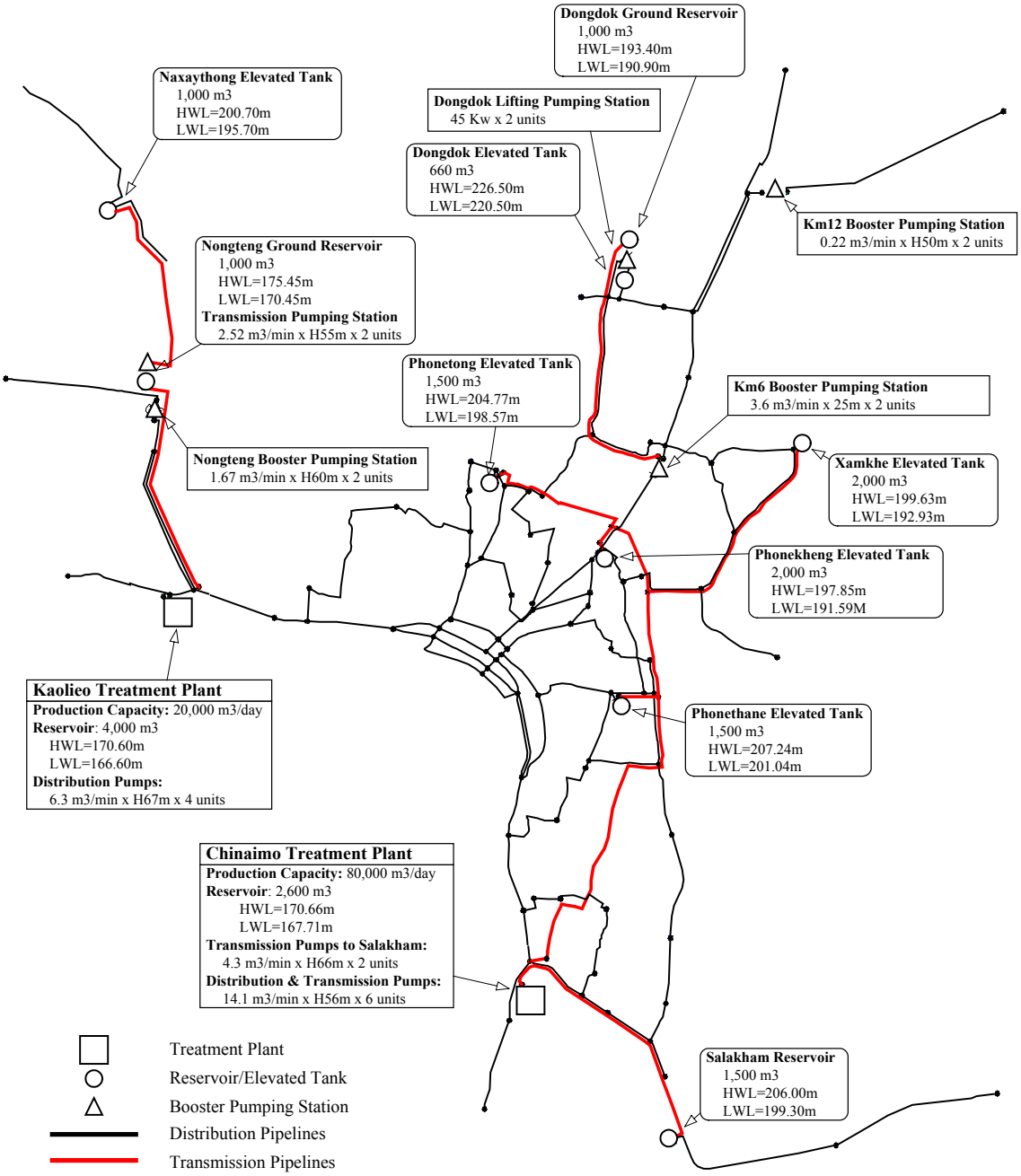
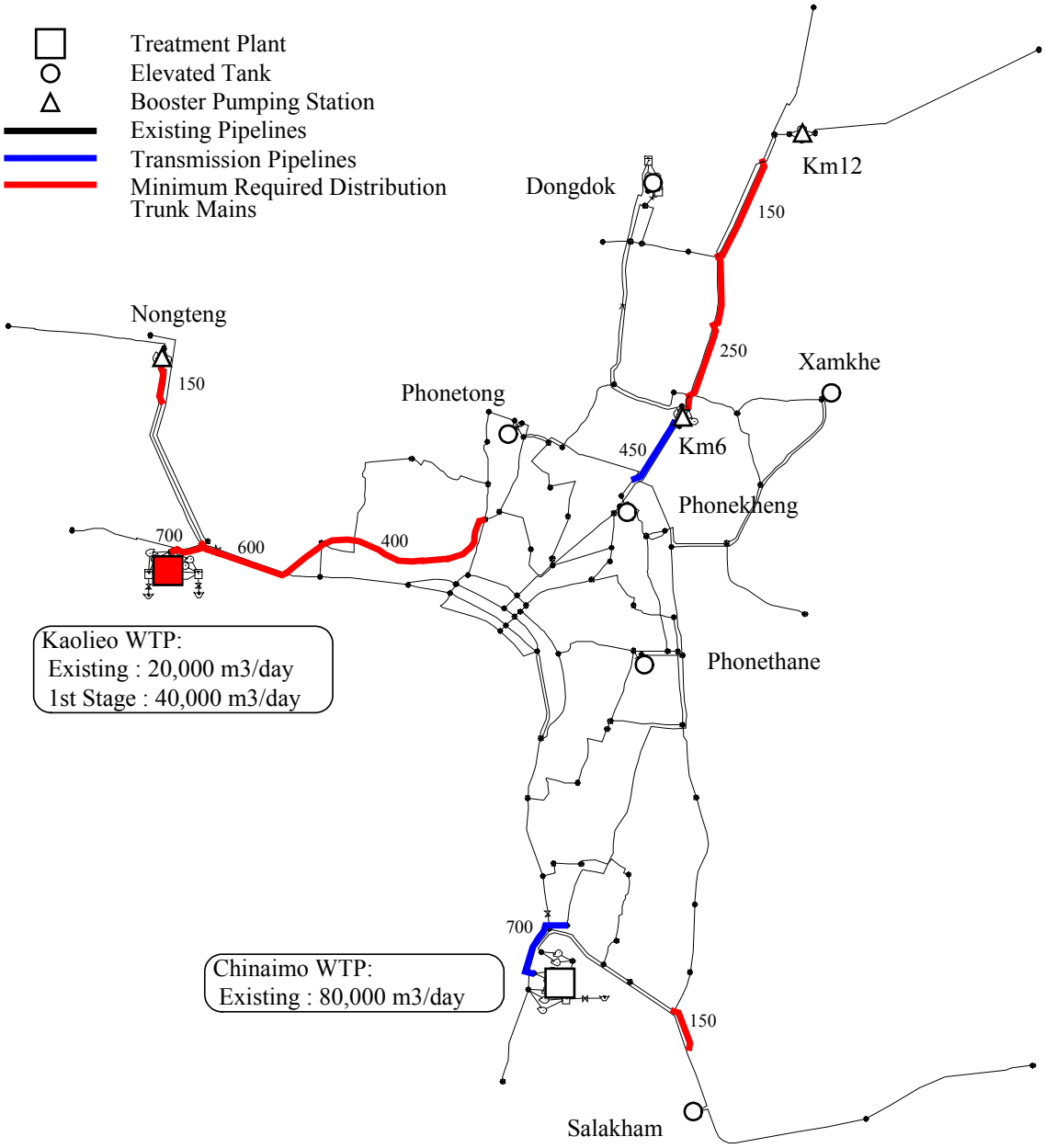
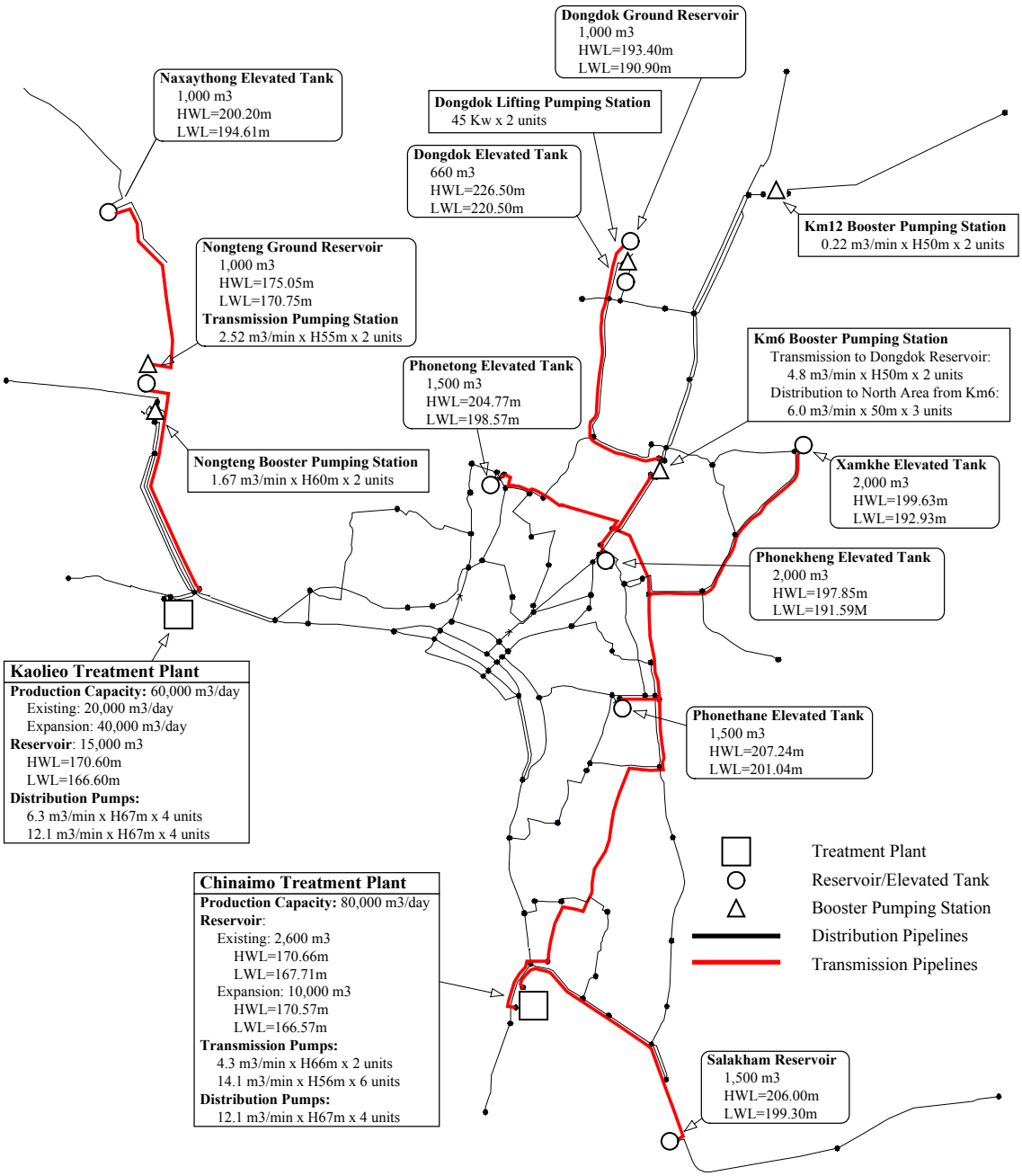
Existing Water Supply System in Vientiane



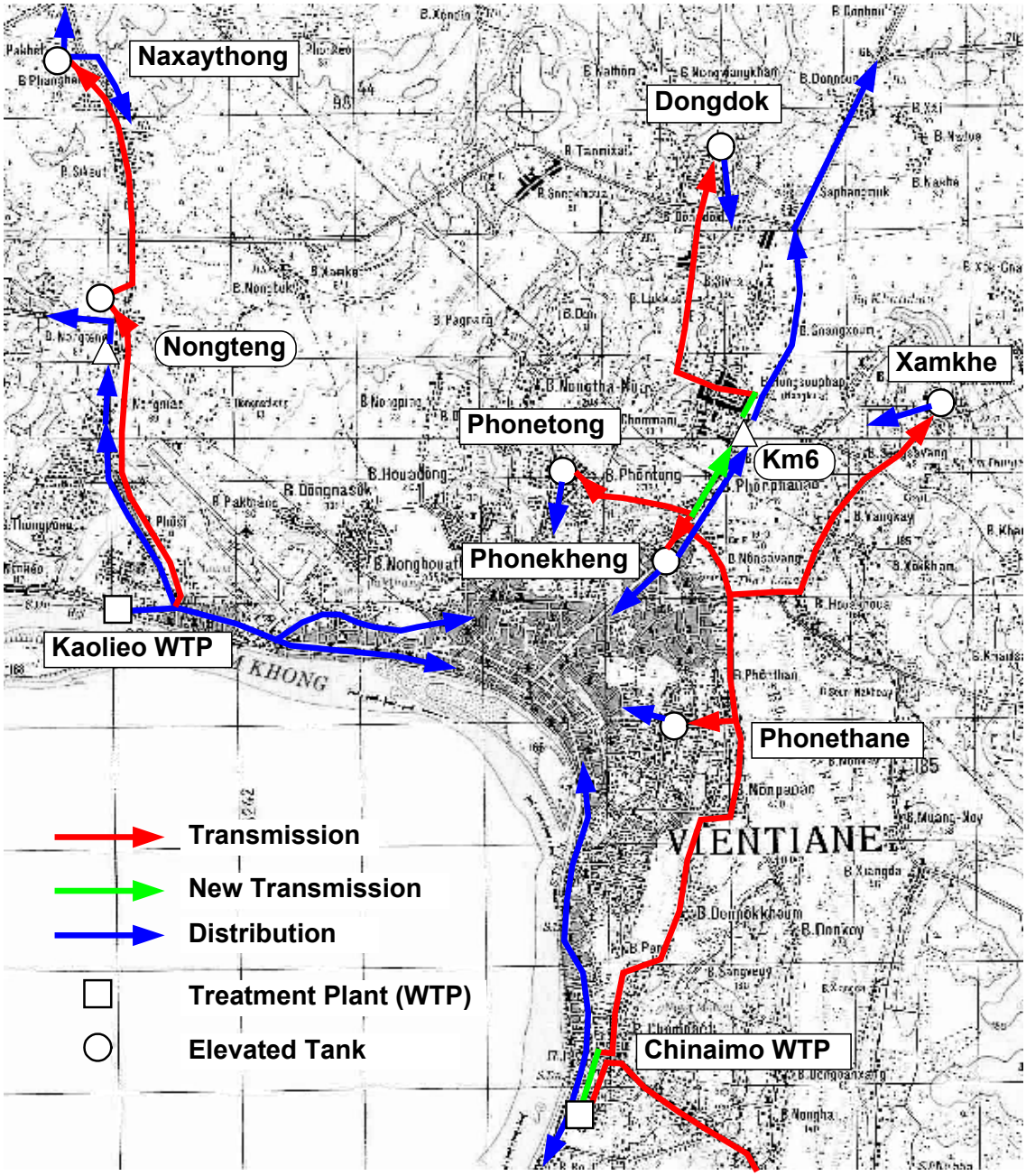
Scope of the Priority Projects



Future Water Supply System in Vientiane upon Completion of the 1st Stage Project



Transmission and Distribution System upon Completion of the 1st Stage Project



THE STUDY
ON
VIENTIANE WATER SUPPLY DEVELOPMENT PROJECT IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

FINAL REPORT

Volume II : Main Report : Master Plan

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ABBREVIATIONS

ADB	Asian Development Bank
AFD	French Development Agency
B/C	Benefit/Cost Ratio
CPC	Committee for Planning and Cooperation
CPI	Consumer Price Index
DCTPC	Department of Communication, Transport, Post and Construction, Vientiane Capital City
D/D	Detailed Design
DGM	Deputy General Manager
DHUP	Department of Housing and Urban Planning, MCTPC
DSCR	Debt Service Coverage Ratio
DSR	Debt-service Ratio
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GDP	Gross Domestic Product
GM	General Manager
GOJ	Government of Japan
GOL	Government of Lao PDR
GRDP	Gross Regional Domestic Product
GVA	Gross Value Added
Hhlds	Households
JICA	Japan International Cooperation Agency
Lao PDR	Lao People's Democratic Republic
LDCD	Leakage Detection and Control Division, NPVC
LLCR	Loan Life Debt Service Coverage Ratio
LLDC	Least Less Developed Countries
lpcd	litre per capita day, unit water consumption per day per capita
LRAC	Long-Run Average Cost
MCTPC	Ministry of Communication, Transport, Post and Construction
MOF	Ministry of Finance
MPH	Ministry of Public Health
NPL	Nam Papa Lao
NPSE	Nam Papa State-Owned Enterprise
NPVC	Nam Papa Vientiane Capital City, Water Supply Company of the Vientiane Capital City
NPV	Net Present Value
NPVC Master Plan	Master Plan: Vientiane Water Supply Development Project, November 1999
NRW	Non Revenue Water

NSC	National Statistical Centre
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PPP	Public Private Partnership
popn	Population
ROE	Return on Equity
ROI	Return on Investment
S/V	Construction Supervision
UFW	Unaccounted-for Water
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
URI	Urban Research Institute, MCTPC
V. C. City	Vientiane Capital City
VUDAA	Vientiane Urban Development and Administration Authority
VUDMP	Vientiane Urban Development Master Plan
WASA	Water Supply Authority, DHUP, MCTPC
WRCC	Water Resources Coordination Committee
WTP	Water Treatment Plant

SUMMARY OF THE MASTER PLAN

SUMMARY

1. Introduction

In March 2003, a JICA Study Team of 10 study team members from Nihon Suido Consultants Co., Ltd., Tokyo, Japan was dispatched to the Lao PDR, and commenced this study after confirmation of the scope of work, schedule, methodology and undertakings of the GOL of the study through an inception meeting.

The objectives of the Study are:

1. To prepare a long term master plan for the Vientiane water supply. The target year of the master plan is 2020; target year of facility planning is 2015.
2. To conduct a feasibility study on priority project(s) identified in the master plan
3. To transfer technology to the counterpart personnel in the course of the study.

The study is to cover the present and planned service areas of the "Master Plan: Vientiane Water Supply Development Project, November 1999" (here in after referred to as "NPVC Master Plan").

The Study is conducted in three phases as follows:

Phase I: A Reconnaissance Survey
Phase II: The Preparation of a Master Plan
Phase III: A Feasibility Study on the Priority Project

The Phase I of the Study was conducted during the first field investigation in Lao PDR from March to April in 2003. Phase II of the Study was also conducted during the first field investigation in Lao PDR from May to July in 2003. During the Phase II, priority projects were identified and agreement was reached with Lao PDR side that the identified projects should be the subject of a subsequent feasibility study. Phase III was conducted during the second field investigation in Lao PDR from August to November in 2003 and the subsequent work from that phase was conducted in Japan from December 2003 to January 2004. The scope of work during Phase III centred on the feasibility study of the priority projects and included an overall evaluation and recommendations concerning the project implementation.

2. Development Plan of Vientiane Capital City

Vientiane Urban Development Master Plan (VUDMP) was formulated in 1991 with UNDP/UNCHS

support and revised in 2000. The revised VUDMP by the Urban Research Institute, a division of the MCTPC was approved in 2002 by the Prime Minster, and the implementation of improvements to roads and drainage systems started. This was financed by the ADB. The implementing agency of the projects is the Vientiane Urban Development and Administration Authority (VUDAA) of the Vientiane Capital City Government.

This VUDMP covers the central part of the Vientiane Capital City and the area covered by the VUDMP is called as "Capital Municipality Zones". Although the VUDMP covers only the central part of the Capital City, "Special Development Zones", "Satellite Towns Zones" and "Long-Term Expansion Urban Zones" which are outside of the planning zone, are also discussed in the VUDMP report.

The VUDMP defines the policy for urban development and land use patterns for future development to achieve a well coordinated development. Although the development policy and land use plans are defined, specific target years or sources of funds for implementation are not described in the report.

The Capital Municipality Zones are categorized into 17 kinds of land use zones and areas where development will take place in the future and areas that should be reserved as green space or paddy fields are distinguished. For the areas outside of the Capital Municipality Zone, the development plan is described in the "National Infrastructure and Services" section of the VUDMP.

According to the Decree (No. 37/PM), the water supply sector development in the capital city, Vientiane, is defined as the first priority and the service ratio in urban area should be increased to 80% by 2020.

3. Existing Conditions of Vientiane Water Supply System

The Vientiane Water Supply Company (Nam Papa Vientiane Capital City: NPVC) was reorganised from Lao Water Supply Company (Nam Papa Lao: NPL) under the provision of Decree (No.37/PM) on September 30, 1999. The NPL used to cover the entire country's water supply services. After the reorganisation, the NPVC became one of a number of Nam Papa State-owned Enterprises (NPSE's), and covers Vientiane Capital City only. In terms of training for water engineers, the NPVC has trained all the NPSE's in the country.

The service area that is supplied by the existing Kaolieo and Chinaimo WTPs covers the central part of the capital city and the northern area of the capital city along Road No. 13 and Thangone Road. Thadeua WTP supplies water to the area along the Mekong River near the Friendship Bridge. The Thangone WTP covers a very limited area in Thangone. The NPVC service area is divided into seven zones and each zone is managed by a NPVC branch office.

The total number of connections is 43,444 and total metered water consumption is 2,416,152 m3/month (77,940 m3/day), as of March 2003.

The existing Kaolieo WTP is located in the west of the central part of the capital city along the Mekong River. The Kaolieo Treatment Plant, which has a capacity of 20,000 m3/day, was constructed in 1964 by Japan's Grant Aid Project and is the oldest treatment plant in Vientiane. In 1983, rehabilitation works were implemented also by Japan's Grant Aid. Deterioration of facilities and equipment have become significant problems for the stable operation of the plant since the last rehabilitation work was implemented about 20 years ago.

The Chinaimo WTP is located in the south of the central part of the capital city along the Mekong River. The Chinaimo Treatment Plant which has a capacity of 40,000 m3/day, was constructed in 1980, and financed by the ADB. In 1992 - 1996, rehabilitation and expansion works were implemented by Japan's Grant Aid and the total capacity was expanded to 80,000 m3/day. Compared with the Kaolieo WTP, the condition of facilities and equipment are better. However, stable water distribution and transmission has not been achieved since the plant only has transmission facilities and is not designed as a distribution centre.

The total length of pipelines with a diameter greater than 40 mm is estimated to be about 460 km in length. Pipelines more than 300 mm in diameter are manufactured from Ductile Iron Pipe (DIP) and Steel Pipe (SP) and pipelines less than 300 mm in diameter are mainly PVC. Pipelines in the downtown area of the Vientiane Capital City were installed in the 1960s and 1980s at the time of the construction of the Kaolieo and Chinaimo WTPs respectively. Although the NPVC installed small diameter pipelines by itself, pipelines of large size diameters made from DIP and SP, were mainly installed in the 1990s by the Japan's Grant Aid project, and the projects financed by ADB.

Construction work to extend the water distribution network in 5 areas by AFD aid, commenced in March 2003 and the pipe materials are currently being delivered. A leakage reduction project is also underway according to an action plan which was prepared by AFD aid. Water meter investigations in each zone were also conducted by testing on site, as well as by calibration using a

meter test bench in the workshop at the NPVC. According to the reports on the leak detection campaign and the reduction of unaccounted-for water by the NPVC, the losses in terms of volumes of unaccounted-for water represent about 30% of the total water supply.

Vientiane Water Supply System has 9 reservoirs with a total capacity of 17,460 m3 including 3 ground reservoirs and 6 elevated tanks. The total capacity of the reservoirs is calculated to be equivalent to 4.2 hours of the total production capacity of the Chinaimo and Kaolieo WTP's.

A network analysis of the existing system has been conducted using WaterCAD which runs under the AutoCAD environment, after examination of the existing transmission and distribution pipeline networks with a diameter greater than 100mm. Survey results of flow and pressure measurements have been also been taken into account for the calibration of the network model.

4. Financial Conditions of NPVC

The sales revenue of the NPVC comes from water sales, new connection fees, income from projects undertaken, rental fees of heavy equipment and rental fees of water meters. In 2002, the sales revenues of the NPVC accounted for 19.8 billion kip. Of these sales revenues, 78% was accrued from water sales.

In 2002, the total expenditure of the NPVC was 21.6 billion kip. Expenditure is divided into two main categories: (a) 11.2 billion kip for purchasing of materials and equipment for water production (52% of the total), and (b) 10.4 billion kip for service and administration expenses supporting water supply services (48%). At the end of the fiscal year, the total expenditure was reduced through a closing adjustment of 2.4 billion kip. Accordingly, the net expenditure for the year 2002 was 19.2 billion kip.

Water sales in 2002 increased remarkably, 165% more than in 2000. This was because of an incremental increase of the average unit price of water from 269 kip/m^3 in 2000 to 547 kip/m^3 in 2002, in spite of the fact that the volume of water supplied in 2002 increased only 118% more than in 2000. For the same period, production costs increased 143%. Thus, the gross profit increased by 218% for these three years.

Item	2000	2001	2002	Increment (2000~02)
Gross Sales	12.0	15.8	19.8	165%
Production Cost	8.4	10.6	12.0	143%
Gross Profit	3.6	5.2	7.8	218%
Services and Administration Expenses	5.1	5.5	6.3	122%
Operating Profit	-1.5	-0.3	1.5	-
Net non-operating Earnings & Expenses	-0.8	-0.8	-0.7	-
Net Profit before Tax	-2.3	-1.1	0.8	-
Appropriation for Tax	0.1	0.1	-0.2	-
Net Profit after Tax	-2.4	-1.2	0.6	-

The incremental increase of services and administration expenses was 122% for the same period. As a result, the operating profit generated a surplus of 1.5 billion kip in 2002. Since the net non-operating earnings and expenses was -0.7 billion kip, the net profit before tax was 0.8 billion kip.

In 2002, the total assets were estimated at 39.0 billion kip. Fixed assets accounted for 22.6 billion kip or 58% of the total assets. Current assets accounted for 16.3 billion kip or 42% of the total. Of the total current assets, accounts receivable was 3.6 billion kip or 9%. This amount is equivalent to three months' water sales.

In 2002, the ratio of net profit to total capital was 1.9%, which was not small and was better than the Japanese index. The ratio of net expense to net sales was almost the same as the Japanese index in 2002, but larger in 2000 and 2001. The ratios in these years indicate unstable conditions for profitability.

	Item	Unit	2000	2001	2002	Japanese*1
1.	Ratio of Net Profit to Total Capital	%	-	-	1.9	0.7
2.	Ratio of Net Expense to Net Sale Amount	%	122	109	96	95
3.	Current Ratio	%	280	228	303	302
4.	Ratio of Fixed Assets to Long-term Capital	%	79	77	67	95
5.	Ratio of Deprecation of Fixed Assets	%	6.1	7.1	9.6	3.4
6.	Turnover of Account Receivable		2.7	3.2	3.7	7.9
7.	Number of Employees per Water Supplied	Persons/ 10^4m^3/day	44	41	40	12

Note: *1 Quoted from Japanese management indices of water supply services (more than 300,000 consumers) in 2001.

The current ratio of the NPVC was around 300%, which is a good condition for solvency and for short-term safety. The ratio of fixed assets to long-term capital was less than 100%, which is also a fair condition for long-term safety. The ratio of depreciation to fixed assets is usually 3% in every case for Japanese water supply systems. However, the ratio of the NPVC was almost 2 to 3 times larger than the Japanese standard.

In terms of the turnover of accounts receivable, the NPVC recorded a worsening index 2.7 to 3.7. These figures were considerably lower than the Japanese index of 7.9. This means that the NPVC takes more than 3 months to collect bills.

The number of staff at the water supply services seems to be quite large compared with the Japanese average. It ranged between 40 and 44 persons per 10,000 m^3 per day, which is around 4 times the Japanese average.

Unit water production costs during the past four years were larger than the average unit prices compared with the Japanese average. This was the reason why the NPVC recorded a final net deficit for the three years from 1999 to 2001. The new tariff system in 2002 turned the NPVC profitable in 2002, but the net profit was comparatively small. The new unit production cost in 2002 was 529 kip/m^3. In the same year, the average unit price was calculated at 547 kip/m^3. The unit price after tax was 521 kip/m^3, so it still resulted in a profit smaller than the unit production cost.

People in Vientiane are not always recognising that the cheaper water charges are the best solution for their social life, according to the JICA household survey conducted in March 2003. They understand that a shortage of water supply leads to social confusion. During the dry season this year, there was a shortage of water supply and this led to social confusion. People are aware that a shortage of water can upset their social life. In general, they are substantially aware of the importance of maintaining adequate water supplies for their living circumstances.

5. Master Plan

The Master Plan for the Vientiane Water Supply Development Project is being prepared to solve existing problems which the NPVC and people in Vientiane presently encounter with the water supply system, and to increase the water supply capacity with an adequate transmission/distribution system. This will enable the NPVC to meet future water demands and enable the security of the sustainable development of Vientiane and to maintain hygienic living environments for the citizens of Vientiane.

The future population of Vientiane is forecast in three steps, 1) Capital City population forecast, 2) District level population forecast, and 3) Village level population forecast. Capital City population is forecast taking account of past trends, other population forecasts conducted by agencies/projects concerned, the average population increase in the whole the Lao PDR, and applying statistical curves and lines. After forecasting the total capital city population to 2020, district level populations are forecast considering past trends of population increases in the respective districts. The total district level population is forecasted so as to be equal to the forecasted capital city population. Population increasing ratios for each village are also examined and based on past trends. Future populations in each village are forecast so as to be equal to the forecasted district population in total.

One of the most important information for the planning of the future service area expansion is future land use and urban development plans. This information is fortunately included in the VUDMP. Planned industrial areas and reserved areas are taken into account to outline future water service areas. The priority areas for expansion of the service area are also studied, considering on-going projects such as the expansion of the distribution network by the AFD. Expansion of future service areas is finalised by consultation with the WASA and NPVC.

Future water demand is projected for domestic and non-domestic purposes separately. For the domestic water demand, future water demand is calculated from village level populations, service ratios, the calculated served population and the per capita water consumption. Usually per capita water consumption would be expected to increase in future; per capita water consumption in Vientiane is expected to decrease from its current level of 174 lpcd to 170 lpcd by 2010. This is because about 20% of households have in-house leakages not repaired. This situation will be improved by adequate public relation activities managed by the NPVC. Also, there is expectation to be some influence on water usage by the tariff increase which is planned under this Master Plan. Non-domestic water demand is projected from past trends and the industrial area development planned by the Vientiane Capital City. In this Mater Plan, it is strongly recommended that the

NPVC promotes water conservation activities and a reduction of UFW to avoid over-scaled project formation. Table below shows summary of future water demand projection.

Summary of Water Demand Projection

	Unit	2000	2005	2010	2015	2020
Population	person	599,000	687,084	788,165	902,716	1,034,521
Served Population	person	215,522	275,567	370,269	466,981	564,648
Service Ratio	%	36.0%	40.1%	47.0%	51.7%	54.6%
Population in Service Area	person	297,575	380,342	499,737	586,710	662,441
Service Ratio in Service Area	%	72.4%	72.5%	74.1%	79.6%	85.2%
Number of Domestic Connections	nos.	34,210	43,741	58,773	74,124	89,627
Number of Non-domestic Connections	nos.	5,095	6,340	7,889	9,817	12,215
Total Number of Connections	nos.	39,305	50,081	66,662	83,940	101,842
Served Population (Incremental)	person		60,046	94,702	96,712	97,667
Number of Domestic Connections (Incremental)	nos.		9,531	15,032	15,351	15,503
Per Capita Consumption	lpcd	174	172	170	170	170
Total Domestic Water Demand	m3/day	37,501	47,398	62,946	79,387	95,990
Non-Domestic Water Demand	m3/day	30,361	37,780	47,011	58,499	72,793
Total Water Demand	m3/day	67,862	85,177	109,957	137,885	168,783
UFW Ratio	%	33%	28%	25%	25%	25%
Day Average Water Demand	m3/day	101,286	118,302	146,609	183,847	225,044
Day Maximum Water Demand	m3/day	111,415	130,132	161,270	202,232	247,548

To meet the increasing future water demand, the following alternatives were compared and the best alternative plan was selected.

1. Expansion of the existing Chinaimo Treatment Plant,
2. Expansion of the existing Kaolieo Treatment Plant,
3. Construction of new Thangone Treatment Plant, and
4. Combination of the above three alternatives.

To compare these alternatives, the study team prepared water supply facility plans including intake, treatment plants, clear water transmission pipelines, and distribution pipelines. Each alternative's construction costs, operation and maintenance costs have been calculated. to compare each system as a whole. The social, environmental, technical, and economic aspects of each alternative has also been compared. Furthermore, the organization, management, financial condition, and human resource development areas have been carefully examined for the soundness of the future NPVC management.

As a result of the comparative study, a plan of expansion of the existing Kaolieo Treatment Plant under the 1st Stage (by year 2007) and construction of new Thangone Treatment Plant under the 2nd Stage (by year 2012) (Alternative K-1) has been selected as the best alternative. The components of alternative K-1 are as follows.

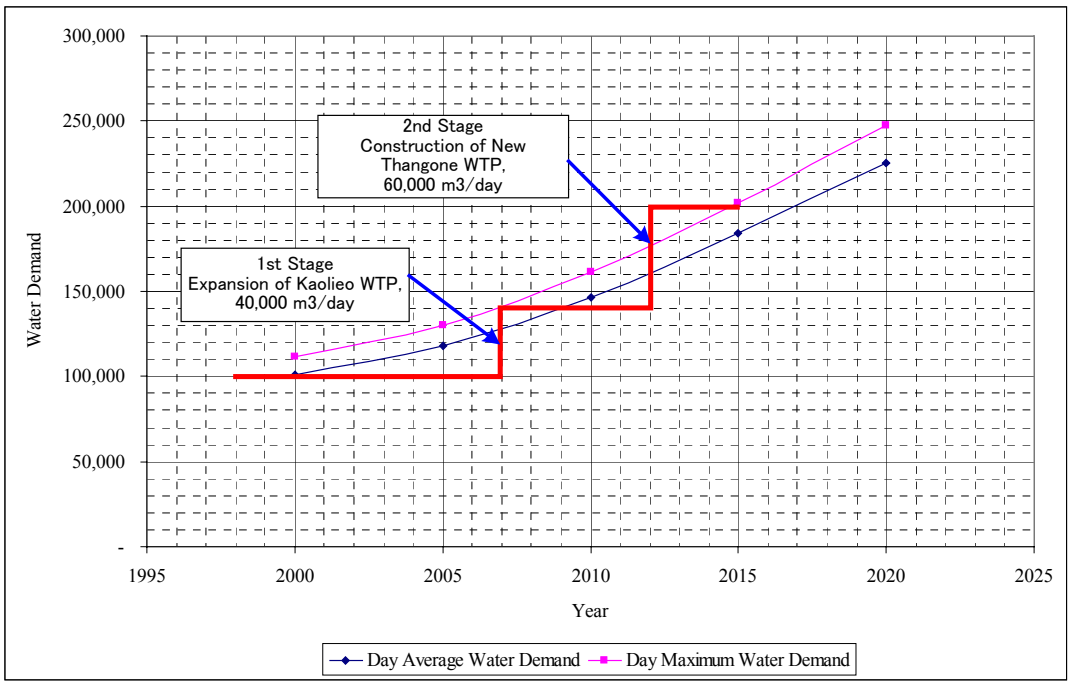
1st Stage: Expansion of Existing Kaolieo Water Treatment Plant

- Intake Facilities: Construction of new intake facilities from the Mekong River
- Treatment Plant: Expansion of 40,000 m3/day
- Clear Water Transmission Pipelines: Installation of 2.2 km of pipelines
- Booster Pumping Stations: Improvement of the Km6 BP Station
- Distribution Trunk Mains: Installation of 24.2 km of pipelines

2nd Stage: Construction of New Thangone Water Treatment Plant

- Intake Facilities: Construction of new intake facilities from the Nam Ngum River
- Treatment Plant: Construction to produce a capacity of 60,000 m3/day
- Clear Water Transmission: Installation of 10.6 km of pipelines
- Distribution Centre: Construction of a new distribution centre with a capacity of 60,000 m3/day
- Booster Pumping Stations: Improvement of the Km12 BP Station
- Distribution Trunk Mains: Installation of 73.6 km of pipelines

The system expansion plan is shown in the figure below. The 1st Stage Project will be completed by 2007 and the 2nd Stage Project will be completed by 2012.



The scale of the 1st Stage Project was decided considering the adequate scale of the project. This was to avoid difficulties among international lending agencies in finding funding sources for the Lao PDR. After the completion of the 1st Stage Project, the daily maximum water demand will still not be satisfied, and the water shortage situation will continue until the completion of the 2nd Stage. Therefore, it is strongly recommended that the NPVC promotes water conservation activities through adequate public relations, and to reduce the UFW by intensive measures.

The scale of the 2nd Stage may be rather large for international or Lao PDR's own funding bodies, even though the economic and financial viability has been calculated as described in the Master Plan. Therefore, in order to adapt the 2nd Stage Project at an appropriate capital investment scale, efforts on water conservation and reduction of the UFW are indispensable by the NPVC.

After completion of the 1st Stage Project, a feasibility study will be required to implement the 2nd Stage. During the feasibility study for the 2nd Sage, the scale of the 2nd Stage will be reviewed. If the maximum water demand is reduced by the promotion of water conservation and the reduction of UFW is less than estimated by the study, the implementation of the 2nd Stage could be divided into two phases, each stage being a phased production capacity increase of 30,000 m3/day, or, alternatively, to be reduced to 50,000 m3/day from 60,000 m3/day. Such modifications of scale to the 2nd Stage will reduce the financial impacts to the NPVC.

Preliminary cost estimates were conducted and the project costs for the 1st and 2nd Stages are shown below together with the planned implementation schedule.

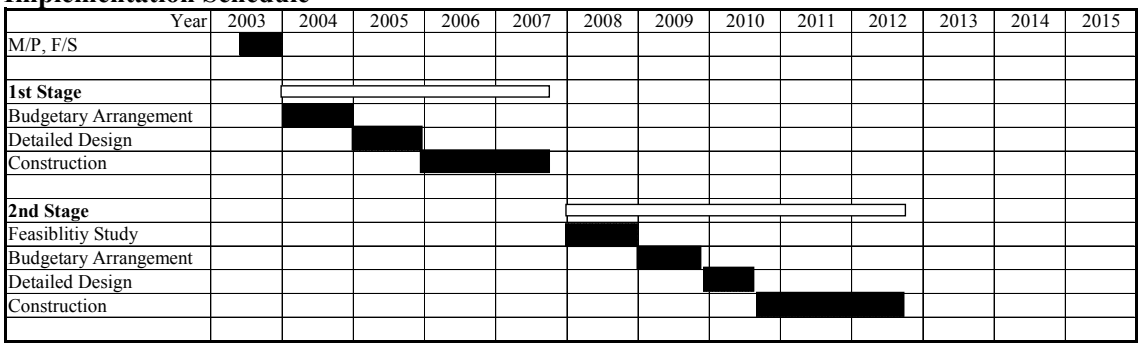
(x 1,000 US$)

	Total	Foreign	Local
FIRST STAGE	**35,372**	**22,549**	**12,823**
1. Construction Cost	26,048	17,122	8,926
1.1 Treatment Plants	15,081	9,055	6,026
Expansion of Kaolieo T.P.	9,624	5,762	3,862
Rehabilitation of Kaolieo T.P.	3,023	1,951	1,072
Expansion of Reservoir in Chinaimo T.P.	2,434	1,342	1,092
1.2 Clear Water Transmission Pipelines	1,234	984	250
1.3 Distribution Center	0	0	0
1.4 Booster Pump Station	737	607	130
1.5 Distribution Trunk Mains	6,393	4,694	1,699
1.6 Secondary and Tirtially Distribution Mains	606	510	96
1.7 House Connection Installation	752	620	132
1.8 Unaccounted-for Water Reduction	1,245	652	593
2. Consulting Services	1,822	1,540	282
2.1 D/D and S/V for Stage 1 (2004 - 2007)	1,822	1,540	282
3. Contingencies	5,817	3,887	1,930
3.1 Physical Contingency	2,787	1,866	921
3.2 Price Contingency	3,030	2,021	1,009
4. Administration Cost	1,685	0	1,685

(x 1,000 US$)

	Total	Foreign	Local
SECOND STAGE	**66,065**	**44,316**	**21,749**
1. Construction Cost	41,563	28,801	12,762
1.1 Treatment Plants	13,427	8,693	4,734
Construction of Thangone T.P.	13,427	8,693	4,734
1.2 Clear Water Transmission Pipelines	7,521	6,198	1,323
1.3 Distribution Center	4,376	2,984	1,392
1.4 Booster Pump Station	366	294	72
1.5 Distribution Trunk Mains	11,156	7,280	3,876
1.6 Secondary and Tirtially Distribution Mains	1,202	1,011	191
1.7 House Connection Installation	1,874	1,544	330
1.8 Unaccounted-for Water Reduction	1,641	797	844
2. Consulting Services	3,505	2,954	551
2.1 Feasibility Study for Stage 2 (2008)	595	496	99
2.2 D/D and S/V for Stage 2 (2009 - 2012)	2,910	2,458	452
3. Contingencies	17,851	12,561	5,290
3.1 Physical Contingency	4,507	3,175	1,332
3.2 Price Contingency	13,344	9,386	3,958
4. Administration Cost	3,146	0	3,146
Total Project Costs	**101,437**	**66,865**	**34,572**

Implementation Schedule



Among the projects examined, the following priority projects have been selected based on their urgency and importance for the improvement of the water supply. Project scale was carefully examined considering the NPVC's financial capabilities and future tariff schedules. Selected priority projects are as shown below.

- Rehabilitation of the existing Kaolieo Treatment Plant, with a production capacity of 20,000 m3/day
- Improvement of the Chinaimo Treatment Plant, with a production capacity of 80,000 m3/day
    - Expansion of reservoirs (10,000 m3) including additional distribution pumping facilities
    - Installation of a transmission pipeline from the Chinaimo Treatment Plant to the existing transmission pipelines (separation of transmission and distribution system)
- Expansion of the Kaolieo Treatment Plant, 40,000 m3/day
- Improvement of the Km6 BP Station
- Installation of 2.2 km of transmission mains

The costs required for the priority projects are as shown table below.

(x 1,000 US$)

	Total	Foreign	Local
PRIORITY PROJECT	**18,246**	**11,391**	**6,854**
1. Construction Cost	17,052	10,646	6,406
1.1 Treatment Plants	15,081	9,055	6,026
Expansion of Kaolieo T.P.	9,624	5,762	3,862
Rehabilitation of Kaolieo T.P.	3,023	1,951	1,072
Expansion of Reservoir in Chinaimo T.P.	2,434	1,342	1,092
1.2 Clear Water Transmission Pipelines	1,234	984	250
1.3 Booster Pump Station	737	607	130
2. Consulting Services	1,194	745	448
2.1 D/D and S/V for Stage 1 (2004 - 2007)	1,194	745	448

In this Master Plan, priority projects have been selected from treatment plant facilities and clear water transmission pipelines. Other components such as distribution systems and house connections will be selected as priority projects under the study which is conducted by the AFD. The minimum requirements of distribution systems which will be necessary to distribute water from the expanded Kaolieo treatment plants are examined as below and these pipelines were agreed to be included in the priority project among agencies concerned.

Dia (mm)	Length (km)	Cost (1000 US$)
150	4.57	229
250	3.22	309
400	4.89	1,540
600	1.76	1,006
700	0.68	483
Total	15.12	3,567

6. Economic and Financial Evaluation of the Master Plan

(1) Economic Evaluation

Among the various benefits of water supply, the tangible benefits were selected for economic evaluation, and bounded into the following three components: (1) water source saving benefit for domestic water consumers, (2) public health improvement, and (3) water source saving benefit for non-domestic water consumers. The water source saving benefit accrues from the elimination of water procurement systems, in cases where water supply systems are introduced in the project areas. They were quantified into their respective components in the table below. Future projected economic conditions by 2020, domestic water consumers will improve their water procurement systems in proportion to the betterment of their living standards owing to the projected national economic growth. Thus, these conditions increase the unit benefit in economic terms for the future.

Beneficiary		Benefit Component	Unit Benefit in Economic Terms at 2003 Constant Prices	
			Present	2020 Conditions
(1)	Residents	Water source saving benefit	US$0.41/$m^3$	US$0.71/$m^3$
(2)	Residents	Public health improvement benefit		
(3)	Non-residential Water Consumers	Water source saving benefit	US$0.21/$m^3$	US$0.21/$m^3$

Economic costs of construction, O&M and replacement of the master plan schemes were converted

from the respective financial costs estimated at market prices, applying a conversion factor.

Item		Financial Cost (US$ Million)	Economic Cost (US$ Million)
Construction Cost*		98.6	79.4
O&M Cost (at matured stage)		2.1	1.4
Replacement Cost	2022	5.4	5.4
	2027	7.2	7.1

Note: * Total cost was estimated for components related to the proposed scheme.

The evaluation indices in the case with economic growth in the future were 12.8% of EIRR, US$2.96 million of NPV and 1.06 of B/C. The project could be viable from an economic point of view, because its EIRR exceeded the opportunity cost of capital.

Item	EIRR (%)	NPV* (US$ Million)	B/C*
Under Present Conditions	8.5	-10.9	0.77
With Economic Growth Conditions	12.8	3.0	1.06

Note: * Discounted at 12%.

(2) Financial Analysis

Annual revenue accrues mainly from water sales, water meter installations and water meter rentals in the new project operation. The revenue until the target year 2020 was estimated at 2003 constant prices in the table below. The revenue was based on the latest tariff of the NPVC.

(Unit: US$1000/year)

Item	2007	2010	2015	2020
Water Sales	465	576	1,296	1,423
Water Meter Installation	131	156	398	406
Water Meter Rental	3	14	53	99
Total	599	746	1,747	1,928

The investment cost of the new water supply schemes was estimated at US$98.6 million. These costs do not include supplementary works such as “UFW Reduction” in this analysis. The O&M costs were estimated at US$0.8 million/year in 2007 and US$2.1 in 2020. Replacement costs were taken into account, as mentioned in the economic evaluation.

Through the financial analysis based on the demand projection, and the costs mentioned above, the relationship between the water rate and financial cost was elucidated as follows.

Case	Financial Cost		Average Water Rate	
	Interest Rate (%)	Remark	Water Cost (US$/m^3)	Ratio to Present Rate
Case 1	0.0%	Complete Subsidy	0.19	3.8 times
Case 2	3.0%	Chinaimo Expansion	0.25	5.0 times
Case 3	6.3%	International Loan	0.34	6.8 times
Case 4	9.9%	Private Bank Loan	0.45	9.0 times

According to the surveys listed in the table below, an average water charge for domestic water consumers ranges between 1.0% and 1.6% of the family income. Affordability-to-pay for water is considered as not more than 5% of family income, as declared and/or reported by the authorities.

Survey/Report		Ratio of Water Charge to Household Income (Expenditure)
LECS2*, 1997/98, NSC		1.0%
Household Survey by JICA in March 2003	People Served by NPVC	1.6%
	People without Water Supply Service	1.4%
Prime Ministerial Decision (37/PM), Sept. 30, 1999	For low-income people	Not more than 3%
	In case of higher water rate	Not more than 5%
World Bank Report "Investing in Development", 1985		3% ~ 5%

Note: * "Households of Lao PDR, Lao Expenditure and Consumption Survey"

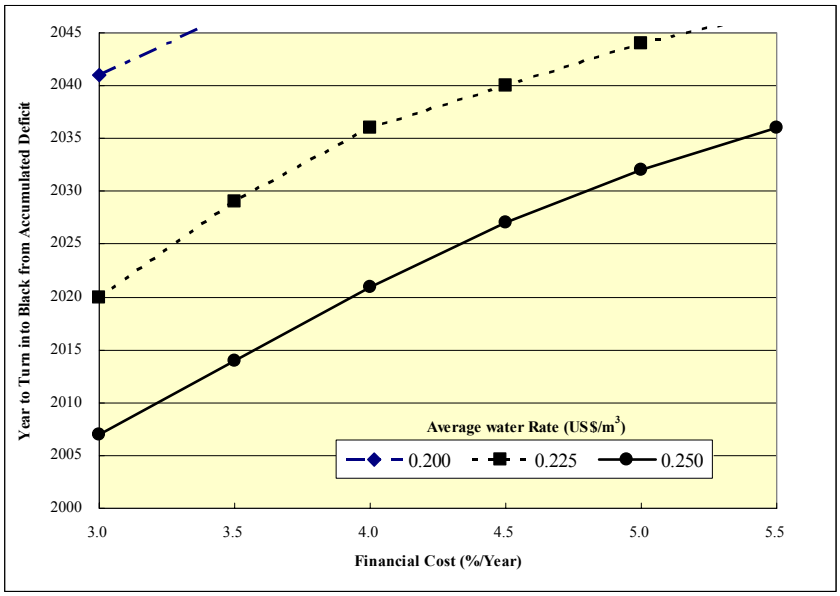
As shown in the table below, the ratio of water charge to family income in Case 1 was 4.0% which is within the affordable range of 3% to 5%, so it would be considered that Case 1 is fair for the people. In Case 2, the rate was 5.4% which is over the range, so it would not be affordable. However, the water tariff could be made within the affordable range by means of cross subsidization taking affordability of domestic consumer into consideration.

Case	Water Unit Rate		Water Charge	Percentage of Water Charge to HH Income	Affordability*1
	(US$/m^3)	(Kip/m^3)	(Kip/month)	(%)	
Case 1	0.19	2,010	64,000	4.0	○
Case 2	0.25	2,680	86,000	5.4	△
Case 3	0.34	3,640	117,000	7.3	△
Case 4	0.45	4,820	154,900	9.7	×

Note: *1 Signs mean: ○ - fair, △ – hard, and × - impossible

(3) Financial Simulation

Through the simulation analysis, the relationship between the water cost and financial cost was depicted as shown in the figure on the right. For instance, if the average water rate was cut down to US$0.225/m^3 (10% down) and the financial cost went up to 4.5%/year (around 50% up), the year of solving accumulated deficit would be delayed to 2040 from 2007. In making a management plan for the project, the procurement of financial sources and the establishment of water rates are important issues.



7. Initial Environmental Examination

Although significant environmental impacts as a result of the implementation of the priority projects are not foreseen, possible environmental impacts have been listed and screened. A forthcoming environmental impact assessment will be conducted during the next feasibility study period.

8. Evaluation of the Master Plan and Recommendations

The prepared Master Plan has been evaluated from technical, socio-economic, and environmental aspects to help confirm the adequacy of the plan. Based on the identified issues of the existing conditions and development plans, the following recommendations are included in the Master Plan:

(1) Institutional, Organisational, and Legislative Aspects

- Expansion of an autonomous, and Legislative Aspects
- Promotion of Public Private Partnership
- Reconsideration of the roles of Drinking Water Factory

(2) Technical Aspects

- Coordination with AFD Study
- Reduction of UFW
- Monitoring water quality and quantity
- Promotion of water conservation
- Recruiting and training additional staff
- A Feasibility Study and Review of the Master Plan will be required

(3) Managerial Aspects

- Maintenance of good customer relations
- Strengthening of billing relating works

(4) NPVC Financial Aspects

- Improvement of the following issues: (a) expansion of equity instead of liability, (b) increase of water sales, (c) decrease of water production cost, (d) shortening water charge collection, and (e) cultivation of versatile workers.
- Procurement of financial sources with cheaper financial costs to supply water within consumers' affordability-to-pay.
- Setting up reasonable water tariffs based on the mutual understanding between water consumers and the water supplier.
- Finding rational water price for motivating water conservation.

(5) Improvement in Public/Customer Relations