JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

No. 1

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
MINISTRY OF COMMUNICATIONS, TRANSPORTS,
POSTS AND CONSTRUCTION
NAM PAPA LAO

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES IN VIENTIANE PREFECTURE IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

SEPTEMBER 1992

Nihon Suido Consultants Co., Ltd.

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PREFACE

In response to a request from the Government of the Lao People's Democratic Republic (the Lao PDR), the Government of Japan decided to conduct a basic design study on the project for Improvement of Water Supply Facilities in Vientiane Prefecture and entrusted the study to the Japan International Cooperation Agency (JICA).

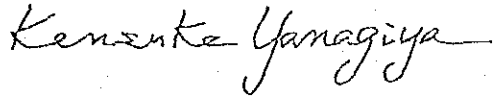
JICA sent to the Lao PDR a study team headed by Mr. Hiroki Hashizume, Deputy Director for International Cooperation, International Affairs Division, Ministry of Health and Welfare, from March 21 to May 15, 1992.

The team held discussions with the officials concerned of the Government of the Lao PDR, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Lao PDR in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Lao People's Democratic Republic for their close cooperation extended to the teams.

September, 1992



Kensuke Yanagiya
President
Japan International Cooperation Agency

September, 1992

Mr. Kensuke Yanagiya,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the project for Improvement of Water Supply Facilities in Vientiane Prefecture in the Lao People's Democratic Republic.

This study has been made by Nihon Suido Consultants Co., Ltd, based on a contract with JICA, from March 12, 1992 to September 30, 1992. Throughout the study, we have taken into full consideration of the present situation in the Lao People's Democratic Republic, and have planned the most appropriate project in the scheme of Japan's grant aid.

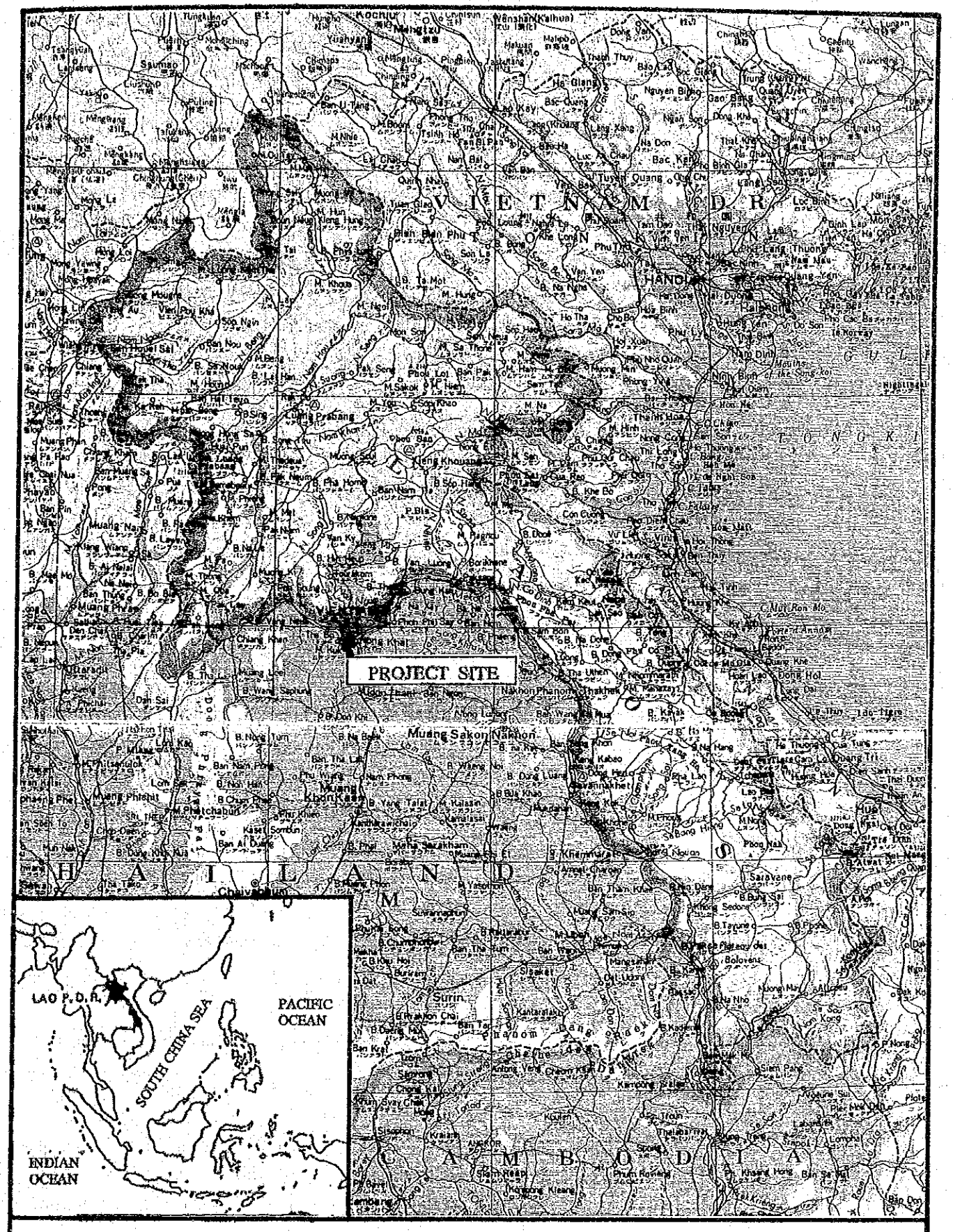
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, the Ministry of Health and Welfare and the Embassy of the Lao People's Democratic Republic in Japan. We also wish to express our deep gratitude to the officials concerned of the Ministry of Communications, Transports, Posts and Construction, Nam Papa Lao and the Embassy of Japan in the Lao People's Democratic Republic for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,

T. Miikura

Team leader. Takayuki NIIKURA
Basic design study team on the project for Improvement of Water Supply Facilities in Vientiane Prefecture.
Nihon Suido Consultants Co., Ltd



LOCATION MAP

SUMMARY

The Lao People's Democratic Republic (the Lao PDR) is a landlocked country between Vietnam and Thailand, and on a border to the south, Kampuchea and to the north, China and Myanmar. The country has an area of 236,800km2, where agriculture is dominating and GDP by agriculture accounts for 42% of the total in between 1986 and 1990. Main crop is rice. The agricultural products are increasing, giving favorable effects on whole area of economic activities in the country.

From population statistics, the country has a population of 4,200,000 in 1991, out of which 760,000 people (18%) are living in the urban area and the remaining 3,440,000 (82%) in the rural area.

Seven out of 17 provincial capitals have piped water supply systems which serve 250,000 people or about 33% of the estimated total urban population. Water supply systems in rural area generally rely on rivers, streams, springs and dug wells as water sources, with an estimated service coverage ranging from 10 to 15%. The balance of the populations depends on unhygienic water from traditional sources.

There are two water supply systems in Vientiane Prefecture: Kaolieo Water Treatment Plant (WTP) constructed in 1964 under Japanese grant aid has a production capacity of 20,000 cmd and Chinaimo WTP constructed in 1980 under financial and technical assistance from Asian Development Bank (ADB) has 40,000 cmd production capacity.

Water consumption in Vientiane Prefecture, due mainly to rapid growth of the population, has increased significantly in the recent decade, almost exceeding the total production capacity of 60,000 cmd. Consumers even in the service area are suffering from decreased water pressure due to insufficiency in pipe diameter and deterioration of pipes.

In the third National Five Year Plan, the Government of the Lao PDR has showed its intention to establish water supply systems in all provincial capitals.

Nam Papa Lao (NPL), responsible for development, operation, management and maintenance of water supply systems in whole provincial towns in the Lao PDR including Vientiane, is facing shortage of funds for rehabilitation and upgrading of the existing water supply systems.

In May 1989, the Government of the Lao PDR prepared Vientiane Master Plan for Urban Development, addressing urgent needs of water supply system improvement in the prefecture. Since then, several studies on water supply system improvement in Vientiane have been carried out in cooperation with the United Nation's Development Program (UNDP), World Bank (WB) and ADB. These reports also suggest the necessity of 1) rehabilitation and upgrading of Chinaimo WTP from 40,000cmd to 80,000cmd and 2) rehabilitation and expansion of distribution pipe network. Particularly, a feasibility study carried out by ADB consultants in March 1992 verifies viability of the whole project on condition that revision of water rate structure should be made within allowable level of consumers.

To improve water supply conditions in Vientiane Prefecture, the Government of the Lao PDR has made a request for the Japanese grant aid in implementing rehabilitation and upgrading of Chinaimo WTP in January 1989. JICA sent a Preliminary Study Team and Basic Design Study Team in October 1991 and March 1992 respectively. The scope of the JICA Basic Design Study for the Project, finally agreed between the JICA Basic Design Study team and the agencies concerned of the Governmetn of the Lao PDR contains rehabilitation and upgrading of Chinaimo WTP and pipeline extension to Tha Deua with an elevated storage tank.

The present report, the Basic Design Study Report for Improvement of Water Supply facilities in Vientiane Prefecture, proposes the most appropriate basic design inclusive of design concept, implementation schedules, selection of materials and equipment to be procured, and operation and maintenance plan.

The executing agency for the present project is NPL. To execute/manage the project successfully, NPL is required to establish Project Management Office in NPL head office and Project Implementation Office in Chinaimo WTP. Staff required for these offices are summed up to 25. Staffing of Chinaimo WTP will be strengthened from 34 to 48 staff number for the increased task of operation and maintenance of the completed facilities.

The present basic design is worked out in conformity with the design criteria and treatment processes currently applied to the existing WTP. Further, attention is paid to an establishment of reliable water supply. Matters such as simplicity in structure, energy saving, maximum utilization of local products and systematic water flow are also considered in designing the water supply facilities.

Table S-1 outlines the project components together with the equipment and materials to be procured under the current Project.

In consideration of the administrative procedures required for Japanese grant aid and the distinctive function of each facility, the Project is divided into three steps: 1) construction of silt removal facilities with bank protection, 2) upgrading of Chinaimo WTP and 3) rehabilitation of Chinaimo WTP and pipeline extension to Tha Deua.

At the outset of each Step, consultants to be employed by NPL will prepare detailed design of planned facilities together with tender documentation. Under Step 1, silt removal facilities will be constructed to extract required amount of raw water. The construction will be completed in the dry season. Under Step 2, the upgrading of Chinaimo WTP will be undertaken to secure additional production capacity of 40,000cmd. This ensures the constant 40,000cmd water production even during rehabilitation works under Step 3. In Step 3, the rehabilitation of Chinaimo WTP and pipeline extension from Chinaimo WTP to Tha Deua inclusive of construction of an elevated storage tank will be completed. Major works contained in each step are summarized in Table S-2.

Table S.1 Contents of Work Requested and Assessed

Item	Requested	Assessed
1) Construction		
(1)- Expansion of Chinaimo WTP (Including measuring mechanical, chemical dosing, and electrical facilities)	Design capacity, 40,000 m^3/day including const-ruction of a clear water reservoir with 30-60 minutes' storage capacity.	Design capacity, 40,000 m^3/day including const-ruction of a clear water reservoir with 60 minutes' storage capacity
- Intake raw water pump	Replacement of raw water pumps to meet production capacity of 80,000m^3/day (4 NOS)	Overhaul existing raw water pumps (3 NOS out of 4 NOS) plus new submergible motor pumps (2 NOS)
	-	Bank protection work around drain shoot channel at intake site (Approx 60m)
(2)- Rehabilitation of existing Chinaimo WTP	1 LS. Including, measurement, chemical dosing and alum solution tanks etc.	1 LS. Including, measurement, chemical dosing and alum solution tanks etc.
(3)- Transmission and distribution system to Tha Deua		
a) Transmission and distribution pipeline installation work	1 LS.	Transmission pipelines DIP, ϕ 300mm, 6.2km Distribution pipelines DIP, ϕ 350mm, 4.0km Distribution pipelines DIP, ϕ 300mm, 4.6km
b) Elevated storage tank	1 NO.	1 NO. (Capacity. 1,500m^3)
2) Procurement of machine		
Intake silt removal facility	1 LS.	1 unit of a cramshell
3) Detailed design and construction supervision	Complete process	Complete process

Table S.2 Contents of Work by Step

Phase	Contents	
1st Step :	– Intake silt removal facility work	Construction of platforms setting a clamshell.
	– Bank protection work	Approx 60m
	– Detailed design and construction supervision	
2nd Step :	– Expansion work of Chinaimo WTP	
	– Construction of Treatment Facilities	Receiving well, flocculation & sedimentation basins, rapid sand filters, pump well, measuring facilities, chemical dosing facilities and alum solution tanks, etc.
	– Construction of a clear water reser–voir	Volume, 3,300 m^3
	– Intake raw water pumps	Submersible pumps, 2 NOS.
	– Transmission and distri–bution facilities	
	– Power substation	
	– Detailed design and construction supervision	
3rd Step :	– Rehabilitation work of Chinaimo WTP (Existing)	Overhaul existing raw water pumps, 3 NOS out of 4 NOS. Overhaul existing transmission (distribution) pumps, 3 NOS. Flocculation & sedimentation basins. Overhaul or removal measuring facilities, chemical dosing facilities and alum solution tanks etc. Finishing works.
	– Construction transmi–ssion and distribution system to Tha Deua	Transmission pipeline, DIP, ø300, L=6.2km Distribution pipeline, DIP, ø350, L=4.0km Distribution pipeline, DIP, ø300, L=4.6km Elevated storage tank, VOL. 1,500m^3
	– Detailed design and Construction supervision	

The construction and test run for Steps 1, 2 and 3 require 8 months, 12 months and 12 months respectively.

Lao portion of total project cost is estimated at 79 million Kip for the land acquisition for elevated storage tank, and warehouse construction.

The project will contribute directly or indirectly to 1) improvement of present water supply condition; unit water consumption increasing from 200 litres per capita per day (lpcd) in 1992 to 214 lpcd in 1995 and 225 lpcd in 1997, 2) enhancement of commercial and industrial activities in Vientiane Prefecture and 3) increase of service coverage of water supply.

To attain maximum benefits from the project, NPL and MCTPC are recommended to take necessary measures as follows:

1) Continuation of intensive leakage abatement
2) Training of NPL staff and recruitment
3) Allocation of necessary budget for operation and maintenance
4) Revision of water tariff structure
5) Effective water tariff collection

TABLE OF CONTENTS

ABBREVIATION

Lao PDR	:	Lao People's Democratic Republic
MCTPC	:	Ministry of Communications, Transports, Posts and Construction)
NPL	:	Nam Papa Lao
JICA	:	Japan International Cooperation Agency
ADB	:	Asian Development Bank
WB	:	World Bank
IDA	:	International Development Association
JWWA	:	Japan Water Works Association
IMF	:	International Monetary Fund
UN	:	the United Nations
UNDP	:	United Nations Development Program
EC	:	European Community
CMEA	:	Council for Mutual Economic Assistance
JIS	:	Japan Industrial Standard
BS	:	British Standard
E/N	:	Exchange of Notes
CIF	:	Cost, Insurance, and Freight
FOB	:	Free on Board
DIP	:	Ductile Iron Pipe
CIP	:	Cast Iron Pipe
ACP	:	Asbestos Cement Pipe
PVC	:	Polyvinyl Chloride pipe
SP	:	Steel Pipe
FRP	:	Fiberglass Reinforced Plastic Pipe
pH	:	Hydrogen Ion Concentration
Lpcd	:	Liters per capita per day
ø	:	Phi
%	:	Percents
°C	:	Degrees Centigrade
l	:	Liters
¥	:	Japanese Yen
Kip	:	Kip

CHAPTER 1 INTRODUCTION

In reply to the request made by the Government of the Lao People's Democratic Republic (Lao PDR), the Government of Japan has determined to conduct basic design study for Improvement of Water Supply Facilities in Vientiane Prefecture. To this end, the Japan International Cooperation Agency (JICA) has sent the Basic Design Study Team (the Team) to Vientiane, the Lao PDR March 1992 to conduct field surveys and confirm the scope of the basic design. The Team consisting of eight members was headed by Mr. Hiroki Hashizume, Team Leader. The scope of the Basic Design finally agreed between the agencies concerned is enumerated below:

1) Expansion of Chinaimo WTP by 40,000cmd (from 40,000 to 80,000cmd) including construction of a clear water reservoir with 30 to 60 minutes' storage capacity.

2) Rehabilitation of Chinaimo WTP to restore design production capacity of 40,000cmd, including rehabilitation of the intake such as silt removal and replacement of the pumps to meet production capacity of 80,000cmd.

3) Pipeline extension to Tha Deua area and construction of a related elevated reservoir.

On the basis of the scope of work listed above, the Team conducted the field surveys at the respective sites in Vientiane, and had interviews with officials and staff concerned of NPL and the governments to collect and review relevant data. Detailed analyses and studies were carried out by the Team in Japan in the period from 16 May to 31 August 1992.

The present Basic Design Study Report for Improvement of Water Supply Facilities in Vientiane Prefecture, hence, deals with the issues related to rehabilitation and expansion of Chinaimo WTP and pipeline extension to Tha Deua area.

The study team's organization, schedules, visited agencies, minutes of discussions and the list of collected data are shown in the Appendix 1 to this report.

CHAPTER 2 BACKGROUND OF THE PROJECT

Most of information given hereunder are excerpts mainly from the Draft Final Report on Rehabilitation and Upgrading Project for Vientiane Water Supply, prepared by the ADB consultants in March 1992 (ADB Report). On the basis of the updated data, minor amendment or revision was made by the Team.

2.1 Outline of Water Supply Sector

Out of 17 provincial capitals, seven including the capital city Vientiane have piped water supply systems which serve about 250,000 people or about 33 percent of the estimated total urban population. Water supply service in terms of water quality and quantity is generally poor, especially in southern towns.

Water supply systems in rural areas are largely based on traditional sources including rivers, streams, springs, dug wells, and gravity fed pipeline systems. Coverage in rural areas is estimated at between 10-15 per cent with consumption at about 25-75 lpcd. The balance of the rural populations still depends on unhygienic and untreated water from traditional sources.

Main institutions involved in urban water supply sector are the Ministry of Communications, Transports, Posts and Construction (MCTPC) and Nam Papa Lao (NPL), while the Ministry of Health (MOH) is responsible for rural water supply sector.

Department of Construction and Urban Planning of the MCTPC is responsible for urban water supply policies and operations of NPL. It has set a target of providing piped water supplies to all 17 provincial capitals by the end of the current five year development plan (1995) and a long term objective of providing all communities with access to safe potable water at a reasonable cost. To achieve this target, restructuring of water supply sector was made in early 1992.

After centralization of all Nam Papas (water supply enterprises) in the country to a national organization, NPL became a sole agency responsible for control and management of all provincial water supply systems. Fig 2-1 portrays present organization chart of NPL. Under one General Manager, 7 provincial town water supply systems are operated. The main branch and organization of NPL is in Vientiane, and is divided into 5 service sections and 7 operational divisions. The 5 service sections provide assistance to, or have functional responsibilities, in relation to NPL's branches in other towns as well as to Vientiane. NPL in Vientiane has a staff of 345 and the branches in the towns of Savannakhet (89), Oudomsai

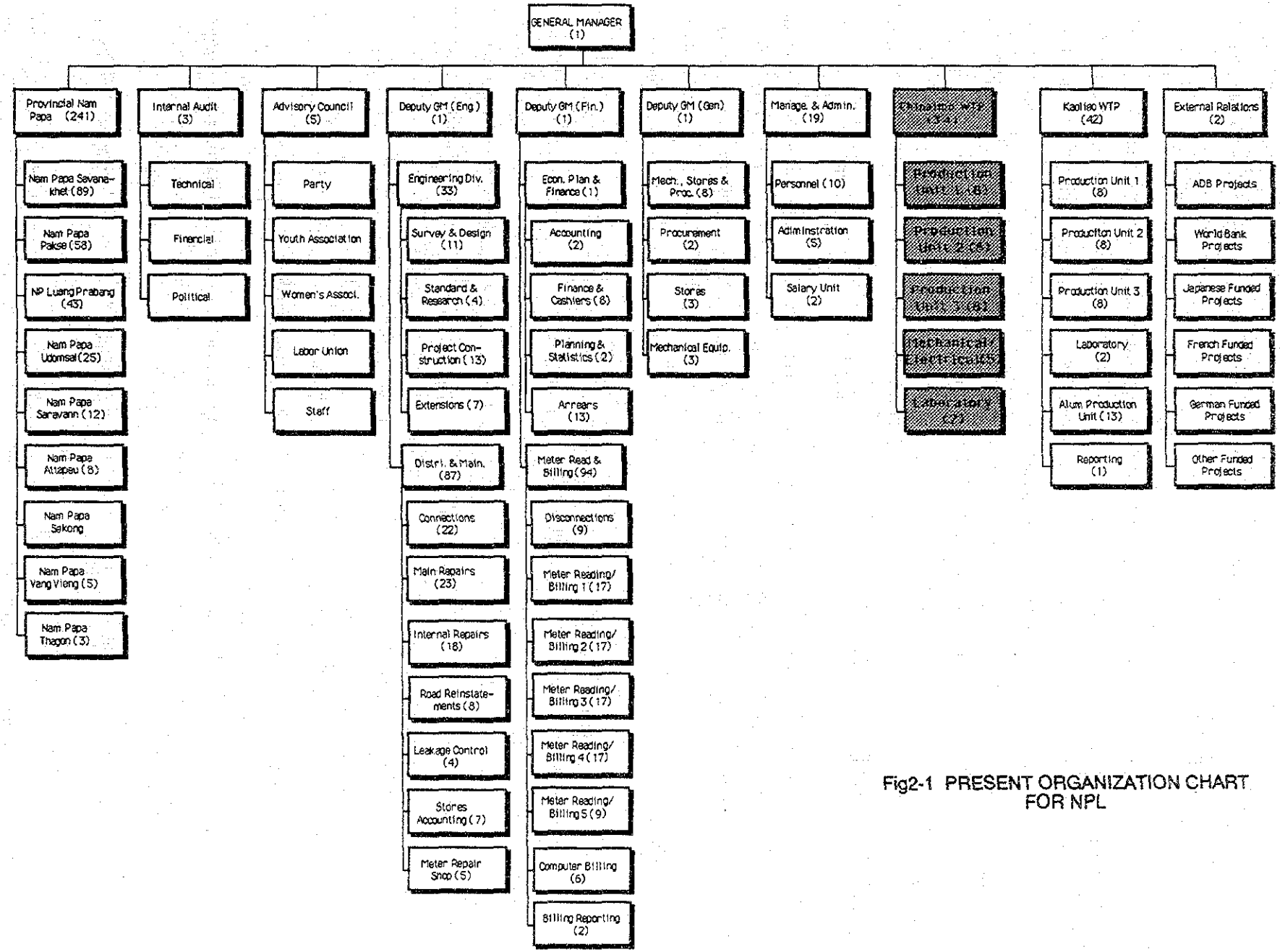


Fig2-1 PRESENT ORGANIZATION CHART FOR NPL

(25), Luang Prabang (43), Pakse (58), Saravane (12), Attaper (6), Sekong (4), Vang Vieng (5) and Thangon (3) have a further 245 staff, with each provincial Nam Papa being headed by a General Manger.

A large number of the important decisions particularly in areas such as investment and pricing, however, have been determined under jurisdiction of MCTPC. Under the circumstances, it can be said that NPL organization is in a developing stage to act as the sole agency responsible for operation and management of major provincial towns' water supply systems in the Lao PDR. Present organization of NPL, therefore, is considered still provisional in the course of transition into a National Water Supply Agency.

2.2 Outline of the Request

Service coverage of the water supply system in Vientiane Prefecture is estimated around 40%. Many people are suffering from shortage of potable water. Due to limited production capacity of the existing treatment plants and lack of appropriate size of pipeline network, many consumers even in the existing service area cannot get hygienic piped water on a continuous basis.

To improve water supply conditions in Vientiane Prefecture, the Government of the Lao People's Democratic Republic (Lao PDR) has made a formal request in January 1989 for the Japanese grant aid in implementing rehabilitation and expansion of the existing Chinaimo Water Treatment Plant (WTP) in Vientiane Prefecture. In reply to the request, JICA has sent a preliminary study team to conduct field survey and had discussions with the officials concerned of the Government of the Lao PDR between October 27 and November 17, 1991. In the series of discussions, the Government of the Lao PDR has indicated its desire to implement the following (as referred to Appendix-1).

1) Upgrading of Chinaimo WTP from 40,000cmd to 80,000cmd

2) Extending of the existing distribution pipe network to the Phong Tong, Tha Deua, Thathong District, Sam Khey, etc.

3) Construction of elevated tanks (1,500m3) with reservoirs at South Vientiane and North Vientiane, and a reservoir with pumping facilities at Dong Dok.

4) Rehabilitation of Chinaimo WTP

5) Rehabilitation of the existing distribution pipe network including replacement/repair of the old pipelines, installation of valves, fire hydrants and pipes interconnecting Chinaimo system to Kaolieo system.

2.3 Outline of the Project Area

The project area covers Tha Deua and Chinaimo situated along the left bank of the Mekhong River in south Vientiane Prefecture, where rapid development is expected concurrently with a completion of Mittaphap (Friendship) Lao-Thailand Bridge and a commercial complex in 1994. Under this heading, outline of the Vientiane Prefecture will be described with an emphasis on infrastructure.

2.3.1 Geography

Climate of Vientiane Prefecture is characterized by subtropical monsoon and savanna. It has hot and wet seasons. The average yearly temperature is 26 degrees celsius, varying from monthly averages of 21 degrees in December to 30 degrees celsius in April. Rainfall averages 1,600mm/year, varying from 20 mm/month in January to 500 mm/month in September. The Prefecture covers an area of 3,920 square kilometers. It is bordered to the south by the Mekhong River. The prefecture is low lying land with large areas of swamp and paddy fields amongst the urban development. It is divided into eight districts with large differences in the degree of urbanization between the districts.

2.3.2 Population

The population of Vientiane Prefecture has increased significantly during the last fifteen years or so as a result of social and economic developments in the country. For the years 1975 to 1985 the annual growth was about 3.1 per cent, due mainly to internal migration from the rural areas to urban areas. For the years 1985 to 1990 the growth rate has slightly decreased to 3.0 per cent. Population statistic since 1975 is presented in Table 2-1.

Table 2-1 POPULATION STATISTIC

Year	Population	Annual Growth Rate	Remarks
1975	286,725	-	
1980	333,893	3.1	
1985	388,820	3.1	Census
1990	450,790	3.0	Estimated
1991	459,454	1.9	Estimated

Source: Vientiane Municipality Office and NPL

The present population density of the Vientiane prefecture is estimated to be only 1.2 persons per hectare. This is explained by the significant areas of open ground including low lying swamps, rice fields, temple grounds, and public monuments.

2.3.3 Socio-economic Conditions

The prefecture depends on agriculture. Main crops of the area are rice and maize. In the urban center of the Vientiane Prefecture, governmental offices gather, together with a number of historic temples, markets, shops, restaurants and hotels. Locally produced textile, lacquerware and other various consumables are available in the city center. Imported goods mostly from Thailand and communist countries are also found.

Industrial activities are particularly acute in the area along with Route No.2 to Tha Deua. In Tha Deua area, Mittaphap (friendship) bridge over the Mekhong river, that connects the Lao PDR and Thailand is currently under construction and expected to complete in 1994. The government's recent policy for free trade and open market will accelerate the development of the area.

The Prefecture, thus, has a potential to rapidly develop as a center of commerce, industry, education, and administration of the Lao PDR.

2.3.4 Infrastructure

Public investment by the Government has been limited to the specific area of the infrastructure such as electricity, road, and water supply. In general term, however, such infrastructure development is still in an initial stage, not necessarily sufficient to enhance public health and welfare of the people.

Under technical and financial assistance from overseas, Nam Ngum dam associated with power line network was completed in December 1971. Since then, power supply conditions in the Vientiane Prefecture have been significantly improved. The Lao PDR currently exports 80% of the generated power to Thailand. Despite its excess power, people in the Prefecture are still suffering from frequent power failure due to storm and thunder.

Main national roads that connect the center of urban Vientiane with provincial and district towns are generally in poor conditions. There are three main roads in the Vientiane Prefecture: Route No. 2 to Tha Deua, Route No. 10 to Phakho, and Route No.13 to Phon Hong as shown on Fig 2-2. Due to years of use, rather weak foundation and thin layer of asphalt, most of them are not necessarily maintained in a desirable condition for mass transport.

Major public transportation in the urban center are bicycles, scooters, motor bicycles, buses and samloos. Four-wheeled vehicles, however, are increasing in number in the recent years. Road conditions in the urban center are generally in an acceptable level under the circumstances.

Drainage system constructed in the colonial days under French Government was limited to the area of old town. Most channels are trapezoidal shape and made of concrete. It was observed during the survey that most of rainwater mingled with overflow effluent from domestic septic tanks are stagnant on the urban main road for a considerable period after rainfall, creating unhygienic cesspool. To date, several related studies on Drainage and Sanitation have been carried out by ADB, WB and UNDP.

Water supply in Vientiane dates back to 1964 when Nam Papa Vientiane, then responsible for development, planning, operation and maintenance of the water supply system in the Prefecture, started supply of water to the urbanized area from the Kaolieo WTP. The plant with a production capacity of 20,000cmd extracts raw water from the Mekhong River. To meet the increased demand of the area, newly constructed Chinaimo WTP was commissioned in 1980 under financial and technical assistance of ADB. The plant is located at south of the congested area and have a design production capacity of 40,000cmd. Rehabilitation of the Kaolieo WTP and extension of distribution mains took place in 1983. Since then, any large scale investments have not been undertaken although several studies and analyses were carried out by UNDP, WB and ADB.

In the past 5 years, population in the prefecture increased with an annual average growth rate of 2.9%. This high ratio as compared to 2.5%, i.e., population growth rate of the country, is attributable to a number of immigrants from the rural area to Vientiane prefecture to seek job opportunity. Infrastructural capacities of the area, particularly in sanitary aspects are

Fig. 2. 2
Vientiane Prefecture

outgrown by this rapidly increasing population.

Resulting from the situation mentioned above, the total water demand of the area has increased and is estimated at around 59,400cmd in 1992, almost in an equivalent level to the production capacity of the existing treatment plants, 60,000cmd. In addition, pipe reticulations so far installed are not necessarily sufficient in terms of pipe diameter and materials to supply water to the people. This implies that water supply conditions even in the service area differ much from area to area, depending on the physical configuration of pipeline network as shown on Fig 2-3. It is obvious that the rapidly increasing water demand in the area will soon exceed the production capacity.

Water supply conditions in the Vientiane Prefecture are to be improved immediately as described above. Particulars of the existing water supply system are enumerated in Tables 2-2 & 2-3.

Table 2-2 SERVICE COVERAGE AND WATER BALANCE (as of 1992)

Population	467,000
Population Served	190,000
Service Coverage	41%
Average Daily Water Consumption	32,200 cmd
Per Capita Consumption	170 lpcd
Unaccounted-for Water (35%)	17,300 cmd
Sub-total	49,500 cmd
Peak Factor	1.2
Day maximum Water Consumption	59,400 cmd
Production Capacity	60,000 cmd
Water Balance	+600 cmd

Table 2-3 OUTLINE OF THE EXISTING WATER SUPPLY FACILITIES

FACILITIES	ITEMS	DESCRIPTION
Kaolieo WTP		
	Water Source	The Mekhong River by intake pumps
	Production Capacity	20,000cmd
	Treatment Process	Intake - Mixing Chamber - Flocculation - Sedimentation -Rough Filtration - Rapid Sand Filtration - Reservoir - Pump Distribution
	Storage Capacity	4,000m3 in clear water reservoir

Chinaimo WTP

Water Source	The Mekhong River by intake pumps
Production Capacity	40,000cmd
Treatment Process	Intake - Mixing Chamber - Flocculation - Sedimentation - Rapid Filtration - Pump Distribution
Storage Capacity	none

Trunk Mains (installed from 1964 to date)

Diameter & Length	SP1,000mm x 486m SP 700mm x 2,529m SP 600mm x 4,247m SP 450mm x 7,044m DIP 450mm x 4,435m SP 400mm x 5,019m DIP 400mm x 1,320m
Sub-total	25,080m

Distribution Pipes (installed from 1964 to date)

Materials	SP, DIP, ACP, GSP & PVC
Diameter & Total Length	50mm - 350mm x 116,313m
Total Trunk & Distribution Pipes	141,393m

Phonekheng Elevated Tank

GL	178.0m
HWL	199.14m
Storage Capacity	2,000m3
Inlet	SP 400mm
Outlet	SP 400mm

Phonethane Elevated Tank

GL	176.8m
HWL	202.80m
Storage Capacity	1,500m3
Inlet	SP 400mm
Outlet	SP 450mm

Phonetong Elevated Tank

GL	179.0m
HWL	205.00m
Storage Capacity	1,500m3
Inlet	SP 400mm
Outlet	SP 450mm

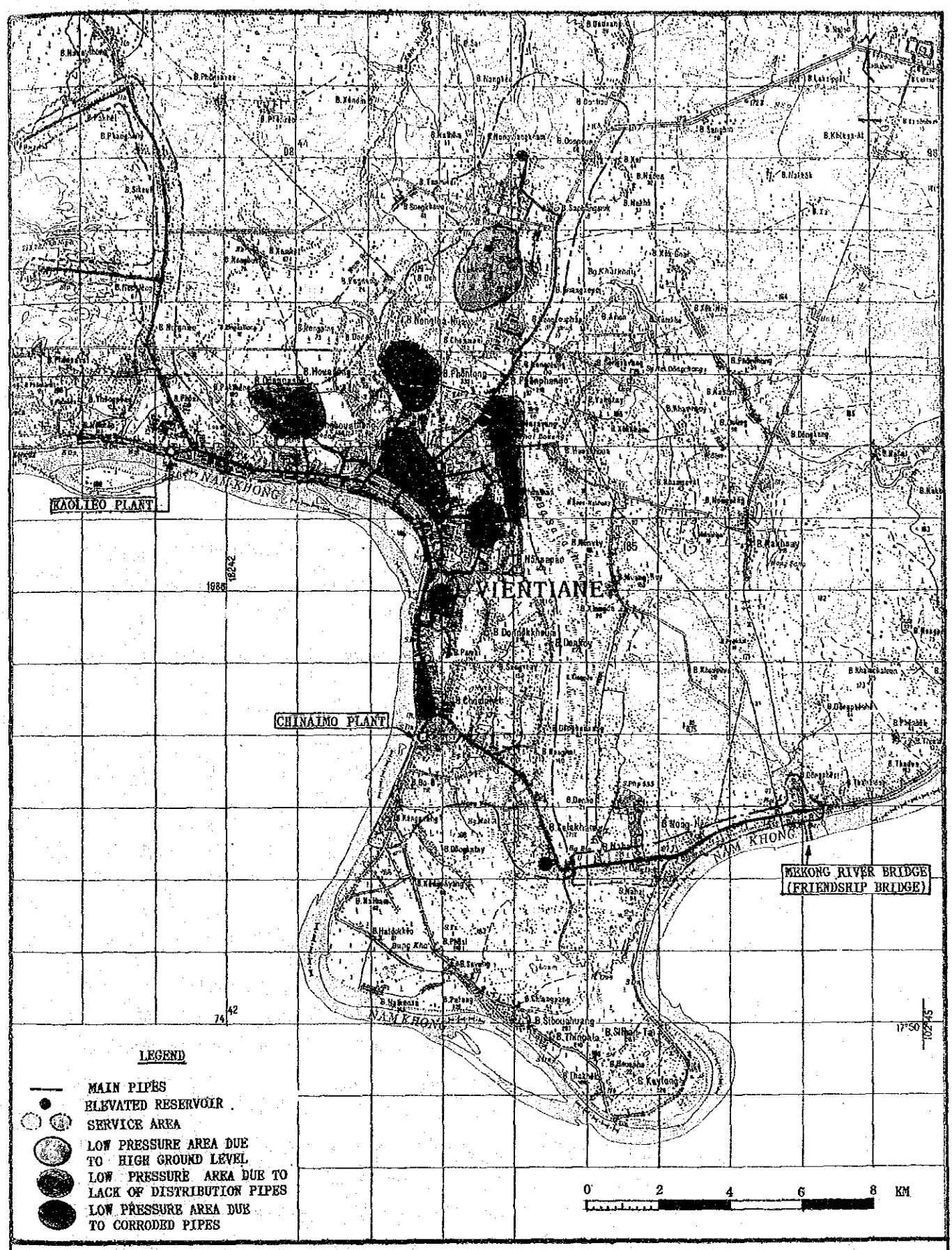


Fig. 2.3 WATER PRESSURE DISTRIBUTION IN SERVICE AREA

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objectives

As described in the former Chapters, ADB is now planning to provide technical and financial assistance to NPL in developing more reliable distribution pipeline network in Vientiane related to the current project. It can be understood that these projects supplement each other to improve water supply conditions in Vientiane. Taking into consideration the scope of overall project components, objectives of the project are listed below.

1) to establish stable and reliable water supply system in Vientiane. Many people in the service area are suffering from water shortage due mainly to the limited production capacity of the existing WTPs and a lack of sufficient distribution pipe network.

2) to supply water to Tha Deua, a residential and commercial complex near Mittaphap Bridge to be completed by 1994 with assistance of Australia.

3) to enhance public health and to upgrade living standards by improving water supply conditions in Vientiane.

4) to strengthen the financial aspects of NPL.

3.2 Adequacy of the Request

As explained in the former Chapter, present water demand is nearly exceeding the production capacity of the existing treatment plants. The water demand forecast in the relevant reports are quoted herein to overview the future trend. Fig 3-1 shows future water demand up to 2010. The planned expansion of the Chinaimo WTP with 40,000cmd increases the total production capacity from 60,000cmd to 100,000cmd. This implies, according to the water demand curves, that expanded facilities will suffice water demand up to around 1997- 2000.

In addition to the planned complex in Tha Deua, completion of the Mittaphap (friendship) Bridge over the Mekhong River will promote industrial and commercial development of the area. At present, the people in the area are depending on shallow wells, bore holes or water vendors for daily water use. Increased industrial and commercial activities will boost water demand of the area. The pipeline extension to the area, hence, are crucial and should be realized under the current project.

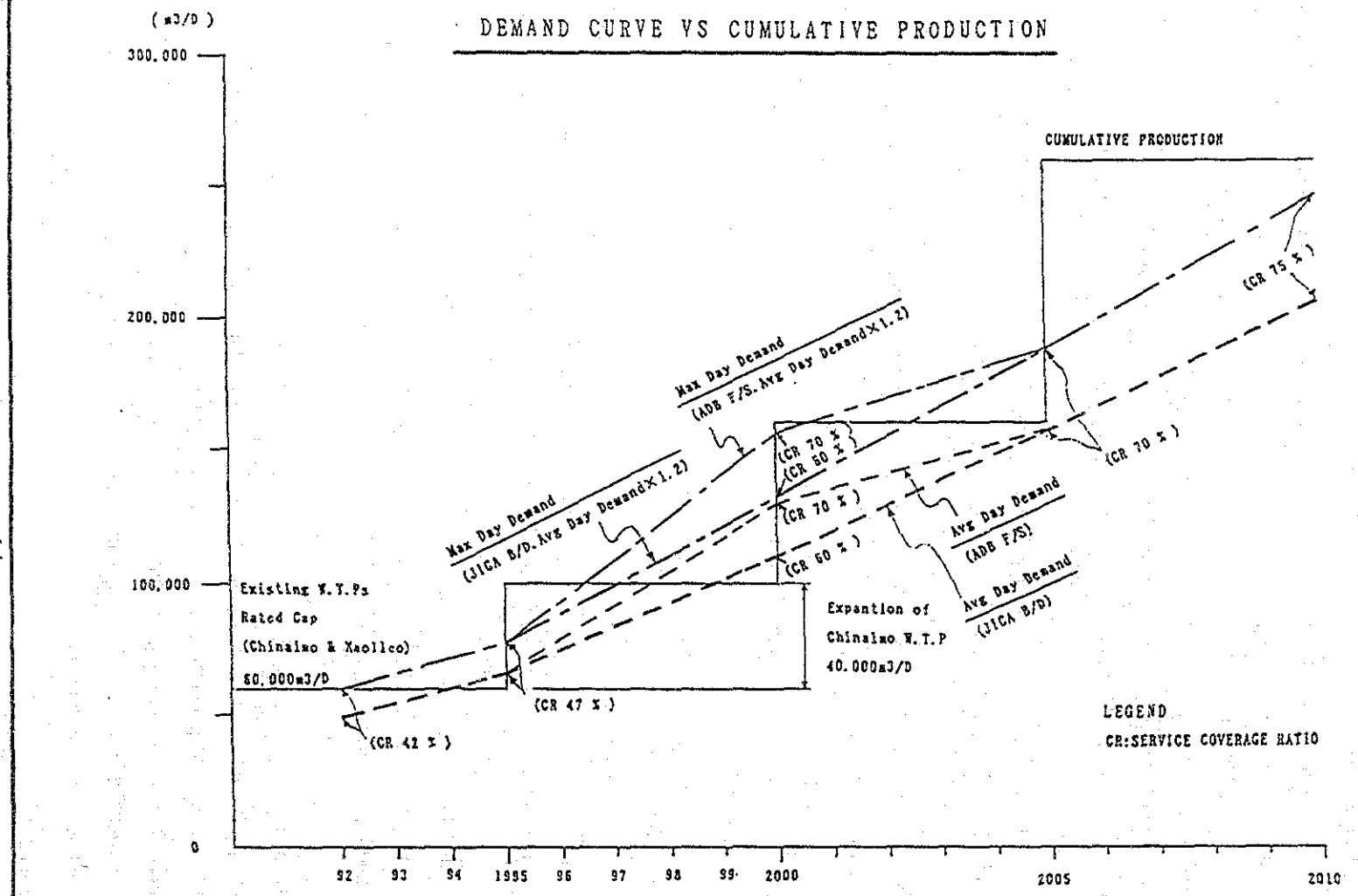


Fig. 3.1
DEMAND CURVE VS
CUMULATIVE PRODUCTION

In the meantime, the scope of the current basic design study does not contradict nor duplicate with those of other projects being undertaken under assistance of ADB, WB and French Government. It is therefore beneficial to implement the project as expeditiously as possible.

3.3 Executing Agency and Operational Structure

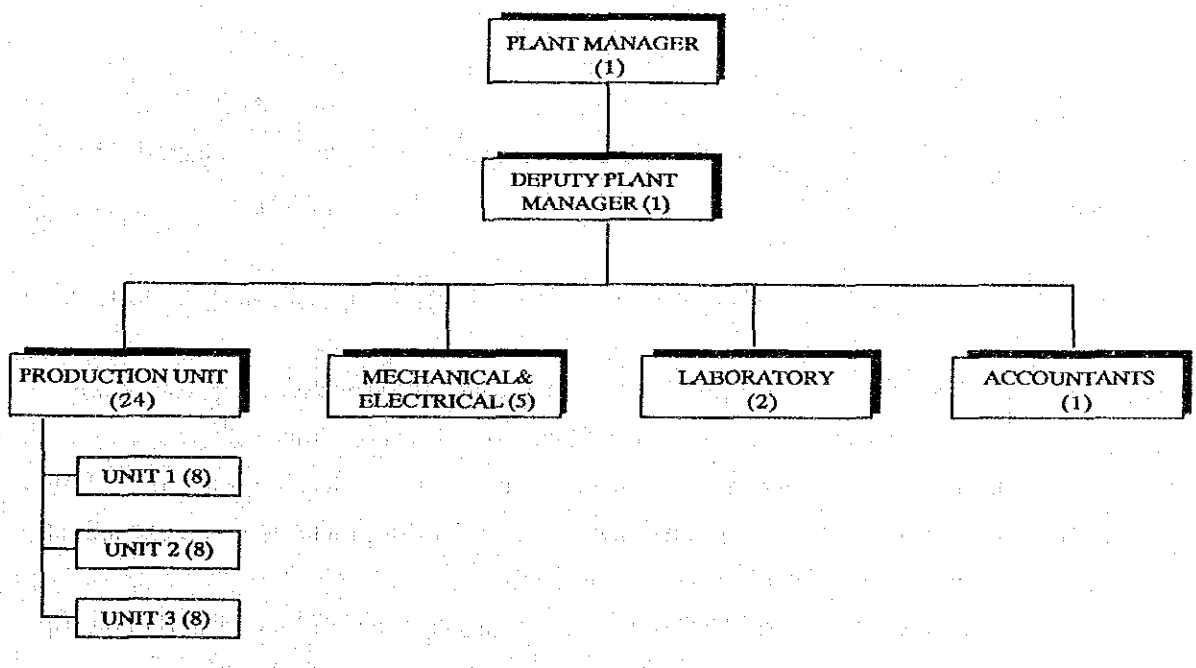
1) NPL and MCTPC

NPL is an executing agency for all components of the current Project. Under jurisdiction of MCTPC, NPL will play an important role in project management and coordination.

2) Chinaimo WTP Organization and Operation Structure

Present organization for operation and maintenance of Chinaimo WTP has an adequate number of skilled and unskilled staff as shown on Fig 3-2. Some senior staff in the WTP are well-trained with sound water supply engineering.

Fig 3-2 ORGANIZATION CHART FOR CHINAIMO WTP



Under limited financial resources, Chinaimo WTP has been well-maintained and operated since its construction in 1984. During JICA Team's field surveys, any critical issues related to the plant operation were not found except alum dosing. The laboratory staff conduct jar testing every day. Most appropriate alum dosing rate is then determined. These steps taken by the staff are evaluated accurate and complete. The problem they encountered now is how to control dosing rate. Under circumstances that the dosing equipment for flow control are worn out, they are trying to attain equal chemical dosage rate by preparing required volume of alum solution daily in the mixing/ solution tank. The dosing are carefully done so as to consume all solution within 24 hours. This dosing step is based on their experiences.

Record keeping, an essential part of operation and maintenance of the treatment plant, is in an excellent level. Daily, weekly, monthly and annual reports that carry sufficient information are being prepared by the staff. Data on chemical storage, consumption, chemicals delivered, power and fuel consumption, raw water intake rate, water production, results of laboratory testing, information on backwashing and sludge removal are all kept in the reports. Format of the reports has been refined and revised by the senior staff for their convenience. Further, they retain maintenance records of mechanical and electrical equipment. Due to shortage of spare parts and tools, their maintenance is being limited to minor repair or overhaul.

Chemicals are usually maintained in an appropriate level of storage (minimum 30 days for alum and 6 months for hypochlorite) as far as NPL budgets allow. Team's review shows that necessary procedures for purchase and delivery of chemicals are taken by the plant senior staff.

As far as laboratory testing is concerned, commonly accepted methods have been introduced through several series of on-the-job and overseas training so far conducted. Routine testing are generally well-conducted by a limited number of laboratory staff.

In the meantime, many water supply systems in the Lao PDR, due to shortfall in number of hydrochemists, are being operated under absence of skilled engineers. There are increasing needs of human resource development particularly in the area of water testing. In this regard, the laboratory staff in Chinaimo WTP should play a leading role. It is a fact that agriculture depending on fertilizer widely introduced in the Lao PDR has imperiled the safety of water purification. Furthermore, commercial and industrial development in the recent years has increased kinds and volume of wastes from factories and institutions. They have discharged various kinds of trace organics and chemical compounds to the public area without proper treatment. In view of the expanded responsibility of NPL as sole water supply agency in the Lao PDR, it seems urgent that water quality management for various kinds of contaminants

should be strengthened further.

In an attempt to prepare organization and staffing plan after expansion of Chinaimo WTP to 80,000 cmd, major stresses are placed on the following:

1) Most appropriate staffing based on actual staff performance, experiences and organization
2) Minimum change in the current organization
3) Number of staff to be minimized
4) Increased responsibilities for human resource development
5) O& M of the existing and expanded facilities simultaneously
6) Three shift staffing for operation of the treatment facilities as currently practiced.

The recommended staffing for operating whole treatment facilities are tabulated below:

Table 3-1 RECOMMENDED ORGANIZATION FOR CHINAIMO WTP

	NUMBER OF STAFF		
UNIT	PRESENT	RECOMMENDED	
Plant Manager	1	1	(1+1)
Deputy Plant Manager	1	1	
Reporting Unit			
Accountant	1	1	
Elec. & Mech. Unit			
Elec. & Mech. Engineer	2	2	(1+1)
Elec. & Mech. Technician	3	3	(1)
Laboratory Unit			
Chemist cum Bacteriologist	1	2	(1)
Lab. Assistant	1	4	(1)
Production Unit (three shifts)			
Leader	1 x 3	1 x 3 shifts	
Intake Pump Operators	2 x 3	2 x 3 shifts	
Plant Operators	2 x 3	2 x 3 shifts	(6)
Distribution pump Operators	2 x 3	2 x 3 shifts	(3)
Unskilled Laborers	2	3 x 3 shifts	(9)
Driver	1	1	(1+1)
Watchman	-	-	(3+3)
Total Number of Staff (including shift staff)	34	48	

Note: Figures in parentheses are number of staff suggested in the ADB report. The above total number of staff, 48, is equivalent to 6 persons/10,000cmd. In the existing Chinaimo and Kaolico WTPs, 8 and 10 persons/10,000cmd are currently staffed respectively.

Major differences from the ADB's recommended organization are found on the number of chemists, laboratory assistants and electric & mechanical technicians. This consideration is made in view of increased needs of NPL for human resource development. Assistants/ technicians after several years of on-the-job training in Chinaimo WTP, may be mobilized to provincial Nam Papas as skilled staff/engineer.

Major functions of each unit are tentatively assumed as below:

1) Plant Manager

-to be responsible for overall aspects of plant operation and maintenance,
-to be responsible for review and approval of an annual operation plan prepared by the deputy plant manager and other reports prepared and requests filed by the relevant units,
-to provide General Manager/Deputy General Mangers in NPL office with necessary information and data on plant operation and maintenance periodically and/or when required,
-to evaluate staff performance periodically based on information provided by the unit leaders,
-to attend weekly meetings in NPL office,
-to make review of the present organization periodically with particular attention to internal information system, task requirements and staffing,
-to chair monthly or weekly technical meetings between the units in Chinaimo WTP to enhance technology transfer between the staff.

2) Deputy Plant Manager

-to assist Plant Manager in carrying out his responsibilities for overall aspects of plant operation and maintenance,
-to prepare draft annual operation plan for perusal of Plant Manager based on information provided by each unit,
-to make review of various reports prepared/requests filed by the relevant unit leaders prior to submission to Plant Manager.

3) Reporting Unit

-to keep records of all data and information relevant to plant operation and maintenance,
-to take necessary measures for purchase of materials and equipment, their spare parts, chemicals and agents, office equipment, stationeries, etc.,
-to prepare draft annual budget plan,

-to compile daily, weekly, monthly and annual reports under guidance of Plant Manager/Deputy Plant Manager.

4) Electrical and Mechanical Unit

-to conduct periodical overhaul of all electrical and mechanical equipment and repair in accordance with repair manuals when any damages or defects are found,

-to provide technical information regarding electrical and mechanical equipment installed in the plant to personnel in other units for their understanding,

-to keep records of maintenance for submission to Plant Manager,

-to take necessary procedures through Reporting Unit for repair order to the local workshops when repair works are found beyond capability of the staff.

5) Laboratory Unit

-to conduct routine laboratory testing in accordance with water testing manuals to ensure safety of treated water,

-to keep records in the standardized format and provide information on required chemical dosing rate to the relevant units,

-to provide information on testing results with technical comments to Plant Manager,

-to conduct laboratory testing for specific purposes when needs arises,

-to take necessary measures for maintaining testing equipment, glassware, chemical agents and other miscellaneous consumable/assets in normal conditions to ensure appropriateness of their quality and stock.

6) Production Unit

-to achieve effective operation and control of treatment facilities including raw water pumping station, receiving well, flocculation basins, sedimentation basins, filters, distribution facilities, and other miscellaneous mechanical and electrical equipment/devices installed in the plant under direction of production unit leader and/or plant manager,

-to monitor and control raw water intake rate and water production rate along with the production targets set up by NPL,

-to keep clean and sanitary in the plant yard and buildings

-to endeavor to minimize water losses in the plant

-to periodically carry out cleaning of each basin and filter backwashing under direction of production unit leader and/or plant manager

-keep daily operation records in the specified format including such items as intake rate, production rate, pump operation and its performance, chemical dosing rate, chemical and power consumption, performance of flocculators, sedimentation basins, filters, backwashing and cleaning, water level of the reservoirs, etc.

In relation to reorganization of Chinaimo WTP Division, NPL should pay special attention to the following:

1) Mobilization of sufficient number of staff for operation unit, laboratory unit, and mechanical and electrical unit before initiation of the expanded plant operation.
2) Provision of opportunities for on-the-job and overseas training to the staff/operators in Chinaimo WTP.
3) Preparation of operation manuals written in Lao language for indepth understanding by operators regarding water treatment process control.
4) Periodical review of staff performance and provision of incentives to the staff.

3.4 Outline of Project Facilities and Equipment

The basic design for the project will be detailed in Chapter 4. Project facilities and equipment to be procured are listed in Table 3-2.

Table 3-2 LIST OF EQUIPMENT FOR REHABILITATION AND EXPANSION

ITEM	REHABILITATION	EXPANSION
1. RAW WATER INTAKE		
Raw Water Pumps	-Overhaul(vertical shaft) 18m3/mx14.8mx75kWx4	-Newly installed submersible pump 18m3/mx14.8mx75kWx2
Screen Silt Removal		-Float type -Platform & Excavator (caterpillar oil pressure type)
Geared Trolley Type Chain Hoist	-Manual to motor driven	-Newly installed 1 set
Raw Water Level Meter	-Replaced by ultrasonic type	
Motor Control Center (MCC)	-Overhaul 2 Nos.	-Newly installed 1 No.
Bank Protection	-Bank protection for drain channel and pier at the downstream of the intake	

2. RAW WATER TRANSMISSION

Pipeline		-Dia.800mm,1100mm,sp
Flow Meter Chamber		-Reinforced concrete structure
Flow Control Valve		-Dia.1100mm butterfly valve
Flow Meter		-Ultrasonic type
Receiving Well		-Reinforced concrete structure
Sampling Pipes		-Dia 25mm PVC

3. FLOCCULATION AND SEDIMENTATION

Flash Mixer	-Dismantled	-New raw water pipe inner mixing
Flocculator	-Replaced by vertical zigzag flow type flocculator -Install dia. 800mm inlet pipe -Dismantled inlet gates	-Construction of 4 basins
Sedimentation Basin	-Split roll to perforated wall -One perforated walls -Separation walls for desludging -Pipeline for desludging -Repair desludging valves -Improve washing pipe -Replaced by overflow-trough -Settled water channel partition gate -Settled water channel drain valve installation	-Construction 4 basins
Washing Pump	-Replaced by 0.75m3/mx30mx7.5kWx1	
Water Level Detector	-Replaced by electrode type	

4. FILTERS

Filter Basin	-Clap valves to be replaced by pneumatic gate	-Construction 4 basins
Air Blower		-Newly installed 94.6m3/mx0.3/kg/m2x125HP
Air Compressor	-Overhaul	
Clogging Meter	-Replaced by pressure type	-Newly installed 4 Nos.

Flow Controller	-Overhaul	-Newly installed 4 Nos.
Total Filtered Water Controller		-Weir construction -Gate installation 1350x1350mm -Flow meter installation
Backwash Tank Water Level Detector	-Replaced by electrode type	

5. DISTRIBUTION FACILITIES

Distribution Pumps	-Overhaul 14m3/mx56mx180kWx3	-Newly installed 14m3/mx56mx180kWx3 4.3m3/mx66mx80kWx2
Distribution Pump Discharge Valve	-Replaced by motor driven 3 Nos.	-Newly installed 5 Nos.
Vacuum Pump	-Overhaul	
Clear Water Reservoir		-Construction 3,300m3
Clear Water Res. Level Meter		-Newly installed pressure type
Flow Meter		-Newly installed ultrasonic type 2 sets
Pressure Meter		-Newly installed -Bourdon tube type 2 sets
MCC	-Overhaul 1 No.	-Newly installed 1 No.

6. CHEMICAL DOSAGE

<u>Alum</u>		
Solution Tank	-Dismantled 2 Nos.	-Newly installed 4 Nos.
Mixer		-Newly installed 4 Nos.
Doser		-Newly installed 2 Nos.
<u>Hypochlorite</u>		
Solution Tank	-Overhaul 2 Nos.	-Newly installed 1 No.
Mixer		-Newly installed 3 Nos.
Doser		-Newly installed 3 Nos.
<u>Lime</u>		
Solution Tank	-Overhaul 2 Nos.	
Mixer		-Newly installed 2 Nos.
Saturator		-Newly installed 1 No.
Slurry Pumps		-Newly installed 2 Nos.
MCC	-Overhaul	

7. ELECTRICAL FACILITY & INSTRUMENTATION		
Power Substation	-Connected to New Substation 1000 kVA	-Newly installed 2000 kVA
Monitoring Panel	-Dismantled 1 No.	-Newly installed 1 No. graphic panel
Automatic Controller		-Newly installed -Raw water control 1 No. -Distribution pressure control 1 No. -Distribution flow control 1 No.
8. OTHERS		
Interphone	-Dismantled	-Newly installed 1 set
Draft Chamber	-Dismantled 2 Nos.	-Newly installed -Draft chamber 1 No. Sink 1 No.
Jar Tester		-1 No. for Kaolieo
Tools		-1 set
9. TRANSMISSION TO THA DEUA		
Elevated Tank		-Newly constructed 1500 m3, H=40m
Ductile Iron Pipe		-Transmission Pipeline Dia. 300mm x 6.2km -Distribution Pipeline Dia. 350mm x 4.0km Dia. 300mm x 4.6km
Fittings		1 set

3.5 Operation and Maintenance Plan

As described in the foregoing sections, Chinaimo WTP is well-maintained by the staff and operators. Due mainly to shortage of funds, their capability of periodical and routine operation/maintenance has been undermined to a large extent. To facilitate the staff for effective M&O, sufficient number of spare parts, tools and equipment are indispensable. To this end, equipment and spare parts which are not found or in shortage in their plant stockyard will be procured under the current project as shown in Table 3-3.

procured under the current project as shown in Table 3-3.

Table 3-3 TOOLS AND ELECTRIC METERS

1. Arc welder		1 piece
2. Submersible pump	for 75mm	1 "
	50mm	1 "
3. Pipe wrenches	for 75mm	1 "
	40mm	1 "
4. Spanners set		2 sets
5. Box wrench set		2 sets
6. Offset spanner set		2 sets
7. Power drill		1 set
8. Offset sander grinder		1 set
9. File set		1 set
10. Vernier caliper		1 piece
11. Feeler gauge		1 "
12. Circuit tester		1 "
13. Megger	250V	1 "
	500V	1 "
14. Standard potential current generator		1 "

Financial standing of NPL as of 1991 shows adequate balance of expenditures and income. However, necessary expenditures for operation and maintenance of WTP are sometimes restricted because of shortage of funds in NPL.

To make overview of financial standing of NPL after completion of the planned facilities, incremental expenditures and income are tentatively estimated as follows. The ratio of accounted-for water to the water production is assumed to be 65%, and the percentages of water uses and their unit prices assumed to be the same as those of the total average of the Nam Papa Vientiane.

Table 3.4 INCREMENTAL EXPENDITURE AND WATER SALES

Item		Equation	Kip (unit: x 1,000)
Expenditure			
Chemicals	-Alum	770,000kg x 210Kip	= 161,700 Kip
	-Chlorine	33,000m3/day x 365days x 1mg/l / 0.6 x 1/1,000 x 1,060Kip/kg	= 21,280 Kip
Power		3,745,000kwh x 11Kip/kwh	= 41,195 Kip
Fuel	- Gasoline	260 l/month x 12months x 235Kip/l	= 733 Kip
	- Oil	54 l/month x 1,100Kip x 12 months	= 713 Kip
Salary		30,000Kip/month x (48-34)personnel x 12months	= 5,040 Kip
Depreciation			= 376,900 Kip
Sub-total			607,561 Kip
Income			
Water Sales		1,001,860 (from the 1991 income statement) x 40,000/60,000 cmd	= 668,000 Kip

As listed above, the amount of expenditure for the increase of water, i.e., Kip 608 million is less than the assumed revenue of Kip 668 million. This tentative estimates indicate that the revenue generated from the project will be more than the incremental expenditure, demonstrating the viability of the Project.

3.6 Technical Cooperation

To generate maximum benefit from the current project and improve NPL practice particularly in the field of laboratory testing and managerial aspects (inventory control and metering & billing), technical cooperation and training are indispensable.

As training needs in the area of water quality monitoring and management is considered urgent and indispensable, NPL is recommended to pursuit the possibility of inviting experts under assistance of international financing agencies for on-the-job training of the laboratory staff.

In relation to the technical cooperation, the ADB report recommends medium and long term financial training divided into three mainstreams of general, professional, and specific courses, each for managerial and technical personnel, for senior financial personnel, and for personnel in functional positions of NPL respectively.

CHAPTER 4 BASIC DESIGN

4.1 Design Concept

As stated in Chapter 3, the scope of basic design covers upgrading and rehabilitation of Chinaimo WTP and pipeline extension to Tha Deua district. In order to have the design of these facilities meet the level of financial condition and water treatment technology of NPL, the team follows design concepts summarized below.

(1) Employment of Simple Facilities

One of the problems Vientiane water supply system encounters now is a difficulty of obtaining spare parts of electrical and mechanical equipment. The main reason is that Nam Papa is financially vulnerable, thus has no room to purchase necessary spare parts, and the location of the country is not geographically advantageous. In general, when the facilities become more complicated, more spare parts are required. In this country where most spare parts are to be imported and only few are locally available, purchase and arrival of spare parts have been always delayed. Because of this reason, water supply facilities have not been satisfactorily operated, and damaged equipment have been left without repair for long time. Therefore, the situation is sometimes serious if damaged equipment is one of the major facilities. In such case, safe drinking water supply will not be attained. In general, simple equipment can be easily maintained and repaired by local skills, while complicated equipment will hardly be repaired or sometimes never be repaired locally. Taking these conditions into account, selection of facilities are made with an emphasis on structural simplicity without degrading the capability of facilities.

(2) Upgrading Operation and Handling of Facilities

Simple facilities, although advantageous in maintenance aspects, do not always result in easiness of handling. The important thing is how to incorporate each facility into one total system. The system has to respond to the variable raw water quality. If the system can not be easily handled, an operator would not take appropriate actions toward various qualities of the water. As a result, there happen such cases as overdosing or underdosing chemicals, discharging treated water into the river, etc. In order to reduce accidents to the extent possible, the present Basic Design is made taking into account easiness of handling.

(3) Maximum Utilization of Local Materials

Maximum utilization of local materials is meaningful to lower the project cost as well as

to stimulate the economic activities of aided countries. Because using local materials is particularly advantageous in repairing the facilities, this is also considered in this Basic Design.

(4) Effective Use of Existing Facilities

Among the equipment and facilities of Chinaimo WTP, there are many which are extremely deteriorated, thus are to be repaired or replaced. In addition, there are some which are not satisfactorily running to meet the required level of water quality. And there are some which are evaluated to be improved from a point of easy maintenance. In proposing repairing and remodeling the existing facilities, principal idea is placed on effective use of the existing facilities. Whether certain deteriorated equipment be replaced or repaired will be decided after carefully evaluating the value of the existing facilities. In addition, for those equipment which need repair in the future, extra spare parts are to be procured under the current Project taking into account the past repair records.

(5) Energy Saving for Water Treatment Process

At present there is some quantity of raw water which is pumped up from the river to the receiving well and is discharged to the river again without being used effectively. This obviously means waste of energy. Because there are some other points where the energy is similarly wasted, these points should be rectified from the point of reducing operation and maintenance costs. Energy saving, thus, is considered in the design.

(6) Independent Process Unit

Consideration is made on each process unit to be independent to the extent possible so that each unit can be operated separately. By this consideration desludging of a sedimentation basin can be independently carried out without interfering other basins. This is also advantageous in operation and maintenance point of view.

4.2 Examination of Design Conditions

4.2.1 Upgrading and Rehabilitation of Chinaimo WTP

(1) Upgrading of Water Treatment Capacity

Based on the present basic design, the capacity of Chinaimo WTP will be expanded by 40,000 cmd, resulting in 80,000cmd production capacity in total. The justification of the

proposed upgrading capacity was discussed in Section 3.2.

(2) Water Treatment Method

Chinaimo WTP employs a treatment method consisting of flocculation basins, chemical sedimentation basins and rapid sand filters. This method is considered easy in operation and maintenance. Fundamental change of this system is not advisable at present from the point of plant operation. Hence, rehabilitation proposed herein is to ensure reliability of the system and to attain easiness in plant operation. Mixing method at the rapid mixing basin is improved from mechanical mixing to a mixing by hydraulic turbulance in the raw water transmission. Mixing method in the flocculation basins is also improved from mechanical mixing to a mixing by baffle wall zig-zag flow. To settle particles more effectively in the sedimentation basins, effluent PVC pipes at each sedimentation basins are replaced by four rows of overflow weirs.

(3) Chemicals and Designed Dosing Rates

Chemicals currently used at Chinaimo WTP are solid aluminum sulfate(coagulant), hypochlorite(disinfectant), and slaked lime (pH control). Among them, solid aluminum sulfate and slaked lime are produced in the territory of Laos and are constantly supplied in respects of quality and quantity. Hypochlorite (containing 60 % effective chlorine) is imported from overseas (Japan). Considering the quality of the raw water and the treated water, availability and safety of chemicals, it is reasonable to use the chemicals continuously. The design dosages of these chemicals are determined from the past operation records as follows:

- Solid aluminum sulfate : Max. 160 mg/l
- Hypochlorite : Max. 2 mg/l
- Slaked lime : Max. 10 mg/l

(4) Water Transmission Quantity

At present there is a plan to rehabilitate the existing water distribution facilities. According to this plan, the treated water from the treatment plant is firstly transmitted to the elevated tanks, thereafter, it is distributed to the areas all over the city. The treatment plants and the reservoirs are connected by transmission mains. No pipe branch is existing on the transmission mains because of the purpose of the transmission mains. Therefore, there is little hourly and seasonal flow fluctuation. Accordingly the transmission capacity from the Chinaimo WTP is determined at 80,000 m3/d based on the maximum daily demand. And this quantity is used to determine the capacities of treatment facilities and transmission pumps.

(5) Storage Capacity of Clear Water Reservoir

The balancing storage of the clear water reservoir is determined at one hour equivalent to 80,000 m3/d. As stated in Section (4) above, the transmission quantity from the treatment plant is on the maximum daily demand basis, thus the hourly fluctuation is negligible. Therefore it is not necessary to consider provision of extra capacity of the clear water reservoir for the hourly fluctuation. On the other hand, the treated water quantity varies slightly because of backwashing at the filters and cleaning at the sedimentation basins. The variable water quantity is assumed at 12 % and the duration period, 6 hours. In order to meet this fluctuation and to transmit the water constantly the balancing storage of one hour equivalent (3,300 m3) to the maximum daily demand of 80,000m3/d is considered sufficient.

4.2.2 Pipeline Extension to Tha Deua

(1) Planned Service Area

As shown in Fig. 4.1, the planned service area of Tha Deua district is the southeastern part of Vientiane Prefecture along Route No.2. The western boundary of the service area is about 6.2 km east to Chinaimo WTP and the eastern boundary is 1.0 km east to Laos-Thailand Friendship Bridge. The area further east to Tha Deua service area is supposed to be covered by a project aided by French Government. The distance between the east and west boundaries spans about 8.6 km. The northern boundary is about 800 m north to Route No. 2 and the southern boundary is about 200 m from the Route to the Mekong River. The total area served is about 8.6 km2.

The reason to designate this area as the planned service area is (a) there is a plan to develop a commercial district around Laos-Thailand Friendship Bridge, (b) upon completion of the Bridge, there seems to have various factories and leisure facilities constructed, and (c) there are currently no water supply facilities to secure safe drinking water in this district. Therefore, a large water demand is expected in this district in the near future.

(2) Planned Service Population

The service population to be planned in this design is the one that NPL has estimated by itself. The target year is 2000 A.D. The planned service area consists of 1) the planned commercial and industrial districts near Laos-Thailand Friendship Bridge and 2) the residential and factory districts along Route No.2.

The present population in these areas consists of 3,300 in the commercial and industrial districts and 6,600 in the residential and factory districts. The service population in the target year is estimated at 6,100 and 8,400 respectively with a total of 14,500. The population increase employed for this estimation is 8.0 % for the commercial and industrial districts and 2.9 % for the other districts.

The Vientiane Master Plan applies a somewhat high population growth rate 8.0 % for the commercial and industrial districts. As the development in the area is pushed by the government, this growth rate is considered reasonable and is also applied in the present basic design. For other residential areas, the population growth rate, 2.8%, is applied, which is the average population growth rate of Vientiane Prefecture in 1985 - 1991.

(3) Per Capita Consumption and Water Demand

In estimating the water demand for the target year, characteristics of the planned service areas and the development plan of the commercial and industrial districts are considered. And estimation is made to the different two categories, i.e., domestic use and commercial, industrial and other uses. Further an unaccounted-for water ratio is assumed and thereafter the total water demand is determined. The planned total water demand is 5,069 m3/d, consisting of 1,885 m3/d for domestic, 2,170 m3/d for commercial, industrial and others, and 1,014 m3/d for unaccounted-for water, respectively.

The domestic per capita consumption is assumed at 130 lpcd, referring to the value of 100 lpcd designated by Nam Papa and 187 lpcd described in the ADB report. Namely, considering the present per capita consumption of about 100 lpcd, the per capita consumption in the year 2000 is assumed at 150 lpcd for the tap water domestic user and 50 lpcd for the standpipe domestic user, each of which will share 80 % and 20 % of the total population served, respectively. Then, an average is calculated mathematically, arriving at the designed per capita consumption of 130 lpcd. On the other hand, the commercial and industrial use of water is derived from what was estimated by NPL based on their questionnaire surveys. The unaccounted-for water is assumed at 25 % of the total water consumption. This value coincides with the value estimated in the ADB rehabilitation program of distribution system.

(4) Elevated Storage Tank and Distribution System

The treated water at Chinaimo WTP is firstly transmitted to an elevated storage tank to be constructed near the boundary between the existing and the planned service area. Stored water in the tank is, then, distributed to Tha Deua by gravity. The storage capacity of the tank shall meet the hourly demand fluctuation with an 6 hour storage of the maximum daily demand.

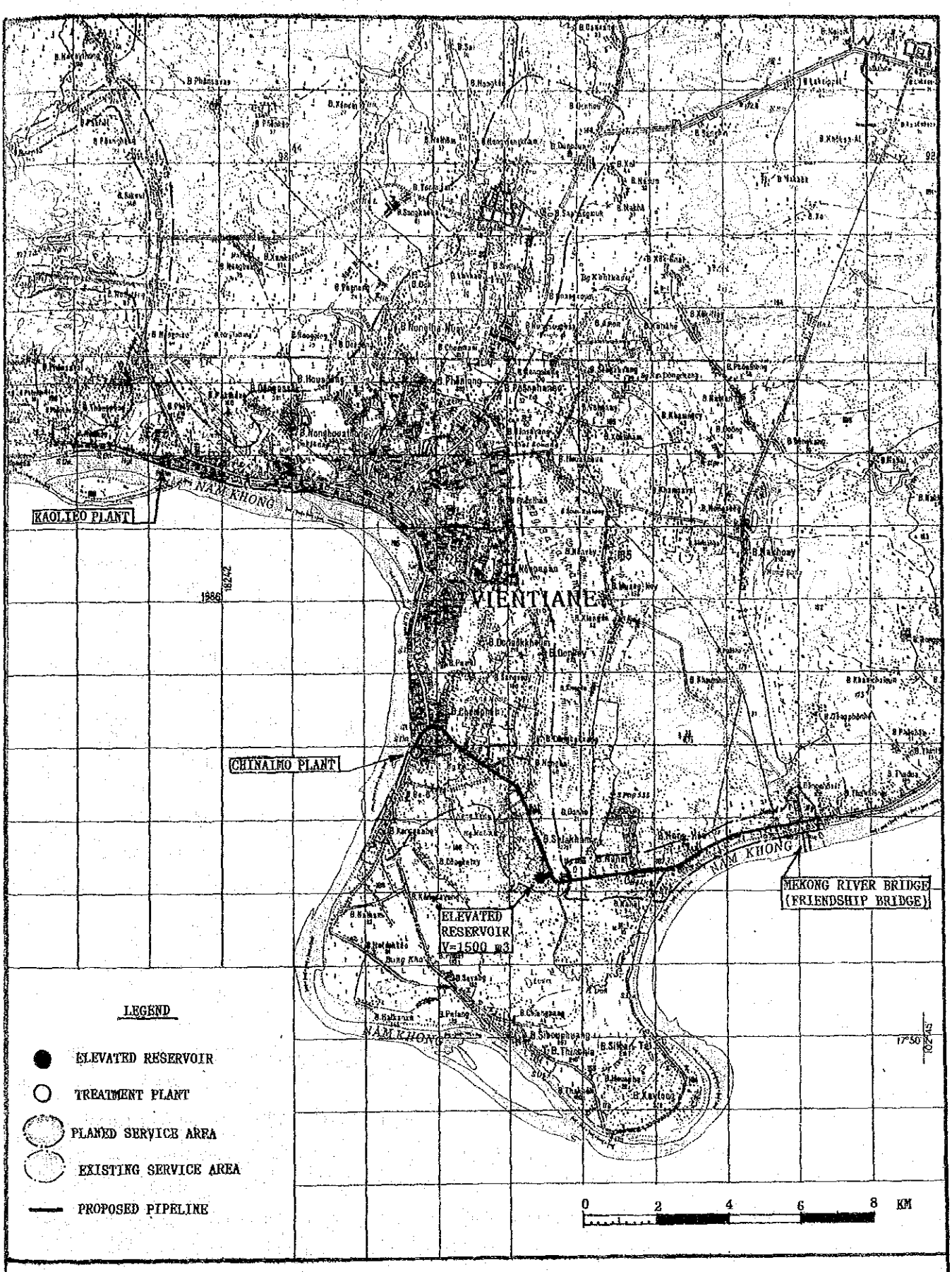


Fig.4.1 PLANED SERVICE AREA