KINGDOM OF CAMBODIA
PHNOM PENH WATER SUPPLY AUTHORITY (PPWSA)

PREPARATORY SURVEY
ON
THE PROJECT FOR
EXPANSION OF THE WATER SUPPLY SYSTEM
IN TA KHMAU

FINAL REPORT

MARCH 2020

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIHON SUIDO CONSULTANTS CO., LTD.
CROWN AGENTS JAPAN LTD.

Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Consortium consist of Nihon Suido Consultants Co., Ltd. and Crown Agents Japan Ltd.

The survey team held a series of discussions with the officials concerned of the Royal Government of Cambodia, and conducted field investigations. As a result of further studies in Japan, 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.

Finally, I wish to express my sincere appreciation to the officials concerned of the Royal Government of Cambodia for their close cooperation extended to the survey team.

March, 2020

MUTOU MEGUMI
Director General,
Global Environment Department
Japan International Cooperation Agency

Summary

1 Overview of the Kingdom of Cambodia

The total landmass of the Kingdom of Cambodia (hereinafter referred to as Cambodia) is approximately 181,000 km^2 (a little less than half of Japan's total area). The Mekong River traverses the country from north to south, crossing the boundary with Lao PDR in the north. Tonle Sap Lake and a number of river systems are the dominant features forming the Central Plains which cover three quarters of the country. The Tonle Sap River runs off Tonle Sap Lake and joins with the Mekong River at the capital, Phnom Penh. To the north and northeast, near the boundaries with Viet Nam and Lao PDR, are mountain ranges with dense virgin forests and diverse wildlife. According to the International Monetary Fund (IMF[1]), Cambodia has an estimated population of 16,500,000.

Cambodia, lying entirely within the tropics, has a hot and humid climate, which is divided into wet (June to October) and dry (November to May) seasons. Severe heat occurs in the second half of the dry season (December to April) and the day time temperature can rise to 35 to 40°C. The annual average precipitation is 1,559 mm^2.

In 2018, according to the World Bank National Accounting Data (WB), Cambodia's Gross Domestic Product (GDP) per capita was 1,510 USD. This is relatively low in comparison to other countries in the region. Cambodia is still classified as one of the Least Developed Countries, with 23% of the labor force engaged in the primary sector of the economy, 31% and 40% in the secondary and tertiary sectors respectively, according to Japan International Cooperation Agency (JICA), in March 2019. During the past ten years, Cambodia has enjoyed increased political stability and more territorial unity than in previous decades. The country has experienced significant economic growth, the average annual growth in GDP over the four consecutive years from 2004 to 2007 has exceeded 10%. However, economic growth stalled in 2008 as a result of the worldwide financial crisis, falling to 0.1% in 2009, but recovering to 6.0% in 2010. The integration with the regional and global economies since accession to the Association of Southeast Asian Nations (ASEAN) in 1999 and the World Trade Organization (WTO) in 2004 has continued to strengthen the country's economy.

Although the population living below the poverty line has fallen from more than 50% in 2004 to around 20%[3] in 2011, a high percentage of the population of Cambodia remains in poverty. Poverty reduction continues to be an important priority in Cambodia. It is understood that comprehensive growth based on diversified industrial activities and productivity improvement is central to the promotion of income opportunities for the poor.

2 Background of the Project

Development of water supply in the country started in the mid-1990s, mainly in Phnom Penh Capital City. JICA conducted the Study on Phnom Penh Water Supply System in 1993. With the support of the Government of Japan (hereinafter referred to as "GOJ") and other donors, water supply capacity in Phnom Penh has improved with the construction and rehabilitation of facilities

[1] IMF April, 2019
[2] Department of Meteorology of Ministry of Water Resources and Meteorology
[3] The World Bank (April 2014) "Cambodia Poverty Assessment 2013"

and capacity building for operation and maintenance. Phnom Penh has a service ratio of over 90 % for 24-hour water supply. Water supply is still inadequate in the surrounding areas because production capacity is not keeping up with the rapid increase in domestic and commercial demand. The expansion of water supply facilities is urgently needed.

Ta Khmau city is part of Kandal province and located south of Phnom Penh city. Public water had been supplied mainly from the Bassac river and wells within Ta Khmau city. At present, water is supplied directly through distribution pipes connected to the Phnom Penh system, which is operated by the Phnom Penh Water Supply Authority (hereinafter referred to as "PPWSA"). PPWSA was instructed to supply water to Ta Khmau in 2004 by the Royal Government of Cambodia (hereinafter referred to as RGC) due to the growing population and water quality problems (e.g. arsenic has been detected in multiple wells). There are many low-income households, and PPWSA takes measures to provide free connections and lower water tariffs.

In order to meet water demand of Ta Khmau city, it is necessary to develop a new water treatment plant (hereinafter referred to as "WTP"). However, construction of a new WTP could lead to excessive financial burden on PPWSA. So, the possibility of developing water treatment facilities by application of grant aid cooperation (grant aid with right of operation and management, hereinafter referred to as "Grant with O&M") that also satisfies infrastructure export policies is currently being studied. The objective is to reduce initial investment costs and utilize knowledge, experience and know-how of Japanese companies through operation, maintenance and management of water treatment plant with consideration of the requests from the Government of Cambodia.

In addition, according to the "Phnom Penh Water Supply Authority Master Plan - Period 2016-2030" (hereinafter referred to as "Third Master Plan 2016-2030"), the population in Phnom Penh has also increased rapidly, and capacity of the existing water treatment plants may be insufficient to meet demand by 2020. A study of the expansion of existing water treatment plant capacities in Phnom Penh city by using loan schemes has started.

3 Results of the Preparatory Survey and Scope of Project

(1) Results of the Preparatory Survey

JICA dispatched five preparatory survey teams to Cambodia in 2019, on the dates shown below.

First Survey in Cambodia:	March 17 to April 10, 2019
Second Survey in Cambodia:	June 18 to July 02, 2019
Third Survey in Cambodia:	Aug 25 to Aug 31, 2019
Fourth Survey in Cambodia:	October 15 to October 23, 2019
Fifth Survey in Cambodia:	November 17 to November 23, 2019

The objectives of the Survey are to carry out outline design of comparator facilities (assumed facilities), to formulate a business plan, and to estimate the gross project cost as a Project for Grant - SPC Scheme based on the above requirements, after considering the relevance of the project content and scale.

(2) Scope of the Project

1) Construction of Water Supply Facilities

Components of the Project for Expansion of Water Supply System in Ta Khmau are shown as follows.

Facility	Intake and Raw Water Transmission Facilities	− Intake Capacity : 31,500 m^3/day − Raw Water Intake Tower − Raw Water Transmission Facility
	Water Treatment Facility	− Water Treatment Capacity : 30,000 m^3/day − Water Treatment Facility
	Distribution Facilities	− Clear Water/Service Reservoir − Distribution Equipment − Bulk Meter (Count: 1)
	SCADA	− Central Supervisory System in the WTP
Consulting Service		− Tender Assistance − Design Confirmation − Various Management Activities During Construction Phase

3 Project Implementation Schedule and Project Cost Estimate

(1) Project Implementation Schedule

An implementation plan was formulated as a multi-year project due to the relationship between construction contents and construction period. Bidding will be done in the first year, and construction (design, procurement, construction, O&M preparation) will be carried out from the following year. The construction period is 12.5 months for bidding and 33 months for design, procurement, and construction.

(2) Project Cost Estimate

The total project cost borne by the Cambodian side will be approximately 17 million yen. The Cambodian side is responsible for land preparation for WTP construction, electrical Work, unexploded or mine survey, environmental and social considerations and bank arrangement.

4 Project Evaluation

4-1 Adequacy of the Project

(1) Project Beneficiaries

This project will improve the water supply capacity to Ta Khmau City and increase the beneficiary population of Ta Khmau City. In addition to the construction of a new WTP, the current water supply service will be improved, which will not only benefit the increasing population served but also improve the water supply service to the residents who are currently receiving water. The amount of water currently being distributed from Phnom Penh to Ta Khmau City will be able to be distributed to Phnom Penh after the construction of the WTP, which will improve the water supply service in Phnom Penh.

(2) Urgency of Project Implementation

The existing PPWSA water supply system is capable providing water service to only 60% of the water demand in Ta Khmau City in 2030. Therefore, the expansion of water supply facilities in Ta Khmau City is an urgent matter.

(3) Consistency between the Project and Cambodia Planning

The National Strategic Development Plan (NSDP) sets the water service target of 100% in urban areas by 2025. This project will help PPWSA achieves this water service ratio.

(4) Compliance with Japan's Assistance Policy for Cambodia

Japan's assistance policy for Cambodia is to support the recipient country in achieving their development goals. "Promotion of Social Development" is one of the priority pillars of this policy. Development of the water supply systems promote social development and is therefore consistent with the policy for Japanese assistance in Cambodia.

4-2 Effectiveness

The project is expected to provide the following beneficial outcomes:

(1) Quantitative Effects

The expansion of water supply facilities in Ta Khmau city will result in improvements to the following indicators listed.

No.	Indicator	Baseline Data (Year 2015)	Target (Year 2027) （3 years after completion of the new facilities）
1	Water Supply Capacity (daily average basis)	11,440 m^3/day	30,000 m^3/day

(2) Qualitative Effects

Qualitative Effects are as follows;

- Maintaining appropriate residual water pressure and increasing water supply capacity will improve water supply services.
- Promotion of house connections to poor households will improve the access to safe water supply to poor households.
- Maintaining special water tariff rates applied to poor households.
- Improving of operation and maintenance capacity through technology transfer for operation and maintenance of WTPs.
- Improving public health. More people will have access to safe water supply and water shortage will be eliminated.

In conclusion, the project will be effective in meeting its goals.

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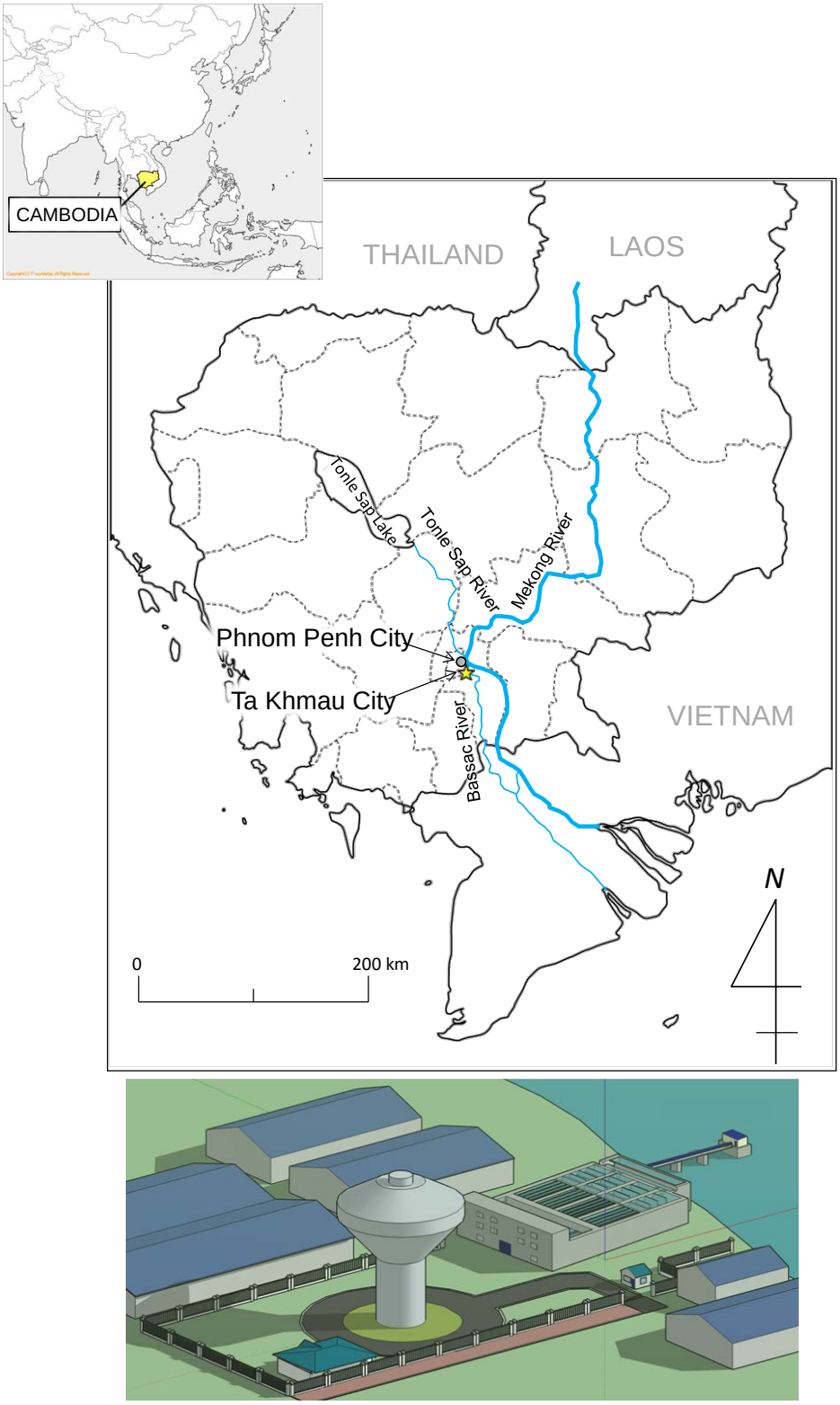

Location Map / Perspective

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Abbreviations

ADB	Asian Development Bank
AfD	Agence Française de Développement (French Development Agency)
ASEAN	Association of Southeast Asian Nations
CAPEX	Capital Expenditure
CDC	The Council for Development of Cambodia
CMAC	Cambodian Mines Action Centre
CNDWQS	Cambodian National Drinking Water Quality Standard
CNMC	Cambodia National Mekong Committee
CPI	Consumer Price Index
DD	Detail Design
GDP	Gross Domestic Product
GOJ	Government of Japan
DBO	Design, Build and Operate
DSCR	Debt Service Coverage Ratio
EDC	Electricité du Cambodge
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
GDT	General Department of Taxation
HDPE	High Density Polyethylene
HWL	High Water Level
IEE	Initial Environmental Examination
IEIA	Initial Environmental Impact Assessment
ILO	International Labour Organization
IMF	International Monetary Fund
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standard
JV	Joint Venture
LCC	Life Cycle Cost
LWL	Low Water Level
M/D	Minute of Discussion
MEF	Ministry of Economy and Finance
MIH	Ministry of Industry & Handicraft
MoE	Ministry of Environment
MoWRAM	Ministry of Water Resources and Meteorology
MSL	Mean Sea Level
NRW	Non-Revenue Water
NSDP	National Strategic Development Plan
NSSF	National Social Security Fund
NGO	Non Governmental Organizations
O&M	Operation and Maintenance
ODA	Official Development Assistance
OPEX	Operating Expense
OSH	Occupational Safety and Health
PaAs	Protected Areas
PAC	Polyelectrolyte Aluminium Chloride
P/Q	Pre-Qualification Exercise
PPP	Public–Private Partnership
PPWSA	Phnom Penh Water Supply Authority
QCBS	Quality and Cost Based Selection
QIP	Qualified Investment Project
RGC	Royal Government of Cambodia
SCADA	Supervisory Control And Data Acquisition
SEA	Strategic Environmental Assessment
SOP	Standard Operating Procedures
SPC	Special Purpose Company

TOR	Terms of Reference
UXO	Unexploded Ordnance
VAT	Value Added Tax
WB	World Bank
WTO	World Trade Organization
WTP	Water Treatment Plant

Chapter 1 Background of the Project

1-1 Project Background

Development of water supply in the country started in the mid-1990s, mainly in the capital city of Phnom Penh. JICA conducted the Study on Phnom Penh Water Supply System in 1993. With the support of the Government of Japan (hereinafter referred to as "GOJ") and other donors, water supply capacity in Phnom Penh has improved with the construction and rehabilitation of facilities and capacity building for operation and maintenance. Now, Phnom Penh has a service ratio of over 90 % for 24-hour water supply. Water supply is still inadequate in the surrounding areas because production capacity is not keeping up with the rapid increase in domestic and commercial demand. The expansion of water supply facilities is urgently needed.

Ta Khmau city is part of Kandal province and located south of Phnom Penh city. Public water had been supplied mainly from the Bassac River and wells within Ta Khmau city. At present, water is supplied directly through distribution pipes connected to the Phnom Penh system, which is operated by the Phnom Penh Water Supply Authority (hereinafter referred to as "PPWSA"). PPWSA was instructed to supply water to Ta Khmau in 2004 by the Royal Government of Cambodia (hereinafter referred to as RGC) due to the growing population and water quality problems (e.g. arsenic has been detected in multiple wells). There are many low-income households in the area, and PPWSA takes measures to provide free connections and lower water tariffs.

In order to meet water demand of Ta Khmau city, it is necessary to develop a new water treatment plant (hereinafter referred to as "WTP"). However, construction of a new WTP could lead to excessive financial burden on PPWSA. So, the possibility of developing water treatment facilities by application of grant aid cooperation (grant aid with right of operation and management, hereinafter referred to as "Project for Grant with O&M - SPC Scheme") that also satisfies infrastructure export policies is currently being studied. The objective is to reduce initial investment costs and utilize knowledge, experience and know-how of Japanese companies through operation, maintenance and management of water treatment plant with consideration of the requests from the Government of Cambodia.

In addition, according to the "Phnom Penh Water Supply Authority Third Master Plan - Period 2016-2030" (hereinafter referred to as "Third Master Plan 2016-2030"), the population in Phnom Penh has also increased rapidly, and capacity of the existing water treatment plants may be insufficient to meet demand by 2020. A study of the expansion of existing water treatment plant capacities in Phnom Penh city by using loan schemes has started.

1-2 Natural Conditions

Topographical survey, soil investigation, water quality survey and underground utility survey described below were carried out to determine the design conditions for the proposed project sites. The existing environmental conditions for the project sites are described in section "**1.3 Environmental and Social Considerations**".

1-2-1 Topographic Survey

The topographic surveys were conducted at the planned intake and water treatment facility construction site. The planned site for the water treatment plant was a flat site with GL + 12m. According to the cross-section survey of the revetment of the Bassac River, the revetment at the planned intake site had a relatively gentle slope.

1-2-2 Soil Investigation

The ground and soil investigation were conducted at the planned intake and water treatment facility construction site. It was confirmed that viscous soil with N value of 10 is deposited around 20m, viscous soil with N value of 30 is deposited around 30 m and viscous soil with N value of 50 or more is deposited around 45 to 50 m from the present ground elevation. The main structure shall be pile foundation based on soil test results.

1-2-3 Water Quality Survey

Water quality survey for water source was conducted. Results of the water quality survey are shown in **Table 1-2.1**.

Table 1-2.1 Results of the Water Quality Survey

No.	Item	Unit	No.1	No. 2	No. 3	No. 4	No. 5	No. 6	CNDWQS
	Sampling Date		Mar. 29	Apr. 29	May 29	Jul. 3	Aug. 21	Sep. 11	
1	pH	°C	7.64	7.30	6.75	7.90	7.65	7.07	6.5-8.5
2	Water Temp.	-	32.0	33.0	31.0	28.5	31.8	25.3	No value
3	Turbidity	NTU	18	6	48	12	142	300	<5.0
4	Colour	TCU	65	55	110	75	40	35	<5.0
5	Total Hardness	mg/L	110	130	170	124	95	140	<300
6	Total Alkalinity	mg/L	61	95	119	84	80	23	No value
7	COD_{Mn}	mg/L	5.88	3.33	5.00	0.86	2.54	5.88	<8.0[4)]
8	CN^-	mg/L	0.007	0.006	0.004	0.003	0.003	0.003	<0.02
9	NH_4-N	mg/L	0.017	1.09	3.35	0.44	0.08	0.19	1.5
10	Odor	-	No smell	No smell	No smell	No smell	No smell	No smell	Acceptable
11	F^-	mg/L	0.79	1.04	0.01	0.002	0.012	0.001	<1.5
12	NO_2-N	mg/L	0.03	0.09	0.14	0.10	0.01	0.02	<0.92
13	NO_3-N	mg/L	5.00	3.70	1.40	0.40	1.70	1.20	<11.3
14	SO_4^{2-}	mg/L	4.16	23	26	19	20	2.0	<250
15	Cl^-	mg/L	32.1	17.9	16.9	18.2	7.9	9.0	<250
16	Hg	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001
17	Cr	mg/L	0.002	0.007	0.001	<0.0005	<0.0005	<0.0005	<0.05

No.	Item	Unit	No.1	No. 2	No. 3	No. 4	No. 5	No. 6	CNDWQS
18	Al	mg/L	<0.00003	<0.00003	0.002	<0.00003	0.035	0.035	<0.2
19	Cd	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.003
20	Cu	mg/L	0.004	<0.003	<0.003	<0.003	<0.003	<0.003	<1
21	Fe	mg/L	0.66	0.08	0.14	<0.013	<0.013	0.20	<0.3
22	Pb	mg/L	<0.0002	<0.0002	<0.0002	0.0010	<0.0002	<0.0002	<0.01
23	Mn	mg/L	0.138	0.019	0.046	<0.0003	<0.0003	0.0244	<0.1
24	Zn	mg/L	0.005	<0.001	0.007	<0.001	0.001	<0.001	<3
25	Total Coliforms	MPN/ 100ml	1.5×10^2	7.5×10^2	2.1×10^3	2.1×10^3	2×10^2	4.3×10^2	0
26	Geosmin	mg/L	0.000010	-	-	<0.000001	<0.000001	-	<0.00001[3)]
27	2-MIB[1)]	mg/L	0.000014	-	-	0.000002	0.000001	-	<0.00001[3)]
28	THMFP[2)]	mg/L	0.10	-	-	0.04	0.06	-	<0.1[3)]
29	Phenols	mg/L	<0.0005	-	-	0.0014	<0.0005	-	<0.005[3)]

CNDWQS: Cambodian National Drinking Water Quality Standard.
1) 2-MIB: 2-Methyl-Isoborneol
2) THMFP: Trihalomethane Formation Potential.
3) Japan Drinking Water Quality Standard.
4) Value of Cambodian water quality standard in public water areas.

The following items exceed drinking water quality standard, but can be removed by water treatment.

- Turbidity: Relatively low for raw river water.
- Color: High value; however it can be removed by oxidation, flocculation and filtration.
- Iron (Fe): High value; however it can be removed by oxidation, flocculation and filtration.
- NH_4-N: High value in the sample of May 29, 2019; however it can be removed by oxidation and flocculation

1-2-4 Underground Utility Survey

Underground utility survey was conducted. The survey location is shown in **Figure 1-2.1**.

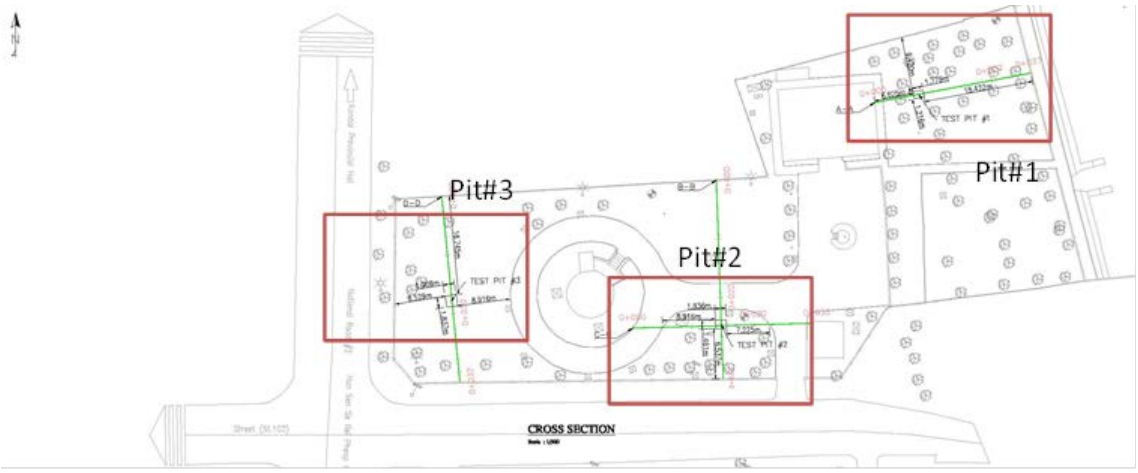


Figure 1-2.1 Underground Utility Survey Location Map

Results of the underground utility survey are shown in **Table 1-2.2** and **Figure 1-2.2**.

Table 1-2.2 Results of the Underground Utility Survey

	Target	Result
Pit#1	Existing pile structure	No foundation pile confirmed
Pit#2	Existing pile structure	Confirmation of 400mm diameter foundation pile remaining at test drilling depth of 3.3m
Pit#3	Existing pipe	Confirmation of existing pipe HDPE DN400 at test drilling depth of about 2.2m

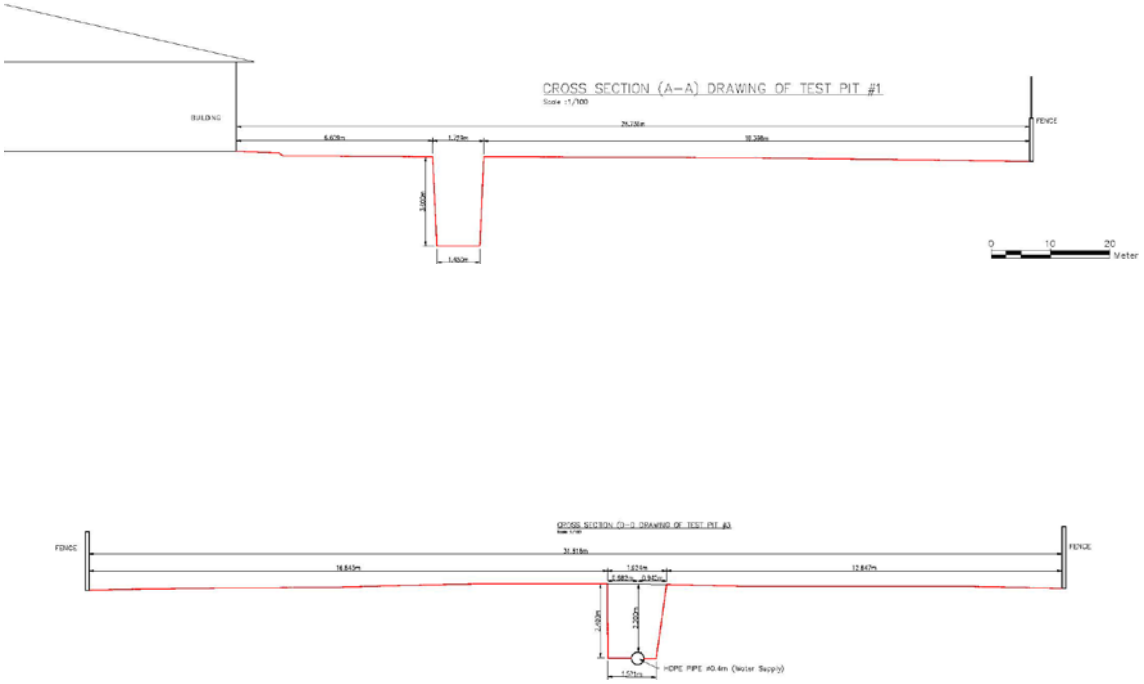


Figure 1-2.2 Results of the Underground Utility Survey

From the results of the underground utility survey, it was confirmed that the structure was left behind at Pit # 2 when the existing WTP was renovated.

1-3 Environmental and Social Considerations

1-3-1 Evaluation of Environmental and Social Considerations

The Project is classified as Category B under the JICA Guidelines for Environmental and Social Considerations (April 2010) considering the Project characteristics and site conditions (WTP located within the existing facility site owned by PPWSA and without Protected Areas in surrounding areas).

According to the Sub-decree on EIA Process (1999) of Cambodia, an initial environmental impact assessment (hereinafter referred to as "IEIA") or an environmental impact assessment (hereinafter referred to as "EIA") is required if there are more than 10,000 users for a water supply project. Therefore, an IEIA/EIA will be necessary because the expected served population of the Project will be about 120,000 people in the future. By reviewing the components of the Project, Ministry of Environment (MoE) informed that only an IEIA report is needed to be submitted.

The IEIA study was conducted by PPWSA with the support of JICA Survey Team and registered local consultants (SUSTINAT Green Co., Ltd.). The IEIA report was submitted to MoE in August 2019 and have been revised. It is expected that the IEIA report will be approved by MoE by February 2020.

1-3-2 Outline of Project Components that have Environmental and Social Impacts

(1) Project Title

The Project title is "Project for Expansion of Water Supply System in Ta Khmau in the Kingdom of Cambodia".

(2) Project Location

As shown in **Figure 1-3.1**, Ta Khmau WTP is located within an existing facility site owned by PPWSA, about 10 km south of Phnom Penh, on the right bank of Bassac River.

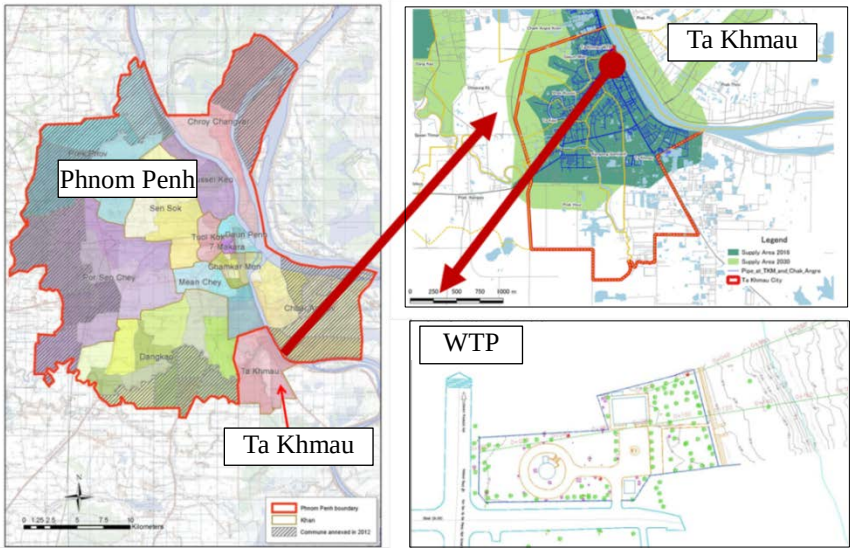


Figure 1-3.1 Project Location

(3) Outline of the Project Components

The objective of the project is to construct a new water treatment plant by applying the JICA "Project for Grant Aid with O&M - SPC Scheme". The outline of the Project is summarized in **Table 2-1.1**.

1-3-3 Existing Environmental Conditions

1-3-3-1 Meteorological phenomenon

Phnom Penh has a tropical wet and dry climate. The climate is hot year-round with only minor variations. Temperature typically ranges from 22 to 35 °C, humidity ranges from 70 to 80%, and weather is subject to the tropical monsoons as shown in **Figure 1-3.2**.

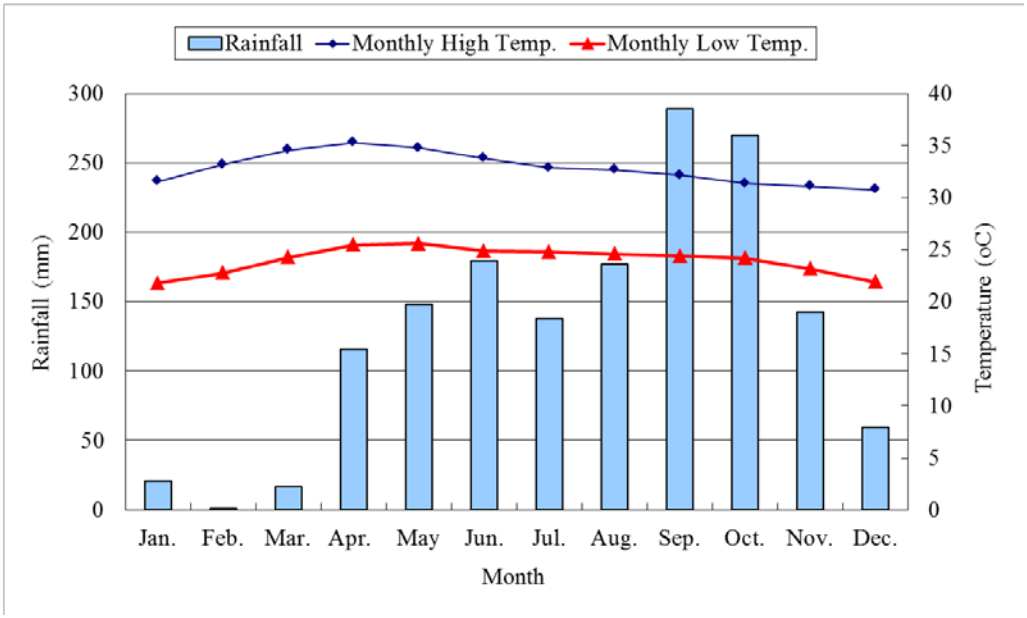


Figure 1-3.2 Monthly High and Low Temperature and Rainfall

Temperature (1988–2013), Rainfall (2014-2018)
Source: Department of Meteorology of Ministry of Water Resources and Meteorology

1-3-3-2 Topographical Features and Land Use

Phnom Penh is in the south-central region of Cambodia, and is fully surrounded by Kandal Province. Phnom Penh and the surrounding areas consist of a typical flood plain area with an elevation of 12 m. Four major water courses meet at a point called the Chattomukh (Four Faces) in Phnom Penh. The Mekong River flows in from the northeast and the Tonle Sap River, emanating from the Tonle Sap Lake, flows in from the northwest. They divide into two parallel channels, the Mekong River proper and the Bassac River. Land use plan is shown in **Figure 1-3.3**.

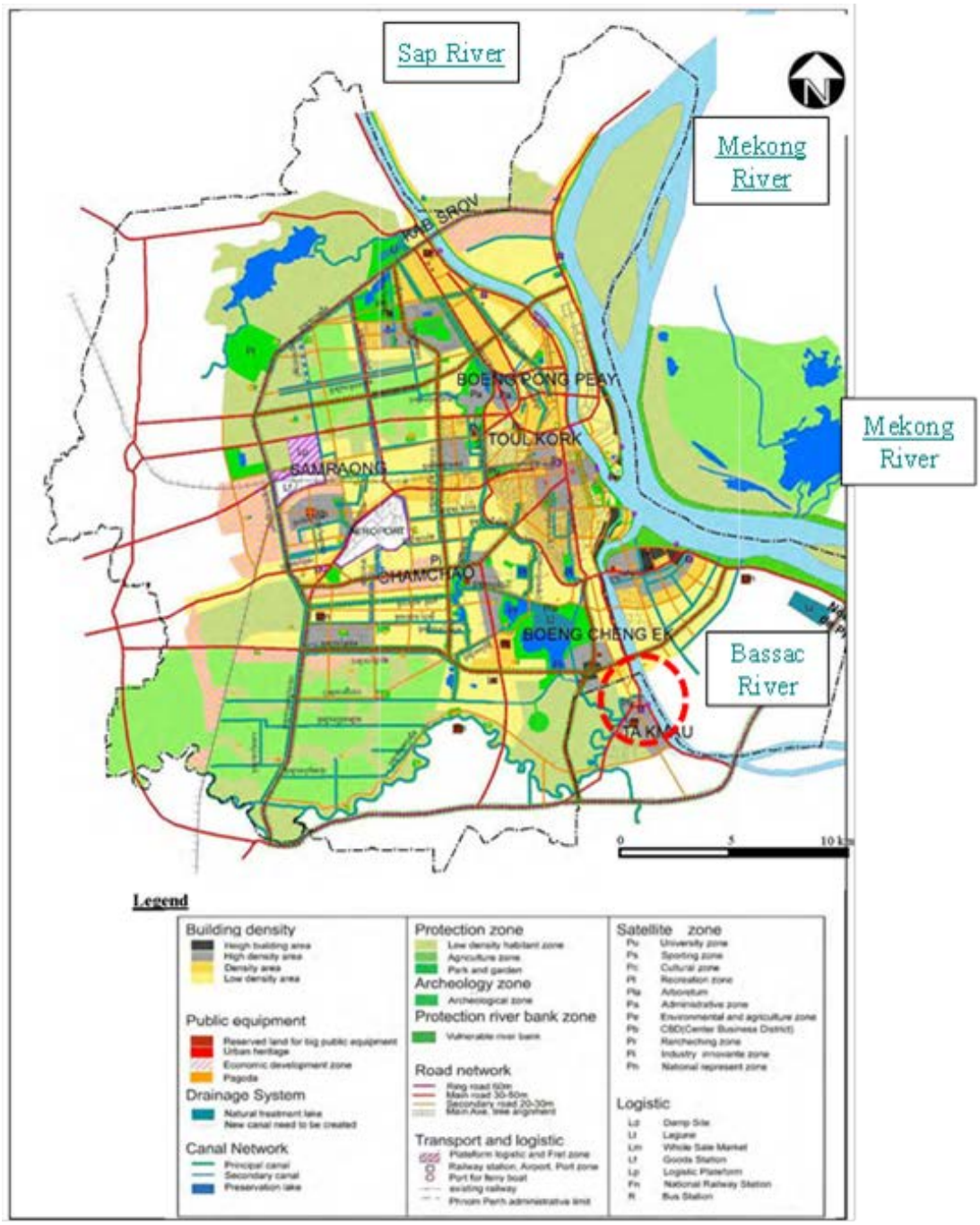


Figure 1-3.3 Land Use Plan of Phnom Penh in 2035

Source: White Book on Development and Planning of Phnom Penh, PPCC

Ta Khmau City, located south of Phnom Penh, is the capital and largest city of Kandal Province. Approximately 60% of the citizens of Ta Khmau travel to work in Phnom Penh.

1-3-3-3 Water environment

(1) Water quality

Water quality in the Sap, Mekong and Bassac rivers are described in **Table 1-3.1**. Water quality in the Sap and Bassac rivers is poor compared to that of the Mekong River. The main issue is considered to be high concentration of ammonia nitrogen and organic matter from sewage discharge.

Table 1-3.1 Water Quality of Sap, Mekong and Bassac Rivers

Parameter		Unit	Sap River[a)]	Mekong River[b)]	Bassac River[c)]	Cambodia Drinking Water Standard
Physical	1. Temperature	^{0}C	23.8 - 32.8[1)] 28.8[2)]	22.4 - 32.6 28.7	25.0 - 31.5 28.5	-
	2. pH	-	6.6 - 8.4 7.2	6.8 - 8.6 7.8	7.0 - 8.3 7.7	6.5-8.5
	3. Turbidity	NTU	8 - 1,000 111	9 - 913 113	7 - 972 105	5
	4. DO	mg/L	0.7 - 8.1 5.3	4.0 - 9.4 6.8	6.1 - 8.4 7.5	- (>5[3)])
	5. Color	TCU	5.3 - 80 25	0 - 132 26	5.3 - 80 25	5
Mineral	6. Conductivity	μs/cm	61 - 233 106	60 - 226 148	76 - 281 165	-
	7. Total hardness	mg/L	16 - 88 40	24 - 96 60	32 - 118 68	300
Chemical	8. Organic matter	mg/L	4 - 42 18	0.8 - 57 10	7.1 - 22 13	-
	9. Ammonia nitrogen	mg/L	0 - 1.63 0.37	0 - 0.48 0.13	0.10 - 1.81 0.59	1.5
	10. Iron	mg/L	0 - 6.4 0.6	0 - 3.4 0.26	0.09 - 1.95 0.67	0.3
	11. Manganese	mg/L	0 - 0.12 0.03	0 - 0.2 0.02	0.02 - 0.06 0.03	0.1
Biological	12. E. Coli	cfu/100mL	0 - $3*10^3$ $7*10^2$	0 - $3*10^4$ $7*10^2$	0 - $3*10^3$ $7*10^2$	0

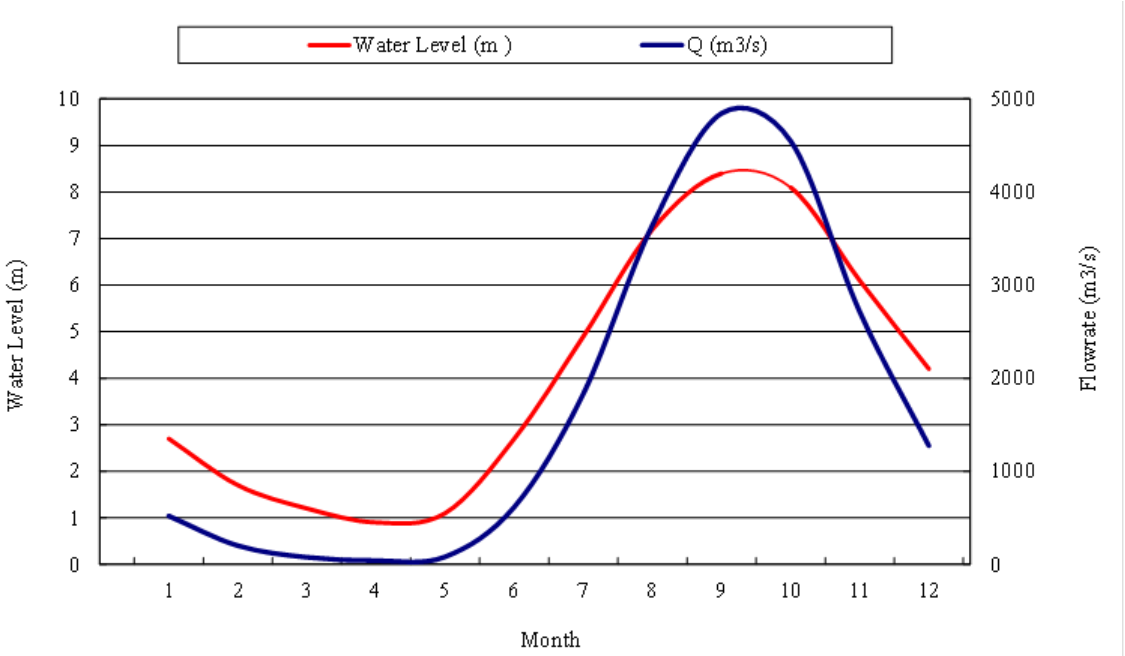
Note: 1) Minimum and maximum values
2) Average values.
3) Japanese environmental standards for rivers (Class B, the lowest level of the water source for water supply)

Source: a) Third Master Plan 2016-2030 (Raw water quality of Phum Prek WTP)
b) Third Master Plan 2016-2030 (Raw water quality of Chroy Chanvar WTP)
c) JICA Survey Team based on the information provided by PPWSA (Raw water quality of Chamcar Mon WTP, 2016)

(2) Flowrate and Water Level of Raw Water Source

Figure 1-3.4 presents the fluctuation of average flowrate and water level in Bassac River for the period 1960-2014. Minimum monthly flowrate of Bassac River was 40 m^3/s. Intake volume for the Project is 33,000 m^3/d or 0.38 m^3/s, which represents only 0.95% of the minimum monthly flowrate of Bassac River.

In addition, according to data from the Ministry of Water Resources and Meteorology of the last 5 years (2014 – 2018), the lowest flowrate of the Bassac river was 17 m^3/s (water level 1.59m), which occurred in April. The maximum flowrate was 5,229 m^3/s (water level 9.95m), which occurred in September.



Monthly Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Q (m^3/s)	520	200	76	40	81	616	1,833	3,647	4,847	4,549	2,713	1,274	1,700
Water Level (m)	2.7	1.7	1.2	0.9	1.1	2.7	4.9	7.2	8.4	8.1	6.1	4.2	4.1

Figure 1-3.4 Fluctuation of Flowrate and Water Level in Bassac River (1960-2014)

Source: Rehabilitation and Extension of Chamcar Mon WTP, SAFEGE, January 2016

(3) Protected Areas

As of 2017, the Ministry of Environment (hereinafter referred to as "MoE") has designated 50 Protected Areas (hereinafter referred to as "PaAs") which cover more than 7.5 million hectares, equivalent to 41 % of the country's total land area. These Protected Areas do not exist near Phnom Penh. The Protected areas in relation to the Project site are shown in **Figure 1-3.5**.

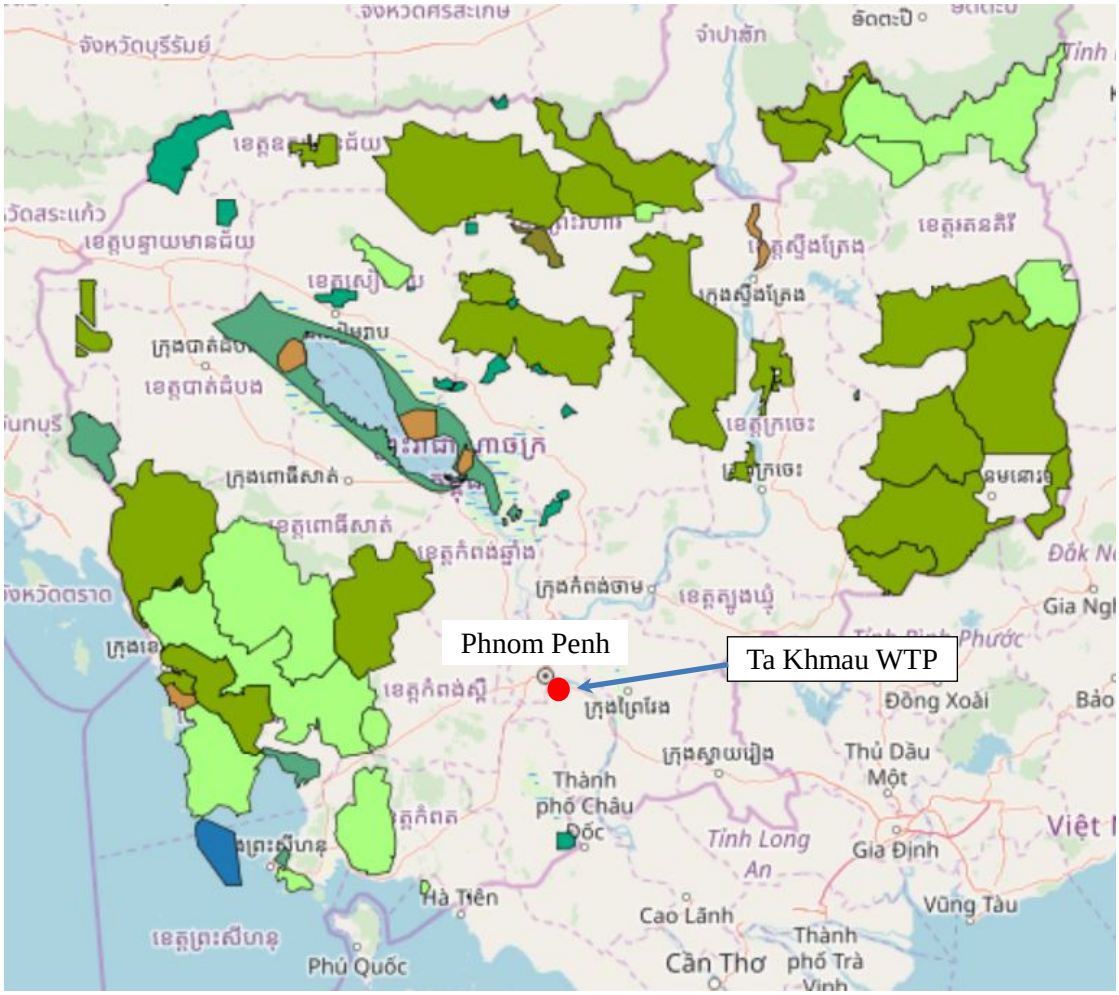


Figure 1-3.5 Location Map of Protected Areas around Project Area

Source: Ministry of Environment

1-3-3-4 Existing Social Conditions

1-3-3-4-1 Population and Ethnic Groups

(1) Population

According to the 2013 census data from the National Council for Democratic Development (hereinafter referred to as "NCDD"), the area and population of Ta Khmau City are 30.46 km^2 and 71,497, respectively. Average population density is around 3,067 people/km^2. Detailed information of the area and population in Ta Khmau City is summarized in **Table 1-3.2**.

Table 1-3.2 Summary of the Area and Population Ta Khmau City

No.	Sangkat (Commune)	Surface (km^2)	Population (2013) (person)	Density (2013)(2013person/km^2)
1	Daeum Mean	2.91	14,143	4,860
2	Ta Khmau	9.34	21,702	2,324
3	Prek Russei	2.07	9,388	4,535
4	Kompong Samnanh	3.42	12,421	3,632
5	Ta Kdol	2.49	5,587	2,244
6	Prek Hour	10.23	8,256	807
Total	-	30.47	71,497	-

Source: NCDD (National Council for Democratic Development)

1-3-3-4-2 Socio-economic Conditions

According to the results of an interview survey on 98 households from Daeum Mean Sangkat (commune) and Ta Khmauthe Sangkat, the minimum income of households is around 600,000 riels per month and the highest income is 5,000,000 riels per month. **Figure 1-3.6** shows income and expenditure in both communes.

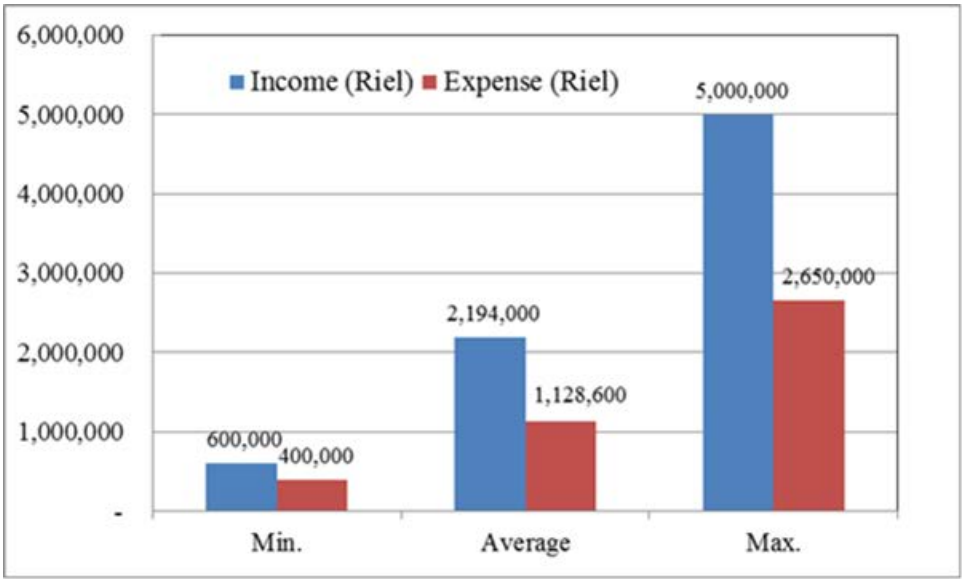


Figure 1-3.6 Income and Expenditure in Daeum Mean Sangkat and Ta Khmau the Sangkat

Source: Interview data, 21-22 June 2019.

1-3-4 Laws and Regulations Related to Environmental Consideration

(1) Laws and Regulations Related to Environmental Consideration

Laws and regulations in Cambodia relevant to environmental and social considerations are summarized in **Table 1-3.3**.

Table 1-3.3 Laws and Regulations Related to Environmental and Social Considerations in Cambodia

No.	Law and Regulation	Date
1	Law on Environmental Protection and Natural Resource Management	Nov. 1996
2	No. 72 ANRK.BK, Anukret (Sub-decree) on Environmental Impact Assessment (EIA) Process	Aug. 1999
3	No. 376 BRK.BST, Prakas (Declaration) on General Guideline for Developing IEIA/EIA Reports	Sep. 2009
4	Prakas (Joint Declaration) between MoE and MEF on Determination of Service Fee for EIA Reviewing and Monitoring	2000 2012
5	No. 215 BRK, Prakas (Declaration) on Registration of Consulting Firm for Studying and Preparing Environmental and Social Impact Reports	May 2014
6	No.27 ANRK/BK, Anukret (Sub-decree) on Water Pollution Control	Apr. 1999
7	No.36 ANRK.BK, Anukret (Sub-decree) on Solid Waste Management	Apr. 1999
8	No. 42 ANK/BK, Anukret (Sub-decree) on the Control of Air Pollution and Noise Disturbance	Jul. 2000
9	Law on Water Resources Management	Jun. 2007
10	No. NS/RKM/0208/007, Law on Protected Area Management (Protected Areas Law)	Feb. 2008

Source: JICA Survey Team based on an interview with MoE

(2) Comparison of Cambodian Laws and Regulations with the JICA Guidelines

There are no significant differences between JICA guidelines and Cambodian laws and regulations, except that in the latter, there is less emphasis on “strategic environmental assessment (SEA)”, “global warming”, “environmental monitoring form”, “information disclosure”, and “alternatives comparison”. The detailed results of the comparison between Cambodian laws and regulations with the JICA guidelines are described in **Table 1-3.4**.

Table 1-3.4 Comparison of JICA Guidelines and Cambodian Regulations

Item	JICA Guidelines	Cambodian Guidelines	Gaps of JICA and Cambodian GLs, Measures
Underlying principles	Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	An IEIA/EIA shall be conducted on every project and shall be approved by the MoE. Both positive and negative environmental and socio-economic impacts arising from their project activities shall be assessed.	Basically same as JICA guidelines, but alternatives analysis is not clarified. Alternative analysis was conducted in the Project.

Item	JICA Guidelines	Cambodian Guidelines	Gaps of JICA and Cambodian GLs, Measures
Information disclose	EIA reports must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	Information disclosure is carried out through public participation such as stakeholder meeting.	Information disclosure is not clarified. In the Project, written materials will be provided to local residents in Khmer language, and finally a summary of the IEIA report will be disclosed to public via homepage of PPWSA.
Public consultation	For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared. Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	Public participation is one of the important contents in the EIA report in Declaration on General Guideline for conducting IEIA1/EIA Reports, 2009 (Annex 1). In IEIA/EIA report, following contents have to included: - Dissemination by the project owner with local authorities and local communities of the development project; - Feedback from relevant ministries/ agencies/ departments and relevant local authorities; - Comments from relevant non-government organizations (NGOs); - Consultation with affected local communities	No significant gaps. However, no specific requirements for records and timing of stakeholder meeting are provided. In the Project, records of public consultation were prepared and stakeholder meeting was held during the preparatory survey.

Item	JICA Guidelines	Cambodian Guidelines	Gaps of JICA and Cambodian GLs, Measures
Impacts assessment items	The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	Detailed assessment of physical, biological and socio-economic environment and resources are required, based mainly on primary data on the area within or in the surrounding the project site. This will form the basis for identification, prediction and analysis of potential adverse environmental and social impacts by project activities, aiming to identify actions to minimize negative impacts and maximize positive impacts. Following items have to be included in IEIA/EIA report: Physical resources: soil, climate, air quality, hydrology. Biological resources: forest, wildlife species, habitats, biodiversity and ecology system, wet land system. Socio-economic aspects: demography and settlement, economic status, land use, water use, energy use, infrastructure, education, public health and well-being, cultural heritages, tourism area	Basically same as JICA guidelines, but no detailed items are clarified. JICA Guidelines has been applied.
Monitoring	Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.	Environmental monitoring is required under EMP. However, no monitoring forms are clarified.	It is proposed to apply monitoring forms based on JICA guidelines.
Ecosystem and biota	Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	Description and impacts analysis of biological resources (including forest, wildlife species, habitats, biodiversity and ecology system, wet land system) are required in the Declaration on General Guideline for conducting IEIA1/EIA Reports, 2009 (Annex 1).	Basically same as JICA guidelines.

Item	JICA Guidelines	Cambodian Guidelines	Gaps of JICA and Cambodian GLs, Measures
Indigenous peoples	Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.	Description and impacts analysis of ethnic minority or indigenous people are required.	Basically same as JICA guidelines.

Source: JICA Survey Team

(3) EIA/IEIA Procedures

According to the Sub-decree on EIA Process (1999) of Cambodia, an initial environmental impact assessment (hereinafter referred to as "IEIA") or an environmental impact assessment (hereinafter referred to as "EIA") is required if there are more than 10,000 users for a water supply project. Therefore, an IEIA/EIA will be necessary because the expected served population of the Project will be about 120,000 people. The IEIA/EIA procedure in Cambodia is presented in **Figure 1-3.7**.

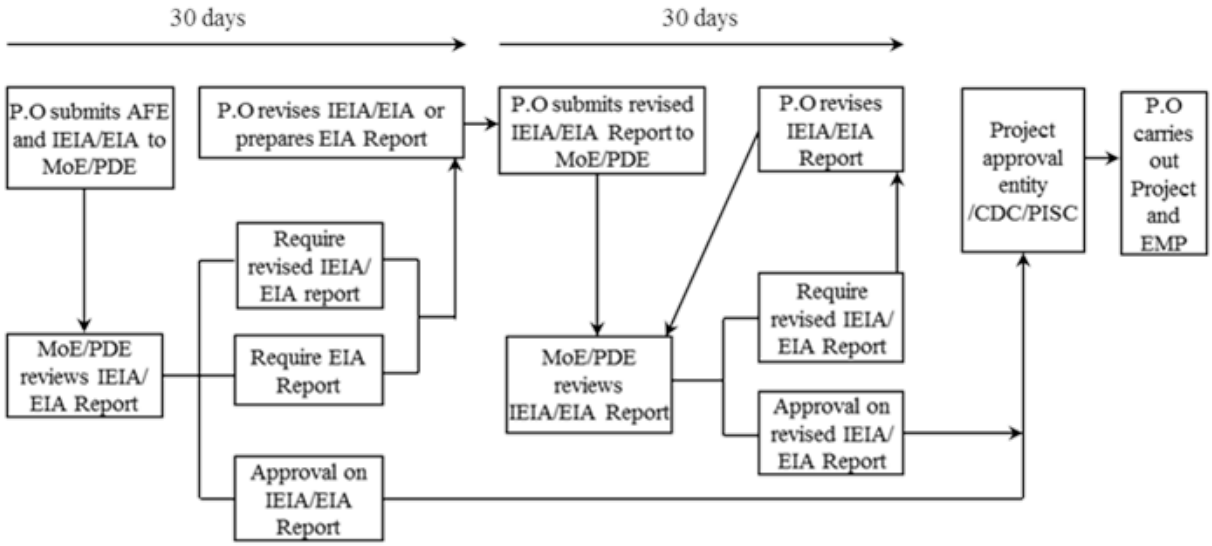


Figure 1-3.7 IEIA/EIA Procedure in Cambodia

Source: Declaration on General Guidelines for Developing IEIA/EIA Reports (2009).

The roles and responsibilities of implicated organizations are summarized in **Table 1-3.5**.

Table 1-3.5 Roles and Responsibilities for IEIA/EIA

No.	Organization	Roles and Responsibilities
1	MoE	MoE is responsible for project screening and scoping (approval of TOR), review and evaluation of IEIA/EIA report, monitoring and follow-up on EMP etc. (projects with more than 2 million USD investment) MoE is also responsible for monitoring illegal disposal of construction solid wastes.
2	PDE	PDE is responsible for project screening and scoping (approval of TOR), review and evaluation of IEIA/EIA report, monitoring and follow-up on EMP etc. (projects with less than 2 million USD investment)
3	CDC	CDC is responsible for approving the IEIA/EIA report and supporting FDI (Foreign Direct Investment) for IEIA/EIA study. Facilitates and coordinates government-donor relations.
4	PISC	Supports to provincial governor for approving the IEIA/EIA report (small project).
5	MIH	As regular member for concerned ministry for industrial compliance and monitoring.
6	MoWRAM	Approval for intake water
7	MLMUPC	Responsible for construction permit and compliance based on Sub-Decree No.86
8	CNMC	Approval for intake water
9	ISC	Responsible for establishing national standards

MIH: Ministry of Industry and Handicraft
MoWRAM: Minister of Water Resources and Meteorology
MLMUPC: Ministry of Land Management, Urbanization and Construction
CNMC: Cambodia National Mekong Committee
ISC: Institute of Standards of Cambodia

After reviewing the components of the Project, MoE determined that only an IEIA report is required to be submitted. The IEIA study was conducted by PPWSA with the support of JICA Survey Team and registered local consultants (SUSTINAT Green Co., Ltd.). The IEIA report was submitted to MoE in August 2019. It is expected that MoE will issue an approval letter for the IEIA report by the end of November, 2019.

1-3-5 Comparison of Alternatives

The alternatives of not constructing the WTP versus constructing the WTP are compared in terms of their technical requirements and environmental impacts. As summarized in **Table 1-3.6**, the comparison shows that a WTP with conventional treatment (coagulation, sedimentation and filtration) is the preferred option.

Table 1-3.6 Comparison of Treatment Alternatives

Item		Alternative 1	Alternative 2
		Without Project	With Project
WTP	Capacity	0	33,000 m^3/day
	Area	0	App. 0.45 ha
	Location	-	Within the existing facility owned by PPWSA
	Shortage of drinking water supplied	Negative impacts	Positive impacts
Technical aspect	Dealing with raw water pollution	-	Partly yes
	Transmission water from other WTPs	Needed	Not needed
	Construction cost	0	High
	O&M cost	High (long distance transmission)	Mid (short distance transmission)
	O&M level	-	Mid-level

Item		Alternative 1	Alternative 2
		Without Project	With Project
Environmental and social considerations	1) Land acquisition	Not needed	Not needed
	2) Public health	Negative impacts (no water supply during water stop period due to limited treated water volume from other WTPs)	Positive impacts (stable water supply)
	3) Waste (sludge etc.)	-	Light impacts
	4) Low income households	Light impacts (current tariff)	Positive impacts (tariff may be reduced)
Preferred option		Not recommended (unstable water supply and negative impacts on public health)	Recommended (stable water supply and positive impacts on public health)

1-3-6 Scoping for Initial Environmental Examination (IEE)

The Project is classified as Category B under the JICA Guidelines for Environmental and Social Considerations (April 2010) considering the Project characteristics and site conditions (WTP located within the existing facility site owned by PPWSA and without Protected Areas in surrounding areas). An Initial Environmental Examination (hereinfafter referred to as "IEE") was carried out during this Preparatory Survey based on the JICA guidelines.

JICA Guidelines defines the IEE as "a study that includes the analysis of alternative plans, predicts and assesses environmental impacts, as well as preparation of mitigation measures and monitoring plans, based on easily available information such as existing data and simple field surveys". The scoping checklist for the Project is summarized in **Table 1-3.7**.

Table 1-3.7 Scoping Checklist for the WTP Construction

No.	Impact Item	Evaluation		Comments
		P & C	Operation	
Social Environment				
1	Resettlement	D	D	Since the WTP will be constructed on land owned by PPWSA, there will be no land acquisition or involuntary resettlement for the Project.
2	Local economy (employment and livelihood etc.)	D	B+	Water supply project will create positive impacts on the local economy due to increase of service level.
3	Land use and utilization of local resources (fishing)	C	D	There are some non-licensed fishing activities. Some impacts on the fishing activities may occur. Some countermeasures will be necessary to reduce the impacts.
4	Water usage/water right	C	B-	Intake amount (33,000 m^3/d) will have impacts on water usage. Intake approval will be necessary.
5	Social institutions	D	D	Water supply system construction normally has limited negative impact on social institutions.
6	Existing social infrastructures and services (such as traffic etc.)	B-	C	Traffic disruption (especially on National Road No. 2) may occur during construction. The impacts of traffic congestion should be examined. No pipeline installation is planned.
7	Poor households	C	C	Appropriate water tariff with consideration for low income users will be studied.
8	Indigenous, or ethnic people	D	D	According to the results of socio-economic survey at Daeum Mean and Ta Khmau communes, no group of ethnic minorities were identified. Thus, the impacts on ethnic people will be not expected.
9	Misdistribution of	D	D	This is unlikely since the project will provide 100% service

No.	Impact Item	Evaluation		Comments
		P & C	Operation	
	benefit and damage			coverage to the area.
10	Local conflict of interests	D	D	This is unlikely since the project will provide 100% service coverage to the area.
11	Gender	D	B+	During construction stage, female workers may be employed for construction works. However, the number of female workers will be less than ten persons. The impact will be limited. Workload of women and children in collecting water from wells and public water taps will be reduced after operation.
12	Children's rights	D	B+	Health of children will be improved.
13	Cultural heritage	D	D	There will be no negative impact since no pipeline installation is planned and the WTP will be built at an existing site. In addition, there are no cultural heritages around the construction site.
14	Infectious diseases such as HIV/AIDS	C	D	Some local workers will be employed for the construction and there may be a potential of infectious diseases such as HIV/AIDS. Some measures will be taken.
15	Accidents (risk etc.) and working environment	C	D	During construction, some accidents (collapse etc.) and poor working environment (such as forced overtime work etc.) can be considered. However, some safety measures will be taken to prevent accidents. SPC will transfer Japanese O&M know-how to PPWSA staff to ensure safe operation of the facilities. PPWSA will also conduct monitoring on working environment.
Natural Environment				
16	Geographical features	D	D	The change of topography and geology due to excavation (the depth of excavation at intake tower is estimated about 3-4 meters) will be limited.
17	Ground subsidence	D	D	No ground subsidence is expected due to application of piles for supporting the structures.
18	Bottom sediment	D	D	During construction of the intake, bottom sediment may be disturbed for only a very short-period.
19	Biota and ecosystem	D	D	According to the results of IEIA survey, the project site does not encompass primeval forests, tropical rain forests, or ecologically valuable habitats. Survey results show that of 13 species of birds, all of them are common species. Because the construction site is very limited, impacts are not expected.
20	Meteorology (global warming)	D	B+	Power consumption at distribution pumping station is expected to be reduced because the WTP is close to the service area.
21	Landscape	D	D	The scale of the proposed facilities is small (app. 0.2ha, 55m×35m). The impact is considered to be negligible.
22	Protected areas	D	D	There is no protected area near Phnom Penh and Ta Khmau.
Pollution				
23	Air pollution	B-	D	During construction, dust and exhaust gas may be generated by construction equipment, vehicles, and excavation activities. During WTP operation, no negative impact on air pollution is expected because no SO_2, NO_2, CO, or dust will be discharged.
24	Water pollution	B-	B-	During construction, water pollution may occur due to construction of intake facility and discharge of wastewater from construction sites. During WTP operation, backwash water will be recycled and wastewater from the administration building will be treated by wastewater treatment facility.
25	Soil pollution	D	D	Impacts of sludge on soil are expected to be limited since no toxic materials will be applied during operation phase.
26	Waste	C	B-	During construction, construction wastes will be transported and disposed to Boeng Tompun (lagoon) for landfill reuse. However, sludge will be transported outside of the WTP.

No.	Impact Item	Evaluation		Comments
		P & C	Operation	
27	Noise and vibration	C	D	There are no hospitals, schools or residence around the construction site. Pumps will be housed in the pumping station.
28	Offensive odor	D	D	No odor will be produced.

Note; P & C : Pre-construction and construction phase
A+/- : Significant positive/negative impact is expected.
B+/- : Positive/negative impact is expected to some extent.
C+/- : Impacts are unknown and necessary to be studied.
D : Negative impact is negligible.

Source: JICA Survey Team.

1-3-7 Terms of Reference (TOR) for Environmental and Social Considerations

Based on the results of scoping, study methods for potential negative impacts on natural and social environment are proposed as shown in **Table 1-3.8**.

Table 1-3.8 Proposed TOR for Environmental and Social Considerations

No.	Impact Item	Study Item	Proposed Study Method and Alternatives
1	Utilisation of local resources (fishing)	Number of fishing activity around the WTP	1) Collection information from local authorities. 2) Collection information by IEIA study team at site.
2	Water usage/water right	Low flowrate of Bassac River	1) Collection information from PPWSA and MoWRAM. 2) Obtain approval from related authorities.
3	Traffic	Current traffic situation	1) Confirm residential situations and current traffic flow around the WTP during IEIA study. 2) Confirm construction methods and equipment. 3) Propose traffic control methods.
4	Poor households	1) Poverty rate 2) Current tariff system	1) Interview survey during IEIA study. 2) Collection information from PPWSA and local authority.
5	Infectious diseases such as HIV/AIDS	Number of local workers	1) Confirm construction method and period etc. 2) Collection information from existing projects through PPWSA.
6	Accidents (risk etc.)	Safety regulations and historical records	1) Collection information from related authorities. 2) Collection information from PPWSA and other WTPs for historical accident records.
7	Air pollution	1) Air quality standards 2) Current air quality	1) Collection environmental standards and existing air quality data. 2) Measuring current air quality during IEIA study.
8	Water pollution	1) Surface water quality standards 2) Current water quality	1) Collection surface water quality standards and existing information of water quality in Bassac River. 2) Water quality survey in Bassac River
9	Waste	Reuse methods and regulations etc.	1) Confirm with MoE for sludge disposal and reuse. 2) Confirm with PPWSA for reuse methods.
10	Noise and vibration	1) Noise standards 2) Current noise level	1) Collection environmental standards for noise and existing noise data. 2) Measuring current noise level. 3) Propose noise control measures.

Source: JICA Survey Team.

1-3-8 Result of Review of Environmental and Social Impacts

The survey results based on the TOR prepared in the previous section are shown in **Table 1-3.9**.

Table 1-3.9 Results of Review of Environmental and Social Impacts

<table>
<tr><th>No.</th><th>Impact Item</th><th>Results of Assessment</th></tr>
<tr><td>1</td><td>Alternatives examination</td><td>To avoid or minimize significant environmental and social impacts as well as to reduce construction and O&M costs, alternatives studies on water treatment have been examined.</td></tr>
<tr><td>2</td><td>Utilisation of local resources (fishing)</td><td>According to the information from Chief of Ta Khmau Commune, there are some non-licensed fishing activities (approximately 10 Vietnamese and Cham families who are not residents of Ta Khmau City). During the construction phase, the turbidity of river water downstream (0 to 500 m) may increase. There will be no toxic materials discharged into the river. Thus, water pollution downstream of the river is considered to be limited.
In addition, fishing activity is prohibited from July 1 to November 30 each year because this is the breeding season for all kinds of fish. Therefore, the impacts of the construction on fishing activity are not expected during this period. During fishing season, the construction of the WTP may create impacts on fishing activity. However, fishing activity can be conducted at upstream or downstream (500 m or more) of intake construction site. Therefore, the impacts on fishing activity are low and mitigable.</td></tr>
<tr><td>3</td><td>Water usage/water right</td><td>Raw water of 0.38 m^3/s (33,000 m^3/d) will be intaken from Bassac River, which is 0.95% of monthly minimum flowrate (40 m^3/s) of the River. In addition, an approval letter has been issued unconditionally from Cambodia National Mekong Committee (CNMC) and Minister of Water Resources and Meteorology (MoWRAM). Therefore, the impacts on water usage are low.
However, in case of extreme low flowrate (For example, on May 4th 1960 the lowest water level was 0.2 m MSL), intake stop may occur. Countermeasures should be considered.</td></tr>
<tr><td>4</td><td>Traffic</td><td>1) The field observation shows that traffic flow along the road around the WTP after 8 am is light (<1,000 veh/hr).
2) There are no residents around the WTP, but there is some infrastructure such as factories. In addition, before 7 am, most people already start for work, while the construction will start from 8 am.
3) Trucks and other construction vehicles (total number is estimated to be about 17 per day) may create negative impacts on National Road No. 2 and some countermeasures should be considered.
4) If some traffic control measures are applied, the impacts on traffic are low.</td></tr>
<tr><td>5</td><td>Poor households</td><td>Poverty rate in Ta Khmau City is presented in the following table.
<table>
<tr><th>No.</th><th>Sangkat (Commune)</th><th>ID Poor 1 (the poorest)</th><th>ID Poor 2 (poor)</th></tr>
<tr><td>1</td><td>Daeum Mean</td><td>30</td><td>25</td></tr>
<tr><td>2</td><td>Ta Khmau</td><td>147</td><td>120</td></tr>
<tr><td>3</td><td>Prek Russei</td><td>79</td><td>93</td></tr>
<tr><td>4</td><td>Kompong Samnanh</td><td>56</td><td>73</td></tr>
<tr><td>5</td><td>Ta Kdol</td><td>25</td><td>51</td></tr>
<tr><td>6</td><td>Prek Hour</td><td>80</td><td>149</td></tr>
<tr><td>Total</td><td>-</td><td>417</td><td>511</td></tr>
</table>
Source: Interview data with village/commune authorities.
PPWSA has set appropriate water tariff system and house connection fee for low income households based on its water supply for poor program. Comparing the water tariff system of 2001 to 2017, current unit tariff has been reduced by 9% to 27% for low water consumption (0 to 7 m3/month, for details see Section 1-4-2-3 Water tariff and historical revision). PPWSA has also applied subsidy policy for the poorest since May, 2005: 30%, 50%, 70% and 100% of the total connections fee based on the real poverty. In addition, the WTP will be constructed using Japanese Grant Aid, which will reduce the financial pressure of PPWSA, allowing it to set lower tariff to the public. Therefore, impacts on poor households are low or even positive.</td></tr>
<tr><td>6</td><td>Infectious diseases such as HIV/AIDS</td><td>1) The maximum number of local workers is estimated to be less than 100 persons.
2) Law on the prevention and control of HIV/AIDS in Cambodia (2002) stipulates the importance of information, education and communication.
3) If some education and control measures are applied, the impacts are considered to be low.</td></tr>
<tr><td>7</td><td>Accidents (risk etc.)</td><td>Cambodian construction workers are facing many health and safety issues at work, with some losing their lives while others are often disabled. The International Labour Organization (ILO)</td></tr>
</table>

<table>
<tr><th>No.</th><th>Impact Item</th><th>Results of Assessment</th></tr>
<tr><td></td><td></td><td>cited several reasons, including the absence of an Occupational Safety and Health (OSH) law and regulation for labour inspection in construction sites, lack of resources to enforce standards and unsatisfactory data on work-related accidents.
During the construction phase of the Project, some countermeasures have to be applied to avoid accidents.</td></tr>
<tr><td>8</td><td>Air pollution</td><td>Air quality standard of Cambodia, Japan and current air quality at Daeum Mean commune are shown in the following table.

<table>
<tr><th>No.</th><th>Parameters</th><th>Unit</th><th>Daeum Mean</th><th>Cambodia Standard</th><th>Japan Standard</th></tr>
<tr><td>1</td><td>Carbon monoxide (CO)</td><td>mg/m^3</td><td>0.87</td><td>20</td><td>20</td></tr>
<tr><td>2</td><td>Nitrogen dioxide (NO_2)</td><td>mg/m^3</td><td>0.026</td><td>0.1</td><td>0.04</td></tr>
<tr><td>3</td><td>Sulfur dioxide (SO_2)</td><td>mg/m^3</td><td>0.024</td><td>0.3</td><td>0.04</td></tr>
<tr><td>4</td><td>Ozone (O_3)</td><td>mg/m^3</td><td>0.47</td><td>0.2</td><td>0.06</td></tr>
<tr><td>5</td><td>Lead (Pb)</td><td>mg/m^3</td><td>ND</td><td>0.005</td><td>-</td></tr>
<tr><td>6</td><td>Total suspended particles (TSP)</td><td>mg/m^3</td><td>0.231</td><td>0.33</td><td>0.1</td></tr>
<tr><td>7</td><td>Particulate matter 10 (PM10)</td><td>mg/m^3</td><td>0.112</td><td>0.005</td><td>-</td></tr>
<tr><td>8</td><td>Particulate matter 2.5 (PM2.5)</td><td>mg/m^3</td><td>0.081</td><td>0.025</td><td>0.015</td></tr>
</table>
Source: MoE Yearbook 2019
In the project area, the level of O_3, PM10 and PM2.5 are slightly above standard which requires to do dust pollution control during construction.</td></tr>
<tr><td>9</td><td>Water pollution</td><td>Drinking water quality standard of Cambodia, Japan and current water quality in Bassac River are shown in the following table.
<table>
<tr><th>Parameter</th><th>Unit</th><th>2016</th><th>2019</th><th>CNDWS</th><th>Japan[1)]</th></tr>
<tr><td>1. Temp.</td><td>C^0</td><td>25.0 - 31.5
28.5</td><td>25.3 – 33.0
30.3</td><td>-</td><td>-</td></tr>
<tr><td>2. pH</td><td>-</td><td>7.0 - 8.3
7.7</td><td>6.75 - 7.90
7.39</td><td>6.5-8.5</td><td>5.8-8.6</td></tr>
<tr><td>3. Turbidity</td><td>NTU</td><td>7 - 972
105</td><td>6 - 300
88</td><td>5</td><td>2</td></tr>
<tr><td>4. DO</td><td>mg/L</td><td>6.1 - 8.4
7.5</td><td>-</td><td>-</td><td>>5[2)]</td></tr>
<tr><td>5. Color</td><td>TCU</td><td>5.3 - 80
25</td><td>35 - 110
63</td><td>5</td><td>5</td></tr>
<tr><td>6. COD_{Mn}</td><td>mg/L</td><td>1.78 – 5.5
3.25</td><td>0.86 – 5.88
3.92</td><td>-</td><td>3 (TOC)</td></tr>
<tr><td>7. Ammonia nitrogen</td><td>mg/L</td><td>0.10 - 1.81
0.59</td><td>0.02 - 3.35
0.86</td><td>1.5</td><td>-</td></tr>
<tr><td>8. E. Coli</td><td>cfu/100mL</td><td>$0 - 3*10^3$
$7*10^2$</td><td>$1.5 - 7.5*10^3$
$3.3*10^2$</td><td>0</td><td>0</td></tr>
</table>
Source: JICA Survey Team.

1) Japanese drinking water quality.
2) Japanese environmental standards for rivers (Class B, the lowest level of the water source for water supply)
CNDWS: Cambodia National Drinking Water Standard

The average concentrations of COD_{Mn} and ammonia Bassac River in 2019 are slightly increased comparing with that of 2016. In addition, during construction phase, it is estimated that wastewater from the daily use of staff-workers approximately 2.4 m^3/d. which will discharged into existing sewer located along National Road No.2 with other wastewaters generated from construction site.
During operation phase, backwash water (app. 480 m^3/d) will be recycled within the WTP after treatment. Domestic wastewater will be treated by septic tank and then discharged into existing sewer.</td></tr>
<tr><td>10</td><td>Waste</td><td>During construction phase, part of construction waste soil (app. 1,000 m^3) will be reused for backfilling at construction site. The remaining waste soil (app. 1,000 m^3) will be reused for backfilling of Boeng Tompun (lagoon, 3 km far from the WTP). Other construction wastes will be disposed at existing solid waste landfill site by a licensed contractor. The amount of domestic solid wastes is estimated to be only around 5 kg/d from construction site. In addition, temporary toilet at the construction site for workers should be installed during</td></tr>
</table>

<table>
<tr><th>No.</th><th>Impact Item</th><th>Results of Assessment</th></tr>
<tr><td></td><td></td><td>construction considering limited capacity of existing toilet located at the site.
During operation phase, PPWSA will collect and transport sludge (app. 3 tDS/d) to the new landfill site because the existing Dangkor landfill site (10 km far from the WTP, with leachate treatment) will be full by the end of 2020 or early 2021 and Phnom Penh authorities are looking for sites that can replace the Dangkor landfill site in Kandal Provincial. In addition, now PPWSA is preparing a plan to sell sludge to local construction company who intends to reuse sludge as backfilling materials.</td></tr>
<tr><td>11</td><td>Noise and vibration</td><td>Noise standard of Cambodia and Japan is shown in the following table.
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Location</th><th colspan="3">Duration</th></tr>
<tr><th>6:00-18:00</th><th>18:00-22:00</th><th>22:00-6:00</th></tr>
<tr><td>1</td><td>Silent areas (hospitals, schools, libraries and kindergartens)</td><td>≤ 45
(50)[1)]</td><td>≤ 40
(50)</td><td>≤ 35
(40)</td></tr>
<tr><td>2</td><td>Residential area (hotel, administration offices, villa, apartment)</td><td>≤ 60
(55)</td><td>≤ 60
(55)</td><td>≤ 45
(45)</td></tr>
<tr><td>3</td><td>Mixed commercial, business and service areas</td><td>≤ 70
(65)</td><td>≤ 65
(65)</td><td>≤ 50
(60)</td></tr>
<tr><td>4</td><td>Heavy industries mixed with residential areas</td><td>≤ 75
(70)</td><td>≤ 70
(70)</td><td>≤ 50
(65)</td></tr>
</table>
Source: MoE
1): Japanese noise standard.

In this project, a noise survey was conducted within the existing WTP site and the results are summarized in the following table.
<table>
<tr><th>Time</th><th>Noise [dB(A)]</th><th>Cambodian Standard[1)] [dB(A)]</th></tr>
<tr><td>Day (6:00-18:00)</td><td>57-69</td><td>75</td></tr>
<tr><td>Evening (18:00-22:00)</td><td>52-63</td><td>70</td></tr>
<tr><td>Night (22:00-6:00)</td><td>45-57</td><td>50</td></tr>
</table>
Source: JICA Survey Team
1) Standard for heavy industries mixed with residential areas.

The noise levels at the project area are lower than that of Cambodian standards, while the noise levels in night time exceeded the standard occasionally. In addition, no sensitive facilities such as (hospital or school etc.) around the WTP site have been identified.
However, it is estimated that noise levels at the boundary of the WTP in day time would be 78 to 87 dB due to operation of construction equipment and vehicles, which has exceeded the standard (75 dB) slightly.

The results of vibration survey within the existing WTP site and Japanese standards are presented in the following table.
<table>
<tr><th>Time</th><th>Vibration (dB)</th><th>Japanese Standard[1)] (dB)</th></tr>
<tr><td>Day (8:00-19:00)</td><td>Leg: 13-26
(Lmax: 17-52)</td><td>65</td></tr>
<tr><td>Night (19:00-8:00)</td><td>Leg: 13-40
(Lmax: 16-75)</td><td>60</td></tr>
</table>
Source: JICA Survey Team
1) Environmental Quality Standard of Japan.

The vibration levels (equivalent levels) at the project area are lower than that of Japanese standards.</td></tr>
</table>

Note; P & C : Pre-construction and construction phase
A+/- : Significant positive/negative impact is expected.
B+/- : Positive/negative impact is expected to some extent.
C+/- : Impacts are unknown and necessary to be studied.
D : Negative impact is negligible

Source: JICA Survey Team.

1-3-9 Assessment of Environmental and Social Impacts

Based on the results of environmental and social impacts survey, a matrix of environmental and social considerations is prepared in **Table 1-3.10**.

Table 1-3.10 Assessment of Environmental and Social Impacts

No.	Item	Assessment in Scoping Phase		Assessment by Survey Results		Contents
		P&C	O	P&C	O	
Social Environment						
1	Resettlement	D	D	N/A	N/A	-
2	Local economy (employment and livelihood etc.)	D	B+	N/A	B+	-
3	Land use and utilization of local resources (fishing)	C	D	B-	N/A	There are some non-licensed fishing activities. Some impacts on the fishing activities may occur. Before construction starts, information will be delivered to fisherman via commune and village chiefs in advance. During fishing season, fishing activity can be conducted upstream or downstream (500m or more) of intake construction site.
4	Water usage/water right	C	B-	D	B-	Compared with low flow (40 m^3/s) of Bassac river, intake volume (0.38 m^3/s) will not have significant impacts on water usage. An approval letter has been obtained from Cambodia National Mekong Committee on Sep. 12, 2019. However, in case of extreme low flowrate of Bassac River, intake stop may occur.
5	Social institutions	D	D	N/A	N/A	-
6	Existing social infrastructures and services (such as traffic etc.)	B-	C	B-	D	Traffic flow along the road around the WTP after 8 am is light. Trucks and other construction vehicles (17vehicles/day) may create negative impacts on public traffic. Therefore, some measures should be taken. During operation, the impacts on traffic are expected to be very limited because there are very few vehicles in the WTP.
7	Poor households	C	C	D	B+	Total number of Poor 1 and Poor 2 householders in Ta Khmau City is 928. The WTP will be constructed by using Japanese Grant Aid, which will reduce the financial pressure of PPWSA allowing it to set lower tariff to the public. PPWSA has also set appropriate water tariff system and house connection fee for low income households. Therefore, the impacts are expected to be positive.
8	Indigenous, or ethnic people	D	D	N/A	N/A	-
9	Misdistribution of benefit and damage	D	D	N/A	N/A	-
10	Local conflict of interests	D	D	N/A	N/A	-
11	Gender	D	B+	N/A	B+	-
12	Children's rights	D	B+	N/A	B+	-
13	Cultural heritage	D	D	N/A	N/A	-
14	Infectious diseases such as HIV/AIDS	C	D	D	N/A	The maximum number of local workers is estimated to be less than 100 persons. During construction, contractor will follow relevant regulations. Thus, the impacts are considered to be mitigable and limited.
15	Accidents (risk etc.)	C	D	B-	N/A	There were some cases of disability accident in construction phase of other projects. Therefore, some

No.	Item	Assessment in Scoping Phase		Assessment by Survey Results		Contents
		P&C	O	P&C	O	
						countermeasures must be considered during construction of the WTP.
Natural Environment						
16	Geographical features	D	D	N/A	N/A	-
17	Ground subsidence	D	D	N/A	N/A	-
18	Bottom sediment	D	D	N/A	N/A	-
19	Biota and ecosystem	D	D	N/A	N/A	-
20	Meteorology (global warming)	D	B+	N/A	B+	-
21	Landscape	D	D	N/A	N/A	-
22	Protected areas	D	D	N/A	N/A	-
Pollution						
23	Air pollution	B-	D	B-	N/A	During construction phase, equipment, vehicles, and excavation activities will generate limited amounts of dust and exhaust.
24	Water pollution	B-	B-	B-	B-	During construction phase, the amount of wastewater generated from the construction site is estimated to be very limited. While during operation phase, backwash water will be recycled within the WTP after treatment. Therefore, the impacts of the Project are expected to be light.
25	Soil pollution	D	D	N/A	N/A	-
26	Waste	C	B-	B-	B-	During construction surplus waste soil will reused for backfilling at construction site and Boeng Tompun (lagoon). When the plant is in operation, PPWSA will collect and transport sludge to the new landfill site. In addition, now PPWSA is preparing a plan to sell sludge to local construction company who intends to reuse sludge as backfilling materials. Thus, the impact is considered to be not significant.
27	Noise and vibration	C	D	B-	N/A	There are no sensitive facilities such as (hospital or school etc.) around the WTP site. However, it is estimated that noise levels at the boundary of the WTP in day time would be 78 to 87 dB due to operation of construction equipment and vehicles. This exceeds the standard (75 dB) slightly. During operation, the noise levels are estimated to be less than standards because all pumps will be installed within buildings. Thus, the impact is considered to be light.
28	Offensive odor	D	D	N/A	N/A	

Note: P & C : Pre-construction and construction phase
O : Operation phase
A+/- : Significant positive/negative impact is expected.
B+/- : Positive/negative impact is expected to some extent.
C+/- : Extent of impact is unexpected, further study is needed
D : Limited/ negligible impact, further study is not needed.
N/A : Impact assessment is not conducted because the item was categorized as D in scoping phase.

Source: JICA Survey Team.

1-3-10 Mitigation Measures and the Cost

Table 1-3.11 and **Table 1-3.12** present the recommended mitigation measures for environmental management plan (EMP) during construction and operation phase. The detailed EMP is shown in attached Appendix.

Table 1-3.11 Proposed Mitigation Measures (Construction Phase)

No.	Item	Proposed Mitigation Measures	Implementing& (Inspection) Organization	Estimated Cost (USD/year)
Social Environment				
1	Land use and utilization of local resources (fishing)	Before construction starts, information will be delivered to fisherman via commune and village chiefs as well as post at Ta Khmau port in advance.	Contractor (PPWSA & communes)	Included in construction costs
2	Existing social infrastructures and services (such as traffic etc.)	The construction of the WTP may create traffic disruption (especially on National Road No. 2). 1) Prepare a detailed traffic control plan and to coordinate with local government. 2) Prepare proper construction schedule and methods to reduce traffic disruption and traffic accident. 3) Assign traffic control person at the entrance of the WTP while construction is taking place. 4) Cooperated with the Traffic Police to facilitate traffic. 5) Install traffic lights at the crossroad to avoid possible accidents.	Contractor (PPWSA, Traffic Police Office, communes)	Included in construction costs
3	Accidents (risk etc.)	1) Prepare appropriate construction plan. 2) Educate staff/workers on the safety and fire. 3) Set up regularly inspection etc.	Contractor (MIH/PPWSA)	Included in construction costs
Pollution				
1	Air pollution	1) Cover stored materials with plastic or other materials. 2) Cover trucks, and to spray exposed areas with water. 3) Wash vehicles before going out the construction site. 4) Minimize traffic over freshly exposed surfaces. 5) Install barrier walls for limiting wind dispersing if necessary. 6) Prepare air quality monitoring plan and carry out it during construction. (for details, see Environmental Monitoring Plan)	Contractor (MoE/PDE, PPWSA)	Included in construction costs
2	Water pollution	1) The embankment will be constructed to prevent land erosion during the rainfall. 2) Carry out water quality monitoring. 3) Install wastewater treatment system within the WTP to treat domestic wastewater during.	Contractor (MoE/PDE, PPWSA)	Included in construction costs
3	Waste	1) Prepare reasonable plan for solid waste disposal, especially for excavated soil. 2) Install temporary toilet at the construction site for workers, and set sanitary bins for domestic wastes. 3) Dispose solid wastes appropriately (The amount of solid waste is estimated to be only around 5 kg/day).	Contractor (MoE/PDE, PPWSA)	PPWSA may benefit from it (selling the wastes to buyer)
4	Noise and vibration	1) Prepare a detailed plan for noise control and coordinate with local government. 2) Prepare proper construction schedule and methods. 3) Set speed limits for vehicles and train workers on mitigation measures for environmental impacts. 4) Use low noise level equipment, if necessary. 5) Prepare noise monitoring plan and carrying out monitoring during construction.	Contractor (MoE/PDE, PPWSA)	Included in construction costs

Source: JICA Survey Team.

Table 1-3.12 Proposed Mitigation Measures (Operation Phase)

No.	Item	Proposed Mitigation Measures	Implementing & (Inspection) Organization	Estimated Cost (USD/year)
Social Environment				
1	Water usage/water right	1) Monitor the water level (flowrate) of Bassac River. 2) Prepare a detailed water supply plan to deal with intake stop during extreme low flowrate of Bassac River. (such as transmit water from other WTPs to Ta Khmau City)	Operator (MIH/PPWSA)	Included in OM costs of other WTPs
Pollution				
1	Water pollution	1) Keep the facilities and equipment in good condition. 2) Carry out water quality monitoring on recycled water, effluent of septic tank and Bassac River.	Operator (MoE/PDE, PPWSA)	Included in OM costs of the WTP
2	Waste	1) Prepare reasonable plan for solid waste disposal, especially for sludge. 2) Thickened sludge will be transported to new landfill site by PPWSA or sold to local construction company as backfilling materials. Thus, check the volume of sludge transported. 3) Dispose solid wastes appropriately and cooperate with CINTRI Co. Ltd.).	Operator (MoE/PDE, PPWSA)	PPWSA may benefit from it (selling the wastes to buyer)

Source: JICA Survey Team.

1-3-11 Monitoring Plan and the Cost

A draft environmental monitoring plan is shown in **Table 1-3.13**. The contents should be updated according to modifications made at subsequent stages of the Project.

Table 1-3.13 Proposed Environmental Monitoring Plan

Monitoring Parameter	Monitoring Location	Monitoring Parameter	Compliance Standards	Monitoring Frequency	Implementing & (Inspection) Organization	Estimated Cost (USD/year)
During Construction Phase						
Traffic	(1) at entrance of the WTP	Visual observation	-	During working hours of every day	Contractor (PPWSA, Traffic Police Office, communes)	Included in construction costs
Air quality	(1) at the WTP boundary	CO, NO_2, SO_2, O_3, Pb, TSP, PM10 and PM2.5	Sub-Decree No. 42 on Air Pollution Control and Noise Disturbance	Once, preconstruction: Once/6 months during construction	Contractor (MoE/PDE, PPWSA)	2,000
Waste	(1) at the gate of the WTP (1) at Boeng Tompun (lagoon)	Volume of wastes	-	Once/week	Contractor (MoE/PDE, PPWSA)	Included in construction costs
Noise	(1) at construction site; (2) at western boundary of the WTP	Equivalent continuous A sound level ($L_{aeq, 10}$)	Sub-Decree No. 42 on Air Pollution Control and Noise Disturbance	Once, preconstruction: Once/6 months during construction	Contractor (MoE/PDE, PPWSA)	1,000
Water pollution	(1) at upstream of the WTP: (1) at downstream of	pH, DO, SS, turbidity, COD, NH_4-N, Coliform	Sub-Decree No. 42 on Water Pollution	Once, preconstruction: Once/6 months	Contractor (MoE/PDE, PPWSA)	1,000

Monitoring Parameter	Monitoring Location	Monitoring Parameter	Compliance Standards	Monitoring Frequency	Implementing & (Inspection) Organization	Estimated Cost (USD/year)
	the WTP		Control	during construction		
During Operation Phase						
Air quality	(1) at the WTP boundary	CO, NO_2, SO_2, O_3, Pb, TSP, PM10 and PM2.5	Sub-Decree No. 42 on Air Pollution Control and Noise Disturbance	Once/year during construction	Operator (MoE/PDE, PPWSA)	1,000
Waste	(1) at the gate of the WTP (1) at new landfill site	Volume of wastes and disposal method	-	Once/month	Operator (MoE/PDE, PPWSA)	Included in OM costs of the WTP
Water pollution	(1) at upstream of the WTP: (1) at downstream of the WTP	pH, DO, SS, turbidity, COD, NH_4-N, Coliform	Sub-Decree No. 42 on Water Pollution Control	Once/3 months	Operator (MoE/PDE, PPWSA)	2,000

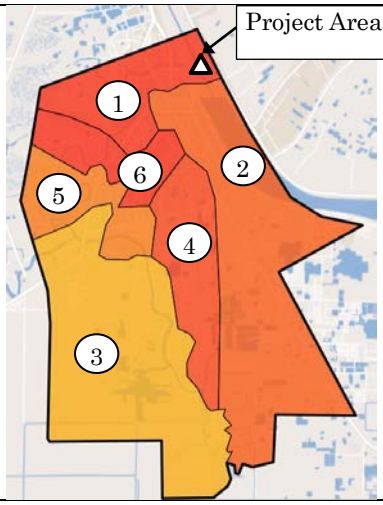
Source: JICA Survey Team.

1-3-12 Stakeholder Meeting

Two stakeholder meetings were held for the purpose of disclosing information of the project contents and IEIA report, and reaching social consensus with local stakeholders. The outline of the stakeholder meetings is summarized in **Table 1-3.14**. The majority of comments from the attendees were statements of thanks for the Project. Other issues were as follows. There were no significant issues or objections.

Table 1-3.14 Outline of the Stakeholder Meetings

Item	1st Stakeholder Meeting	2nd Stakeholder Meeting
Purpose	1) Introduction of the project 2) Collection of the stakeholder comments and opinions on the project	1) Explanation for the Results of IEIA Study (Draft) 2) Collection of the stakeholder comments and opinions on the draft IEIA report
Organizer	PPWSA, SUSTINAT Green	PPWSA, Kandal Provincial Department of Environment (DoE)
Time	June 22, 2019	July 18, 2019
Place	Daeum Mean Commune (vicinity of WTP, see location map of each commune)	Meeting Hall of Kandal Provincial DoE
Participant	10 residents (5 men and 5 women, number of participants is appointed by MoE considering no land acquisition and resettlement)	23 Participants (PPWSA, DoE, Ta Khmau City, Departments of Water Resource & Meteorology, Health, Agriculture, Land Management etc.)
Notification method	2 weeks before the stakeholder meeting, the stakeholders are notified by poster at the commune, telephone, direct visit etc.	Invited by MoE based on “Sub-decree on EIA Process”
Main Consultation Contents	1) Improvement of house connection and regular water supply Answer: The project will provide 100% service coverage to Ta Khmau City. 2) Appropriate water tariff Answer: Appropriate water tariff will be set by PPWSA.	1) Noise and vibration impacts on people and worker Answer: Noise control plan will be prepared by contractor and PPWSA will conduct regular inspection. 2) Service areas of water supply Answer: The project will provide 100% service coverage to Ta Khmau City. 3) Countermeasures on raw water quality deterioration

<table>
<tr><th>Item</th><th>1st Stakeholder Meeting</th><th>2nd Stakeholder Meeting</th></tr>
<tr><td></td><td>3) Lower price (than the standard price) of house connection
Answer: Subsidy will be applied to low income households.</td><td>Answer: Pre-chlorination will be applied to remove ammonia in the water. In addition, cascade type aeration will also be introduced.
4) Possibility of paused water supply during construction
Answer: During construction, no paused water supply will be occurred.</td></tr>
<tr><td>Photos of Stakeholder Meeting</td><td>  </td><td>  </td></tr>
<tr><td>Location Map of Commune</td><td> 
</td><td>
<table>
<tr><th>No.</th><th>Sangkat (Commune)</th></tr>
<tr><td>1</td><td>Daeum Mean</td></tr>
<tr><td>2</td><td>Ta Khmau</td></tr>
<tr><td>3</td><td>Prek Russei</td></tr>
<tr><td>4</td><td>Kompong Samnanh</td></tr>
<tr><td>5</td><td>Ta Kdol</td></tr>
<tr><td>6</td><td>Prek Hour</td></tr>
</table>
</td></tr>
</table>

1-3-13 Land Acquisition and Resettlement

The 0.45 ha of land required for this Project is located within the existing WTP site owned by PPWSA. Therefore, neither land acquisition nor resettlement are required.

1-3-14 Others

1-3-14-1 Monitoring Form (draft)

An environmental checklist for the Project is prepared as required by the JICA Environmental Guidelines, and the details are shown in attached Appendix 05.

1-3-14-2 Environmental Checklist

Monitoring form to be used for environmental monitoring is shown in attached Appendix 05.

1-4 Present Conditions of the Project

1-4-1 Organization

1-4-1-1 Phnom Penh Water Supply Authority

Both the implementing agency and project executing agency are PPWSA. The organization chart of PPWSA is shown in **Figure 1-4.1**. The Major Roles of department is shown in **Table 1-4.1**. The project will be implemented by the Planning and Project Department of PPWSA, but the Director General will ultimately consult with the Board of Directors for decision-making.

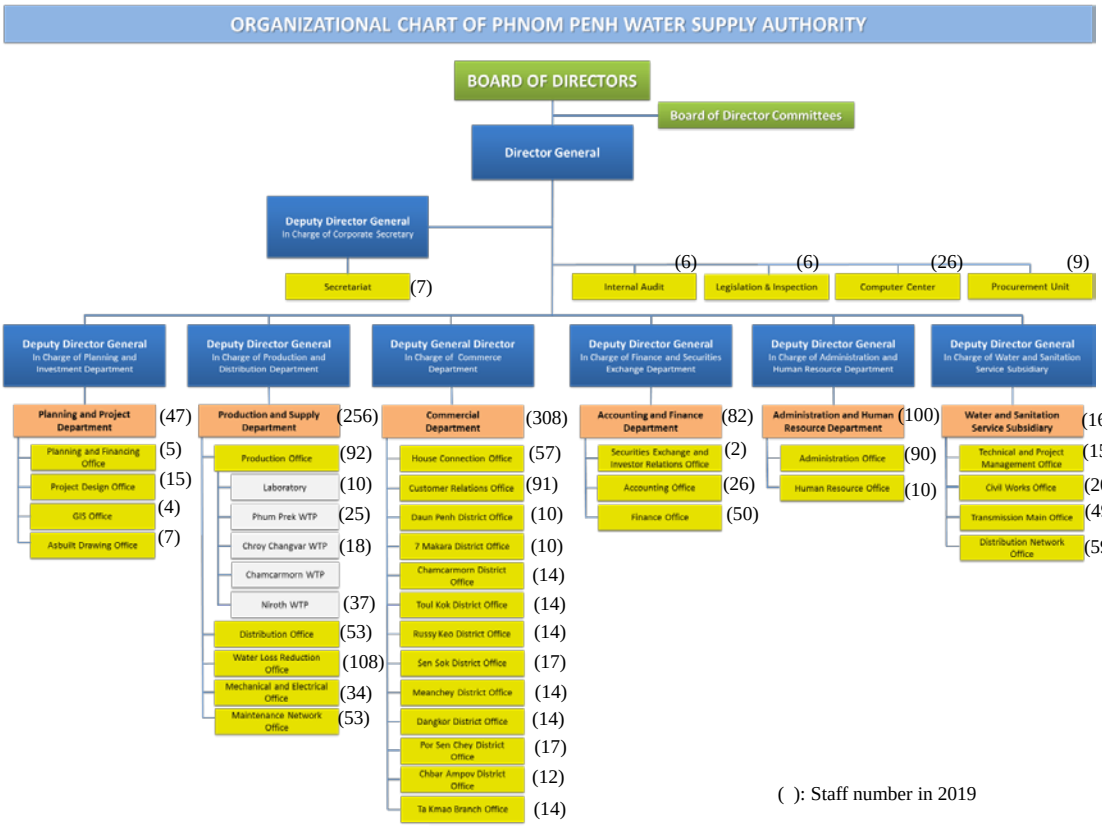


Figure 1-4.1 PPWSA Organization

Source: PPWSA

Table 1-4.1 Major Roles of Department

Department	Major Roles
Planing and Project Department	− Preparing the operational and annual investment plans of PPWSA to be submitted for adoption by the Board of Directors through the Director General; − Preparing short-term, medium-term and long-term plans; − Preparing statistics and all business and financial indicators; − Preparing and managing development plans of PPWSA,including budget plans and foreign financial resources; − Studying civil engineering plans, investment plans relating to the installation of water distribution pipelines and inspecting these plans; − Managing procurement activities that utilize PPWSA's internal resources and foreign financial resources.
Production and Supply Department	− Managing the implementation of all water treatment and supply plans in accordance with the technical standards and programs; − Installing, maintaining, and repairing the electrical system for the water treatment facilities and all electrical equipment for the administration office;
Commercial Department	− Preparing, managing and ensuring the security of customers' accounting documents; − Managing bill collections; − Inspecting and analyzing water consumptions of the customers in order to reduce water losses; − Managing and implementing technical tasks relating to household connections.
Accounting and Finance Department	− Controlling the implementation of PPWSA's accounting rules and procedures in accordance with the applicable accounting laws; − Organizing and controlling the operation of PPWSA's accounting system; − Analyzing and reporting on the financial position and variances of financial performance to the Director General and the management on a regular basis; − Advising the management on any business operation which is in violation of the accounting and financial principles of PPWSA as determined by the Prakas of the MEF.
Administration and Human Resources Department	− General administration, security, safety, protocol and human resources management and the preparation of short, medium and long term employment plans and human resources development.
Water and Sanitation Service Subsudiary	− Maintaining, repairing and installing valves and main water transmission networks in accordance with the annual plan; − Reducing water losses.

1-4-2 Budget

1-4-2-1 Socio-economic situation in Cambodia

In 2018, according to the World Bank National Accounting Data (WB), Cambodia’s Gross Domestic Product (GDP) per capita was 1,510 USD. This is relatively low in comparison to other countries in the region. Cambodia is still classified as one of the Least Developed Countries, with 23% of the labor force engaged in the primary sector of the economy, 31% and 40% in the secondary and tertiary sectors respectively, according to Japan International Cooperation Agency (JICA), in March 2019. During the past ten years, Cambodia has enjoyed increased political stability and more territorial unity than in previous decades. The country has experienced significant economic growth; the average annual growth in GDP over the four consecutive years from 2004 to 2007 has exceeded 10%. However, economic growth stalled in 2008 as a result of the worldwide financial crisis, falling to 0.1% in 2009, but recovering to 6.0% in 2010. The integration with the regional and global economies since accession to the Association of Southeast Asian Nations (ASEAN) in 1999 and the World Trade Organization (WTO) in 2004 has continued to strengthen the country’s economy.

Figure 1-4.2 Economic Growth Rate

Source: National Institute of Statics of Cambodia

Although the population living below the poverty line has fallen from more than 50% in 2004 to around 20% in 2011, a high percentage of the population of Cambodia remains in poverty. Poverty reduction continues to be an important priority in Cambodia. It is understood that comprehensive growth based on diversified industrial activities and productivity improvement is central to the promotion of income opportunities for the poor.

Since this project involves the acquisition of concession, Cambodia's inflation rate is an important factor for business. In the Cambodian market, inflation rate has averaged 2.8% over the past 10 years. The he latest average IMF inflation forecast for 2019-2024 is 2.7%, and the expected inflation rate after 2022 is 3.0%.

Figure 1-4.3 Inflation Forecast

Source: IMF2019

1-4-2-2 PPWSA' financial information

PPWSA is a company listed in the Cambodia Securities Exchange. Since listing on the Exchange in 2012 it has performed well. Operating margin and net profit margin have been stable whilst revenue has grown due to the increase in water production. In 2018 PPWSA reported solid financials with current ratio, equity ratio and debt service coverage ratio at 165%, 62,3% and

134% respectively.

Phnom Penh City and its surrounding cities can be classified into 2 areas; one area has many customers who are chargeable with the high commercial tariff (this area is called "profitable area"), and the other area is made up of many customers to whom are chargeable with lower residential tariff – this lower rate being less than required to recover the facility investment (this area is called "unprofitable area"). PPWSA is strategically investing with loans in the profitable area while utilizing ODA grants in the unprofitable area in order to expand the water supply network. Even though PPWSA's debt is increasing, it can be viewed as a sound debt expansion considering the increase in turnover and greater assets. Dividends have been increasing and PPWSA paid KHR13.4bn (equivalent to JPY 480 million @36KHR/JPY) to its shareholders in 2018. Under the assumption that grant aid money will be used for the development of facilities for this project, PPWSA's financial and credit risks are quite limited.

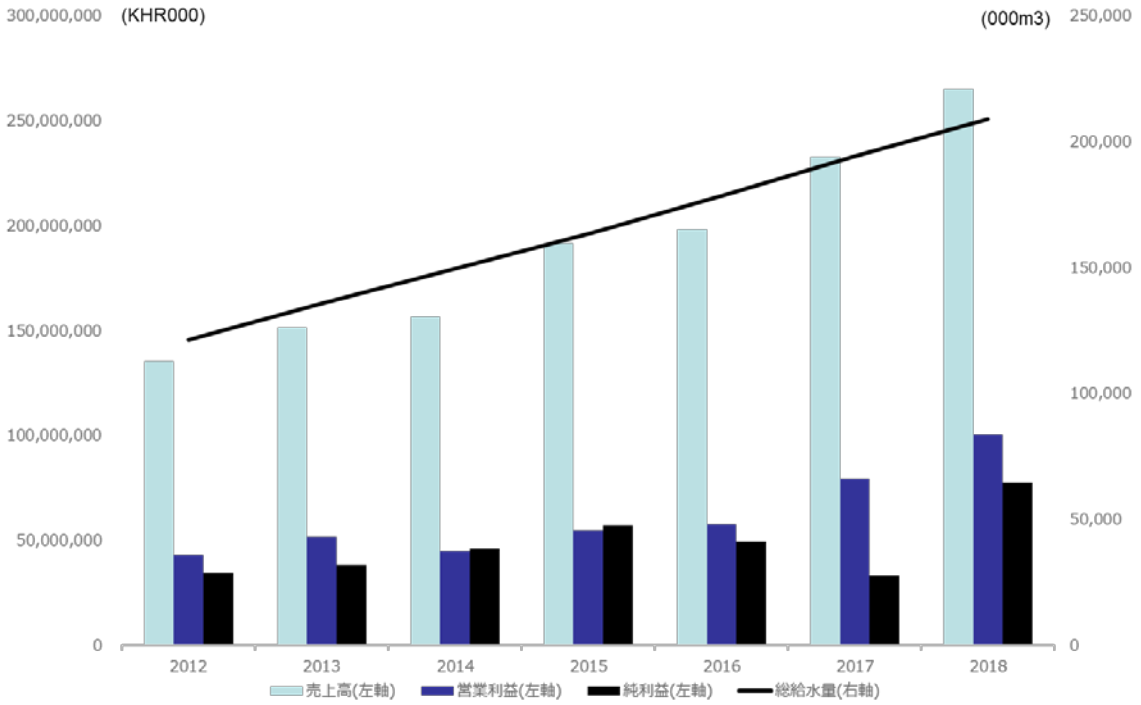


Figure 1-4.4 PPWSA Historical Revenue/Operating profit/Net profit/Water production

Table 1-4.2 PPWSA Financial statements

	2014	2015	2016	2017	2018
Statement of Comprehensive Income					
Revenues	156,542,849	191,348,246	198,179,874	232,893,089	265,093,293
Operating profit	44,651,578	54,642,638	57,469,473	79,486,598	100,142,223
Net profit	45,747,911	56,949,131	49,273,104	33,067,826	77,391,285
Statement of Financial Position					
Assets	1,166,051,073	1,245,432,128	1,297,729,600	1,362,011,777	1,449,204,814
(Cash and back accounts)	14,962,141	12,555,435	16,386,849	15,992,527	13,353,758
Liabilities	429,882,445	461,463,946	477,757,804	522,886,991	546,082,611
Equity	736,168,628	783,968,182	819,971,796	839,124,786	903,122,203
Statement of Cash Flows					
Cash from operating activities	84,204,478	78,919,844	100,564,035	83,383,404	82,906,841
Cash used in investing activities	-101,087,805	-81,663,015	-74,697,592	-60,123,881	-98,608,948
Cash (used in)/from financing activities	21,276,753	336,465	-22,035,029	-23,653,845	13,063,338
Net change in cash and cash equivalents	4,393,426	-2,406,706	3,831,414	-394,322	-2,638,769
	2014	2015	2016	2017	2018
Profitability					
Operating margin	28.5%	28.6%	29.0%	34.1%	37.8%
Net profit margin	29.2%	29.8%	24.9%	14.2%	29.2%
Solvency					
Current ratio	541%	472%	331%	204%	165%
Capital ratio	63%	63%	63%	62%	62%
Debt service coverage ratio (DSCR)	236%	177%	238%	143%	134%

1-4-2-3 Water tariff and historical revision

PPWSA's water tariff (April 2019) is shown below.

Water Tariff
(January 2001 – April 2017)

Category of customer	Qty of water used (m^3/month)	Tariff (KHR/m^3)
Domestics	0 m^3– 07 m^3	550
	08 m^3–15 m^3	770
	16 m^3–50 m^3	1,010
	Over 50 m^3	1,270
Government institutions & distributors	Without consideration of Qty	1,030
Commercial, Autonomous State Authorities and retailers	0 m^3–100 m^3	950
	101 m^3–200 m^3	1,150
	201 m^3–500 m^3	1,350
	Over 500 m^3	1,450

water meter maintenance fee KHR50/mm/month.

Water Tariff
(May 2017 – Current)

Category of customer	Qty of water used (m^3/month)	Tariff (KHR/m^3)
Domestics	0 m^3– 03 m^3	400
	04 m^3– 07 m^3	500
	08 m^3–15 m^3	770
	16 m^3–50 m^3	1,010
	Over 50 m^3	1,270
Government institutions & distributors	Without consideration of Qty	1,030
Commercial, Autonomous State Authorities and retailers	0 m^3–100 m^3	950
	101 m^3–200 m^3	1,150
	201 m^3–500 m^3	1,350
	Over 500 m^3	1,450
Landlord	Without consideration of Qty	700

water meter maintenance fee KHR50/mm/month.

Further to the tariff review approved by Council of Ministers of Cambodia, in May 2017, the resulting average tariff turned out to be slightly lower than the previous year at 1,002KHR/m^3. However, at the next tariff review due in 2020, the average water tariff is expected to be increased

by 10-20% overall, by lowering the tariff of the small water consumption segment and increasing the tariff of the large water consumption segment.

1-4-3 Water connections

PPWSA has 367,032 water meters connected as of 2018, and the annual increase of the new water meters installed during the same year was 33,744 units. For areas with existing water supply, water connection work is carried out at the request of new consumers. In areas without an existing water supply network, PPWSA conducts a feasibility study and technical study of water supply connectivity to determine the extension of new water network to such areas. Connection fee is borne by the end user, but PPWSA has set up 3 categories of installment payment: 10 months, 15 months and 20 months which can be chosen by the poor, based on what they can afford. PPWSA maintains a 20% discount scheme on connection fees for the poor people who live in suburban communities, and PPWSA has subsidy policy applicable for the poorest people: 30%, 50%, 70% and 100% of subsidy against the total connection fee depending on the poverty level of the household.

1-4-4 Impact of the Project on PPWSA financials

PPWSA records assets acquired by ODA grant in the balance sheet as assets and liabilities in accordance with International Accounting Standard. In the profit and loss calculation, to avoid impact on its income statement, the depreciation expense of the assets is offset by amortizing deferred revenue of the same amount of such depreciation during the useful life of such assets. The business profit of PPWSA during the operation period of SPC is estimated as follows, assuming that bulk water purchased from SPC is sold to PPWSA's customers.

It is assumed that the average water tariff of 1,100KHR/m^3 after tariff revision in 2020 will be increased by 10% from the current 1,002 KHR/m^3 due to the fact that Ta Khmau City has relatively few customers to which commercial tariff is applied. As for operating costs other than the purchase price of bulk water, the results for 1st semester of year 2018 remain unchanged, assuming that the impact of inflation (forecast at 3% by IMF) and cost reduction would be offset.

Table 1-4.3 Impact of the Project on PPWSA financials

(1,000,000KHR)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Purchase volume (1,000m3)	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950
Average tariff (KHR)	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Revenue	12,045	12,045	12,045	12,045	12,045	12,045	12,045	12,045	12,045	12,045
Unit cost of bulk water (KHR)	432	438	445	453	460	468	476	484	493	501
Production cost	4,725	4,800	4,878	4,957	5,040	5,124	5,211	5,301	5,393	5,489
Other operating costs	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895
Total operating cost	10,620	10,695	10,772	10,852	10,934	11,019	11,106	11,196	11,288	11,383
Operating margin	1,425	1,350	1,273	1,193	1,111	1,026	939	849	757	662

Based on the assumptions as stated above, the operating margin of PPWSA would be 11.8% (1,425/12,045=11.8%) in the first operating year. Under the same assumption, the operating margin will decrease over 10 years with increased payment to SPC due to inflation, but still it is expected that an operating margin of approximately 5.5% (662/12,045=5.49%) can be realized. If consideration is given exclusively the Ta Khmau WTP cash-flow balance alone, it can be seen

that the project can continue to generate positive yearly cash balance even after PPWSA pays the agreed yearly increasing production cost to the SPC over 10 years. As a conclusion, the Project will likely have positive impact on PPWSA financials.

As mentioned above, there is a large difference between tariff rates of domestic and commercial consumers, PPWSA invests with ODA grant for expansion of water network in the unprofitable areas including Ta Khmau City where commercial tariff is not applicable to the majority of the customers, this strategy helps PPWSA maintain stable financial conditions.

1-4-5 Existing Facilities

1-4-5-1 Existing Facility at Ta Khmau site

Prior to 2004, water supply to Ta Khmau City was provided by Kandal province. **Figure 1-4.5** shows the outline of Ta Khmau WTP before 2004.

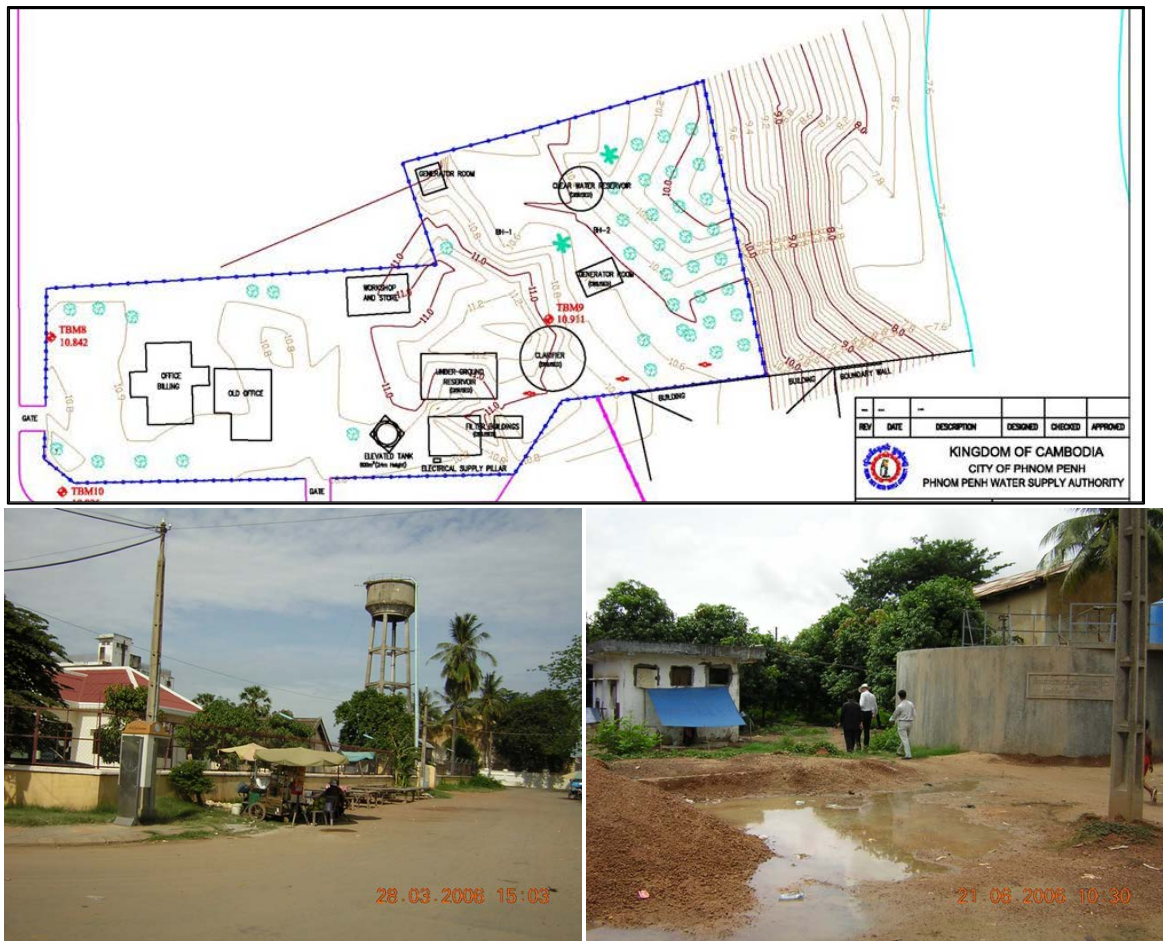
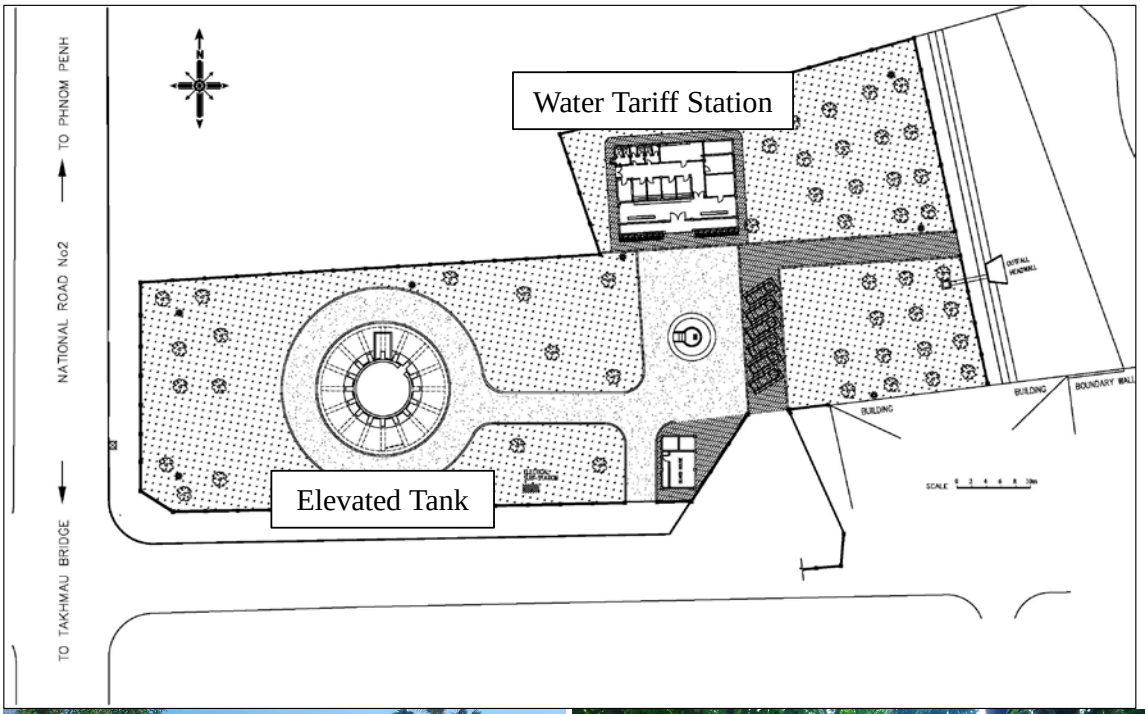


Figure 1-4.5 Overview of Ta Khmau existing WTP (before 2004)



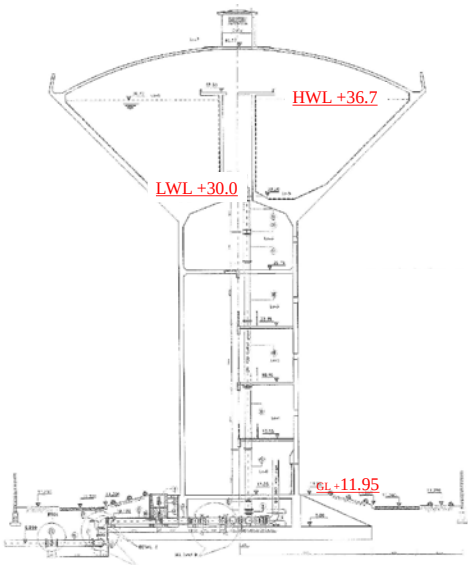
Water Tariff Station

The situation in WTP

Figure 1-4.6 Overview of Ta Khmau existing WTP (current status in 2019)

The elevated tank has a capacity of 1,410 m3. The inflow water level is +30 mASL (ground level is about + 11 m) and the overflow pipe level is +36.7 m. The effective water depth is about 6m.

Ta Khmau Elevated Tank r



Volume：1,410m^3、HWL：36,7 mASL、LWL：30 mASL

Figure 1-4.7 Elevated Tank Structure at Ta Khmau WTP

1-4-5-2 Existing water distribution system in Ta Khmau

In 2004, water distribution in Ta Khmau became a PPWSA water supply area, and until August 2017, water was mainly conveyed from the Chamcar Mon WTP to the elevated tank at the Ta Khmau WTP, and was distributed from the elevated tank to Ta Khmau City.

Currently, with the completion of the second phase of the Niroth WTP, the rehabilitation of the Chamcar Mon WTP begins in October 2017, and is scheduled to be completed in October 2019.

Until the completion of the Chamcar Mon WTP, water is conveyed from the Niroth WTP to the elevated tank of the Ta Khmau WTP, and water is distributed from the elevated tanks to the city of Ta Khmau. The outline of the existing water distribution system is shown in **Figure 1-4.8**.

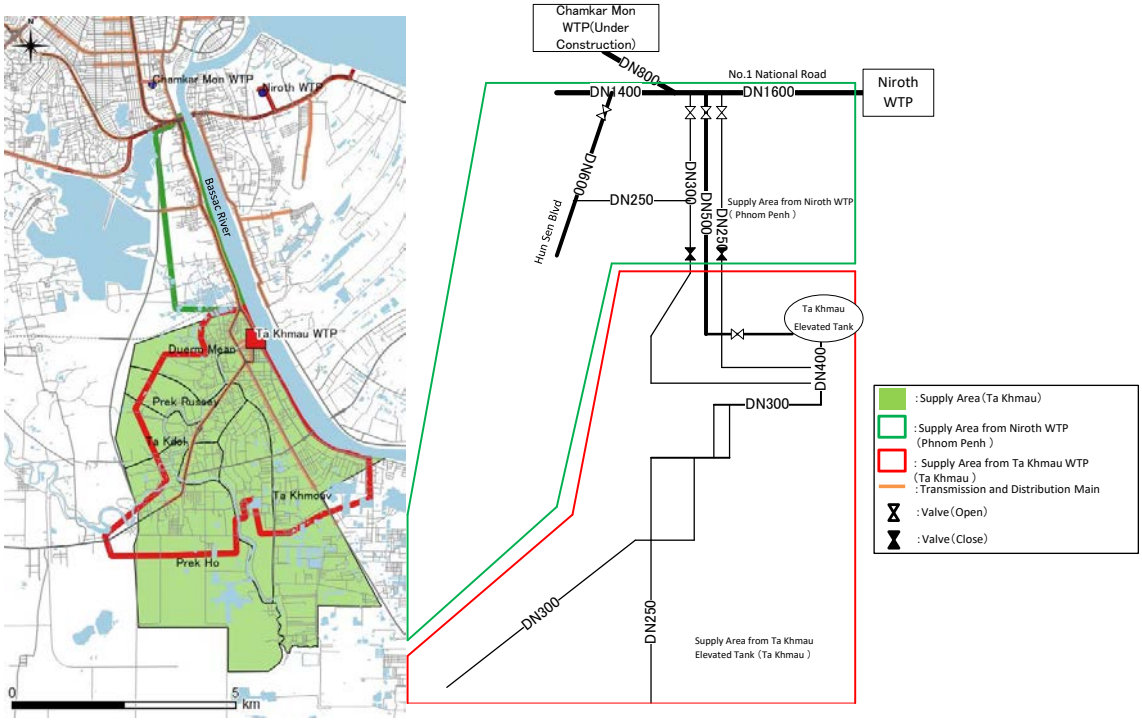


Figure 1-4.8 Outline of Existing Water Distribution System

A flow meter, water pressure gauge, and water level gauge are installed in the elevated tank as shown in **Figure 1-4.9**. PPWSA implements water distribution control while recording and monitoring this information about every 15 minutes in the central monitoring system of Phum Prek WTP.

Figure 1-4.9 Monitoring Status of Ta Khmau Existing WTP

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objective

The National Strategic Development Plan, issued by the RGC in 2006 and reviewed in 2008, aims to boost access to safe water in urban areas to 80% by 2015 and 100% by 2025.

The Project objective is to construct a WTP (30,000m^3/day), improve water supply services to Ta Khmau City and surrounding areas, and contribute to improving the living environment in Ta Khmau City and Phnom Penh.

2-1-2 Project Description

Components of the Project for Expansion of Water Supply System in Ta Khmau (hereinafter referred to as "The Project") are shown in **Table 2-1.1**.

Table 2-1.1 Project Components

Facility	Intake and Raw Water Transmission Facilities	− Intake Capacity : 31,500 m^3/day − Raw Water Intake Tower − Raw Water Transmission Facility
	Water Treatment Facility	− Water Treatment Capacity : 30,000 m^3/day − Water Treatment Facility
	Distribution Facilities	− Clear Water/Service Reservoir − Distribution Equipment − Bulk Meter (Count: 1)
	SCADA	− Central Supervisory System in the WTP
Consulting Service		− Tender Assistance − Design Confirmation − Various Management Activities During Construction Phase

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Principles

The official English name of this Project scheme is "Japanese Grant Aid with O&M Scheme" for legal consistency in Cambodia. The grant will be utilized for the procurement of the plant, equipment, construction of the facilities and related consulting services.

The project contractor, and the prime consulting firm, which enter into contracts with the Recipient (PPWSA) will be principally Japanese nationals as defined in the Exchange of Notes (E/N). The successful bidder selected through a competitive bidding process shall conduct both the EPC and O&M work based on an EPC contract, and an O&M contract and an overarching Comprehensive Contract which will establish the relationship between the mentioned EPC contract and O&M Contract. In the bidding process, bidder's proposals will be assessed and evaluated for technical, commercial, financial and legal compliance. The standard structure of Japanese Grant Aid with O&M Scheme is illustrated as **Figure 2-2.1** and Structure of Japanese

Grant Aid with O&M Scheme specific to this project is illustrated as **Figure 2-2.2**.

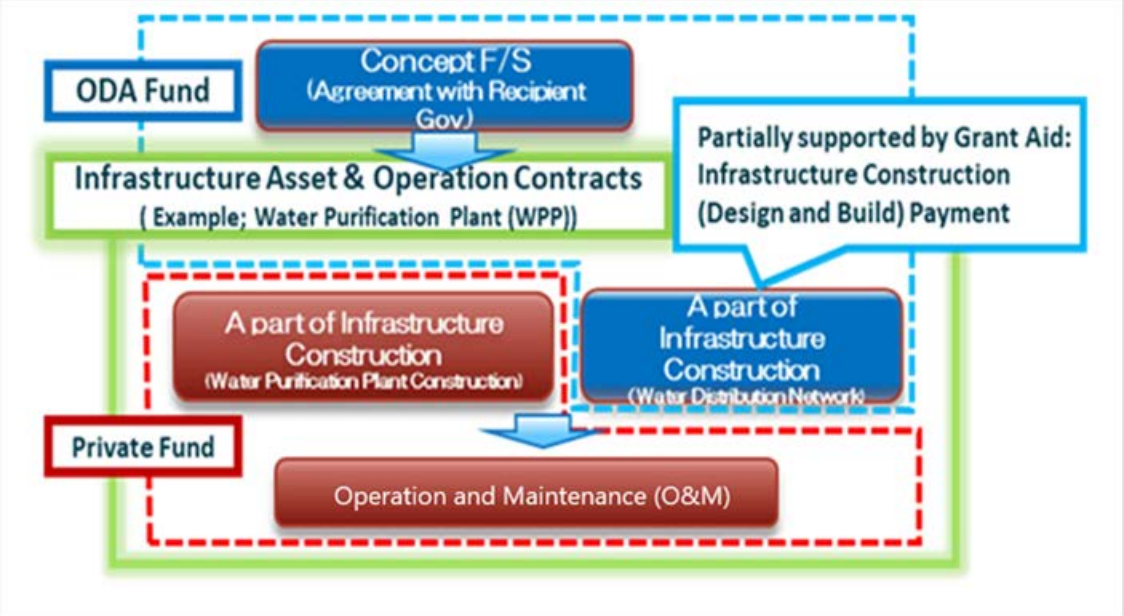


Figure 2-2.1 Standard Japanese Grant Aid with O&M

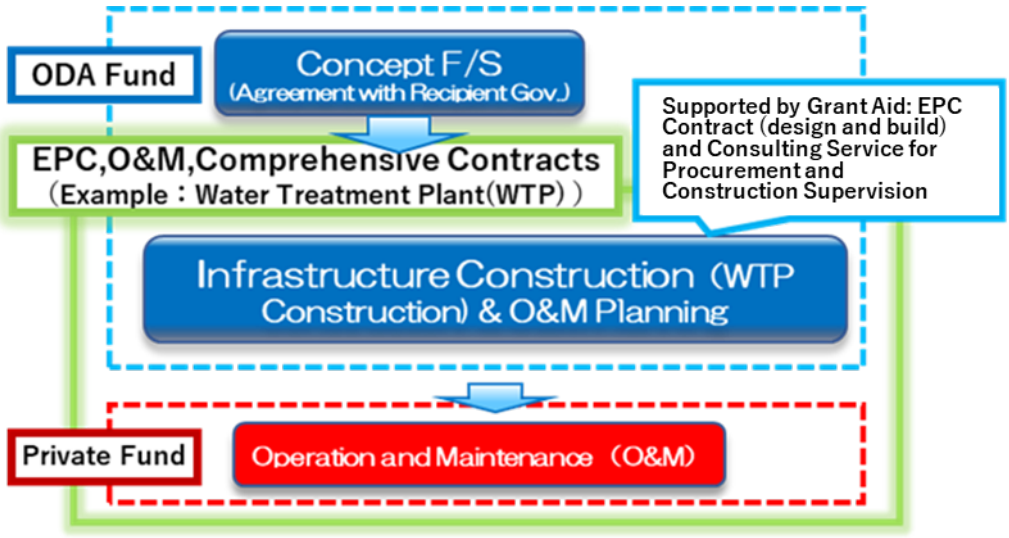


Figure 2-2.2 Japanese Grant Aid with O&M for the Project

The objective of the Project is to improve access to safe water in Ta Khmau City through the expansion of the water supply system, including construction, as well as operation and maintenance of a new water treatment plant in line with government strategy to increase the access ratio to safe water in urban areas.

The WTP facility shall be built based on the EPC contract; therefore, the ultimate design will be prepared by the selected bidder. In order to study appropriate size of the grant necessary, prepare requirements for the Project, and estimate the construction and O&M budget, “comparator

facilities" have been designed for reference.

PPWSA has requested grant aid based on PPWSA's strategy to invest with loan finance for the profitable areas that have relatively large number of commercial customers chargeable with high commercial tariff while utilizing ODA grants finance for expansion of water network in unprofitable areas with fewer commercial customers, including Ta Khmau City. Based on the requirement from the Cambodian government, field research and discussions with the Recipient, PPWSA, the outline design for the comparator facilities was developed under the following principles;

1). Construction of the facilities will be completed by 2023 and target year of the projected water demand will be 2030.
2). Capacity of water purification will be 30,000 m^3/day.
3). The design will comply with standards applied to other grant aid projects and PPWSA's standards as there is no design standard in Cambodia
4). Construction will be sub-contracted to local contractors and supervised by a Japanese contractor considering the ability, size and track record of the local contractors.
5). SPC (Cambodian entity) will operate and maintain the facilities for 10 years after construction.
6). The construction schedule shall consider avoidance of works for the construction of water intake facilities on the river during the rainy season when the river water level rises.

2-2-1-2 Environmental Factors

2-2-1-2-1 Precipitation

Climate of Ta Khmau city is classified as tropical monsoon climate. Rainy season is from May to October and dry season is from November to April. Construction schedule will be prepared based on the collected data on precipitation.

2-2-1-2-2 Topography and Geology

The ground and soil investigation are conducted at the planned intake and water treatment facility construction site. It was confirmed that viscous soil with N value of 50 or more is deposited around 45 to 50 m from the present ground elevation. The main structure will be pile foundation based on soil test results.

2-2-1-2-3 Water Volume and Water Level

Water intake facility is planned on the right bank of the Bassac River. According to the data of MoWRAM in last 5 years (2014-2018), the lowest flowrate of the Bassac river was 17 m^3/s (water level 1.59m), which occurred in April. The maximum flowrate was 5,229 m^3/s (water level 9.95m), which occurred in September. The construction of the intake facility will be greatly affected by the river water level, so the major construction period will be from November to May.

2-2-1-2-4 Water Quality

There are no harmful substances that are difficult to remove based on the results of the raw water source and water quality survey (**Table 1-2.1**). COD tends to be high, but there is no particular problem as a drinking water source. Turbidity is approximately 6 NTU to 300 NTU.

The concentration of Escherichia coli in the raw water is high due to the high ammonia concentration and the influence of drainage water upstream of the intake point. However, pre-chlorine and post-chlorination are planned for E. coli removal.

2-2-1-2-5 Policy on Socio-economic Conditions

Ta Khmau city is located south of Phnom Penh city and is a central city of Kandal province. Ta Khmau WTP is close to the commercial center of Ta Khmau city. Therefore, it is necessary to ensure traffic and safety during the construction period.

2-2-1-3 Socio Economic Factors

Ta Khmau city is located in the southern part of Phnom Penh Capital City and is a central city of Kandal province. Because the Ta Khmau WTP is close to the commercial center of the city, it is necessary to consider the maintenance of traffic and safety of traffic during the construction period.

2-2-1-4 Construction and Procurement Factors

Among the general construction materials, cement is produced in Cambodia. There are many cement factories around Phnom Penh city and Ta Khmau. The cement being produced is normally Portland and is available on the market.

There is no steel mill in Cambodia. Reinforcing bars and structural steel are imported from Thailand and Vietnam. Both are available in the local market.

Water treatment devices and equipment (pumps, etc.) will be selected with consideration of maintainability and availability of spare parts. Intake and distribution pumps, and especially large-scale equipment are not manufactured in Cambodia. They will be procured from Japanese manufacturers, using a process that ensures competitiveness to reduce costs. Chemicals for water treatment will be procured in Cambodia as much as possible.

2-2-1-5 Utilization of Local Contractors

Most of the grant aid projects implemented in Cambodia are implemented using local subcontractors. Many companies own general-purpose machines used for earthwork and concrete work, and lifting machines were also found in various places in Phnom Penh. According to Japanese prime contractors, many local contractors own general construction machineries but they are not sufficiently maintained and special purpose machines cannot be procured in Cambodia. Even if local contractors are used as subcontractors, the reality is that they are reinforcing human and machinery. Therefore, local contractor will be utilized under sufficient management of Japanese contractor.

2-2-1-6 Operation and Maintenance

O&M of the water treatment plant will be carried out by SPC. The operation and maintenance system at the comparator facility will be considered.

2-2-1-7 Facilities and Equipment to be installed

Mechanical and electrical equipment will be selected with maintenance and availability of spare

parts in consideration. In particular, competitiveness among Japanese bidders will be ensured for large equipment such as intake pumps and water distribution pumps to reduce costs.

2-2-1-8 Construction and Procurement Method and Schedule

Since the construction of water intake facilities is greatly affected by the rainy and dry seasons, it is necessary to pay attention to the setting of the commencement date and schedule.

2-2-1-9 Bidding and contracting principles under Japanese Grant Aid with O&M

The Project is composed of three contracting vehicles, an EPC contract, an O&M Contract and a Comprehensive Contract. The EPC contract is for the design and construction of WTP facilities and its hand-over to PPWSA, the O&M contract is for operation and maintenance of the facilities built and sales of purified bulk water to PPWSA, and Comprehensive Contract is to define the implementation policy and establishment of relationship between the EPC contract and the O&M Contract to transfer risk of malfunction of the facility and deterioration of the water quality. Therefore, before starting the bidding process, consistency among three contracts shall be checked and adjusted to control the performance of the project by the Private parties.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

The scope of the project is to construct a WTP with a capacity of 30,000 m^3/day for distributing water to Ta Khmau city and the surrounding area, and to carry out O&M for ten years. Components of the Project are shown in **Table 2-1.1**.

2-2-2-2 Water Demand Projection

To improve the accuracy of water demand projections, a new methodology was developed in Third Master Plan. It is not based on the length of pipes expected to be laid and connection ratios, but on the connection density (number of connections of any category per hectare of land). The reasons for revising the methodology are as follows:

The connection density can be directly related to the type of urban landscape in each Sangkat. As urban expansion spreads from the central area to the suburbs, it is possible to predict the development of sub-urban areas based on the history of recently developed central areas. There is a “physical reality” for understanding changes to connection density, unlike for the kilometers of pipes to be laid or the number of connections per kilometer of pipe.

Using Monte-Carlo simulation, the water demand predictions are based on forecasts of the following parameters for each Sangkat (including, for each year, expected value and standard deviation):

1). connection density (connections / ha)
2). % of domestic connections
3). daily consumption per domestic and non-domestic connection
4). % NRW

Number of connections and number of new connections per year in Phnom Penh city and Ta Khmau City are shown in **Figure 2-2.3** and **Figure 2-2.4**.

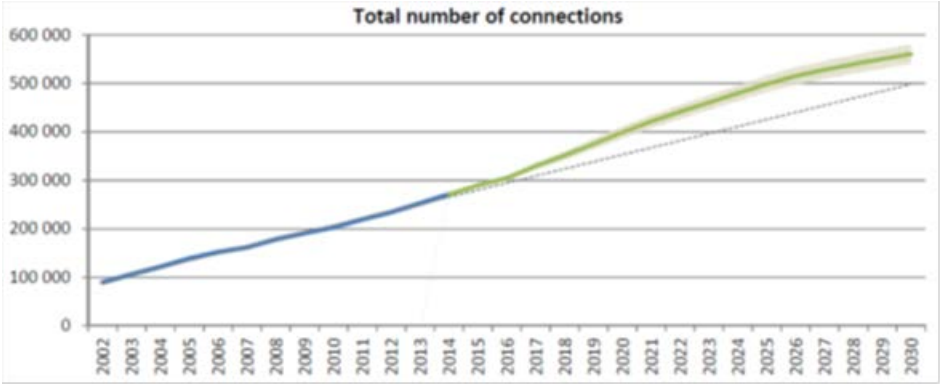


Figure 2-2.3 Number of Connections

Source: The Third Master Plan 2016-2030

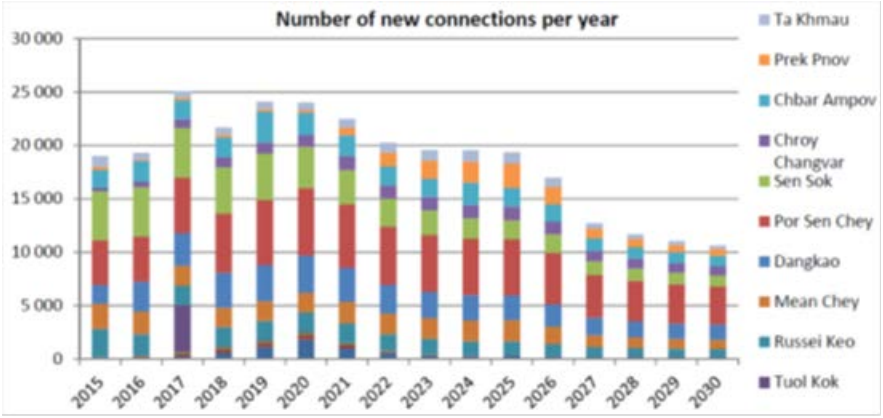


Figure 2-2.4 Number of New Connections per Year

Source: The Third Master Plan 2016-2030

Current and forecasted consumptions are summarized in **Table 2-2.1**.

Table 2-2.1 Water Demand Projection in Third Master Plan

Item	Condition	Remark
Consumptions per domestic connection	0.95 m^3/day in 2015 1.03 m^3/day in 2030	Average of 81 communes Average of 92 communes
Consumptions per non-domestic connection	3.50 m^3/day in 2015 3.65 m^3/day in 2030	Ditto
Daily peak factor	1.15	

Source: The Third Master Plan 2016-2030

Water demand projection in Third Master Plan based on the above parameters is shown in **Table 2-2.2**.

Table 2-2.2 Water Demand Projection of Ta Khmau City in Third Master Plan

		2015	2020	2025	2030
Consumption	m^3/day	11,668	14,854	19,556	21,966
NRW	%	8	10	10	10

		2015	2020	2025	2030
Leakage Amount		1,015	1,650	2,173	2,441
Average Demand	m^3/day	12,683	16,504	21,729	24,407
Peak factor		1.15	1.15	1.15	1.15
Maximum Demand	m^3/day	14,585	18,980	24,988	28,068

Source: The Third Master Plan 2016-2030

The water demand in 2030 by the two projection methods were about 28,000 to 29,000 m^3/day. Therefore, it is considered that the capacity of 30,000 m^3/day is appropriate for Ta Khmau WTP.

2-2-2-3 Water Intake and Raw Water Transmission Facility Plan

(1) Planned Water Intake Amount

Raw water will be taken from the Bassac River. Considering the amount of water loss (mainly sediment sludge and filter washing drainage) caused in the course of water treatment, the raw water intake volume will be 31,500 m^3 /day (30,000 m^3/day x 105% = 31,500 m^3/day).

(2) Intake Facility Plan

Cambodia has abundant experience in maintenance, and operation and management of water intake tower systems. PPWSA requested that a water intake tower system also be adopted for the Ta Khmau WTP.

On the other hand, in order to ensure stable water intake at low water level (+ 0.20m MSL) of the Bassac River, it is necessary to take water from a point approximately 50m off the river bank. In addition, since maintenance such as frequent backwashing of intake pipes and cleaning of coarse screens is required, a water intake tower system that does not require unstable water intake or frequent cleaning (of materials such as garbage or sediment) will be adopted as the outline design of the comparator facility. The intake tower method is effective considering the site restrictions of the Ta Khmau WTP because no water intake facility is constructed in the WTP.

(3) Intake Pump Plan

Vertical mixed flow type intake pumps will be installed in the intake tower. Cambodia has experience operating such intake pumps. A protective tube for pump shaft and water seal system will be provided. The estimated water level at the intake point is shown in **Figure 2-2.5**.

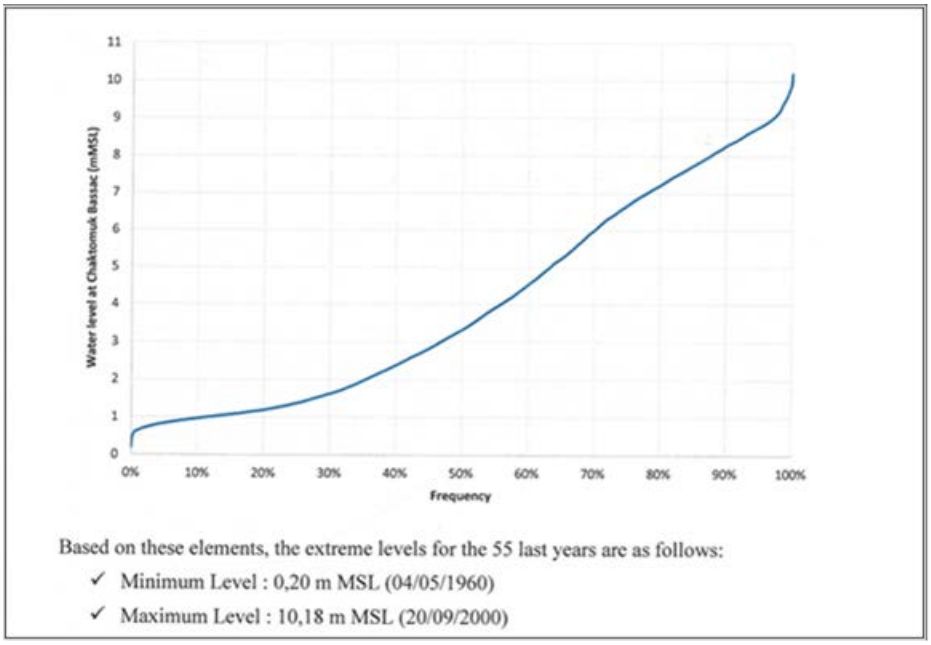


Figure 2-2.5 Water level in Bassac River by F / S at Chamcar Mon WTP

Source: The Third Master Plan 2016-2030

Since the intake water level is approximately 10 m, the pump shall have rotational speed control in consideration of economical intake flow control. The ancillary equipment required for the intake tower is shown in **Table 2-2.3**.

Table 2-2.3 Ancillary Equipment Required for Water Intake Tower

Equipment name	Purpose of installation
Intake gate	to carry out selective intake of water by intake tower closing and water level
Coarse and fine screen	to protect the pump impeller from debris
Sediment discharge pump	to remove sand and sludge expected to be deposited in the intake tower
Pump discharge pipe	to isolate and maintain the pump from other pumps and is necessary for pump start and stop (including valves)
Other equipment	Raw water pipeline and maintenance passage Crane for loading and unloading equipment Indoor and outdoor lighting

(4) Raw Water Transmission Facility Plan

Raw water taken in is transmitted through a transmission pipe from the intake facility to the WTP.

2-2-2-4 Water Treatment Facility Plan

(1) Raw Water Quality and Chemicals Necessary for Water Treatment

The water quality (turbidity, pH, ammonia nitrogen) of the Bassac River, has the following characteristics according to the record of the raw water quality at the intake point of the Chamcar Mon WTP between 2009 and 2017.

- The turbidity fluctuates significantly between dry and rainy season. The minimum value is

approximately 7 NTU, average value is 250 NTU and the maximum value is 1,088 NTU.
- pH is relatively high during rainy season and somewhat lower during dry season. The annual average is approximately 7.4 and the lowest is 6.7. Generally, the range is between 7.2 and 7.7.
- Ammonia nitrogen has an average value of approximately 0.5 mg/L in rainy season and approximately 0.2 mg/L in dry season. Monthly record shows that the value has been increasing since around 2016, and there are four instances in the record that exceed 1.0 mg/L. The maximum recorded value is 1.48 mg/L.

In the outline design of the comparator facility, ammonia nitrogen will be removed by chlorine. Chemicals for water treatment will be as follows:

- Coagulant: PAC
- Disinfectant: On-site sodium hypochlorite

(2) Water Treatment Facility Plan (Outline Design)

1) Design Turbidity

Based on the turbidity record of the Bassac River, at the intake point of the Chamcar Mon WTP as shown in **Figure 2-2.6**, the target turbidity of the WTP at the Comparator Facility is as follows:

- Design maximum turbidity: 1,000 NTU
- Design average turbidity: 120 NTU
- Design minimum turbidity: 10 NTU

For reference, the raw water quality of the Chamcar Mon WTP in the past eight years from 2009 to 2016 is as follows:

- Average turbidity in dry season: 40 NTU
- Average turbidity in rainy season: 245 NTU
- Average turbidity throughout the period: 115 NTU
- Maximum turbidity throughout the period: 1,088 NTU
- Minimum turbidity throughout the period: 7 NTU

The turbidity in approximately two-thirds of the year centering around the dry season is generally below 200 NTU. SOP and operation policy of the facility will be formulated according to the facility components designed by Contractor.

When the maximum turbidity of raw water exceeds 1,000 NTU, water treatment will be extremely uneconomical, and excessive burden on the filter system may make it impossible to wash the filter. To prevent damage to the filtration media, the comparator facility will be designed to restrict or interrupt water intake in such case.

Turbidity tends to rise during the rainy season, but since the upstream dam started operation in January 2009, turbidity exceeded 1,000 NTU only twice in eight years (February 2009 (1026 NTU) and in August 2015 (1,088 NTU)).

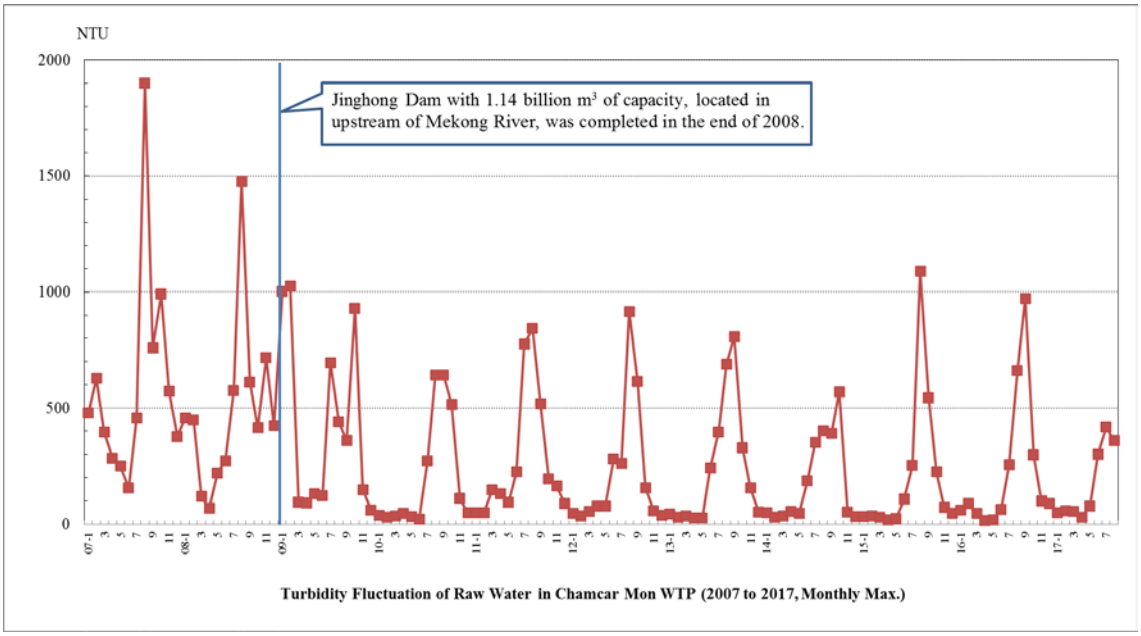


Figure 2-2.6 Turbidity Record at Chamcar Mon Intake Point

2) Water Treatment Process

The outline of the water treatment process is shown in **Figure 2-2.7**, and details are summarized in **Table 2-2.4**. The outline design of the comparator facility was determined considering construction cost and operation cost. The water treatment process is the same as that used in other Grant Aid projects implemented in Cambodia (Kampong Cham, Battambang and Kampot WTP).

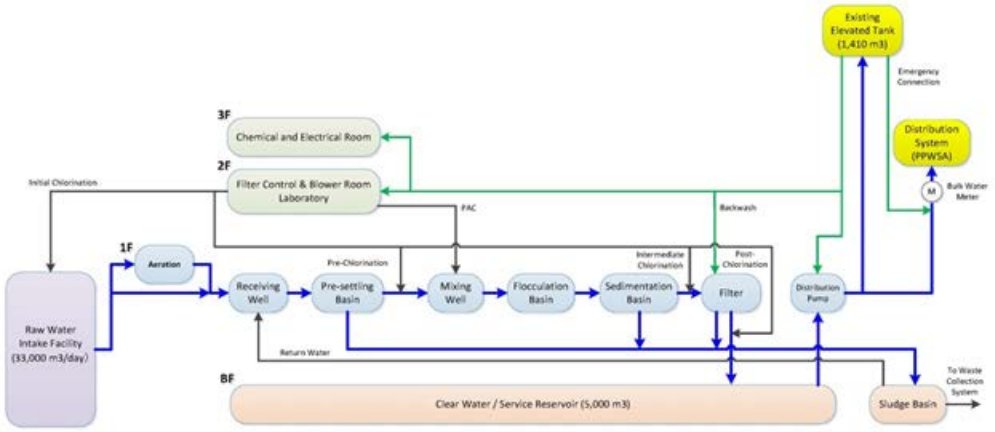


Figure 2-2.7 Water Treatment Process for the Outline Design of Comparator Facility

Table 2-2.4 Outline of Water Treatment Process

Treatment Process	Purpose
Aeration	Aeration is performed to reduce chlorination load.
Receiving Well	To suppress the change in discharge pressure of the intake pump and allow optimum operation without any hydraulic fluctuation in the subsequent treatment process.
Pre-settling Basin	To remove sand and relatively large suspended matter which flowed in with the raw water, and to reduce the injection amount of the coagulant required in the sedimentation process.
Mixing Process (Rapid Mixing)	To form fine flocs so that the coagulant can be injected uniformly into the raw water by giving large stirring energy in as short time as possible to mix raw water and coagulant. This is a hydraulic stirring system that coagulant is injected into a place where the raw water falls over the weir, and mixed with the raw water. This system has the following advantages over the other system (mechanical mixing machine and others). − No need to construct separate mixing tank. − Can be mixed reliably in a short time. − No need to install equipment such as mixer which requires stirring power. − More economical in construction and O&M cost than other methods. − Almost no need for maintenance and no need for long-term suspension of mixing tank in case of maintenance.
Flocculation Process	To provide gentle agitation energy and detention time to make the fine flocs produced by the mixing process grow. This is a method of mixing by the energy of the water flow itself. The horizontal baffled channel (with vertical baffled channel) method is adopted in which the mixing intensity gradually decreases as it goes downstream. This method has the following advantages over other methods (mechanical mixing). − No need to install equipment such as mixer which requires stirring power. − More economical in construction and O&M cost than other methods. − Almost no need for maintenance.
Sedimentation Process	To remove the floc created in the flocculation process by gravity sedimentation to reduce the burden on the subsequent filtration process. Tube settler upward flow sedimentation basin system that can take a large surface load is adopted since there is a limit to the construction area of the WTP. This method has been used in PPWSA WTP.
Filtration Process	To treat the settled water with fine flocs that could not be removed in the sedimentation step. There is a filtration method that captures fine flocs in the entire filter media using relatively large diameter filter media (sand) and washes the filter media with air and water. Other filtration method captures fine flocs in the surface layer of the filter media using filter media (sand) having a relatively small effective diameter and washes the filter media with water only. Most WTPs in Cambodia adopt the former method, and there are many operation results. Therefore, the former method will be adopted.
Clear Water/Service Reservoir	It is a facility where post-chlorinated water is injected into the filtered water and the finished clean water is stored, and at the same time it adjusts and relieves the imbalance between the amount of purified water and the amount of distributed water.
Filtered Wash Water	Closed system will be applied to the filtered wash water and it will be returned to the receiving well.
Chemical Feeding Process	Coagulant feeding equipment − Powdered PAC will be used. After dissolution, PAC solution will be injected by gravity. The injection volume corresponds to the maximum turbidity: 1000 NTU. Chlorine feeding equipment − On-site sodium hypochlorite formed by electrolyzing the salt is adopted. The feeding facility shall have the capacity that can process ammonia nitrogen in addition to the usual feeding process (pre-chlorine, medium-chlorine, post-chlorine). − Alkaline agent feeding equipment Powdered slaked lime is available as an alkaline agent. Judging from the raw water quality, there is no need to construct an alkaline agent feeding facility because the pH is relatively high and PAC is used as the coagulant.

3) Outline Design

General layout of the comparator facility in the outline design is shown in **Figure 2-2.8**.

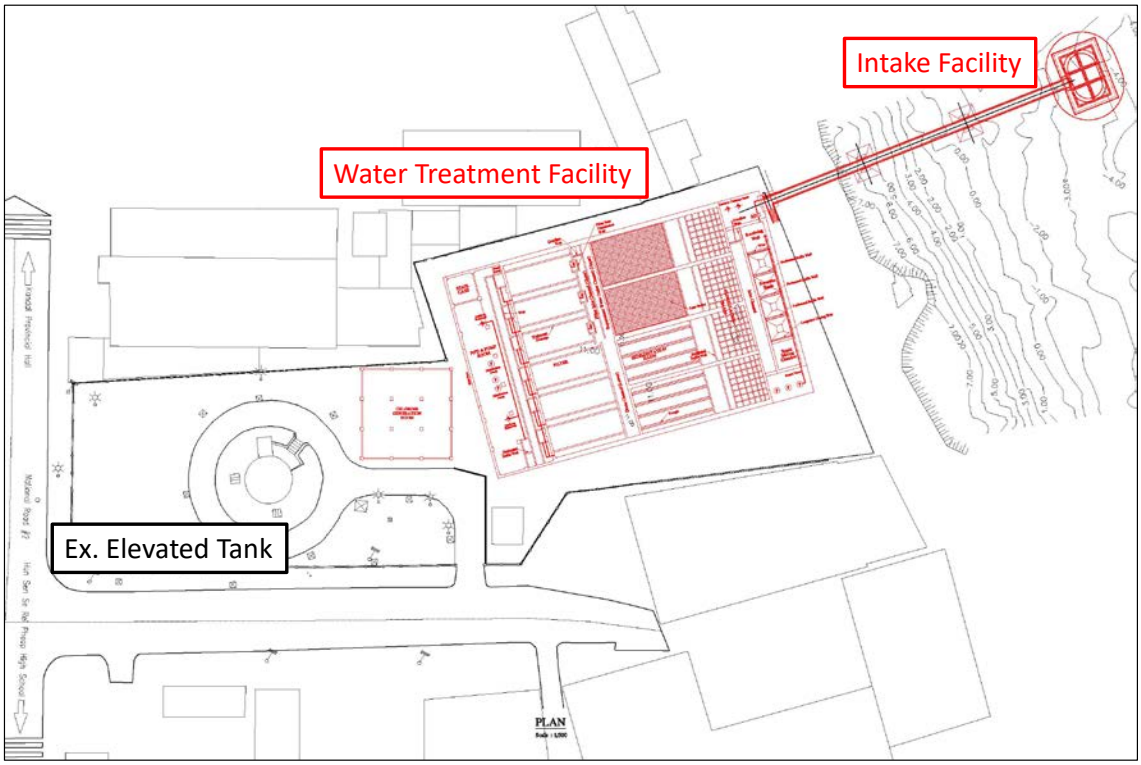


Figure 2-2.8 General Plan of Comparator Facility under Outline Design (draft)

2-2-2-5 Transmission and Distribution Facility Planning

(1) Water Distribution Plan

For the outline design of the comparator facility, a direct-pump distribution system is adopted considering the fact that the water supply area is almost flat and economics of distribution energy. The direct-pump water distribution system will keep the discharge pressure of the distribution pump constant, and the water distribution pressure can be controlled by the number of pumps and pump speed. SPC is required to operate distribution pumps to keep required discharge pressure at off-take point.

(2) Distribution Amount Fluctuation and Reservoir Capacity

Distribution flow record to Ta Khmau over the past year was reviewed and the peak distribution volume factor and distribution reservoir capacity are as follows (**Figure 2-2.9**).

- Distribution amount peak factor: 1.4
- Reservoir capacity: 4 hours

Ta Khmau Reservoir

Day max. =	30000	m3/day	Res. Cap.=	5000	m3
=	1250.00	m3/hr	Effec. Dpt.=	5	m3
Day ave.=	30000.0	m3/day	Effec.Area=	1000	m2
	1250.0	m3/hr		4.0	hours

Time (hr)	Peak Factor	% of Daily Demand (%)	Water Demand (m3/hr)	Fire Demand (m3/hr)	Total Outlet	Inlet (m3/hr)	Volume (m3)	Water Level (m)
0								
6:00	1.10	4.6%	1,375		1,375	1,250	4,875	4.9
7:00	1.36	5.7%	1,700		1,700	1,250	4,425	4.4
8:00	1.31	5.5%	1,638		1,638	1,250	4,038	4.0
9:00	1.25	5.2%	1,563		1,563	1,250	3,725	3.7
10:00	1.22	5.1%	1,525		1,525	1,250	3,450	3.5
11:00	1.20	5.0%	1,500		1,500	1,250	3,200	3.2
12:00	1.18	4.9%	1,475		1,475	1,250	2,975	3.0
13:00	1.12	4.7%	1,400		1,400	1,250	2,825	2.8
14:00	1.08	4.5%	1,350		1,350	1,250	2,725	2.7
15:00	1.06	4.4%	1,325		1,325	1,250	2,650	2.7
16:00	1.08	4.5%	1,350		1,350	1,250	2,550	2.6
17:00	1.20	5.0%	1,500		1,500	1,250	2,300	2.3
18:00	1.26	5.3%	1,575		1,575	1,250	1,975	2.0
19:00	1.27	5.3%	1,588		1,588	1,250	1,638	1.6
20:00	1.21	5.0%	1,513		1,513	1,250	1,375	1.4
21:00	1.13	4.7%	1,413		1,413	1,250	1,213	1.2
22:00	0.94	3.9%	1,175		1,175	1,250	1,288	1.3
23:00	0.76	3.2%	950		950	1,250	1,588	1.6
0:00	0.64	2.7%	800		800	1,250	2,038	2.0
1:00	0.54	2.3%	675		675	1,250	2,613	2.6
2:00	0.49	2.0%	613		613	1,250	3,250	3.3
3:00	0.48	2.0%	600		600	1,250	3,900	3.9
4:00	0.49	2.0%	613		613	1,250	4,538	4.5
5:00	0.63	2.6%	788		788	1,250	5,000	5.0
Total	24	100%	30000	0		Min.	1212.50	1.21
			Total	30000				

Max.	1.36	Required Min. Cap. of Res. (hour)	
Min.	0.48		3.03 hr

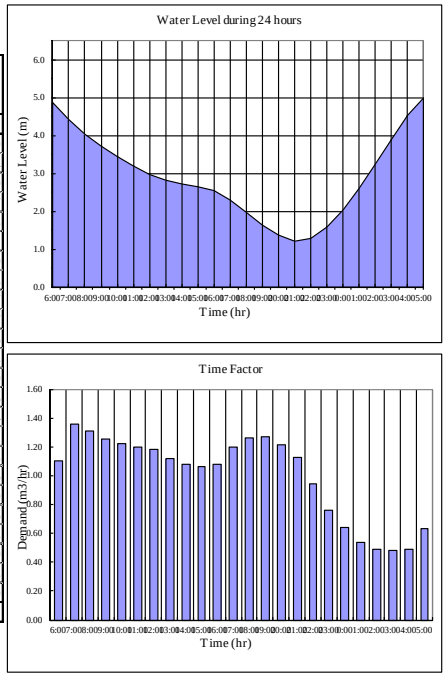


Figure 2-2.9 Water Distribution Hourly Fluctuation Rate and Reservoir Capacity

(3) Use of Existing Elevated Tank

The existing elevated tank at the Ta Khmau WTP can be used effectively in the future as its construction is new and well maintained. However, since the water level of the elevated tank is lower than the designed optimal distribution pressure in the outline design of the comparator facility, the elevated tank cannot be used for water distribution.

Therefore, the elevated tank will be used for supplying filter wash water, site water, and emergency water supply during distribution pump stoppage due to power failure etc.

(4) Transmission and Distribution Pipe Planning

Installation of water distribution pipes is not included in the scope of the project. This will be implemented by PPWSA. The outline of the transmission and distribution pipe maintenance plan by PPWSA is shown in **Figure 2-2.10**.

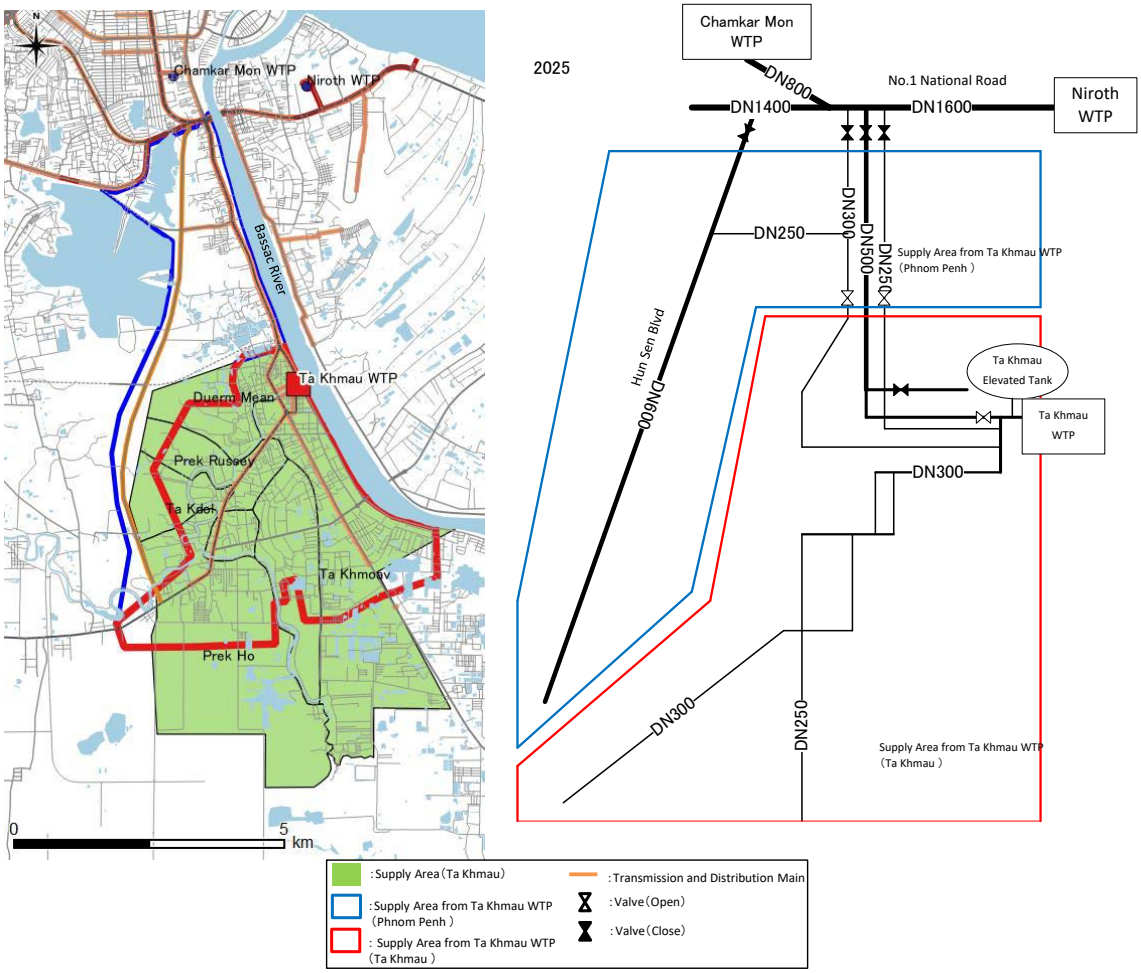


Figure 2-2.10 Outline of PPWSA Transmission and Distribution Plan

After completion of the Ta Khmau WTP, it is planned to distribute water to Ta Khmau City and the southern side of Phnom Penh. For distribution in the southern part of Phnom Penh, PPWSA plans to install a new 600 mm diameter pipe along Hun Sen Road. Areas along the south side of National Road No.1 and along Hun Sen Road of Phnom Penh City will be supplied from Ta Khmau WTP.

PPWSA will install the distribution system which has capacity of more than 30,000m^3/day and purchase 30,000 m^3/day of treated water per day from SPC. If the production volume falls below this, caused by any reason on PPWSA side such as insufficient demand of water or malfunction of the distribution network, SPC shall discuss it with PPWSA.

If the water demand in the distribution area in Ta Khmau falls below 30,000 m^3/day, the excess water can be distributed to other areas of Ta Khmau and Phnom Penh maintained by PPWSA.

2-2-2-6 Mechanical Equipment Planning

For the outline design of the comparator facility, mechanical equipment shall be high efficiency, long life, few failures, with low initial investment and maintenance costs. Major mechanical equipment of the comparator facility is shown in **Table 2-2.5**.

Table 2-2.5 Major Mechanical Equipment

Equipment Name	Location
1. Intake pump equipment − Intake pump − Inflow gate − Intake pump discharge piping (including valves) − Sediment discharge pump − Equipment loading crane	Intake pump station
2. Pre-settling basin facility (piping and valves)	Pre-settling basin
3. Coagulant feeding pipe	Mixing well
4. Sedimentation basin sludge extraction piping (including automatic valves) equipment	Sedimentation basin
5. Filter equipment − Inflow valve and outflow, cleaning piping (including automatic valve) equipment − Blower for air cleaning	Filter
6. Distribution pump equipment − Distribution pump − Distribution pump discharge piping (including valves) − Crane for loading equipment − On-site water supply branch piping (including valves)	Distribution pump station
7. Chemical feeding equipment − Coagulant (PAC) feeding equipment − Chlorination agent production and injection equipment	Chemical feeding room
8. Drainage basin equipment − Wastewater return pump − Sludge extraction pump − Drainage and sludge extraction pump discharge piping (including valves) − Hoists for pump maintenance	Drainage basin

2-2-2-7 Electrical Equipment Planning

(1) Power Receiving and Transforming Plan

The WTP receives electricity at 22kV from the distribution line of the Electricité du Cambodge (hereinafter referred to as EDC). The 22kV received will be stepped down by transformers (to be installed in the WTP) and will be distributed to each panel. Transformers conforming to EDC's specifications will be installed by Contractor. Construction of utility poles and piping/wiring work from the power receiving point to the transformer, and application for electricity connection will be borne by the Cambodian side.

(2) Power Outage Measures

Due to the shortage of power supply capacity in the dry season, scheduled power suspension was conducted from March to May 2019. The target areas were Phnom Penh city and Kandal province, including Ta Khmau City. The Project team asked EDC whether it was possible to receive two circuits from different substations. EDC confirmed that power can be delivered from different substations and power systems, such as from northern circuit and southern circuit. In addition, EDC confirmed that simultaneous blackouts can be avoided if prior consultation is made in advance, even in the case of planned power curtailments.

As a countermeasure of power failures, Ta Khmau WTP will receive two circuits. Construction of redundant power receiving equipment is economically favorable to investment in private

power generation infrastructure. In addition, available land area is limited and the two-line power receiving equipment can be installed in a space-saving manner. The Niroth WTP, which was completed in 2017, adopts a similar method of receiving two lines of duty and standby.

(3) SCADA

For the outline design of the comparator facility, SCADA to control equipment and monitor status of the measured items in an integrated manner will be installed. The configuration of the SCADA system is shown in **Figure 2-2.11**.

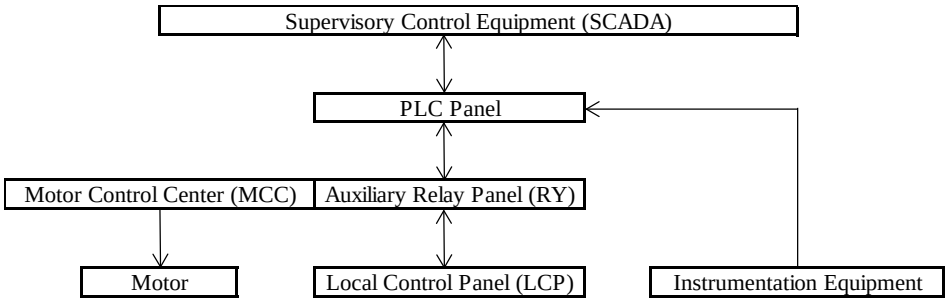


Figure 2-2.11 System Configuration of SCADA

Each digital and analog signal from the field is input to the sequencer board and transmitted to the SCADA, and the control signal from the SCADA is input to the auxiliary relay board via the sequencer board. Items of monitoring are as follows.

Table 2-2.6 Item of Monitoring

Operation condition	Flow meter	Water level	Water Pressure	Water quality
− Intake pump − Distribution pump − Air scouring blower − Motorized valve − Sludge extraction pump − Chemical feed facility	− Intake flow − Distribution flow − Back wash flow − Filter flow	− Bassac river water level − Clear water tank water level − Chemical preparation tank water level	− Distribution water pressure	− Chromaticity − pH (Receiving well, after Sedimentation basin) − TDS or Conductivity − Turbidity − (Receiving well, after Sedimentation basin, after Filter basin)

(4) Equipment Planning

Electrical equipment will have high efficiency, long life, few failures, and low initial investment and maintenance costs. Major electrical facilities of the comparator facility are shown in **Table 2-2.7**.

Table 2-2.7 Main Electrical Equipment

Equipment Name	Location
1. Power receiving and transforming equipment − Transformer (duty line) − Transformer (standby line) − Switchboard	 Outdoor Outdoor Indoor

Equipment Name	Location
2. Operation control equipment − Motor control center (including VFD panel) − Auxiliary relay panel − Local control panel	 Electrical room Electrical room Local
3. Instrumentation equipment − Flowmeter − Water level gauge	 Each measurement location Each measurement location
4. Supervisory control equipment − SCADA − PLC panel	 Monitoring room Monitoring room

2-2-2-8 Procurement Situation Survey

(1) General Materials

Among the main materials related to construction, cement is produced in Cambodia, and large-scale premix concrete plants with Thai capital exist in various places in Phnom Penh. As for structural steel and rebar, imported products from Vietnam, Thailand, etc. are available in the city.

(2) Mechanical and Electrical Equipment

Mechanical and electrical equipment cannot be produced in Cambodia, so it will be procured in Japan, but what can be procured in neighboring countries such as Thailand and Vietnam will be procured from these third countries.

(3) Domestic Transport

Sea transportation of equipment procured from Japan and third countries will be landed at Sihanoukville Port, and carried inland via Route 4 to Phnom Penh. Sihanoukville Port is the largest commercial port in Cambodia, has a large container base, and has no transportation problems. The road condition of the transportation route from Sihanoukville to Phnom Penh is good.

(4) Construction Plan

Ta Khmau is located in the southern part of Phnom Penh. The climate is a tropical monsoon, with the rainy season from May to October and the dry season from November to April.

The water intake facility is planned on the right bank of the Bassac River. The construction of intake facilities will be greatly affected by the river water level. Major construction will be carried out during the dry season.

(5) Soft Component (Technical Assistance) Plan

Soft Component (Technical Assistance) will not be provided for this project.

2-2-3 Outline Design Drawings

The drawing list of the outline design of comparator facilities is shown in **Table 2-2.8**. Outline design drawings of comparator facilities are shown in attached Appendix.

Table 2-2.8 List of Outline Design Drawings

No.	Facility	Drawing Title	Dwg No.
1	General	General Plan (1)	G-1
2		General Plan (2)	G-2
3		General Plan (3)	G-3
4		General Plan (4)	G-4
5	Intake	Raw Water Pump Station General Plan (1)	I-1
6		Raw Water Pump Station General Plan (2)	I-2
7		Raw Water Pump Station General Plan (3)	I-3
8		Raw Water Pump Station General Plan (4)	I-4
9		Raw Water Pump Station General Plan (5)	I-5
10		Raw Water Pump Station General Plan (6)	I-6
11		Raw Water Pump Station General Plan (7)	I-7
12	Treatment Facility	Water Treatment Plant General Plan (1)	W-1
13		Water Treatment Plant General Plan (2)	W-2
14		Water Treatment Plant General Plan (3)	W-3
15		Water Treatment Plant General Plan (4)	W-4
16		Water Treatment Plant General Plan (5)	W-5
17		Water Treatment Plant General Plan (6)	W-6
18		Water Treatment Plant General Plan (7)	W-7
19		Water Treatment Plant General Plan (8)	W-8
20		Water Treatment Plant General Plan (9)	W-9
21		Water Treatment Plant General Plan (10)	W-10

2-2-4 Contracting Structure and Bidding Evaluation

2-2-4-1 Contracting Structure

The contracting structure of the Project is Design, Build and Operate (DBO). The contracting entity shall be a Japanese company or Japanese companies (hereinafter called as "the Contractor") in charge of WTP facility design and construction, and a SPC established in Cambodia in charge of O&M service provision.

- The bidding process shall comprise the requirements for the WTP facilities design build and O&M services as provided by PPWSA, and the bidder will propose their own work plan and tender price.
- PPWSA will enter into the EPC contract (grant applicable portion) and the O&M contract (non-grant applicable portion except for contract preparation and monitoring related consulting services) as well as the comprehensive contract, with the Contractor.
- After completion of EPC works and commissioning tests, the WTP facilities will be handed over to PPWSA with defect liability period of 1 year.
- The SPC established by the members of the Contractor in Cambodia for provision of the O&M service will operate and manage the facilities for a period of 10 years after completion of the EPC works. The SPC will supply bulk water to PPWSA and PPWSA will pay performance-based fees to the SPC.

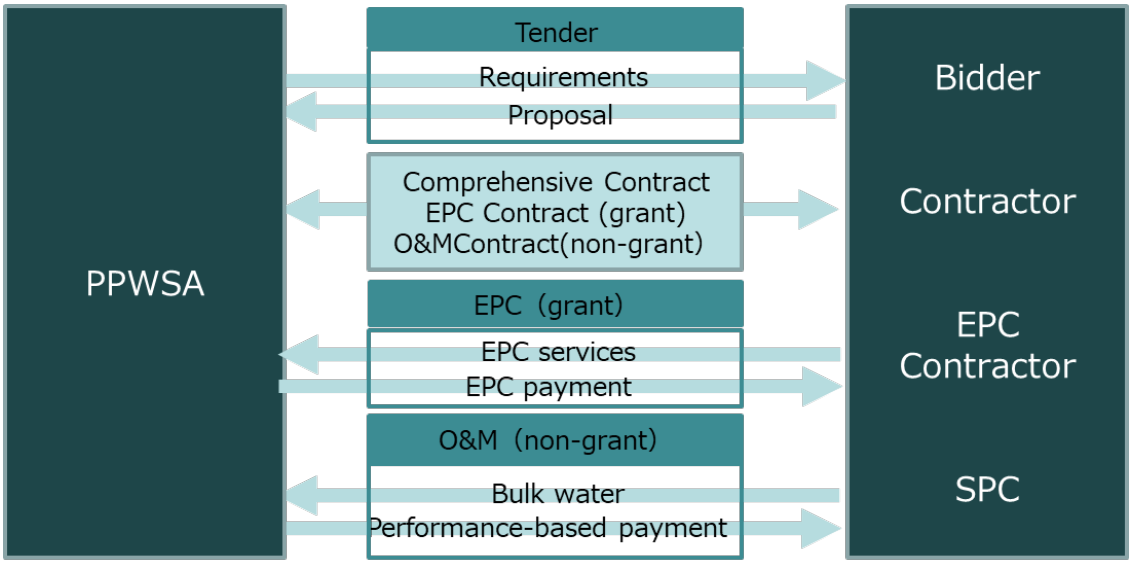


Figure 2-2.12 Contracting Structure

The Project shall include O&M service that will be provided by the SPC and in this respect both PPWSA and the MEF have agreed in the M/D that the bidding for Japanese Grant Aid with O&M should be Japan-tied in accordance with JICA's procurement rules based on the Article 3 of the Public Procurement Law in Cambodia.

2-2-4-2 Bidding Evaluation

The bidding process shall consist of a two- step process: a pre-qualification exercise (hereinafter referred to as "P/Q") and the evaluation of bids sought from pre-qualified bidders. Quality and Cost Based Selection (hereinafter referred to as "QCBS") that includes technical, commercial, financial and legal evaluation will be applied for the evaluation of the bids.

2-2-4-2-1 Pre-qualification

Under the pre-qualification process, the consultants will prepare exclusion grounds and selection criteria and shall require tenderers to submit a P/Q application. If a member of tenderers has engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices, or has inadequate organization or financial structure, it will be disqualified based on the respective criteria for disqualification. Selection criteria shall be set for Grant Aid with O&M Scheme as below.

Table 2-2.9 P/Q Selecting Criteria for the Project

P/Q selection criteria for traditional Grant Aid	P/Q selection criteria for Grant Aid with O&M
1. Business Organization and its eligibility	1. Business Organization and its eligibility
2. Financial situation	2. Financial situation
3. Track record of overseas construction project	3. Track record of overseas construction and operation
4. Track record of similar project	4, Track record of similar project (construction and O&M)
5. Number of engineers	5. Number of engineers with O&M experience

2-2-4-2-2 Bidding Evaluation

In the bidding process, PPWSA shall set the requirements for the facilities and O&M work, and the tenderer will propose its own work plan and tender price. The comprehensive evaluation score will be established using following formula:

Comprehensive Evaluation Score = Technical Score * X + Price Score * (1-X)

where X is a weight factor 1>X>0 (In this stage the Consultants propose 0.5 as X.)

Please refer the separate sheet for the analysis of the weight factor X of Price score)

2-2-4-2-3 Technical Evaluation

Table 2-2.10 Technical Evaluation and Award Criteria

	Award criteria	Award sub-criteria	Score
1	Tenderer experience with respect to comparable projects	Technology, performance, social and environmental considerations	TBA（To be agreed）
2	Proposed organization	Project management, risk management, quality management	TBA
3	Experience of key staff in relation to the scope of work	Qualification and experience	TBA
4	Basic design	Water intake tower, treatment plant, distribution pumps	TBA
5	Construction plan	Proposal of shortening construction schedule, implementation of new methodology and new technology	TBA
6	O&M plan	Automation, semi-automated management	TBA
Total			100

2-2-4-2-4 Price Evaluation

The tenderer bids on 10-year Life Cycle Cost (LCC) where

10-year LCC = EPC price + Net present value of O&M costs discounted at 4.5%

Price score = Lowest Price / Price of the Tenderer * 100

4.5% is the discount rate used by PPWSA when they make a feasibility study for a new investment. Tenderers shall propose following green cell portion of **Table 2-2.11**.

1). EPC price,
2). 10-year average O&M Cost(α),
3). 10-year average fixed volume of electricity usage(β), and
4). the margin rate at bidding to calculate 10-year LCC (green cells)

Table 2-2.11 Price Sheet – 10-Year Total Cost to PPWSA(Example)

Assumptions			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Production	000m3			10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	…(1)
Electricity price	KHR/kWh			584	584	584	584	584	584	584	584	584	584	
Other factors														

EPC cost			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
EPC price	000JPY	X												
O&M costs			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Electricity	000,000KHR			1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932	…(2)
Electricity consumption	000kWh			3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309	…(2')
Other operating costs	000,000KHR			1,789	1,988	1,988	1,988	1,988	1,988	1,988	1,988	1,988	2,187	…(3)

α	**Unit cost of production excl. electricity (10-year average)**	**KHR/m3**	**302**	=sum((3))/sum((1))
β	**Unit consumption of electricity (10-year average)**	**Wh/m3**	**182**	=sum((2'))/sum((1))

Offtake price		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
SPC margin	%		15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Offtake price	KHR/m3		432	438	445	453	460	468	476	484	493	501

Total cost to PPWSA			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
EPC	000KHR	X'												
Bulk water	000KHR			4,725	4,800	4,878	4,957	5,040	5,124	5,211	5,301	5,393	5,489	
Total	000KHR	X'		4,725	4,800	4,878	4,957	5,040	5,124	5,211	5,301	5,393	5,489	…(4)

Net present value of total cost to PPW	**KHR000**	**Net present value of (4**

Bidding will be implemented as below.

1). A tenderer consisting of companies with relevant experience and capabilities will be an entity for the tender.
2). At the time of bidding, the tenderer shall submit a JV agreement that stipulates roles of each company and equity structure of SPC to be established after the tenderer is awarded. The minimum equity requirement for SPC will be discussed and agreed to with PPWSA. The investment amount of SPC must exceed the minimum equity requirement of SPC for this project and equity ratio of the EPC contractor to SPC shall be more than the minimum equity ratio required for EPC contractor.
3). The contracting entity during EPC stage will be a Japanese company or Japanese companies as the Contractor, and the same during the O&M stage will be a Cambodian SPC established by the Contractor or the main members of the Contractors, such as EPC contractor and O&M operator.
4). There will be three (3) contracts, comprising an EPC contract, an O&M contract, and, a comprehensive contract to transfer "the facility malfunction risk excluding the existing elevated water tank deterioration risk" and "treated water's poor quality risk" to the Contractor by integrating both the EPC and O&M contracts, and they shall be concluded at the same time with the Contractor after tender award. It is assumed that the O&M contract will be novated from the Contractor to SPC at the time of SPC establishment in Cambodia.

Items that need to be determined in the SPC minimum investment requirements:

- Minimum investment requirement: A minimum investment requirement for SPC establishment.
- Minimum investment ratio of EPC contractor: Indicates the ratio of investment by SPC contractor to the total investment in SPC investment, and EPC contractor must make an investment exceeding the minimum investment ratio.

The requirement of project track record will be set to ensure competitiveness of the tender, considering the objectives of the Japanese Grant Aid with O&M Scheme.

2-2-4-3 Risk Allocation

Generally, a party which could best manage the risk will own the risk. Based on the principle the risk allocation for the Project is shown below.

Table 2-2.12 Risk Allocation

Risks	PPWSA	SPC	Remarks/Examples
Risks related to EPC contract			
EPC risk	O	O	− Any additional costs caused by PPWSA such as costs caused by PPWSA's variation order to SPC, UXO related costs, shall be borne by PPWSA − Any additional costs caused by change in external conditions such as costs caused by unforeseen ground conditions, major inflation during construction period shall be borne by PPWSA. These costs may be covered by contingency budget of the grant which is applicable according to the JICA guideline. − Any additional costs under the responsibility of SPC such as costs caused by design deficiency, inflation during construction period shall be borne by SPC.
Force majeure risk at the facility construction stage	O		− A Force Majeure is an event that is external, unpredictable, and irresistible and has a significant impact on the project. However, if a Force Majeure should occur during the facility construction stage, such cost shall be borne by PPWSA. (However, such compensation amount will be within the JICA's contingency budget.)
Risks related to O&M contract			
Demand risk	O		− PPWSA shall pay for 30,000m^3/day of treated water if SPC provides or is able to provide 30,000m^3/day of treated water that satisfies the required water quality on a monthly average, regardless of any reason on PPWSA side such as insufficient demand of water or malfunction of the distribution network.
Operation risk		O	− No payment shall be made if the delivered water does not satisfy the water quality requirement due to poor operation by SPC such as facility malfunction, inappropriate usage of water treatment chemicals etc. − In case the water delivered by SPC does not comply with national drinking water standards required by PPWSA and shall result in damages to PPWSA and end-customers, SPC shall compensate for such damage suffered by PPWSA and end-customers.
Electricity price risk	△		− PPWSA takes part of electricity price fluctuation risk, by adjusting the price of bulk water through applying a payment mechanism (price calculation formula) every three years. The price calculation formula is linked to the electricity price and inflation rate. If the calculation result exceeds the bulk water price that has been applied up to the time of the review (current bulk water price), the new bulk water price will be applied. However, if the calculation result falls below the current bulk water price, the current bulk water price will remain unchanged.
Electricity availability risk		O	− In case the electricity is not supplied to the facility due to blackout, neither SPC shall have an obligation to supply water to PPWSA, nor shall PPWSA be obliged to pay SPC for the period of the blackout. SPC does not have a right to claim operating loss caused by such blackout to PPWSA.

Risks	PPWSA	SPC	Remarks/Examples
Inflation risk (during O&M period)	△	△	− PPWSA shall take part of the inflation risk by adjusting the price of bulk water through applying a price calculation formula every three years. The price calculation formula is linked to the electricity price and inflation rate. If the calculation result exceeds the current bulk water price, the new bulk water price is applied. However, if the calculation result falls below the current bulk water price, the current bulk water price will remain unchanged. For inflation, All Items (CPI TOTAL) published monthly by the Cambodian National Bureau of Statistics or a reasonably applicable indicator is applied.
Foreign exchange rate risk		O	− Foreign exchange rate risk associated with SPC equity and profit/dividend shall borne by SPC.
Raw water quality risk	O		− Additional cost of production due to change in quality of raw water shall be paid by PPWSA based on the result of the negotiation between PPWSA and SPC
Licensing risk	O		− IEIA/EIA or any other permit/authorization necessary for the SPC to operate the facility shall be obtained by PPWSA.
Legal risk (change of project specific law)	O		− Additional cost caused by a change in law that specifically affects the project (e.g. upgrade of national quality standard for drinking water) shall be compensated by PPWSA based on the invoice submitted by the SPC.
Legal risk (change of general law)		O	− Additional cost caused by a change in general law that would affect the whole economy (e.g. VAT) shall be covered by the SPC.
Force Majeure risk	O	O	− A Force Majeure is an event that is external, unpredictable, and irresistible and has a significant impact on the project. Both parties may terminate the contract if the impact of a Force Majeure lasts more than 180 days. Neither party has any obligation to each other for the cost of mitigation measures to prevent increasing loss caused by Force Majeure. PPWSA shall have the option to require SPC to transfer to PPWSA all of its right, title and interest in and to the assets. The value of the assets shall be net book value of the assets.

Financial and credit risks for the SPC in relation to contract with PPWSA are supposed to be limited.

2-2-4-4 Payment mechanism and price formula for bulk water supply

2-2-4-4-1 Off-take Price

The SPC shall deliver bulk water to PPWSA and PPWSA, in return, shall pay the SPC according to performance. The price formula shall incorporate the price factors (α, β and agreed margin for SPC) as detailed below.

SPC Invoice (PPWSA payment to SPC) = sales of bulk water + additional services – compensation

Sales of bulk water = volume of water delivered * unit price of bulk water

Unit price of bulk water = α * inflation index + β * electricity price
+ additional production costs + agreed margin for SPC

α	α is a fixed (agreed) basis for O&M costs excluding electricity defined in the contract
β	β is a fixed (agreed) volume of electricity usage per m^3 defined in the contract
agreed margin for SPC	Applicable in the event of quality deterioration of raw water or change in water quality standards which result in additional production costs.

additional production costs	Additional services include deeper analysis of water quality or site visit tour or any other services that are not included in the ordinary O&M activities defined in the contract.
additional services	Additional services include deeper analysis of water quality or site visit tour or any other services that are not included in the ordinary O&M activities defined in the contract.
compensation	SPC shall compensate for any damage (e.g. compensation to end-customers) incurred by PPWSA as a result of negligence or malpractice of the SPC

Factors of Price Formula

Included in "α"	Labor cost (facility operation, SPC management, a Japanese CEO), raw materials, repair, office expenses, financial/legal services, transportation, social securities, VAT/import tax on raw materials, (insurance of facilities and third-party liability cover, if necessary)
Not included in "α"	Overheads to investing companies.
Difference in "α" and PPWSA's cost	PPWSA's cost includes depreciation while SPC's "α" does not as the facilities will be owned by PPWSA. SPC's "α"includes back office expense while PPWSA'S cost does not.

* Assumptions: Inflation rate 3.0%, Electricity cost KHR584/kWh

PPWSA's results in 2017

Items	Cost (KHR/m^3)
Electricity	172.11 (275Wh/m^3)
Depreciation	82.86
Repair	38.85
Raw material	33.45
Labor	18.68
TOTAL	345.95

The detailed bulk water price adjustment method, which practically explains how to use the inflation index and electricity price, shall be agreed with PPWSA during the draft tender document preparation stage. PPWSA agreed to revise the bulk water price every 3 years. Revision calculation will be based on the above-mentioned formula entitled “Unit price of bulk water”. If the calculation result exceeds the current bulk water price, the new bulk water price shall be applied. However, if the calculation result falls below the current bulk water price, the current bulk water price will remain unchanged during succeeding 3 years.

2-2-4-4-2 Electricity Price

Electricity prices by customer type are shown below. The WTP of the Project is an industrial customer subject to price No.4 and required to pay 0.1470USD/kWh.

Table 2-2.13 Electricity Price by Customer

No.	Type of customers and Condition of Purchase	Tariff	Note
1	Connection from HV of sub-station	0.1170 USD/kWh	Customers can pay the consumption in Riels with the official exchange rate of EDC.
2	Connection from MV of sub-station in Phnom Penh and Ta Khmau	0.1350 USD/kWh	
3	Connection from MV of sub-station in other provinces	0.1220 USD/kWh	
4	Connection from distribution line and sub-transmission line by MV meter for industrial customers	0.1470 USD/kWh	
5	Connection from distribution line and sub-transmission line by MV meter for commercial and institution customers	0.1590 USD/kWh	

Source：EDC

PPWSA will contract with electric power company and pay the bill. The SPC pays a part of the bill to PPWSA in the portion of the SPC's usage measured by an electricity meter installed at the facility and shall receive revenue of the sales of bulk water from PPWSA. Therefore, if the actual usage amount of electric power by the SPC is less than the amount agreed with PPWSA, the SPC's electric power cost will be reduced. In such case, not only the SPC will reduce the costs, but also PPWSA can reduce its electricity power payment to electric power supply company at the same time. If the actual usage amount of electric power by SPC should exceed the amount agreed with PPWSA, the SPC shall pay the electricity bill in the amount actually used by them, consequently PPWSA shall have transferred electricity cost variation risk to the SPC in respect of latter's actual usage.

2-2-4-4-3 Chemical Procurement Price

Chemicals used by the SPC for water treatment may be purchased through PPWSA at the same price of PPWSA's purchasing price if such chemical are compatible.

2-2-4-5 Contract Terms

Other contract terms and conditions are shown below.

Table 2-2.14 Other Contract Terms

Contract terms	Conditions
O&M period	− After the completion of the new WTP, the ownership of the WTP will be transferred from the SPC to PPWSA. Then, PPWSA and the SPC shall agree to an O&M contract for 10 years after commencement (definition is to be agreed) of O&M on the facilities owned by PPWSA.
Production of bulk water	− Production of bulk water is fundamentally a responsibility of the SPC.
Repairment	− During O&M period, SPC may use leased facilities free of charge, however, the SPC shall be responsible for any repairs of the facilities at its own cost. SPC shall maintain and ensure the good upkeep of the facilities and equipment in accordance with PPWSA's Standard Operation Procedure (SOP).
Facility	− Intake facility shall be intake tower type − Chlorination shall be on-site chlorination system − Capacity of service reservoir shall be 5,000 m^3/or more − Treated water quality shall be met with Cambodian, National Drinking Water Quality Standard (MIH), in addition, 1 NTU or less is required at outlet of filter − Bulk water volume shall be 30,000 m^3/day − Bulk water shall be supplied around the clock − Discharge pressure at off-take point shall be 4 bar or more
Conditions for the hand-back	− After the end of O&M period, PPWSA has the right to be handed back the leased WTP facilities from the SPC under certain requirements (e.g. the result of the motor vibration test is within 5% of initial specification). − The SPC shall remove any additional facilities or equipment installed for its operation and restore the WTP to its initial condition at its own cost, if required by PPWSA.
Private investment	− The SPC may invest in some additional facilities, software, or any other equipment necessary for the operations. PPWSA has the right to purchase the private investments from the SPC at their residual value (net book value) at the end of O&M period.
Self-monitoring	− SPC shall monitor and report to PPWSA in respect of its operation and maintenance. Monitoring requirements are subject to agreement.
Operation data and financial information	− The SPC shall record and report all the operation data and financial information in required formats. PPWSA may utilize the data to continue operation of the WTP after hand-back.

Contract terms	Conditions
Early termination / compensation events	− Termination for convenience (Unilateral termination) PPWSA has the right to terminate the contract early for public interest. In this case the SPC shall be compensated in full, for all the private investments, inventories and additional costs incurred by the termination of the contract, and opportunity costs for the equity. Opportunity costs for the equity shall be a sum of net profit for the remaining contract period based on the SPC's initial financial plan initially agreed in the contract. − Termination for default by PPWSA The termination condition shall be pursuant to those outlined above for the case of the termination for convenience. − Termination for default by SPC PPWSA shall have the option to require SPC to transfer to PPWSA all of its right, title and interest in and to the assets and inventories. The value of the assets and inventories shall be net book value of the assets minus cost of damages and losses suffered by PPWSA due to the termination of the contract. − Termination for Force Majeure A Force Majeure is an event that is external, unpredictable, and irresistible and has a significant impact on the project. Both parties may terminate the contract if the impact of a Force Majeure lasts for 180 days. Neither party has any obligation to each other for the cost of mitigation measures to prevent increasing loss caused by Force Majeure. PPWSA shall have the option to require SPC to transfer to PPWSA all of its right, title and interest in and to the assets and inventories. The value of the assets and inventories shall be net book value of the assets.
Invoice settlement	− SPC shall report and charge to PPWSA by the 10th day of each month for the bulk water produced in the previous month. PPWSA shall in return review the invoice and make payment within 30days after the date of receipt of the invoice.
Staff Employment	− PPWSA shall take over the employment contracts from the SPC at the end of O&M period. − PPWSA intends to dispatch about 5 staff to SPC and bear the expense of their salaries. PPWSA staff shall report to SPC in daily operation. The respective salaries shall be subtracted from the off-take price. − Ministerial ordinance dated 20th August 2014 allows only 10% or less foreign employees out of total employees. It could be higher if the SPC applies for special provision.
Government guarantee	− There is no government guarantee for the Project as PPWSA is a listed company with firm financials.
Tax exemption	− EPC portion is tax-exempted just like other grant projects. − PPWSA's payment to the SPC is exempted from VAT.
Other items	− When a foreign company establishes a local entity, it must register with the Ministry of Commerce as well as with the tax department in Ministry of Economy and Finance, Ministry of Labor and Vocational Training and National Social Security Fund. These procedures are moving to online registration and the SPC shall review the latest information.

2-2-4-6 Operating Expenditure of the Comparator Facilities

In order to set the maximum price factors (α, β), the operating expenditure is estimated based on the comparator facilities (**Table 2-5.5**).

2-2-4-7 Comparison between the Comparator Facilities and PPWSA's Existing Plants

PPWSA has accomplished high production efficiency in its existing plants and the SPC is required to operate at the same or higher level of efficiency. Consumption of production inputs in

PPWSA's plants are shown below.

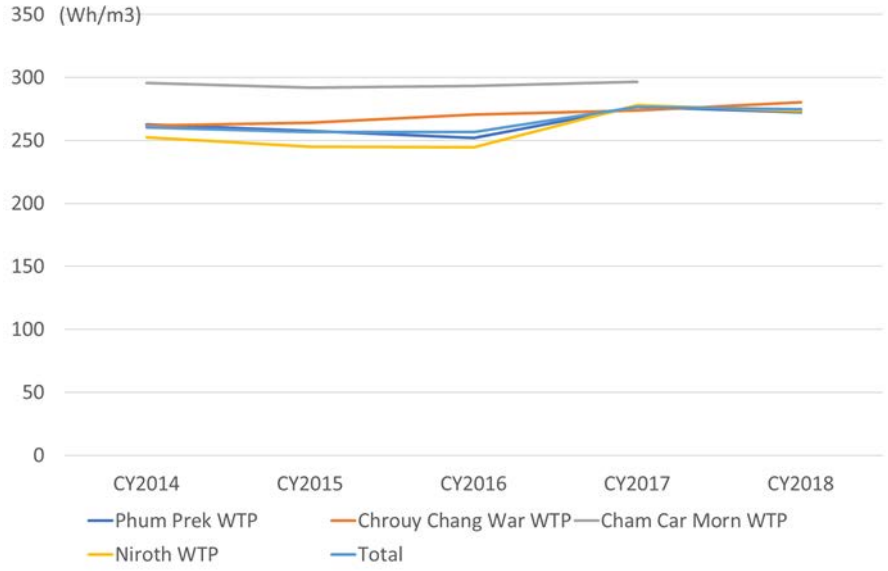


Figure 2-2.13 Electricity Consumption at PPWSA' Plants

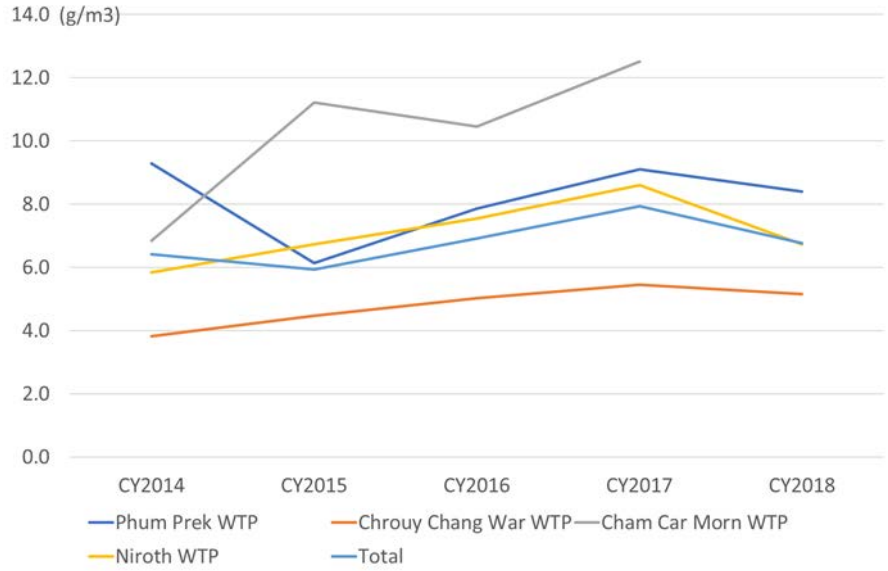


Figure 2-2.14 PAC Consumption at PPWSA' Plants

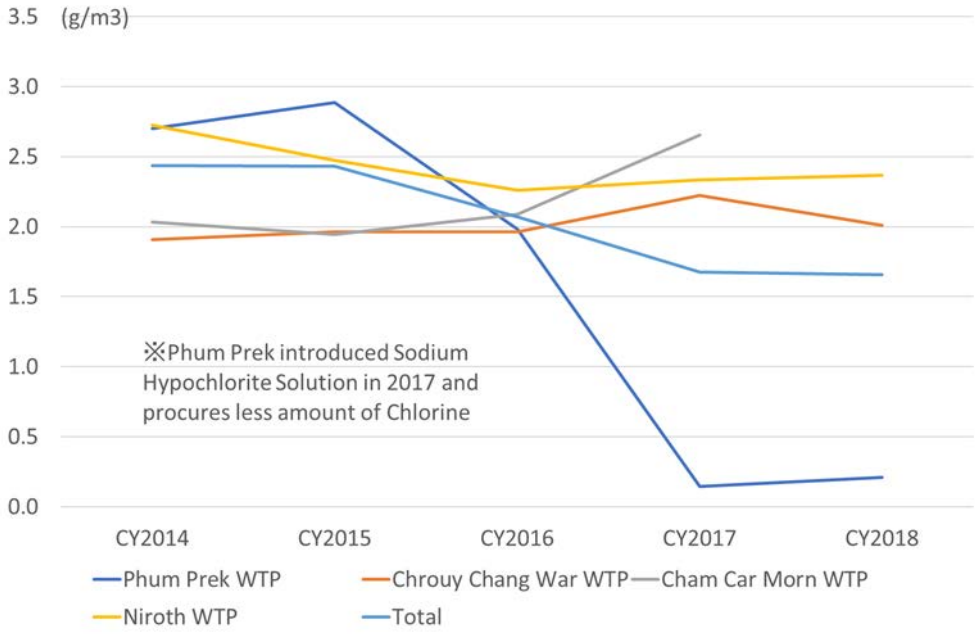


Figure 2-2.15 Chlorine Consumption at PPWSA' Plants

Below is a comparison of cost structure between the comparator facilities and PPWSA's existing plants. The total costs are approximately the same. However, it should be noted that;

- PPWSA is now considering the introduction of fire insurance and third-party liability insurance, but so far existing water treatment plants are not covered by any insurance.
- Depreciation cost is included in PPWSA's production cost, but not in SPC's O&M cost since the facilities will be owned by PPWSA.
- Back office expenditure is included in SPC's cost but not in PPWSA's production cost since back office expenditure is not production cost but the administration cost of PPWSA.

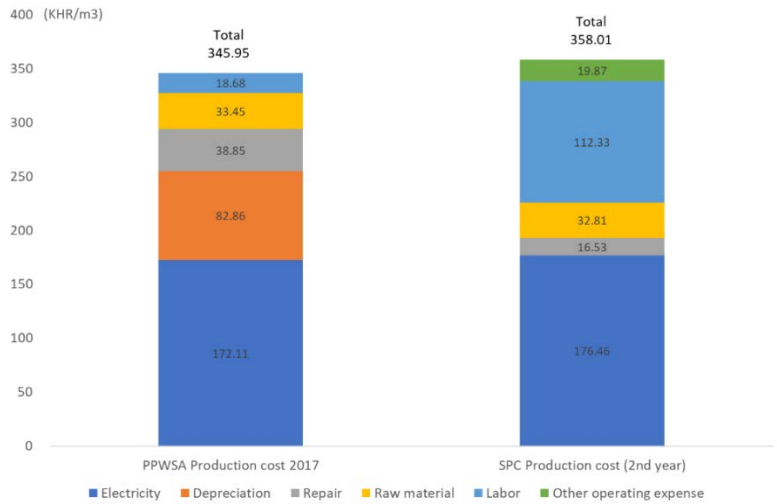


Figure 2-2.16 Cost Structure of the Comparator Facilities and PPWSA's Plant

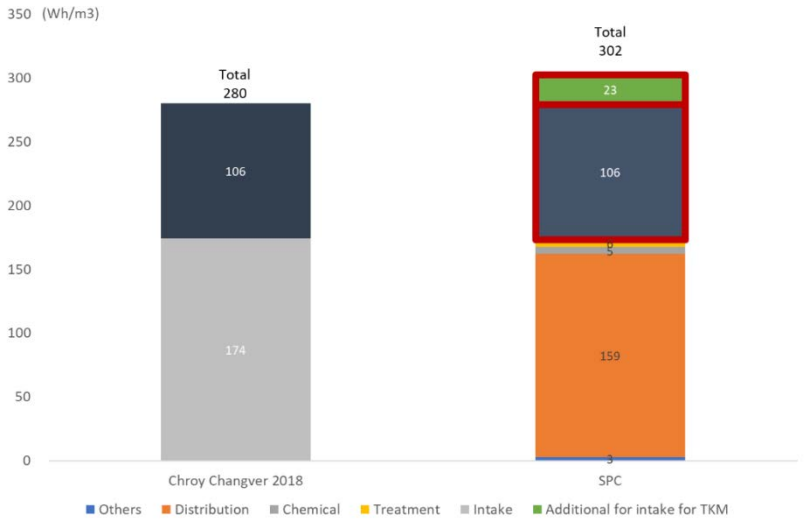


Figure 2-2.17 Electricity Consumption of the Comparator Facilities and PPWSA's Plant

2-2-4-8 SPC Financial Model Based on Comparator Facilities

SPC's financial model is shown below incorporating following assumptions;

Inflation is 3% per year. The first year of operation incorporates 3 years inflation effects after contracting. 10-year average net profit margin is 9.4%, which is considered reasonable given the project risks.

Table 2-2.15 SPC Financial Model based on Comparator Facilities

Operating year				1	2	3	4	5	6	7	8	9	10
(Unit: KHR 000)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
FX rates													
JPY/USD	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45	111.45
KHR/USD	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00	4,035.00
KHR/JPY	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20	36.20
Inflation rate	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Electricity price	584	584	584	584	584	584	584	584	584	584	584	584	584
1. Profit and Loss Statement													
Operating Income													
Amount of Water Production (000m3)				10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950
Price of bulk Water Sale (KHR/m3)				432	438	445	453	460	468	476	484	493	501
Total Operating Income				**4,725,264**	**4,800,395**	**4,877,779**	**4,957,485**	**5,039,582**	**5,124,142**	**5,211,239**	**5,300,949**	**5,393,350**	**5,488,523**
Operating Cost													
Electricity costs				1,932,210	1,932,210	1,932,210	1,932,210	1,932,210	1,932,210	1,932,210	1,932,210	1,932,210	1,932,210
Salaries, wages and related expenses				1,344,108	1,384,431	1,425,964	1,468,743	1,512,806	1,558,190	1,604,935	1,653,083	1,702,676	1,753,756
Raw materials for water treatment				392,595	404,373	416,504	428,999	441,869	455,125	468,779	482,842	497,328	512,248
Repairs and maintenance				0	203,743	209,855	216,151	222,635	229,314	236,194	243,280	250,578	516,191
Depreciation				0	0	0	0	0	0	0	0	0	0
Other operating expense				217,995	244,909	252,257	259,824	267,619	275,648	283,917	292,435	301,208	336,053
Total Operating Cost			0	3,886,909	4,169,667	4,236,790	4,305,928	4,377,139	4,450,487	4,526,035	4,603,850	4,683,999	5,050,458
Gross Operating Profit	**0**	**0**	**0**	**838,355**	**630,728**	**640,989**	**651,557**	**662,443**	**673,655**	**685,203**	**697,098**	**709,350**	**438,065**
Non Operating Cost													
Others			0	0	0	0	0	0	0	0	0	0	0
Total Non Operating Cost			0	0	0	0	0	0	0	0	0	0	0
Net Income before Tax	**0**	**0**	**0**	**838,355**	**630,728**	**640,989**	**651,557**	**662,443**	**673,655**	**685,203**	**697,098**	**709,350**	**438,065**
Tax on Profit	0	0	0	167,671	126,146	128,198	130,311	132,489	134,731	137,041	139,420	141,870	87,613
Net Income after Tax	**0**	**0**	**0**	**670,684**	**504,582**	**512,791**	**521,246**	**529,954**	**538,924**	**548,163**	**557,679**	**567,480**	**350,452**
Operating margin				17.7%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.2%	13.2%	8.0%
Net margin				14.2%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	6.4%
10 year average operating margin	13.0%												
10 year average net margin	10.4%												
2. Cashflow													
Cashflow from Operating Cashflow													
Net Income after Tax	0	0	0	670,684	504,582	512,791	521,246	529,954	538,924	548,163	557,679	567,480	350,452
Depreciation	0	0	0	0	0	0	0	0	0	0	0	0	0
Change in working capital	0	0	-1,181,316	0	0	0	0	0	0	0	0	0	0
Cash Flows from Investment Activity													
Capital Investment	0	0	0	0	0	0	0	0	0	0	0	0	0
Cashflow from Financial Activities													
Equity Injection	0	0	2,000,000	0	0	0	0	0	0	0	0	0	0
Dividend			0	0	0	0	0	0	0	0	0	0	0
Net Cashflow	0	0	818,684	670,684	504,582	512,791	521,246	529,954	538,924	548,163	557,679	567,480	350,452
Opening Cash	0	0	0	818,684	1,489,368	1,993,951	2,506,742	3,027,987	3,557,941	4,096,865	4,645,028	5,202,707	5,770,187
Closing Cash	0	0	818,684	1,489,368	1,993,951	2,506,742	3,027,987	3,557,941	4,096,865	4,645,028	5,202,707	5,770,187	6,120,639
3. Balance Sheet													
Assets													
Cash	0	0	818,684	1,489,368	1,993,951	2,506,742	3,027,987	3,557,941	4,096,865	4,645,028	5,202,707	5,770,187	6,120,639
Other working capital	0	0	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316	1,181,316
Propery, plant and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Assets	0	0	2,000,000	2,670,684	3,175,267	3,688,058	4,209,303	4,739,257	5,278,181	5,826,344	6,384,023	6,951,503	7,301,955
Liabilities													
Borrowings	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity													
Share capital		0	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Retained earnings		0	0	670,684	1,175,267	1,688,058	2,209,303	2,739,257	3,278,181	3,826,344	4,384,023	4,951,503	5,301,955
Total Equity		0	2,000,000	2,670,684	3,175,267	3,688,058	4,209,303	4,739,257	5,278,181	5,826,344	6,384,023	6,951,503	7,301,955

2-2-5 Implementation Plan

2-2-5-1 Implementation Policy

2-2-5-1-1 Organization for Project Implementation

The Project will be implemented by applying Japanese Grant Aid with O&M Scheme (refer to **Section 2-2-1-1**). After the Project is officially approved, the Recipient will assign Japanese consultants which had been assigned for preparatory survey, and also assign the Contractor which will be selected and awarded through a tender process and the SPC which will be established in Cambodia by the members of the Contractor such as EPC contractor and O&M operator to implement the Project. There are two potential structures possible for the Project; one is with SPC signing all the Comprehensive/EPC/O&M contracts, and another is with the Contractor signing all the Comprehensive/EPC/O&M contracts at an initial stage, and in the later stage, O&M Contract is novated to the SPC (**Figure 2-2.19** shows the structure after O&M contract is novated from the Contractor to SPC).

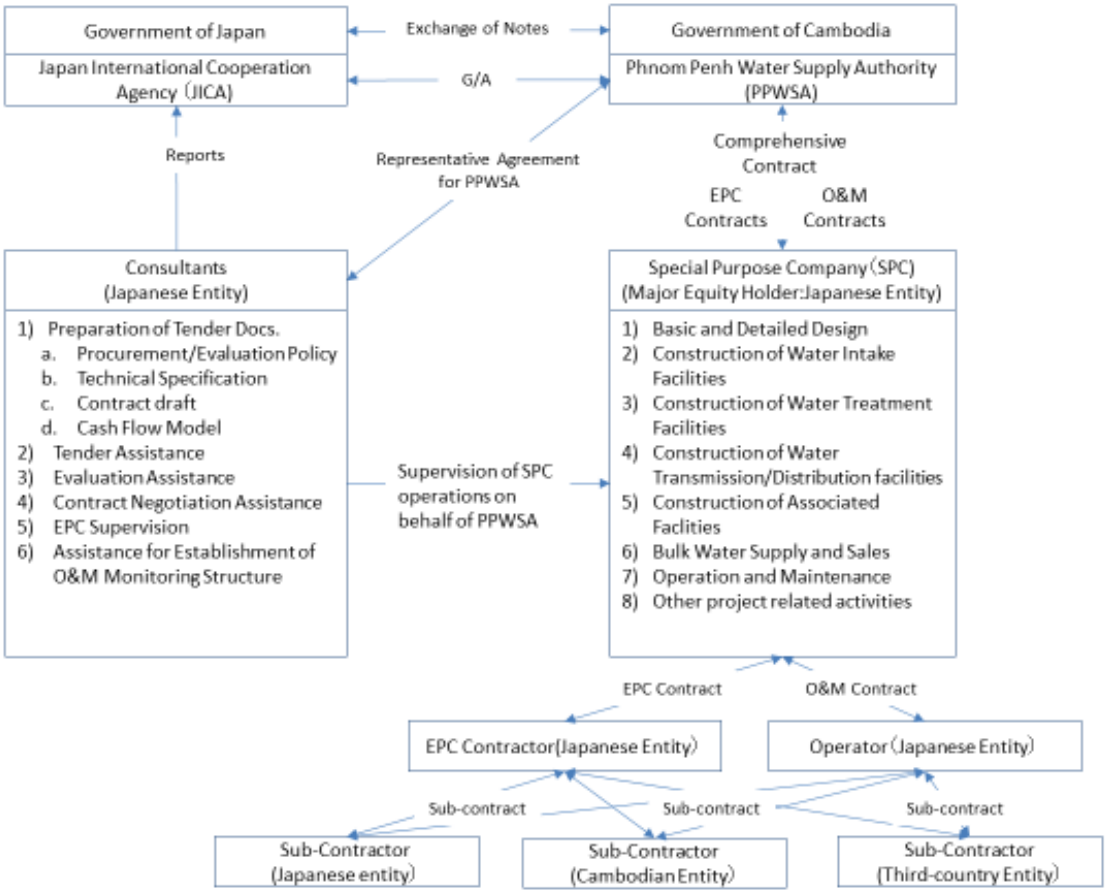


Figure 2-2.18 Project Implementation Structure 1

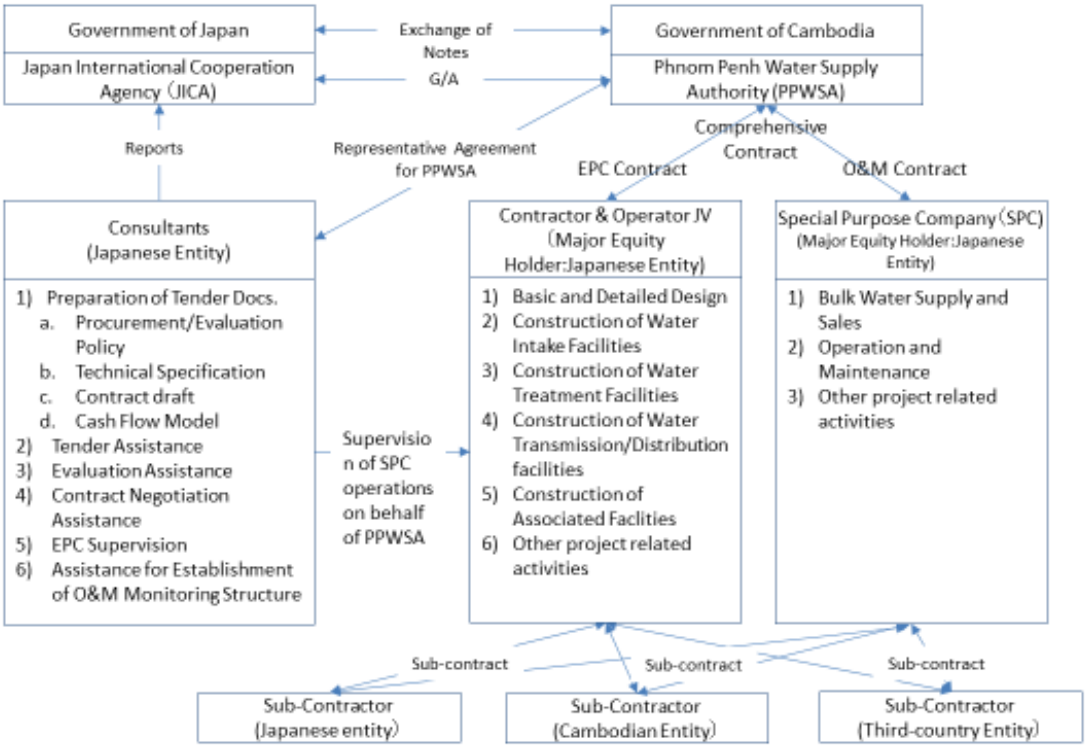


Figure 2-2.19 Project Implementation Structure 2

2-2-5-1-2 Implementing Agency

The Phnom Penh Water Supply Authority (PPWSA) is both the executing agency and implementing agency of this project.

2-2-5-1-3 Consultants (JV)

A Consulting Engineer who is familiar with facility design and supervision will be selected for tender assistance, design confirmation, various management activities during construction phase related to water intake and transmission facility construction, water treatment facility construction, ancillary facility construction, and transmission/distribution facility construction under the Japanese Grant Aid with O&M and a PPP consultant who is familiar with Public Private partnership projects will form the Consultants JV.

2-2-5-1-4 Japanese JV

A joint venture shall be formed for bidding for this project, which is composed of an EPC contractor who has a track record of water supply facilities construction and O&M operator who has a track record of water supply business operations. In this project, this will be the business entity called "the Contractor" that concludes comprehensive, EPC and O&M contracts after a successful bid. In addition, O&M contract will be novated to SPC which will be established in Cambodia by members of the Contractor. If a single company has sufficient EPC and O&M track records of WTPs, the Contractor can be replaced by such single company.

2-2-5-1-5 EPC Contractor

A member of the Contractor who shall be able enter into a lump-sum subcontract under the EPC contract from the Contractor subject to the acceptance of the O&M operator. This facility consists of water intake/water transmission plant, water treatment plant, water transmission/distribution and ancillary facilities. Therefore, a general construction contractor who is capable of designing and constructing a water treatment plant as well as ensuring the quality of civil works and watertight structures in urban areas shall be selected. In order to secure against the risk of the facilities malfunctioning during the O&M period, the EPC contractor's equity proportion in the SPC shall be more than the minimum investment ratio of the EPC Contractor in SPC required by PPWSA.

2-2-5-1-6 Special Purpose Company (SPC) as O&M Operator

A company is to be established in Cambodia by a member company of the Contractor that will provide O&M service for the WTP facilities developed under Japanese Grant Aid with O&M Scheme. Such SPC will be established at the stage of the EPC contract execution, and it is intended that the O&M Contract between PPWSA and the Contractor shall be transformed into a contract between PPWSA and the SPC through a novation agreement. While the SPC shall have the right to sell the bulk water to PPWSA, the SPC shall retain the obligation for repairs and parts replacement for the facility for the appropriate maintenance during the O&M period. At the end of the O&M period, the facilities will be handed back to PPWSA under the agreed conditions.

2-2-5-1-7 Requirements For Mobilization Of Staff And Engineers

The SPC shall be required to mobilize a director, chief construction management engineer, civil water intake facility construction management engineer, water treatment facility construction management engineer, mechanical equipment construction management engineer, electrical equipment construction management engineer, and administrative manager from Japan.

2-2-5-2 Implementation Conditions

The following conditions will apply to the implementation of the project at construction sites:

- Extra effort will be devoted to coordination and information sharing due to the number of stakeholders involved. The Cambodian side, the EPC contractor, the consultant and the related donor organizations will meet regularly to review progress. Other means of communications will also be used.
- The consultant will share information with all stakeholders continuously and deploy one project manager and one resident engineer on site to ensure smooth implementation of the project.
- The EPC contractor will also deploy one representative and one site manager on site.
- The consultant and the construction contractor will set up offices at appropriate locations.
- It is recommended that construction of intake facilities be executed between November and May when the river water level is low. Works should not be conducted between June and October when the water level is higher. During the first dry season of the contract period, temporary water coffers should be constructed. Then excavation and concrete placing can follow.
- Consumers should receive uninterrupted water supply even during the construction period. Should water shutdowns be required, it will be necessary to announce the shutdown period and warn residents of possible turbidity in the water, to obtain their understanding and cooperation.
- The Cambodian side shall assure the safety of the construction work sites as being free from

landmines and unexploded ordinance (UXO) by submitting the official report to the JICA Cambodia Office prior to the commencement of the construction work.

2-2-5-3 Scope of Work

The Japanese side will be responsible for the construction of the facilities. Details of the obligations of the Cambodian side are described in **Chapter 2-3**.

2-2-5-4 Consultant Supervision

(1) Consulting Services for Bidding

The consultants will carry out P/Q while preparing bidding documents. As soon as the bidding document is approved it will be published and distributed to pre-qualified bidders. The bidding will be QCBS and the contract will be Design-Build. Consulting services include;

- Holding explanatory conference, publishing P/Q, evaluating P/Q
- Preparing instruction to bidders, bidder evaluation, evaluation criteria
- Preparing bidding documents
- Conducting survey
- Answering Q&A during bidding
- Conducting proposal evaluation
- Preparing evaluation and recommendation report
- Explaining evaluation report
- Conducting contract negotiation
- Reporting to JICA and the Recipient
- Seeking necessary approvals
- Tender evaluation result report

Workflow of the bidding process is shown in **Figure 2-2.20**. The consultants will support the Recipient throughout the entire bidding process. The process will take 12.5 months.

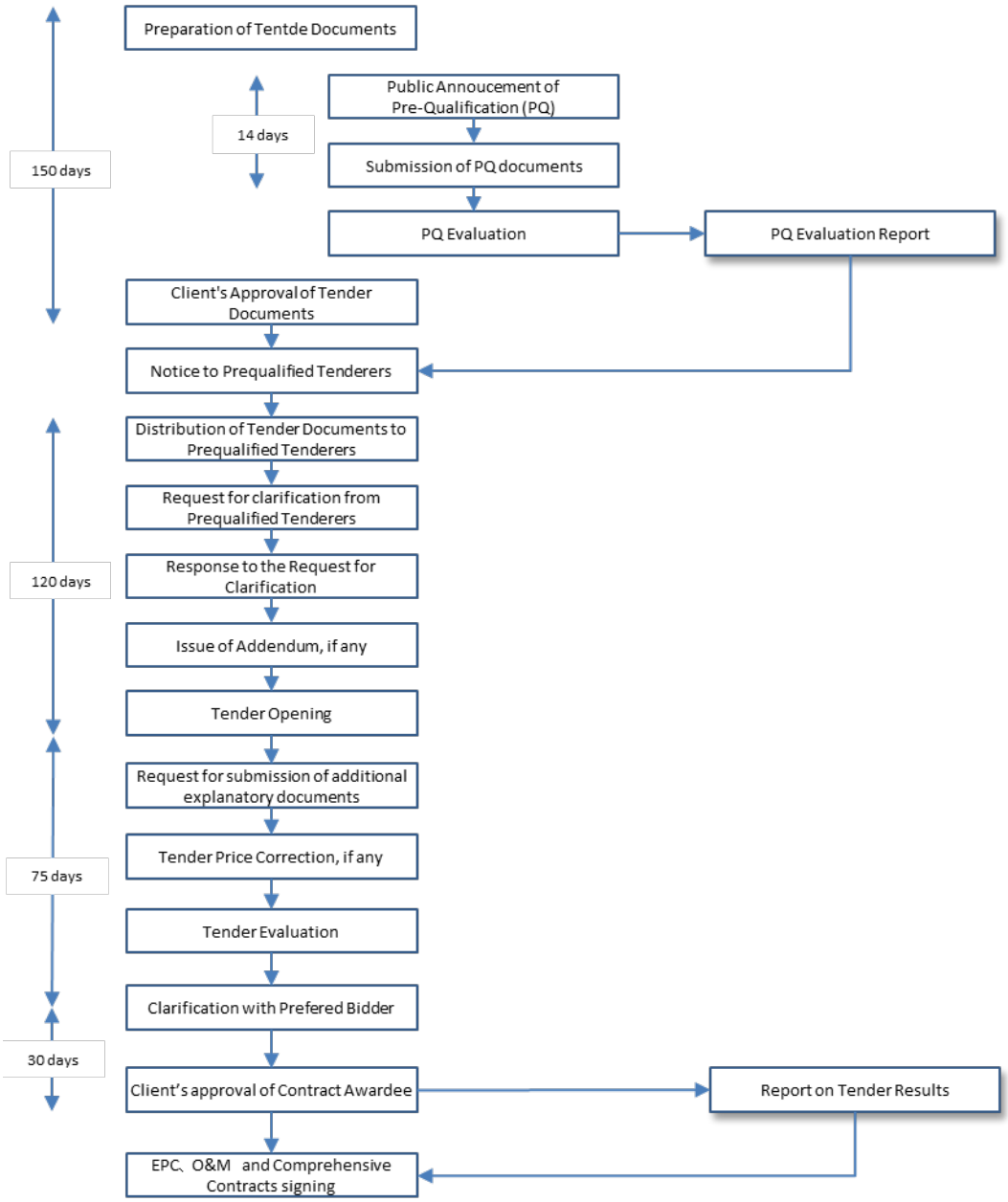


Figure 2-2.20 Work Flow of Bidding Process

When a foreign company registers as a local corporation in Cambodia, in addition to commercial registration with the Ministry of Commerce, tax registration to the General Department of Taxation of the Ministry of Economy and Finance, filing a business establishment with the Ministry of Labor and Vocational Training, and the National Social Security Fund (NSSF) are required.

Since this is a tax-exempt project, commercial registration, tax registration, and approval of the tax exemption master list are required to be able to receive tax-exempt invoices. It is possible to apply for registration with the Ministry of Commerce using the online system. However, it will be necessary to submit original documents of the Articles of Incorporation and a balance

certificate issued by a Cambodian authorized bank, therefore on-site registration with hand-delivery of such documents can shorten the registration approval period to two weeks.

If commercial registration is completed, a business contract can be sighed. Within 15 days from the date of approval for commercial registration, tax registration is required at the General Department of Taxation. However, in accordance with tax registration, application for a patent and Value-Added Tax (VAT) registration at the General Department of Taxation (GDT) is required. Tax-exempt transactions are possible if a master list of items exempted from tax is submitted to the GDT and approved.

To start tax-exempt transaction, it takes 2 to 3 months after the application of commercial registration, so it is recommendable to efficiently use the one month of client's approval period of 30 days. (Please note that the consultant shall not have any liability in regard to any loss or damage caused by the actions taken based on the contents of this document.)

(2) Design Confirmation

In the design confirmation by the consultant, the following tasks are envisaged as being central to requirements.

- Confirmation of basic/detailed design and explanation/discussion with PPWSA
- Discussion/obtaining no objection letter from PPWSA on basic/detailed design proposals and verification results.

(3) Various Management Activities during Construction Phase

The services of various management activities during construction phase to be executed by the consultants shall cover the following tasks as central to requirement.

- Confirmation of documents, materials, equipment, drawings, construction schedules, construction methods, construction procedures, safety measures, quality assurance, environmental and social impact measures, etc. related to construction work
- Construction quality control meeting secretariat
- Confirmation of design for water treatment and explanation/discussion with PPWSA
- Confirmation of inspection records, construction records, etc.
- Witness of plant start-up, advice and guidance
- Report to JICA
- Perform defect inspection
- Supporting O&M contract negotiation and settlement and smooth implementation
- Establishing O&M monitoring structure and system,
- Reviewing basic monitoring system before the commencement of the detail design
- Reviewing detailed design and its monitoring index negotiated with PPWSA
- Reviewing progress of monitoring system (included KPIs and monitoring frequencies)
- Reviewing work plan, SPC management plan, financial plan during O&M period
- Reviewing monitoring flow, reporting flow, business continuity plan and reporting system in case of malfunction of the facility
- Studying and deciding appropriate minimum equity requirement for SPC with PPWSA
- Studying and deciding appropriate minimum equity requirement proportion for EPC contractor with PPWSA
- Reviewing operation manual and its development support
- Other matters negotiation with PPWSA
- Negotiating on how to modify the detailed contract terms of O&M Contract Studying,

reviewing and modifying conditions of facility hand-back after the O&M period.
- Legal review on the O&M contract modification method

This project scope covers the construction of water intake/transmission facility, water treatment plant, transmission/distribution and ancillary facilities. In sum, the scope comprises the construction of a series of water treatment plant facilities involving various civil, mechanical and electrical works. It is intended that during the construction period, engineers will be dispatched for the provision of short-term inputs related construction issues in various fields from the commencement of works up to plant start-up/completion in order to conduct consistent design and various management activities for these interrelated works.

A monitoring system shall be established in line with EPC contractor's facility design. The consultants will prepare contract terms for O&M prior to tendering, and shall adjust and modify the detailed contract based on pre contract negotiations with the successful Japanese contractor/contractors. The consultants will also support PPWSA in establishing monitoring system.

2-2-5-5 Quality Control Plan

The SPC will prepare a quality control plan. The quality control plan which shall be consistent with SPC's proposed management policy, contents, methods, and applicable standards, will be verified by consultants with the required specifications of the project. It is assumed that JIS, ISO or equivalent international standards will be applied as quality standards.

2-2-5-6 Procurement Plan

(1) Selection of Suppliers of Materials and Equipment

The materials and equipment necessary for this project will be procured locally or in Japan. The potential for third country procurement will be examined and determined in consideration of the following requirements;

- The need to meet the specifications
- Availability of right quality and sufficient quantity of required materials and equipment in the domestic market in Cambodia.
- Ease of repair and maintenance including availability of spare parts.
- adequate price
- the availability of suitable aftercare commitment

In principle, construction materials and equipment shall be procured in Cambodia or Japan. In case the procurement in Cambodia or Japan is difficult, third country procurement is allowed.

The procurement plan for construction materials is shown in **Table 2-2.16**.

Table 2-2.16 Procurement Plan for Construction Materials

Name of Materials	Source of Procurement			Remarks
	Cambodia	Japan	Third Countries	
1. Construction Materials				
Ready Mix Concrete, Sand, Gravel, Cement, Steel Bar	○			
Formwork Wooden Plate, Wood	○			
Steel Sheet Pile and H-shape Steel Pile	○			
Paints, Lubricant, Fuel	○			
Scaffolding and Support	○			
2. Mechanical Equipment				
Intake and Distribution Pump		○	○	Thailand or Vietnam
Other Pump		○	○	
Overhead Traveling Crane		○	○	
Water Treatment Equipment		○	○	
Chemical Feeding Equipment		○	○	
Exhaust Fan		○	○	
Pipe, Valve		○	○	
3. Electrical Equipment				
Transformer		○	○	Thailand or Vietnam
Receiving Panel		○	○	
Distributing Panel		○	○	
Motor Control Center (including VFD panel)		○	○	
Auxiliary Relay Panel		○	○	
Local Control Panel		○	○	
Flowmeter		○	○	
Level Meter		○	○	
Supervisory Control Equipment		○	○	
PLC Panel		○	○	
Distribution Board		○	○	
Lighting Equipment,		○	○	
Cables and Cable Conduits		○	○	

2-2-5-7 Construction Machinery

(1) Selection of Construction Machinery Suppliers

There are many construction machinery companies in Cambodia, and required machinery can be leased and will be procured locally.

(2) Construction Machine Unit Price Determination Method

As a general rule, the selection of construction machinery will be based on the lowest price of three company estimates that are sought and assessed and through this method the unit price shall be determined.

2-2-6 Transportation/Packing Plan

(1) Transportation Plan

It is intended that construction materials and equipment will be procured locally, but if procured from Japan, they will require transportation.

(2) Transport Route

Whilst construction materials and equipment will be procured locally, mechanical and electrical equipment will be procured in Japan. **Figure 2-2.21** shows the transportation route for materials procured in Japan.

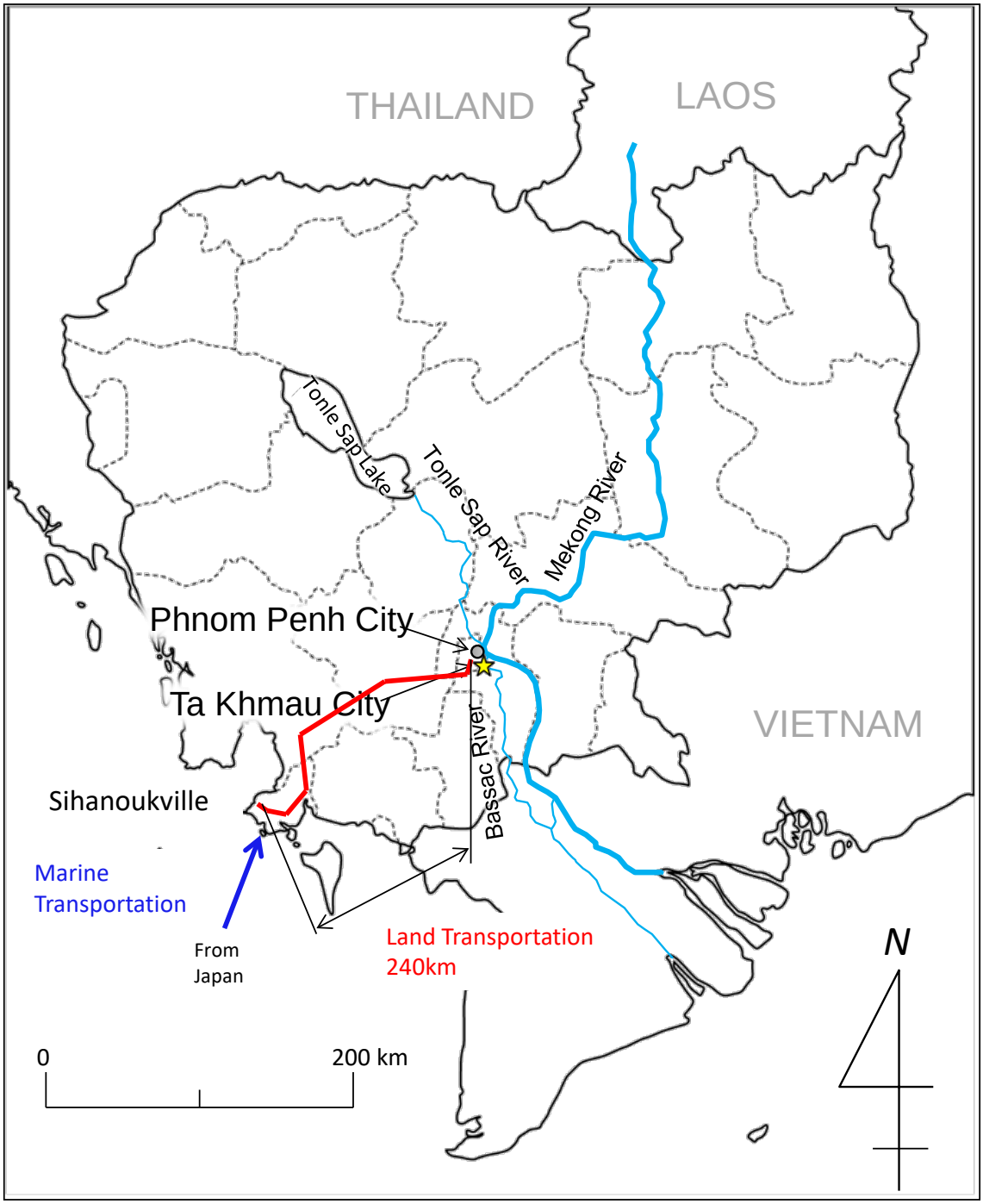


Figure 2-2.21 Routes for Transportation

2-2-7 Initial Operation Guidance/Operation Guidance Plan

The water treatment plant newly constructed in this project will be handed over to PPWSA and maintained by personnel employed by SPC after construction. Although this is a facility that the EPC contractor designs and constructs, the same EPC contractor establishes SPC, and in turn the SPC prepares a maintenance manual that summarizes maintenance management indicators, maintenance management methods etc. Additionally, EPC/SPC staff will also provide technical guidance and capacity development by themselves. In their supervising role, the consultant shall provide advice on maintenance manuals, plant start-up, and training.

2-2-8 Soft Component (Technical Assistance) Plan

Soft Component (Technical Assistance) will not be provided for this project.

2-2-9 Implementation Schedule

An implementation plan was formulated as a multi-year project due to the relationship between construction contents and construction period. Bidding will be done in the first year, and construction (design, procurement, construction, O&M preparation) will be carried out from the following year. The construction period is 12.5 months for bidding (**Figure 2-2.22**) and 33 months for design, procurement, and construction (**Figure 2-2.23**).

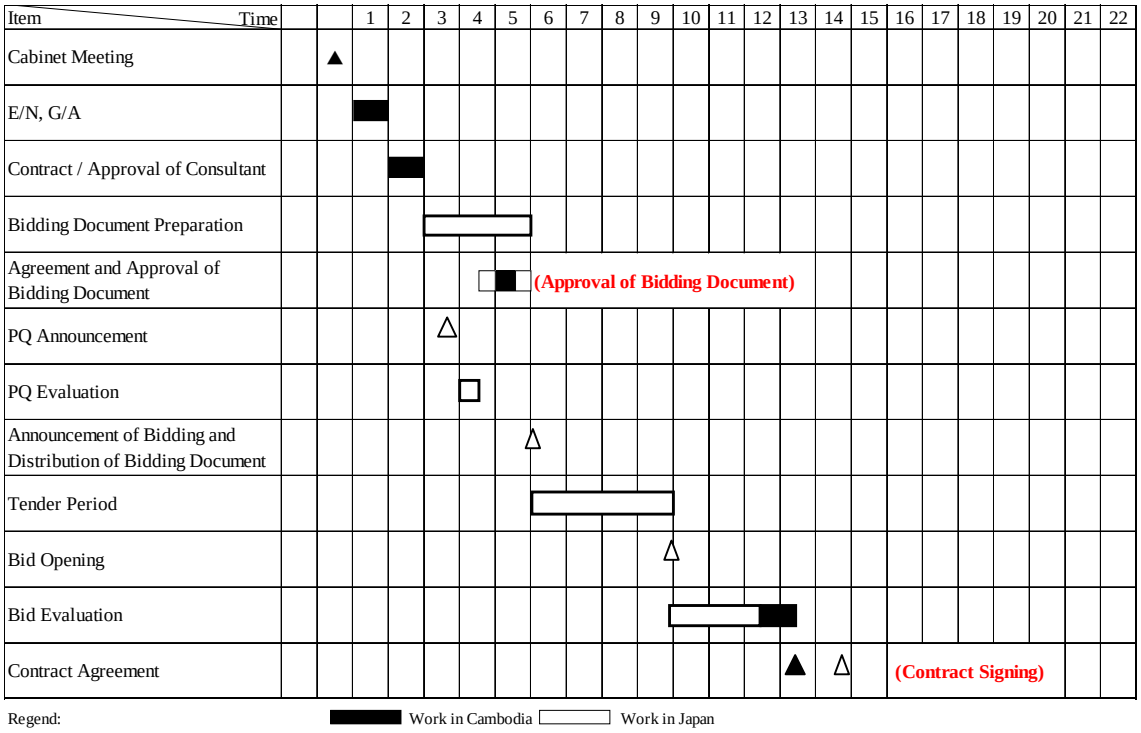


Figure 2-2.22 Implementation Schedule (Tender)

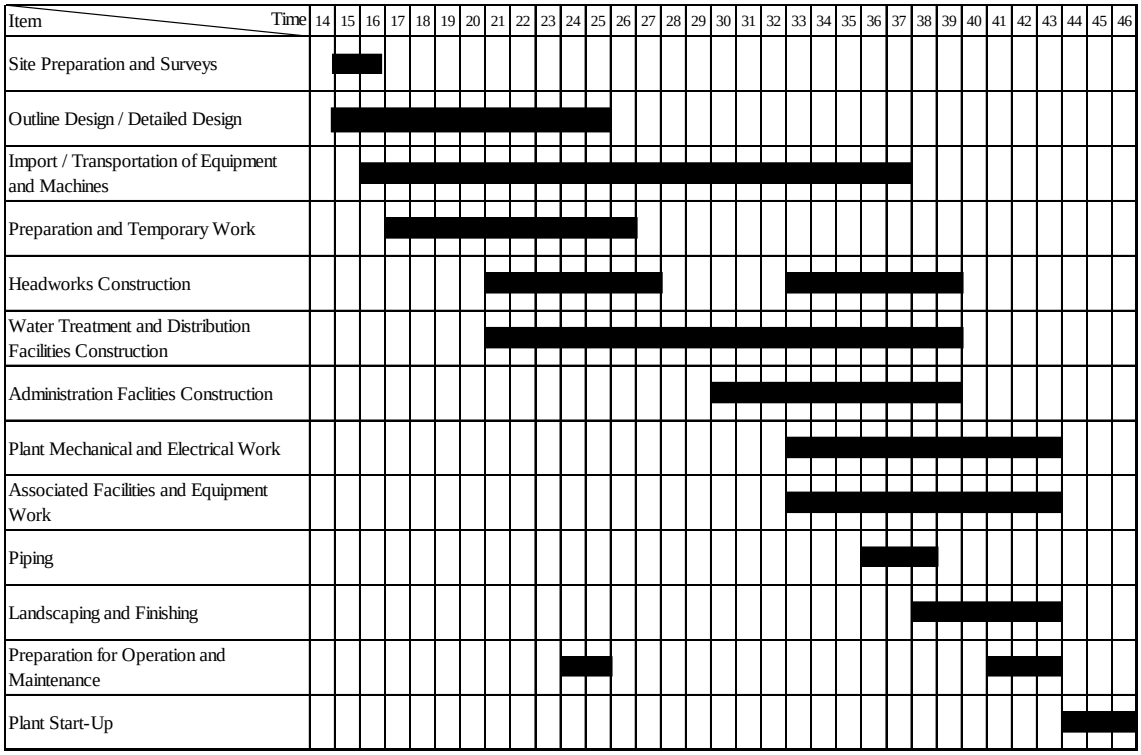


Figure 2-2.23 Implementation Schedule (Design, Procurement, Construction and Preparation for Operation and Maintenance)

The implementation Schedule (Design, Procurement, Construction and Preparation for Operation and Maintenance) is an assumption of a comparator facility, and the implementation Schedule proposed by the contractor is evaluated at the time of bidding.

2-3 Obligations of Recipient Country

2-3-1 Land Acquisition and Preparation of WTP Site

Construction of the WTP does not require new land acquisition because the new facilities will be constructed on the premises of PPWSA as shown in **Figure 2-3.1**. There exist elevated water tank and tariff collection office on the site. After the construction of the WTP, the tariff collection office will be relocated to the national highway side on the premises by PPWSA to secure area for facilities construction.

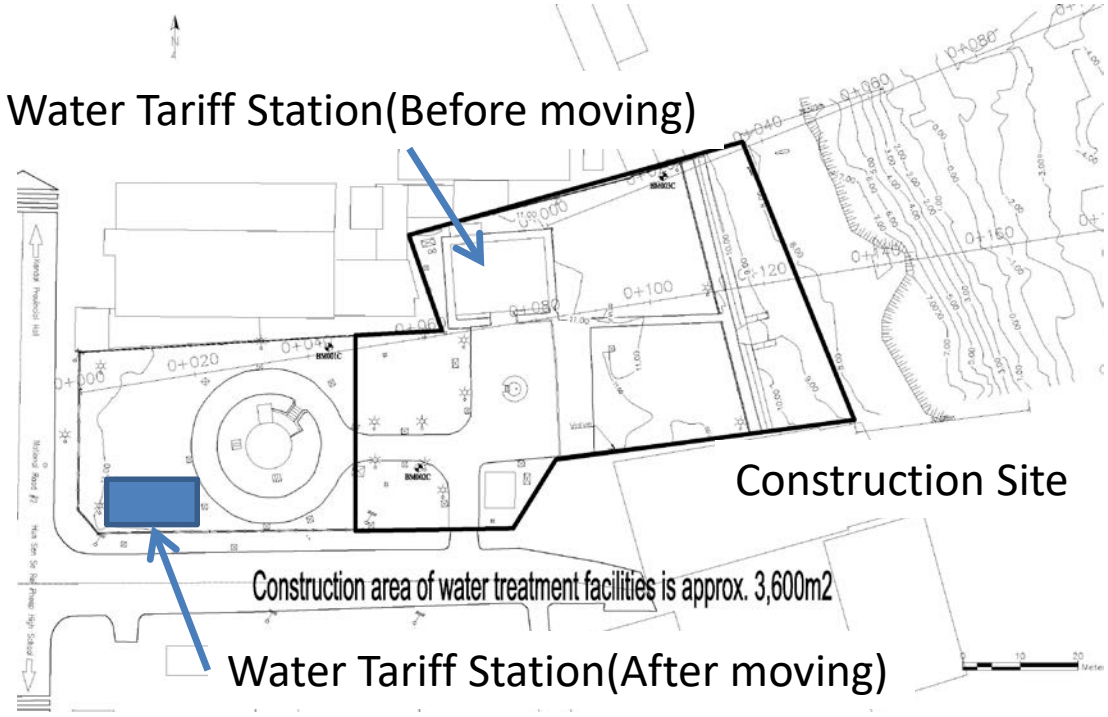


Figure 2-3.1 WTP Construction Area

There is a banana field on the riverside of the boundary. Logging, felling and stamping of the field shall be carried out by PPWSA before the commencement of construction.

2-3-2 Water Intake Permissions

Water rights are not stipulated in Cambodia under the current legal system; however, MoWRAM will be responsible for managing surface water and groundwater volume management. PPWSA has submitted an application letter to MoWRAM for permission to take water from the Bassac River and will receive a letter from MoWRAM regarding consent.

Regarding to intake facility construction, according to PPWSA, permission for river traffic is not necessary because it was notified at the stakeholder meeting.

2-3-3 Electrical Work

Substations to be installed on the premises of new water intake facility and WTP shall be included in the Japanese Grant Aid with O&M. Construction of utility poles and wiring work including conduit from the power receiving point to the transformer, procedures for receiving power, and procedures for receiving two lines shall be obligations of the Cambodian side.

2-3-4 Investigation and Disposal of Land Mines and Unexploded Bombs

CMAC is a governmental organization which has been instrumental in demining and removing unexploded ordnance throughout Cambodia. According to its mine/unexploded UXO map (**Figure 2-3.2**), there is a possibility that landmines and unexploded ordinances exist in and around Ta Khmau City. Therefore, the Cambodian side should take measures before project

implementation.

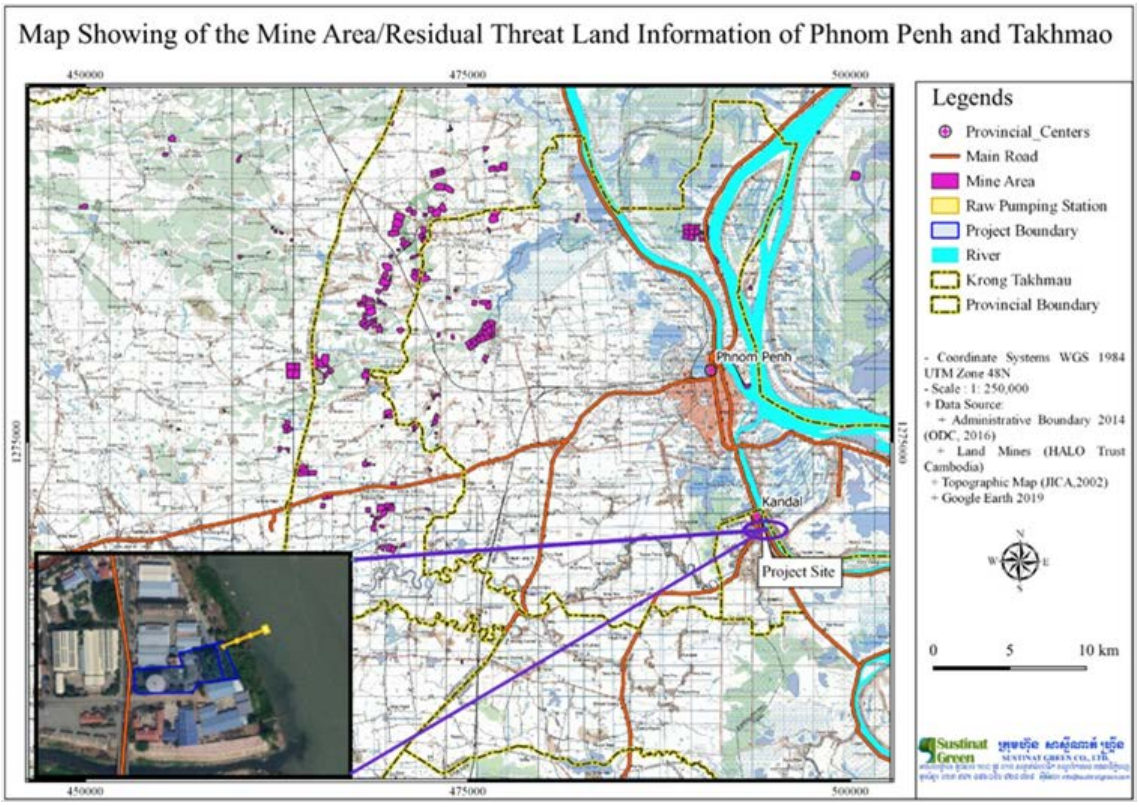


Figure 2-3.2 Potential Area Contaminated by Land Mines and Unexploded Ordnance in Ta Khmau City

Source: CMAC

Investigation and disposal of land mines and unexploded ordnances before the commencement of construction, and measures in case of encountering landmines and unexploded explosives (UXO) during construction, shall be borne by the Cambodian side.

2-3-5 Response to Environmental and Social Considerations

To comply with the Cambodian Environmental Impact Assessment Act, an IEE and IIEIA were prepared by PPWSA. IEIA report and Pre-feasibility study report were submitted to the Ministry of Environment in August 2019 for approval. Preparation of IEIA report was supported under this survey and IEIA report will be approved by the Ministry of Environment by February 2020.

2-3-6 Others

In addition to the above, the following components also will be the obligations of the Cambodian side to implement the Project.

- Budgeting of the project components for which the Cambodian side is responsible
- Bank arrangements
- Procedure of tax exemption

2-4 Project Operation Plan

2-4-1 SPC operation and maintenance system

The operation and maintenance of the facilities shall be carried out by the SPC. Where the Contractor proposes advanced and efficient water treatment facilities, or when O&M operator with experience in highly efficient and effective maintenance management in Japan performs maintenance management, technology transfer of these activities will be expected. In particular, technology transfer such as preventive maintenance, inventory management, document management, human resource management, and capacity development/evaluation are to be expected.

During the inception discussion, there was a view that PPWSA could participate as a member of the SPC and that there was room for consideration to dispatch employees appropriate place to receive training related to maintenance.

In addition, PPWSA recognizes as an issue that an appropriate monitoring mechanism has not been established, although monitoring of the WTP is a clear requirement. There is a desire to refer to the construction and operation of PPWSA's own monitoring mechanism, such as O&M monitoring of Japanese companies through this project and the response methods taken based on the monitoring results.

At present, the Chroy Changvar WTP has four teams comprising four members each, and the Niroth WTP also four teams comprising seven members each. Of the 4 teams at each WTP, 3 teams work 8 hours with 3 shifts and 1 team act as reserve.

Considering the difference in WTP facility size, daily operation and maintenance requirements of the comparator facility (30,000m^3/day) should be less than that of Chroy Changvar WTP (130,000m^3/day) and Niroth WTP (260,000m^3/day). It is expected that operation and maintenance works can be accomplished by 3 shifts (8 hours each). Currently, there are 5 people stationed in the Ta Khmau WTP during the daytime including the director and manager and excluding the water quality inspection staff. This number of staff is considered sufficient to perform daily operation and regular cleaning etc. of the new WTP facilities. It is assumed that the SPC will dispatch engineers and workers to piping, mechanical and electrical equipment failures, etc. and request PPWSA for assistance through the SPC as necessary.

Table 2-4.1 shows a proposed O&M organization of the comparator facility.

Table 2-4.1 Proposed O&M Organization of the Comparator Facility

	Origin	Duty	Number	Shift	Total Number
CEO	Japanese/ Foreign	Control of WTP Works	1	0.5	1
O&M Technical training advisor	Japanese/ Foreign	Instruction of O&M Works	1	0.5	
Chief Manager	Local	Management of Entire WTP Works	1	1	1
Facility Manager	Local	Support of Chief Manager to Control Daily Regular Work	1	1	1
Quality Manager	Local	Water Quality Analysis of Daily Regular Work	1	1	1
Admin/ business Staff	Local	Administration Works	3	1	3
M & E Engineer	Foreign/ Local	Maintenance and Repair of M&E Equipment	1	1	1
Operating Staff	Local	Plant O&M	2	3	6
					14

2-4-2 Project Maintenance Plan

Upon implementation of the project, the operation and maintenance requirements are proposed by the SPC.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

2-5-1-1 Project Cost borne by Cambodia Side

The cost to be paid by Cambodia is approximately 170 million yen (total cost until 2024 when the construction of the facilities is completed), and the breakdown is shown in **Table 2-5.1**.

Table 2-5.1 Breakdown of Cost borne by Cambodia Side

	Item	Contents	USD	Million JPY
1	Land preparation for WTP construction	Land preparation of WTP site and relocation of tariff collection office	61,000	
2	Electrical Work	Cost for two-line power receiving such as procedures, construction. Cost for construction work for the primary side power receiving facility for water intake and WTP	5,000	
3	Unexploded or mine survey	Expenses for investigating in advance whether there are unexploded bombs and landmines etc.	25,000	
4	Environmental and social considerations	Environmental impact monitoring costs (2021-2024)	31,250	
5	Banking fee	Banking arrangement fees		3.6
TOTAL			122,250	3.6

2-5-1-2 Conditions for Cost Estimates

1) Date of Estimates:	As of April, 2019	
2) Exchange Rate:	US$ 1 = 111.21 JPY	
	KHR 1 = 0.026 JPY	
3) Period of Construction:	Total:	45.5 months
	Bidding Document Preparation:	5 months
	Tendering:	7.5 months
	Construction/Procurement:	33 months
4) Others:	The Project should be implemented in accordance with the procedures of Japan's Grant Aid Scheme.	

2-5-2 Operation and Maintenance Cost based on the comparator facilities

2-5-2-1 Assumptions

(1) Labor cost

The labor cost is estimated based on the organization chart in **Table 2-5.2**.

Japanese CEO and O&M manager together account for one person and the annual salary is assumed at JPY20,000,000/year. Salaries of local employees are assumed based on PPWSA's current rates.

Table 2-5.2 Labor Cost

Position	Number	Annual salaries (000KHR)	Total (mnKHR)
CEO	0.5	724,092	362
O&M & technical training advisor	0.5	724,092	362
Chief manager	1	60,221	60
Facility manager	1	47,634	48
Quality manager	1	47,634	48
Admin/business staff	3	35,047	105
M&E Engineer	1	35,047	35
Operating staff	6	35,047	210
Total	14	--	1,230

(2) Electricity Cost

Electricity cost is estimated based on the comparator facilities. Electricity price is assumed at the current price (KHR584/kWh).

Table 2-5.3 Electricity Cost

	Capacity (kW)	Operating rate (hour/day)	Annucal consumption (MWh)	Annual cost (mmKHR)
Intake	161.2	24	1,412	825
Treatment	88.3	2	64	38
Chemical	40.8	4	60	35
Distribution	199	24	1,743	1,018
Others	10	8	29	17
Total	499.3	--	3,309	1,932

(3) Raw Material Cost

Consumption of PAC and Chlorine is estimated based on PPWSA's current operations. Unit price is assumed at PPWSA's current purchase price.

Table 2-5.4 Raw Material Cost

	Consumption (g/m3)	Annual consumption(kg)	Unit price(oooKHR/kg)	Total (mn KHR)
PAC	10	109,500	2,137	234
Chlorine	5	54,750	2,288	125
Total	--	--	--	359

(4) Repairment Cost

Out of total CAPEX, 1/3 is assumed as machinery and electrics that need to be repaired with 0.5% per year repair cost. For the first year of operation the cost is covered by EPC contract and no repair cost is assumed. For the final year the SPC has to satisfy the hand-back conditions and the repair cost is assumed at 1.0%.

(5) Other Operating Costs

Other operating costs include social securities (KHR40,000/month/person), transportation cost (JPY50,000/month), office expenditure (JPY100,000/month), financial/legal advisor/ audit fee (JPY50,000/month) and 10% of those cost as contingency budget as well as 24% import tax on raw material and 10% of VAT for the other operating costs.

2-5-2-2 Operation and Maintenance Costs

OPEX estimates based on the comparator facilities are shown below.

Table 2-5.5 Opex Based on the Comparator Facilities

Assumptions		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Production volume	000 m3		10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950
Electricity price	KHR/kWh		584	584	584	584	584	584	584	584	584	584

O&M expenditure		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Electricity	mn KHR		1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932	1,932
consumption	MWh		3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309	3,309
Labor	mn KHR		1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
# of employees	person		14	14	14	14	14	14	14	14	14	14
Raw materials	mn KHR		359	359	359	359	359	359	359	359	359	359
PAC	mn KHR		234	234	234	234	234	234	234	234	234	234
Chlorine	mn KHR		125	125	125	125	125	125	125	125	125	125
Repair	mn KHR		0	181	181	181	181	181	181	181	181	362
Other operating costs	mn KHR		199	218	218	218	218	218	218	218	218	236
Total	mn KHR		3,721	3,920	3,920	3,920	3,920	3,920	3,920	3,920	3,920	4,119

Chapter 3 Project Evaluation

3-1 Preconditions

Preconditions and responsibilities by the Cambodian side for project implementation are described in "**Chapter 2-3 Obligations of Recipient Country**". The key conditions are as follows.

3-1-1 Land Acquisition and Preparation of WTP Site

Construction of the WTP does not require new land acquisition because the new facilities will be constructed on the premises of PPWSA

3-1-2 Water Intake Permissions

PPWSA has submitted an application letter to MoWRAM and CNMC for permission to take water from the Bassac River and has received an approval letter from MoWRAM and CNMC regarding consent.

3-1-3 Investigation of Land Mines and Unexploded Ordnance

The Cambodian side should take measures before project implementation. Investigation and disposal of land mines and unexploded ordnances before the commencement of construction, and measures in case of encountering landmines and unexploded explosives (UXO) during construction, shall be borne by the Cambodian side.

3-1-4 Approval of IEIA Report

According to Article 7 of Sub-Decree on Environmental Impact Assessment and the comments of the MoE, the Project Owner, the PPWSA, shall prepare and submit an IEIA report to the MoE for approval. Japanese side was supported the preparation of the IEIA report and IEIA report was approved by February 2020.

3-1-5 Electric Transmission Lines to the New Intake Facilities and Water Treatment Plants

Japanese Grant Aid will provide and install the transformers at the new intake station and water treatment plant. The Cambodian side will construct the power transmission facilities to the transformers and procedures for receiving power and application procedures for receiving two circuits.

3-1-6 Procedure of Tax Exemption

In June 2019, a basic agreement was reached from the CDC on tax exemption for the EPC portion.

3-2 Necessary Inputs by Recipient Country

Although the WTP is constructed with the grant aid, 30,000 m^3/day of bulk water to PPWSA must be secured by PPWSA.

3-3 Important Assumptions

The desired project outcomes can only be achieved if the following assumptions remain true:

- Serious natural disaster will not occur.
- Serious deterioration of the economy will not occur.
- Demographics in the project area will not change unexpectedly.
- The existing treatment capacity will be maintained.

3-4 Project Evaluation

3-4-1 Adequacy of the Project

(1) Project Beneficiaries

This project will improve the water supply capacity to Ta Khmau City residents and increase the beneficiary population of Ta Khmau City. In addition to the construction of a new WTP, the current water supply service will be improved, which will not only benefit the increasing population served by water but also improve the water supply service to the residents who are currently receiving water. The water currently being distributed from Phnom Penh to Ta Khmau City will be distributed to Phnom Penh after the construction of the WTP, which will improve the water supply service in Phnom Penh.

(2) Urgency of Project Implementation

The existing PPWSA water supply system is capable of providing water service to only 60% of the water demand in Ta Khmau City in 2030, because of insufficient production capacity. Therefore, the expansion of water supply facilities in Ta Khmau City is an urgent matter.

(3) Consistency between the Project and Cambodia Planning

The National Strategic Development Plan (NSDP) sets the water service target of 100% in urban areas by 2025. This project will help PPWSA achieve this water service ratio.

(4) Compliance with Japan's Assistance Policy for Cambodia

Japan's assistance policy for Cambodia is to support the recipient country in achieving their development goals. "Promotion of Social Development" is one of the priority pillars of this policy. Development of the water supply system promotes social development and is therefore consistent with the policy for Japanese assistance in Cambodia.

3-4-2 Effectiveness

The project is expected to provide the following beneficial outcomes:

3-4-2-1 Quantitative Effects

The expansion of water supply facilities in Ta Khmau city will result in improvements to the indicators listed in **Table 3-4.1**.

Table 3-4.1 Quantitative Effects

No.	Indicator	Baseline Data (Year 2015)	Target (Year 2027) (3 years after completion of the new facilities)
1	Water Supply Capacity (daily average basis)	11,440 m^3/day	30,000 m^3/day

3-4-2-2 Qualitative Effects

Qualitative Effects are as follows;

- Maintaining appropriate residual water pressure and increasing water supply capacity will improve water supply services.
- Promotion of house connections to poor households will improve the access to safe water supply to poor households.
- Maintaining special water tariff rates applied to poor households.
- Improving of operation and maintenance capacity through technology transfer for operation and maintenance of WTPs.
- Improving public health. More people will have access to safe water supply and water shortage will be eliminated.

In conclusion, the project will be effective in meeting its goals.

3-5 Items to be Noted or Confirmed in the Project

Items to be noted or confirmed in the Project shall include the following.

- G/A shall provide that the Article 3 of the Public Procurement Law in Cambodia applies to the whole Project, and EPC and O&M contracts are tied to each other.

Appendix 1　Member List of the Survey Team

JICA Officials

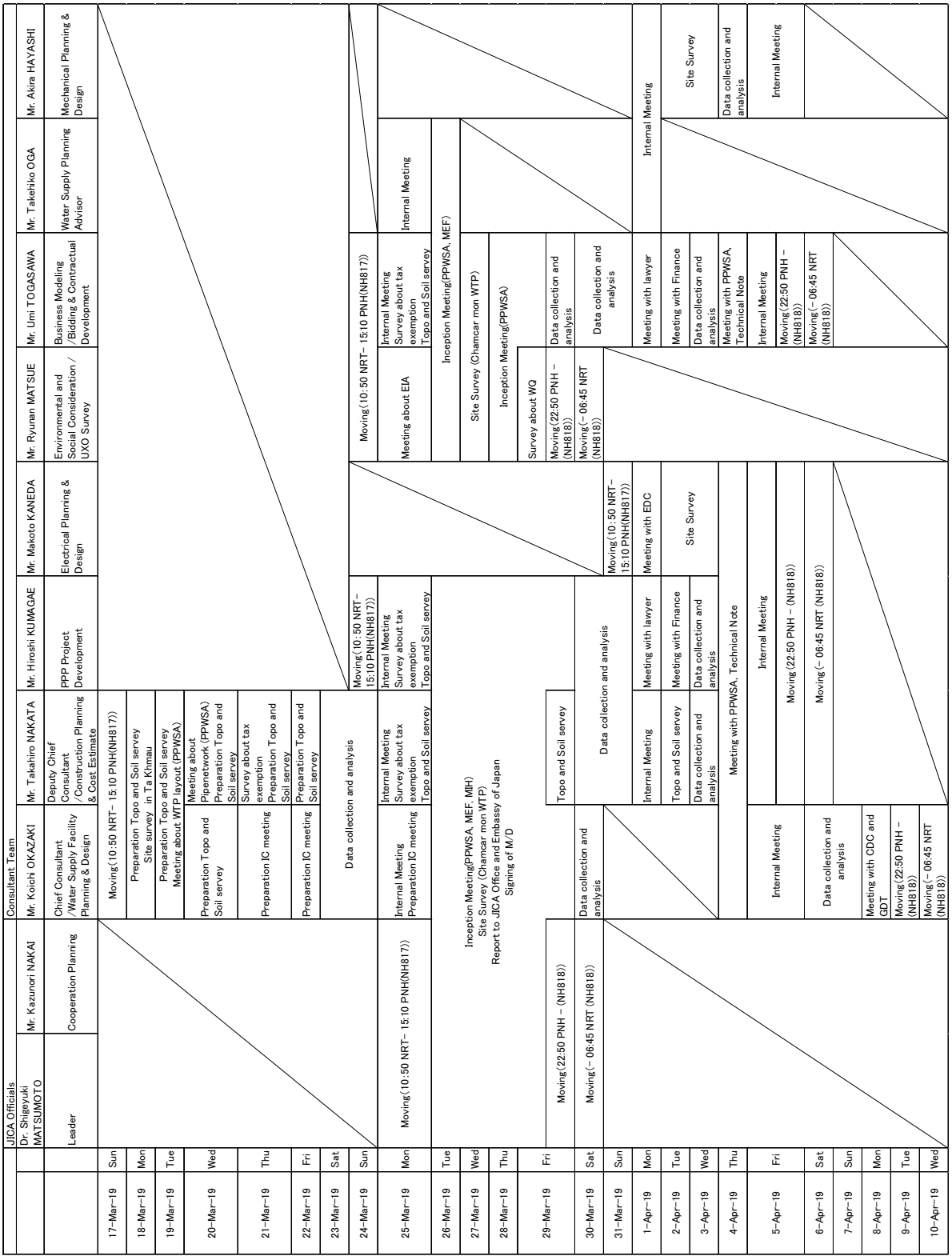
Name	Position	Organization
Dr. Shigeyuki MATSUMOTO	Leader	Deputy General Director, Water Resources Group, Global Environment Department, JICA
Mr. Kazunori NAKAI	Cooperation Planning	Senior Engineering Officer, Water Resources Team, Global Environment Department, JICA

Consultant Team

Name	Position	Organization
Mr. Koichi OKAZAKI	Chief Consultant /Water Supply Facility Planning & Design	Nihon Suido Consultants Co., Ltd.
Mr. Takahiro NAKATA	Deputy Chief Consultant /Construction Planning & Cost Estimate	Nihon Suido Consultants Co., Ltd.
Mr. Hiroshi KUMAGAE	PPP Project Development	Crown Agents Japan Limited
Mr. Makoto KANEDA	Electrical Planning & Design	Nihon Suido Consultants Co., Ltd.
Mr. Ryunan MATSUE	Environmental and Social Consideration / UXO Survey	Nihon Suido Consultants Co., Ltd.
Mr. Umi TOGASAWA	Business Modeling /Bidding & Contractual Development	Crown Agents Japan Limited
Mr. Takehiko OGA	Water Supply Planning Advisor	Nihon Suido Consultants Co., Ltd.
Mr. Akira HAYASHI	Mechanical Planning & Design	Nihon Suido Consultants Co., Ltd.

Appendix 2　Study Schedule

First Survey in Cambodia:　March 17 to April 10, 2019



Second Survey in Cambodia: June 18 to July 02, 2019

		JICA Officials		Consultant Team		
		Dr. Shigeyuki MATSUMOTO	Mr. Kazunori NAKAI	Mr. Koichi OKAZAKI	Mr. Hiroshi KUMAGAE	Mr. Umi TOGASAWA
		Leader	Cooperation Planning	Chief Consultant /Water Supply Facility Planning & Design	PPP Project Development	Business Modeling /Bidding & Contractual Development
18-Jun-19	Tue			Moving 10:50 NRT-15:10 PNH(NH817)		
19-Jun-19	Wed			Meeting and datacollection (PPWSA) Meeting about IEIA (PPWSA and consultant)		
20-Jun-19	Thu					
21-Jun-19	Fri					
22-Jun-19	Sat			Data collection and analysis		
23-Jun-19	Sun					
24-Jun-19	Mon	Moving 10:50 NRT- 15:10 PNH(NH817)		Meeting and datacollecti	Moving 10:50 NRT- 15:10 PNH(NH817)	
25-Jun-19	Tue	Interim Meeting(PPWSA, GDT) Report to JICA Office and Embassy of Japan Signing of M/D				
26-Jun-19	Wed					
27-Jun-19	Thu					
28-Jun-19	Fri	Moving(22:50 PNH - (NH818))		Site Survey and Water Sapmling	Moving(22:50 PNH - (NH818))	
29-Jun-19	Sat	Moving(- 06:45 NRT (NH818))		Data collection and analysis	Moving(- 06:45 NRT (NH818))	
30-Jun-19	Sun					
1-Jul-19	Mon			Moving(22:50 PNH - (NH818))		
2-Jul-19	Tue			Moving(- 06:45 NRT (NH818))		

Third Survey in Cambodia: Aug 25 to Aug 31, 2019

		Consultant Team
		Mr. Koichi OKAZAKI
		Chief Consultant /Water Supply Facility Planning & Design
25-Aug-19	Sun	Moving(10:50 NRT-15:10 PNH(NH817))
26-Aug-19	Mon	Meeting about IEIA (PPWSA)
27-Aug-19	Tue	
28-Aug-19	Wed	Meeting about Water rights (PPWSA)
29-Aug-19	Thu	Site Survey and Water Sapmling
30-Aug-19	Fri	Moving(22:50 PNH - (NH818))
31-Aug-19	Sat	Moving(- 06:45 NRT (NH818))

Fourth Survey in Cambodia: October 15 to October 23, 2019

		Consultant Team	
		Mr. Koichi OKAZAKI	Mr. Takahiro NAKATA
		Chief Consultant /Water Supply Facility Planning & Design	Deputy Chief Consultant /Construction Planning & Cost Estimate
29-Sep-19	Tue	Moving(10:50 NRT-15:10 PNH(NH817))	
30-Sep-19	Wed	Meeting about IEIA and Finance (PPWSA)	
1-Oct-19	Thu	Meeting about IEIA (PPWSA)	
15-Oct-19	Tue		Moving(10:50 NRT-15:10 PNH(NH817))
16-Oct-19	Wed	Internal Meeting	
17-Oct-19	Thu	Data collection and analysis	
18-Oct-19	Fri		Site Survey
19-Oct-19	Sat	Data collection and analysis	
20-Oct-19	Sun		
21-Oct-19	Mon	pre-DOD Meeting(PPWSA)	
22-Oct-19	Tue	Moving(22:50 PNH - (NH818))	Site Survey and Water Sapmling
23-Oct-19	Wed	Moving(- 06:45 NRT (NH818))	Moving(13:20 PNH - RGN (PG093))

Fifth Survey in Cambodia: November 17 to November 23, 2019

		JICA Officials		Consultant Team			
		Dr. Shigeyuki MATSUMOTO	Mr. Kazunori NAKAI	Mr. Koichi OKAZAKI	Mr. Takahiro NAKATA	Mr. Hiroshi KUMAGAE	Mr. Takehiko OGA
		Leader	Cooperation Planning	Chief Consultant /Water Supply Facility Planning & Design	Deputy Chief Consultant /Construction Planning & Cost Estimate	PPP Project Development	Water Supply Planning Advisor
17-Nov-19	Sun	Moving(10:50 NRT-15:10 PNH(NH817))	Moving(10:50 NRT-15:10 PNH(NH817))	Moving(10:50 NRT-15:10 PNH(NH817))	Moving(11:20 RGN- 19:35 PNH(TG0584))	Moving(10:50 NRT-15:10 PNH(NH817))	
18-Nov-19	Mon	DOD Meeting(PPWSA, MIH) Report to JICA Office and Embassy of Japan Signing of M/D					
19-Nov-19	Tue						
20-Nov-19	Wed						
21-Nov-19	Thu	Moving(22:50 PNH - (NH818))	Moving(22:50 PNH - (NH818))				
22-Nov-19	Fri	Moving(- 06:45 NRT (NH818))	Moving(- 06:45 NRT (NH818))	Moving(22:50 PNH - (NH818))	Moving(22:50 PNH - (NH818))	Moving(22:50 PNH - (NH818))	
23-Nov-19	Sat			Moving(- 06:45 NRT (NH818))	Moving(- 06:45 NRT (NH818))	Moving(- 06:45 NRT (NH818))	

Appendix 3 List of Parties Concerned in the Recipient Country

Phnom Penh Water Supply Authority

- H.E. Dr. SIM Sitha (PhD) Director General
- Dr. CHEA Visoth (PhD) Deputy Director General, in charge of Corporate Secretary,
- Mr. SAMRETH Sovithiea Deputy General Director, in charge of Plan and Investment Project
- Mr. MA Noravin Deputy Director General, in charge of Production and Distribution Department
- Mr. ROS Kimleang Deputy Director General, in charge of Finance and Securities Exchange Department
- Mr. CHEA Satephoat Director of Planning and Project Department

Ministry of Industry & Handicraft (MIH)

- H.E. Mr. CHAM Prasidh Senior Minister

The Council for the Development of Cambodia (CDC)

- Mr. Lim Visat Assistant to H.E. Sok Chenda Sophea, Minister attached to the Prime Minister, Secretary General of the Council for the Development of Cambodia