	8	42.1
No	2	-	-	6	8	42.1
Unknown	-	1	-	2	3	15.8
8.2 Other Sources						
8.2.1 Color						
Yes	1	4	1	1	7	16.3
No	6	3	14	2	25	58.1
Unknown	2	2	6	1	11	25.6
8.2.2 Smell						
Yes	2	2	4	1	9	20.9
No	5	5	15	2	27	62.8
Unknown	2	2	2	1	7	16.3
8.2.3 Turbidity						
Yes	3	5	4	1	13	30.2
No	5	2	13	2	22	51.2
Unknown	1	2	4	1	8	18.6

Table A1-5-3 Summary of Questionnaire Survey in Patum Thani and Prachatipat (Industry) (Cont'd)

AREA / ITEM	Ban Klang	Lad Lum Kaeo	Nava Nakorn	FAC-GO	Total	Rate (%)
10 Willingness to Connect						
Yes	6	4	11	-	21	56.8
No	2	4	1	-	7	18.9
Unknown	-	-	9	-	9	24.3
11. Willingness to Pay for Connection Fee						
< 2,000 (Baht)	1	2	3	-	6	28.5
2,001 - 3,000	-	1	1	-	2	9.5
3,001 - 5,000	1	-	1	-	2	9.5
5,001 - 7,000	-	1	-	-	1	4.8
7,001 - 10,000	-	-	1	-	1	4.8
10,001 - 15,000	-	-	-	-	-	-
15,001 - 20,000	-	-	1	-	1	4.8
20,000 <	-	-	-	-	-	-
Unknown	4	-	4	-	8	38.1
12. Willingness to Pay for Water Charge						
< 1,000 (Baht/mo)	-	2	1	-	3	14.3
1,001 - 2,000	1	1	1	-	3	14.3
2,001 - 5,000	-	1	2	-	3	14.3
5,001 - 10,000	1	-	3	-	4	19.0
10,001 - 15,000	-	-	-	-	-	-
15,001 - 20,000	-	-	-	-	-	-
20,001 - 30,000	-	-	-	-	-	-
30,001 - 50,000	-	-	-	-	-	-
50,001 -100,000	-	-	-	-	-	-
100,000 <	-	-	-	-	-	-
Unknown	4	-	4	-	8	38.1

APPENDIX A-4-5

Industrial Wastewater from Existing Factories

Table A4-5-1 Existing Industrial Water Consumption

NO.	FACT CODE (a)	CATEG. CODE (b)	SEWAGE WATER DISCHARGE (c)	RATIO TO CAL.OF FRESH WATER (d)	FRESH WATER CONSUMPTION (e)	CODE
1	13	18	35	0.410	14	4.4
2	14	18	250	0.410	103	4.4
3	15	18	12	0.410	5	4.4
4	28	18	20	0.410	8	4.4
5	35	18	3	0.410	1	4.4
6	36	18	300	0.410	123	4.4
7	37	18	90	0.410	37	4.4
8	21	19	1,000	0.410	410	4.4
9	22	19	600	0.410	246	4.4
10	11	20	1,000	0.440	440	4.4
11	12	20	400	0.440	176	4.4
12	16	20	300	0.440	132	4.4
13	18	20	1,200	0.440	528	4.4
14	31	20	800	0.440	352	4.4
15	33	20	1,800	0.440	792	4.4
16	39	20	700	0.440	308	4.4
17	4	20	5	0.440	2	4.7
18	5	20	120	0.440	53	4.7
19	6	20	6,000	0.440	2,640	4.7
20	7	20	900	0.440	396	4.7
21	8	20	2,200	0.440	968	4.7
22	36	21	2,000	3.514	7,028	4.3
23	19	21	30	3.514	105	4.4
24	20	24	1,000	1.135	1,135	4.4
25	17	24	2,000	1.135	2,270	4.4
26	24	24	1,000	1.135	1,135	4.4
27	26	24	2,000	1.135	2,270	4.4
28	27	24	4,000	1.135	4,540	4.4
29	29	24	4,000	1.135	4,540	4.4
30	25	26	10	0.227	2	4.4
31	30	30	30	0.666	20	4.4
32	1	30	270	0.666	180	4.7
33	2	30	20	0.666	13	4.7
34	3	30	80	0.666	53	4.7
35	38	31	200	0.367	73	4.4
36	23		5	1.000	5	4.4
37	32		25	1.000	25	4.4
38	34		5	1.000	5	4.4
		TOTAL	34,410	0.905	31,133	
31	40	NAVA	2,000	1.000	2,000	4.4

APPENDIX A-4-6

Data on Nava Nakorn Industrial Estate

Table A4-6-1 Water Consumption at Naba Nakorn Industrial Estate

No.1

FACTORY CODE	CATEGORY (CODE)	NO.OF EMP. (pers.) (a)	LAND AREA (ha) (b)=(e)*0.16	WATER CONSUMP. (cu m/m) (c)	Q/EMP. (d)/(a)	Q/AREA (d)/(b)	WATER CONSUMP. (cu m/d) (d)=(c)/30	LAND AREA (rai) (e)
1	12	8	0.33	284	1.18	28.69	9.47	2.09
2	20	28	0.31	179	0.21	19.25	5.97	1.95
3	13	35	0.18	2,380	2.27	440.74	79.33	1.12
4	29	23	0.18	9	0.01	1.67	0.30	1.12
5	29	252	0.43	562	0.07	43.57	18.73	2.70
6	30	220	2.53	6,387	0.97	84.15	212.90	15.84
7	20	25	0.36	163	0.22	15.09	5.43	2.22
8	20	30	0.26	215	0.24	27.57	7.17	1.65
9	22	64	0.40	226	0.12	18.83	7.53	2.49
10	17	57	0.54	229	0.13	14.14	7.63	3.37
11	32	5	0.37		0.00	0.00	0.00	2.30
12	17	22	0.37	57	0.09	5.14	1.90	2.33
13	32	745	0.87	1,637	0.07	62.72	54.57	5.46
14	12	60	1.07	1,804	1.00	56.20	60.13	6.71
15	22	293	1.07	1,056	0.12	32.90	35.20	6.70
16	26	33	0.43	426	0.43	33.02	14.20	2.69
17	20	33	0.43	426	0.43	33.02	14.20	2.69
18	31	28	0.85	543	0.65	21.29	18.10	5.34
19	12	41	0.95	4,551	3.70	159.68	151.70	5.92
20	13	60	0.94	2,370	1.32	84.04	79.00	5.85
21	34	75	0.81	788	0.35	32.43	26.27	5.05
22	23	52	0.45	637	0.41	47.18	21.23	2.80
23	23	45	0.45	579	0.43	42.89	19.30	2.80
24	30	73	0.45	462	0.21	34.22	15.40	2.84
25	17	125	0.45	420	0.11	31.11	14.00	2.82
26	29	45	0.49	419	0.31	28.50	13.97	3.05
27	28	135	0.50	1,221	0.30	81.40	40.70	3.10
28	20	18	0.39	139	0.26	11.88	4.63	2.45
29	30	620	1.63	9,829	0.53	201.00	327.63	10.17
30	28	282	0.40	1,350	0.16	112.50	45.00	2.53
31	17	140	0.40	956	0.23	79.67	31.87	2.53
32	20	7	0.46	132	0.63	9.57	4.40	2.85
33	20	25	5.45	133	0.18	0.81	4.43	34.04
34	15	360	0.51	1,878	0.17	122.75	62.60	3.17
35	13	120	0.48	1,145	0.32	79.52	38.17	3.00
36	20	19	0.41	88	0.15	7.15	2.93	2.57
37	25	67	0.39	641	0.32	54.79	21.37	2.43
38	30	40	0.40	253	0.21	21.08	8.43	2.51
39	17	361	0.38	1,310	0.12	114.91	43.67	2.40
40	26	398	3.69	10,239	0.86	92.49	341.30	23.09
41	20	20	0.15	135	0.23	30.00	4.50	0.94
42	26	50	0.15	62	0.04	13.78	2.07	0.93
43	14	250	0.45	388	0.05	28.74	12.93	2.81
44	31	40	0.45	1,753	1.46	129.85	58.43	2.81
45	22	42	0.45	497	0.39	36.82	16.57	2.79
46	12	20	0.22	220	0.37	33.33	7.33	1.40
47	22	20	0.21	135	0.23	21.43	4.50	1.31
48	12	37	0.51	1,278	1.15	83.53	42.60	3.16
49	12	55	0.49	782	0.47	53.20	26.07	3.08
50	14	72	0.22	758	0.35	114.85	25.27	1.39
51	14	107	0.26	558	0.17	71.54	18.60	1.62
52	13		0.25			0.00	0.00	1.54
53	32	420	0.32	771	0.06	80.31	25.70	1.97
54	20	20	0.32	195	0.33	20.31	6.50	1.97

Table A4-6-1 Water Consumption at Naba Nakorn Industrial Estate (cont'd)

No. 2

FACTORY CODE	CATEGORY (CODE)	NO.OF EMP. (pers.) (a)	LAND AREA (ha) (b)=(e)*0.16	WATER CONSUMP. (cu m/m) (c)	Q/EMP. (d)/(a)	Q/AREA (d)/(b)	WATER CONSUMP. (cu m/d) (d)=(c)/30	LAND AREA (rai) (e)
55	20	14,700	3.58	4,988	0.01	46.44	166.27	22.40
56	30	130	3.44	1,624	0.42	15.74	54.13	21.52
57	30	1,025	6.90	5,871	0.19	28.36	195.70	43.10
58	18	250	0.68	2,728	0.36	133.73	90.93	4.22
59	31	90	0.73	1,085	0.40	49.54	36.17	4.59
60	18	20	0.73	188	0.31	8.59	6.27	4.59
61	20	80	1.48	2,628	1.10	59.19	87.60	9.22
62	25	133	7.80	7,256	1.82	31.01	241.87	48.75
63	14		0.99	307		10.34	10.23	6.20
64		170	1.17	720	0.14	20.51	24.00	7.31
65	31	460	1.92	4,875	0.35	84.64	162.50	12.00
66	20	107	2.55	7,715	2.40	100.85	257.17	15.93
67	17	120	0.95	579	0.16	20.32	19.30	5.93
68		30	0.77	230	0.26	9.96	7.67	4.81
69	23	500	0.40	1,047	0.07	87.25	34.90	2.47
70		30	0.42	925	1.03	73.41	30.83	2.62
71	22	12	0.57	89	0.25	5.21	2.97	3.58
72	27	103	0.77	2,280	0.74	98.70	76.00	4.81
73	20	30	0.43	173	0.19	13.41	5.77	2.71
74	25		1.08	3,206		98.95	106.87	6.78
75	15	250	0.44	481	0.06	36.44	16.03	2.78
76	23		0.39			0.00	0.00	2.43
77	15	240	0.81	325	0.05	13.37	10.83	5.09
78			0.39			0.00	0.00	2.44
79	18	190	5.10	1,395	0.25	9.12	46.50	31.88
80	34	433	0.42	1,430	0.11	113.49	47.67	2.65
81	22	21	0.42	194	0.31	15.40	6.47	2.65
82	30	1,100	0.86	12,032	0.37	466.36	401.07	5.37
83	29	30	0.40	115	0.13	9.58	3.83	2.47
84	30	150	0.44	519	0.12	39.32	17.30	2.78
85	24	380	0.44	2,672	0.23	202.43	89.07	2.74
86	24	480	0.44	1,374	0.10	104.09	45.80	2.74
87	34	1,073	0.88	2,785	0.09	105.49	92.83	5.48
88	20	80	0.44	808	0.34	61.21	26.93	2.74
89	30	12	0.44	165	0.46	12.50	5.50	2.74
90	32	780	1.34	1,491	0.06	37.09	49.70	8.35
91	20		0.44			0.00	0.00	2.72
92	26	290	9.97	3,339	0.38	11.16	111.30	62.34
93	28	70	0.81	3,306	1.57	136.05	110.20	5.05
94	23	800	0.57	787	0.03	46.02	26.23	3.56
95	14	30	0.51	132	0.15	8.63	4.40	3.20
96	22		0.51			0.00	0.00	3.20
97	20		1.09			0.00	0.00	6.80
98	23	70	1.13	422	0.20	12.45	14.07	7.05
99	12	85	0.77	1,261	0.50	54.59	42.03	4.80
100	20	31	0.67	270	0.29	13.43	9.00	4.20
101	28		0.74			0.00	0.00	4.62
102	20	25	0.38	386	0.52	33.86	12.87	2.40
103	30	360	3.22	150	0.01	1.55	5.00	20.11
104	13	40	10.08	100	0.08	0.33	3.33	63.00
105	27	500	24.14	3,771	0.25	5.21	125.70	150.87
106	30	55	3.22	1,547	0.94	16.02	51.57	20.11
107	34	75	1.60	605	0.27	12.60	20.17	10.00
108	32	100	1.60		0.00	0.00	0.00	10.00
109			0.40	453		37.75	15.10	2.50

Table A4-6-1 Water Consumption at Naba Nakorn Industrial Estate (cont'd)

No. 3

FACTORY CODE	CATEGORY (CODE)	NO.OF EMP. (pers.) (a)	LAND AREA (ha) (b)=(e)*0.16	WATER CONSUMP. (cu m/m) (c)	Q/EMP. (d)/(a)	Q/AREA (d)/(b)	WATER CONSUMP. (cu m/d) (d)=(c)/30	LAND AREA (rai) (e)
110	34	120	0.40	269	0.08	22.42	8.97	2.50
111	34	123	3.25	446	0.12	4.57	14.87	20.31
112	30	800	0.40	2,321	0.10	193.42	77.37	2.47
113	23	30	0.40	131	0.15	10.92	4.37	2.50
114	28		0.40			0.00	0.00	2.50
115	12	80	0.40	300	0.13	25.00	10.00	2.50
116	15	60	0.40	3,333	1.85	277.75	111.10	2.50
117	15	60	0.40	223	0.12	18.58	7.43	2.50
118	18	180	0.80	437	0.08	18.21	14.57	5.00
119	32	75	1.60	234	0.10	4.88	7.80	10.00
120	30		0.80			0.00	0.00	4.97
121		35	0.80	529	0.50	22.04	17.63	5.00
122	25	500	0.80	1,315	0.09	54.79	43.83	5.00
123	23		0.80	1,534		63.92	51.13	5.00
124			1.60	1,063		22.15	35.43	10.00
125			1.60			0.00	0.00	10.00
126	30		0.80	699		29.13	23.30	4.97
127	17		1.03	199		6.44	6.63	6.44
128	18	280	2.35	1,641	0.20	23.28	54.70	14.67
129	31		2.35			0.00	0.00	14.70
130	34	220	4.70	2,067	0.31	14.66	68.90	29.40
131	31		2.35			0.00	0.00	14.70
132	34	150	1.96	586	0.13	9.97	19.53	12.25
133	22	50	1.80	751	0.50	13.91	25.03	11.26
134			13.12			0.00	0.00	82.03
135	30	450	3.12	1,510	0.11	16.13	50.33	19.47
136	31		1.55	328		7.05	10.93	9.69
137	30		7.00			0.00	0.00	43.72
138	30		7.19			0.00	0.00	44.93
139	32	113	3.25	480	0.14	4.92	16.00	20.33
140	27	240	1.47	723	0.10	16.40	24.10	9.21
141	30	48	1.44	300	0.21	6.94	10.00	9.00
142	20	50	1.44	500	0.33	11.57	16.67	9.00
143	30		2.88	740		8.57	24.67	17.97
144	30	200	2.96		0.00	0.00	0.00	18.47
145	30	407	1.18		0.00	0.00	0.00	7.40
146	30	167	1.18	810	0.16	22.88	27.00	7.40
147	34	150	2.96		0.00	0.00	0.00	18.50
148	28	229	2.84		0.00	0.00	0.00	17.75
149			8.47			0.00	0.00	52.92
150	27	200	4.57		0.00	0.00	0.00	28.56
151			12.54			0.00	0.00	78.40
152			0.83			0.00	0.00	5.20
153			0.40			0.00	0.00	2.50
154	30		0.40			0.00	0.00	2.50
155			0.48			0.00	0.00	3.00
156	22	22	0.48	72	0.11	5.00	2.40	2.97
157			2.93			0.00	0.00	18.30
158	23		2.35	1,594		22.61	53.13	14.66
159			13.42			0.00	0.00	83.88
160	32	450	7.40		0.00	0.00	0.00	46.27
161	32		1.52			0.00	0.00	9.50
162	32	300	6.15		0.00	0.00	0.00	38.46
163	32	60	1.86	623	0.35	11.17	20.77	11.60
164	27		2.71			0.00	0.00	16.92

Table A4-6-1 Water Consumption at Naba Nakorn Industrial Estate (cont'd)

No. 4

FACTORY CODE	CATEGORY (CODE)	NO.OF EMP. (pers.) (a)	LAND AREA (ha) (b)=(e)*0.16	WATER CONSUMP. (cu m/m) (c)	Q/EMP. (d)/(a)	Q/AREA (d)/(b)	WATER CONSUMP. (cu m/d) (d)=(c)/30	LAND AREA (rai) (e)
165	30	440	6.40		0.00	0.00	0.00	40.00
166			7.12			0.00	0.00	44.48
167			0.80			0.00	0.00	5.00
168	20		0.95			0.00	0.00	5.96
169	20	30	0.80		0.00	0.00	0.00	5.00
170			1.03			0.00	0.00	6.46
171	30	230	3.30		0.00	0.00	0.00	20.60
172	32		0.85			0.00	0.00	5.30
173			1.17			0.00	0.00	7.30
174			5.58			0.00	0.00	34.89
175			1.31			0.00	0.00	8.20
176			1.56			0.00	0.00	9.76
		38,511.00	331.91	180,242.00	0.16	18.10	6,008.07	2,074.46

APPENDIX A-6-1

Construction Unit Cost

Unit Cost

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cost)	Pavement	Total 2
Pipeline									
	(**********		P W A 's	Unit Rate	(1987)	**********			)
a. A/C Pipe(Normal Tytpe)		(25%)							
100 mm	85	21	56	162	6	35	224	140	364
150 mm	142	36	77	255	11	56	353	154	507
200 mm	255	64	90	409	19	90	569	166	735
250 mm	352	88	126	566	29	125	792	179	971
300 mm	507	127	167	801	40	177	1119	223	1342
400 mm	970	243	248	1461	80	324	2050	248	2298
500 mm	1362	341	278	1981	132	444	2812	283	3095
600 mm	1761	440	354	2555	161	570	3615	319	3934
b. Steel Pipe		(35%)							
150 mm	545	191	99	835	12	178	1127	140	1267
200 mm	720	252	111	1083	22	232	1471	154	1625
250 mm	1080	378	153	1611	38	346	2195	166	2361
300 mm	1330	465	202	1998	58	432	2736	179	2915
400 mm	1420	497	250	2167	80	472	2991	223	3214
500 mm	1785	625	361	2771	160	615	3901	248	4149
600 mm	2140	749	468	3357	264	760	4820	283	5103
700 mm	2495	873	582	3950	322	897	5686	319	6005

Unit Cost

For Transmission Pipeline (Transportation < 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1	Pavement (w/10%cont)	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
	(****** Unit Rate Based on Pipe Material Cost as of December,1988								******)			
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	7	41	261	153	414	364	1.14	410
150 mm	189	19	87	295	12	64	408	168	577	507	1.14	580
200 mm	328	33	101	462	21	101	643	181	824	735	1.12	820
250 mm	454	45	142	641	32	141	895	196	1091	971	1.12	1,090
300 mm	643	64	188	895	44	197	1249	244	1493	1342	1.11	1,490
400 mm	1217	122	279	1618	87	358	2270	271	2541	2298	1.11	2,540
500 mm	1699	170	313	2182	144	488	3096	309	3405	3095	1.10	3,410
600 mm	2187	219	398	2804	176	626	3967	349	4315	3934	1.10	4,320
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	13	159	1008	168	1176	1267	0.93	1,270
200 mm	908	136	125	1168	24	250	1587	181	1769	1625	1.09	1,770
250 mm	1210	182	172	1564	42	337	2135	196	2332	2361	0.99	2,360
300 mm	1507	226	227	1960	63	425	2693	244	2937	2915	1.01	2,940
400 mm	1887	283	281	2451	87	533	3378	271	3649	3214	1.14	3,650
500 mm	2261	339	406	3006	175	668	4233	309	4542	4149	1.09	4,540
600 mm	2723	408	526	3657	288	829	5252	349	5600	5103	1.10	5,600
700 mm	3179	477	655	4311	352	979	6206	407	6612	6005	1.10	6,610
800 mm	4527	679	932	6138	460	1385	8781	465	9246			9,250
900 mm	5104	766	1051	6921	582	1575	9986	523	10508			10,510
1000 mm	6804	1021	1401	9225	718	2088	13234	581	13815			13,820
1100 mm	7926	1189	1632	10746	869	2439	15460	639	16099			16,100
1200 mm	9048	1357	1863	12268	1034	2793	17705	697	18402			18,400
1350 mm	11000	1650	2265	14915	1309	3407	21594	784	22378			22,380
1500 mm	12953	1943	2667	17563	1616	4027	25526	871	26398			26,400

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation < 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
	(****** Unit Rate Based on Pipe Material Cost as of December,1988								******)			
a. A/C Pipe (Class 20 Normal type)		(25 %)										
100 mm	115	29	63	207	7	45	284	153	437	364	1.20	440
150 mm	189	47	87	323	12	70	446	168	614	507	1.21	610
200 mm	328	82	101	511	21	112	708	181	890	735	1.21	890
250 mm	454	113	142	709	32	155	986	196	1181	971	1.22	1,180
300 mm	643	161	188	991	44	217	1378	244	1621	1342	1.21	1,620
400 mm	1217	304	279	1801	87	397	2513	271	2784	2298	1.21	2,780
500 mm	1699	425	313	2437	144	542	3435	309	3744	3095	1.21	3,740
600 mm	2187	547	398	3132	176	695	4403	349	4752	3934	1.21	4,750
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	13	182	1154	168	1322	1267	1.04	1,320
200 mm	908	318	125	1350	24	289	1829	181	2010	1625	1.24	2,010
250 mm	1210	424	172	1806	42	388	2459	196	2654	2361	1.12	2,650
300 mm	1507	527	227	2262	63	488	3095	244	3338	2915	1.15	3,340
400 mm	1887	660	281	2828	87	612	3880	271	4151	3214	1.29	4,150
500 mm	2261	791	406	3458	175	763	4835	309	5144	4149	1.24	5,140
600 mm	2723	953	526	4202	288	943	5977	349	6325	5103	1.24	6,330
700 mm	3179	1113	655	4946	352	1113	7052	407	7459	6005	1.24	7,460
800 mm	4527	1584	932	7043	460	1576	9986	465	10451			10,450
900 mm	5104	1786	1051	7941	582	1790	11344	523	11867			11,870
1000 mm	6804	2381	1401	10586	718	2374	15045	581	15626			15,630
1100 mm	7926	2774	1632	12332	869	2772	17570	639	18209			18,210
1200 mm	9048	3167	1863	14077	1034	3173	20113	697	20810			20,810
1350 mm	11000	3850	2265	17115	1309	3869	24522	784	25307			25,310
1500 mm	12953	4533	2667	20153	1616	4571	28974	871	29846			29,850

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Transmission Pipeline (Transportation >= 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (>=800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
(****** Unit Rate Based on Pipe Material Cost as of December,1988 ******)												
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	13	43	270	153	423	364	1.16	420
150 mm	189	19	87	295	24	67	424	168	593	507	1.17	590
200 mm	328	33	101	462	42	106	670	181	852	735	1.16	850
250 mm	454	45	142	641	63	148	937	196	1133	971	1.17	1,130
300 mm	643	64	180	895	87	206	1308	244	1551	1342	1.16	1,550
400 mm	1217	122	279	1618	175	377	2387	271	2658	2298	1.16	2,660
500 mm	1699	170	313	2182	288	519	3288	309	3597	3095	1.16	3,600
600 mm	2187	219	398	2804	352	663	4201	349	4549	3934	1.16	4,550
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	26	162	1025	168	1193	1267	0.94	1,270
200 mm	908	136	125	1168	48	255	1619	181	1801	1625	1.11	1,800
250 mm	1210	182	172	1564	83	346	2192	196	2387	2361	1.01	2,390
300 mm	1507	226	227	1960	127	438	2778	244	3022	2915	1.04	3,020
400 mm	1887	283	281	2451	175	551	3495	271	3766	3214	1.17	3,770
500 mm	2261	339	406	3006	350	705	4466	309	4775	4149	1.15	4,780
600 mm	2723	408	526	3657	577	889	5636	349	5984	5103	1.17	5,980
700 mm	3179	477	655	4311	704	1053	6674	407	7081	6005	1.18	7,080
800 mm	4527	679	932	6138	919	1482	9393	465	9857			9,860
900 mm	5104	766	1051	6921	1163	1698	10760	523	11283			11,280
1000 mm	6804	1021	1401	9225	1436	2239	14190	581	14771			14,770
1100 mm	7926	1189	1632	10746	1738	2622	16616	639	17256			17,260
1200 mm	9048	1357	1863	12268	2068	3011	19081	697	19778			19,780
1350 mm	11000	1650	2265	14915	2617	3682	23336	784	24120			24,120
1500 mm	12953	1943	2667	17563	3231	4367	27677	871	28548			28,550

Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation >= 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (>=800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
(****** Unit Rate Based on Pipe Material Cost as of December,1988 *******												
a. A/C Pipe (Class 20 Normal type)		(25 %)										
100 mm	115	29	63	207	13	46	293	153	446	364	1.23	450
150 mm	189	47	87	323	24	73	462	168	630	507	1.24	630
200 mm	328	82	101	511	42	116	736	181	917	735	1.25	920
250 mm	454	113	142	709	63	162	1028	196	1223	971	1.26	1,220
300 mm	643	161	188	991	87	227	1436	244	1680	1342	1.25	1,680
400 mm	1217	304	279	1801	175	415	2630	271	2901	2298	1.26	2,900
500 mm	1699	425	313	2437	288	572	3627	309	3936	3095	1.27	3,940
600 mm	2187	547	398	3132	352	732	4637	349	4986	3934	1.27	4,990
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	26	185	1171	168	1340	1267	1.06	1,340
200 mm	908	318	125	1350	48	294	1861	181	2042	1625	1.26	2,040
250 mm	1210	424	172	1806	83	397	2514	196	2709	2361	1.15	2,710
300 mm	1507	527	227	2262	127	502	3179	244	3423	2915	1.17	3,420
400 mm	1887	660	281	2828	175	631	3997	271	4268	3214	1.33	4,270
500 mm	2261	791	406	3458	350	800	5068	309	5377	4149	1.30	5,380
600 mm	2723	953	526	4202	577	1004	6361	349	6709	5103	1.31	6,710
700 mm	3179	1113	655	4946	704	1187	7520	407	7927	6005	1.32	7,930
800 mm	4527	1584	932	7043	919	1672	10598	465	11062			11,060
900 mm	5104	1786	1051	7941	1163	1912	12118	523	12641			12,640
1000 mm	6804	2381	1401	10586	1436	2525	16001	581	16582			16,580
1100 mm	7926	2774	1632	12332	1738	2955	18726	639	19365			19,370
1200 mm	9048	3167	1863	14077	2068	3391	21490	697	22187			22,190
1350 mm	11000	3850	2265	17115	2617	4144	26264	784	27049			27,050
1500 mm	12953	4533	2667	20153	3231	4911	31125	871	31996			32,000

Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

Construction Works	Price in 3 Lowest Tenders (1988) (A)	Estimated Cost (A)*1.35	PWA's Unit Cost (for 1987)	Adopted Cost (1988)
Concrete Work (incl.Form Work,Scafolding)	Baht 2,200 /cu m	Baht 2,970 /cu m	-	
Re-Bar	Baht 18 /kg	Baht 24 /kg	-	
Unit Concrete Cost (incl.Form Work,Scafolding, Re-Bar(100kg/cu m concrete))		Baht 5,370 /cu m	-	5,400
Earth Work				
Excavation (with Backfill)	55 /cu m	79 /cu m	-	80
Soil Fill	53 /cu m	76		120 (From PWA Cost)
Architectural Works				
Administration Bldg.	4,516 /sq m	6,451 /sq m		
Head Quarter Bldg.	3,612	5,160		5,000
Chlorination House	Baht 2,830 /sq m	Baht 4,043 /sq m	3610 - 4300	3,800
Pump House (excl.pump pit)	Baht 1,860 /sq m	Baht 2,657 /sq m	3540 - 4200	3,600

Unit Cost

Construction Works	PWA's Cost (for 1987) (Baht 1000)	Unit Cost (Baht/cu m/h) (A)	Estimated Cost (for 1989) (A)*1.30	Adopted Cost (1988)
Treatment Facilities			Unit Cost (Baht/cu m/h)	Unit Cost (Baht/cu m/h)
Sedimentation Basin				
50 cu m/hr	1,310	26,200	34,100	34,000
100 cu m/hr	1,633	16,330	21,200	21,000
200 cu m/hr	3,136	15,680	20,400	20,000
250 cu m/hr	5,133	20,532	26,700	27,000
500 cu m/hr	7,708	15,416	20,000	20,000
1000 cu m/hr	17,723	17,723	23,000	23,000
Filters				
50 cu m/hr	588	11,760	15,300	15,000
100 cu m/hr	1,044	10,440	13,600	14,000
200 cu m/hr	2,227	11,135	14,500	15,000
250 cu m/hr	2,337	9,348	12,200	12,000
500 cu m/hr	4,674	9,348	12,200	12,000
1000 cu m/hr	11,356	11,356	14,800	15,000
Clear Water Reservoir			Unit Cost (Baht/cu m)	Unit Cost (Baht/cu m)
500 cu m	887	1,774	2,300	2,300
1000 cu m	1,628	1,628	2,100	2,100
1500 cu m	2,699	1,799	2,300	2,300
2000 cu m	2,803	1,402	1,800	1,800
2250 cu m	3,282	1,459	1,900	1,900
3000 cu m	6,633	2,211	2,900	2,900
3300 cu m	6,603	2,001	2,600	2,600
4000 cu m	7,730	1,933	2,500	2,500
5800 cu m	10,809	1,864	2,400	2,400
Elevated Tank			Cost (Baht 1000)	Cost (Baht 1000)
50 cu m	722		940	900
120 cu m	1,146		1,490	1,500
250 cu m	1,394		1,810	1,800

APPENDIX A-8-1

Details of Water Demand Prediction

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Population in Service Area by Tambon																						
Amphor Tambon Class																						
1 Muang																						
1 Med	0	0	0	0	0	9,498	10,056	10,614	11,173	11,731	12,290	12,848	13,304	13,759	14,215	14,670	15,126	15,582	16,037	16,493	16,948	17,404
2 Med	0	0	0	0	0	5,807	6,148	6,489	6,830	7,170	7,511	7,852	8,130	8,408	8,687	8,965	9,243	9,521	9,799	10,077	10,355	10,633
3 Med	0	0	0	0	0	3,183	3,299	3,415	3,531	3,647	3,763	3,879	3,980	4,081	4,182	4,283	4,384	4,485	4,586	4,687	4,788	4,889
4 Med	0	0	0	0	0	6,117	6,454	6,791	7,127	7,464	7,800	8,137	8,414	8,692	8,969	9,247	9,524	9,802	10,079	10,357	10,634	10,912
5 Med	0	0	0	0	0	1,829	1,896	1,963	2,030	2,096	2,163	2,230	2,288	2,346	2,404	2,462	2,520	2,578	2,636	2,694	2,752	2,810
6 Med	0	0	0	0	0	3,232	3,350	3,468	3,585	3,703	3,820	3,938	4,041	4,143	4,246	4,348	4,451	4,554	4,656	4,759	4,861	4,964
7 Med	0	0	0	0	0	5,447	5,788	6,129	6,471	6,812	7,154	7,495	7,771	8,046	8,322	8,597	8,873	9,149	9,425	9,700	9,976	10,252
8 Med	0	0	0	0	0	4,454	4,627	4,790	4,953	5,115	5,278	5,441	5,583	5,724	5,866	6,007	6,149	6,291	6,433	6,574	6,716	6,858
9 Med	0	0	0	0	0	5,391	5,706	6,021	6,336	6,651	6,966	7,281	7,538	7,795	8,053	8,310	8,567	8,824	9,081	9,339	9,596	9,853
10 Med	2,667	2,864	3,061	3,258	3,454	3,651	3,848	4,112	4,377	4,641	4,906	5,170	5,378	5,585	5,793	6,000	6,208	6,416	6,624	6,831	7,039	7,247
11 Med	1,984	2,131	2,278	2,425	2,572	2,719	2,866	3,064	3,261	3,459	3,656	3,854	4,009	4,165	4,320	4,476	4,631	4,786	4,941	5,097	5,252	5,407
12 Hi	15,578	16,091	16,604	17,116	17,629	18,141	18,654	19,248	19,842	20,437	21,031	21,625	22,148	22,672	23,195	23,719	24,242	24,765	25,289	25,812	26,336	26,859
14 Med	0	842	2,169	3,497	4,824	6,152	7,479	7,882	8,285	8,687	9,090	9,493	9,823	10,154	10,484	10,815	11,145	11,475	11,806	12,136	12,467	12,797
2 San Kok																						
1 Low	0	0	0	0	0	0	0	596	1,192	1,787	2,383	2,979	3,010	3,042	3,073	3,105	3,136	3,167	3,199	3,230	3,262	3,293
2 Low	0	0	0	0	0	0	0	386	772	1,158	1,544	1,930	1,950	1,971	1,991	2,012	2,032	2,052	2,072	2,093	2,113	2,133
3 Low	0	0	0	0	0	0	0	373	746	1,120	1,493	1,866	1,886	1,905	1,925	1,944	1,964	1,984	2,003	2,023	2,042	2,062
5 Low	908	919	930	941	951	962	973	984	996	1,007	1,018	1,030	1,041	1,052	1,062	1,073	1,084	1,095	1,106	1,116	1,127	1,138
6 Low	1,376	1,392	1,408	1,425	1,441	1,458	1,474	1,491	1,508	1,526	1,543	1,560	1,576	1,593	1,609	1,626	1,642	1,658	1,675	1,691	1,708	1,724
7 Low	2,018	2,042	2,066	2,090	2,113	2,137	2,161	2,186	2,212	2,237	2,263	2,288	2,312	2,336	2,360	2,384	2,408	2,432	2,456	2,480	2,504	2,528
8 Med	6,564	6,631	6,698	6,766	6,833	6,901	6,968	7,039	7,109	7,180	7,250	7,321	7,389	7,456	7,524	7,591	7,659	7,727	7,794	7,862	7,929	7,997
3 Lad Lum Kaeo																						
1 Low	0	0	0	0	0	0	0	881	1,763	2,644	3,526	4,407	4,511	4,615	4,718	4,822	4,926	5,030	5,134	5,237	5,341	5,445
3 Low	0	0	0	0	0	0	0	438	876	1,315	1,753	2,191	2,243	2,294	2,346	2,397	2,449	2,501	2,552	2,604	2,655	2,707
5 Low	0	0	0	0	0	0	0	553	1,106	1,658	2,211	2,764	2,787	2,811	2,834	2,858	2,881	2,904	2,927	2,951	2,974	2,997
4 Thanyaburi																						
1 Hi	43,205	46,321	49,437	52,553	55,668	58,784	61,900	66,054	70,227	74,391	78,554	82,718	86,003	89,288	92,572	95,857	99,142	102,427	105,711	108,996	112,280	115,565
2 Med	0	4,787	5,292	5,797	6,303	6,808	7,313	8,085	8,857	9,630	10,402	11,174	11,726	12,283	12,837	13,392	13,946	14,501	15,055	15,610	16,164	16,719
3 & 4 Med	16,172	16,802	17,432	18,063	18,693	19,324	19,954	20,702	21,451	22,199	22,948	23,696	24,343	24,990	25,636	26,283	26,930	27,576	28,223	28,869	29,516	30,162
5 Lam Luka																						
1 Med	22,164	23,957	25,750	27,543	29,335	31,128	32,921	35,385	37,848	40,312	42,775	45,239	47,143	49,048	50,952	52,857	54,761	56,665	58,570	60,474	62,379	64,283
2 Med	0	0	1,419	2,839	4,258	5,678	7,097	7,647	8,197	8,748	9,298	9,848	10,278	10,693	11,115	11,538	11,960	12,382	12,805	13,227	13,650	14,072
3 Med	0	0	0	0	0	0	0	2,256	4,512	6,769	9,025	11,281	11,536	11,791	12,045	12,300	12,555	12,809	13,064	13,318	13,573	13,827
4 Med	0	0	0	0	0	0	0	2,191	4,382	6,574	8,765	10,956	11,203	11,450	11,698	11,945	12,192	12,439	12,686	12,934	13,181	13,428
6 Khlong Luang																						
1 Med	0	0	14,032	28,064	42,097	56,129	70,161	75,666	81,171	86,676	92,181	97,686	99,045	100,404	101,764	103,123	104,482	105,841	107,200	108,558	109,917	111,276
2 Med	0	0	0	0	0	0	0	1,892	3,784	5,676	7,568	9,460	9,757	10,054	10,351	10,648	10,945	11,242	11,539	11,836	12,133	12,430
3 Med	0	0	0	0	0	0	0	888	1,777	2,665	3,554	4,442	4,522	4,601	4,681	4,760	4,840	4,920	4,999	5,079	5,158	5,238
Total	112,636	124,779	140,577	172,375	196,173	264,940	291,093	319,690	348,287	376,885	405,482	434,079	446,663	459,246	471,830	484,413	496,997	509,579	522,162	534,744	547,327	559,909

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Service Ratio (%)																						
Amphor Tambon																						
1 Muang																						
1 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
2 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
3 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
4 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
5 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
6 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
7 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
8 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
9 Med	0	5	6	7	8	9	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
10 Med	0	10	12	14	16	18	20	21	22	23	24	25	28	31	34	37	40	44	48	52	56	60
11 Med	0	10	12	14	16	18	20	21	22	23	24	25	28	31	34	37	40	44	48	52	56	60
12 Hi	60	60	62	63	65	66	68	69	71	72	74	75	77	78	80	81	83	84	86	87	89	90
14 Med	0	0	2	4	6	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
2 Sam Nok																						
1 Low	0	0	0	0	0	0	0	4	8	12	16	20	23	26	29	32	35	38	41	44	47	50
2 Low	0	0	0	0	0	0	0	4	8	12	16	20	23	26	29	32	35	38	41	44	47	50
3 Low	0	0	0	0	0	0	0	4	8	12	16	20	23	26	29	32	35	38	41	44	47	50
5 Low	10	12	14	15	17	18	20	20	20	20	20	20	23	26	29	32	35	38	41	44	47	50
6 Low	10	12	14	15	17	18	20	22	24	26	28	30	31	32	33	34	35	38	41	44	47	50
7 Low	10	12	14	15	17	18	20	22	24	26	28	30	31	32	33	34	35	38	41	44	47	50
8 Med	10	12	14	15	17	18	20	22	24	26	28	30	31	32	33	34	35	40	45	50	55	60
3 Lad Lum Kaeo																						
1 Low	0	0	0	0	0	0	0	0	0	0	10	20	23	26	29	32	35	38	41	44	47	50
3 Low	0	0	0	0	0	0	0	0	0	0	10	20	23	26	29	32	35	38	41	44	47	50
6 Low	0	0	0	0	0	0	0	0	0	0	10	20	23	26	29	32	35	38	41	44	47	50
4 Thanyaburi																						
1 Hi	40	40	43	45	48	50	53	55	58	60	63	65	68	70	73	75	78	80	83	85	88	90
2 Med	0	0	0	0	0	5	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
3 & 4 Med	10	10	13	16	19	22	25	26	27	28	29	30	32	34	36	38	40	44	48	52	56	60
5 Lam Luta																						
1 Med	50	50	51	51	52	52	53	53	54	54	55	55	56	56	57	57	58	58	59	59	60	60
2 Med	0	0	2	4	6	8	10	13	16	19	22	25	28	31	34	37	40	44	48	52	56	60
3 Med	0	0	0	0	0	0	0	5	10	15	20	25	28	31	34	37	40	44	48	52	56	60
4 Med	0	0	0	0	0	0	0	5	10	15	20	25	28	31	34	37	40	44	48	52	56	60
6 Khlong Luang																						
1 Med	0	0	6	12	18	24	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
2 Med	0	0	0	0	0	0	0	5	10	15	20	25	28	31	34	37	40	44	48	52	56	60
3 Med	0	0	0	0	0	0	0	5	10	15	20	25	28	31	34	37	40	44	48	52	56	60

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Served Population by Tambon																						
Amphor Tambon																						
1 Muang																						
Zone 6 1 Med	0	0	0	0	0	475	1,006	1,380	1,788	2,229	2,704	3,212	3,725	4,266	4,833	5,428	6,050	6,856	7,698	8,576	9,491	10,442
Zone 6 2 Med	0	0	0	0	0	298	615	844	1,093	1,362	1,652	1,963	2,276	2,607	2,953	3,317	3,697	4,189	4,704	5,240	5,799	6,380
Zone 5 3 Med	0	0	0	0	0	159	330	444	585	693	828	970	1,114	1,265	1,422	1,585	1,754	1,973	2,201	2,437	2,681	2,933
Zone 6 4 Med	0	0	0	0	0	306	645	883	1,140	1,418	1,716	2,034	2,356	2,694	3,050	3,421	3,810	4,313	4,838	5,386	5,955	6,547
Zone 6 5 Med	0	0	0	0	0	91	190	256	325	398	476	558	641	727	817	911	1,008	1,134	1,265	1,401	1,541	1,686
Zone 5 6 Med	0	0	0	0	0	162	335	451	574	704	840	985	1,131	1,284	1,444	1,609	1,780	2,004	2,235	2,475	2,722	2,978
Zone 6 7 Med	0	0	0	0	0	272	579	797	1,035	1,294	1,574	1,874	2,176	2,494	2,829	3,181	3,549	4,025	4,524	5,044	5,587	6,151
Zone 6 8 Med	0	0	0	0	0	223	463	623	792	972	1,161	1,360	1,563	1,775	1,994	2,223	2,460	2,788	3,088	3,419	3,761	4,115
Zone 7 9 Med	0	0	0	0	0	485	571	783	1,014	1,264	1,533	1,820	2,111	2,417	2,738	3,075	3,427	3,883	4,359	4,856	5,374	5,912
Zone 7 10 Med	0	286	367	456	553	657	770	864	963	1,067	1,177	1,293	1,506	1,731	1,970	2,220	2,483	2,823	3,179	3,552	3,942	4,348
Zone 7 11 Med	0	213	273	340	412	489	573	643	717	796	878	964	1,123	1,291	1,469	1,656	1,852	2,106	2,372	2,650	2,941	3,244
Zone 7 12 Hi	9,347	9,655	10,226	10,817	11,423	12,046	12,685	13,358	14,048	14,755	15,479	16,219	16,966	17,729	18,510	19,307	20,121	20,902	21,698	22,508	23,333	24,173
Zone 7 14 Med	0	0	43	140	289	308	748	1,025	1,326	1,651	2,000	2,373	2,751	3,148	3,565	4,001	4,458	5,049	5,667	6,311	6,981	7,678
2 Sam Kok																						
Zone 5 1 Low	0	0	0	0	0	0	0	24	95	214	381	596	692	791	891	993	1,098	1,204	1,312	1,421	1,533	1,647
Zone 5 2 Low	0	0	0	0	0	0	0	15	62	139	247	386	449	512	577	644	711	780	850	921	995	1,067
Zone 5 3 Low	0	0	0	0	0	0	0	15	60	134	239	373	434	495	558	622	687	754	821	890	960	1,031
Zone 7 5 Low	91	110	126	143	158	177	195	197	199	201	204	206	239	273	308	343	379	416	453	491	530	569
Zone 7 6 Low	138	167	192	217	242	268	295	328	362	397	432	468	489	510	531	553	575	630	687	744	803	862
Zone 7 7 Low	202	245	281	318	355	393	432	481	531	582	634	686	717	748	779	811	843	924	1,007	1,091	1,177	1,264
Zone 7 8 Med	656	795	911	1,028	1,148	1,270	1,394	1,548	1,706	1,867	2,030	2,196	2,290	2,386	2,483	2,581	2,681	3,091	3,507	3,931	4,361	4,798
3 Lad Lum Kaeo																						
Zone 8 1 Low	0	0	0	0	0	0	0	0	0	0	353	881	1,037	1,200	1,368	1,543	1,724	1,911	2,105	2,304	2,510	2,723
Zone 8 3 Low	0	0	0	0	0	0	0	0	0	0	175	438	516	596	680	767	857	950	1,046	1,146	1,248	1,354
Zone 8 6 Low	0	0	0	0	0	0	0	0	0	0	221	553	641	731	822	914	1,008	1,104	1,200	1,298	1,398	1,499
4 Thanyaburi																						
Zone 1 1 Hi	17,282	18,528	21,060	23,754	26,609	29,627	32,807	36,599	40,591	44,783	49,175	53,767	58,138	62,680	67,393	72,276	77,331	82,351	87,529	92,864	98,358	104,009
Zone 3 2 Med	0	0	0	0	0	340	731	1,051	1,417	1,830	2,288	2,794	3,284	3,808	4,365	4,955	5,578	6,380	7,226	8,117	9,052	10,031
Zone 3 3 & 4 Med	1,617	1,680	2,266	2,890	3,552	4,251	4,989	5,383	5,792	6,216	6,655	7,109	7,798	8,496	9,229	9,988	10,772	12,134	13,547	15,012	16,529	18,097
5 Lam Luka																						
Zone 4 1 Med	11,082	11,979	13,029	14,102	15,196	16,311	17,448	18,895	20,362	21,849	23,355	24,881	26,212	27,565	28,941	30,340	31,761	33,093	34,439	35,801	37,178	38,570
Zone 4 2 Med	0	0	28	114	255	454	710	994	1,312	1,662	2,046	2,462	2,876	3,315	3,779	4,269	4,784	5,448	6,145	6,878	7,644	8,443
Zone 4 3 Med	0	0	0	0	0	0	0	113	451	1,015	1,805	2,820	3,230	3,655	4,095	4,551	5,022	5,636	6,271	6,925	7,601	8,296
Zone 4 4 Med	0	0	0	0	0	0	0	110	438	986	1,753	2,739	3,137	3,550	3,977	4,420	4,877	5,473	6,089	6,725	7,381	8,057
6 Khlong Luang																						
Z1-15%,Z2-85%1 Med	0	0	842	3,368	7,577	13,471	21,048	24,213	27,598	31,203	35,029	39,074	41,599	44,178	46,811	49,499	52,241	55,037	57,888	60,793	63,752	66,766
Zone 2 2 Med	0	0	0	0	0	0	0	95	378	851	1,514	2,365	2,732	3,117	3,519	3,940	4,378	4,946	5,539	6,155	6,794	7,458
Zone 2 3 Med	0	0	0	0	0	0	0	44	178	400	711	1,111	1,266	1,426	1,591	1,761	1,936	2,165	2,400	2,641	2,889	3,143
Total	40,415	43,659	49,648	57,685	67,772	82,527	99,556	112,454	126,913	142,933	161,263	181,529	197,205	213,460	230,293	247,704	265,693	286,452	307,889	330,005	352,798	376,270
Average Service Ratio(%)	35.9	35.0	33.4	33.5	34.5	31.1	34.2	35.2	36.4	37.9	39.8	41.8	44.2	46.5	48.8	51.1	53.5	56.2	59.0	61.7	64.5	67.2

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Served Population by Zone																							
Zone 1	Hi	17,282	18,528	21,060	23,754	26,609	29,627	32,807	36,599	40,591	44,783	49,175	53,767	58,138	62,690	67,393	72,276	77,331	82,351	87,529	92,864	98,358	104,009
	Med	0	0	126	505	1,137	2,021	3,157	3,632	4,140	4,681	5,254	5,861	6,240	6,627	7,022	7,425	7,836	8,256	8,683	9,119	9,563	10,015
	Low																						
Zone 2	Hi																						
	Med	0	0	716	2,863	6,441	11,450	17,891	20,720	24,014	27,774	31,999	36,689	39,357	42,094	44,900	47,775	50,719	53,893	57,143	60,469	63,872	67,352
	Low																						
Zone 3	Hi																						
	Med	1,617	1,680	2,266	2,890	3,552	4,592	5,720	6,434	7,209	8,045	8,943	9,902	11,074	12,304	13,594	14,943	16,350	18,514	20,773	23,129	25,581	28,129
	Low																						
Zone 4	Hi																						
	Med	11,082	11,979	13,058	14,215	15,451	16,765	18,158	20,112	22,563	25,512	28,959	32,903	35,854	38,084	40,793	43,579	46,444	49,650	52,945	56,330	59,803	63,365
	Low																						
Zone 5	Hi																						
	Med	0	0	0	0	0	321	665	895	1,139	1,396	1,668	1,954	2,246	2,550	2,865	3,194	3,534	3,977	4,436	4,912	5,404	5,912
	Low	0	0	0	0	0	0	0	54	217	488	867	1,355	1,575	1,799	2,027	2,259	2,496	2,737	2,983	3,232	3,486	3,744
Zone 6	Hi																						
	Med	0	0	0	0	0	1,658	3,497	4,781	6,173	7,674	9,283	11,001	12,737	14,562	16,477	18,481	20,574	23,286	26,116	29,066	32,134	35,321
	Low																						
Zone 7	Hi	9,347	9,655	10,228	10,817	11,423	12,046	12,685	13,358	14,048	14,755	15,479	16,219	16,966	17,729	18,510	19,307	20,121	20,902	21,698	22,508	23,333	24,173
	Med	556	1,295	1,595	1,964	2,402	3,209	4,055	4,863	5,726	6,644	7,617	8,646	9,780	10,973	12,224	13,533	14,901	16,351	19,084	21,300	23,599	25,981
	Low	430	522	599	677	757	838	922	1,006	1,092	1,180	1,269	1,360	1,445	1,531	1,618	1,707	1,791	1,978	2,147	2,327	2,509	2,695
Zone 8	Hi																						
	Med																						
	Low	0	0	0	0	0	0	0	0	0	0	749	1,672	2,194	2,527	2,871	3,225	3,590	3,965	4,351	4,748	5,156	5,575
Total		40,415	43,659	49,648	57,685	67,772	82,527	99,556	112,454	126,919	142,933	161,263	181,529	197,205	213,468	230,293	247,704	265,693	286,452	307,889	330,005	352,798	376,270
Unit Water Consumption (lpcd)																							
High Dens Area		167	170	173	176	179	182	185	188	191	194	197	200	203	206	209	212	215	218	221	224	227	230
Med Dens Area		95	100	104	108	112	116	120	124	128	132	136	140	142	144	146	148	150	156	162	168	174	180
Low Dens Area		77	80	83	86	89	92	95	98	101	104	107	110	113	116	119	122	125	128	131	134	137	140
Domestic Water Consumption by Zone																							
Zone 1		2,888	3,150	3,657	4,235	4,890	5,627	6,448	7,331	8,283	9,306	10,402	11,574	12,688	13,866	15,110	16,421	17,802	19,248	20,751	22,334	23,991	25,725
Zone 2		0	0	74	309	721	1,328	2,147	2,569	3,074	3,666	4,352	5,136	5,589	6,062	6,555	7,071	7,608	8,401	9,251	10,159	11,114	12,123
Zone 3		155	168	235	312	398	533	686	798	923	1,062	1,216	1,386	1,572	1,772	1,985	2,211	2,453	2,888	3,365	3,886	4,451	5,063
Zone 4		1,854	1,198	1,358	1,535	1,731	1,945	2,179	2,494	2,888	3,365	3,938	4,606	5,035	5,484	5,956	6,450	6,967	7,745	8,577	9,463	10,406	11,406
Zone 5		0	0	0	0	0	37	80	116	168	235	320	423	497	576	660	748	842	971	1,109	1,258	1,418	1,582
Zone 6		0	0	0	0	0	192	420	593	790	1,013	1,263	1,540	1,809	2,097	2,406	2,735	3,086	3,633	4,231	4,883	5,591	6,358
Zone 7		1,657	1,813	1,985	2,174	2,381	2,642	2,921	3,213	3,526	3,862	4,221	4,604	4,996	5,410	5,846	6,304	6,786	7,453	8,166	8,932	9,747	10,614
Zone 8		0	0	0	0	0	0	0	0	0	0	89	206	248	293	342	393	449	508	570	636	706	780
Total		5,762	6,328	7,310	8,566	10,121	12,303	14,881	17,114	19,652	22,512	25,792	29,476	32,433	35,560	38,859	42,335	45,991	50,845	56,029	61,551	67,424	73,657

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Water Consumption for Gov/Inst/Commercial (based on Population Ratio by Zone)																						
A. Government (unit consumption = 5 l/day/pop in service area)																						
Zone 1	241	265	317	362	402	508	526	572	614	652	684	713	729	746	762	779	797	806	816	826	837	848
Zone 2	0	0	11	43	93	184	262	295	330	366	402	439	446	453	460	467	474	479	485	490	495	501
Zone 3	23	24	34	43	51	74	84	91	99	106	112	118	125	132	139	146	153	165	176	187	198	209
Zone 4	154	171	195	212	224	269	265	286	310	336	364	393	402	410	418	426	434	442	449	456	464	471
Zone 5	0	0	0	0	0	5	10	13	19	25	32	40	43	47	50	53	56	60	63	66	69	72
Zone 6	0	0	0	0	0	27	51	68	85	101	117	132	144	157	169	181	192	207	221	235	249	263
Zone 7	145	164	186	201	211	258	258	273	286	298	306	314	319	325	331	338	344	354	364	374	384	393
Zone 8	0	0	0	0	0	0	0	0	0	0	9	22	25	27	29	32	34	35	37	38	40	41
Sub-Total	563	624	743	862	981	1,325	1,455	1,598	1,741	1,884	2,027	2,170	2,233	2,295	2,359	2,422	2,485	2,548	2,611	2,674	2,737	2,800
B. School (Number of student = X % of population in service area)																						
Ratio (X) =	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
B-1 Number of student																						
Zone 1	9,633	10,591	12,681	14,498	16,063	20,320	21,031	22,874	24,551	26,085	27,372	28,517	29,163	29,822	30,492	31,173	31,862	32,237	32,634	33,051	33,485	33,935
Zone 2	0	0	428	1,711	3,729	7,352	10,462	11,781	13,181	14,647	16,092	17,546	17,828	18,113	18,399	18,686	18,975	19,174	19,382	19,597	19,818	20,045
Zone 3	901	960	1,356	1,727	2,056	2,948	3,345	3,658	3,957	4,243	4,497	4,736	5,016	5,294	5,570	5,844	6,117	6,587	7,046	7,496	7,937	8,371
Zone 4	6,177	6,847	7,815	8,496	8,945	10,764	10,618	11,435	12,384	13,454	14,563	15,736	16,061	16,387	16,715	17,045	17,375	17,665	17,958	18,256	18,556	18,858
Zone 5	0	0	0	0	0	206	389	540	744	994	1,275	1,583	1,731	1,871	2,005	2,133	2,256	2,389	2,516	2,639	2,758	2,874
Zone 6	0	0	0	0	0	1,065	2,045	2,718	3,388	4,047	4,668	5,261	5,770	6,266	6,752	7,228	7,697	8,285	8,858	9,420	9,970	10,512
Zone 7	5,816	6,558	7,435	8,043	8,442	10,333	10,328	10,932	11,453	11,907	12,253	12,542	12,770	13,009	13,257	13,512	13,774	14,169	14,561	14,962	15,341	15,728
Zone 8	0	0	0	0	0	0	0	0	0	0	377	895	994	1,087	1,176	1,261	1,343	1,411	1,476	1,539	1,600	1,659
Total	22,527	24,956	29,715	34,475	39,235	52,988	58,219	63,938	69,657	75,377	81,096	86,816	89,333	91,849	94,366	96,883	99,399	101,916	104,432	106,949	109,465	111,982
B-2 Water Consumption (unit consuaption = 20 l/day/student)																						
Zone 1	193	212	254	290	321	406	421	457	491	522	547	570	583	596	610	623	637	645	653	661	670	679
Zone 2	0	0	9	34	75	147	209	236	264	293	322	351	357	362	368	374	379	383	388	392	396	401
Zone 3	18	19	27	35	41	59	67	73	79	85	90	95	100	106	111	117	122	132	141	150	159	167
Zone 4	124	137	156	170	179	215	212	229	248	269	291	315	321	328	334	341	348	353	359	365	371	377
Zone 5	0	0	0	0	0	4	8	11	15	20	26	32	35	37	40	43	45	48	50	53	55	57
Zone 6	0	0	0	0	0	21	41	54	68	81	93	105	115	125	135	145	154	165	177	185	199	210
Zone 7	116	131	149	161	169	207	207	219	229	238	245	251	255	260	265	270	275	283	291	299	307	315
Zone 8	0	0	0	0	0	0	0	0	0	0	8	18	20	22	24	25	27	28	30	31	32	33
Sub-Total	451	499	594	689	785	1,060	1,164	1,279	1,393	1,508	1,622	1,736	1,787	1,837	1,887	1,938	1,988	2,036	2,089	2,139	2,189	2,240

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
C. Hospital Use	(Population per bed =			345	person/bed)		(unit consumption =			1.5 cu m/d/bed)												
Zone 1	209	230	276	315	349	442	457	497	534	567	595	620	634	648	663	678	693	701	709	719	728	738
Zone 2	0	0	9	37	81	160	227	256	287	318	350	381	388	394	400	406	412	417	421	425	431	436
Zone 3	20	21	29	38	45	64	73	80	86	92	98	103	109	115	121	127	133	143	153	163	173	182
Zone 4	134	149	170	185	194	234	231	249	269	292	317	342	349	356	363	371	378	384	390	397	403	410
Zone 5	0	0	0	0	0	4	8	12	16	22	28	34	38	41	44	46	49	52	55	57	60	62
Zone 6	0	0	0	0	0	23	44	59	74	88	101	114	125	136	147	157	167	180	193	205	217	229
Zone 7	126	143	162	175	184	225	225	238	249	259	266	273	278	283	288	294	299	308	317	325	333	342
Zone 8	0	0	0	0	0	0	0	0	0	0	8	19	22	24	26	27	29	31	32	33	35	36
Sub-Total	490	543	646	749	853	1,152	1,266	1,390	1,514	1,639	1,763	1,887	1,942	1,997	2,051	2,106	2,161	2,216	2,270	2,325	2,380	2,434
A+B+C Total of Governental/Institutional Consumpton																						
Zone 1	543	707	846	968	1,072	1,356	1,404	1,527	1,639	1,741	1,827	1,903	1,946	1,990	2,035	2,080	2,126	2,151	2,178	2,206	2,235	2,265
Zone 2	0	0	29	114	249	491	698	786	880	976	1,074	1,171	1,190	1,209	1,228	1,247	1,266	1,280	1,294	1,308	1,323	1,338
Zone 3	60	64	91	115	137	197	223	244	264	283	300	316	335	353	372	390	408	440	470	500	530	559
Zone 4	412	457	522	567	597	718	709	763	827	898	972	1,050	1,072	1,094	1,116	1,138	1,160	1,179	1,199	1,218	1,238	1,259
Zone 5	0	0	0	0	0	14	26	36	50	66	85	106	116	125	134	142	151	159	168	176	184	192
Zone 6	0	0	0	0	0	71	136	181	226	270	312	351	385	418	451	482	514	553	591	629	665	702
Zone 7	388	438	496	537	563	690	689	730	764	795	818	837	852	868	885	902	919	946	972	998	1,024	1,050
Zone 8	0	0	0	0	0	0	0	0	0	0	25	60	66	73	79	54	90	94	99	105	107	111
Total	1,503	1,666	1,983	2,301	2,618	3,535	3,885	4,267	4,649	5,031	5,412	5,794	5,962	6,130	6,298	6,466	6,634	6,802	6,970	7,139	7,306	7,474
Commercial Water Consumption	(unit consumption =				10	l/day/pop in service area)																
Zone 1	482	530	634	725	803	1,016	1,052	1,144	1,226	1,304	1,369	1,426	1,458	1,491	1,525	1,559	1,593	1,612	1,632	1,652	1,674	1,691
Zone 2	0	0	21	86	186	368	523	589	659	732	805	877	891	906	920	934	949	959	969	980	991	1,002
Zone 3	45	48	68	86	103	147	167	183	198	212	225	237	251	265	279	292	306	329	352	375	397	419
Zone 4	309	342	391	425	447	538	531	572	619	673	728	787	803	819	836	852	869	883	898	913	928	943
Zone 5	0	0	0	0	0	10	19	27	37	50	64	79	87	94	100	107	113	119	126	132	138	144
Zone 6	0	0	0	0	0	53	102	136	169	202	233	263	288	313	338	361	385	414	443	471	499	526
Zone 7	291	328	372	402	422	517	516	547	573	595	613	627	639	650	663	675	689	708	728	748	767	786
Zone 8	0	0	0	0	0	0	0	0	0	0	19	45	50	54	59	63	67	71	74	77	83	83
Total	1,126	1,248	1,486	1,724	1,962	2,649	2,911	3,197	3,483	3,769	4,055	4,341	4,467	4,592	4,718	4,844	4,970	5,096	5,222	5,347	5,473	5,599

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Water Consumption by Univercity/Colledges																						
Zone 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 2	0	0	0	0	0	3,184	3,278	3,372	3,467	3,561	3,656	3,750	3,844	3,939	4,033	4,128	4,222	4,317	4,411	4,506	4,600	4,695
Zone 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 6	0	0	0	0	0	2,417	2,598	2,779	2,960	3,140	3,321	3,502	3,683	3,864	4,044	4,225	4,406	4,586	4,766	4,945	5,125	5,305
Zone 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	5,601	5,876	6,151	6,426	6,702	6,977	7,252	7,527	7,802	8,078	8,353	8,628	8,902	9,177	9,451	9,725	10,000
Other Use (4.6 % of Domestic & Governmental Use)																						
Zone 1	162	177	207	239	274	321	361	407	456	508	563	620	673	729	789	851	917	984	1,055	1,129	1,206	1,288
Zone 2	0	0	5	19	45	84	131	184	182	214	250	290	312	334	358	383	408	446	485	527	572	619
Zone 3	10	11	15	20	25	34	42	48	55	62	70	78	88	98	108	120	132	153	176	202	229	259
Zone 4	68	76	86	97	107	123	133	150	171	196	226	260	281	303	325	349	374	411	450	491	536	583
Zone 5	0	0	0	0	0	2	5	7	10	14	19	24	28	32	36	41	46	52	59	66	74	82
Zone 6	0	0	0	0	0	12	26	36	47	59	72	87	101	116	131	148	166	193	222	254	288	325
Zone 7	94	104	114	125	135	153	166	181	197	214	232	250	269	289	310	331	354	386	420	457	495	537
Zone 8	0	0	0	0	0	0	0	0	0	0	5	12	14	17	19	22	25	28	31	34	37	41
Total	334	368	427	500	586	729	863	984	1,118	1,267	1,435	1,622	1,766	1,918	2,077	2,245	2,421	2,652	2,898	3,150	3,438	3,732

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Industrial Water Consumption																						
Nava Nakorn (Phase 1-3)	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720	18,720
Connection Ratio	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Nava Nakorn (Expansion)	0	936	1,872	2,808	3,744	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680
Connection Ratio	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exis. Factory (other than N.Nakorn)	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413
Connection Ratio	0.00	0.00	0.00	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
B.I.P	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808
Connection Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Future (in DTCP BangKrab	0	217	435	652	870	1,087	1,305	1,522	1,740	1,957	2,175	2,392	2,609	2,827	3,044	3,262	3,479	3,697	3,914	4,132	4,349	
Connection Ratio	0.00	0.00	0.00	0.00	0.25	0.40	0.50	0.57	0.63	0.67	0.70	0.73	0.75	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Future (in DTCP Rangsit)	0	208	416	624	832	1,040	1,248	1,456	1,664	1,872	2,080	2,288	2,496	2,704	2,912	3,120	3,328	3,536	3,744	3,952	4,160	
Connection Ratio	0.00	0.00	0.00	0.00	0.25	0.40	0.50	0.57	0.63	0.67	0.70	0.73	0.75	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Future (Other Area)	0	450	900	1,350	1,800	2,250	2,700	3,150	3,600	4,050	4,500	4,950	5,400	5,850	6,300	6,750	7,200	7,650	8,100	8,550	9,000	
Connection Ratio	0.00	0.00	0.00	0.00	0.25	0.40	0.50	0.57	0.63	0.67	0.70	0.73	0.75	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Service States by Zone (1:Served, 0:Unserved)																						
Zone 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 2	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 5	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 6	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zone 8	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1

Future Development in DTCP's Industrial Area (DTCP's Industrial Area: 720 ha (480ha x 50% at Thanyaburi + 480 ha at Bang Krabi) x 30 cu m/d/ha x 0.65)
Future Development outside DTCP's Industrial Area (600 ha x 30 cu m/d/ha)

Ratio of Consumption by Zone

	Nava Nakorn	Existing Factories	B.I.P	Future (BankK)	Future (Rangs)	Future (Other)
Zone 1	0.00	0.301	0.00	0.00	1.00	0.00
Zone 2	1.00	0.144	0.00	0.00	0.00	0.06
Zone 3	0.00	0.000	0.00	0.00	0.00	0.17
Zone 4	0.00	0.000	0.00	0.00	0.00	0.04
Zone 5	0.00	0.264	0.00	0.00	0.00	0.09
Zone 6	0.00	0.105	1.00	1.00	0.00	0.05
Zone 7	0.00	0.186	0.00	0.00	0.00	0.21
Zone 8	0.00	0.000	0.00	0.00	0.00	0.33
	1.00	1.000	1.00	1.00	1.00	1.00

Patum Thani & Prachatipat

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Industrial Water Consumption (cu m/d)																						
Zone 1	0	0	0	0	0	1,123	2,247	3,370	4,494	5,617	6,741	7,864	8,987	10,111	11,234	12,066	12,274	12,482	12,690	12,898	13,106	13,314
Zone 2	0	0	0	0	0	22,939	24,351	24,826	25,302	25,777	26,253	26,728	27,204	27,679	28,154	28,304	28,342	28,379	28,417	28,454	28,492	28,529
Zone 3	0	0	0	0	0	75	150	225	300	375	450	525	600	675	750	1,050	1,125	1,200	1,275	1,350	1,425	1,500
Zone 4	0	0	0	0	0	17	34	51	68	84	101	118	135	152	169	236	253	270	287	304	321	338
Zone 5	0	0	0	0	0	842	1,685	2,527	3,369	4,211	5,054	5,896	6,738	7,581	8,423	8,580	8,620	8,659	8,698	8,738	8,777	8,817
Zone 6	0	0	0	0	0	574	1,149	1,723	2,297	5,679	6,254	6,828	7,402	7,977	8,551	9,571	9,826	10,081	10,336	10,590	10,845	11,100
Zone 7	0	0	0	0	0	659	1,319	1,978	2,638	3,297	3,957	4,616	5,275	5,935	6,594	6,969	7,063	7,157	7,251	7,344	7,438	7,532
Zone 8	0	0	0	0	0	0	0	0	0	0	900	1,050	1,200	1,350	1,500	2,100	2,250	2,400	2,550	2,700	2,850	3,000
Total	0	0	0	0	0	26,231	30,934	34,700	38,467	45,042	49,709	53,625	57,542	61,459	65,376	62,877	69,753	70,628	71,504	72,378	73,255	74,130

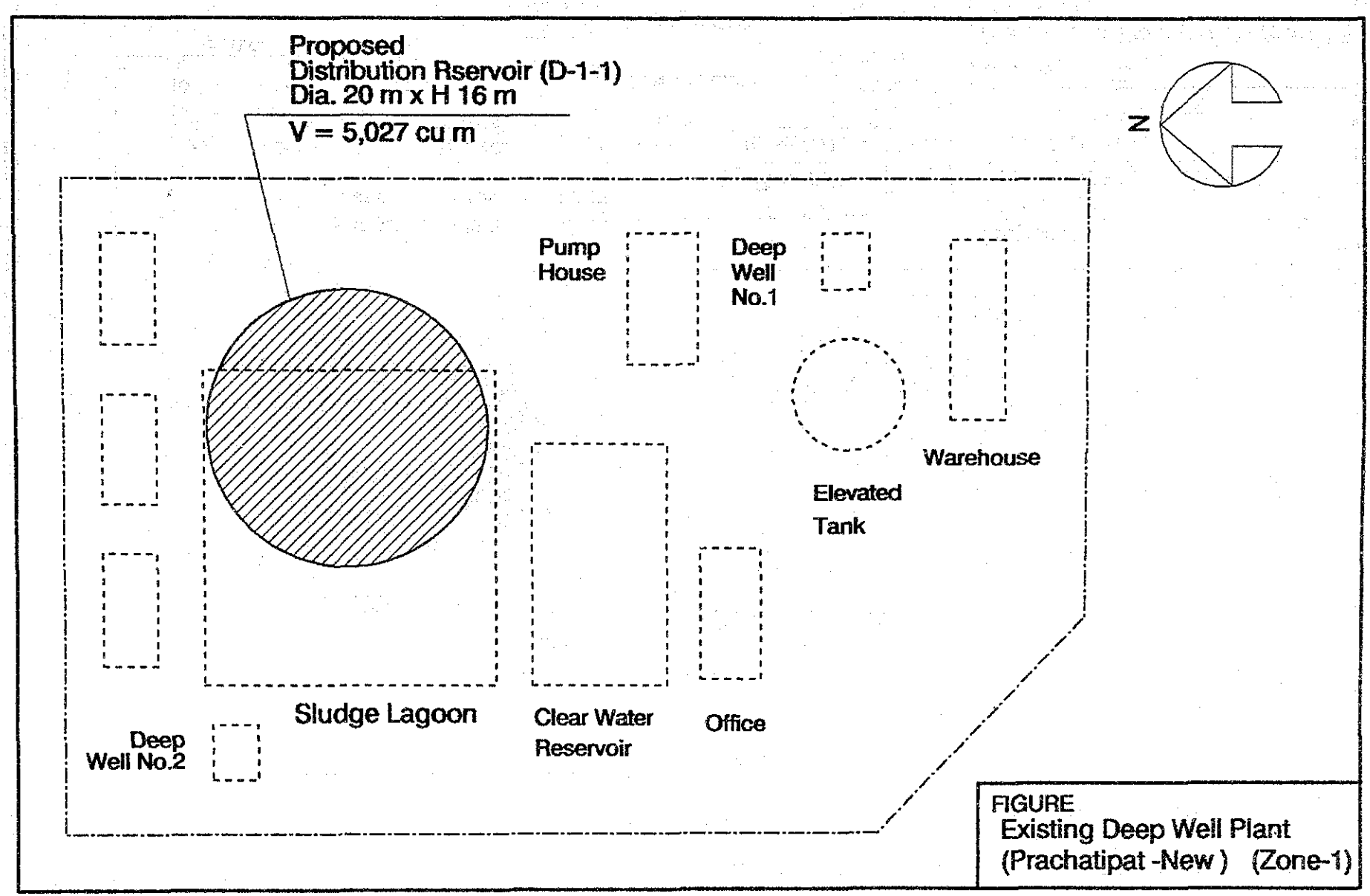
Patum Thani & Prachatipat

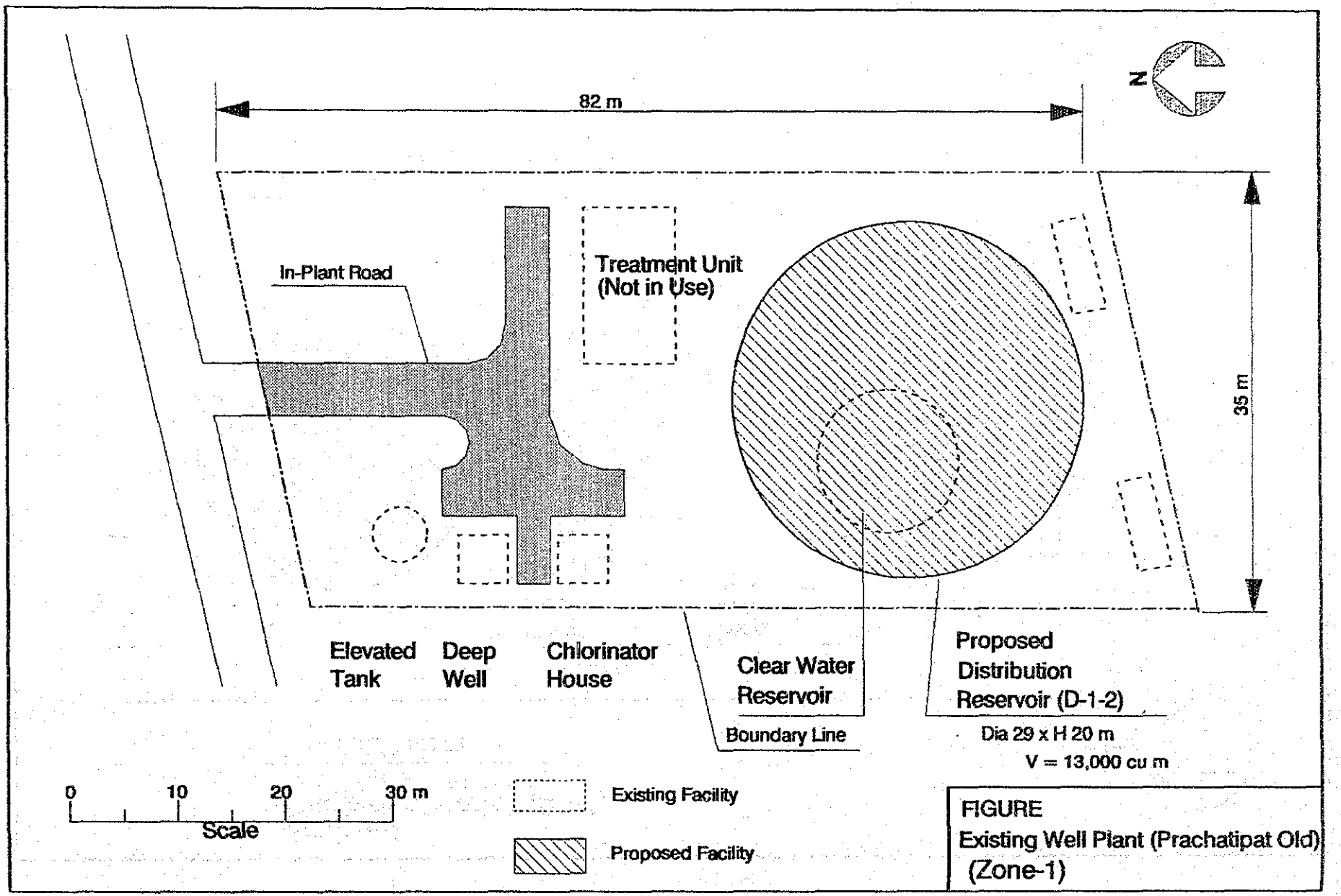
Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Daily Average Consumption by Zone (cu m/d)																						
Zone 1	4,173	4,564	5,344	6,167	7,040	9,443	11,511	13,779	16,099	18,476	20,901	23,387	25,753	28,183	30,693	32,978	34,712	36,470	38,305	40,219	42,213	44,288
Zone 2	0	0	129	528	1,201	28,393	31,128	32,298	33,563	34,928	36,388	37,953	39,030	40,128	41,249	42,067	42,795	43,787	44,833	45,934	47,092	48,307
Zone 3	270	291	409	533	662	985	1,269	1,498	1,739	1,994	2,261	2,542	2,846	3,163	3,493	4,063	4,423	5,010	5,639	6,312	7,032	7,799
Zone 4	1,853	2,073	2,357	2,624	2,882	3,341	3,585	4,029	4,572	5,219	5,966	6,822	7,325	7,852	8,401	9,025	9,622	10,488	11,410	12,396	13,428	14,527
Zone 5	0	0	0	0	0	906	1,815	2,713	3,634	4,576	5,541	6,528	7,465	8,407	9,353	9,619	9,771	9,961	10,150	10,370	10,591	10,822
Zone 6	0	0	0	0	0	3,320	4,431	5,447	6,489	10,364	11,455	12,571	13,668	14,784	15,921	17,523	18,382	19,459	20,588	21,772	23,014	24,315
Zone 7	2,430	2,682	2,957	3,238	3,502	4,661	5,611	6,649	7,699	8,764	9,840	10,934	12,031	13,152	14,297	15,182	15,811	16,650	17,539	18,479	19,471	20,518
Zone 8	0	0	0	0	0	0	0	0	0	0	1,029	1,373	1,576	1,787	1,998	2,663	2,880	3,100	3,323	3,550	3,781	4,015
Total	8,726	9,609	11,206	13,090	15,287	51,049	59,350	66,413	73,795	84,322	93,380	102,110	109,697	117,461	125,405	133,119	138,397	144,925	151,738	159,025	166,621	174,592
Unaccounted-for Water Ratio (%)																						
For Zone 1 and 7 only	26	26	26	26	25	25	25	25	24	24	23	23	23	22	22	21	21	21	21	20	20	20
For Other Zones	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Total Daily Average Demand by Zone (cu m/d)																						
Zone 1	5,639	6,167	7,202	8,289	9,437	12,625	15,349	18,275	21,239	24,247	27,285	30,373	33,273	36,231	39,249	41,957	43,939	46,048	48,243	50,526	52,898	55,360
Zone 2	0	0	161	660	1,502	35,491	38,910	40,372	41,954	43,660	45,485	47,441	48,787	50,160	51,561	52,584	53,494	54,734	56,042	57,418	58,865	60,384
Zone 3	338	364	511	667	828	1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
Zone 4	2,316	2,592	2,946	3,280	3,602	4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,495	16,785	18,159
Zone 5	0	0	0	0	0	1,132	2,268	3,391	4,542	5,720	6,926	8,160	9,332	10,509	11,691	12,023	12,214	12,451	12,700	12,963	13,238	13,528
Zone 6	0	0	0	0	0	4,150	5,538	6,809	8,112	12,955	14,319	15,714	17,085	18,480	19,901	21,904	22,977	24,323	25,735	27,215	28,767	30,394
Zone 7	3,224	3,624	3,999	4,352	4,695	6,231	7,482	8,818	10,156	11,501	12,846	14,200	15,544	16,905	18,283	19,316	20,014	21,023	22,089	23,214	24,400	25,648
Zone 8	0	0	0	0	0	0	0	0	0	0	1,286	1,716	1,973	2,234	2,498	3,328	3,600	3,875	4,154	4,437	4,726	5,019
Total	11,577	12,746	14,820	17,248	20,063	65,037	75,614	84,574	93,892	107,100	118,430	129,309	138,708	148,287	158,051	167,472	173,795	181,827	190,275	199,152	208,469	218,240
Total Daily Maximum Demand by Zone (cu m/d)																						
Peak Factor = 1.26																						
Zone 1	6,787	7,408	8,643	9,947	11,324	15,150	18,418	21,930	25,487	29,096	32,742	36,447	39,927	43,478	47,098	50,348	52,727	55,258	57,892	60,632	63,478	66,432
Zone 2	0	0	194	793	1,802	42,590	46,692	48,447	50,345	52,392	54,582	56,930	58,545	60,192	61,874	63,100	64,193	65,681	67,250	68,902	70,638	72,460
Zone 3	406	436	614	800	994	1,478	1,903	2,247	2,609	2,991	3,392	3,814	4,269	4,744	5,240	6,095	6,635	7,515	8,459	9,469	10,548	11,699
Zone 4	2,779	3,110	3,535	3,936	4,323	5,011	5,378	6,044	6,858	7,828	8,948	10,233	10,988	11,777	12,602	13,537	14,433	15,732	17,115	18,594	20,142	21,791
Zone 5	0	0	0	0	0	1,359	2,722	4,070	5,450	6,864	8,311	9,791	11,198	12,610	14,029	14,428	14,656	14,941	15,240	15,555	15,886	16,233
Zone 6	0	0	0	0	0	4,980	6,646	8,171	9,734	15,546	17,182	18,857	20,502	22,177	23,881	26,284	27,573	29,188	30,882	32,658	34,521	36,473
Zone 7	3,941	4,349	4,798	5,222	5,633	7,477	8,978	10,582	12,188	13,801	15,415	17,040	18,653	20,286	21,939	23,179	24,017	25,228	26,507	27,857	29,280	30,777
Zone 8	0	0	0	0	0	0	0	0	0	0	1,543	2,059	2,368	2,680	2,997	3,994	4,320	4,650	4,985	5,325	5,671	6,023
Total	13,893	15,295	17,784	20,697	24,076	78,045	90,737	101,489	112,670	128,520	142,116	155,171	166,450	177,945	189,661	200,966	208,554	218,193	228,330	238,982	250,163	261,888
Treatment Plant Capacity (cu m/day)	Starting in 1995																					
Line 1	70,750																					
Line 2	70,750																					
Line 3											70,750											
Line 4																70,750						
Total Capacity	141,500	141,500	141,500	141,500	141,500	212,250	212,250	212,250	212,250	212,250	283,000	283,000	283,000	283,000	283,000	283,000	283,000	283,000	283,000	283,000	283,000	283,000

APPENDIX A-8-2

Layout of the Distribution Reservoirs in the Existing Waterworks


Proposed
Distribution Rservoir (D-1-1)
Dia. 20 m x H 16 m
V = 5,027 cu m
N
Pump
House
Deep
Well
No.1
Warehouse
Elevated
Tank
Sludge Lagoon
Clear Water
Reservoir
Office
Deep
Well No.2
FIGURE
Existing Deep Well Plant
(Prachatipat -New) (Zone-1)


82 m
N
In-Plant Road
Treatment Unit
(Not in Use)
35 m
Elevated
Tank
Deep
Well
Chlorinator
House
Clear Water
Reservoir
Boundary Line
Proposed
Distribution
Reservoir (D-1-2)
Dia 29 x H 20 m
V = 13,000 cu m
0
10
20
30 m
Scale
Existing Facility
Proposed Facility
FIGURE
Existing Well Plant (Prachatipat Old)
(Zone-1)

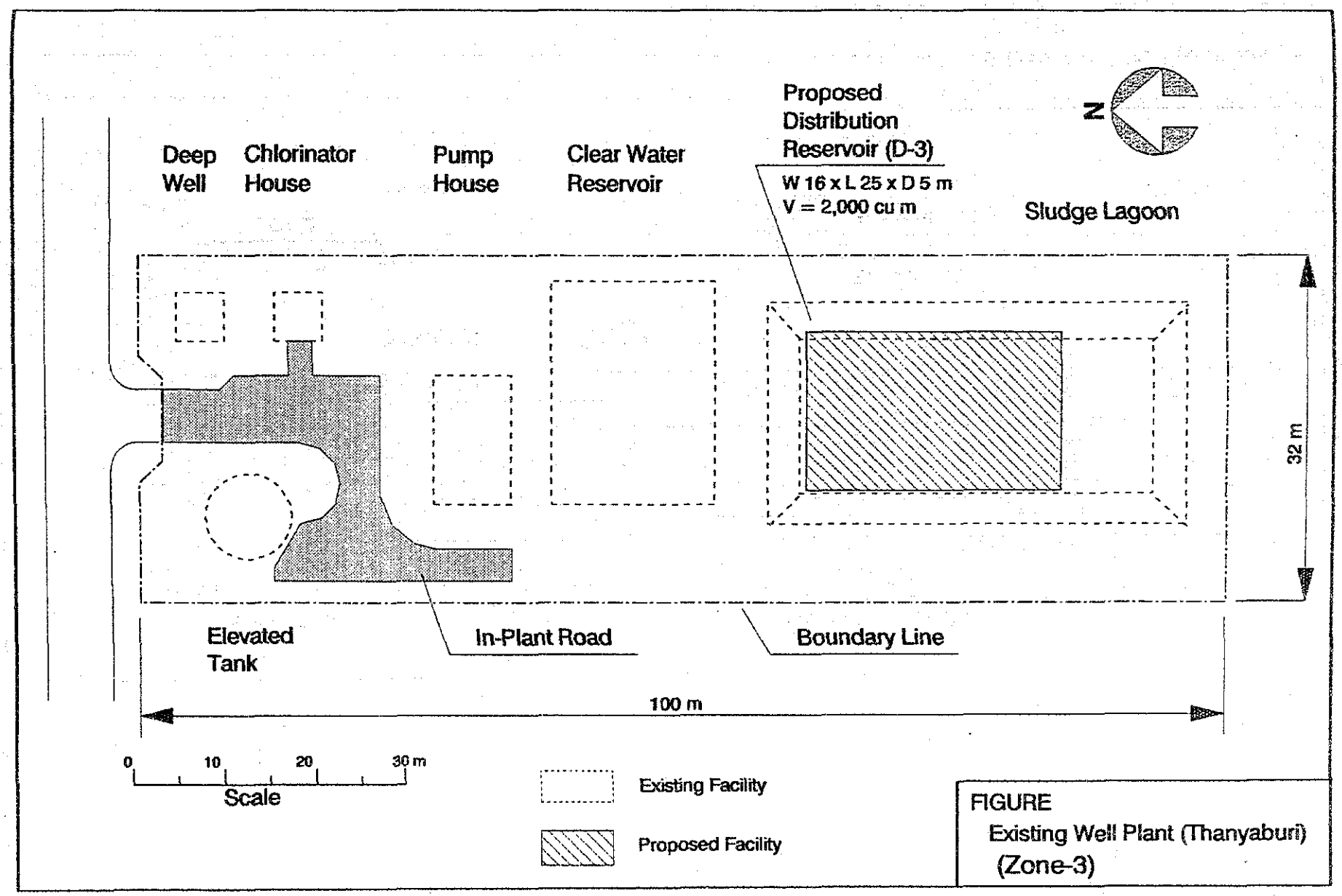


FIGURE
Existing Well Plant (Thanyaburi)
(Zone-3)

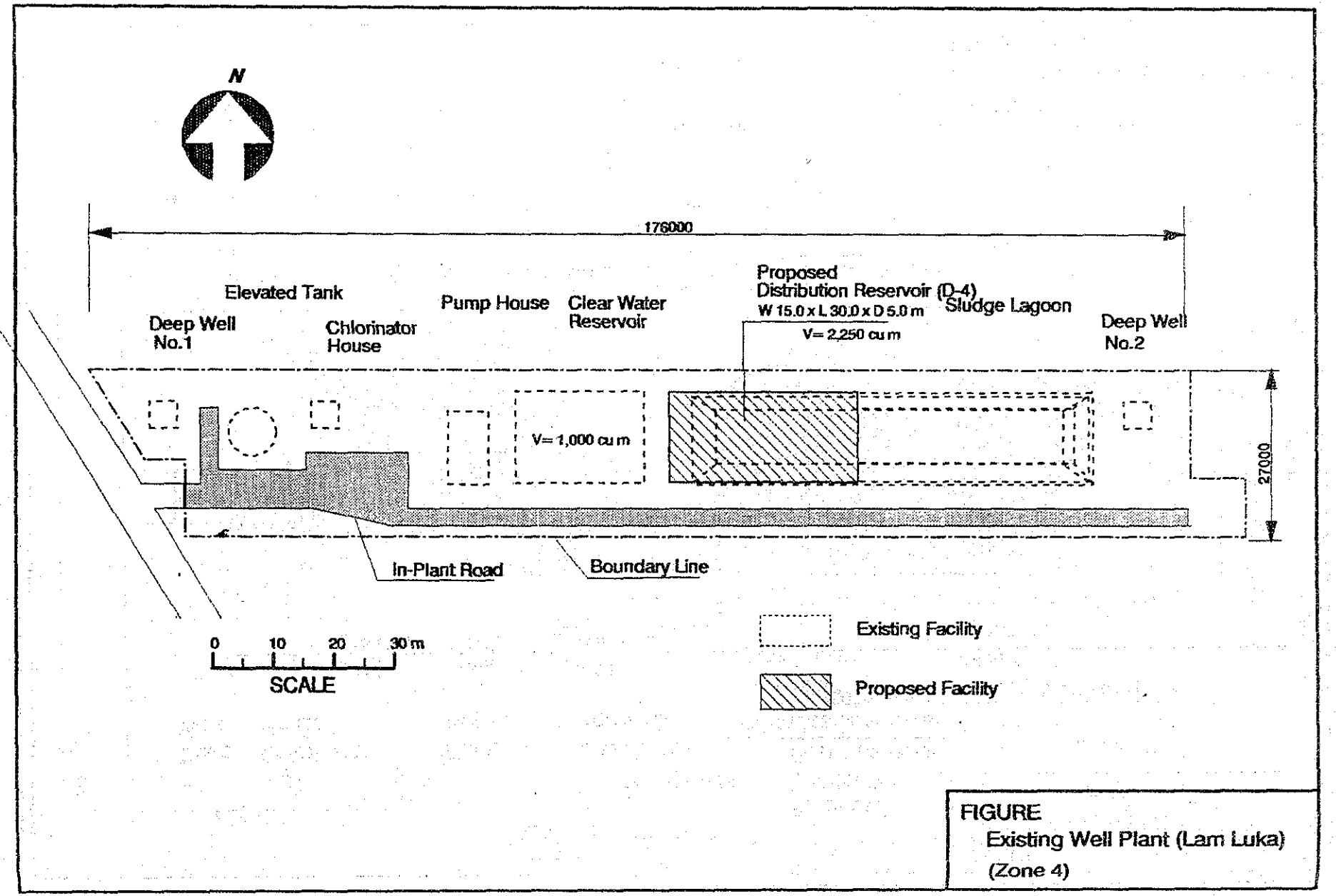
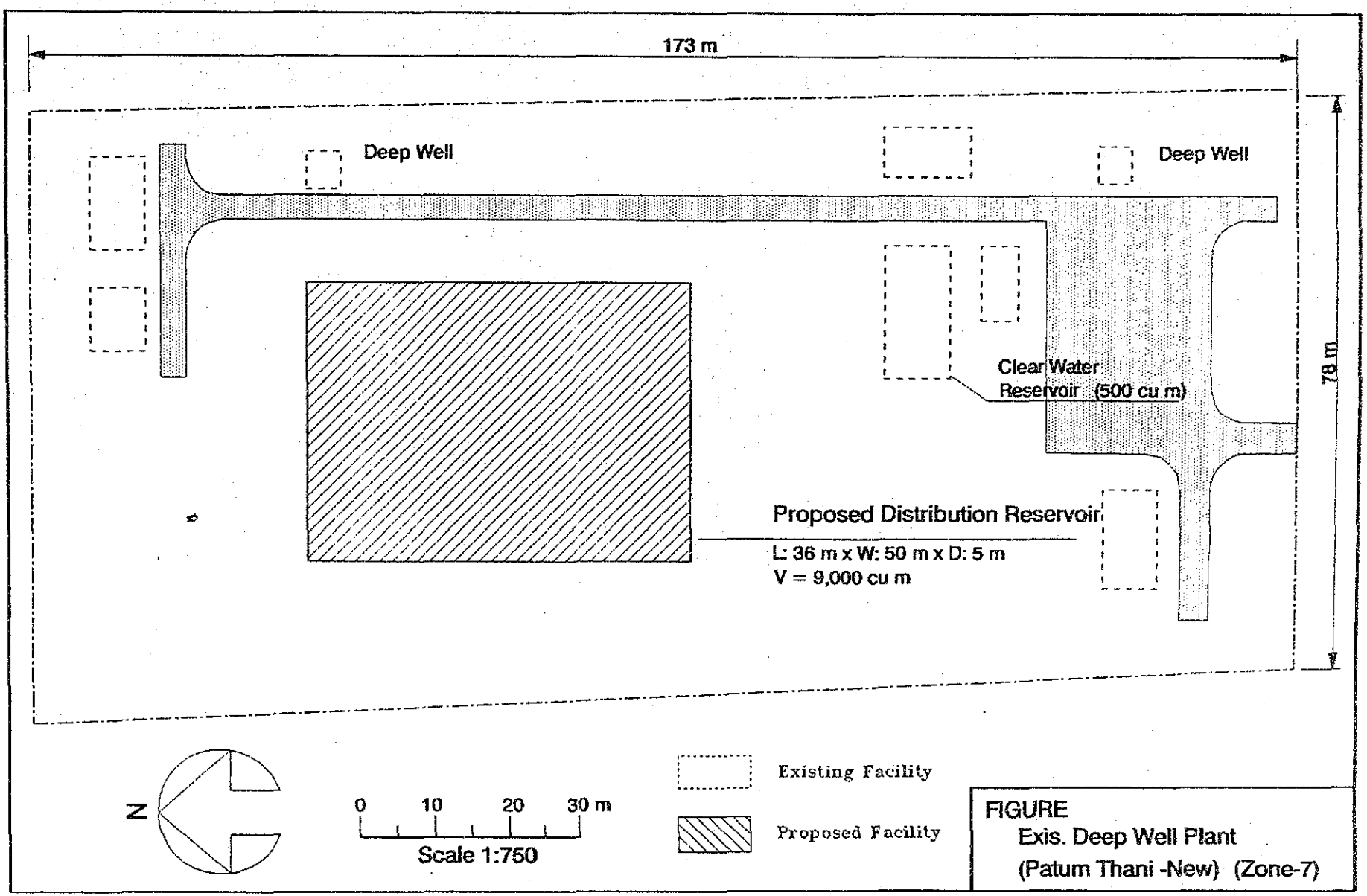


FIGURE
Existing Well Plant (Lam Luka)
(Zone 4)


173 m
78 m
Deep Well
Deep Well
Clear Water
Reservoir (500 cu m)
Proposed Distribution Reservoir
L: 36 m x W: 50 m x D: 5 m
V = 9,000 cu m
N
0 10 20 30 m
Scale 1:750
Existing Facility
Proposed Facility
FIGURE
Exis. Deep Well Plant
(Patum Thani -New) (Zone-7)

APPENDIX A-8-3

Details of the Cost Comparison for the Alternatives

Alternative : I-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	RO	Pro	312,000						66,915	1,600	2,000
Raw Water Pipe (1500 mm Steel Pipe)			Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)			
		Pro	261,888	Chaopraya River	T1	312,000	0.2		26,400	5,280	0	0
Treatment Plant				Q(D.max)								
	T1	Pro		283,000						656,917	110,000	137,500
Distribution Reservoir			(cu m)									
	D1	Pro	18,000							152,700	0	0
	D2	Pro	20,600							163,200	6,000	18,750
	D3	Pro	2,000							16,980	0	0
	D4	Pro	2,200							17,500	0	0
	D6	Pro	8,800							67,000	6,000	18,750
	D7	Pro	9,000							89,200	0	0
	ED1	Ex	2,000							-		
	ED2	Ex	1,006							-		
	ED3	Ex	1,000							-		
	ED4	Ex	500							-		
Sub-Total			65,100							506,500	12,000	37,500

Transmission/ Distribution Main	Pipe No.	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Baht1000)
	1	T1	D2	172,382	1000	5.5	S	35.2	13,820	76,010
	2	D2	1	194,120	1200	2.3	S	7.5	18,400	42,320
	3	1	N.Nakn	18,720	400	1.2	S	11.0	3,650	4,380
	4	1	2	175,400	1200	4.5	S	12.2	18,400	82,800
	5	2	3	18,840	500	6.0	S	18.7	4,540	27,240
	6	2	4	156,560	1200	8.0	S	17.6	18,400	147,200
	7	4	D1	88,223	700	0.7	S	7.4	6,610	4,627
	8	4	D3	11,699	400	2.0	S	7.7	3,650	7,300
	9	D1	7	108,153	800	2.7	S	21.6	9,250	24,975
	10	D3	5	15,208	500	12.0	S	25.2	4,540	54,480
	11	5	6	3,042	300	10.5	AC	13.5	1,490	15,645
	12	7	D4	21,791	600	8.5	S	14.3	5,600	47,600
	13	D4	8	28,329	500	5.8	S	38.5	4,540	26,332
	14	8	9	5,666	300	9.0	AC	36.6	1,490	13,410

Alternative : 1-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)			Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
			15	T1	10	94,376	1200	8.0	S	6.9	18,400	147,200		
			16	10	D6	47,024	700	4.5	S	14.8	6,610	29,745		
			17	D6	12	47,414	600	1.0	S	7.1	5,600	5,600		
			18	12	13	15,805	500	5.5	S	12.4	4,540	24,970		
			19	12	14	15,805	500	4.5	S	10.1	4,540	20,430		
			20	12	15	15,805	400	1.0	S	6.7	3,650	3,650		
			21	13	14	4,741	300	4.5	AC	13.2	1,490	6,705		
			22	13	15	4,741	300	6.5	AC	19.0	1,490	9,685		
			23	10	11	47,351	700	2.5	S	8.3	6,610	16,525		
			24	11	16	4,221	250	1.0	AC	5.7	1,090	1,090		
			25	11	D7	36,800	600	2.6	S	11.5	5,600	14,560		
			26	D7	17	46,340	600	0.8	S	5.4	5,600	4,480		
			27	17	18	4,001	300	5.8	AC	12.4	1,490	8,642		
			28	17	19	42,339	600	2.0	S	11.5	5,600	11,200		
			29	19	20	20,005	500	7.5	S	26.1	4,540	34,050		
			30	19	21	17,832	500	5.0	S	14.1	4,540	22,700		
			31	21	22	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total								146.4				953,801		

Grand Total

Construction Cost	Land Cost
2,188,513	177,000

Total Construction Cost

2,365,513

Alternative : 1-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	RO	Pro	312,000						66,915	1,600	2,000
Raw Water Pipe (1500 mm Steel Pipe)			Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)			
		Pro	261,888	Chaopraya River	T1	312,000	0.2		26,400	5,280	0	0
Treatment Plant						Q(D.max)						
	T1	Pro				283,000				656,017	110,000	137,500
Distribution Reservoir			(cu m)									
	D1	Pro	18,000							152,700	0	0
	D2	Pro	19,100							163,200	6,000	18,750
	D3	Pro	2,000							16,900	0	0
	D4	Pro	2,200							17,500	0	0
	D6	Pro	13,000							99,000	6,000	18,750
	D7	Pro	9,000							89,200	0	0
	ED1	Ex	2,000							-		
	ED2	Ex	1,000							-		
	ED3	Ex	1,000							-		
	ED4	Ex	500							-		
Sub-Total			67,800							538,500	12,000	37,500

Transmission/ Distribution Main	Pipe No.	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Bx1000)
	1	T1	1	172,382	1100	4.5	S	18.1	16,100	72,450
	2	1	D2	72,460	800	1.0	S	3.8	9,250	9,250
	3	1	D1	99,922	1000	14.0	S	32.7	13,820	193,480
	4	D2	2	94,199	1000	2.3	S	4.8	13,820	31,786
	5	2	NavNkn	18,720	400	1.2	S	11.0	3,650	4,380
	6	2	3	75,479	1000	4.5	S	6.3	13,820	62,190
	7	3	4	18,840	500	6.0	S	18.7	4,540	27,240
	8	3	5	23,550	600	5.5	S	10.7	5,600	30,800
	9	D1	6	86,361	600	0.7	S	15.0	5,600	3,920
	10	6	7	43,181	600	4.0	S	23.8	5,600	22,400
	11	D1	10	21,791	500	2.7	S	11.0	4,540	12,258
	12	D1	D3	11,699	300	2.7	AC	41.9	1,490	4,023
	13	10	D4	21,791	500	8.5	S	34.7	4,540	38,590
	14	D3	8	15,268	500	12.0	S	25.2	4,540	54,480

Alternative : 1-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)			Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
			15	8	9	3,042	300	10.5	AC	13.5	1,490	15,645		
			16	D4	11	28,329	500	5.8	S	38.5	4,540	26,332		
			17	11	12	5,666	300	9.0	AC	36.6	1,490	13,410		
			18	T1	13	89,506	1000	10.5	S	20.0	13,820	145,110		
			19	13	D6	52,706	600	2.0	S	17.2	5,600	11,200		
			20	D6	14	21,103	500	0.2	S	0.8	4,540	908		
			21	14	15	10,552	400	4.2	S	13.3	3,650	15,330		
			22	D6	16	47,414	600	1.0	S	7.1	5,600	5,600		
			23	16	17	15,805	500	5.5	S	12.4	4,540	24,970		
			24	16	18	15,805	500	4.5	S	10.1	4,540	20,430		
			25	16	19	15,805	400	1.0	S	6.7	3,650	3,650		
			26	17	19	4,741	300	6.5	AC	19.0	1,490	9,685		
			27	17	18	4,741	300	4.5	AC	13.2	1,490	6,705		
			28	13	D7	35,300	500	2.6	S	25.9	4,540	11,804		
			29	D7	20	46,340	600	0.8	S	5.4	5,600	4,480		
			30	20	21	4,001	300	5.8	AC	12.4	1,490	8,642		
			31	20	22	42,339	600	2.0	S	11.5	5,600	11,200		
			32	22	23	20,005	500	7.5	S	26.1	4,540	34,050		
			33	22	24	17,832	500	5.0	S	14.1	4,540	22,700		
			34	24	25	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total								163.5 km				977,348		

Grand Total

Construction Cost	Land Cost
2,244,060	177,000

Total Project Cost

2,421,060

Alternative : 2-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	RO	Pro	312,000						66,915	1,600	2,000
Raw Water Pipe (1500 mm Steel Pipe)			Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)		
		Pro	261,888	Chaopraya River	T1	312,000	7.0		26,400	184,800	0	0
Treatment Plant						Q(D.max)					
	T1	Pro				283,000				656,017	110,000	137,500
Distribution Reservoir			(cu m)								
	D1	Pro	18,000							152,700	0	0
	D2	Pro	20,600							163,200	6,000	18,750
	D3	Pro	2,000							16,900	0	0
	D4	Pro	2,200							17,500	0	0
	D6	Pro	8,800							67,000	6,000	18,750
	D7	Pro	9,000							89,200	0	0
	ED1	Ex	2,000							-		
	ED2	Ex	1,000							-		
	ED3	Ex	1,000							-		
	ED4	Ex	500							-		
Sub-Total			65,100							506,500	12,000	37,500

Transmission/ Distribution Main	Pipe No	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Baht 1000)
	1	T1	D2	172,382	1200	9.0	S	23.7	18,400	165,600
	2	D2	1	194,120	1000	0.5	S	4.0	13,820	6,910
	3	1	2	47,099	800	7.0	S	12.1	9,250	64,750
	4	1	3	18,840	500	6.0	S	18.7	4,540	27,240
	5	1	4	123,471	1000	8.0	S	27.6	13,820	110,560
	6	4	D1	88,223	800	0.7	S	3.8	9,250	6,475
	7	4	D3	11,699	400	2.0	S	7.7	3,650	7,300
	8	D1	7	108,153	800	2.7	S	21.6	9,250	24,975
	9	D3	5	15,208	500	12.0	S	25.2	4,540	54,480
	10	5	6	3,042	300	10.5	AC	13.5	1,490	15,645
	11	7	D4	21,791	600	8.5	S	14.3	5,600	47,600
	12	D4	8	28,329	500	5.8	S	38.5	4,540	26,332
	15	8	9	5,666	300	9.0	AC	36.6	1,490	13,410
	16	T1	10	94,376	900	3.0	S	10.5	10,510	31,530

Alternative : 2-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
	17	10	D6	47,024	700	6.5	S	21.4	6,610	42,965		
	18	D6	12	47,414	600	1.0	S	7.1	5,600	5,600		
	19	12	13	15,805	500	5.5	S	12.4	4,540	24,970		
	20	12	14	15,805	500	4.5	S	10.1	4,540	20,430		
	21	12	15	15,805	400	1.0	S	6.7	3,650	3,650		
	22	13	14	4,741	300	4.5	AC	13.2	1,490	6,705		
	23	13	15	4,741	300	6.5	AC	19.0	1,490	9,685		
	24	10	11	47,351	700	2.5	S	8.3	6,610	16,525		
	25	11	16	4,221	250	1.0	AC	5.7	1,090	1,090		
	27	11	D7	36,800	500	2.6	S	28.0	4,540	11,804		
	29	D7	17	46,340	600	0.8	S	5.4	5,600	4,480		
	30	17	18	4,001	300	5.8	AC	12.4	1,490	8,642		
	31	17	19	42,339	600	2.0	S	11.5	5,600	11,200		
	32	19	20	20,005	500	7.5	S	26.1	4,540	34,050		
	33	19	21	17,832	500	5.0	S	14.1	4,540	22,700		
	34	21	22	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total					Total	146.4 Km				845,553		

Grand Total

Construction Cost	Land Cost
2,259,785	177,000

Total Project Cost

2,436,785

Alternative : 2-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	RO	Pro	312,000						66,915	1,600	2,000
Raw Water Pipe (1500 mm Steel Pipe)			Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)			
		Pro	261,888	Chaopraya River	T1	312,000	7.0		26,400	184,800	0	0
Treatment Plant						Q(D.max)						
	T1	Pro				283,000				656,017	110,000	137,500
Distribution Reservoir			(cu m)									
	D1	Pro	18,000							152,700	0	0
	D2	Pro	19,100							163,200	6,000	18,750
	D3	Pro	2,000							16,900	0	0
	D4	Pro	2,200							17,500	0	0
	D6	Pro	13,000							99,000	6,000	18,750
	D7	Pro	9,000							89,200	0	0
	ED1	Ex	2,000							-		
	ED2	Ex	1,000							-		
	ED3	Ex	1,000							-		
	ED4	Ex	500							-		
Sub-Total			EXP							538,500	12,000	37,500

Transmission/ Distribution Main	Pipe No.	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Bx1000)
	1	T1	1	172,382	1000	2.5	S	16.0	13,820	34,550
	2	1	D2	72,460	800	6.5	S	24.8	9,250	60,125
	3	1	D1	99,922	900	7.0	S	27.3	10,510	73,570
	4	D2	2	94,199	800	0.5	S	3.1	9,250	4,625
	5	2	3	47,099	700	7.0	S	23.1	6,610	46,270
	6	2	4	18,840	500	6.0	S	18.7	4,540	27,240
	7	2	5	23,550	600	6.7	S	13.0	5,600	37,520
	8	D1	6	86,361	600	0.7	S	15.0	5,600	3,920
	9	6	7	43,181	600	4.0	S	23.8	5,600	22,400
	10	D1	10	21,791	500	2.7	S	11.0	4,540	12,258
	11	D1	D3	11,699	300	2.7	AC	41.9	1,490	4,023
	12	10	D4	21,791	500	8.5	S	34.7	4,540	38,590
	13	D3	8	15,208	500	12.0	S	25.2	4,540	54,480
	14	8	9	3,042	300	10.5	AC	15.5	1,490	15,645

Alternative : 2-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)			Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
			15	D4	11	28,329	500	5.8	S	38.5	4,540	26,332		
			16	11	12	5,666	300	9.0	AC	36.6	1,490	13,410		
			17	T1	13	89,506	800	5.5	S	31.1	9,250	50,875		
			18	13	D6	52,706	600	2.0	S	17.2	5,600	11,200		
			19	D6	14	21,103	400	0.2	S	2.3	3,650	730		
			20	14	15	10,552	400	4.2	S	13.3	3,650	15,330		
			21	D6	16	47,414	600	1.0	S	7.1	5,600	5,600		
			22	16	17	15,805	500	5.5	S	12.4	4,540	24,970		
			23	16	18	15,805	500	4.5	S	10.1	4,540	20,430		
			24	16	19	15,805	400	1.0	S	6.7	3,650	3,650		
			25	17	19	4,741	300	6.5	AC	19.0	1,490	9,685		
			26	17	18	4,741	300	4.5	AC	13.2	1,490	6,705		
			27	13	D7	35,300	500	2.6	S	25.9	4,540	11,804		
			28	D7	20	46,340	500	0.8	S	13.2	4,540	3,632		
			29	20	21	4,001	300	5.8	AC	12.4	1,490	8,642		
			30	20	22	42,339	600	2.0	S	11.5	5,600	11,200		
			31	22	23	20,005	500	7.5	S	26.1	4,540	34,050		
			32	22	24	17,832	500	5.0	S	14.1	4,540	22,700		
			33	24	25	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total							155.7 km					734,411		

Grand Total

Construction Cost	Land Cost
2,180,643	177,000

Total Project Cost

2,357,643

Alternative : 3-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	RO	Pro	312,000						66,915	1,600	2,000
Raw Water Pipe (1500 mm Steel Pipe)		Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)			
		Pro	261,888	Chaopraya River	T1	312,000	0.2	26,400	5,280	0	0
Treatment Plant					Q(D.max)						
	T1	Pro			283,000				656,017	110,000	137,500
Distribution Reservoir		(cu m)									
	D1	Pro	18,000						152,700	0	0
	D2	Pro	20,600						163,200	6,000	18,750
	D3	Pro	2,000						16,900	0	0
	D4	Pro	2,200						17,500	0	0
	D6	Pro	8,800						67,000	6,000	18,750
	D7	Pro	9,000						89,200	0	0
	ED1	Ex	2,000						-		
	ED2	Ex	1,000						-		
	ED3	Ex	1,000						-		
	ED4	Ex	500						-		
Sub-Total			65,100						506,500	12,000	37,500

Transmission/ Distribution Main	Pipe No	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Baht 1000)
	1	T1	D2	172,382	1200	9.0	S	23.7	18,400	165,600
	2	D2	1	194,120	1000	0.5	S	4.0	13,820	6,910
	3	1	2	47,099	800	7.0	S	12.1	9,250	64,750
	4	1	3	18,840	500	6.0	S	18.7	4,540	27,240
	5	1	4	123,471	1000	8.0	S	27.6	13,820	110,560
	6	4	D1	88,223	800	0.7	S	3.8	9,250	6,475
	7	4	D3	11,699	400	2.0	S	7.7	3,650	7,300
	8	D1	7	108,153	800	2.7	S	21.6	9,250	24,975
	9	D3	5	15,208	500	12.0	S	25.2	4,540	54,480
	10	5	6	3,042	300	10.5	AC	13.5	1,490	15,645
	11	7	D4	21,791	600	8.5	S	14.3	5,600	47,600
	12	D4	8	28,329	500	5.8	S	38.5	4,540	26,332
	15	8	9	5,666	300	9.0	AC	36.6	1,490	13,410
	16	T1	10	94,376	900	3.0	S	10.5	10,510	31,530

Alternative : 3-1

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)			Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
			17	10	D6	47,024	700	6.5	S	21.4	6,610	42,965		
			18	D6	12	47,414	600	1.0	S	7.1	5,600	5,600		
			19	12	13	15,805	500	5.5	S	12.1	4,540	24,970		
			20	12	14	15,805	500	4.5	S	10.1	4,540	20,430		
			21	12	15	15,805	400	1.0	S	6.7	3,650	3,650		
			22	13	14	4,741	300	4.5	AC	13.2	1,490	6,705		
			23	13	15	4,741	300	6.5	AC	19.0	1,490	9,685		
			24	10	11	47,351	700	2.5	S	8.3	6,610	16,525		
			25	11	16	4,221	250	1.0	AC	5.7	1,090	1,090		
			27	11	D7	36,800	500	2.6	S	28.0	4,540	11,804		
			29	D7	17	46,340	600	0.8	S	5.4	5,600	4,480		
			30	17	18	4,001	300	5.8	AC	12.4	1,490	8,642		
			31	17	19	42,339	600	2.0	S	11.5	5,600	11,200		
			32	19	20	20,005	500	7.5	S	26.1	4,540	34,050		
			33	19	21	17,832	500	5.0	S	14.1	4,540	22,700		
			34	21	22	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total							Total	146.4 Km				845,553		

Grand Total

Construction Cost	Land Cost
2,080,265	177,000

Total Project Cost

2,257,265

Alternative : 3-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)	Design Capa					Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
Raw Water Intake Pumping Station											
	R0	Pro	312,000						66,915	1,500	2,000
Raw Water Pipe (1500 mm Steel Pipe)			Q(D.Max)	From	To		Length (km)	H.Loss (m)	Unit Cost (Baht/m)		
		Pro	261,888	Chaopraya River	T1	312,000	0.2		26,400	5,280	0	0
Treatment Plant						Q(D.max)					
	T1	Pro				283,000				656,017	110,000	137,500
Distribution Reservoir			(cu m)								
	D1	Pro	18,000							152,700	0	0
	D2	Pro	19,100							163,200	6,000	18,750
	D3	Pro	2,000							16,900	0	0
	D4	Pro	2,200							17,500	0	0
	D6	Pro	13,000							99,000	6,000	18,750
	D7	Pro	9,000							89,200	0	0
	ED1	Ex	2,000							-		
	ED2	Ex	1,000							-		
	ED3	Ex	1,000							-		
	ED4	Ex	500							-		
Sub-Total			67,800							538,500	12,000	37,500

Transmission/ Distribution Main	Pipe No.	From	To	Design Q (cu m/d)	Dia. (mm)	Length (Km)	Material	Fric.Loss (m)	Unit Cost (Baht/m)	Cost (Bx1000)
	1	T1	1	172,382	1000	2.5	S	16.0	13,820	34,550
	2	1	D2	72,460	800	6.5	S	24.8	9,250	60,125
	3	1	D1	99,922	900	7.0	S	27.3	10,510	73,570
	4	D2	2	94,199	800	0.5	S	3.1	9,250	4,625
	5	2	3	47,099	700	7.0	S	23.1	6,610	46,270
	6	2	4	18,840	500	6.0	S	18.7	4,540	27,240
	7	2	5	23,550	600	6.7	S	13.0	5,600	37,520
	8	D1	6	86,361	600	0.7	S	15.0	5,600	3,920
	9	6	7	43,181	600	4.0	S	23.8	5,600	22,400
	10	D1	10	21,791	500	2.7	S	11.0	4,540	12,258
	11	D1	D3	11,699	300	2.7	AC	41.9	1,490	4,023
	12	10	D4	21,791	500	8.5	S	34.7	4,540	38,590
	13	D3	8	15,208	500	12.0	S	25.2	4,540	54,480
	14	8	9	3,042	300	10.5	AC	13.5	1,490	15,645

Alternative : 3-2

Facility	Ref.	Status	Capacity Q(D.Ave) (cu m/d)			Design Capa						Cost (Bx1000)	Land Area (sq m)	Land Cost (Bx1000)
			15	D4	11	28,329	500	5.8	S	38.5	4,540	26,332		
			16	11	12	5,666	300	9.0	AC	36.6	1,490	13,410		
			17	T1	13	89,506	800	5.5	S	31.1	9,250	50,875		
			18	13	D6	52,706	600	2.0	S	17.2	5,600	11,200		
			19	D6	14	21,103	400	0.2	S	2.3	3,650	730		
			20	14	15	10,552	400	4.2	S	13.3	3,650	15,330		
			21	D6	16	47,414	600	1.0	S	7.1	5,600	5,600		
			22	16	17	15,805	500	5.5	S	12.4	4,540	24,970		
			23	16	18	15,805	500	4.5	S	10.1	4,540	20,430		
			24	16	19	15,805	400	1.0	S	6.7	3,650	3,650		
			25	17	19	4,741	300	6.5	AC	19.0	1,490	9,685		
			26	17	18	4,741	300	4.5	AC	13.2	1,490	6,705		
			27	13	D7	35,300	500	2.6	S	25.9	4,540	11,804		
			28	D7	20	46,340	500	0.8	S	13.2	4,540	3,632		
			29	20	21	4,001	300	5.8	AC	12.4	1,490	8,642		
			30	20	22	42,339	600	2.0	S	11.5	5,600	11,200		
			31	22	23	20,005	500	7.5	S	26.1	4,540	34,050		
			32	22	24	17,832	500	5.0	S	14.1	4,540	22,700		
			33	24	25	7,829	400	5.0	S	9.1	3,650	18,250		
Sub-Total								155.7 km				734,411		

Grand Total

Construction Cost	Land Cost
2,001,123	177,000

Total Project Cost

2,178,123

RAW WATER TRANSMISSION COST

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
A. Planned Daily Average Water Demand: Q(Zone i)DA (cu m/d)																						
Zone 1 (Prachatipat)	5,639	6,167	7,202	8,289	9,437	12,625	15,349	18,275	21,239	24,247	27,285	30,373	33,273	36,231	39,249	41,957	43,939	46,049	48,243	50,526	52,898	55,360
Zone 2 (Rangsit)	0	0	161	660	1,502	35,491	38,910	40,372	41,954	43,660	45,485	47,441	48,787	50,160	51,561	52,584	53,494	54,734	56,042	57,418	58,865	60,384
Zone 3 (Thanyaburi)	338	364	511	667	828	1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
Zone 4 (Lam Luka)	2,316	2,592	2,946	3,280	3,602	4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
Zone 5 (Sam Khok)	0	0	0	0	0	1,132	2,268	3,391	4,542	5,720	6,926	8,160	9,332	10,509	11,691	12,023	12,214	12,451	12,700	12,963	13,238	13,528
Zone 6 (Muang)	0	0	0	0	0	4,150	5,538	6,809	8,112	12,955	14,319	15,714	17,085	18,480	19,901	21,904	22,977	24,323	25,735	27,215	28,767	30,394
Zone 7 (Municip.)	3,284	3,624	3,999	4,352	4,695	6,231	7,482	8,818	10,156	11,501	12,846	14,200	15,544	16,905	18,283	19,316	20,014	21,023	22,099	23,214	24,400	25,648
Zone 8 (L.Lum Kaeo)	0	0	0	0	0	0	0	0	0	0	1,286	1,716	1,973	2,234	2,498	3,328	3,600	3,875	4,154	4,437	4,726	5,019
Total (Zone i)	11,577	12,746	14,820	17,248	20,063	65,037	75,614	84,574	93,892	107,100	118,430	129,309	138,708	148,287	158,051	167,472	173,795	181,827	190,275	199,152	208,469	218,240
B. Planned Daily Maximum Water Demand: Q(Zone i)DM *(cu m/d) Peak Factor = 1.20																						
Zone 1 (Prachatipat)	6,767	7,400	8,643	9,947	11,324	15,150	18,418	21,930	25,487	29,096	32,742	36,447	39,927	43,478	47,099	50,348	52,727	55,258	57,892	60,632	63,478	66,432
Zone 2 (Rangsit)	0	0	194	793	1,802	42,590	46,692	48,447	50,345	52,392	54,582	56,930	58,545	60,192	61,874	63,100	64,193	65,681	67,250	68,902	70,638	72,460
Zone 3 (Thanyaburi)	406	436	614	800	994	1,478	1,903	2,247	2,609	2,991	3,392	3,814	4,269	4,744	5,240	6,095	6,635	7,515	8,459	9,469	10,548	11,699
Zone 4 (Lam Luka)	2,779	3,110	3,535	3,936	4,323	5,011	5,378	6,044	6,858	7,828	8,948	10,233	10,988	11,777	12,602	13,537	14,433	15,732	17,115	18,584	20,142	21,791
Zone 5 (Sam Khok)	0	0	0	0	0	1,359	2,722	4,070	5,450	6,864	8,311	9,791	11,198	12,610	14,029	14,428	14,656	14,941	15,240	15,555	15,886	16,232
Zone 6 (Muang)	0	0	0	0	0	4,980	6,646	8,171	9,734	15,546	17,182	18,857	20,502	22,177	23,881	26,284	27,573	29,188	30,892	32,658	34,521	36,473
Zone 7 (Municip.)	3,941	4,349	4,798	5,222	5,633	7,477	8,978	10,582	12,188	13,801	15,415	17,040	18,653	20,286	21,939	23,179	24,017	25,228	26,507	27,857	29,280	30,777
Zone 8 (L.Lum Kaeo)	0	0	0	0	0	0	0	0	0	0	1,543	2,059	2,368	2,680	2,997	3,994	4,320	4,650	4,985	5,325	5,671	6,023
Total (Zone i)	13,993	15,295	17,784	20,697	24,076	78,045	90,737	101,489	112,670	128,520	142,116	155,171	166,450	177,945	189,661	200,966	208,554	218,193	228,330	238,982	250,163	261,888

1. Transmission Pipe

Alternative	Design Flow Q 2011 (cu m/d)	Dia (mm)	L (km)	Head Loss for Q(2011) V (m/sec)	Loss (m)
1-1 & 1-2	288,076	1,500	0.2	1.89	0.5
2-1 & 2-2	288,076	1,500	7.0	1.89	16.1
3-1 & 3-2	288,076	1,500	0.2	1.89	0.5

2. Required Pump Head and Flow Rate

Alternative	Total Head(m)	Flow in 2011 Qdm(cu m/min)	Required Water Demand in Each Year (cu m/d)																			
1-1 & 1-2	0.5	200.1	78,045	90,737	101,489	112,670	128,520	142,116	155,171	166,450	177,945	189,661	200,966	208,554	218,193	228,330	238,982	250,163	261,888			
2-1 & 2-2	16.1	200.1	78,045	90,737	101,489	112,670	128,520	142,116	155,171	166,450	177,945	189,661	200,966	208,554	218,193	228,330	238,982	250,163	261,888			
3-1 & 3-2	0.5	200.1	78,045	90,737	101,489	112,670	128,520	142,116	155,171	166,450	177,945	189,661	200,966	208,554	218,193	228,330	238,982	250,163	261,888			

3. Flow Rate in Daily Average Operation (cu m/d)

Alternative																						
1-1 & 1-2	65,037	75,614	84,574	93,892	107,100	118,430	129,309	138,708	148,287	158,051	167,472	173,795	181,827	190,275	199,152	208,469	218,240					
2-1 & 2-2	65,037	75,614	84,574	93,892	107,100	118,430	129,309	138,708	148,287	158,051	167,472	173,795	181,827	190,275	199,152	208,469	218,240					
3-1 & 3-2	65,037	75,614	84,574	93,892	107,100	118,430	129,309	138,708	148,287	158,051	167,472	173,795	181,827	190,275	199,152	208,469	218,240					

RAW WATER TRANSMISSION COST

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
4. Pump Characteristics																						
Alternative	Dia (mm)	Motor Power(Kw)	H (m)	Q (cu m/min/unit)	No.of Pump(unit)																	
1-1 & 1-2	800	200	12.0	66.7	3 (excluding 1 unit stand-by)																	
2-1 & 2-2	800	460	27.6	66.7	3 (excluding 1 unit stand-by)																	
3-1 & 3-2	800	200	12.0	66.7	3 (excluding 1 unit stand-by)																	
5. No.of Operating Pumps																						
Alternative																						
1-1 & 1-2					1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
2-1 & 2-2					1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
3-1 & 3-2					1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
6. Maxiaum Pump Capacity (cu m/d)																						
Alternative																						
1-1 & 1-2					96,025	96,025	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	288,076	288,076	288,076	288,076	288,076	288,076	288,076
2-1 & 2-2					96,025	96,025	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	288,076	288,076	288,076	288,076	288,076	288,076	288,076
3-1 & 3-2					96,025	96,025	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	192,051	288,076	288,076	288,076	288,076	288,076	288,076	288,076
7. Motor Output (Kw) ** including output for a stand-by pump																						
Alternative																						
1-1 & 1-2					400	400	600	600	600	600	600	600	600	600	600	800	800	800	800	800	800	800
2-1 & 2-2					920	920	1,380	1,380	1,380	1,380	1,380	1,380	1,380	1,380	1,380	1,840	1,840	1,840	1,840	1,840	1,840	1,840
3-1 & 3-2					400	400	600	600	600	600	600	600	600	600	600	800	800	800	800	800	800	800
8. Energy Consuaption (KwH/day) for Daily Average Demand																						
Alternative																						
1-1 & 1-2					3,251	3,780	4,228	4,693	5,354	5,920	6,464	6,934	7,412	7,900	8,371	8,687	9,089	9,511	9,955	10,421	10,909	
2-1 & 2-2					7,477	8,693	9,723	10,795	12,313	13,616	14,867	15,947	17,049	18,171	19,254	19,981	20,905	21,876	22,896	23,968	25,091	
3-1 & 3-2					3,251	3,780	4,228	4,693	5,354	5,920	6,464	6,934	7,412	7,900	8,371	8,687	9,089	9,511	9,955	10,421	10,909	

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

RAW WATER TRANSMISSION COST

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
9. Pump Operation Cost (Baht x1,000/year)																						
Alternative 1-1,1-2,3-1 & 3-2																						
Demand Charge						1,099	1,099	1,649	1,649	1,649	1,649	1,649	1,649	1,649	1,649	1,649	2,198	2,198	2,198	2,198	2,198	2,198
Energy Charge						1,460	1,697	1,898	2,107	2,403	2,658	2,902	3,113	3,328	3,547	3,758	3,900	4,080	4,270	4,469	4,678	4,898
Total Cost						2,559	2,796	3,547	3,756	4,052	4,307	4,551	4,762	4,977	5,196	5,957	6,099	6,279	6,468	6,668	6,877	7,096
																			Total of 1995 - 2011 =			85,944
Alternative 2-1 & 2-2																						
Demand Charge						2,528	2,528	3,792	3,792	3,792	3,792	3,792	3,792	3,792	3,792	3,792	5,056	5,056	5,056	5,056	5,056	5,056
Energy Charge						3,357	3,903	4,365	4,846	5,528	6,113	6,674	7,159	7,654	8,158	8,644	8,971	9,385	9,821	10,279	10,760	11,265
Total Cost						5,885	6,431	8,158	8,639	9,320	9,905	10,467	10,952	11,446	11,950	13,780	14,027	14,441	14,877	15,336	15,817	16,321
																			Total of 1995 - 2011 =			197,672

Note: Pumps is designed for Qda (Daily Maxiaua Demand) times 1.1
8 . Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(qla)/max.capacity of pump)
9. Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head, = 10 m)+(Pump Loss 1.5 m)
Electricity Fee = Rate of Provincial Electricity Authority (PEA) as of January, 1989.

Year	1,989	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
Operation Cost																							
Alt. 1-1,1-2,3-1 & 3-2	0	0	0.0	0.0	0.0	0.0	2.6	2.8	3.5	3.8	4.1	4.3	4.6	4.8	5.0	5.2	6.0	6.1	6.3	6.5	6.7	6.9	7.1
Alt. 2-1 & 2-2	0	0	0.0	0.0	0.0	0.0	0.0	5.9	6.4	8.2	8.6	9.3	9.9	10.5	11.0	11.4	12.0	13.7	14.0	14.4	14.9	15.3	15.8

Discount Rate 9.00 %
NPV
Alt. 1-1,1-2,3-1 & 3-2 22.85 Million Baht
Alt. 2-1 & 2-2 46.16 Million Baht

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-1

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011

1. Transmission Pipe : ******)) shows a starting year of water transmission — Head Loss for Q(2011) (m)

No	From	To	Design Flow Q 2011 (cu m/d)	Dia (mm)	L (km)	V (m/sec)	Loss (m)
1	T1	02	172,382	1,000	5.5	2.54	35.2
2	02	1	194,120	1,200	2.3	1.99	7.5
3	1	M.Nakn	18,720	400	1.2	1.31	11.0
4	1	2	175,400	1,200	4.5	1.79	12.2
5	2	3	18,840	500	6.0	1.11	19.7
6	2	4	156,560	1,200	8.0	1.60	17.6
7	4	01	88,223	700	0.7	2.65	7.4
8	4	03	11,699	400	2.8	1.08	7.7
9	01	7	108,153	800	2.7	2.19	21.6
10	03	5	15,208	500	12.8	0.90	25.2
11	5	6	3,042	300	10.5	0.59	13.5
12	7	04	21,791	600	8.5	0.84	14.3
13	04	8	28,329	500	5.8	1.47	38.5
14	8	9	5,666	300	9.0	0.93	36.6
15	T1	10	94,376	1,200	8.0	0.97	6.9
16	10	D6	47,024	700	4.5	1.41	14.8
17	06	12	47,414	600	1.0	1.94	7.1
18	12	13	15,805	500	5.5	0.95	12.4
19	12	14	15,805	500	4.5	0.93	10.1
20	12	15	15,805	400	1.0	1.46	6.7
21	13	14	4,741	300	4.5	0.78	15.2
22	13	15	4,741	300	6.5	0.78	19.0
23	10	11	47,351	700	2.5	1.42	8.3
24	11	16	4,221	250	1.0	1.00	5.7
25	11	07	36,800	600	2.6	1.51	11.5
26	07	17	46,340	600	0.8	1.90	5.4
27	17	18	4,001	300	5.8	0.66	12.4
28	17	19	42,339	600	2.0	1.75	11.5
29	19	20	20,005	500	7.5	1.18	26.1
30	19	21	17,832	500	5.0	1.05	14.1
31	21	22	1,829	400	5.0	0.72	9.1

Total 146.4 km

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-1

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2. Required Pump Head and Flow Rate						Y			E			A			R							
Routing Pipe No. / Total Loss(m) / Flow in 2011 QDH,HH(cu m/min)						Required Water Demand in Each Year (cu m/d)																
T1 1 / 35.2 / 119.7						64,229	72,391	78,667	85,298	92,308	99,665	107,423	113,729	120,191	126,814	133,081	137,988	144,186	150,716	157,587	164,806	172,382
T1 15-23-25 / 26.8 / 65.5						14,224	19,162	24,043	29,007	38,271	44,945	50,685	56,080	61,537	67,056	72,214	74,963	78,489	82,186	86,062	90,123	94,376
D1 9-12 / 35.9 / 75.1						17,184	22,224	27,799	33,600	39,645	45,905	52,427	58,162	64,042	70,070	76,085	80,613	86,082	91,834	97,875	104,211	110,851
D2 2-4-6-8 / 44.8 / 134.8						77,006	86,399	93,201	100,402	108,026	116,039	124,502	131,292	138,249	145,376	152,011	157,245	163,890	170,891	178,257	185,993	194,120
D3 10-11 / 38.7 / 10.6						1,921	2,474	2,921	3,392	3,889	4,409	4,958	5,549	6,167	6,812	7,924	8,625	9,770	10,997	12,309	13,712	15,208
D4 13 / 38.5 / 19.7						6,515	6,991	7,857	8,916	10,177	11,633	13,302	14,284	15,311	16,382	17,598	18,763	20,452	22,250	24,160	26,185	28,329
(D5)																						
D6 17-18 / 19.5 / 32.9						6,474	8,639	10,622	12,654	20,210	22,337	24,514	26,653	28,830	31,045	34,170	35,845	37,944	40,146	42,456	44,877	47,414
D7 26-28-30-31 / 43.0 / 32.2						8,220	10,172	12,256	14,344	16,441	20,546	23,329	25,827	28,356	30,918	33,825	35,339	37,341	39,439	41,637	43,936	46,340
(D8)																						
3. Flow Rate in Daily Average Operation (cu m/d)																						
T1 for Zone 1-4						15,369	53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,900	114,990	120,155	125,597	131,322	137,338
T1 for Zone 5-8						4,695	11,514	15,288	19,019	22,810	30,177	35,376	39,790	43,934	48,128	52,372	56,571	58,805	61,672	64,678	67,829	71,131
D1						13,867	18,032	21,416	25,183	29,128	33,263	37,569	42,078	45,987	49,999	54,117	58,317	61,496	65,421	69,555	73,904	78,473
D2						15,369	53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,900	114,990	120,155	125,597	131,322	137,338
D3						828	1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790
D4						3,602	4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785
(D5)																						
D6						0	4,150	5,538	6,809	8,112	12,955	14,319	15,714	17,085	18,480	19,901	21,904	22,977	24,323	25,735	27,215	28,767
D7						4,695	6,231	7,482	8,818	10,156	11,501	14,132	15,916	17,517	19,139	20,781	22,644	23,615	24,898	26,243	27,652	29,125
(D8)																						

4. Pump Characteristics

	Dia (mm)	Motor Power(Kw)	H (m)	Q (cu m/min/unit)	No.of Pump(unit)
T1 for Zone 1-4	600	470	46.7	39.9	3 (excluding 1 unit stand-by)
T1 for Zone 5-8	500	210	38.3	21.8	3 (excluding 1 unit stand-by)
D1	500	300	47.4	25.0	3 (excluding 1 unit stand-by)
D2	600	640	56.3	44.9	3 (excluding 1 unit stand-by)
D3	300	70	50.2	5.3	2 (excluding 1 unit stand-by)
D4	300	130	50.0	9.8	2 (excluding 1 unit stand-by)
(D5)					
D6	300	90	31.0	11.0	3 (excluding 1 unit stand-by)
D7	300	150	54.5	10.7	3 (excluding 1 unit stand-by)
(D8)					

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-1

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
5. No.of Operating Pumps																						
T1 for Zone 1-4						2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
T1 for Zone 5-8						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
D1						1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4
D2						2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
D3						1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
D4						1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
(D5)																						
D6						1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3
D7						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
(D8)																						
6.Maximum Pump Capacity (cu m/d)																						
T1 for Zone 1-4						114,921	114,921	114,921	114,921	114,921	114,921	114,921	114,921	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382
T1 for Zone 5-8						31,459	31,459	31,459	31,459	62,917	62,917	62,917	62,917	62,917	94,376	94,376	94,376	94,376	94,376	94,376	94,376	94,376
D1						36,051	36,051	36,051	36,051	72,102	72,102	72,102	72,102	72,102	72,102	108,153	108,153	108,153	108,153	108,153	108,153	144,204
D2						129,413	129,413	129,413	129,413	129,413	129,413	129,413	194,120	194,120	194,120	194,120	194,120	194,120	194,120	194,120	194,120	194,120
D3						7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	15,208	15,208	15,208	15,208	15,208	15,208	15,208
D4						14,164	14,164	14,164	14,164	14,164	14,164	14,164	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329
(D5)																						
D6						15,805	15,805	15,805	15,805	31,610	31,610	31,610	31,610	31,610	31,610	47,414	47,414	47,414	47,414	47,414	47,414	47,414
D7						15,447	15,447	15,447	15,447	30,893	30,893	30,893	30,893	30,893	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340
(D8)																						
7. Motor Output (Kw)																						
T1 for Zone 1-4						940	940	940	940	940	940	940	940	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410
T1 for Zone 5-8						210	210	210	210	420	420	420	420	420	630	630	630	630	630	630	630	630
D1						300	300	300	300	600	600	600	600	600	600	900	900	900	900	900	900	1,200
D2						1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920
D3						70	70	70	70	70	70	70	70	70	70	140	140	140	140	140	140	140
D4						130	130	130	130	130	130	130	260	260	260	260	260	260	260	260	260	260
(D5)																						
D6						90	90	90	90	180	180	180	180	180	180	270	270	270	270	270	270	270
D7						150	150	150	150	300	300	300	300	300	450	450	450	450	450	450	450	450
(D8)																						
Total						3,170	3,170	3,170	3,170	3,920	3,920	3,920	4,690	5,160	5,520	5,980	5,980	5,980	5,980	5,980	5,980	6,280

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-1

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			E			A			R							
8. Energy Consumption (KWH/day) for Daily Average Demand																						
I1 for Zone 1-4						3,017	10,587	11,842	12,869	13,954	15,101	16,304	17,573	18,605	19,662	20,746	21,771	22,573	23,587	24,656	25,780	26,961
I1 for Zone 5-8						752	1,845	2,449	3,047	3,654	4,835	5,668	6,375	7,039	7,711	8,391	9,065	9,421	9,881	10,362	10,867	11,396
D1						2,770	3,601	4,277	5,030	5,817	6,643	7,503	8,404	9,184	9,986	10,808	11,647	12,282	13,066	13,891	14,760	15,672
D2						3,648	12,705	14,320	15,561	16,873	18,260	19,715	21,250	22,497	23,776	25,086	26,325	27,296	28,522	29,814	31,173	32,601
D3							272	350	414	480	551	624	702	786	873	965	1,122	1,222	1,384	1,557	1,743	1,942
D4						795	928	987	1,109	1,259	1,437	1,643	1,878	2,017	2,162	2,313	2,485	2,649	2,888	3,142	3,411	3,697
(D5)																						
D6						0	0	0	0	0	0	0	2,148	2,335	2,526	2,720	2,994	3,140	3,324	3,517	3,719	3,932
D7						1,094	1,452	1,744	2,055	2,367	2,680	3,294	3,709	4,083	4,461	4,843	5,278	5,504	5,885	6,116	6,445	6,788
(D8)																						
Total						12,074	31,303	35,970	40,085	44,405	49,507	54,751	62,039	66,546	71,156	75,871	80,684	84,087	88,454	93,956	97,898	102,989
9. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge						8,711	8,711	8,711	8,711	10,772	10,772	10,772	12,888	14,180	15,169	16,433	16,433	16,433	16,433	16,433	16,433	17,257
Energy Charge						5,421	14,053	16,149	17,996	19,936	22,226	24,580	27,853	29,876	31,945	34,062	36,223	37,751	39,712	41,777	43,951	46,237
Total Cost						14,132	22,765	24,860	26,707	30,708	32,998	35,353	40,741	44,055	47,114	50,495	52,656	54,184	56,145	58,210	60,384	63,494
																					Total (1991-2011) =	715,003

Note: Pumps is designed for QDM (Daily Maximum Demand) for transmission, and for QHM (Hourly Maximum Demand) for distribution.
10. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(q1a)/max.capacity of pump)
11. Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head, =0)+(Residual Head 10.0 m)+(Pump Head 1.5 m)
DA : Daily Average
DM : Daily Maximum
HM : Hourly Maximum
Electricity Fee = Rate of Provincial Electricity Authority(PEA) as of January, 1989.

Year	1,989	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010
Operation Cost	0	0	0.0	0.0	0.0	0.0	14.1	22.8	24.9	26.7	30.7	33.0	35.4	40.7	44.1	47.1	50.5	52.7	54.2	56.1	58.2	60.4
Discount Rate	10.00 %																					
NPV	160.80 x Million Baht																					

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			E			A			R							

1. Transmission Pipe : ######>> shows a starting year of water transmission

No	From	To	Design Flow Q 2011 (cu m/d)	Dia (mm)	L (km)	Head Loss for Q(2011) V (m/sec)	(m) Loss (m)
1	T1	1	172,382	1,100	4.5	2.10	18.1
2	1	D2	72,469	800	1.0	1.67	3.8
3	1	D1	99,922	1,000	14.0	1.47	32.7
4	D2	2	94,199	1,000	2.3	1.39	4.8
5	2	Navnkn	18,720	400	1.2	1.72	11.0
6	2	3	75,479	1,000	4.5	1.11	6.3
7	3	4	18,840	500	6.0	1.11	18.7
8	3	5	23,550	600	5.5	0.96	10.7
9	D1	6	86,361	600	0.7	3.54	15.0
10	6	7	43,181	600	4.0	1.77	23.8
11	D1	10	21,791	500	2.7	1.28	11.0
12	D1	D3	11,699	300	2.7	1.92	41.9
13	10	D4	21,791	500	8.5	1.28	34.7
14	D3	8	15,208	500	12.0	0.90	25.2
15	8	9	3,042	300	10.5	0.50	13.5
16	D4	11	28,329	500	5.8	1.67	38.5
17	11	12	5,666	300	9.0	0.93	36.6
18	T1	13	89,586	1,000	10.5	1.32	20.0
19	13	D6	52,706	600	2.0	2.16	17.2
20	D6	14	21,103	500	0.2	1.24	0.8
21	14	15	10,552	400	4.2	0.97	13.3
22	D6	16	47,414	600	1.0	1.94	7.1
23	16	17	15,885	500	5.5	0.93	12.4
24	16	18	15,805	500	4.5	0.93	10.1
25	16	19	15,805	400	1.0	1.46	6.7
26	17	19	4,741	300	6.5	2.59	19.0
27	17	18	4,741	300	4.5	2.59	13.2
28	13	D7	35,300	500	2.6	2.08	25.9
29	D7	20	46,340	600	0.8	1.90	5.4
30	20	21	4,001	300	5.8	0.66	12.4
31	20	22	42,339	600	2.0	1.73	11.5
32	22	23	20,005	500	7.5	1.18	26.1
33	22	24	17,832	500	5.0	1.05	14.1
34	24	25	7,829	400	5.0	0.72	9.1
				Total	163.5 km		

Alternative : 1-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2. Required Pump Head and Flow Rate																						
Routing Pipe No.	Total Loss(m)	Flow in 2011 QOM,HM(cu m/min)				<<< ********** Required Water Demand in Each Year (cu m/d) ********** >>>																
T1 1-3	50.8	119.7				64,229	72,391	78,667	85,298	92,308	99,665	107,423	115,729	120,191	126,814	133,081	137,988	144,186	150,716	157,587	164,806	172,382
T1 18-28	45.9	62.2				13,816	18,346	22,822	27,372	36,212	42,452	47,748	52,721	57,753	62,847	67,885	70,566	74,007	77,614	81,395	85,357	89,506
B1 9-10	38.8	60.8				10,695	14,944	19,508	24,133	28,825	33,565	38,381	42,905	47,521	52,229	56,452	59,545	62,835	66,260	69,821	73,521	77,361
B1 11-13(Zone4)	45.7	15.1				5,011	5,378	6,044	6,858	7,828	8,948	10,233	10,988	11,777	12,602	13,537	14,433	15,732	17,115	18,584	20,142	21,791
B1 12 (Zone-3)	41.9	8.1				1,478	1,903	2,247	2,609	2,991	3,392	3,814	4,269	4,744	5,240	6,095	6,635	7,515	8,459	9,469	10,548	11,699
D2 4-6-7	29.8	65.4				55,367	60,700	62,980	65,448	68,110	70,957	74,008	76,108	78,250	80,436	82,030	83,450	85,385	87,425	89,572	91,829	94,199
D3 14-15	38.7	10.6				1,921	2,474	2,921	3,392	3,889	4,409	4,958	5,549	6,167	6,812	7,924	8,625	9,770	10,997	12,309	13,712	15,208
D4 16	38.5	19.7				6,515	6,991	7,857	8,916	10,177	11,633	13,302	14,284	15,311	16,382	17,598	18,763	20,452	22,250	24,160	26,185	28,329
(D5)																						
D6 22-23	19.5	47.6				8,241	12,178	15,913	19,739	29,134	33,142	37,243	41,210	45,223	49,283	52,926	54,898	57,368	59,959	62,677	65,528	68,518
D7 29-31-32	45.0	32.2				8,220	10,172	12,256	14,344	16,441	20,546	23,329	25,827	28,356	30,918	33,825	35,339	37,341	39,439	41,637	43,936	46,340
(D8)																						
3. Flow Rate in Daily Average Operation (cu m/d)																						
T1 for Zone 1-4						53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,908	114,990	120,155	125,597	131,322	137,338	143,652
T1 for Zone 5-8						11,514	15,288	19,019	22,810	30,177	35,376	39,790	43,934	48,128	52,372	56,571	58,805	61,672	64,678	67,829	71,131	74,588
B1 for Distribution						12,625	15,349	18,275	21,239	24,247	27,285	30,373	33,273	36,231	39,249	41,957	43,939	46,048	48,243	50,526	52,898	55,360
B1 for Transmission for Zone-4						4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
B1 for Transmission for Zone-3						1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
D2						35,491	38,910	40,372	41,954	43,660	45,485	47,441	48,787	50,160	51,561	52,584	53,494	54,734	56,042	57,418	58,865	60,384
D3						1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
D4						4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
(D5)																						
D6						5,283	7,806	10,201	12,653	18,676	21,245	23,874	26,417	28,989	31,592	33,927	35,191	36,774	38,435	40,178	42,005	43,922
D7						6,231	7,482	8,818	10,156	11,501	12,846	14,200	15,544	16,905	18,283	19,316	20,014	21,023	22,089	23,214	24,400	25,648
(D8)																						

4. Pump Characteristics

	Dia (mm)	Motor Power(Kw)	H (m)	Q (cu m/min/unit)	No.of Pump(unit)
T1 for Zone 1-4	600	630	62.3	39.9	3 (excluding 1 unit stand-by)
T1 for Zone 5-8	500	300	57.4	20.7	3 (excluding 1 unit stand-by)
B1 for Distribution	400	260	50.3	20.0	3 (excluding 1 unit stand-by)
B1 for Transmission for Zone-4	400	220	57.2	15.1	1 (excluding 1 unit stand-by)
B1 for Transmission for Zone-3	300	110	53.4	8.1	1 (excluding 1 unit stand-by)
D2	500	230	41.3	21.8	3 (excluding 1 unit stand-by)
D3	300	70	50.2	5.3	2 (excluding 1 unit stand-by)
D4	300	130	50.0	9.8	2 (excluding 1 unit stand-by)
(D5)					
D6	400	130	31.0	15.9	3 (excluding 1 unit stand-by)
D7	300	150	54.5	10.7	3 (excluding 1 unit stand-by)
(D8)					

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 1-2

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
5. No.of Operating Pumps																						
T1 for Zone 1-4						2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
T1 for Zone 5-8						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
D1 for Distribution						1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3
D1 for Transmission for Zone-4						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D1 for Transmission for Zone-3						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D2						2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
D3						1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
D4						1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
(D5)																						
D6						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
D7						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
(D8)																						
6.Maximum Pump Capacity (cu m/d)																						
T1 for Zone 1-4						114,921	114,921	114,921	114,921	114,921	114,921	114,921	114,921	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382
T1 for Zone 5-8						29,835	29,835	29,835	29,835	59,670	59,670	59,670	59,670	59,670	89,506	89,506	89,506	89,506	89,506	89,506	89,506	89,506
D1 for Distribution						28,787	28,787	28,787	28,787	57,574	57,574	57,574	57,574	57,574	57,574	57,574	86,361	86,361	86,361	86,361	86,361	86,361
D1 for Transmission for Zone-4						21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791
D1 for Transmission for Zone-3						11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699
D2						62,799	62,799	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199
D3						7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	15,208	15,208	15,208	15,208	15,208	15,208	15,208
D4						14,164	14,164	14,164	14,164	14,164	14,164	14,164	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329
(D5)																						
D6						22,839	22,839	22,839	22,839	45,678	45,678	45,678	45,678	45,678	68,518	68,518	68,518	68,518	68,518	68,518	68,518	68,518
D7 for Distribution						15,447	15,447	15,447	15,447	30,893	30,893	30,893	30,893	30,893	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340
(D8)																						
7. Motor Output (Kw)																						
T1 for Zone 1-4						1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890
T1 for Zone 5-8						300	300	300	300	600	600	600	600	600	900	900	900	900	900	900	900	900
D1 for Distribution						260	260	260	260	520	520	520	520	520	520	520	780	780	780	780	780	780
D1 for Transmission for Zone-4						220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
D1 for Transmission for Zone-3						110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
D2						460	460	690	690	690	690	690	690	690	690	690	690	690	690	690	690	690
D3						70	70	70	70	70	70	70	70	70	70	140	140	140	140	140	140	140
D4						130	130	130	130	130	130	130	260	260	260	260	260	260	260	260	260	260
(D5)																						
D6						130	130	130	130	260	260	260	260	260	390	390	390	390	390	390	390	390
D7						150	150	150	150	300	300	300	300	300	450	450	450	450	450	450	450	450
(D8)																						
Total						3,090	3,090	3,320	3,320	4,160	4,160	4,160	4,290	4,920	5,500	5,570	5,830	5,830	5,830	5,830	5,830	5,830

Water Transaission/Distribution Cost - Patua Thani & Prachatipat

Alternative : 1-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
8. Energy Consumption (KWH/day) for Daily Average Demand																						
T1 for Zone 1-4						14,084	15,874	17,250	18,704	20,241	21,854	23,556	24,938	26,356	27,808	29,182	30,258	31,617	33,049	34,556	36,139	37,800
T1 for Zone 5-8						2,779	3,689	4,590	5,505	7,282	8,527	9,602	10,602	11,614	12,639	13,652	14,191	14,883	15,609	16,369	17,166	18,000
D1 for Distribution						2,737	3,327	3,961	4,604	5,256	5,914	6,584	7,212	7,854	8,508	9,095	9,524	9,982	10,457	10,952	11,466	12,000
D1 for Transmission for Zone-4						1,012	1,086	1,220	1,385	1,581	1,807	2,066	2,219	2,378	2,544	2,733	2,914	3,177	3,456	3,753	4,067	4,400
D1 for Transmission for Zone-3						278	358	422	491	563	638	717	803	892	985	1,146	1,248	1,413	1,591	1,781	1,984	2,200
D2						734	788	885	1,005	1,147	1,311	1,499	1,610	1,725	1,846	1,983	2,114	2,305	2,507	2,723	2,951	3,192
D3							350	414	480	551	624	702	786	873	965	1,122	1,222	1,384	1,557	1,743	1,942	2,154
D4						920	987	1,109	1,259	1,437	1,643	1,878	2,017	2,162	2,313	2,485	2,649	2,888	3,142	3,411	3,697	4,000
(D5)																						
D6						0	0	0	0	0	0	0	3,609	3,960	4,316	4,635	4,807	5,074	5,251	5,439	5,738	6,000
D7						1,452	1,744	2,055	2,367	2,680	2,994	3,310	3,623	3,940	4,261	4,502	4,665	4,900	5,148	5,410	5,687	5,977
(D8)																						
Total						23,995	28,203	31,907	35,799	40,738	45,323	49,914	57,419	61,755	66,185	70,535	73,593	77,571	81,767	86,186	90,836	95,724
9. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge						8,491	8,491	9,123	9,123	11,432	11,432	11,432	11,789	13,520	15,114	15,306	16,021	16,021	16,021	16,021	16,021	16,021
Energy Charge						10,773	12,662	14,325	16,072	18,289	20,348	22,409	25,778	27,725	29,714	31,667	33,039	34,826	36,709	38,693	40,781	42,975
Total Cost						19,264	21,153	23,448	25,195	29,721	31,779	33,841	37,567	41,245	44,828	46,973	49,060	50,846	52,730	54,714	56,802	58,996
																					Total (1991-2011) =	678,163

Note: Pumps is designed for QDM (Daily Maximum Demand) for transmission, and for QHM (Hourly Maximum Demand) for distribution.
10. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actucl daily demand(q1s)/max.capecity of pump)
11. Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head, =0)+(Residual Head 10.0 m)+(Pump Loss 1.5 m)
DA : Daily Average
DM : Daily Maximum
HH : Hourly Maximum
Electricity Fee = Rate of Provincial Electricity Authority(PEA) as of January, 1989.

Year	1,989	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010
Operation Cost	0	0	0.0	0.0	0.0	0.0	19.3	21.2	23.4	25.2	29.7	31.8	33.8	37.6	41.2	44.8	47.0	49.1	50.8	52.7	54.7	56.8
Discount Rate	10.00 %																					
NPV	154.51 x Million Baht																					

Alternative : 2-1 & 3-1

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
1. Transmission Pipe : ******>> shows a starting year of water transmission																					Head Loss for Q(2011)DR	(m)

No	From	To	Design Flow Q 2011 (cu m/d)	Dia (mm)	L (km)	V (m/sec)	Loss (m)
1	T1	D2	172,382	1,200	9.0	1.76	25.7
2	D2	1	194,120	1,000	8.5	2.86	4.0
3	1	2	47,099	800	7.0	1.08	12.1
4	1	3	18,840	500	6.0	1.11	18.7
5	1	4	123,471	1,000	8.0	1.82	27.6
6	4	D1	88,223	800	0.7	2.03	3.6
7	4	D3	11,699	400	2.0	1.08	7.7
8	D1	7	108,153	800	2.7	2.49	21.6
9	D3	5	15,208	500	12.0	0.90	25.2
10	5	6	3,042	300	10.5	0.50	15.5
11	7	D4	21,791	600	8.5	0.89	14.3
12	D4	8	28,329	500	5.8	1.67	38.5
15	8	9	5,666	300	9.0	0.93	36.6
16	T1	10	94,376	900	3.0	1.72	10.5
17	10	D6	47,024	700	6.5	1.41	21.4
18	D6	12	47,414	600	1.0	1.94	7.1
19	12	13	15,805	500	5.5	0.93	12.4
20	12	14	15,805	500	4.5	0.93	10.1
21	12	15	15,805	400	1.0	1.46	6.7
22	13	14	4,741	300	4.5	0.78	13.2
23	13	15	4,741	300	6.5	0.78	19.0
24	10	11	47,351	700	2.5	1.42	8.3
25	11	16	4,221	250	1.0	1.00	5.7
27	11	D7	36,800	500	2.6	2.17	28.0
29	D7	17	46,340	600	0.8	1.90	5.4
30	17	18	4,001	300	5.8	0.66	12.4
31	17	19	42,339	600	2.0	1.73	11.5
32	19	20	20,005	500	7.5	1.18	26.1
33	19	21	17,832	500	5.0	1.05	14.1
34	21	22	7,829	400	5.0	0.72	9.1
				Total	146.4 km		

Water Transaission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 2-1 & 3-1

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
2 Required Pump Head and Flow Rate																						
Routing Pipe No.	Total Loss(m)	Flow in 2011 QDH,MH(cu m/min)				<<< ********** Required Water Demand in Each Year (cu m/d) ********** >>>																
T1 1	23.7	119.7				64,229	72,391	78,667	85,298	92,308	99,665	107,423	113,729	120,191	126,814	133,081	137,986	144,186	150,716	157,587	164,806	172,382
T1 14-22-24	46.8	65.5				14,224	19,162	24,043	29,007	38,271	44,945	50,685	56,080	61,537	67,056	72,214	74,965	78,489	82,186	86,062	90,123	94,376
D1 8-11	35.9	75.1				17,184	22,224	27,799	33,600	39,645	45,905	52,427	58,162	64,042	70,070	76,085	80,613	86,082	91,834	97,875	104,211	110,852
D2 2-5-7	43.1	134.8				77,006	86,399	93,201	100,402	108,026	116,039	124,502	131,292	138,249	145,376	152,011	157,245	163,890	170,891	178,257	185,997	194,120
D3 9-10	38.7	10.6				1,921	2,474	2,921	3,392	3,889	4,409	4,958	5,549	6,167	6,812	7,924	8,625	9,770	10,997	12,309	13,712	15,208
D4 12	38.5	19.7				6,515	6,991	7,857	8,916	10,177	11,633	13,302	14,284	15,311	16,382	17,598	18,763	20,452	22,250	24,160	26,185	28,329
(D5)																						
D6 16-17	19.5	32.9				6,474	8,639	10,622	12,654	20,210	22,337	24,514	26,653	28,830	31,045	34,170	35,845	37,944	40,146	42,456	44,877	47,414
D7 25-27-28	43.0	32.2				8,220	10,172	12,256	14,344	16,441	20,546	23,329	25,827	28,356	30,918	33,825	35,339	37,341	39,439	41,637	43,936	46,340
(D8)																						
3. Flow Rate in Daily Average Operation (cu m/d)																						
T1 for Zone 1-4						53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,900	114,990	120,155	125,597	131,322	137,338	143,652
T1 for Zone 5-8						11,514	15,288	19,019	22,810	30,177	35,376	39,790	43,934	48,128	52,372	56,571	58,805	61,672	64,678	67,829	71,131	74,588
D1						18,032	21,416	25,183	29,128	33,263	37,569	42,078	45,987	49,999	54,117	58,317	61,496	65,421	69,555	73,904	78,473	83,268
D2						53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,900	114,990	120,155	125,597	131,322	137,338	143,652
D3						1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
D4						4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
(D5)																						
D6						4,150	5,538	6,809	8,112	12,955	14,319	15,714	17,085	18,480	19,901	21,904	22,977	24,323	25,735	27,215	28,767	30,394
D7						6,231	7,482	8,818	10,156	11,501	14,132	15,916	17,517	19,139	20,781	22,644	23,615	24,898	26,243	27,652	29,125	30,666
(D8)																						

4. Pump Characteristics

	Dia (mm)	Motor Power(Kw)	H (m)	Q (cu m/min/unit)	No.of Pump(unit)
T1 for Zone 1-4	600	360	35.2	39.9	3 (excluding 1 unit stand-by)
T1 for Zone 5-8	500	320	58.3	21.8	3 (excluding 1 unit stand-by)
D1	500	300	47.4	25.0	3 (excluding 1 unit stand-by)
D2	600	620	54.6	44.9	3 (excluding 1 unit stand-by)
D3	300	70	50.2	5.3	2 (excluding 1 unit stand-by)
D4	300	130	50.0	9.8	2 (excluding 1 unit stand-by)
(D5)					
D6	400	130	31.0	16.5	2 (excluding 1 unit stand-by)
D7	400	220	54.5	16.1	2 (excluding 1 unit stand-by)
(D8)					

Alternative : 2-1 & 3-1

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			E			A			R								
5. No.of Operating Pumps																						
T1 for Zone 1-4						2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
T1 for Zone 5-8						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
D1						1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4
D2						2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
D3						1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
D4						1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
(D5)																						
D6						1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
D7						1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
(D8)																						
6.Maximum Pump Capacity (cu m/d)																						
T1 for Zone 1-4						114,921	114,921	114,921	114,921	114,921	114,921	114,921	114,921	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382
T1 for Zone 5-8						31,459	31,459	31,459	31,459	62,917	62,917	62,917	62,917	62,917	94,376	94,376	94,376	94,376	94,376	94,376	94,376	94,376
D1						36,051	36,051	36,051	36,051	72,102	72,102	72,102	72,102	72,102	72,102	108,153	108,153	108,153	108,153	108,153	108,153	144,204
D2						129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	194,120	194,120	194,120	194,120	194,120	194,120	194,120	194,120	194,120
D3						7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	15,208	15,208	15,208	15,208	15,208	15,208	15,208
D4						14,164	14,164	14,164	14,164	14,164	14,164	14,164	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329
(D5)																						
D6						23,707	23,707	23,707	23,707	23,707	23,707	47,414	47,414	47,414	47,414	47,414	47,414	47,414	47,414	47,414	47,414	47,414
D7						23,170	23,170	23,170	23,170	23,170	23,170	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340
(D8)																						
7. Motor Output (Kw)																						
T1 for Zone 1-4						720	720	720	720	720	720	720	720	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080
T1 for Zone 5-8						320	320	320	320	640	640	640	640	640	960	960	960	960	960	960	960	960
D1						300	300	300	300	600	600	600	600	600	600	900	900	900	900	900	900	1,200
D2						1,240	1,240	1,240	1,240	1,240	1,240	1,240	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860
D3						70	70	70	70	70	70	70	70	70	70	140	140	140	140	140	140	140
D4						130	130	130	130	130	130	130	260	260	260	260	260	260	260	260	260	260
(D5)																						
D6						130	130	130	130	130	130	260	260	260	260	260	260	260	260	260	260	260
D7						220	220	220	220	220	220	440	440	440	440	440	440	440	440	440	440	440
(D8)																						
Total						3,130	3,130	3,130	3,130	3,750	3,750	4,100	4,850	5,210	5,550	5,900	5,900	5,900	5,900	5,900	5,900	6,200

Alternative : 2-1 & 3-1

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
8. Energy Consumption (KWH/day) for Daily Average Demand																						
T1 for Zone 1-4						8,048	9,071	9,857	10,688	11,566	12,488	13,460	14,251	15,060	15,890	16,675	17,290	18,067	18,885	19,746	20,651	21,600
T1 for Zone 5-8						2,811	3,732	4,643	5,569	7,367	8,636	9,714	10,726	11,749	12,786	13,811	14,356	15,056	15,790	16,559	17,365	18,209
D1						3,601	4,277	5,038	5,817	6,643	7,503	8,404	9,184	9,986	10,808	11,647	12,282	13,066	13,891	14,760	15,672	16,630
D2						12,308	13,873	15,075	16,346	17,689	19,099	20,586	21,794	23,033	24,302	25,503	26,443	27,631	28,882	30,199	31,582	33,034
D3						272	350	414	480	551	624	702	786	873	965	1,122	1,222	1,384	1,557	1,743	1,942	2,154
D4						920	987	1,109	1,259	1,437	1,643	1,878	2,017	2,162	2,313	2,485	2,649	2,888	3,142	3,411	3,697	4,000
(D5)																						
D6						546	729	896	1,068	1,705	1,884	2,068	2,249	2,432	2,619	2,885	3,024	3,201	3,337	3,582	3,786	4,000
D7						1,420	1,705	2,009	2,314	2,621	3,220	3,627	3,992	4,361	4,736	5,160	5,381	5,674	5,980	6,301	6,637	6,988
(D8)																						
Total						29,927	34,724	39,034	43,541	49,580	55,099	60,439	64,998	69,657	74,419	79,286	82,648	86,966	91,515	96,302	101,333	106,616
9. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge						8,601	8,601	8,601	8,601	10,305	10,305	11,267	13,328	14,317	15,196	16,213	16,213	16,213	16,213	16,213	16,213	17,038
Energy Charge						13,436	15,589	17,524	19,548	22,259	24,737	27,134	29,181	31,273	33,410	35,595	37,105	39,043	41,086	43,235	45,493	47,865
Total Cost						22,037	24,191	26,125	28,149	32,564	35,042	38,401	42,509	45,590	48,607	51,809	53,318	55,257	57,299	59,448	61,707	64,903
																					Total (1991-2011) =	746,953

Note: Pumps is designed for QDH (Daily Maximum Demand) for transmission, and for QHM (Hourly Maximum Demand) for distribution.
10. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(q1a)/max.capacity of pump)
11. Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head, =0)+(Residual Head 10.0 m)+(Pump Loss 1.5 m)
DA : Daily Average
DM : Daily Maximum
HM : Hourly Maximum
Electricity Fee = Rate of Provincial Electricity Authority(PEA) as of January, 1989.

Year	1,989	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010
Operation Cost	0	0	0.0	0.0	0.0	0.0	22.8	24.2	26.1	28.1	32.6	35.0	38.4	42.5	45.6	48.6	51.8	53.3	55.3	57.3	59.4	61.7
Discount Rate	10.00 %																					
NPV	171.17 x Million Baht																					

Water Transaission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 2-2 & 3-2

Item				1990	1991	1992	1993	Y 1994	1995	1996	E 1997	1998	1999	A 2000	2001	2002	R 2003	2004	2005	2006	2007	2008	2009	2010	2011
1. Transaission Pipe : ******>> shows a starting year of water transaission																								Head Loss for Q(2011)	(m)
No	From	To	Design Flow Q 2011 (cu m/d)	Dia (mm)	L (km)																			V (m/sec)	Loss (m)
1	T1	1	172,382	1,000	2.5																			2.54	16.0
2	1	D2	72,460	800	6.5																			1.67	24.8
3	1	D1	99,922	900	7.0																			1.82	27.3
4	D2	2	94,199	800	0.5																			2.17	3.1
5	2	3	47,099	700	7.0																			1.42	23.1
6	2	4	18,840	500	6.0																			1.11	18.7
7	2	5	23,550	600	6.7																			0.96	13.0
8	D1	6	86,361	600	0.7																			3.54	15.0
9	6	7	43,181	600	4.0																			1.77	23.8
10	D1	10	21,791	500	2.7																			1.28	11.0
11	D1	D3	11,699	300	2.7																			1.92	41.9
12	10	D4	21,791	500	8.5																			1.28	34.7
13	D3	8	15,208	500	12.0																			0.90	25.2
14	8	9	3,042	300	10.5																			0.50	13.5
15	D4	11	28,329	500	5.8																			1.67	38.5
16	11	12	5,666	300	9.0																			0.93	36.6
17	T1	13	89,506	800	5.5																			2.06	31.1
18	13	D6	52,706	600	2.0																			2.16	17.2
19	D6	14	21,103	400	0.2																			1.34	2.3
20	14	15	10,552	400	4.2																			0.97	13.3
21	D6	16	47,414	600	1.0																			1.94	7.1
22	16	17	15,805	500	5.5																			0.93	12.4
23	16	18	15,805	500	4.5																			0.93	10.1
24	16	19	15,805	400	1.0																			1.46	6.7
25	17	19	4,741	300	6.5																			2.59	19.0
26	17	18	4,741	300	4.5																			2.59	13.2
27	13	D7	35,300	500	2.6																			2.08	25.9
28	D7	20	46,340	500	0.8																			2.73	13.2
29	20	21	4,001	300	5.8																			0.66	12.4
30	20	22	42,339	600	2.6																			1.73	11.5
31	22	23	20,005	500	7.5																			1.18	26.1
32	22	24	17,832	500	5.0																			1.05	14.1
33	24	25	7,829	400	5.0																			0.72	9.1
				Total	155.7 km																				

Alternative : 2-2 & 3-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2. Required Pump Head and Flow Rate																						
Routing Pipe No. / Total Loss(m) / Flow in 2011 QOM,HM(cu m/min)																						
T1 1-3 43.3 119.7						64,229	72,391	78,667	85,298	92,308	99,665	107,425	113,729	120,191	126,814	133,081	137,988	144,186	150,716	157,587	164,806	172,382
T1 17-27 57.0 62.2						13,816	18,346	22,822	27,372	36,212	42,452	47,748	52,721	57,753	62,847	67,885	70,566	74,007	77,614	81,395	85,357	89,506
D1 8-9 38.8 60.0						10,695	14,944	19,508	24,133	28,825	33,565	38,381	42,905	47,521	52,229	56,452	59,545	62,835	66,260	69,821	73,521	77,361
D1 11 (Zone-3) 41.9 8.1						1,478	1,903	2,247	2,609	2,991	3,392	3,814	4,269	4,744	5,240	6,095	6,635	7,515	8,459	9,469	10,548	11,699
D1 10-12(Zone4) 45.7 15.1						5,011	5,378	6,044	6,858	7,828	8,948	10,233	10,988	11,777	12,602	13,537	14,433	15,732	17,215	18,584	20,142	21,791
D2 4-5 26.2 65.4						55,367	60,700	62,989	65,448	68,110	70,957	74,008	76,108	78,250	80,436	82,030	83,450	85,385	87,425	89,572	91,829	94,199
D3 13-14 38.7 10.6						1,921	2,474	2,921	3,392	3,889	4,409	4,958	5,549	6,167	6,812	7,924	8,625	9,770	10,997	12,309	13,712	15,208
D4 15 38.5 19.7						6,515	6,991	7,857	8,916	10,177	11,633	13,302	14,284	15,311	16,382	17,598	18,763	20,452	22,250	24,160	26,185	28,329
(D5)																						
D6 21-22 19.5 47.6						8,241	12,178	15,913	19,739	29,134	33,142	37,243	41,210	45,223	49,283	52,926	54,898	57,368	59,959	62,677	65,528	68,518
D7 28-30-31 50.8 32.2						8,220	10,172	12,256	14,344	16,441	20,546	23,329	25,827	28,356	30,918	33,825	35,339	37,341	39,439	41,637	43,936	46,340
(D8)																						
3. Flow Rate in Daily Average Operation (cu m/d)																						
T1 for Zone 1-4						53,524	60,326	65,556	71,082	76,923	83,054	89,519	94,774	100,159	105,679	110,900	114,998	120,155	125,597	131,322	137,338	143,652
T1 for Zone 5-8						11,514	15,288	19,019	22,810	30,177	35,376	39,790	43,934	48,128	52,372	56,571	58,805	61,672	64,678	67,829	71,131	74,588
D1 for Distribution						12,625	15,349	18,275	21,239	24,247	27,285	30,373	33,273	36,231	39,249	41,957	43,939	46,048	48,243	50,526	52,878	55,360
D1 for Transmission for Zone-3						1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
D1 for Transmission for Zone-4						4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
D2						35,491	38,910	40,372	41,954	43,660	45,485	47,441	48,787	50,160	51,561	52,584	53,494	54,734	56,042	57,418	58,865	60,384
D3						1,232	1,586	1,872	2,174	2,493	2,826	3,178	3,557	3,953	4,367	5,079	5,529	6,263	7,049	7,891	8,790	9,749
D4						4,176	4,481	5,037	5,715	6,524	7,457	8,527	9,157	9,815	10,501	11,281	12,027	13,110	14,263	15,487	16,785	18,159
(D5)																						
D6						5,283	7,806	10,201	12,653	18,676	21,245	23,874	26,417	28,989	31,592	33,927	35,191	36,774	38,435	40,178	42,005	43,922
D7						6,231	7,482	8,818	10,156	11,501	12,846	14,200	15,544	16,905	18,283	19,316	20,014	21,023	22,089	23,214	24,400	25,648
(D8)																						

4. Pump Characteristics

	Dia (mm)	Motor Power(Kw)	H (m)	Q (cu m/min/unit)	No.of Pump(unit)
T1 for Zone 1-4	600	550	54.8	39.9	3 (excluding 1 unit stand-by)
T1 for Zone 5-8	500	360	68.5	28.7	3 (excluding 1 unit stand-by)
D1 for Distribution	400	260	50.3	20.0	3 (excluding 1 unit stand-by)
D1 for Transmission for Zone-3	300	110	53.4	8.1	1 (excluding 1 unit stand-by)
D1 for Transmission for Zone-4	400	220	57.2	15.1	1 (excluding 1 unit stand-by)
D2	500	210	37.7	21.8	3 (excluding 1 unit stand-by)
D3	300	70	50.2	5.3	2 (excluding 1 unit stand-by)
D4	300	130	50.6	9.8	2 (excluding 1 unit stand-by)
(D5)					
D6	500	190	31.0	23.8	2 (excluding 1 unit stand-by)
D7	400	260	62.3	16.1	2 (excluding 1 unit stand-by)
(D8)					
				Total	22

Alternative : 2-2 & 3-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
5. No.of Operating Pumps																						
T1 for Zone 1-4						2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
T1 for Zone 5-8						1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3
D1 for Distribution						1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3
D2 for Transmission for Zone-3						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D1 for Transmission for Zone-4						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D2						2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
D3						1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
D4						1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
(D5)																						
D6						1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
D7						1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
(D8)																						
6.Maximum Pump Capacity (cu m/d)																						
T1 for Zone 1-4						114,921	114,921	114,921	114,921	114,921	114,921	114,921	114,921	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382	172,382
T1 for Zone 5-8						29,835	29,835	29,835	29,835	59,670	59,670	59,670	59,670	59,670	89,506	89,506	89,506	89,506	89,506	89,506	89,506	89,506
D1 for Distribution						28,787	28,787	28,787	28,787	57,574	57,574	57,574	57,574	57,574	57,574	57,574	86,361	86,361	86,361	86,361	86,361	86,361
D1 for Transmission for Zone-3						11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699	11,699
D1 for Transmission for Zone-4						21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791	21,791
D2						62,799	62,799	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199	94,199
D3						7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	7,604	15,208	15,208	15,208	15,208	15,208	15,208	15,208
D4						14,164	14,164	14,164	14,164	14,164	14,164	14,164	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329	28,329
(D5)																						
D6						34,259	34,259	34,259	34,259	34,259	34,259	68,518	68,518	68,518	68,518	68,518	68,518	68,518	68,518	68,518	68,518	68,518
D7						23,170	23,170	23,170	23,170	23,170	23,170	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340	46,340
(D8)																						
7. Motor Output (Kw)																						
T1 for Zone 1-4						1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
T1 for Zone 5-8						360	360	360	360	720	720	720	720	720	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080
D1 for Distribution						260	260	260	260	520	520	520	520	520	520	520	780	780	780	780	780	780
D1 for Transmission for Zone-3						110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
D1 for Transmission for Zone-4						220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
D2						420	420	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630
D3						70	70	70	70	70	70	70	70	70	70	140	140	140	140	140	140	140
D4						130	130	130	130	130	130	130	260	260	260	260	260	260	260	260	260	260
(D5)																						
D6						190	190	190	190	190	190	380	380	380	380	380	380	380	380	380	380	380
D7						260	260	260	260	260	260	520	520	520	520	520	520	520	520	520	520	520
(D8)																						
Total						3,120	3,120	3,330	3,330	3,950	3,950	4,400	4,530	5,080	5,440	5,510	5,770	5,770	5,770	5,770	5,770	5,770

Water Transmission/Distribution Cost - Patum Thani & Prachatipat

Alternative : 2-2 & 3-2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
					Y			E			A			R									
8. Energy Consumption (KwH/day) for Daily Average Demand																						
T1 for Zone 1-4					12,296	13,858	15,060	16,329	17,671	19,079	20,565	21,772	23,009	24,277	25,476	26,416	27,602	28,852	30,168	31,550	33,000	
T1 for Zone 5-8					3,334	4,427	5,508	6,606	8,739	10,245	11,523	12,723	13,937	15,167	16,382	17,029	17,860	18,730	19,643	20,599	21,600	
D1 for Distribution					2,737	3,327	3,961	4,604	5,256	5,914	6,584	7,212	7,854	8,508	9,095	9,524	9,982	10,457	10,952	11,466	12,000	
D1 for Transmission for Zone-3					278	358	422	491	563	638	717	803	892	985	1,146	1,248	1,413	1,591	1,781	1,984	2,200	
D1 for Transmission for Zone-4					1,012	1,086	1,220	1,385	1,581	1,807	2,066	2,219	2,378	2,544	2,733	2,914	3,177	3,456	3,753	4,067	4,400	
D2					670	719	808	917	1,047	1,197	1,369	1,470	1,575	1,686	1,811	1,931	2,104	2,289	2,486	2,694	2,915	
D3						350	414	480	551	624	702	786	873	965	1,122	1,222	1,384	1,557	1,743	1,942	2,154	
D4					920	987	1,109	1,259	1,437	1,643	1,878	2,017	2,162	2,313	2,485	2,649	2,888	3,142	3,411	3,697	4,000	
(D5)																						
D6					703	1,039	1,358	1,684	2,486	2,828	3,178	3,516	3,859	4,205	4,516	4,684	4,895	5,116	5,348	5,591	5,846	
D7					1,678	2,015	2,375	2,735	3,097	3,460	3,824	4,186	4,553	4,924	5,202	5,390	5,662	5,949	6,252	6,571	6,907	
(D8)																						
Total					23,628	28,167	32,235	36,490	42,427	47,434	52,405	56,703	61,092	65,573	69,969	73,007	76,966	81,140	85,536	90,161	95,022	
9. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge					8,574	8,574	9,151	9,151	10,855	10,855	12,091	12,448	13,960	14,949	15,141	15,856	15,856	15,856	15,856	15,856	15,856	
Energy Charge					10,608	12,646	14,472	16,382	19,048	21,296	23,527	25,457	27,427	29,439	31,412	32,777	34,554	36,428	38,401	40,478	42,660	
Total Cost					19,181	21,219	23,623	25,533	29,902	32,150	35,619	37,905	41,387	44,388	46,554	48,633	50,410	52,284	54,257	56,334	58,516	
																				Total (1991-2011) =		677,696

Note: Pumps is designed for QDH (Daily Maximum Demand) for transmission, and for QHH (Hourly Maximum Demand) for distribution.
10. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(q1a)/max.capacity of pump)
11. Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head, =0)+(Residual Head 10.0 m)+(Pump Loss 1.5 m)
DA : Daily Average
DM : Daily Maximum
HM : Hourly Maximum
Electricity Fee = Rate of Provincial Electricity Authority(PEA) as of January, 1989.

Year	1,989	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
Operation Cost	0	0	0.0	0.0	0.0	0.0	19.2	21.2	23.6	25.5	29.9	32.2	35.6	37.9	41.4	44.4	46.6	48.6	50.4	52.3	54.3	56.3	58.5
Discount Rate	9.00 %																						
NPV	176.93 x Million Baht																						

APPENDIX A-8-4

Capacity Calculation for the Water Treatment Plant and Distribution Reservoirs

Distribution Reservoir Capacity

Item	Alternative 1-1 2-1 3-1	Alternative 1-2 2-2 3-2
1. D-1		
a. Zone-1 Demand (Daily Max)	75,501	75,501
b. Zone-3 Demand (Daily Max)	11,699	11,699
c. Zone-4 Demand (Daily Max)	12,722	12,722
* Required reservoir volume = a*6hrs+(b+c)* 0.5 hr	19,384	19,384
** Proposed Reservoir **		
a. D-1 at exis.new Plant exis. Reservoir 2,000 + New construction 5,000)	7,000	7,000
b. D-1 at old Plant New construction 13,000)	13,000	13,000
Total	20,000	20,000
2. D-2		
a. Zone-2 Demand (Daily Max)	74,074	74,074
b. Zone-1 Demand (Daily Max)	75,501	75,501
c. Zone-3 Demand (Daily Max)	11,699	11,699
d. Zone-4 Demand (Daily Max)	12,722	12,722
* Required reservoir volume = a*6hrs+(b+c+d)* 0.5hr	20,600	
= a*6hrs		19,019
** Proposed Reservoir **		
New Construction	20,600	19,100
3. D-3		
a. Zone-3 Demand (Daily Max)	11,699	11,699
* Required reservoir volume = a*6hrs	2,925	2,925
** Proposed Reservoir **		
a. D-3 at exis.Plant exis. Reservoir 1,000 + New construction 2,000)	3,000	3,000

Distribution Reservoir Capacity

Item	Alternative 1-1 2-1 3-1	1-2 2-2 3-2
4. D-4		
a. Zone-4 Demand (Daily Max)	12,722	12,722
* Required reservoir volume = a*6hrs	3,181	3,181
** Proposed Reservoir **		
a. D-4 at exis.Plant exis. Reservoir 1,000 + New construction 2,200)	3,200	3,200
5. D-6		
a. Zone-5 Demand (Daily Max)	16,233	16,233
b. Zone-6 Demand (Daily Max)	34,859	34,859
* Required reservoir volume = b*6hrs	8,715	
= (a+b)*6hrs		12,773
** Proposed Reservoir **		
New Construction	8,800	13,000
6. D-7		
a. Zone-7 Demand (Daily Max)	30,777	30,777
b. Zone-8 Demand (Daily Max)	6,023	6,023
* Required reservoir volume = (a+b)*6hrs	9,200	9,200
** Existing Reservoir Volume		
a. D-7 at exis.new Plant exis. Reservoir 500 + New construction 9,000)	9,500	9,500

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
Planned Flow (Daily Max)	Q= 283,000 cu m/d = 11,792 cu m/hr = 196.5 cu m/min = 3.275 cu m/sec	Q= 141,500 cu m/d = 5,896 cu m/hr = 98.3 cu m/min = 1.638 cu m/sec
No. of Treatment Line	4 Lines 70,750 cu m/d x 4 lines	2 Lines 70,750 cu m/d x 2 lines
(1) Receiving Well		
Criteria	T= 1.5 min d= 5 m	T= 1.5 min d= 5 m
No.	1 unit	1 unit
Dimension	Circular Dia 9 m v= 318 cu m t= 1.6 min	Circular Dia 9 m v= 318 cu m t= 3.2 min
(2) Mixing Tank		
Criteria	T= 1.0 min	T= 1.0 min
Dimension	Square x 4 units L m x W m x D m x units 4.0 4.0 3.0 4 v = 192 cu m t = 1.0 min	Square x 2 units L m x W m x D m x units 4.0 4.0 3.0 2 v = 96 cu m t = 1.0 min
Mixer	Mechanical Flush Mixer	Mechanical Flush Mixer

Capacity Calculation for Treatment Plant

Item	Total Systen (for 2011)	Phase 1 (for 2001)
(3) Coagulant Mixer		
Coagulant	Solid Aluminum Sulphate (Al2(SO4)3) containing 15 % Al2-03	Solid Aluminum Sulphate (Al2(SO4)3) containing 15 % Al2 03
	Dosage Rate : 20-50 mg-solid alum/l Average 25 mg/l	Dosage Rate : 20-50 mg(Al2 03)/l Average 25 mg/l
	Coagulant Solution : 5 % solution	Coagulant Solution : 5 % solution
	Dosage Amount : 7,075 kg-Alum/day	Dosage Amount : 3,538 kg-Al2 03/day
	Coagulant Solution (5 % solution) = 142 cu m/day	Coagulant Solution (5 %) = 71 cu m/day
No. of Mixer	8 units	4 units
Type	Batch Type Mixing	Batch Type Mixing
Capacity	17.7 cu m/unit	17.7 cu m/unit
Dimension	Square x 8 units L m x W m x D m x units 3.0 3.0 2.0 8	Square x 4 units L m x W m x D m x units 3.0 3.0 2.0 4
	v = 18.0 cu m/unit	v = 18.0 cu m/unit
	Total V = 144.0 cu m	V = 72.0 cu m

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(4) Flocculator		
Type	Mechanical Flocculator	Mechanical Flocculator
No.	N = 4 lines x 4 units	N = 2 lines x 4 units
	= 16 units	= 8 units
Unit Flow	q = 12.28 cu m/min/unit	q = 12.28 cu m/min/unit
Criteria	T = 30 min	T = 30 min
	n = 3 stages	n = 3 stages
Dimension	W m x L m x D m x n stages	W m x L m x D m x n stages
	10 3.6 3.6 3	10 3.6 3.6 3
	v = 389 cu m/unit	v = 389 cu m/unit
	t = 31.7 min	t = 31.7 min

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(5) Sedimentation Basin		
Type	Rectanglar, Horizontal Flow	Rectanglar, Horizontal Flow
No.	N = 4 line x 4 basins = 16 basins	N = 2 line x 4 basins = 8 basins
Unit Flow	q = 737.0 cu m/hr/basin	q = 737.0 cu m/hr/basin
Criteria	Retention Time T = 4 hours	Retention Time T = 4 hours
Dimension	W max L max D max N 12 50 5.0 16	W max L max D max N 12 50 5.0 8
	v = 3,000 cu m/basin	v = 3,000 cu m/basin
	t = 4.1 hours	t = 4.1 hours
Flow velocity	v = 20.5 cm/min	v = 20.5 cm/min
Surface Load	a = 29.5 m3/m2/day	a = 29.5 m3/m2/day
Sludge Removal	Mechanical Scraper	Mechanical Scraper
Sludge Amount		
Solid Amount (ton-DS)	So = Q(K(T1-T2)+0.16xB)x10^-6 where So:Sludge dry weight(ton) Q :Treated water amount(m3/d) K :Coefficient converting turbidity to SS (0.8-1.5 ->>1.2) T1 :Turbidity in raw water (ave 57) T2 :Turbidity after Sedimentation (ave = 7) B :Alum dosage rate (ave.= 25 mg/l)	
	So = 18.11 ton-DS/day	So = 9.06 ton-DS
	Water Contents of Drained Sludge	Water Contents of Drained Sludge
	w = 99.5 %	w = 99.5 %
	Sludge Volume	Sludge Volume
	v = 3,622 cu m/d	v = 1,811 cu m/d

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(6) Rapid Sand Filter		
Type	Down Flow, Single Media	Down Flow, Single Media
No.	N = 4 lines x 4 units = 16 units	N = 2 lines x 4 units = 8 units
Unit Flow	q = 17,688 cu m/day/unit	q = 17,688 cu m/day/unit
Criteria	Surface Load 120 - 150 m3/m2/day	Surface Load 120 - 150 m3/m2/day
Dimension	W m x L m x N units 10 15.0 16	W m x L m x N units 10 15.0 8
	a = 150 sq m/unit	a = 150 sq m/unit
Surface Load	La = 117.9 m3/m2/day	La = 117.9 m3/m2/day
Filter Washing		
Frequency	Once a day for each filter	Once a day for each filter
Rate	Surface Washing 0.2 m3/m2/min x 5 min Backwashing 0.6 m3/m2/min x 10 min	Surface Washing 0.2 m3/m2/min x 5 min Backwashing 0.6 m3/m2/min x 10 min
Water Amount required	Surface Washing v = 150 sq m/unit x 16 units x 0.2 m3/m2/min x 5 min = 2,400 cu m/day Backwashing v = 150 sq m/unit x 16 units x 0.6 m3/m2/min x 10 min = 14,400 cu m/day	Surface Washing v = 150 sq m/unit x 8 units x 0.2 m3/m2/min x 5 min = 1,200 cu m/day Backwashing v = 150 sq m/unit x 8 units x 0.6 m3/m2/min x 10 min = 7,200 cu m/day
	Total q= 16,800 cu m/day	Tota q = 8,400 cu m/day

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
Solid Amount in Wastewater		
Solid Amount (ton-DS)	So = Q*K*(T1-T2)*10^-6 where So:Sludge dry weight(ton) Q :Treated water amount(m3/d) K :Coefficient converting turbidity to SS (0.8-1.5 ->>1.2) T1 :Turbidity before filter(ave 7) T2 :Turbidity after filter(ave = 0) B :Alum dosage rate (ave.= 25 mg/l)	
	So = 2.38 ton-DS/day	So = 1.19 ton-DS
SS Contents	s = 142 mg/l	s = 142 mg/l

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(7) Clear Water Reservoir		
No.	N = 2 units	N = 1 units
Criteria	Retention Time	Retention Time
	T = 3 hours	T = 3 hours
Required Volume	V = 35,375 cu m	V = 17,688 cu m
Dimension	L m x W m x D m x N units 60 60 5 2	L m x W m x D m x N units 60 60 5 1
	Total Volume	Total Volume
	v = 36,000 cu m	v = 18,000 cu m
Retention Time	t = 3.1 hours	t = 3.1 hours
(8) Chlorination Equipment		
Injection Point	at the Inlet of Clear Water Reservoir	at the Inlet of Clear Water Reservoir
Dosage Rate	2.0 ppm	2.0 ppm
Type	Liquid Chlorine (1-ton cylinder)	Liquid Chlorine (1-ton cylinder)
Amount	566 kg- Cl gas/day	283 kg- Cl gas/day
Injector	Vacuum Type Injector	Vacuum Type Injector
	No. of unit 4 units (excl. 2 units stand-by)	No. of unit 2 units (excl. 1 units stand-by)
	Rate 5.90 kg/h/unit	Rate 5.90 kg/h/unit
	Capacity 10 kg/h/unit	Capacity 10 kg/h/unit
Storage	1 month	1 month
Storage Amount	566 kg /day x 30 day = 16,980 kg	283 kg /day x 30 day = 8,490 kg
	= 17 cylinders	= 9 cylinders

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(9) Sludge Lagoon		
Filter Washing Water	ql = 16,800 cu m/day	ql = 8,400 cu m/day
Retention Time	T = 1.0 day	T = 1.0 day
Required Volume	v = 16,800 cu m	v = 8,400 cu m
No of Lagoon	n = 2 units	n = 2 units
Dimension	(Bottom) L max W max D max N 68 33 3.0 2 (Top) L max W m 80 45	(Bottom) L max W max D max N 68 33 3 2 (Top) L max W m 80 45
	v = 17,532 cu m	v = 17,532 cu m
Side Slope	s = 1 : 2.0	s = 1 : 2.0
Retention Time	t = 1.04 Day	t = 2.09 Day

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)	Phase 1 (for 2001)
(10) Sludge Drying Bed		
Drain Water from Sedimentation Basin		
Volume	v1 = 3,622 cu m/d	v1 = 1,811 cu m/d
Solid	s1 = 18.1 ton-DS/d	s1 = 9.1 ton-DS/d
Drain Water from Sludge Lagoon (Thickened backwash water)		
Solid	s1 = 2.4 ton-DS/d	s1 = 1.2 ton-DS/d
Water Contents	w = 99.0 %	
Volume	v = 238 cu m/d	
Total Solid	s = s1 + s2 = 20.5 ton-DS/d	s = s1 + s2 = 10.2 ton-DS/d
Water Contents of Dried Sludge	w = 55 %	w = 55 %
Sludge Thickness	d = 60 cm after dried	d = 60 cm
Drying Period	t = 30 day	t = 30 day
Required Area	a = 2,277 sq m	a = 1,138 sq m
No of Unit	n = 4 units	n = 2 units
Type	Recutanglar, Concrete Made	
Dimension	L max W max D max N 30 20 1 4	(Bottom) L max W max D max N 30 20 1 2
Surface Area	a = 2,400 sq m at Bottom	a = 1,200 sq m at Bottom

Capacity Calculation for Treatment Plant

Item		Total System (for 2011)		Phase 1 (for 2001)
(11) Clear Water Pump				
for Zone 1-4				
No.	N =	3 units + 1 stand-by	N =	2 units + 1 stand-by
Flow per unit	q =	40.4 cu m/min/unit	q =	40.4 cu m/min/unit
Diameter	D =	600 mm	D =	600 mm
Head	H =	50 m	H =	50 m
Motor output	P =	560 KW	P =	560 KW
Total Capacity	Q =	174,528 cu m/day	Q =	116,352 cu m/day
for Zone 5-8				
No.	N =	3 units + 1 stand-by	N =	1 units + 1 stand-by
Flow per unit	q =	21.3 cu m/min/unit	q =	21.3 cu m/min/unit
Diameter	D =	400 mm	D =	400 mm
Head	H =	72 m	H =	72 m
Motor output	P =	300 KW	P =	300 KW
Total Capacity	Q =	92,016 cu m/day	Q =	30,672 cu m/day
(12) Sludge Lagoon Drain Pump				
No.	N =	2 units + 1 stand-by	N =	2 units + 1 stand-by
Quantity drained	Q =	16,800 cu m/day	Q =	8,400 cu m/day
Draining Time	t =	12.0 hours	t =	12.0 hours
Pump Flow	q =	11.7 cu m/min/unit	q =	11.7 cu m/min/unit
Diameter	D =	300 mm	D =	300 mm
Head	H =	10 m	H =	10 m
Motor output	P =	30 KW	P =	30 KW