Ministry of Communication,
Transport, Post and Construction
Lao People's Democratic Republic

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REHABILITATION
OF
WATER SUPPLY FACILITIES
IN SAVANNAKHET AREA
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

MARCH 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
Nihon Suido Consultants Co., Ltd.

PREFACE

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

JICA sent to Lao PDR a study team from October 1st to November 9th, 2000.

The team held discussions with the officials concerned of the Government of 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 Lao PDR in order to discuss a draft basic design, and as this result, the present report was finalized.

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 Lao People's Democratic Republic for their close cooperation extended to the teams.

March 2001

Kunihiko Saito
President
Japan International Cooperation Agency

March 2001

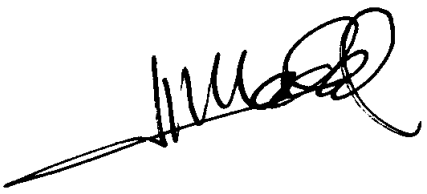
LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Rehabilitation of Water Supply Facilities in Savannakhet in Lao People's Democratic Republic.

This study was conducted by Nihon Suido Consultants Co, Ltd., under a contract to JICA, during the period from September 25th, 2000 to March 30th, 2001. In conducting the study, we have examined the feasibility and rational of the project with due consideration to the present situation of Lao PDR and formulate the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

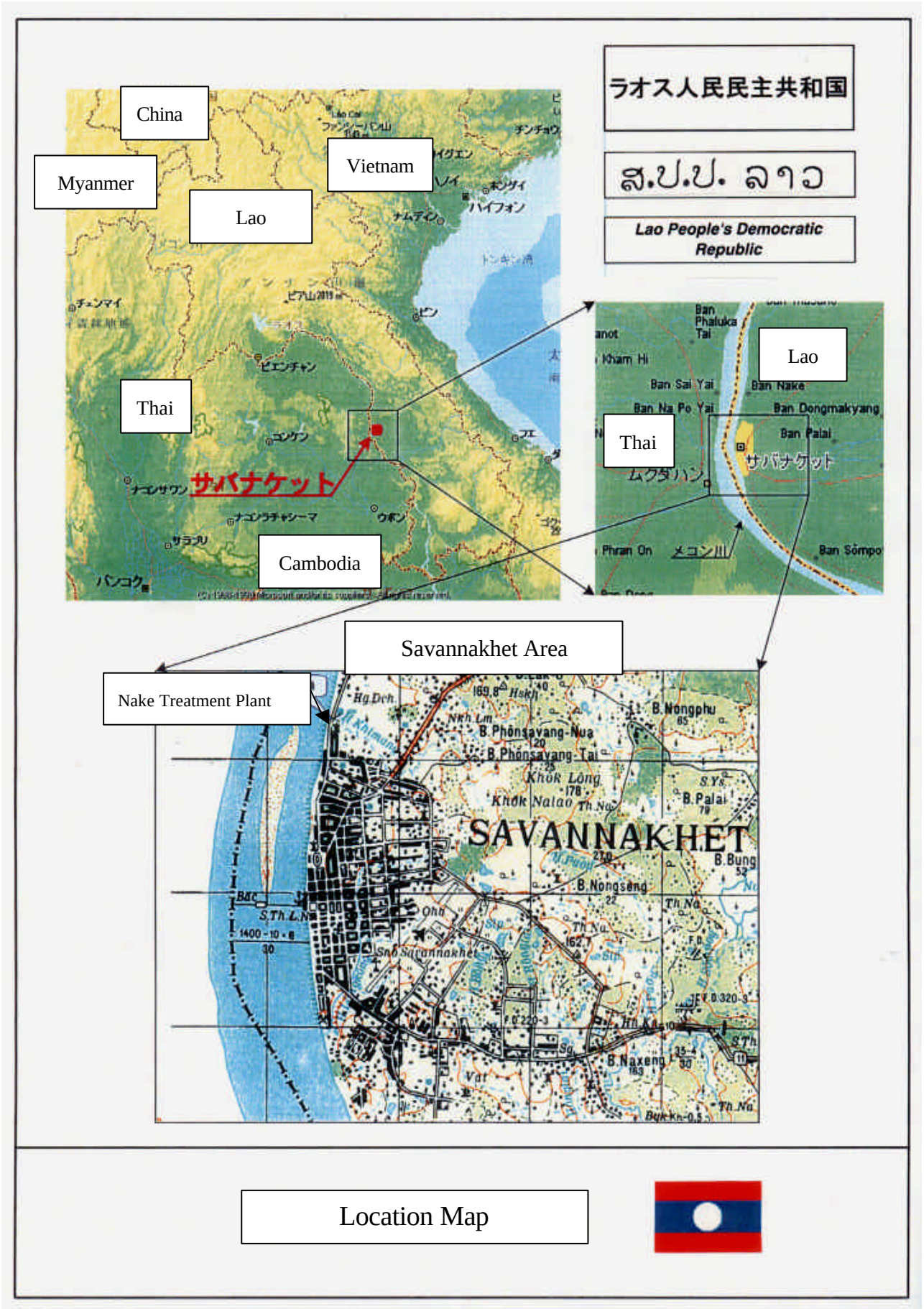
Very truly yours,



Hiroshi Machida
Project Manager,
Basic Design Study Team on
The Project for Rehabilitation of
Water Supply Facilities in Savannakhet Area

Nihon Suido Consultants Co., LTD.

LOCATION MAP


ラオス人民民主共和国
ສ.ປ.ປ. ລາວ
Lao People's Democratic Republic
China
Myanmer
Vietnam
Lao
Thai
Cambodia
サバナケット
Thai
Lao
Savannakhet Area
Nake Treatment Plant
SAVANNAKHET
Location Map

ABBREVIATION

Abbreviations

Lao PDR	: Lao People's Democratic Republic
MCTPC	: Ministry of Communication, Transport, Post, and Construction
WASA	: Water Supply Authority
DCTPC	: Department of Communication, Transport, Post, and Construction, Savannakhet Province
NPS	: Nam Papa Savannakhet (Savannakhet Water Supply Company)
DHUP	: Department of Housing and Urban Planning
JICA	: Japan International Cooperation Agency
ASEAN	: Association of South East Asian Nations

ODA	: Official Development Assistance
PIP	: The Public Investment Program
BHN	: Basic Human Needs
E/N	: Exchange of Notes
OJT	: On-the-Job Training

Exchange Rate : 1US$ = 108.96 Yen = 7,562.00 Kip (as of November 2000)

BASIC DESIGN STUDY REPORT
ON THE PROJECT FOR
REHABILITATION AND EXPANSION OF
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IN SAVANNAKHET AREA IN LAO PDR

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CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

The Lao People's Democratic Republic (hereinafter referred to as Lao PDR) is an inland country situated in the middle of the Indo-China peninsula, and the area of the country is about 237,000 km^2 with the population of some 5 million (in 1998). Of the total population, about 80% of 4 million people are in rural area and the remaining 20% of one million people live in the urban area. The average population density of Lao PDR shows 21 people/km^2 which is the least density within the ASEAN countries.

Table 1-1 Population and Population Density

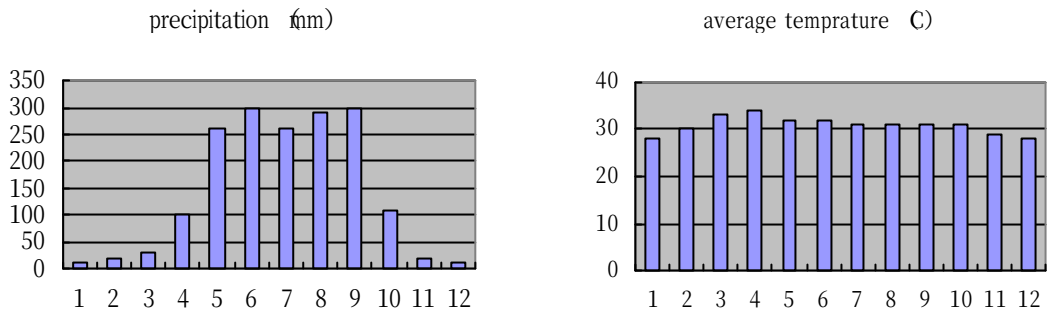
No.	Province	Area (km^2)	Population (×1,000)	Population Density (people/km^2)
	Whole Country	236,800	4,967	21.0
1	Vientiane Municipality	3,920	569	145.2
2	Phongsaly	16,270	166	10.2
3	Luangnamtha	9,325	125	13.4
4	Oudomxay	15,370	228	14.8
5	Bokeo	6,196	123	19.9
6	Luangprabang	16,875	396	23.5
7	Huaphanh	16,500	266	16.1
8	Xayabury	16,389	317	19.3
9	Xiengkhuang	15,880	218	13.7
10	Vientiane	15,927	311	19.5
11	Borikhamxay	14,863	178	11.9
12	Khammuance	16,315	296	18.1
13	Savannakhet	21,774	729	33.5
14	Saravane	10,691	278	26.0
15	Sekong	7,665	70	9.1
16	Champasack	15,415	544	35.3
17	Attapeu	10,320	95	9.2
18	Xaysomboun SR	7,105	59	8.3

(Source) BASIC STATISTICS 98、(National Statistical Center, 1999)

About 47% of the Lao PDR national land is covered with forest, and the flat plain spreads along with the Mekong river and its tributaries between the westward of Lao PDR and Thailand. The climate of the Lao PDR belongs to the tropical monsoon zone in high temperature and

humidity. The climate is clearly divided into two seasons, that is, rainy season for May to October, and dry season for November to April. The precipitation and average temperature of the capital city of Vientiane are shown below:

Fig 1-1 Precipitation and Average Temperature in Vientiane



Source: South-East Asia on a Shoestring, Lonely Planet Publications

The number of the Labour force is some 1.7 million in 1996, of which belongs to 80% in agriculture, 1.6% in mine and industry, 0.6% in construction industry, 0.6% in transportation industry, 2.2% of trading industry, and 14.9% of government offices. The agriculture shows the main industry of the Lao PDR at present (The Present Condition of Laos Economic Society; ver. 4). The Gross Domestic Product (GDP) of the Lao PDR in the statistic data by National Statistical Center is as follows:

Table 1-2 Gross Domestic Product (GDP) (unit : million Kip)

Sector	1997	Percentage	1998	Percentage
Agriculture	498,683	52.2%	517,067	52.1%
Industry	198,848	20.8%	215,739	21.7%
Services	238,296	25.0%	249,708	25.2%
Import Duties	19,183	2.0%	10,412	1.1%
GDP	955,009		992,926	
Annual GDP Growth Rate	6.9%		4.0%	

Source: BASIC STATISTICS 98、(National Statistical Center, 1999)

Since the government of Lao agreed a protocol of official aids with the Soviet government in 1975, the Soviet was the largest donor for the Laos for 1980s. After the Lao government has employed the policy of 'the New Consideration' in 1986, the pro-Vietnam and pro-Soviet policies were altered, and the relation between Thailand, China, and neighboring countries has been strengthening all the more, retaining with the special relation between Vietnam and Lao

PDR. Furthermore, the relationship for the Western countries has been solidifying with soft diplomacies. On the other hand, the economic reformation with market oriented economy has been promoted. The Lao PDR has joined with ASEAN officially in July 1997. The main economic indexes in the report of 'ODA White Paper of Japan' say as follows:

Table 1-3 Main Economic Indexes

		1990	1995	1996	1997
Population (×1,000)		4,186	4,882	4,726	4,849
Nominal GNP	Total (million $)	848	1,694	1,895	1,924
	per capita ($)	200	350	400	400
Ordinal Balance (million $)		-110.8	-346.2	-346.8	-316.0
Financial Balance (million $)		-	-	-	-
Consumer's price index (1990=100)		100	169.9	191.7	-
Remaining of Obligation (million $)		1,768	2,165	2,263	2,320
Exchange Rate (US$ 1 = Kip)		707.75	804.69	921.14	1,256.73

Source: ODA White Paper of Japan; 1999 version

The study area of the Project is the so-called Savannakhet city consisting of densely populated area of Khanthabouly District in Savannakhet province, and it is located at about 300 km southwest from the capital city of Vientiane. The Savannakhet city is the second largest city in Lao PDR having some 100,000 population. Its surrounding areas are positioned as the hub of East-West Transport Corridor Project by which the northeast of Thailand and Danang port in Vietnam through Dong Ha will be connected in the near future. Along with this, Japan as well financed the road improvement project for National Road No. 9. In addition, construction of the Second International Bridge has been planned to connect Mukdahan and Savannakhet under the Japan's financial assistance.

The water supply project was started with French financial assistance in 1974 with design and construction by CTE company (Compagnie Europeenne de Traintement des Eaux). The project consisted of construction for Nake Water Treatment Plant with a production capacity of 15,000 m^3/day and distribution network of 54 km in length. The operation of the facility was commenced from 1977. Since then, Savannakhet Water Supply Company (NPS: Nam Papa Savannakhet) has been responsible for operating the system under the control by Department of Communication, Transport, Post and Construction in Savannakhet Province. After 20 years operation, however, the Plant capacity has been decreasing from 15,000 m^3/day to 12,000 m^3/day due to deterioration of the plant facilities. At present, intermittent supply occurs sometimes caused by frequent failure of plant equipment.

Under such conditions, the government of Lao requested the government of Japan the grant aid in order to rehabilitate the Plant facilities to recover the production capacity of 15,000 m^3/day and to construct a new plant having a production capacity of 10,000 m^3 /day with extension of distribution network.

Since the background of the project and conditions of the water supply system were not clear at the time of the request, the Preparatory Study was conducted in March 2000 to study the necessity of the project and its contents under the grant aid. On the basis of the above study, the present Basic Design Study has been started.

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of The Project

2-1 Objectives of The Project

The water supply in Savannakhet city has been operated for more than 20 years since 1977. While the production capacity of Nake Water Treatment Plant has been decreasing due to deterioration of the plant facilities. For this reason, stable water supply become difficult in recent years with intermittent supply due to frequent failures of plant equipment. Further, malfunction of flow measuring devices makes it difficult to facilitate proper quantitative control of production which unable to grasp tendency of water demand increase accurately as well as unaccounted-for-water ratio. Water quality control is also difficult caused by defective equipment for water quality analysis.

Further decrease of production is expected when no improvement work of the water treatment plant is undertaken, which will cause shortage of water supply to the demand of Savannakhet in the near future. This will result serious problem in Savannakhet city when no availability of alternative water source such as groundwater is taken into account.

In these circumstances, the purpose of the Project is to rehabilitate the deteriorated facilities and equipment to recover the original plant production capacity. In addition, introduction of the soft component is vital for proper operation and maintenance of the improved water treatment plant as well as proper water quality control. It is also important to give advice and guidance to NPS for financial improvement to facilitate sound management of water supply operation.

2-2 Basic Concept of The Project

Based on the background, objectives and contents of the Project, it is planned and designed to prepare an appropriate size and contents of the basic design for project implementation. Further, it is planned to show the contents of works to be conducted by the Lao side to attain the fruitful results as Japanese grant aid project. A proposed implementation schedule and issues to be paid attention for the project implementation are also recommended.

2-2-1 Examination on Water Supply Plans

To select the proposed works and contents of the present project, (1) water supply plan for the

existing service area and (2) that for the Study Area in this Project will be duly examined following to the procedure presented below, and described in the following sections.

(1) Existing Service Area and Study Area

The existing service area for the present basic design stands for the area presently covered by NPS water supply system. While, the study area stands for the following area, stipulated in the Minute of Discussion: Central part of Khanthabouly District located between the Kaysone Road and A2 Road. These two areas are shown in the Figure 2-1.

(2) Scheme-frame Setting

As discussed in the above, such scheme-frame as population served and water demand for the existing service area are designed as follows:

While, that of scheme-frame for the study area are designed and presented in 2-2-3.

Table 2-1 Procedure for Setting Scheme-frame

(1)	Future population projection for Khanthabouly District, to which Savannakhet City belongs.
(2)	Estimate the population and served population in the existing service area.
(3)	Estimate the population in the study area by applying the proportional ratio to the above estimated population in (2).
(4)	Calculate the daily average water demand, using the unit/per-capita consumption and accounted-for-water ratio.
(5)	Study the peak factor
(6)	Estimate the system capacity as day maximum water demand

2-2-2 Water Supply Framework in The Existing Service Area

(1) Population in The Existing Service Area

The future population in the existing service area was estimated by the following methodology. The past population, in the Khanthabouly District was quoted from the statistic data for Savannakhet Province. And, the future population is estimated using the population increase rate, which was applied in the study reports of related on-going projects.

1) Population in Khanthabouly District

The recent population increase trend for Khanthabouly District, obtained from the existing statistic data is presented in the Table 2-2. The available data are limited for four years after 1996, due to

the change of administrative boundary in 1996. As for an analysis of population increase, numbers of data are considered not sufficient.

Table 2-2 Population in Khanthabouly

	Unit	1995	1996	1997	1998	1999
Population	Person	122,378	94,059	96,528	97,568	99,048

(**Source**) 「Department of Planning and Cooperation, Savannakhet Province」
Note: Population decrease in a 1995-1996 period, due to the change of administrative boundary

In this basic design, the population increase rate is studied referring the figures in the following two on-going schemes:

(1) Special Economic Zone Development in Border Area, Oct. 2000; JICA
Increase rate: 2.9% (1998-2020), and

(2) Integrated Regional Development Plan for Savannakhet and Khammouan Region in Lao PDR, Aug. 2000; JICA
Savannakhet Urban annual growth rate: 3.3% (1998-2020)
Rural annual growth rate: 1.8%.

The construction of the Second International Bridge, which is the key project of on-going East-West Corridor Project, is scheduled to complete in 2003. The case study of the First International Bridge, which connects Nongkhai (Thailand side) and Tadua (Vientiane side), shows that population increase rate in Tadua starts increasing significantly after several years from its completion. Supposing the effect of the completion of the Second International Bridge follows the case of the First International Bridge, it is anticipated that significant population increase would start from 2008, five years after its completion scheduled in 2003. Based on this assumption, the population increase rate in Khanthabouly District is estimated as shown below:

Population increase rate for 2000 – 2008 : 2.9%
Population increase rate 2009 : 3.3%

Table 2-3 Future Population in Khanthabouly District

Year	1999	2000	2001	2002	2003	2004
Population in Region	99,048	101,568	104,510	107,540	110,660	113,870
Increase Rate		2.9%	2.9%	2.9%	2.9%	2.9%
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Population in Region	117,170	120,570	124,070	127,670	131,880	136,230
Increase Rate	2.9%	2.9%	2.9%	2.9%	3.3%	3.3%

2) Population in The Existing Service Area

The existing service area is concentrated into 35 Bans, which area is mostly populated area.

(See Fig.2-1)

The population in the existing service area, from the year 1995 to year 2000, is presented in the Table 2-4, shown below.

Table 2-4 Population in The Existing Service Area

	Unit	1995	1996	1997	1998	1999	2000
Population	Person	58,323			61,086	61,791	63,465

Source: 「Statistic Data supplied by State Planning Bureau, Savannakhet Province」

Note: Data in 1996 and 1997 are not available

The past population in the area is applied the existing statistic figure, obtained from State Planning Bureau, Savannakhet Province. The future population (2001 – 2010) in the existing service area is projected, using the above population increase rate of 2.9% and 3.3% as the population increase trend is considered as similar trend as Khanthabouly District. The above population projection is presented in Table 2-5.

Table 2-5 Future Population in The Existing Service Area

Year	1999	2000	2001	2002	2003	2004
Population	61,791	63,465	65,310	67,200	69,150	71,160
Increase Rate		2.9%	2.9%	2.9%	2.9%	2.9%
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Population	73,220	75,340	77,520	79,770	82,400	85,120
Increase Rate	2.9%	2.9%	2.9%	2.9%	3.3%	3.3%

3) Served Population

The applicants for new service connection for NPS have to fill number of family member in the application form. This family member have accumulated and recorded as the served population by NPS. The record of served population is shown in the Table 2-6, presented below.

Table 2-6 Number of Service Connections and Served Population

Year	Water Sale (m^3)	Connection	Persons/ Connection	Serve d Population	Lpcd
1995	2,905.411	7,158	7.4	53,067	150.0
1996	2,996,458	7,570	7.1	53,730	152.8
1997	2,974,986	7,946	6.8	54,338	150.0
1998	3,386,456	8,254	7.2	59,853	155.0
1999	3,404,633	8,776	6.9	60,179	155.0
2000		9,045			

Note: lpcd: Litter per-capita-per-day Consumption (Unit: liter)

The service ratio is calculated using the served population shown in the Table 2-6 and the population in the existing service area, presented in Table 2-4.

The obtained ratios are shown in Table 2-7 below.

Table 2-7 Service Ratio

	Unit	1995	1996	1997	1998	1999	2000
Population in Service Area	Person	58,323			61,086	61,791	63,465
Served Population	Person	53,067	53,730	54,338	59,853	60,179	
Service Ratio	%	91			98	97	

The above table is interpreted as such situation that population has to rely on the piped water, since no other water source is available. This high service ratio (98%) is considered to be the same after the year 2000.

Based on the above service ratio, the population served is estimated and presented in the following Table 2-8.

Table 2-8 Served Population in The Existing Service Area

Year	1999	2000	2001	2002	2003	2004
Service Ratio	97%	98%	98%	98%	98%	98%
Served Population	60,179	62,195	64,003	65,858	67,766	69,735
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Service Ratio	98%	98%	98%	98%	98%	98%
Served Population	71,755	73,833	75,972	78,176	80,750	83,416

(2) Water Demand in The Existing Service Area

1) Per capita Consumption

Table 2-6 presents the per-capita consumption for years 1995 to 1999, which were reported by NPS. According to the records, it varied from 150 lpcd to 153 lpcd in the years 1995 ~ 1997. And, it is stabilized at 155 lpcd from 1998. Based on the above, it is considered that per-capita consumption will not be changed in the near future thus it is determined at 155lpcd for the present study to calculate the future water demand.

2) Accounted-for-Water Ratio

The term of accounted-for-water stands for the water billed to the consumers, and it is presented as the percentage of sold water to the total supplied water as shown below:

Accounted-for-water ratio (%) = (Sold water volume/Total supplied water volume) x (100)

The present accounted-for-water ratio of NPS water supply is evaluated at 70% from the present condition (refer to Appendix 5-8). In this study, the ratio 70% is applied for the design purpose. The accounted-for-water ratio, in future in 2009 to 2010, is considered to be improved gradually to 75%, due active efforts to be made by NPS together with the system development for distribution network with new pipelines.

3) Peak Factor

The ratio for daily maximum water demand to daily average water demand is defined as Peak Factor.

Peak Factor = (Daily Maximum Demand)/(Daily Average Demand)

According to the information obtained from NPS, the reliable data could not be obtained, thus they are not applied for the present study. As for the example in Japan about the subject ratio, it is ranging from 1.24 to 1.22 for water supply system, which served population is in a range of 20,000 to 50,000 and 50,000 to 100,000 respectively as shown in Table 2-9. While, that ratio for Vientiane City is estimated at 1.20, which is slightly higher comparing with the case in Japan.

As for Savannakhet City, the said factor is set at 1.25 taking the scale of the water supply system into account, and kept this figure for future planning.

Table 2-9 Peak Factor in Japan

Served Population	Above 1million	500,000 to 1million	250,000 to 500,000	100,000 to 250,000	50,000 to 100,000
Peak Factor	1.20	1.18	1.19	1.20	1.22
Served Population	30,000 to 50,000	20,000 to 30,000	10,000 to 20,000	5,000 to 10,000	5,000 Less
Peak Factor	1.24	1.26	1.28	1.36	1.42

Source: 「Water Supply Statistics」 1998, Japan Water Works Association」

4) Future Water Demand

Using the above factors, Average Daily Water Demand is calculated and shown in the following Table 2-10.

Table 2-10 Average Daily Water Demand

Year	**2001**	**2002**	**2003**	**2004**	**2005**
Average Daily Water Demand	14,173	14,584	15,007	15,441	15,665
Accounted-for-water ratio	70%	70%	70%	70%	71%
Year	**2006**	**2007**	**2008**	**2009**	**2010**
Average Daily Water Demand	15,894	16,132	16,374	16,668	17,239
Accounted-for-water ratio	72%	73%	74%	75%	75%

5) Water Demand for Planned Industrial and Housing Estate

Under the Development Plan for the Special Economic Zone, an industrial estate which will have water demand 1,600m^3/day is planned to be constructed in 2004. This industrial estate is located at about 1.5 km away to the north of Nake Water Treatment Plant, near the Second International Bridge across the Mekong river.

The expected types of industries for the industrial estate are as follows:

(1) Process for agriculture products,
(2) Food process, and
(3) Wood process.

The construction of some hotels and housing scheme for the employee/workers is also planned in this newly developed area. However, the water demand and required water quality for the above types of industries are not confirmed yet. For example, some water for washing purpose in the manufacturing process will be included, which water quality is usually not necessary to the quality level for drinking water, but sufficient for a level of clarified water.

There is information that the industrial estate is examining to construct its own water supply system. Further, the estate is planned out of the Study Area. (Refer to the Fig 2-1)

According to the City Planning for Khanthabouly District prepared by MCTPC, another development of industrial estate is programmed in the east of the Savannakhet Airport as well under the Development Program for Special Economic Zone. However, the size of development scheme and proposed type of industries is not clear yet as well as timing of construction. The planned location of this industrial zone is presented on the Fig. 2-1. The location of this estate is also out of the Study Area of the Project.

The Study Team thus concluded that water demands for the said areas are not included in the present study as two schemes are considered not suitable for the grant aid program of Japan which usually covers such sectors as medical, health, education for primary and medium levels, environment, rural and agricultural development for basic human needs (BHN). Further, they are located out of the study area, and their content and details are not clear at present.

2-2-3 Water Supply Framework in The Study Area

As defined in the preceding Section, 2-2-1, the Project Area should be the central area of Khanthabouly District between Kaysone Road and A2 Road in Savannakhet Province.
The same procedure as mentioned in Section 2-2-2 is applied to estimate the water demand in the Study Area.

(1) Served Population in The Study Area

Fig. 2-1 shows the Study Area and the existing service area within which 35 Bans (Villages) are

included. As for the population projection in the Study Area, the same increase rate as that in the existing service area is applied. The general procedure for population projection in each ban is presented as shown in Table 2-11.

Table 2-11 Procedure for Population Projection in The Study Area

Location of Ban	Remarks
1) Ban is located in the study area, and also in the existing service area	Population in whole area is counted
2) Ban is not located in the study area nor existing service area	Population in whole area is not counted
3) Ban is extended between the study area and existing service area	Population is proportionally estimated by the ratio of the area

The future population of each ban is estimated and sum of them is presented in Table 2-12 below.

Table 2-12 Population in The Existing Service Area and The Study Area

Year	1999	2000	2001	2002	2003	2004
Population in Service Area	61,791	63,465	65,310	67,200	69,150	71,160
Population in Study Area	39,610	40,791	41,826	42,874	43,936	45,010
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Population in Service Area	73,220	75,340	75,520	79,770	82,400	85,120
Population in Study Area	46,091	47,171	48,260	49,346	50,615	51,886

(2) Water Demand for The Study Area

The future water demand is estimated in the same manner applied in the preceding section 2-2-2, and the results are presented in Table 2-13 below.

Table 2-13 Water Demand in The Study Area

(Average Daily Water Demand and Maximum Daily Water Demand)

Year	1999	2000	2001	2002	2003	2004
Population in the Study Area	39,610	40,791	41,826	42,874	43,926	45,010
Average Daily Water Demand (m^3/day)	8,773	9,003	9,261	9,494	9,729	9,968
Maximum Daily Water Demand (m^3/day)	10,966	11,291	11,576	11,868	12,161	12,460
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Population in the Study Area	46,091	47,171	48,260	49,340	50,615	51,886
Average Daily Water Demand (m^3/day)	10,061	10,155	10,246	10,336	10,461	10,722
Maximum Daily Water Demand (m^3/day)	12,576	12,694	12,808	12,920	13,076	13,403

2-2-4 Basic Concepts

1) Results of Survey and Study on Project Components

Base on the survey results, components of the Project were extracted and evaluated for their priority. The results of the study and evaluation are summarized and presented in the following Table 2-14.

Table 2-14 Project Components and Evaluation

	Project Component	Evaluation	Priority
1	Renovate and rehabilitate the existing water treatment facilities to secure safe and stable water supply	Grade of deterioration is very remarkable for the existing facilities and equipment. Renovation/rehabilitation of the existing facilities are indispensable	Grade A
2	To augment and supply water required for the populated area of Savannakhet City. When necessary, to expand the water treatment facilities.	On estimation, in 2003 average water demand will reach production capacity of the treatment plant. In conclusion of study from the present status, stable and safe water supply is crucial rather than expansion of the existing production facilities. While, additional capacity of clear water reservoir shall be required for stable plant operation and peak hour supply	Grade B
3	Rehabilitate the existing distribution network in the Study Area. (including secondary pipes)	As the results of evaluation, the existing distribution network is considered in good condition and not necessary to renovate at present.	Grade C
4	Add to the above works item3, new pipelines be installed, (basically, in the Study Area)	In the Project Area, the existing distribution system is evaluated as working in good condition with enough capacity. Pipeline system for the newly developed area, is considered not required urgently. Thus, installation of new pipelines is not recommended in this project.	Grade C
5	Develop appropriate operation and maintenance of the plant and improvement of water supply management upon the completion of the Project	It is crucial to improve operation practice of the treatment plant including measuring/controlling flows and water quality with periodical and continuous recording of them. The improvement of water supply management is also important and urgently required including strengthening financial status. The above shall be the basis for future development of water supply system by own-force.	Grade A

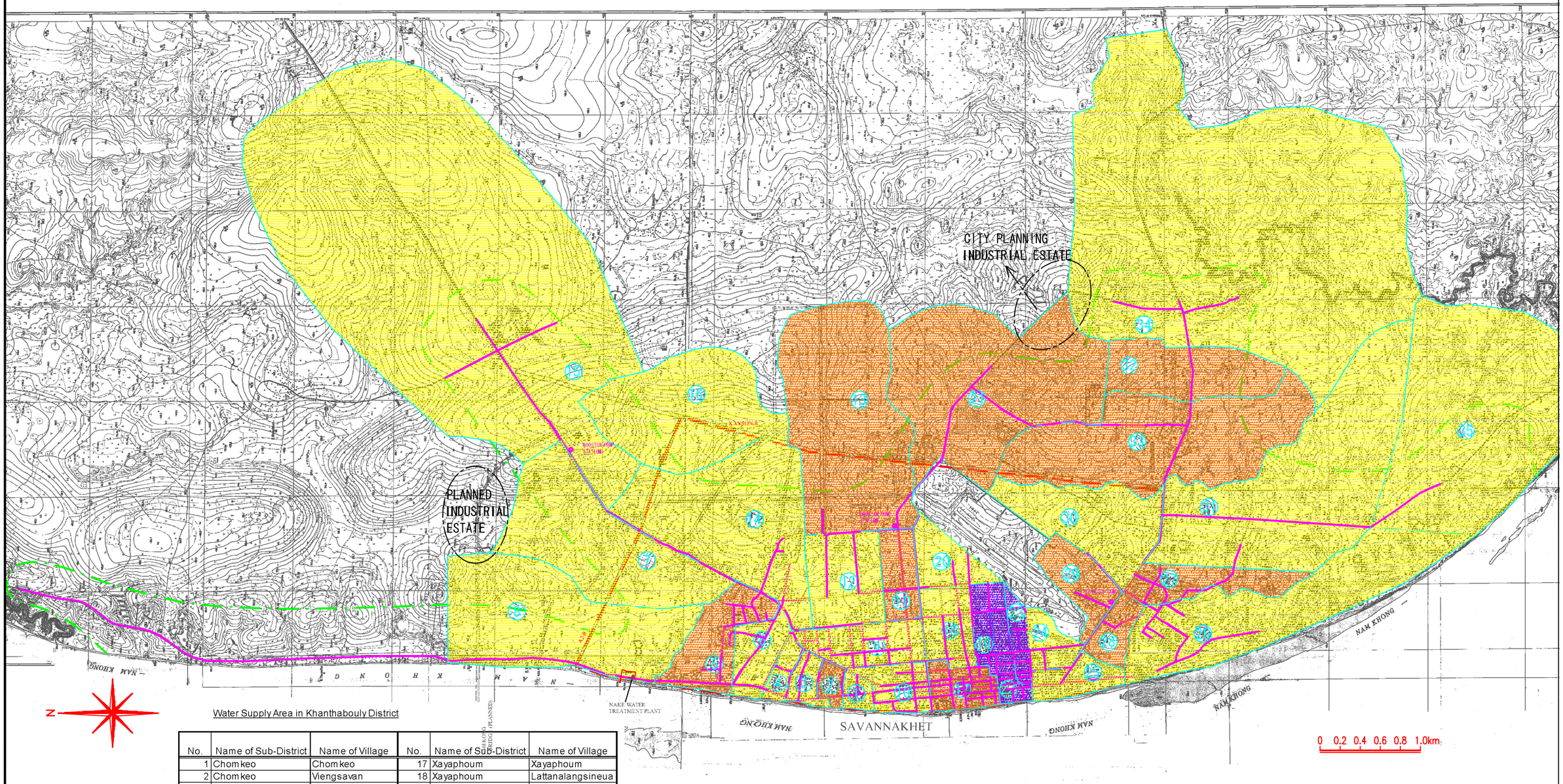
Based on the above study, following priority works are selected and recommended to be implemented as shown in Table 2-15.

Table 2-15 The First Priority Project, Selected for the Present Project

1) Rehabilitation works for mechanical and electrical facilities/equipment in Nake Water Treatment Plant (Capacity: 15,000m^3/day)

2) Expansion of clear water reservoir (1,500 m^3) and associated facilities.

To comply with the objective of the above rehabilitation project, contents and/or item of works included in the proposed project are studied in detail and presented in the succeeding section.



Water Supply Area in Khanthabouly District

No.	Name of Sub-District	Name of Village	No.	Name of Sub-District	Name of Village
1	Chomkeo	Chomkeo	17	Xayaphoum	Xayaphoum
2	Chomkeo	Viengsavan	18	Xayaphoum	Lattanalangsineua
3	Chomkeo	Phoxaytay		Xayaphoum	Lattanalangsikang
4	Chomkeo	Phoxayeua	19	Xayaphoum	Lattanalangsitay
5	Chomkeo	Huamuongtha	20	Xayaphoum	Latsavongsay
6	Chomkeo	Huamongtai	21	Xayaphoum	Nonesavath
7	Chomkeo	Huamongneua	22	Xayamougkun	Xayamougkun
8	Chomkeo	Nake	23	Xayamougkun	Thongnhon
	Chomkeo	Vongsavang		Xayamougkun	Tongsamakhy
	Chomkeo	Thaoudom	24	Xayamougkun	Xay Udom
9	Sunantha	Sunantha	25	Xayamougkun	Thahe
10	Sunantha	Thamuong	26	Phonsavanh	Phonsavanh
11	Sunantha	Sibunheuang	27	Phonsavanh	Phonsaad
12	Sunantha	Nalao	28	Phonsavanh	Sapharntay
13	Sunantha	Sanamxay	29	Phonsavanh	Sapharnneua
14	Sunantha	Phonesavangtay	30	Phonsavanh	Dongdamduane
15	Sunantha	Phonesavangneua	31	Phonsavanh	Sonexay
	Sunantha	Udomvilay	32	Phonsavanh	Nonesaat
16	Sunantha	Phoxay	33	Phonsavanh	Phonexay
	Sunantha	Nongphu	34	Phonsavanh	Naseng
	Sunantha	Nongdeun	35	Phonsavanh	Doneseng

LEGEND

- Study Area
- Existing Pipelines
- Service Area
- Ban (Village) 境界
- Higher than average 1.5 % (Population Increasing Rate)
- Between 0 and 1.5 % (- do -)
- Decreasing (- do -)

The Lao People's Democratic Republic
Ministry of Communication, transport, Post and Construction

The Basic Design Study on
The Project for Rehabilitation
Water Supply Facilities In Savannakhet Area

TITLE: Existing Service Area and Designed Service Area

SCALE: 1/40000

DRAWING NO.: Fig. 2-1

NIHON SUIDO CONSULTANTS CO., LTD, TOKYO, JAPAN

Approved By Date

Designed By Date

JAPAN INTERNATIONAL COOPERATION AGENCY

Table 2-16 Served Population and Water Demand in The Existing Service Area

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population in Khanthabouly District (1)	122,378	94,059	96,528	97,568	99,048	101,568	104,510	107,540	110,660	113,870	117,170	120,570	124,070	127,670	131,880	136,230
Population in the Existing Service Area (2)	58,323			61,086	61,791	63,465	65,310	67,200	69,150	71,160	73,220	75,540	77,520	79,770	82,400	85,120
Served Population (3)	53,067	58,730	54,338	59,853	60,179	62,195	64,003	65,858	67,766	69,735	71,755	73,833	75,972	78,176	80,750	83,416
Population Increase			2.6%	1.1%	1.5%	2.5%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	3.3%	3.3%
Service Ratio (3)/(2)	91%			98%	97%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Rating for Served Population (3)/(1)	43%	57%	56%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%
Per-Capita Consumption (lpcd)	150	153	150	155	155	155	155	155	155	155	155	155	155	155	155	155
Consumption (m3/day)	7,961	8,221	8,151	9,277	9,327	9,639	9,921	10,209	10,505	12,410	12,724	13,044	13,374	13,716	14,618	15,031
Accounted-for-water Ratio (%)	70	70	70	70	70	70	70	70	70	70	70	70	70	74	75	75
Average Daily Water Demand (m3/day)	11,373	11,744	11,644	13,253	13,324	13,770	14,173	14,584	15,007	17,729	17,921	18,117	18,321	18,535	19,491	20,041
Peak Factor	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Daily Maximum Water Demand (m3/day)	14,216	14,680	14,555	16,566	16,655	17,213	17,716	18,230	18,759	19,304	19,585	19,868	21,161	20,466	20,863	21,552

Note: 1) Population decreased in 1995-1996, due to administrative boundary change in Khanthabouly District.

2) Population increase rates for 2000 – 2008 and 2009 & 2010 are applied 2.9% and 3.3% respectively.

2-3 Basic Design

2-3-1 Design Concepts

The objective of the Project is to improve the existing water treatment plant. The design concept for the present basic design study is to examine the necessity for rehabilitation and replacement of the deteriorated facilities and equipment in order to revive the design capacity of 15,000 m3/day and to facilitate safe and steady water supply to the citizen. When it is confirmed to restore the existing facilities and equipment, methodology of rehabilitation and selection of equipment to be replaced will be duly examined taking the technical level of NPS into account.

One of the most important issues for the present project is to upgrade technical level of the operators for proper operation and maintenance of the system. Another important aspect is to control and minimize time for the water supply shutdown during the rehabilitation works. Most appropriate method and sequence of the works shall be examined and apply to maintain continuous water supply as possible or to minimize the time for water supply shut-down where it is inevitable.

Important subject to be executed in the Project is to operate and control the system based on the accurate flow measurement and water quality analysis. These measurements include (1) raw water intake flow, (2) distribution water flow, and (3) proper chemical dosage. Therefore, it is indispensable to equip measuring devices and equipment for sound plant operation.

Based on the above, the design concepts for the proposed Project are summarized and presented in Table 2-17 below.

Table 2-17 Design Concepts for the Project

①	Principally, it is targeted to revive the original production capacity with necessary replacement and repair of the existing facilities and equipment in the existing water treatment plant.
②	Practical rehabilitation method with adequate selection of equipment shall be applied, to revive the original function for each facility and equipment.
③	To adopt adequate method of the rehabilitation works with proper sequence of works which minimize the time for water supply shutdown.
④	To install instrumentation and equipment for water flow measurement in order to operate and control the plant operation and distribution based on accurate measurements.

The designate major facilities and equipment for rehabilitation of the present Project are as follows:

① Intake facilities, mainly for intake pumps,

② Most of the mechanical and electrical facilities and equipment for water treatment plant, and

③ Distribution facilities, mainly for pumping equipment and construction of a new clear water reservoir with associated facilities.

2-3-2 Study on Improvement/Rehabilitation of Existing Facilities

In order to formulate rehabilitation items, detailed surveys have been conducted on the present conditions of each facilities and equipment. Base on the surveys, each facility and equipment was evaluated and necessity of the rehabilitation was identified. The results of evaluation and methodology for improvement are described in the following sections.

(1) Raw Water Intake Facilities

As for the Raw Water Intake Facilities, civil structures (intake tower) and pipelines are remained as they are, while equipment in general is to be replaced with new one. Every facilities and equipment are evaluated and shown in Table 2-18 below:

Table 2-18 Improvement of Intake Facilities and Equipment

Item	Necessity of Improvement	Methodology of Improvement
Intake Facilities		
101) Intake Tower	No specific problem are observed in structure, thus no improvement work is required.	Use existing structure for future operation.
102) Operation Bridge	No specific problem are observed in structure, thus no improvement work is required.	Use existing structure for future operation.
201) Intake Pump	Many troubles due to over-load exist, and found difficulty for repair, thus need for replacement.	Replacement with new pumps. (apply submersible pump) cf. Appendix 5-1
202) Discharge pipe	Check-valves are damaged, thus need for replacement.	Replace check-valves with the similar type.
203) Drain pump	Not used due to unnecessary to make empty basins.	No improvement is required.
204) Monorail hoist	Danger to use existing one, and inadequate to repair, thus need for replacement.	Install new hoist with rail.
205) Pump control panel	Refer to "(4) Electrical and Instrumentation Equipment"	
103) Raw water transmission main	Existing pipeline is still usable and has a capacity of design flow, thus use existing main.	Utilize existing main for future operation.
206) Raw water flow control devices	Water level of Mekong River fluctuates in wide range, thus flow control is inevitable for proper pump operation and protection of over-load of intake pump, thus need to install flow control device.	Install flow control valves just upstream of receiving well. Select optimum type of valve considering reliability for control, easy maintenance and economy.

(2) Water Treatment Facilities

As for the water treatment facilities and equipment as well, most of equipment will be replaced with new ones, while the least modification of civil structures shall be required as shown in Table 2-19.

Table 2-19 Improvement of Water Treatment Facilities and Equipment (1/2)

Item	Necessity of Improvement	Methodology of Improvement
111) Receiving well, and Mixing well	No specific problems are observed in structure, thus no improvement work is required.	Use existing structures with no improvement works.
112) Flocculation basin	No specific problems are observed in structure, thus no improvement work is required.	Use existing structure with no improvement works.
113) Sedimentation basin	No specific problems are observed in structure, thus no improvement work is required.	Use existing structure with no improvement works.
114) Filter	No specific problem is observed on structures, thus no improvement work is required. While no hydraulic control section is provided at the outlet of filter, filter outlet control device could not be functioned when water level of clear water reservoir becomes low.	Use existing structure with no improvement works. Construct junction well at the outlet of filter to facilitate independent hydraulic condition between filter and clear water reservoir and to avoid influence of water level of reservoir against filter operation and control.
211) Rapid mixer	Need more stirring strength for improvement of coagulation, thus need to install new one.	Replace with the new mixer, with G-value 500 sec^{-1}.
212) Flocculator	Frequent operation stops are observed due to deterioration, thus need for replacement.	Replace with the similar type flocculator with existing one.
213) Control panel of mixer and flocculator	Refer to "(4) Electrical and Instrumentation Equipment"	
214) Washing pump for sedimentation basin	Existing pump facility is functioning, thus no improvement work is required.	Use existing one for future operation.
215) Pipelines for washing	Existing pipe system is functioning, thus no improvement work is required.	Use existing pipe system for future operation.
216) Sludge Valve for sedimentation basin	Existing sludge valves are deteriorated, and difficult to repair, thus need for replacement.	Replace with similar type of valves with existing ones: ϕ350mm 4-units.
217) Collecting trough for sedimentation basin	Existing trough is functioning, thus no improvement is required.	Use existing one for future operation.
218) Outlet gate of sedimentation basin	No specific problems are observed, thus no improvement work is required.	Use existing gates for future operation.
219) Inlet gate of filter	Out-of-order, to be replaced with new ones.	Replace with similar type of gate with existing one.
220) Filter media	Spilling away and abrasion of filter sand are observed, thus need to be replaced.	Replace with new filter sand which shall conform to original specifications. Existing sands be reserved for spare, after sieving and selecting materials.
221) Under drain system of filter	Under drain system is damaged, which results uneven washing, thus need for replacement.	Replace with new porous concrete under-drains, which conform to original specifications.

Table 2-19 Improvement of Water Treatment Facilities and Equipment (2/2)

Item	Necessity of Improvement	Methodology of Improvement
222) Back-wash pump	One is not functioning due to motor trouble. Another one is operated not in stable due to deterioration. Valves around pump are deteriorated due to stain. No flow measurement device exists. Need to replace the above equipment.	Replace with new pumps, which conform to original specifications. Replace existing inlet pipe and foot valve with new ones. Install flow meter on outlet pipe of pump for flow measuring. Replace existing sluice valve with controllable butterfly valve, replace check valve as well.
223) Air scouring blower	No specific problems observed, thus no improvement is required.	Utilize the existing equipment for future operation
224) Pipes and valves of filter valves	Frequent malfunction of valves are observed due to deterioration of them, thus need for replacement.	Replace three kinds of valves; outlet valve, air-scoring valve and backwash valve with manually operated floor stand. Other existing valves installed in filter gallery are usable for future operation.
225) Filer outlet control device	Deterioration of control device is observed with severe stain. Spare parts are not available due to old type, thus need for replacement.	Replace with new control devices.
226) Local control panels	Refer to "(4) Electrical and Instrumentation Equipment"	
227) Pumps for plant water supply	Existing system has many troubles.	Abandon existing pump system. Install new supply system by branching from distribution main.

(3) Chemical Feeding Facilities and Related Equipment

Among the existing chemical feeding facilities, fluorine, alkaline agent and hypo-chlorite generating devices have been out-of-order and not in use at all. Weigh scale and monorail hoist are also out-of-order. Evaluation on present conditions with recommended method for improvement of chemical feeding facilities and related equipment are described in the following Table 2-20.

In this basic design study, supply of tools and equipment for water quality analysis and jar test are recommended for practical water treatment plant operation and basic items for them also shown in the Table 2-20.

Table 2-20 Chemical Feeding Facilities and Other Equipment

Item	Necessity of Improvement	Methodology of Improvement
231) Weigh scale	Proper weighing of chemicals is indispensable for proper chemical feeding, thus weight scale shall be required.	Install weigh scale, which is used with monorail hoist. Type: 500kg Hanging hook type weigh One unit.
232) Monorail hoist	Existing monorail hoist is out of order Chemical solution, especially for coagulation agents is designed for 4 times a day. For efficient work of chemical preparation, need to provide monorail hoist.	Install motored monorail hoist Capacity: 500kg, One unit Existing rail is also to be replaced
233) Coagulant (Alum) feeding facilities	The present system (injector type) is deteriorated. Existing chemical solution tanks (RC made) are structurally usable but need repair its surfaces on both inside and outside. Two mixers on solution tanks are either out of order or deteriorated. From the above, improvement of both feeding equipment and solution tank with mixer are required.	Replace existing injector with diaphragm pump for independent chemical feeding taking importance of Alum feeding into account. Repair existing two RC solution tanks with applying FRP-lining on inner wall for corrosion protection. Replace mixers with the similar type with the existing ones.
234) Alkaline (Lime) feeding facilities	Existing two solution tanks (RC made) are structurally usable but surfaces are deteriorated. Both mixers for tanks and circulation pumps were removed due to out of order. Feeding equipment (pressure injector type) is also out of order. Lime dosage shall be required for high turbidity (800 above) of raw water, expected in July to September time. Thus improvement of above facilities and equipment are to be made.	Use existing two RC tanks for future operation with repair on surfaces of tank. Replace two mixers on solution tanks. Apply present system with pressure injector. Apply simple feeding system without circulation pumps. Replace injectors with similar type with existing one.
235) Chlorine feeding facilities	Out of two mixers, one is out of order and another is deteriorated. Feeding equipment (pressure injector type) is deteriorated. Only post chlorination is applied at present, while intermediate chlorination shall be required. Overall improvement shall be required for chlorination.	Use existing three RC tanks (two are for hypo-chlorite and one is for fluorine) for future operation with repair of concrete surfaces and FRP lining on inner surface for corrosion protection Replace feeding equipment with the similar system applied at present (manual weighing with pressure injector for feeding)
236) Hypo chlorite generating devices	Out-of-order	To be abandoned.
237) Fluorine dosing device	Out-of-order	To be abandoned.
238) Chemical feed control panel	Refer to "(4) Electrical and Instrumentation Equipment"	
239) Laboratory equipment	Equipment for water quality analysis are out of order. Need to supply equipment for proper coagulation and water quality control.	Supply equipment for basic need for coagulation and water quality analysis including (1) Turbidity meter, (2) Jar-tester, (3) Comparator for pH and residual chlorine meter.

(4) Electrical and Instrumentation Equipment

1) Electrical Equipment and Associated Facilities

The present conditions of electrical equipment and associated facilities are evaluated and necessity of improvement with methods are studied and presented in the following **Table 2-21**.

Table 2-21 Electrical Equipment

Item	Necessity of Improvement	Methodology of Improvement
241) High Voltage power receiving facility	Existing facilities are deteriorated due to over loaded operation, and they shall be accelerated. Need for improvement totally.	Install new power receiving equipment, and existing one be demolished. Transformer capacity: 550KVA, with associated facilities and lightning equipment.
242) Power control panel	Existing panels are severely deteriorated, and no spare parts are available due to old type panel. Need to be replaced.	Install new control panel. Principally, manual control operation is applied with MCC panel & side panel system using reliable protective relaying system.
243) Lightning Facility	The site is suffered from frequent thunders, while only one lightning system exist at intake tower. Existing transformer once damaged by thunder Additional lightning systems for facilities are necessary.	Locate lightning systems at important facilities to protect them from thunder attack.
244) Cable & Wiring	Existing cable and wiring systems are deteriorated as they are more than 20 years old. Need to replace them.	Replace with new cable and wiring system at the time of installation of electric equipment with cable racks & flexible PVC conduits and hand-holes.
245) Power generator	Existing facility is judged to be usable, thus no improvement is required.	Use existing power generator for future operation.

2) Instrumentation Equipment for Raw Water Intake and Water Treatment Plant Facilities

Present operation of the water treatment plant is evaluated and necessity of the instrumentation equipment and improvement of the existing equipment are studied as shown in the following Table 2-22.

Table 2-22 Instrumentation Equipment

Item	Necessity of Improvement	Methodology of Improvement
246)Instrumentation equipment for raw water intake and water treatment system	No instrumentation equipment exist for raw water pump operation based on water level and flow requirement, which results over discharge of raw water pump. Also no equipment is available to grasp overall operation of the water treatment plant. For proper operation of the plant, adequate instrumentation equipment shall be equipped.	Install raw water intake level and flow measuring devices for intake flow control Ultra sonic flow meter is used. Install monitoring panel for overall plant operation in electric room including raw water intake, treatment process and distribution.
247)Instrumentation equipment for distribution system	Existing distribution flow meter (orifice type) is broken, thus need to replace it with new one. Appurtenant equipment such as pressure gauge and level meter are out of order, which shall be replaced.	Replace existing flow meter with new one. Replace existing deteriorated pressure gauges on distribution pumping system. Install water level meter in distribution pump well. All output data/information on status of distribution shall be transmitted and indicated on the monitoring panel installed in the above electric room.

(5) Distribution Facilities

Each item of the distribution facilities is described in the following Table 2-23.

Table 2-23 Distribution Facilities and Equipment

Item	Necessity of Improvement	Methodology of Improvement
121) Clear water reservoir	The existing reservoir has insufficient capacity causes sudden water level change of reservoir and distribution pump well by filter washing, while no specific problem on its structure is observed. Need to provide additional capacity of reservoir.	Construct new reservoir with capacity of 1,500 m3 with associated piping. Use existing reservoir together with newly constructed reservoir for future operation.
122) Distribution Pump well	No specific problems is observed other than described above, thus no improvement is required.	Use existing pump well for future operation.
251) Distribution pumps	Many troubles occurred. No spare parts are available due to old type.	Replace existing three pumps with new ones with similar specification.
252) Pipe around distribution pump	Vibration on discharge pipe is observed since no support exists. Foot valve on suction pipe is deteriorated caused leaks from it. Existing piping system and foot valves are to be replaced.	Replace pipes and valve around distribution pumps at the time of pump replacement.
253) Flow meter for distribution	Refer to "(4) Electrical and Instrumentation Equipment"	
254) Air Vessel	Distribution system was analyzed as the air vessel is necessary for surge control, while the existing air vessel is deteriorated, thus it is to be replaced.	Replace the existing air vessel with appurtenant equipment.
255) Air compressor	Existing air compressor is out of order, thus need for replacement.	Replace with new one.
256) Monorail hoist	Existing monorail hoist is out of order, thus need for replacement.	Install new manually operated monorail hoist with 1.5ton capacity with new rail.
257) Control panel for distribution pumps	Refer to "(4) Electrical and Instrumentation Equipment"	

2-3-3 Basic Design

Based on the survey and evaluation on the existing water treatment plant described in the preceding sections, the basic design was made for rehabilitation for existing facilities and equipment as summarized in the following Table 2-24.

Table 2-24 Basic Design for Proposed Facilities and Equipment(1/4)

Item No.	Facility/Equipment Name	Basic Design (Dimensions)
201)	Raw water intake pump	Type: Submersible pump Unit: 3units (2 for operation, 1 stand-by use) Capacity: 5 .5m3/min (= 330m3/hr) x23.5m x 3.7kW Associated equipment of a pump Check valve: φ250mm x 1 no Motor operated monorail hoist: 3 ton x 1 unit Air valve: φ100mm x 1 no
206)	Raw water Flow control devices	Flow meter Type: Ultra-super-sonic Size: 400mm, Unit: 1 unit Flow control valve Type: Vertical Butterfly Valve (with toothed-vane disk) Size: 400mm, Unit: 2 nos. Bypass valve Type: Vertical Butterfly Valve Size: 450 mm, Unit: 3 nos. Associated pipes Type: Ductile Cast Iron Pipe Size: 450 mm and 400 mm
211)	Rapid mixer	Type: Vertical turbine Unit: 1unit Mixing intensity: G = 500sec-1 Motor power: 2.2kW
212)	Flocculator	Type: Vertical Axial Bottom Hold Unit: 4 units Motor power: 3.7 kW
216)	Sludge valve of sedimentation basin	Type: Flush Bottom Valve with manual operated floor stand Size: φ350mm, Unit: 4 nos.
219)	Inlet gate of filter	Type: Gate with manually operated floor stand Size: 820mm x 265mm, Unit: 4 nos.
220)	Filter sand	Effective size: 1.0mm Uniformity co-efficient: 1.4 Thickness: 1.0 m Volume: 126 m3 (31.5 m3/filter)
221)	Under drain system of filter	Type: porous concrete under drain Unit: 4filter beds (31.5 m3/filter)

Table 2-24 Basic Design for Proposed Facilities and Equipment(2/4)

Item No.	Facility/Equipment Name	Basic Design (Dimensions)
222)	Back-wash pump	Type: Horizontal single suction volute Pump Unit no.: 2units(1 normal operation, 1stnd-by) Capacity: 9.5m3/min x 8m x 30kW Associated equipment of a pump Foot valve: φ350mm x 1 no. Check valve: φ400mm x 1 no. Butterfly valve: φ400mm x 1 no. Suction pipe: 1 lot Flow meter: 1 unit (mechanical type)
224)	Valves of filter	Type: Butterfly Valve with manual operating floor stand Filter outlet valve: φ350mm x 4 nos. Backwash valve: φ350mm x 4 nos. Air scouring valve: φ200mm x 4 nos.
225)	Filer outlet control devices	New flow control devices, Unit: 4 units
114)	Filter connecting well	Type: RC structure, weir type Unit: 1 unit Dimension: B2m x W4.4m x D2.4m
233)	Alum feeding facilities	Alum-sulfate Solution Tank Type: RC Square shape tank (existing) Capacity & unit : 3.5m^3 x 2units Associated facilities (per tank): Chemical feeding hopper (SUS316), Agitator/Mixer, 0.75kW, Shaft & impeller: SUS316 Alum-sulfate feeding p ump Type: Diaphragm measuring pump Capacity: 8.5 lit/min x 1.5 kW Unit: 3units(2 normal operation, 1 stand-by) Motor operated monorail hoist Capacity: 500 kg, Unit: 1 unit
234)	Lime feeding facility	Lime slurry solution tank Type: RC square tank (existing) Capacity & unit: 1.5m^3 x 2units Associated facilities (per tank): Chemical feeding hopper (SUS304), Agitator/Mixer, 1.5kW, Shaft & impeller: SUS304 Manual measuring unit Type: Triangle Measuring Weir Tank Unit: 2 unit (one each for pre- and post- lime) Lime Slurry Injector Type: Pressure Type Suction Injector Unit: 2 units (one each for pre- and post- lime)

Table 2-24 Basic Design for Proposed Facilities and Equipment(3/4)

Item No.	Facility/Equipment Name	Basic Design (Dimensions)
235)	Chlorine feeding facility	Hypo chlorite calcium solution tank Type: RC Square shape tank (existing) Capacity & unit: 1.5m^3 x 3units Associated facilities (per tank): Chemical feeding hopper (SUS304), Agitator/Mixer, 0.4 kW, Shaft & impeller: Steel with rubber lining Manual measuring unit Type: Triangle Measuring Weir Tank Unit: 2units (one each for intermediate- and post-Chlorine) Injector Type: Pressure Type Suction Injector Unit: 2units (one each for intermediate- and post-Chlorine)
241)	High voltage power receiving facility	Power receiving transformer Type: outdoor, oil immersed, self cooling Capacity: 550KVA Voltage: 22kV/380V, 3-phase, Unit: 1unit High voltage switch gear Type: outdoor, manual cut-out, fuse-included Voltage: 24 kV, Unit: 1 unit
242)	Power Control Panel	Power control panel Type: Indoor, metal-enclosed, self-standing Voltage: 600V, 3-phase, Unit: 1 unit Local switch box Type: Indoor, metal-enclosed, stand type Voltage: 600V, 3-phase, Unit: 1 unit
246)	Instrumentation equipment for raw water intake and water treatment system	Level meter Type: Ultra-super-sonic type Unit: 1 unit Flow meter Type: Ultra-super-sonic type, Out-door type Unit: 1unit (include transmitter) Instrumentation panel Type: In-door, metal enclosed, Wall-mounted Unit: 1 panel
247)	Instrumentation equipment for distribution system	Level meter Type: Submerged Water Level Meter Unit: 2 units Flow meter Type: Ultra-super-sonic type, Out-door type Unit: 1unit (include transmitter)

Table 2-24 Basic Design for Proposed Facilities and Equipment(4/4)

Item No.	Facility/Equipment Name	Basic Design (Dimensions)
121)	Clear water reservoir	Unit: 1 basin Capacity: 1,500m3 Dimension: W.15.0m x L.15.0m x D.3.5m x 2units Associated pipes & valves Inlet pipe: φ700mm DIP Outlet pipe:φ800mm DIP Drain and overflow pipe: 1 lot Valve (butterfly valve): Inlet valve:φ700mm x 2 nos. Outlet valve:φ800mm x 3 nos. Interconnecting valve:φ700mm x 1 no. Drain and overflow valve: 1 lot
	Warehouse	W6.0m x L12.0m, Unit: 1 lot
251)	Distribution pump	Type: Single Suction Volute Pump Unit: 3units(2 normal operation, 1stand-by) Specs.: 6.0m3/min(=360m3/h) x45m x 75kW
252)	Associated pipes and valves for distribution pumps (per pump)	Pipes: Steel Pipes (SP), φ250mm~300mm x 1 lot Valves: manual operation Foot valve: φ300mm x 1 no. Check valve:φ250mm x 1 no. Butterfly valve:φ250mm x 1 no.
254)	Air vessel	Type: Steel Made Vertical Type Pressure Cylinder Capacity: 7.5 m3 Unit: 1 unit Associated equipment: Piping: φ250mm x 1 lot Gate valve:φ250mm x 1 no. Check valve:φ250mm x 1 no.
225)	Air compressor	Type: Air Compressor with Storage Vessel Unit: 2 units Capacity: 1.5 kW Associated equipment: Automatic control panel

Laboratory equipment is planned to supply to facilitate adequate chemical feeding for proper coagulation and carrying out water quality analysis for basic quality items. Table 3-25 shows the equipment to be supplied under the present project.

Table 2-25 Equipment to be Supplied

Item No.	Facility/Equipment Name	Basic Design (Dimensions)
	Turbidity meter	Type: Laboratory Turbidmeter Measuring range: 0 ~ 4000 NTU Unit: 1 unit
	Comparator	For measuring pH and residual chlorine Unit: 1 unit
	Jar tester	Type: 4 shafts with stirring strength adjustable, chemical dosage kit, back light Associated tools: Weighing (minimum measuring of 0.01g) x I unit Specific gravity meter x 2 units Beaker (2 litter) x 10 nos. Mortar with pestel x 2 nos.

2-4 Project Implementation System

2-4-1 Organization

The executing agency of the Project is Ministry of Communication, Transport, Post and Construction (MCTPC). While, the Implementation Agency of the Project is Department of Communication, Transport, Post and Construction of Savannakhet Province (DCTPC). Savannakhet Water Company: Nam Papa Savannakhet (NPS) has a responsibility for operation and maintenance of the improved facilities.

NPS is an independent water company for water supply of Savannakhet, under administrative control of DCTPC and technical assistance of DHUP (Department of Housing and Urban Planning) and WASA (Water Supply Authority) in headquarters of MCTPC. The Provincial Governor's approval is necessary to revise water tariff. This means that the Government of Savannakhet Province also involves in terms of water supply administration.

Under the control of MCTPC, Vientiane City has an experience to execute the similar project to the present one in the past; and therefore no serious problem is expected to the ability of Lao side for implementation of the Project.

The organizational structures of MCTPC, DCTPC and NPS are presented in Fig 2-2, Fig. 2-3 and Fig. 2-4 respectively.

2-4-2 Budget/Finance

Upon the completion of the Project, NPS will operate and maintain the improved water treatment plant and also install service connections and small size distribution pipelines to absorb water demand increase.

The financial condition records of NPS in the past 10 years are presented in Table 2-26. From these records, it is observed that expenditure is higher than income and financial position is not stable since 1992 except years in 1997 and 1998 even though water tariff has been revised frequently. It is necessary to increase the present water tariff or to rely on subsidies from MCTPC and/or Savannakhet Province for financing necessary budget for operation and maintenance of the water supply system.

For sound management of water supply business, it is necessary to promote qualified management staff including accountant for proper financial operation by analyzing causes of financial deficit and its solution. It is also necessary to improve the system such as water bill collection and routine works. In this connection, it is important to provide staff training on the following matters:

① Intensifying Financial Management (study and analysis for various cost items of water production and appropriate water pricing),
② Acquisition of Skill for Financial Analysis(prepare proper water tariff with its structure),
③ Intensifying Water Bill-collection System, and
④ Improving Efficiency for Routine Works (prepare manuals for standardization of works).

Integrated training for overall operation & maintenance is also necessary. For effective staff training, (1) to dispatch expert for the training, (2) to install computer system, and (3) to arrange training programs in Japan are considered.

In this report financial analysis is attempt and the result is presented in 3-2-2. Appropriate water tariff setting for Savannakhet Water Supply is the base of sound financial operation. It will need time to revise water tariff and modify tariff structure for the approval of the Governor. It is important to examine the financial status time to time, taking an appropriate reserve for depreciation into account, according to the changes of water supply business circumstances.

For the above financial study, it is essential to nominate qualified financial staff by providing manpower resources training as mentioned.

2-4-3 Manpower Resources and Technology Level

Under the control of MCTPC, similar projects had been implemented in the past. Thus no specific problem is expected for the project implementation for Lao Side. However, improvement of technical level for the present staff will be necessary for proper operation and maintenance of facilities after the completion of the Project.

It is considered that the present operation of water treatment plant is not necessarily carried out properly, where flow measurement and water quality analysis are hardly made because of

malfunction of the equipment. After the completion of the Project, establishment of organizational structure will be required for proper operation and maintenance of improved facilities.

The present status of NPS's staff is presented in Table 2-27, with their experience and educational background. At present (October 2000), the age of total 80 staff is ranging from 20 to 57 with average for 36years old. The average years of work experience are at about 15years, which will be sufficient experience for practical operation and maintenance. However, generally speaking, high academic background holding technical certificate is limited in number. It is considered that technical level of staff for proper operation and control of the system is limited.

It is therefore necessary to conduct training technical staff to do more effective operation and management of water supply facilities, after handed over the completed and improved facilities. The stable and safe water supply shall be realized to the citizen of Savannakhet with proper supply pressure and quality. For such purpose, following training program, with supply of tools and equipment for water quality analysis, is necessary and recommended for the respective staff:

① Training for operators of water treatment plant:
Intensify treatment process operation and water quality control, and

② Training for facility maintenance staff:
Intensify organizational structure for proper maintenance of facilities and equipment.

For the above staff training program, a spot-supervising engineer is recommended to be assigned at the time of installation and test run for facilities and equipment. Necessary and practical training are desired to be conducted during installation and the test operation as OJT.

On this training, preparation of appropriate operation manuals for water quality control and plant operation will be effective.

It is important to realize proper control of water quality (chemical dosage control) and stable water supply (production and distribution control) by conducting routine water quality analysis and flow measuring. Operation records on the above shall be kept and maintained. They will be the basis to study and review for sound operation of the plant as well as for future planning on water supply plan. It is also expected by the above record keeping that the operator will realize the necessity and importance of such equipment as flow measuring and water quality analysis for sound plant operation when they are out of order.

To improve the technical level of staff, especially for water quality analysis and plant operation, basic training at the Cinaimo Water Treatment Plant in Vientiane will be effective as well as mentioned staff training.

Fig. 2-2 Organization Chart of MCTPC

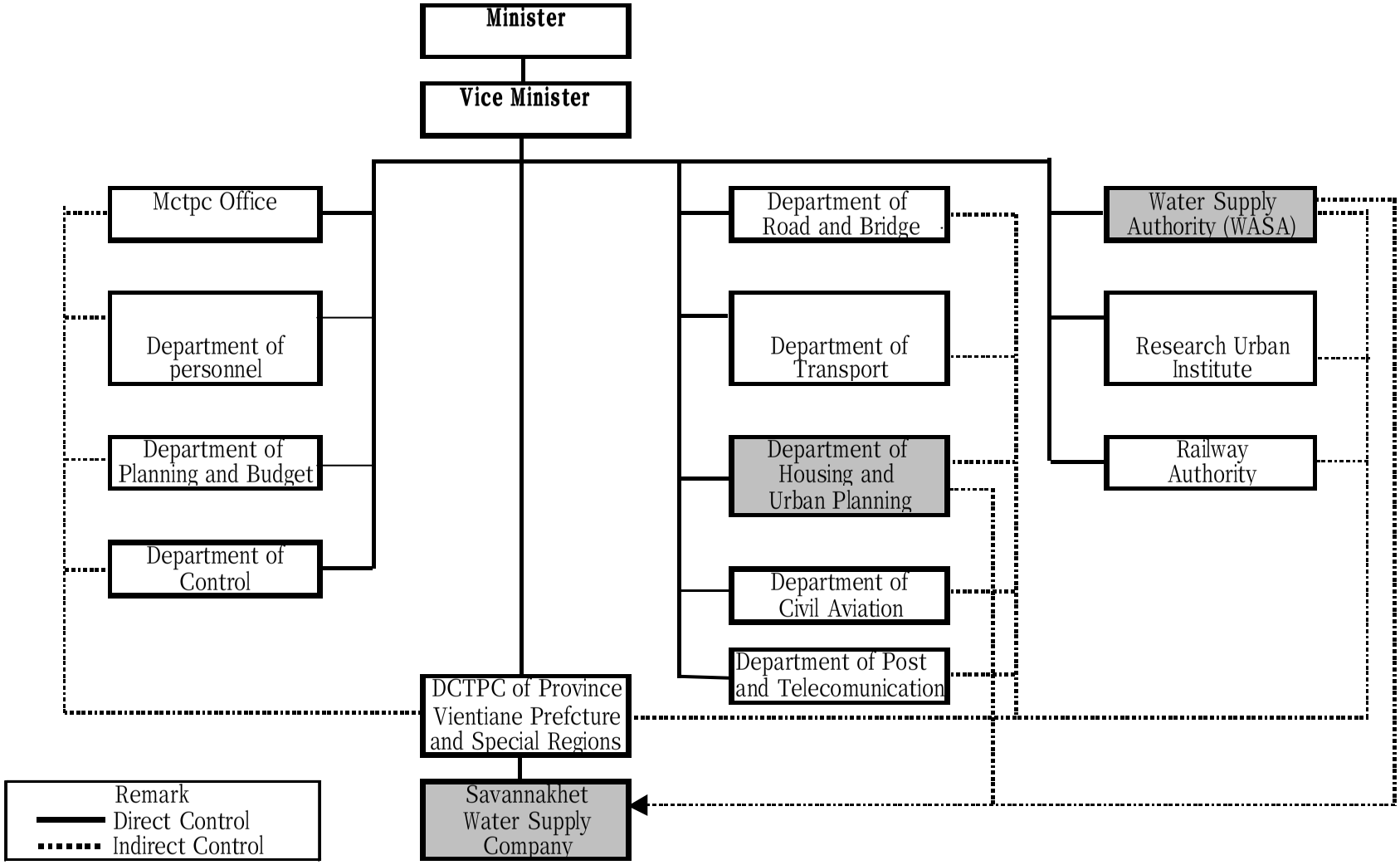


Fig. 2-3 Organization Chart of DCTPC, Savannakhet Province

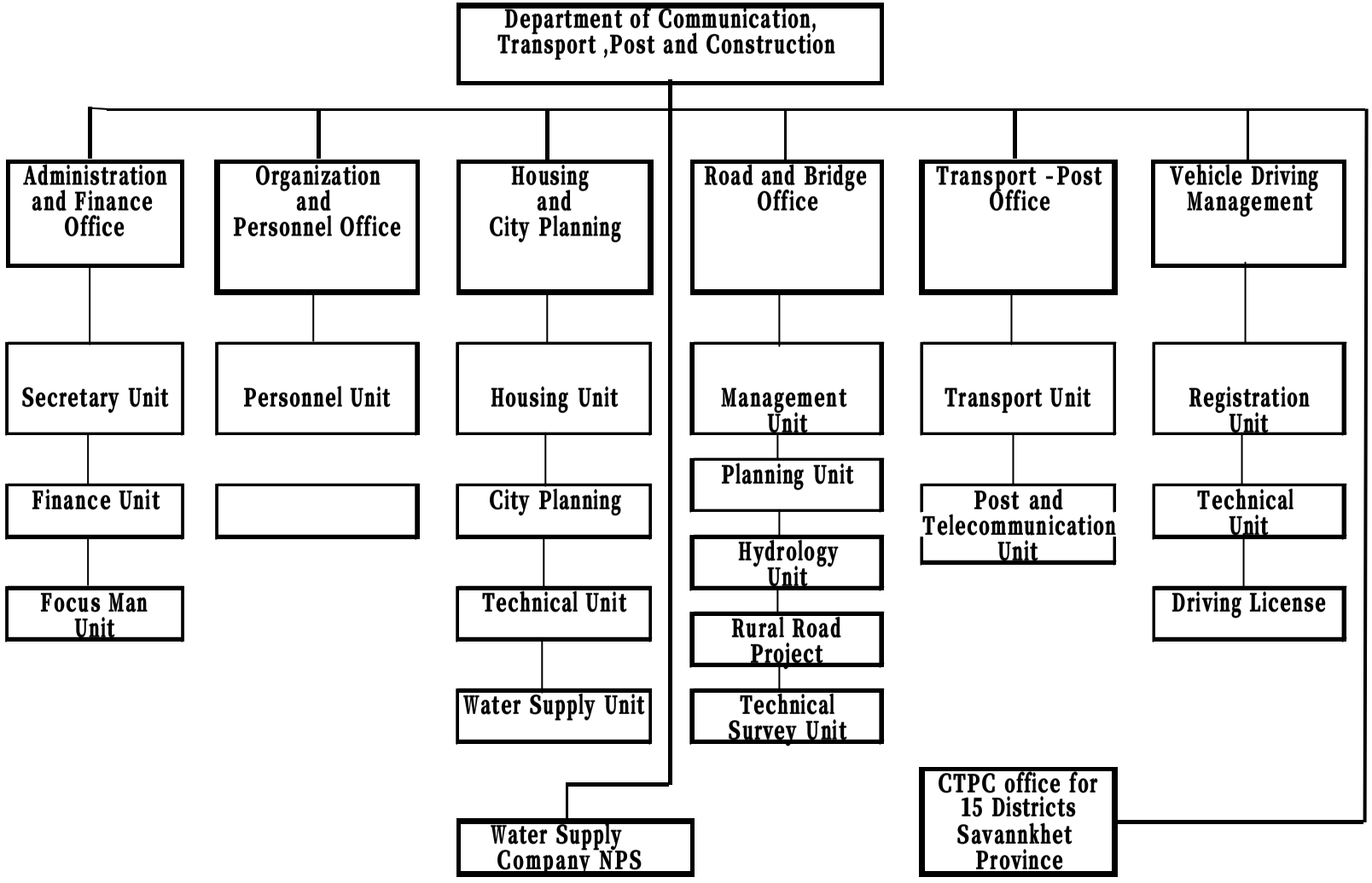
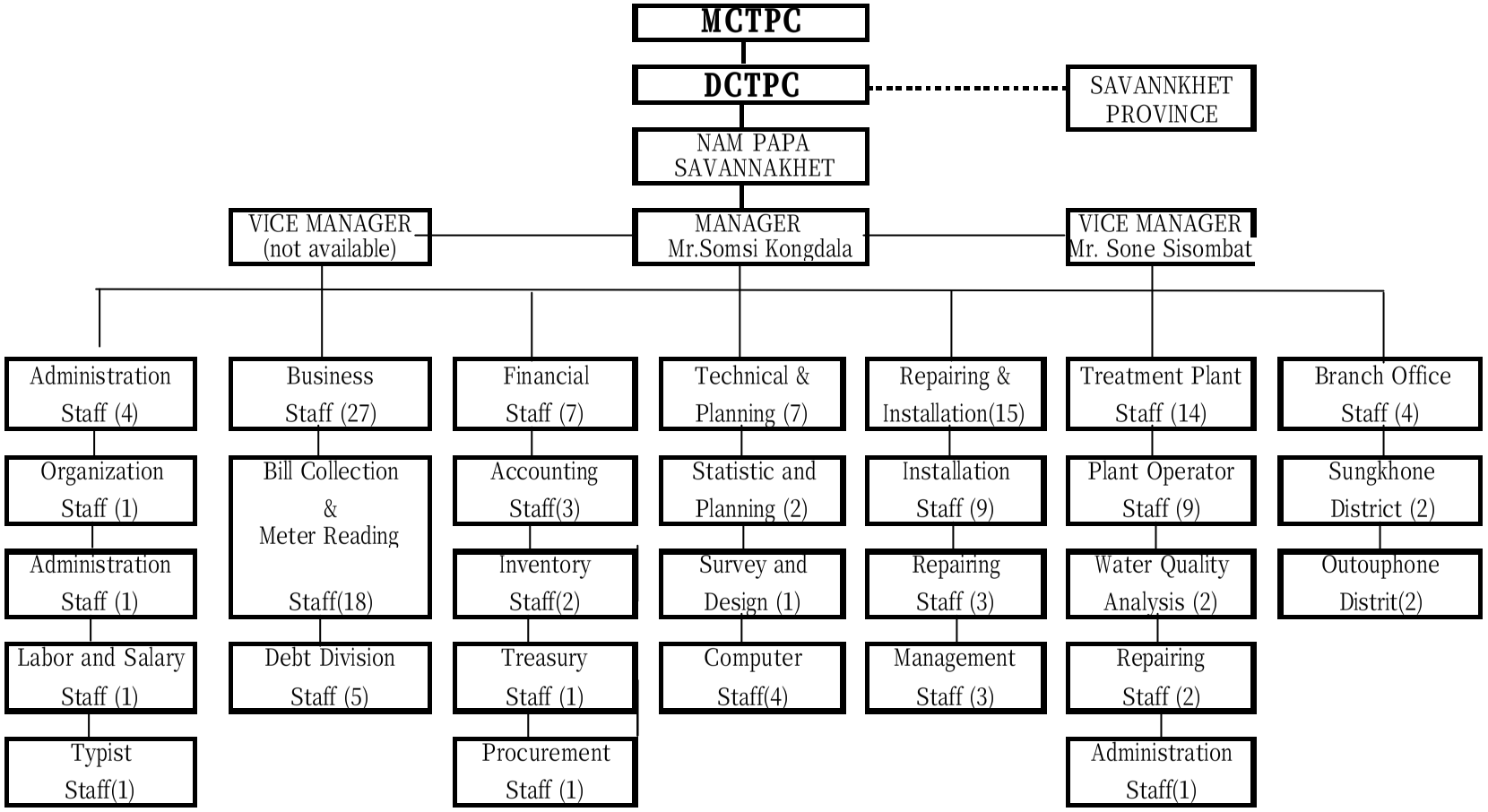


Fig. 2-4 Organization Chart of NPS



MCTPC:Ministry of Communication, Transportation, Post, Construction
DCTPC:Department of Communication, Transportation, Post, Construction

Table-2-26 Financial Record of NPS (1990 – 1999)

ITEM	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
I. .REVENUE										
1.Water Sale										
1.1Governmenti	50,341,025	68,518,615	58,370,060	95,050,470	109,057,090	98,932,720	101,813,040	111,160,760	142,512,860	278,387,310
1.2 Private	49,171,595	60,305,700	64506225	73,466,915	92,658,630	105,295,405	106,753,460	187,398,540	341,458,120	469,720,790
Total for water sale	99,512,620	128,824,315	122,876,285	168,517,385	201,715,720	204,228,125	208,566,500	298,559,300	483,970,980	748,108,100
2.Connection Fee	0	0	0	0	0	0	0	0	96,910	26,845,270
3.Others	26,992,797	30,968,417	19,865,940	14,070,527	16,466,892	17,574,430	13,234,470	32,429,640	32,658,050	209,502,324
Total Revenue	126,505,417	159,792,732	142,742,225	182,587,912	218,182,612	221,802,555	221,800,970	330,988,940	516,725,940	984,455,694
II.. EXPENDITURE										
2.1.Personnel Cost	11,125,884	10,969,865	20,283,262	29,521,255	44,386,510	45,582,878	48,631,129	50,521,187	83,545,442	133,192,750
2.2 Administration Cost	5,254,330	6,717,338	16,165,637	15,172,011	15,486,711	25,871,558	34,119,832	33,646,358	40,208,621	124,036,970
2.3 Depreciation	23,964,067	26,955,104	26,470,457	75,640,598	97,074,821	101,773,130	106,757,820	88,999,200	81,000,000	91,374,702
2.4 Production Cost (Plant)	52,833,320	74,251,363	85,044,598	53,020,860	75,881,521	79,192,482	103,274,747	121,792,881	215,853,210	571,617,595
2.5 Installation and Repairing	0	0	0	0	0	2,981,641	3,716,450	1,452,125	7,521,745	81,846,621
Subtotal	93,177,601	118,893,670	147,963,954	173,354,724	232,829,563	255,401,689	296,499,978	296,411,751	428,129,018	1,002,068,638
2.6 Others	25,620,966	30,252,411	19,171,842	9,890,897	11,454,338	11,953,347	6,854,162	22,126,017	22,107,954	66,987,210
2.7 Tax	3,795,160	6,910,572	7,137,110	9,129,396	10,909,131	14,417,159	10,801,960	10,243,778	15,638,053	51,936,504
Total Expenditure	122,593,727	156,056,653	174,272,906	192,375,017	255,193,032	281,772,195	314,156,100	328,781,546	465,875,025	1,120,992,352
Balance	3,911,690	3,736,079	-31,530,681	-9,787,105	-37,010,420	-59,969,640	-92,355,130	2,207,394	50,850,915	-136,536,658

Table-2-27 Experience and Educational Background of NPS Staff

Section Division	Assignment	No.of Staff	Age in range	Graduation			Experience in Year	Qualification (if available)
				High	Middle	Primary		
1.Management	(1) Manager	1	45		v		24	
	(2) Vice Manager	1	35	v			12	Electrical Engineer
	(3) Vice Manager	0						
		2						
2.Administaration	(1) Organization	1	45		v	v	25	
	(2) Administration	1	37			v	15	Water Supply Engineer
	(3) Labor and Salary	1	38			v	14	
	(4) Typist	1	40		v	v	14	
		4	av(40)				av(17)	
3.Business	(1) Bill Collection				v	v	20,-25	
	and Meter Reading	18	24-44			v		
	(2) Debt Service	9	31-34		v		11,-22	
		27	av(34)				av(13)	
4.Financial	(1) Accounting	3	28-46		v		2,-20	Accountant
	(2) Material/Inventory	2	28-35		v		3,-16	
	(3) Treasury	1	28			v	10	
	(4) Procurement	1	21			v	1	
		7	ac(32)				av(13)	
5.Technical	(1) Section Chief	1	40	v			11,	
	(2)Planning	1	45			v	28	
	(3) Design	1	35		v		9	
	(4) Computer	4	24-36		v		4,10	
		7	av(36)				av(11)	
6.Repairing and Installation	(1) Section Chief	1	40			v	21	
	(2) Installation	9	29-47		v	v	2,-22	
	(3) Repairing	3	20-43		v		11,-22	
	(4) Management	2	37,44		v		10,13	
		15	av(38)				av(15)	
7.Water Treatment Plant	(1) Chief	1	37		v	v	11	
	(2) Plant Operator	8	22-57		v	v	9,-22	
	(3) Water Quality Control	2	33-45		v		2	
	(4) Repairing and Maintenance	2	33,46		v	v	1,-22	
	(5) Administration	1	33		v	v	14	
		14	av(39)				av(14)	
8. Branch Office	(1) Outuphone Distric	2	25,46		v	v	2,21	
	(2) Songkone District	2	35,41			v	1,22	
		4	av(37)				ac(12)	
			Average				Average	
	Total Employee	80	37				14.6	