(5) Alternative T-3

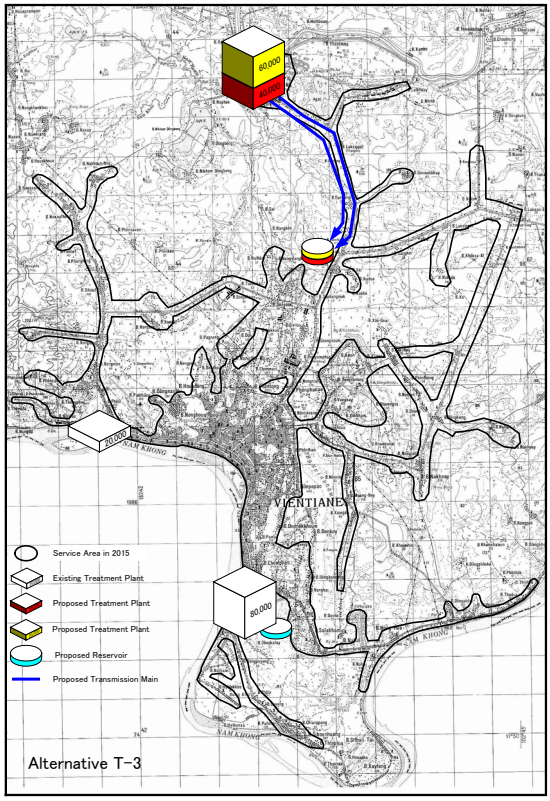
1) Intake and Treatment Plant

1st Stage (Construction of New Thangone Water Treatment Plant, see Figure 7)

- Intake Facilities: Construction of new intake facilities in the Nam Ngum River
- Treatment Plant: Construction of 40,000 m3/day

2nd Stage (Expansion of Thangone Water Treatment Plant, see Figure 9)

- Intake Facilities: Use of existing intake structure, addition of pumps
- Treatment Plant: Expansion of 60,000 m3/day



A new treatment plant with a capacity of 40,000 m3/day at Thangone for the 1st Stage and capacity expansion of 60,000 m3/day at same Thangone Treatment Plant for the 2nd Stage are considered for this alternative, T-3. Process of each treatment is planned to be the same as at the existing Chinaimo Treatment Plant. During the construction of the new Thangone Treatment Plant in the 1st Stage, new intake facilities will be required not only for the 1st Stage of 40,000 m3/day and also for the 2nd Stage of 60,000 m3/day. The plan of the treatment facilities and a flow diagram for the construction of 40,000 m3/day for the 1st Stage are the same as Alternative T-2 as shown on Figures 25 and 26 respectively. Plan of treatment facilities for the expansion of 60,000 m3/day for 2nd Stage is the same as Alternative C-1 as shown in Figures 13. Figures 29 shows the flow diagram for the capacity of 100,000 m3/day after the expansion of 60,000 m3/day at the Thangone Treatment Plant for the 2nd Stage. Detailed specifications of the treatment facilities for alternative T-3 are attached to Annex 14.

2) Pipelines

1st Stage

- Clear Water Transmission Pipelines: Installation of 10.6 km of pipelines
- Distribution Centre: Construction of a new distribution centre with a capacity of 40,000 m3/day
- Distribution Trunk Mains: Installation of 22.7 km of pipelines

2nd Stage

- Clear Water Transmission: Installation of 10.6 km of pipelines
- Distribution Centre: Expansion of the distribution centre for 60,000 m3/day
- Booster Pumping Stations: Improvement of the Km6 and Km12 BP stations
- Distribution Trunk Mains: Installation of 87.9 km of pipelines

For both of the 1st and 2nd Stages, clear water will be transmitted from the new Thangone Treatment Plant to a distribution centre and then distributed to consumers. The distribution centre is proposed to be constructed in the Dongdok area near the junction of the National Roads No.10 and No.13 in the northern part of the city.

For this alternative, improvement of the Km6 BP Station in the 1st Stage will not be required because the water supply to northern area of the City can be covered directly from the new distribution centre. However, in the 2nd Stage, improvement of the Km6 BP Station will be required for supply to the downtown from the distribution centre. Improvement of the Km12 BP Station in the 2nd Stage will be necessary mainly for water supply to new industrial area in the eastern part of the City.

Figure 30 shows the clear water transmission pipelines and distribution trunk mains required in Alternative T-3 and these required pipelines are obtained from a hydraulic network analysis of this alternative. The required pipeline length by pipeline diameters by stages, are summarized on Figure 28.

Figure 28 Required Pipelines by Diameters for Alternative T-3

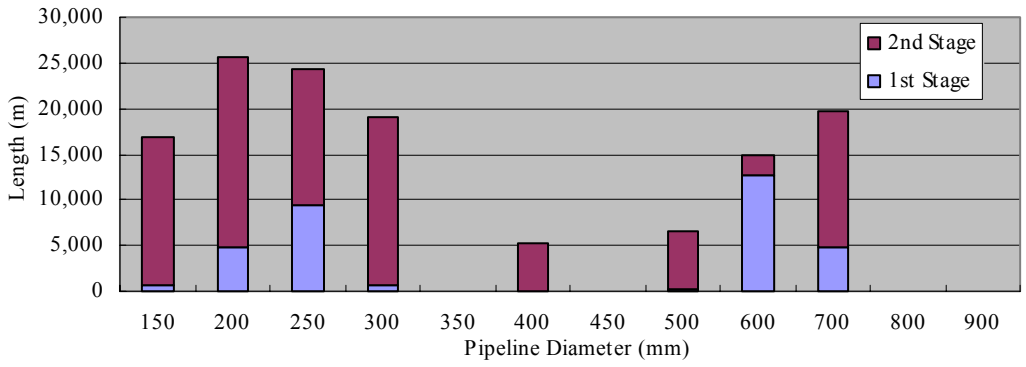


Figure 29 **Flow Diagram for Expansion of 60,000 m3/day at Thangone Treatment Plant which total capacity of 100,000 m3/day**

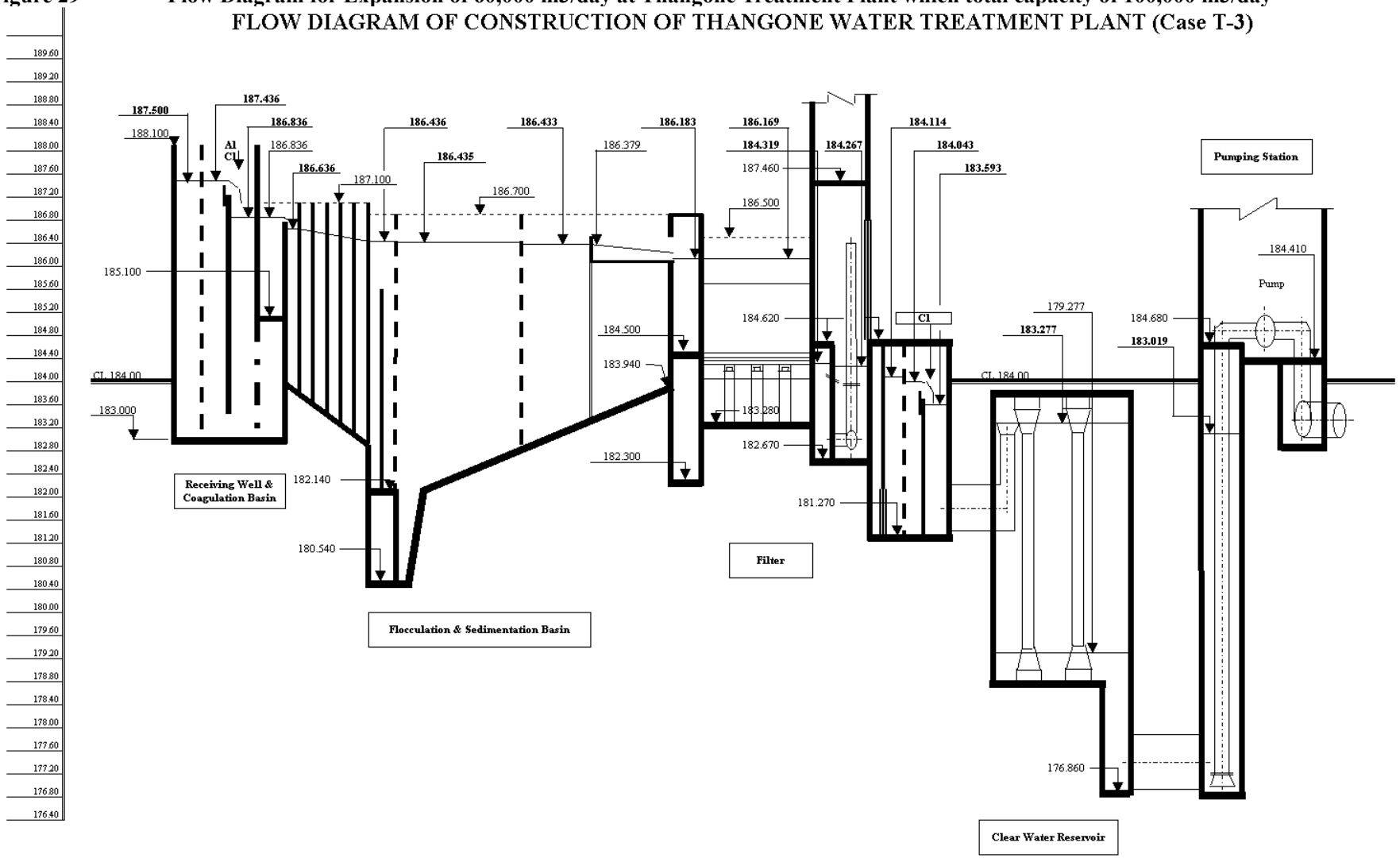
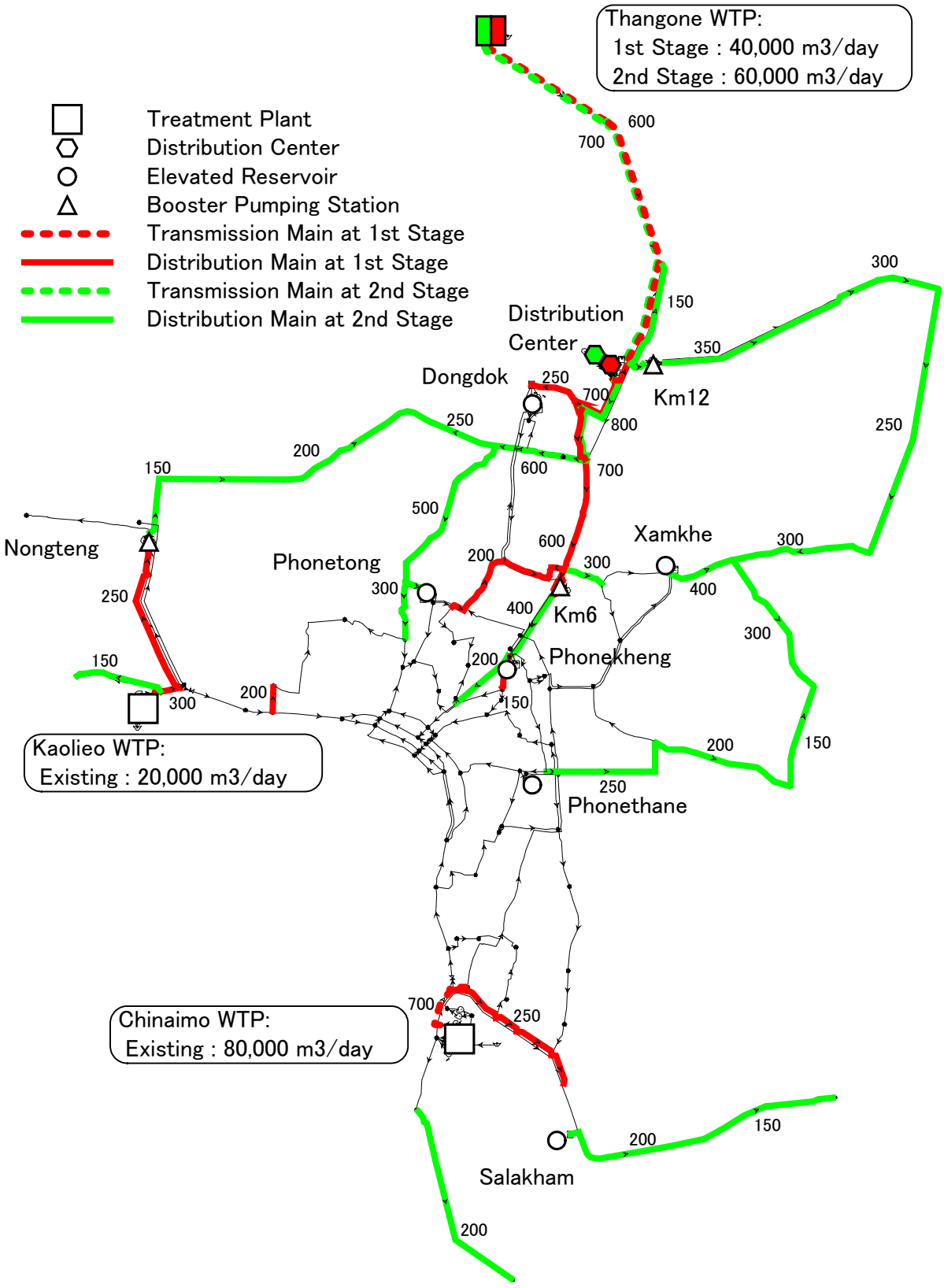


Figure 30 **Clear Water Transmission and Distribution Trunk Mains Required for Alternative T-3**



3) Costs (Construction, O/M)

Based on the results of facility planning for alternative T-3, preliminarily cost estimates have been conducted for the alternative comparison. The results of the cost estimates are as shown in Table 8 in US Dollars.

Table 8 Preliminary Cost Estimates for Alternative T-3

(x 1,000 US$)

Alternative T-3	Total	Foreign	Local
1. Construction Cost	67,127	47,556	19,571
1.1 Treatment Plants	22,367	14,666	7,701
Construction of Thangone T.P. (1st Stage	9,552	6,182	3,370
Construction of Thangone T.P. (2nd Stag	12,815	8,484	4,331
1.1 Treatment Plants	22,367	14,666	7,701
For the 1st Stage	6,456	5,203	1,253
For the 2nd Stage	7,521	6,198	1,323
1.1 Treatment Plants	22,367	14,666	7,701
For the 1st Stage	3,506	2,364	1,142
For the 2nd Stage	4,376	2,984	1,392
1.1 Treatment Plants	22,367	14,666	7,701
For the 1st Stage	-	-	-
For the 2nd Stage	677	546	131
1.5 Distribution Trunk Mains	22,224	15,595	6,629
For the 1st Stage	5,876	4,268	1,608
For the 2nd Stage	16,348	11,327	5,021
2. Operation and Maintenance Cost	7,159	818	6,341
2.1 Electricity	6,109	-	6,109
Thangone T.P. (1st Stage)	1,780	-	1,780
Thangone T.P. (2nd Stage)	966	-	966
Distribution Center	2,398	-	2,398
Booster Pump Station	965	-	965
2.2 Chemical Cost	818	818	-
Thangone T.P. (1st Stage)	505	505	-
Alum	248	248	-
Chlorine	257	257	-
Thangone T.P. (2nd Stage)	313	313	-
Alum	154	154	-
Chlorine	159	159	-
2.3 Salary	232	-	232
Treatment Plant	232	-	232
Thangone T.P. (1st Stage)	216	-	216
Thangone T.P. (2nd Stage)	16	-	16
Total Costs	74,286	48,374	25,912

7 Comprehensive Comparison

(1) Technical Aspects (Construction, O/M)

As mentioned in Table 1 "Preliminary Comparison and Evaluation of Alternatives", significant factors to exclude certain alternatives from the preliminary alternative comparison were not found.

1) Intake Facilities

In case of the 40,000 m3/day expansion of the existing Chinaimo Treatment Plant during the 1st Stage, alternatives C-1 and C-2, additional intake structures will not be required because the existing intake facility was designed and constructed for a capacity of 120,000 m3/day. This advantage, is reflected in the cost comparison.

2) Quality of Raw Water

The quality of raw water from the Nam Ngum River is much better than from the Mekong River because the lower turbidity from the Nam Ngum requires less use of coagulants. Proposed treatment plants for alternative T-2 in both the 1st Stage and 2nd Stage, will be constructed at Thangone and take raw water from the Nam Ngum River. On the other hand alternative C-2 would expand the existing two treatment plants on the Mekong River. This advantage is, however, is reflected in the cost comparison.

3) Conformity to Other Projects

The AFD Project for pipeline installation works are on-going and will be completed in 2004. The service area will be expanded by this project, but no water supply will be secured, especially in the Nongteng and Phonegtong areas. For supplying water to these areas, expansion of the existing Kaolieo Treatment Plant in the 1st Stage, Alternative K-1, has advantages.

4) Human Resources

If a new treatment plant is constructed in the 1st Stage, a new organisation for the new plant should be established with about 35 staff including engineers and skilled operators. Employment and training of these staff members should be treated as a priority. Therefore, Alternatives T-2 and T-3 have disadvantage comparing with other alternatives. This advantage is, however, is reflected in the cost comparison.

5) Land Space Availability

If the new treatment plant is constructed in the 1st Stage, new land space of about 2 ha for the new plant should be provided within a few years. Land space for alternatives C-1, C-2 and K-1 are available within the existing plant premises. Therefore, alternatives T-2 and T-3 have

disadvantages compared with the other alternatives.

6) Suspension of Water Supply

During the rehabilitation of the existing Kaolieo Treatment Plant in the 1st Stage, the plant should periodically stop its operations and water supply services should be suspended. In the case of alternative K-1, after completion of the 40,000 m3/day expansion, the existing Kaolieo Treatment Plant can interrupt its operations, making the rehabilitation work much easier.

(2) Preliminary Cost Estimates for Planned Facilities for Each Alternative

Based on the result of facility planning for each alternative, preliminary cost estimates for each alternative are summarized on Table 9 in US$ and are also shown in Japanese Yen, converted from the US$ amount. The exchange rate used in these calculations is based on the Japanese Yen to US$ as 119 yen to the Dollar, as of April 30, 2003. The Figures 31 to 33 shows the cost comparison for the 1st Stage, 2nd Stage and the combined total of the two stages.

Table 9 Preliminary Cost Estimates for Each Alternative

In US$

(x 1,000 US$)

Construction Cost	C-1	C-2	K-1	T-2	T-3
1st Stage					
Treatment Plants	8,782	8,782	9,624	9,552	9,552
Clear Water Transmission Pipelines	**1,234**	**1,678**	**1,234**	**6,456**	**6,456**
Distribution Center	0	0	0	3,506	3,506
Booster Pump Station	737	737	737	0	0
Distribution Trunk Mains	**7,977**	**8,681**	**6,394**	**5,228**	**5,876**
Sub-total	18,730	19,878	17,989	24,742	25,390
	(741)	(1,889)	0	(6,753)	(7,401)
2nd Stage					
Treatment Plants	13,427	13,427	13,427	13,427	12,815
Clear Water Transmission Pipelines	7,521	7,038	7,521	7,038	7,521
Distribution Center	4,376	4,376	4,376	4,376	4,376
Booster Pump Station	366	874	366	366	677
Distribution Trunk Mains	12,094	14,196	11,156	9,933	16,348
Sub-total	37,784	39,911	36,846	35,140	41,737
	(2,644)	(4,771)	(1,706)	0	(6,597)
Total	**56,514**	**59,789**	**54,835**	**59,882**	**67,127**
	(1,679)	**(4,954)**	**0**	**(5,047)**	**(12,292)**

In Japanese Yen

(x 1,000 yen)

Construction Cost	C-1	C-2	K-1	T-2	T-3
1st Stage					
Treatment Plants	1,045,058	1,045,058	1,145,256	1,136,688	1,136,688
Clear Water Transmission Pipelines	146,846	199,682	146,846	768,264	768,264
Distribution Center	0	0	0	417,214	417,214
Booster Pump Station	87,703	87,703	87,703	0	0
Distribution Trunk Mains	949,263	1,033,039	760,886	622,132	699,244
Sub-total	2,228,870	2,365,482	2,140,691	2,944,298	3,021,410
	(88,179)	(224,791)	0	(803,607)	(880,719)
2nd Stage					
Treatment Plants	1,597,813	1,597,813	1,597,813	1,597,813	1,524,985
Clear Water Transmission Pipelines	894,999	837,522	894,999	837,522	894,999
Distribution Center	520,744	520,744	520,744	520,744	520,744
Booster Pump Station	43,554	104,006	43,554	43,554	80,563
Distribution Trunk Mains	1,439,186	1,689,324	1,327,564	1,182,027	1,945,412
Sub-total	4,496,296	4,749,409	4,384,674	4,181,660	4,966,703
	(314,636)	(567,749)	(203,014)	0	(785,043)
Total	**6,725,166**	**7,114,891**	**6,525,365**	**7,125,958**	**7,988,113**
	(199,801)	**(589,526)**	**0**	**(600,593)**	**(1,462,748)**

119 yen/$ as of April 30 2003

Note: Figures shown in brackets are a deviation from the alternative which shows the minimum cost. It should be noted that construction costs shown in the above table are costs only for alternative comparison. Common costs for all alternatives such as rehabilitation of the Kaolieo Treatment Plant, improvement of the Chinaimo Treatment Plant (including expansion of reservoir, additional distribution pumps, and installation of transmission pipelines), small diameter distribution pipelines, house connections, contingencies, and administration costs are excluded from the construction costs for alternative comparison. Therefore, construction costs shown above do not represent Total Project Costs.

Figure 31 Preliminary Cost Estimates for Each Alternative : 1st Stage

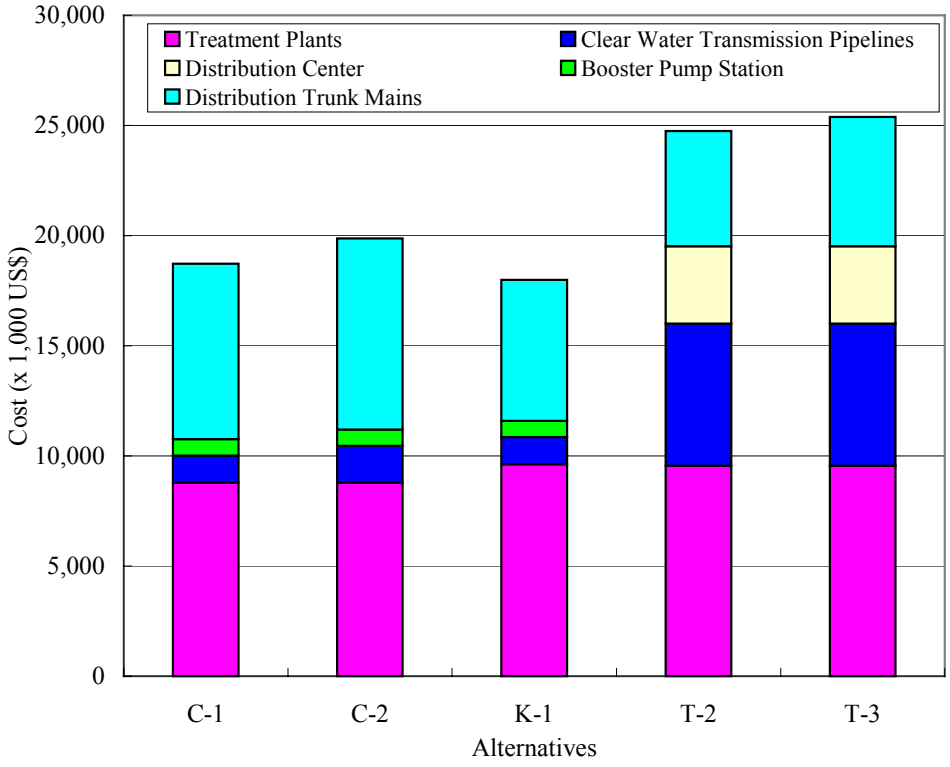


Figure 32 Preliminary Cost Estimates for Each Alternative : 2nd Stage

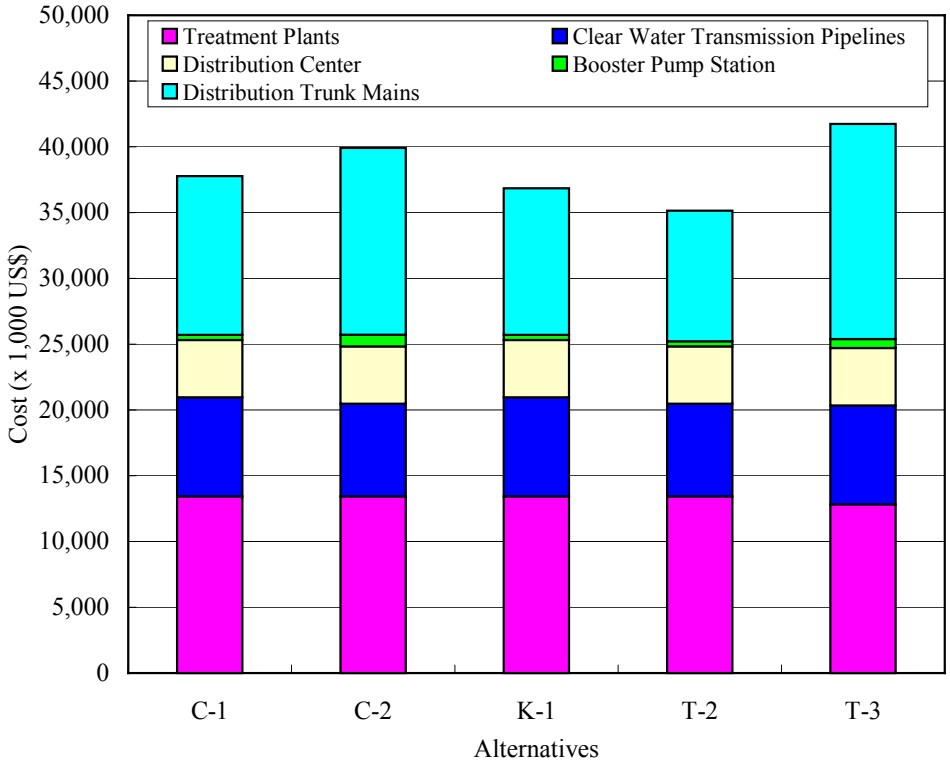
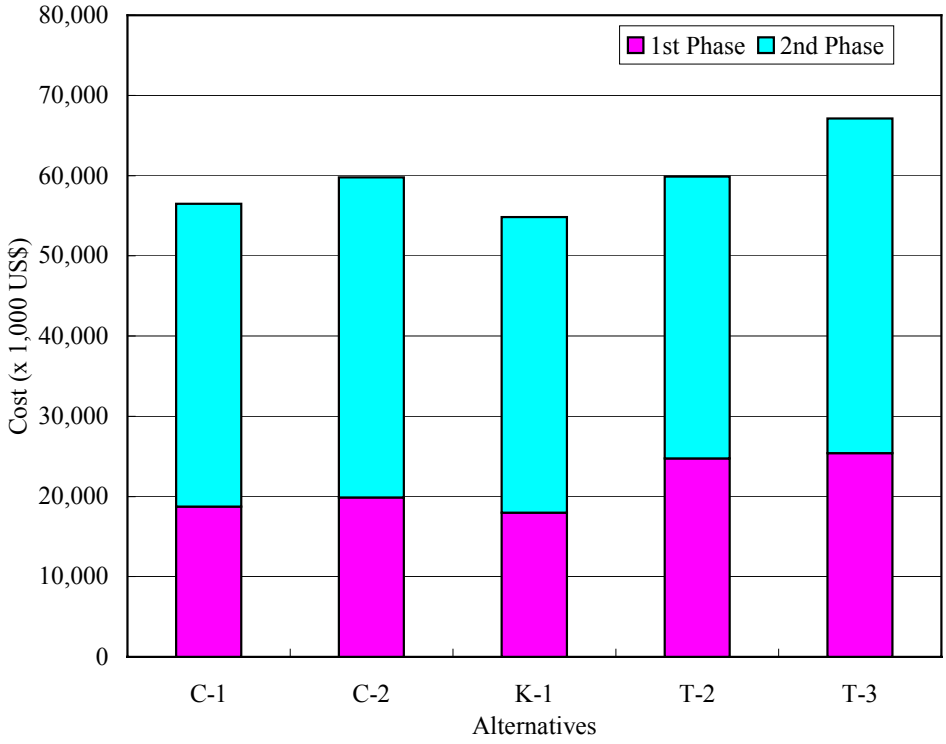


Figure 33 Preliminary Cost Estimates for Each Alternative : Two Stage Total



It should be noted that the construction costs shown in the above table and figures are costs only for the comparison of alternatives. Common costs for all alternatives such as rehabilitation of the Kaolieo Treatment Plant, improvement of the Chinaimo Treatment Plant (including expansion of reservoir, additional distribution pumps, and installation of transmission pipelines), small diameter distribution pipelines, house connections, contingencies, and administration costs are excluded from the construction costs for alternative comparison. Therefore, construction costs shown above **do not represent Total Project Costs**.

(3) Economic Evaluation

There are five alternatives for the comparative study, as discussed in the engineering discussion. In this section, these alternatives are analysed from an economic point of view. Then the best alternative is selected through a process of economic evaluation. The benefits of the respective alternatives are considered to be equal. Thus, a method of "minimum cost comparison" is considered the way to select the best alternative, instead of a general comparison of benefits and cost. As shown in Figure 34 below, the best alternative is selected from the minimum cost comparison from among all the alternatives. The costs are evaluated in economic terms. Economic costs and financial costs are discussed in detail in Section 4.11. The project costs are originally estimated based on market prices, so they have to be converted to economic prices applying conversion factors. In addition, operation and maintenance (O&M) costs are also converted to economic costs in the same procedure. Table 10 shows the conversion of economic costs for each alternative. These costs are allocated in an annual disbursement in conformity with the implementation schedule.

Figure 34 Project Evaluation Methodology

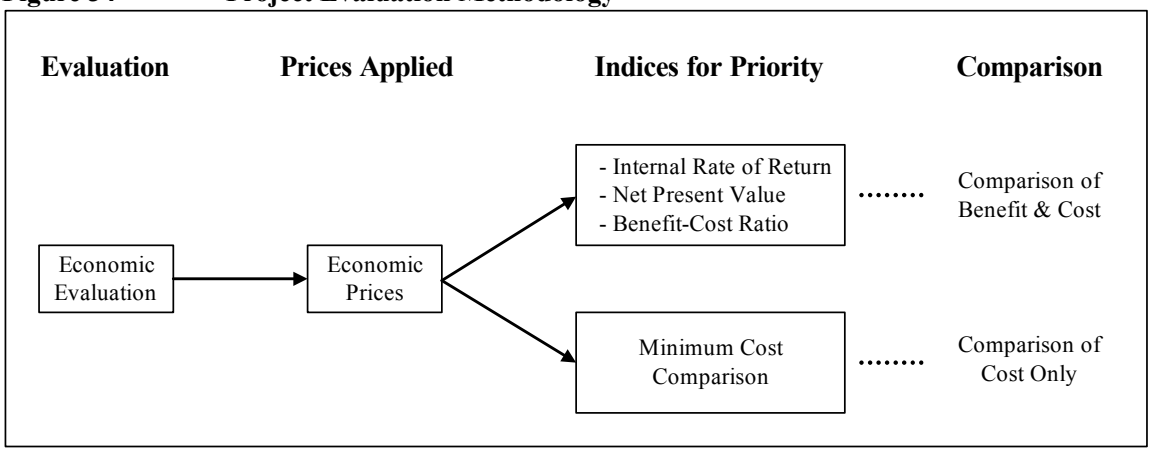


Table 10(1/3) Conversion of Economic Costs

CF: 0.90

C-1
Construction

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	0	0	0	0	0	0
2005	1,873	1,300	573	1,816	1,300	516
2006	9,364	6,498	2,866	9,077	6,498	2,579
2007	7,493	5,200	2,293	7,264	5,200	2,064
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	7,558	5,261	2,297	7,328	5,261	2,067
2011	18,891	13,149	5,742	18,317	13,149	5,168
2012	11,335	7,889	3,446	10,990	7,889	3,101
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Total	56,514	39,297	17,217	54,792	39,297	15,495

O&M

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	53	0	53	48	0	48
2005	53	0	53	48	0	48
2006	53	0	53	48	0	48
2007	461	99	362	425	99	326
2008	477	104	373	440	104	336
2009	491	108	383	453	108	345
2010	489	107	382	451	107	344
2011	489	107	382	451	107	344
2012	946	160	786	867	160	707
2013	930	168	762	854	168	686
2014	965	174	791	886	174	712
2015	1,000	181	819	918	181	737
Total	6,407	1,208	5,199	5,887	1,208	4,679

CF: 0.90

C-2
Construction

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	0	0	0	0	0	0
2005	1,988	1,410	578	1,930	1,410	520
2006	9,938	7,048	2,890	9,649	7,048	2,601
2007	7,952	5,640	2,312	7,721	5,640	2,081
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	7,984	5,545	2,439	7,740	5,545	2,195
2011	19,955	13,859	6,096	19,345	13,859	5,486
2012	11,972	8,315	3,657	11,606	8,315	3,291
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Total	59,789	41,817	17,972	57,992	41,817	16,175

O&M

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	53	0	53	48	0	48
2005	53	0	53	48	0	48
2006	53	0	53	48	0	48
2007	461	99	362	425	99	326
2008	477	104	373	440	104	336
2009	491	108	383	453	108	345
2010	489	107	382	451	107	344
2011	489	107	382	451	107	344
2012	1,029	181	848	944	181	763
2013	1,011	189	822	929	189	740
2014	1,046	197	849	961	197	764
2015	1,080	205	875	993	205	788
Total	6,732	1,297	5,435	6,189	1,297	4,892

Note: It should be noted that construction costs shown in the above tables are costs only for alternative comparison. Common costs for all alternatives such as the rehabilitation of the Kaolieo Treatment Plant, improvement of the Chinaimo Treatment Plant (including expansion of reservoir, additional distribution pumps, and installation of transmission pipelines), small diameter distribution pipeline, house connections, contingencies, and administration costs are excluded from the construction costs for alternative comparison. Therefore, construction costs shown above do not represent Total Project Costs.

Table 10(2/3) Conversion of Economic Costs

CF: 0.90

K-1
Construction

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	0	0	0	0	0	0
2005	1,799	1,205	594	1,740	1,205	535
2006	8,993	6,023	2,970	8,696	6,023	2,673
2007	7,197	4,820	2,377	6,959	4,820	2,139
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	7,370	5,091	2,279	7,142	5,091	2,051
2011	18,422	12,724	5,698	17,852	12,724	5,128
2012	11,054	7,634	3,420	10,712	7,634	3,078
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Total	54,835	37,497	17,338	53,101	37,497	15,604

O&M

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	53	0	53	48	0	48
2005	53	0	53	48	0	48
2006	53	0	53	48	0	48
2007	433	99	334	400	99	301
2008	448	104	344	414	104	310
2009	461	108	353	426	108	318
2010	459	107	352	424	107	317
2011	459	107	352	424	107	317
2012	922	160	762	846	160	686
2013	905	168	737	831	168	663
2014	938	174	764	862	174	688
2015	973	181	792	894	181	713
Total	6,157	1,208	4,949	5,662	1,208	4,454

CF: 0.90

T-2
Construction

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	0	0	0	0	0	0
2005	2,472	1,743	729	2,399	1,743	656
2006	12,372	8,722	3,650	12,007	8,722	3,285
2007	9,898	6,978	2,920	9,606	6,978	2,628
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	7,029	4,811	2,218	6,807	4,811	1,996
2011	17,569	12,024	5,545	17,015	12,024	4,991
2012	10,542	7,215	3,327	10,209	7,215	2,994
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Total	59,882	41,493	18,389	58,043	41,493	16,550

O&M

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	53	0	53	48	0	48
2005	53	0	53	48	0	48
2006	53	0	53	48	0	48
2007	498	55	443	454	55	399
2008	519	59	460	473	59	414
2009	538	61	477	490	61	429
2010	534	61	473	487	61	426
2011	534	61	473	487	61	426
2012	999	143	856	913	143	770
2013	985	149	836	901	149	752
2014	1,024	156	868	937	156	781
2015	1,062	162	900	972	162	810
Total	6,852	907	5,945	6,258	907	5,351

Note: It should be noted that construction costs shown in the above tables are costs only for alternative comparison. Common costs for all alternatives such as the rehabilitation of the Kaolieo Treatment Plant, improvement of the Chinaimo Treatment Plant (including expansion of reservoir, additional distribution pumps, and installation of transmission pipelines), small diameter distribution pipeline, house connections, contingencies, and administration costs are excluded from the construction costs for alternative comparison. Therefore, construction costs shown above do not represent Total Project Costs.

Table 10(3/3) Conversion of Economic Costs

CF: 0.90

T-3
Construction

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	0	0	0	0	0	0
2005	2,538	1,801	737	2,464	1,801	663
2006	12,696	9,009	3,687	12,327	9,009	3,318
2007	10,156	7,207	2,949	9,861	7,207	2,654
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	8,347	5,908	2,439	8,103	5,908	2,195
2011	20,870	14,770	6,100	20,260	14,770	5,490
2012	12,520	8,861	3,659	12,154	8,861	3,293
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Total	67,127	47,556	19,571	65,170	47,556	17,614

O&M

	Financial			Economic		
	Total	Foreign	Local	Total	Foreign	Local
2004	53	0	53	48	0	48
2005	53	0	53	48	0	48
2006	53	0	53	48	0	48
2007	498	55	443	454	55	399
2008	519	59	460	473	59	414
2009	538	61	477	490	61	429
2010	534	61	473	487	61	426
2011	534	61	473	487	61	426
2012	1,075	122	953	980	122	858
2013	1,062	128	934	969	128	841
2014	1,101	133	968	1,004	133	871
2015	1,139	138	1,001	1,039	138	901
Total	7,159	818	6,341	6,525	818	5,707

Note: It should be noted that construction costs shown in the above tables are costs only for alternative comparison. Common costs for all alternatives such as the rehabilitation of Kaolieo Treatment Plant, improvement of the Chinaimo Treatment Plant (including expansion of reservoir, additional distribution pumps, and installation of transmission pipelines), small diameter distribution pipeline, house connections, contingencies, and administration costs are excluded from the construction costs for alternative comparison. Therefore, construction costs shown above do not represent Total Project Costs.

The present values of the respective alternatives are tabulated in Section .6. The present value is calculated applying the discount rate of 12% and the evaluation period of 30 years after the completion of the projects as shown on Table 12. These calculations are summarised in Table 11 and Figure 35. Accordingly, the alternative, K-1 is selected as the best project among the five alternatives, from an economic point of view.

Table 11 Present Values of Alternatives

	Alternative	Present Value (US$ Million in Economic Terms)	Index (K-1 = 100)
1.	C-1	31.4	103
2.	C-2	33.3	110
3.	K-1	30.4	100
4.	T-2	34.7	114
5.	T-3	37.9	125

Figure 35 Net Present Value of Each Alternative

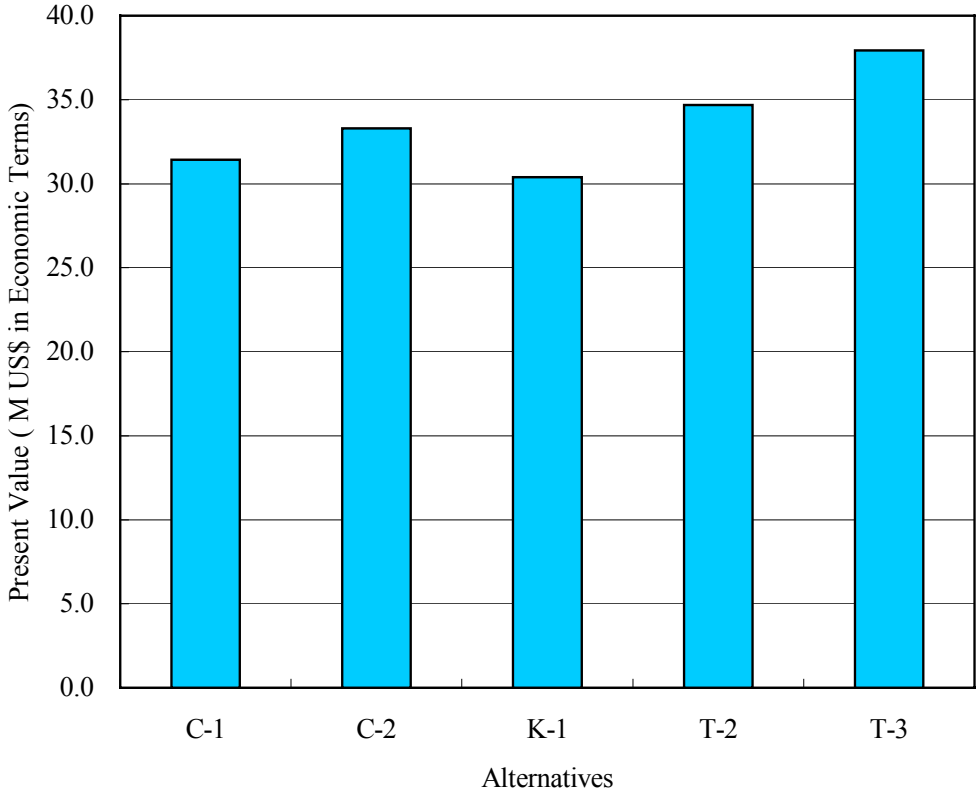


Table 12 Present Values of Preliminary Alternatives

Alternative: C-1 **PV: US$31,426 Million**

Year		Cost (US$1000)		
		Construction	O&M	Total
1	2004	0	48	48
2	2005	1,816	48	1,863
3	2006	9,077	48	9,125
4	2007	7,264	425	7,689
5	2008	0	440	440
6	2009	0	453	453
7	2010	7,328	451	7,779
8	2011	18,317	451	18,768
9	2012	10,990	867	11,858
10	2013	0	854	854
11	2014	0	886	886
12	2015	0	918	918
13	2016		918	918
:	:		:	:
:	:		:	:
41	2044		918	918
42	2045		918	918

Alternative: C-2 **PV: US$33,285 Million**

Year		Cost (US$1000)		
		Construction	O&M	Total
1	2004	0	48	48
2	2005	1,930	48	1,978
3	2006	9,649	48	9,697
4	2007	7,721	425	8,146
5	2008	0	440	440
6	2009	0	453	453
7	2010	7,740	451	8,191
8	2011	19,345	451	19,796
9	2012	11,606	944	12,551
10	2013	0	929	929
11	2014	0	961	961
12	2015	0	993	993
13	2016		993	993
:	:		:	:
:	:		:	:
41	2044		993	993
42	2045		993	993

Alternative: K-1 **PV: US$30,382 Million**

Year		Cost (US$1000)		
		Construction	O&M	Total
1	2004	0	48	48
2	2005	1,740	48	1,787
3	2006	8,696	48	8,744
4	2007	6,959	400	7,359
5	2008	0	414	414
6	2009	0	426	426
7	2010	7,142	424	7,566
8	2011	17,852	424	18,276
9	2012	10,712	846	11,558
10	2013	0	831	831
11	2014	0	862	862
12	2015	0	894	894
13	2016		894	894
:	:		:	:
:	:		:	:
41	2044		894	894
42	2045		894	894

Alternative: T-2 **PV: US$34,681 Million**

Year		Cost (US$1000)		
		Construction	O&M	Total
1	2004	0	48	48
2	2005	2,399	48	2,447
3	2006	12,007	48	12,055
4	2007	9,606	454	10,060
5	2008	0	473	473
6	2009	0	490	490
7	2010	6,807	487	7,294
8	2011	17,015	487	17,501
9	2012	10,209	913	11,123
10	2013	0	901	901
11	2014	0	937	937
12	2015	0	972	972
13	2016		972	972
:	:		:	:
:	:		:	:
41	2044		972	972
42	2045		972	972

Alternative: T-3 **PV: US$37,942 Million**

Year		Cost (US$1000)		
		Construction	O&M	Total
1	2004	0	48	48
2	2005	2,464	48	2,512
3	2006	12,327	48	12,375
4	2007	9,861	454	10,315
5	2008	0	473	473
6	2009	0	490	490
7	2010	8,103	487	8,590
8	2011	20,260	487	20,747
9	2012	12,154	980	13,134
10	2013	0	969	969
11	2014	0	1,004	1,004
12	2015	0	1,039	1,039
13	2016		1,039	1,039
:	:		:	:
:	:		:	:
41	2044		1,039	1,039
42	2045		1,039	1,039

(4) Influence by the Delay of Distribution System Improvement

In addition to the comparative study of alternatives, influence which will be caused by the delay of distribution system improvement has been analyzed focusing on the 1st Stage Projects. Before the commencement of the Study, the study demarcation was agreed among the Lao PDR side, AFD, and JICA. According to the agreement, JICA would solely establish a master plan. Then the feasibility studies would be conducted by the JICA on intake, water treatment plant, and transmission facilities, and on the other hand the AFD would conduct feasibility study on distribution system. Since there is no financial commitment made by any donor at the moment, there is a possibility of time lag of completion of implementation. In case, implementation of the distribution system improvement was delayed, incremental treated water could not be distributed effectively.

In order to minimize such bad influence which will be caused by the time lag of the implementations, the required distribution mains to distribute water from the proposed treatment plant and from transmission mains were identified as counter measures for each alternative. The required distribution mains will not be the same as the distribution mains which were planned at the alternative study, because the required distribution mains for this analysis are only for the 1st Stage and diameter of pipes were decided without consideration of the development under the 2nd Stage. The alternatives examined here were, therefore, only three alternatives, Alternatives C: expansion of the existing Chinaimo WTP, Alternative K: expansion of the existing Kaolieo WTP, and Alternative T which will be newly constructed at Thangone area.

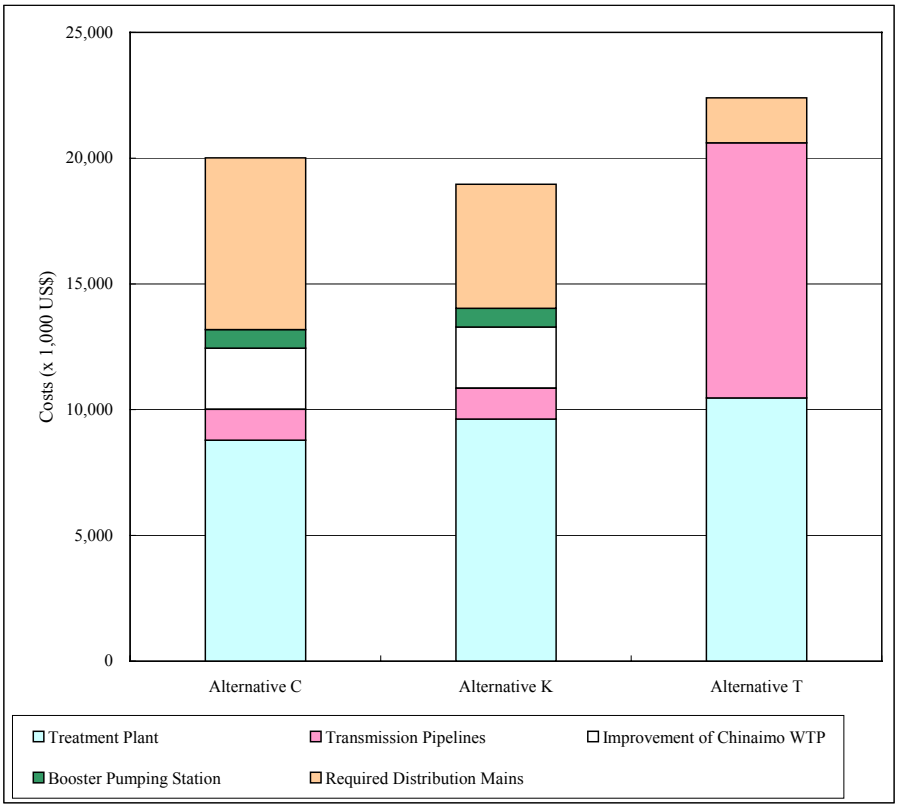
Costs required for the required distribution mains which will be required to accommodate incremental production capacity are added to the construction costs and total costs are compared as shown on Figure 36. As the results of the analysis, Alternative K is evaluated as the plan which would be the least influenced by the delay of the implementation of the distribution system improvement. Details of the analysis are described in Annex 20.

(5) Selection of the Best Alternative by the Least Cost Method

As described in the previous section, the least cost alternative and the lowest influenced alternative is alternative K-1. Alternative K-1 is therefore selected as the best alternative plan. It is therefore recommended to implement water supply system development by the best option, alternative K-1.

Figure 36 Results of the Analysis

x 1,000 US$	Alternative C	Alternative K	Alternative T
Treatment Plant	8,782	9,624	10,461
Transmission Pipelines	1,234	1,234	10,144
Improvement of Chinaimo WTP	2,433	2,433	0
Booster Pumping Station	737	737	0
Required Distribution Mains	6,829	4,936	1,792
Total	20,014	18,964	22,397



8 Detailed Features of the Best Alternative

(1) Features of the Best Alternative

1) Treatment Facilities

1st Stage (Expansion of the existing Kaolieo Water Treatment Plant)

- Intake Facilities: Construction of new intake facilities in the Mekong River
- Treatment Plant: Capacity expansion of 40,000 m3/day

2nd Stage (Construction of the new Thangone Water Treatment Plant)

- Intake Facilities: Construction of new intake facilities in the Nam Ngum River
- Treatment Plant: Construction facilities capable of producing 60,000 m3/day

Treatment and processing is planned to be the same as those at the existing Chinaimo Treatment Plant. Detailed features of the treatment facilities are shown in Table 13.

Table 13 Detailed Features of Treatment Plant for the Best Alternative

First Stage		Expansion of 40,000 m3/day	Second Stage		Construction of 60,000 m3/day
Planned Components of Expansion of Kaolieo Treatment Plant			**Planned Components of Construction of Thangene Treatment Plant**		
Intake Facility	Intake Structure	Construction of New Intake	Intake Facility	Intake Structure	Construction of New Intake
	Intake Pump	15.3 m3/min ×65 kW×3 Units		Intake Pump	15.3 m3/min ×140 kW×4 Units
Raw Water Transmission Pipe		D700 mm×L40 m, Ultrasonic Flow Meter	Raw Water Transmission Pipe		D900 mm×L530 m, Ultrasonic Flow Meter
Receiving Well & Mixing Well	Receiving Well!	1 Basin, D.T.=2.3 min.	Receiving Well & Mixing Well (Same Size for Direct Filtration)	Receiving Well	1 Basin (1 Basin), D.T.=2.4 min.
	Mixing Well	1 Basin, D.T.=1.0 min.		Mixing Well	1 Basin (1 Basin), D.T.=1.0 min.
Flocculation & Sedimentation Basin	Flocculation Basin	Up and Down Flow Baffle Channel 2 Units/Basin×2 Basins, D.T.=28.3 min.	Flocculation & Sedimentation Basin	Flocculation Basin	Up and Down Flow Baffle Channel 2 Units/Basin×3 Basins, D.T.=27.1 min.
	Sedimentation Basin	Horizontal Flow /w Launder Trough, 2 Basins D.T.=2.40 hr, Ave.Velocity=0.36 m/min.		Sedimentation Basin	Horizontal Flow /w Launder Trough, 3 Basins D.T.=2.00 hr, Ave.Velocity=0.37 m/min.
Filtration Facility	Filter Basin	A=78.0 m2×4 Basins, V=141 m/d	Filtration Facility	Filter Basin	A=78.1 m2×6 Basins, V=141 m/d
	Filter Washing Equipment	B.W.P.: 47.0m3/min×70kW×2 Units A.B.P.: 94.6m3/min×90kW×2 Units		Filter Washing Equipment	B.W.P.: 47.0m3/min×70kW×2 Units A.B.P.: 94.6m3/min×90kW×2 Units
Filtered Water Measurement & Chlorine Mixing Chamber	Measurement Chamber	1 Basin, D.T.=1.8 min.	Filtered Water Measurement & Chlorine Mixing Chamber	Measurement Chamber	1 Basin, D.T.=1.8 min.
	Mixing Chamber	1 Basin, D.T.=0.7 min.		Mixing Chamber	1 Basin, D.T.=0.7 min.
Clear Water Reservoir	Clear Water Reservoir	V=10,000 m3	Clear Water Reservoir	Clear Water Reservoir	V=5,000 m3
	Piping	D700mm, D600mm		Piping	D900mm
Distribution Pumping Facility	Distribution Pump Building	A=250 m2	Transmission Pumping Facility	Transmission Pump Building	A=320 m2
	Distribution Pump	12.1 m3/min ×67m×195 kW×4 Units		Transmission Pump	10.5 m3/min ×42.5m×110 kW×5 Units
Chemical Feeding Facility	Chemical Feeding Equipment	Installation of Equipment and Solution Tank	Chemical Feeding Facility	Chemical Feeding Equipment	Installation of Equipment and Solution Tank
	Chemical Building	In preparation for Administration Building		Chemical Building	In preparation for Administration Building
Electrical Equipment Facility	Power Receiving Facility	Power Receiving and Transformer Equip.	Electrical Equipment Facility	Power Receiving Facility	Power Receiving and Transformer Equip.
	Power Supply Facility	Power Supply Equipment		Power Supply Facility	Power Supply Equipment
	Emergency Generator	Generator Cap. for 1/3of Dis. Pump Cap.		Emergency Generator	Generator Cap. for 1/3 of Tran. Pump Cap.
	Instrumentation Equipment	Monitoring, Supervising and Controlling		Instrumentation Equipment	Monitoring, Supervising and Controlling
Administration Building		A=300m2×2F	Administration Building		A=300m2×2F,
Laboratory		In preparation for Administration Building	Laboratory		In preparation for Administration Building
Landscaping and Others		Including demolition & relocation of existing housings	Landscaping and Others		

2) Pipelines

1st Stage

- Clear Water Transmission Pipelines: Installation of 2.2 km of pipelines, see Table 17
- Booster Pumping Stations: Improvement of the Km6 BP station, see Table 14
- Distribution Trunk Mains: Installation of 24.2 km of pipelines, see Table 17

2nd Stage

- Clear Water Transmission: Installation of 10.6 km of pipelines, see Table 18
- Distribution Centre: Construction of a new distribution centre capable of 60,000 m3/day, see Table 15
- Booster Pumping Stations: Improvement of Km12 BP station, see Table 16
- Distribution Trunk Mains: Installation of 73.6 km of pipelines, see Table 18

Table 14 Improvement of Km6 Booster Pumping Station in the 1st Stage

Planned Components of Facility		
Booster Pumping Facility	Pump House	A=45 m2
	Transmission Pump	4.8 m3/min. x 50 m x 57 kW x 2 Units
	Distribution Pump	6.0 m3/min. x 50 m x 72 kW x 3 Units
Electrical Equipment Facility	Power Receiving Facility	Power Receiving and Transformer Equipment
	Power Supply Facility	Power Supply Equipment
	Emergency Generator	Generator Capacity for 1/3 of Trans. & Dis. Pump Capacity
	Instrumentation Equipment	Monitoring, Supervising and Controlling
Landscaping and Others		Including demolition of the existing housing

Table 15 Construction of Distribution Centre in the 2nd Stage

Planned Components of Facility		
Clear Water Reservoir	Clear Water Reservoir	V=10,000 m3
	Piping	D900mm
Distribution Pumping Facility	Distribution Pump Building	A=320 m2
	Distribution Pump	13.5 m3/min ×67m×217 kW×5 Units
Electrical Equipment Facility	Power Receiving Facility	Power Receiving and Transformer Equipment
	Power Supply Facility	Power Supply Equipment
	Emergency Generator	Generator Cap. for 1/3 of Distribution Pump Capacity
	Instrumentation Equipment	Monitoring, Supervising and Controlling
Landscaping and Others		

Table 16 Improvement of Km12 Booster Pumping Station in the 1st Stage

Planned Components of Facility		
Booster Pumping Facility	Pump House	A=25 m2
	Distribution Pump	3.3 m3/min. x 60 m x 48 kW x 3 Units
Electrical Equipment Facility	Power Receiving Facility	Power Receiving and Transformer Equipment
	Power Supply Facility	Power Supply Equipment
	Emergency Generator	Generator Capacity for 1/3 of Distribution Pump Capacity
	Instrumentation Equipment	Monitoring, Supervising and Controlling
Landscaping and Others		Including demolition of the existing housing

Table 17 Pipeline Length by Diameters in the 1st Stage

	Distribution	Transmission	Total
Dia mm	Length m	Length m	Length m
150	2,840	0	2,840
200	0	0	0
250	9,450	0	9,450
300	1,380	0	1,380
350	320	0	320
400	0	0	0
450	4,890	2,220	7,110
500	0	0	0
600	4,660	0	4,660
700	680	575	1,255
800	0	0	0
900	0	0	0
Total	24,220	2,795	27,015

Table 18 Pipeline Length by Diameters in the 2nd Stage

	Distribution	Transmission	Total
Dia mm	Length m	Length m	Length m
150	13,260	0	13,260
200	18,160	0	18,160
250	16,770	0	16,770
300	14,270	0	14,270
350	5,880	0	5,880
400	1,790	0	1,790
450	0	0	0
500	0	0	0
600	650	0	650
700	2,860	10,580	13,440
800	0	0	0
900	0	0	0
Total	73,640	10,580	84,220

(2) Evaluation of the Selected Best Alternative

Selected alternative K-1, as the best alternative has the following advantages.

- The premises of the Kaolieo Treatment Plant can accommodate plant expansion in the 1st Stage without any additional land acquisition.
- After the 1st Stage of expansion of 40,000 m3/day, the capacity of the Kaolieo Treatment Plant will become 60,000 m3/day and the balance of production of the two existing treatment plants, Kaolieo at 60,000 m3/day and Chinaimo at 80,000 m3/day, will be adequate since the central Vientiane area is located between the two existing treatment plants.
- Water supply will be secured to the expanding service area, where pipe installation work is already in progress, financed by the AFD, in the northern part of the Kaolieo Treatment Plant in the 1st Stage
- After completion of the 40,000 m3/day expansion under the 1st Stage, rehabilitation of the existing plant will become much easier since the existing plant can stop its operations for rehabilitation.
- A sufficient raw water source is secured for the future.
- A minimum of additional staff for treatment plant operation will be required for the 1st Stage.
- Necessary arrangements for land acquisition for the 2nd Stage Thangone Treatment Plant will proceed during the 1st Stage. As the planned location of the new Thangone Treatment Plant is in the Irrigation College premises, the Ministry of Agriculture and Forest and will need time to find and procure more land in Thangone area.
- Recruiting and training staff for the new Thangone Treatment Plant will proceed during the 1st Stage.
- Chemical costs will be saved upon completion of new Thangone Treatment Plant in the 2nd Stage
- A dual-source water supply system will be established upon completion of the new Thangone Treatment Plant in the 2nd Stage