

**JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF INDUSTRY, MINES AND ENERGY
PHNOM PENH WATER SUPPLY AUTHORITY**

**THE STUDY
ON
THE MASTER PLAN
OF
GREATER PHNOM PENH WATER SUPPLY
(PHASE 2)
IN
THE KINGDOM OF CAMBODIA**

FINAL REPORT

VOLUME II

MAIN REPORT

FEBRUARY 2006

**NJS CONSULTANTS CO., LTD.
CTI ENGINEERING INTERNATIONAL CO., LTD.**

PREFACE

In response to a request from the Royal Government of Cambodia, the Government of Japan decided to conduct the Study on the Master Plan of Greater Phnom Penh Water Supply (Phase 2) in the Kingdom of Cambodia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the study team headed by Mr. Yoshihiko Sato of NJS consultants Co., Ltd. (consisting of NJS Consultants Co., Ltd. and CTI Engineering International Co., Ltd.) to Cambodia, three times between December 2004 and January 2006.

The team held discussions with the officials concerned of the Royal Government of Cambodia, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship 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 Study.

February 2006

Takashi Kaneko
Vice-President

Japan International Cooperation Agency

February 2006

Mr. Takashi Kaneko
Vice-President
Japan International Cooperation Agency (JICA)
Tokyo, Japan

Letter of Transmittal

It is a greater pleasure that we submit herewith the Final Report of “The Study of the Master Plan of Greater Phnom Penh Water Supply (Phase 2) in the Kingdom of Cambodia”.

The main objective of the Study was placed on the formulation of water supply development plan for Greater Phnom Penh for meeting the water demand up to the year of 2020. The Study conducted Ⅲ a basic study in Phase I and prepared in Phase II a master plan and successively in Phase III a feasibility study. The Report presents the outcomes of the master plan and feasibility study.

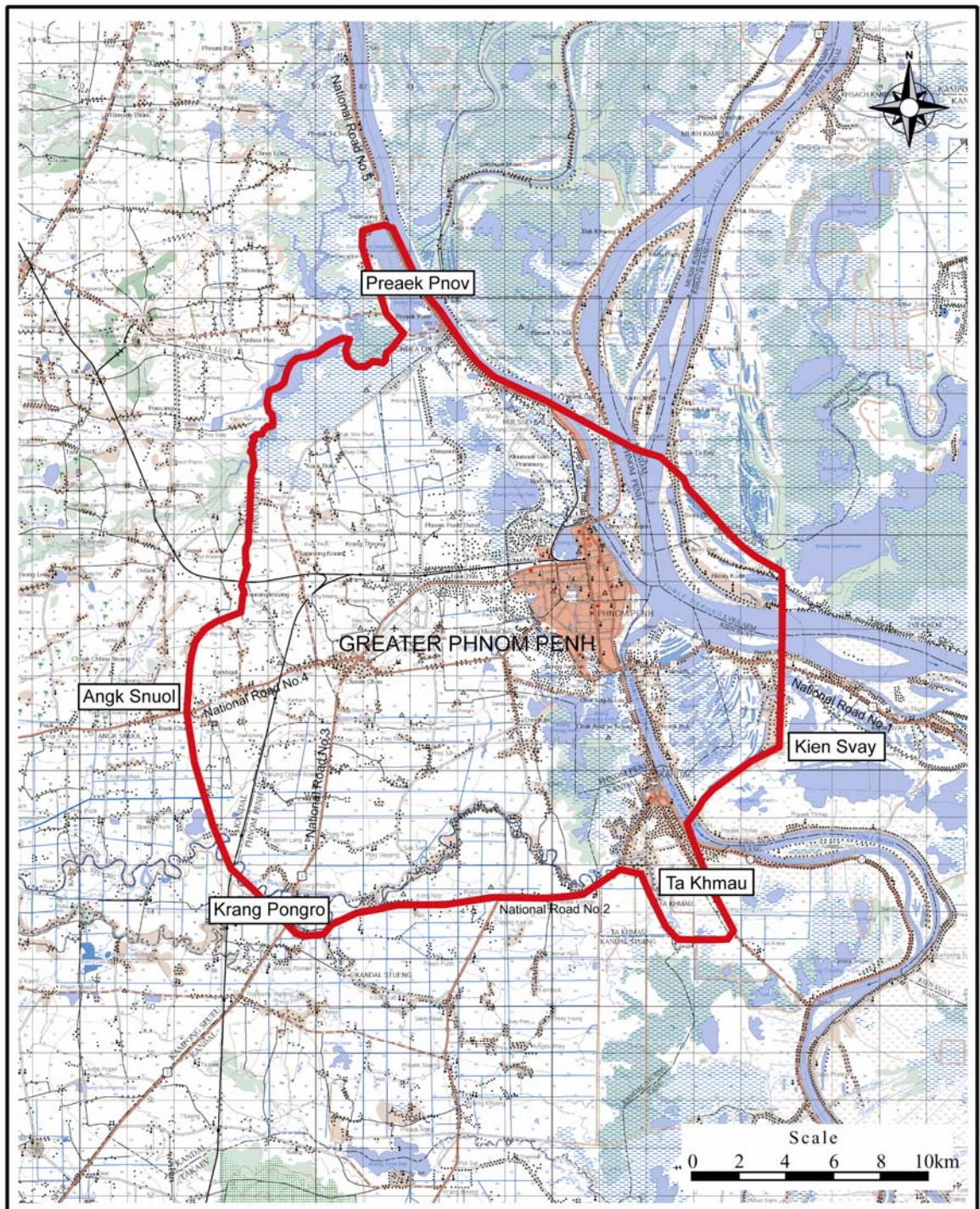
We hope that this Report will be helpful for the realization of the project proposed in this Study. We believe that the successful undertaking of the proposed project would assure stable water supply in Greater Phnom Penh in the long term and thus contribute to the further socio-economic development in the region.

We wish to express our sincere gratitude to the personnel concerned of your Agency for the guidance and support given throughout the Study period. Our deep gratitude is also expressed to the Ministry of Industry, Mines and Energy, Phnom Penh Water Supply Authority, and other concerned authorities of the Royal Government of Cambodia, JICA Cambodia Office and the Embassy of Japan in Cambodia for their close cooperation and assistance extended during the course of the Study.

Very truly yours,

Yoshihiko Sato
Team Leader

The Study on the Master Plan
of Greater Phnom Penh Water Supply
(Phase 2) in the Kingdom of Cambodia



Master Plan (Phase 2) Study Area

Photos

Tonle Sap



Tonle Basak



Mekong River, Intake of Chrouy Changva WTP



Tonle Sap, Intake of Preaek Pnov WTP



Phum Prek WTP



Phum Prek WTP



Chrouy Changva WTP



Chrouy Changva WTP



Photos

Chamkar Mon WTP



Chamkar Mon WTP



Hand Pump in Krang Pongro



Kien Svay WTP



Tumpun Pumping Station



Trabek Pumping Station



Southeast of Phnom Penh (Boeng Cheung Aek)



Northeast of Phnom Penh (Boeng Kbal Damrei)



**THE STUDY
ON
THE MASTER PLAN OF GREATER PHNOM PENH WATER SUPPLY (PHASE 2)
IN THE KINGDOM OF CAMBODIA**

EXECUTIVE SUMMARY

PART A: MASTER PLAN

1. Background of the Project

The Study on the Master Plan of Greater Phnom Penh Water Supply (Phase 2) was undertaken in accordance with the Minutes of Meeting on the Scope of Work for the Study, signed on 29th July 2004, between the Royal Government of Cambodia, represented by the Ministry of Industry, Mines and Energy (MIME) and the Phnom Penh Water Supply Authority (PPWSA), and the Japan International Cooperation Agency (JICA).

The objectives of the Study are:

- 1) To formulate a master plan up to the year 2020 for an efficient and sustainable water supply system for Greater Phnom Penh (Municipality of Phnom Penh, Ta Khmau City and urban areas bordering the Municipality of Phnom Penh in Kandal Province), and to conduct a feasibility study on the priority project(s); and
- 2) To transfer technology to counterpart personnel during the course of the study.

The Study started at the beginning of December 2004 and was completed at the end of January 2006.

This Final Report consists of three volumes:

- Volume I : Summary Report
- Volume II : Part A : Master Plan
Part B : Feasibility Study
- Volume III : Supporting Reports
Part A : Detailed study documents/data
Part B : Drawings

2. Project Framework

The Master Plan takes into consideration the relevant national plans, policies and targets, including specifically the Cambodia Millennium Development Goals (CMDGs). The CMDG target of 80% for the urban population with access to a safe water source by 2015 has already been met in urban Phnom Penh and will be sustained above that level to 2020 and beyond. For the peri-urban areas, the target of 80% coverage will be achieved by 2020.

Based on the future urban development scenarios, the population of the central area is expected to decrease from 715,500 in 2005 to 683,400 in 2020. In the suburban area of Metropolitan Phnom Penh (MPP), the population will double from the present 2005 population level of about 620,000 to 1,320,000 in 2020. This population increase of about 700,000 is expected to occur in Dangkao District, 270,000; in Mean Chey District, 160,000; and in Ruessei Kaev District, 270,000.

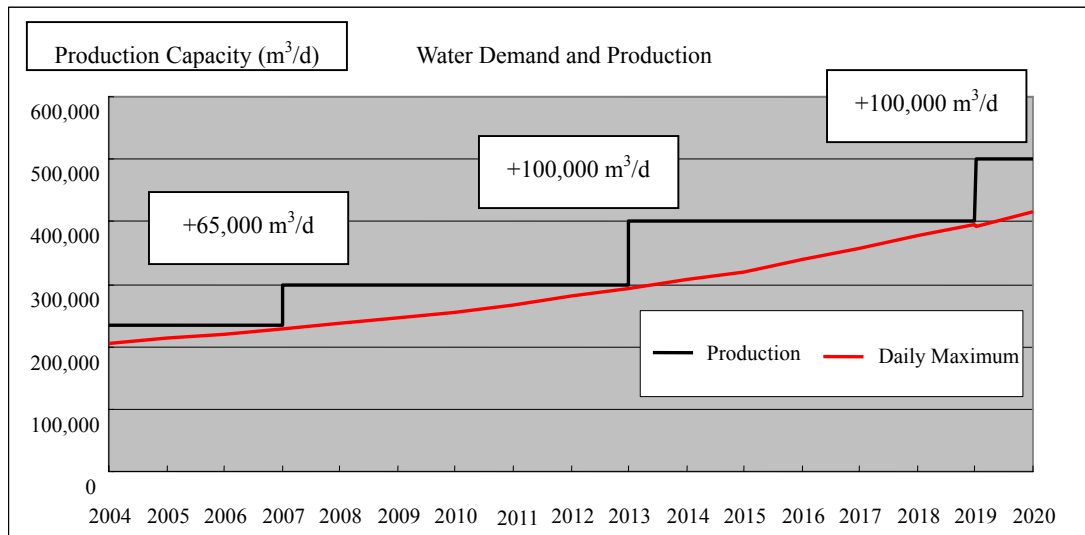
Under the most likely scenario, water demand will increase from 133,402 m³/d in 2004 to 271,093 m³/d in 2020 on a daily average basis and from 204,027 m³/d in 2004 to 414,612 m³/d in 2020 on a daily maximum basis. Overall supply coverage for the MPP (including peri-urban) will go from 67.7% in 2004 to 81% in 2020.

Proposed Water Supply Basic Indicators (unit in m³/d)				
Year	2005	2010	2015	2020
By Central Distribution System (CDS)				
Daily Ave. per capita water demand (lpcd)	80	86	95	104
Peak factor	1.3	1.3	1.3	1.3
Peak Day per capita water demand	104	111	123	135
NRW	15%	15%	15%	15%
Daily Max. per capita demand (lpcd)	122	131	144	158
Total population	1,529,999	1,774,891	2,034,868	2,303,826
Served population	1,035,931	1,244,738	1,491,113	1,866,102
Coverage (%)	67.7	70.1	73.3	81.0
Daily Ave. water demand (m ³ /d)	133,402	166,529	209,292	271,093
Daily Max. water demand (m ³ /d)	204,027	254,691	320,094	414,612
Nos. of served households	105,870	136,540	180,736	247,712
Nos. of non-domestic connections	15,517	18,729	21,640	25,011
Total No. of connections	121,387	155,269	202,376	272,723
By CDS + Well Water Systems				
Total population	1,529,999	1,774,891	2,034,868	2,303,826
Served population	1,070,582	1,321,598	1,641,684	2,082,822
Coverage (%)	70.0	74.5	80.7	90.4
By Well Water Systems				
Served population	34,650	76,860	150,570	216,720
Unit covering population per well	210	210	210	210
Nos. of wells required	165	366	717	1,032
Unit water consumption per capita (lpcd)	40	40	40	40
Well water supply amount (m ³ /d)	1,386	3,075	6,023	8,668

3. Urban Water Supply Development Plan

3-1 Water Production and Treatment

The total water production requirement for the year 2020 is 500,000 m³/d. The required production capacity at each stage up to 2020 is illustrated in the figure below based on the daily maximum water demand.



The present production capacity of 235,000 m³/d can meet the water demand through 2007. With implementation of the Stage I Priority Project to expand the capacity of the Chrouy Changva Water Treatment Plant (WTP) by 65,000 m³/d (bringing total production capacity to 300,000 m³/d), the maximum water demand during Stage I and through the year 2013 of Stage II can be met. After 2013, a second project for construction of a new water treatment plant with an initial production capacity of 100,000 m³/d will be necessary to satisfy the further increased water demand during the latter part of Stage II and beyond. The new plant is proposed to be constructed at Nirouth.

3-2 Water Transmission and Distribution

The objectives for the network expansion plan are to 1) serve the additional demand, while 2) enhancing overall system performance. The strategy for accomplishing these objectives incorporates the following critical concepts: a) division of the network into discrete zones for more intensive and flexible control of flow and pressure, b) creation of transmission network loops for greater redundancy and pressure balancing options, and c) completion of the distribution system, as at present, in closed, metered blocks.

4. Peri-Urban Water Supply Development Plan

The Peri-Urban Water Supply Development Plan has established the clear target of providing safe water coverage to at least 80% of the population of the Phnom Penh peri-urban areas. The strategy for achieving the target entails a combination of piped network extension and development of wells in an appropriate and cost-effective manner.

5. Project Costs

5-1 Capital Costs for Urban Water Supply Development Plan

Based on the water demand, the capital investments for the expansion of the Urban Water Supply Development Plan are estimated in the following table.

Summary of Project Cost

Cost Item	Cost (US\$)	
	Breakdown	Total
Construction Cost		
Stage I (2010)		51,865,000
Chrouy Changva WTP -2nd Stage	22,630,000	
Water Tank	2,555,000	
Transmission/Distribution Pipe	11,880,000	
Monitoring Facility	5,000,000	
Rehabilitation of M&E Equipment	9,800,000	
Stage II (2015)		100,462,000
New Intake & WTP -1st Stage	40,106,000	
Clear Water Reservoir Expansion in Phum Prek WTP	1,184,000	
Transmission/Distribution Pipe	23,923,000	
Sludge Treatment Facility for Chrouy Changva & Phum Prek WTP	18,849,000	
Rehabilitation of M&E Equipment	16,400,000	
Stage III (2020)		44,767,000
New Intake & WTP -2nd Stage	25,982,000	
Transmission/Distribution Pipe	7,238,000	
Sludge Treatment Facility for Chamkar Mon WTP	3,347,000	
Rehabilitation of M&E Equipment	8,200,000	
Total of Construction Cost		197,094,000
Land Acquisition Cost		3,600,000
Equipment Procurement Cost		1,971,000

Cost Item	Cost (US\$)	
	Breakdown	Total
Engineering Service Expense		19,709,000
Government's Administration Expense		9,855,000
Institutional Development Cost		2,062,000
Sub Total		234,291,000
Physical Contingency		23,429,000
Price Contingency		62,232,000
Total Project Cost		319,952,000

5-2 Capital Costs for Peri-urban Water Supply Development Plan

Based on the water demand, the capital investments to support the expansion of the well program in the peri-urban area are estimated below:

Summary of Project Cost for Well Facility

Cost Item	Cost (US\$)			
	Stage I	Stage II	Stage III	Total
Construction Cost				
Well Facility	6,305,000	6,762,000	8,696,000	21,763,000
Total Construction Cost				21,763,000
Equipment Procurement Cost	63,000	68,000	87,000	218,000
Engineering Service Expense	631,000	676,000	870,000	2,176,000
Government's Administration Expense	315,000	338,000	435,000	1,088,000
Sub Total	7,314,000	7,844,000	10,088,000	25,245,000
Physical Contingency	731,000	784,000	1,009,000	2,525,000
Price Contingency	848,000	2,125,000	4,949,000	7,921,000
Total Project Cost	8,893,000	10,753,000	16,044,000	35,691,000

6. Financial Analysis

The financial viability of the Master Plan (Urban water supply) is assessed by comparing the Financial Internal Rate of Return (FIRR) with the Weighted Average Cost of Capital (WACC, used as a proxy for the Opportunity Cost of Capital). The WACC of the project is 3.84% (in real terms), while the FIRR is 5.19%, so the project is considered financially viable.

The results of the financial projections of PPWSA and the financial analysis of the projects show that the proposed Master Plan projects can be implemented on a sustainable basis. Throughout the economic life

of the proposed projects, PPWSA can generate sufficient revenues to cover the costs of their operation and maintenance, together with the existing assets and on going projects, and repay all its debt service obligations as they fall due.

7. Initial Environmental Evaluation

JICA categorized the Master Plan as Category B. The proposed projects will have mostly beneficial impacts. Although some adverse impacts will occur during the construction and operation stage of the project, minimization of environmental disturbances such as noise and dust during construction will be considered in the detailed design, and appropriate environmental management requirements will be incorporated in the specifications of construction contracts.

In order to assure that the proposed mitigation plan, described in “Environment Mitigation Plan” will be adequately conducted, the related agencies should monitor those activities as recommended in “Environmental Monitoring Plan”.

8. Implementation Plan

The project is planned to be implemented divided into three stages based on the design target years of 2010 (Stage I) for the feasibility study, 2015 (Stage II) for the intermediate development plan and 2020 (Stage III) for the long term development plan.

The project implementation schedule is presented in the following figure:

Description	Phase Year	Stage 1					Stage 2					Stage 3				
		2005 1	2006 2	2007 3	2008 4	2009 5	2010 6	2011 7	2012 8	2013 9	2014 10	2015 11	2016 12	2017 13	2018 14	2019 15
Implementation Schedule																
010	Preparation of Project															
011	Feasibility Study															
012	Financial Arrangement and Selection of Construction															
020	Pre-Construction															
021	Detailed Design															
022	P/Q and Tender															
100-300 Construction																
100 Stage I (Q= 65,000m3/d) - 2010																
<Urban Water Supply Supply Projects>																
110 Chrouy Changva WTP -2nd Stage																
111	Intake Station (for Chrouy Changva WTP)															
112	Raw Water Transmission Facilities															
113	Chrouy Changva WTP -2nd Stage (Q=65,000m3/d)															
120 Water Tank																
121	Ta Khmau Water Tank															
122	Booster Pump for Existing Water Tank (3 nos)															
130 Distribution Pipe																
131	Distribution Pipe (Dia 63 to 600)															
132	Distribution Pipe (Dia 700 to 1200)															
140	Rehabilitation of M&E Equipment															
<Peri-Urban Water Supply Supply Projects>																
150	Well Facilities															
200 Stage II (Q= 100,000m3/d) - 2015																
<Urban Water Supply Supply Projects>																
210 New WTP -1st Stage																
211	Intake Station (for New WTP)															
212	Raw Water Transmission Facilities															
213	New WTP -1st Stage (Q=100,000m3/d)															
220 Distribution Pipe																
221	Distribution Pipe (Dia 63 to 600)															
222	Distribution Pipe (Dia 700 to 1200)															
230	Sludge Treatment Facility for Chrouy Changva and Phum Prek WTP															
240	Rehabilitation of M&E Equipment															
<Peri-Urban Water Supply Supply Projects>																
250	Well Facilities															
300 Stage III (Q= 100,000m3/d) - 2020																
<Urban Water Supply Supply Projects>																
310 New WTP -2nd Stage																
311	Intake Facilities (for New WTP)															
312	Raw Water Transmission Facilities															
313	New WTP (Q=100,000m3/d)															
320 Distribution Pipe																
321	Distribution Pipe (Dia 63 to 600)															
322	Distribution Pipe (Dia 700 to 1200)															
330	Sludge Treatment Facility for Chamkar Mon WTP															
340	Rehabilitation of M&E Equipment															
<Peri-Urban Water Supply Supply Projects>																
350	Well Facilities															

PART B: FEASIBILITY STUDY

The Feasibility Study covers the Implementation of the Stage I Priority Projects identified under the Master Plan of the Greater Phnom Penh Water Supply (Phase 2). Stage I of the Master Plan, the target period for this Feasibility Study, covers the years 2005 to 2010. All of the projects identified as Stage I projects in the Master Plan are considered to be Priority Projects.

The Stage I Priority Projects identified in the Master Plan and elaborated in this Feasibility Study encompass the following: 1) water supply augmentation; 2) existing systems rehabilitation; 3) peri-urban water supply; and 4) institutional development.

9. Water Supply Augmentation Project

The Components of the Augmentation Projects are summarized as follows:

9-1 Water Treatment Plant (Chrouy Changva Stage II) Construction Project

The existing Chrouy Changva WTP will be expanded from its present capacity of 65,000 m³/day up to 130,000 m³/day. Sufficient space is available at the existing site. The major facilities to be constructed are flocculation /sedimentation tanks, filters and clear water reservoirs. The existing plant achieves proper treatment performance, securing safe and clean clear water meeting the national drinking water standards. The responsible engineers and operators are accustomed to operating the existing plant. It is therefore recommended to apply the same treatment process/ facility, except minor changes for improvement, as necessary.

There is insufficient space within the existing intake tower to install additional intake pumps or change to larger pumps. Therefore, it is recommended to construct a new intake tower with the capacity to meet the total expanded production capacity of 130,000 m³/day and convert the existing structure and pumping facility for use as a stand-by unit.

The capacity of the clear water reservoir in Chrouy Changva WTP was reviewed and it was identified that the existing reservoir (5,760 m³, equivalent to 2.1 hours at full production of 65,000 m³/day) is far smaller than the requirement to cover water demand fluctuation in a day. Therefore, additional reservoirs should be provided with the expansion of the treatment facilities.

9-2 Transmission and Distribution System Augmentation Project

Stage I of the Master Plan, targeting the year 2010, focuses on reinforcing or creating the two main transmission loops by connecting existing branches. By 2010 the system will be upgraded with:

- ◆ network extension of 52 km of transmission pipes,
- ◆ a new 900 mm pipe from the expanded Chrouy Changva WTP to the Chrouy Changva bridge,
- ◆ a new water tank and transmission to supply Ta Khmau area,
- ◆ a new safety and sustainable policy with redundancy and energy saving incorporating:
 - loop systems;
 - independent pumping station and reservoirs
 - improved monitoring systems.

10. Rehabilitation Project

The other two existing treatment plants (Chamkar Mon and Phum Prek) are both more than ten years old and due for heavy maintenance and rehabilitation of some components. The rehabilitation works consist of overhaul/repair/replacement of mechanical equipment, electrical equipment, and instrumentation, all of which usually deteriorate over the relatively short period of 10 to 20 years. The actual contents of the works shall be determined by PPWSA considering the budget availability and seriousness of the deterioration of the equipment.

The following are examples:

- ◆ Replacement of pump impeller – higher energy consumption (decrease of efficiency)
- ◆ Chemical dosing facility – more chemical consumption (leakage or rude dosing)
- ◆ Chlorination facility – improve safety (leakage)
- ◆ Power supply facility – improve reliability
- ◆ Automatic control system – less manpower
- ◆ Laboratory – proper water quality control

11. Peri-Urban Water Supply Project

In Stage I, communes and villages with an estimated population of 47,741 inhabitants will be selected for attaining the target of safe water coverage of about 60%. The Peri-Urban Water Supply Project should be started in areas adjacent to urbanized areas of MPP and district towns of Ta khmau and Kien Svay in order to relieve the disparity of water supply between them. Accordingly, Dangkao District in MPP and Takmau District and Kien Svay District in Kandal Province will be prioritized for implementation. Basic design parameters include the following:

- ◆ Unit Water Consumption : 40 liter/capita/day
- ◆ Water supply facilities : Deep well
- ◆ Safe pumping yield of well : 20 liter/minute (=1.2 m³/hour)
- ◆ Coverage person per one well : 210 person/well
- ◆ Design water supply amount : 8,400 liter/well

- ◆ Required number of wells : 229 wells
- ◆ Water supply level : Level 1 Tube-well with hand pump
(because of low yield and recharging)

12. Institutional Development & Capacity Building Plan

The broad themes for the institutional development and capacity building plan during Stage I are on sharpening of organizational **directions**, strengthening of management **systems**, and promoting more **delegation** of duties and responsibilities. Many of the current systems need to be formalized and standardized as the PPWSA expands. The priority strategy at this stage of growth focuses on enhancing the stability of the organization – so that its present high performance is sustained in spite of whatever events or changes may occur beyond its control.

Stage I institutional development will be done by **organizational restructuring** (to help build a broader team of managers and supervisors with clear roles and responsibilities and set the stage for even higher levels of coordination among the management team and delegation of authority and responsibility); **intensified training** for all staff on all aspects of utility management and operations (not just technical aspects) and **strengthening of existing management information system** (based on the existing Navision Financials).

The objective of the institutional development assistance project is to ensure that PPWSA can sustainably manage the newly-expanded facilities at least as well as it has been managing its existing facilities. The project envisages that starting 2007 until the end of Stage I, external technical support for institutional development will be part of the future investment programs. This external assistance will augment PPWSA's own efforts in selected areas of need. The assistance will mainly take the form of management (and technical) systems review and development and training services.

13. Environmental Impact Assessment

JICA's Office of Environmental and Social Considerations Review categorized the Stage I Priority Projects as Category B. The Priority Projects will have mostly beneficial impacts. Proper mitigation measures must be implemented throughout the planning, construction, and O&M phase of the each project. Monitoring of the environment and the effectiveness of the mitigation measures is also the responsibility of PPWSA.

PPWSA will need to be careful about the following issues in the implementation of the Stage I Priority Project, if necessary.

- ◆ PPWSA must revise the scoping checklist for each project on site so that no environmental items are missed from the study.

- ◆ PPWSA must update the social and environmental condition around the project site.
- ◆ For the construction of distribution pipes, PPWSA must minimize relocation or modification of existing infrastructures and private structures.
- ◆ PPWSA must prepare a required cost for environmental mitigation and monitoring measures based on the detailed information of project design and schedule if necessary.
- ◆ PPWSA must continue their efforts to distribute information and to negotiate with local communities regarding the design and schedule of construction of each project.
- ◆ In case that PPWSA cause forced relocation of settlement or legal businesses, PPWSA must faithfully participate negotiation procedure and consider proper compensation according to the local common sense as well as the international guidelines if necessary.

FINAL REPORT
THE STUDY ON THE MASTER PLAN OF
GREATER PHNOM PENH WATER SUPPLY (PHASE 2)
IN THE KINGDOM OF CAMBODIA

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PART A
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Abbreviations

ADB	:	Asian Development Bank
BAU	:	Bureau des Affaires Urbaines
BOD	:	Biological Oxygen Demand
BOT	:	Built, Operation, and Transfer
CDS	:	Central Distribution System
CMDGs	:	Cambodian Millennium Development Goals
COD	:	Chemical Oxygen Demand
DPWT	:	Department of Public Works and Transport
EIA	:	Environmental Impact Assessment
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
GOJ	:	The Government of Japan
IEIA	:	Initial Environment Impact Assessment
MIME	:	Ministry of Industry, Mines and Energy
MIS	:	Management Information System
MOE	:	Ministry of Environment
MOP	:	Ministry of Planning
MPP	:	Municipality of Phnom Penh
MPWT	:	Ministry of Public Works and Transport
MWRM	:	Ministry of Water Resources and Meteorology
NRW	:	Non-Revenue Water
PPWSA	:	Phnom Penh Water Supply Authority
PVC	:	Polyvinyl Chloride Pipe
RGC	:	The Royal Government of Cambodia
SEDP	:	Socioeconomic Development Plan (I or II)
TA	:	Technical Assistance
UNDP	:	United Nations Development Program
US\$:	United States Dollar
WB	:	World Bank
WHO	:	World Health Organization
WTP	:	Water Treatment Plant

PART A : MASTER PLAN

Chapter 1. Background of the Project

Chapter 1. Background of the Project

1-1 Authorization

The Study on the Master Plan of the PPWSA is in pursuance of the Scope of Work, signed on July 29, 2004, between the Ministry of Industry, Mines and Energy (MIME), Phnom Penh Water Supply Authority (PPWSA), and Japan International Cooperation Agency (JICA). JICA has organized a study team (“the Study Team”) consisting of experienced specialists of NJS Consultants Co., Ltd in association with CTI Engineering International Co., Ltd. in the fields required for the study.

The Study started at the beginning of December, 2004, and was completed at the end of January, 2006. During the approximately 14-month period, the Study Team undertook the study in close cooperation with the MIME and PPWSA counterpart officials.

1-2 Background

The water supply system in Phnom Penh, the capital of the Kingdom of Cambodia, severely deteriorated due to prolonged lack of operation and maintenance of the facilities during the civil war that ended in 1991. Considering the situation, JICA conducted the “Phnom Penh Water Supply Study” and formulated the Master Plan of the Water Supply System in 1993 (Phase 1 Master Plan), targeting the year 2010.

Following the Phase 1 Master Plan, the city’s water supply facilities have since been constructed or renovated through the efforts of PPWSA with assistance from the Government of Japan (GOJ), other donor countries and international lending agencies. PPWSA has rapidly increased the supply capacity and expanded the served population to reach approximately 800,000 people in the urban and peri-urban areas of the city in 2004. However, due to rapid economic development and urbanization, water demand continues to increase as the urban area expands towards the adjacent Kandal Province.

At present, expansion of the water supply system in the adjacent areas has been implemented based on an authority plan. The Royal Government of Cambodia (RGC) restructured sector responsibilities for drinking water supply in July, 2004, effectively putting PPWSA under the jurisdiction of MIME. This restructuring enables PPWSA to extend water services to Kandal Province. In addition, MIME is preparing a “Water Supply and Sanitation Law” with assistance from the World Bank (WB), which proposes a substantial re-organization of the water and sanitation sector in the country.

In this connection, in June, 2003, the RGC requested the GOJ to provide technical assistance through JICA to develop a Master Plan for Water Supply in the Greater Phnom Penh area. In response to this request, JICA conducted a preliminary study in July of 2004 and agreed with the RGC on the Scope of Work for the Project.

1-3 Objectives of the Study

The objectives of the Study are:

- (1) To formulate a master plan up to the year 2020 for an efficient and sustainable water supply system for Greater Phnom Penh (Municipality of Phnom Penh, Ta Khmau City and urban areas bordering the Municipality of Phnom Penh in Kandal Province), and to conduct a feasibility study on the priority project(s); and
- (2) To transfer technology to counterpart personnel during the course of the study.

1-4 Study Area

The Study Area covers Greater Phnom Penh defined as the Municipality of Phnom Penh, Ta Khmau City, and urban areas bordering the Municipality of Phnom Penh located inside of the outer-ring-dike road, encompassing an area of approximately 510 km² and a population of approximately 1.5 million.

Table 1-1 Study Area

Municipality/ Province	Districts	Total Area (km ²)	Study Area (km ²)	Study Area (%)
Phnom Penh	Chamkar Mon	9.59	9.59	100%
	Doun Penh	7.34	7.34	100%
	7 Meakkara	2.20	2.20	100%
	Tuol Kouk	7.95	7.95	100%
	Dang Kao	187.91	187.91	100%
	Mean Chey	50.86	50.86	100%
	Ruessei Kaev	116.05	116.05	100%
Total Area in Municipality of Phnom Penh		381.90	381.90	100%
Kandal	Kandal Stueng	264.60	31.96	12%
	Kien Svay	384.10	22.37	6%
	Angk Snuol	304.30	34.97	11%
	Ponhea Lueu	337.90	6.56	2%
	Ta Khmau	31.66	31.66	100%
Total Area in Kandal Province		1,322.56	127.52	15%
Total Study Area		Approx. 510 km²		

Source: JICA Study Team Estimation

PPWSA and the Study team agreed that Khsach Kandal and Lvea Aem districts of Kandal Province, which are located on the opposite bank from the Phnom Penh central area, will be

excluded from the Study Area because to supply them from the PPWSA piped water system is not practical. However, the entire area of Ta Khmau city is included in the Study Area.

1-5 Target Year

The target year in this study is 2020, as defined in the study objectives.

1-6 Study Organization

The methodology envisaged by the Study Team in the Inception Report has been maintained. Since the Study will be conducted in three phases, as described below, several reports are being prepared for each phase in the course of the Study.

- ◆ Phase I (Basic Study) Preparatory work for development of the Master Plan and data collection. The work includes review of the existing information/data including technical, organizational, managerial, and financial aspects. The results are summarized in the Progress Report.
- ◆ Phase 2 (Master Plan) Preparation of a master plan outlining the development plan for water supply systems, organizational improvement, capacity building and urgent works for drainage and sewerage improvements. The results are summarized in the Interim Report.
- ◆ Phase 3 (Feasibility Study) Conduct of a feasibility study of the most urgent and important projects in the Master Plan, including preparation of preliminary design of water supply systems, the project cost estimates, O&M plan, institutional development plan, and implementation plan.

1-7 Contents of the Final Report

This Final Report deals with the result of the study for Phase 1, Phase 2, and Phase 3, which is composed of part A and part B.

Part A is the Master Plan formulated based on the activities during Phases 1 and 2 of the Study.

Part B is the Feasibility Study for the priority projects proposed in the Master Plan.

1-8 Study Team Organization

It was a basic understanding between JICA and MIME/PPWSA that the Study would be undertaken with close coordination between both parties. PPWSA created a Counterpart Team

soon after the commencement of the Study in Cambodia. Since then, vital assistance has been provided to the Study Team by all the departments of PPWSA related to the Study.

The Study Team consists of the following 11 members:

JICA Study Team:

	Position	Name
1.	Team Leader/Water Supply Planning	: Yoshihiko Sato
2.	Water Treatment Plant Planning/O&M/Water Quality Control	: Shin-ichi Osaka
3.	Transmission and Distribution Pipelines Planning/O&M	: Guillaume Stetten
4.	Organization Management/Capacity Building	: Wilfrido C. Barreiro
5.	Public Corporation Management	: Peter Ide
6.	Hydrogeology/Groundwater Development	: Teruo Tahara
7.	Drainage and Sewerage Planning	: Tsuyoshi Matsushita
8.	City Planning	: Iwane Mizuno
9.	Social Considerations/Environmental Impact Assessment	: Kakiko Ide
10.	Financial Management	: Nilo Chito C. Sun
11.	Cost Estimation/Construction Planning	: Toru Yagi

The Counterpart Team consists of the following members:

PPWSA Counterpart Team

	Position	Name
1.	Team Leader/Water Supply Planning	: Mr. Long Naro Mr. Samreth Sovithia
2.	Water Treatment Plant Planning/O&M/Water Quality Control	: Mr. Chou Phalla Mr. Keo Heng
3.	Transmission and Distribution Pipelines Planning/O&M	: Mr. Long Naro Mr. Ou Khunavath
4.	Organization Management/Capacity Building	: Mr. Sem Bun Heng Ms. Roeun Nary
5.	Public Corporation Management	: Mr. Sim Kheng Lin Mr. Samreth Sovithia
6.	Social Considerations/Environmental Impact Assessment	: Mr. Long Naro Mr. Chou Phalla
7.	Financial Management	: Mr. Ros Kim Leang
8.	Cost Estimation/Construction Planning	: Mr. Long Naro Mr. Samreth Sovithia

Chapter 2. General Description of the PPWSA Service Area

Chapter 2. General Description of the PPWSA Service Area

2-1 Natural Conditions

2-1-1 Topography

The Kingdom of Cambodia has a land area of 181,035 km² located in the southwestern part of the Indochina peninsula. It lies completely within the tropics, with its southernmost point slightly more than 10°30' above the Equator. International borders are shared with Thailand and the Lao People's Democratic Republic to the west and to the north, and the Socialist Republic of Vietnam to the east and southeast. The country is bounded to the southwest by the Gulf of Thailand. The country has a coastline of 440 km and extensive mangrove forests, some of which are relatively undisturbed. The country is divided by the Mekong River and the Tonle Sap River, with its "Great Lake" (Tonle Sap Lake) being a part thereof.

The Municipality of Phnom Penh has a total area of 374 km². The country's capital city, it is situated in the south of the Central Plain at 11°30' north latitude and 104°50' east longitude. The Municipality is located to the west of the confluence of the Mekong River, Tonle Sap River, and Basak River.

The Municipality consists of seven districts, referred to as "Khans". Four of the seven Khans are considered urban and the remaining three Khans are considered rural. Each district consists of 8 to 12 sub-districts, referred to as "Sangkat". The total area of the four Khans in the urban area is 27 km² and that of the three Khans in the rural area is 347 km², totaling 374 km².

The Municipality is located on a relatively flat alluvial plain. The highest area of the Municipality is around the Royal Palace in Daun Penh District, which has an elevation of 11 meters above sea level. The ground elevation adjacent to the Mekong River is generally more than 10 meters above sea level, which decreases progressively to about 5 meters towards the southwest of the city. In the north, the BLD-URSS road runs from east to west with an elevation of 11.0 meters above sea level, protecting the northern part of the city from flooding.

An embanked road with an elevation of more than 10 meters above sea level surrounds the southwest side of the city and protects against flooding. Boeng Kak in the north and Boeng Trabek Thom in the south are low swamp areas acting as natural stabilization ponds for sewage in the dry season and as detention ponds in the rainy season.

2-1-2 Meteorology

The Kingdom of Cambodia is in the Asian tropical monsoon zone. Phnom Penh is under the monsoon climate influence. The wet season occurs from May till November. The dry season occurs from December to April. The Municipality's climate is also affected by its location in the center of a low altitude deltaic plan between 5.5 and 11 meters above sea level. The Kravana mountains in the South-West and the Chhlomg Loeu plateau in the north surround the town and serve as obstacles to the winds that come from the continent in winter and from the Siam Gulf in summer.

Meteorological data is recorded by the Department of Meteorology of the Ministry of Water Resources and Meteorology at the Porchen Tong Station in Phnom Penh, located as shown below. Rainfall and temperature data are available from 1991 to 2001.

Location of the Porchen Tong Meteorological Monitoring Station:

Latitude : 11°33'
 Longitude : 104°50'E
 Altitude : 10 meters

(1) Temperature

Mean monthly maximum and minimum temperature is shown in Figure 2-1. Mean monthly maximum temperature at Phnom Penh varies from 31.2 °C to 34.3 °C. The highest monthly maximum temperature in the year occurs in May and the lowest in December. Mean minimum temperature varies from 21.2 °C to 25.3 °C. The highest minimum temperature in the year occurs in April and May and the lowest occurs in January.

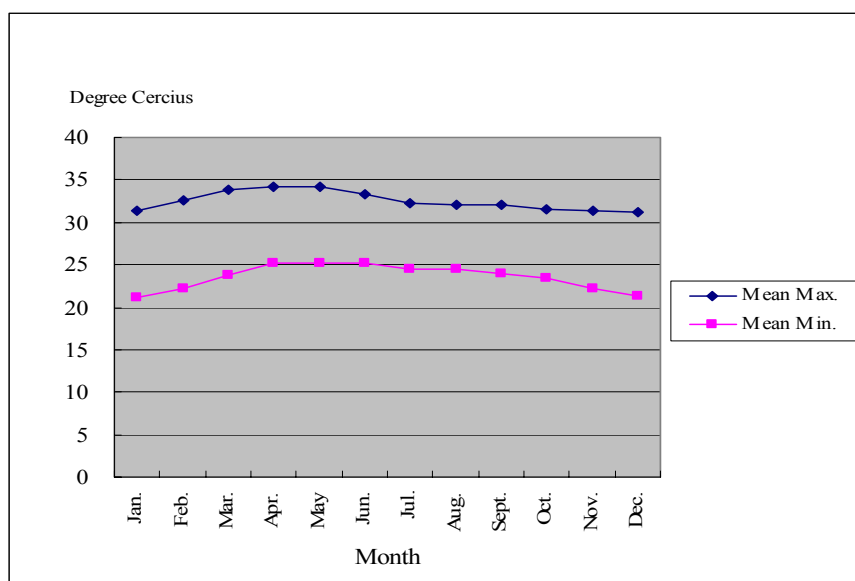


Figure 2-1 Mean Monthly Max. And Min. Temperatures for Phnom Penh (1991-2001)

(2) Rainfall

As seen in Table 2-1, Figure 2-2 and Figure 2-3, annual rainfall at Phnom Penh is irregular, varying from around 1,100 mm to 2,100 mm. The average annual rainfall from 1991 to 2001 was 1,445 mm.

Lower Monthly Rainfalls vary less during December through April and more during May to November when considering the years 1991 to 2001. The Maximum Monthly rainfall in Phnom Penh is noted as 443.5 mm in October 2000. No rainfall is recorded in some months during the early part of the year in 1991, 1993, 1994, 1995, 1996, 1997, 1998, and 2001.

The relative humidity averages about 50 percent or slightly lower in the dry season, but it may remain at around 60 percent in the rainy season.

Table 2-1 Monthly Rainfall and Evaporation for Phnom Penh (1991-2001)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	TTL
1991	0.0	0.0	0.0	83.4	53.4	304.5	284.3	193.7	120.2	210.2	2.2	1.7	1,254
1992	3.1	2.5	0.6	35.0	93.4	113.9	219.5	198.4	216.5	197.2	10.9	3.8	1,095
1993	0.0	0.0	0.0	0.0	47.5	55.1	170.1	312.2	174.1	203.1	155.4	3.2	1,121
1994	0.4	0.0	164.2	61.1	157.7	106.1	96.5	154.3	332.9	126.9	5.6	17.9	1,224
1995	0.0	0.0	18.0	94.3	234.6	146.8	157.4	208.9	277.1	242.6	22.4	11.2	1,413
1996	14.9	0.0	5.2	112.2	173.0	146.2	99.8	150.3	343.3	213.3	345.8	14.3	1,618
1997	0.0	26.1	7.4	20.0	107.6	135.0	213.4	119.8	337.6	337.5	89.8	6.0	1,400
1998	0.0	0.0	0.0	74.2	25.2	225.9	217.2	180.0	247.6	219.4	269.7	25.1	1,484
1999	45.1	23.3	18.9	165.2	119.5	159.3	193.0	185.2	281.0	183.5	148.6	60.3	1,583
2000	8.1	8.3	52.0	190.8	223.8	240.3	233.4	146.2	123.7	443.5	124.7	301.1	2,096
2001	74.4	0.0	211.5	55.0	81.7	125.1	122.4	228.8	254.2	400.1	42.0	9.2	1,604
Max.	74.4	26.1	211.5	190.8	234.6	304.5	284.3	312.2	343.3	443.5	345.8	301.1	2,096
Mean	13.3	5.5	43.4	81.0	119.8	159.8	182.5	188.9	246.2	252.5	110.6	41.3	1,445
Min.	0.0	0.0	0.0	0.0	25.2	55.1	96.5	119.8	120.2	126.9	2.2	1.7	1,095
Evap.*	125.8	145.3	175.3	169.2	141.3	126.0	111.7	113.0	107.3	90.6	103.6	117.7	1,527

Notes: Source: Department of Meteorology, Ministry of Water Resources and Meteorology. *Evaporation data is from 1988 to 2000.

(3) Winds

Winds follow the trade winds and monsoon cycles. From November to January, winter monsoon winds blows from the North-East. From May to October, summer monsoon winds come from the South-West. This divides Phnom Penh's climate into two seasons: dry season from December to April and wet season from May to November.

(4) Evaporation

Evaporation exceeds Mean Rainfall between December and May. In nine out of 13 years since 1988, annual evaporation has exceeded annual precipitation. Water deficit in soils is noted as severe between December and March.

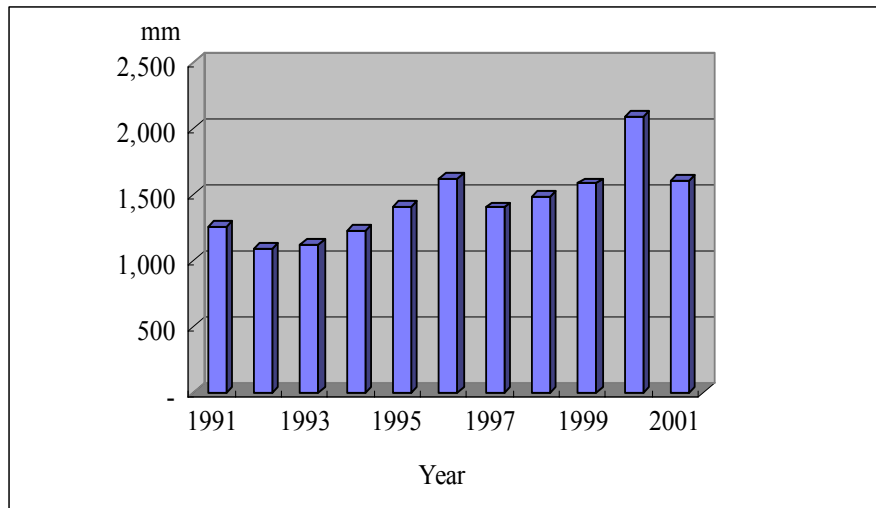


Figure 2-2 Annual Rainfall for Phnom Penh (1991 to 2001)

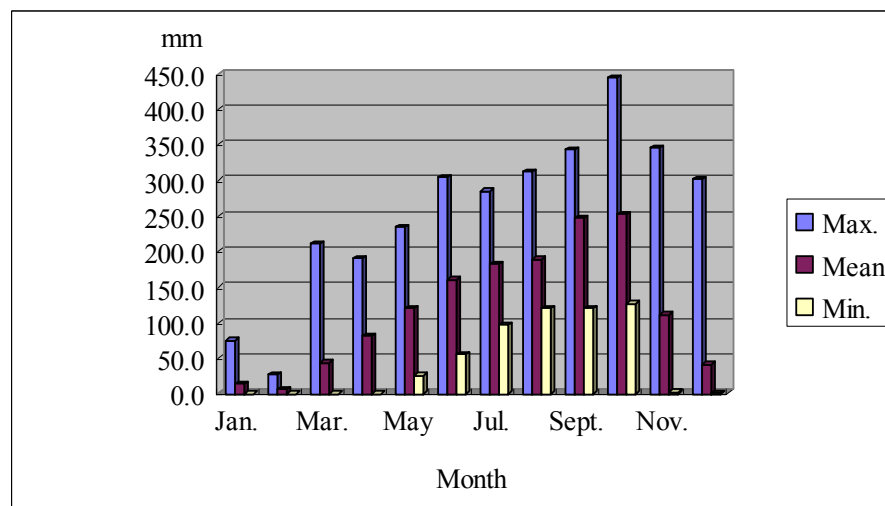


Figure 2-3 Monthly Max. And Min. Rainfall for Phnom Penh (1991-2001)

2-1-3 Hydrogeology

Phnom Penh is located in front of an exceptional X-shaped layout of water ways formed by the Tonle Sap, Tonle Basak and Mekong Rivers, which follow a very irregular flow regime during the year. The city lies on young and old Quaternary alluvial deposits that overlay weathered rock and clay at a depth of 30 to 50 meters, with hard crystalline rock at the base. There are limited groundwater resources and no artesian aquifers.

Due to the ground conditions in the Study Area it is likely that excavation will be more difficult during the wet season. When the river level is high the ground becomes saturated due to the poor local drainage.

2-2 Socio-Economic Conditions

2-2-1 Education, Public Hygiene, and Housing

2-2-1-1 Education

Education is one of the important social indicators in human settlements. Under the French governance and the reign of King Sihanouk, many primary and secondary schools and universities were established. However, during the Pol Pot regime, educational development was intentionally stopped. The present situation of education is described in the *Annual Administrative Collection* of the Ministry of Education, Youth and Sports, the *1998 General Population Census*, *1999 National Literacy Survey*, *2000 Cambodian Demographic and Health Survey*, the *1999 Cambodian Socio-Economic Survey (CSES)* and others.

It is presently estimated that around 27 percent of the population aged 6 or over has no education. In terms of gender, 34 percent of females and 19 percent of males 6 years of age and over have had no formal education. The median years of schooling for males is 2.5 years compared to 1.1 years for females.

53 percent of the population has attended some primary school and 7 percent completed primary school. Around 1.2 percent attended pre-school.

17 percent of the population attended some secondary school and 2.4 percent completed secondary school.

24,408 students enrolled in higher education institutions in 2001-02, an increase of 41.8 percent compared to the 17,216 students in 2000-01 and an increase of 62.9 percent compared to the 14,986 students in 1990-2000. 0.8 percent of the population has some post-secondary education.

2-2-1-2 Public Hygiene

The Ministry of Health is responsible for the administration of health services at the national level and the Department of Health of the Municipality of Phnom Penh is responsible for the Municipality.

The total number of registered public health personnel decreased 7.2 percent from 17,869 in 2001 to 16,581 in 2002. However, the number of doctors increased 11.6 percent to 2,083; pharmacists increased 9.7 percent to 397; dentists increased 37.9 percent to 120; and nurses increased 11.7 percent to 7,662. The number of other health personnel decreased 27.3 percent to 6,319.

The main health problems of inpatients in Phnom Penh area are malaria, diarrhea, dysentery, and cholera.

A total of 101,796 malaria cases were reported in 2001, resulting in 541 deaths. A total of 284,424 children were immunized for measles in 2001, compared to 283,827 in 2000. In 2001, 319,814

children were immunized for BCG; 288,446 children were immunized for polio; 204,559 children were immunized for PAB; and 293,941 children were immunized for DPT.

On average, households spent US\$ 31.9 on transport and treatment at public health establishments; US\$ 27.1 on transport and treatment at private health establishments; US\$ 8.5 on transport and treatment at drugstores; and US\$ 55.9 on transport and treatment by midwives and traditional practitioners. On average, urban households spent 28.5 percent more on treatment than rural households.

2-2-1-3 Housing

A total of 2.2 million households were recorded in the 1998 population census. Urban households accounted for 18 percent of households, compared to 82 percent rural households. The average household size for Cambodia was 5.2, compared to 5.6 persons for urban households.

Over 95 percent of dwellings were owner-occupied, 2.5 percent were occupied rent free, and 1.6 percent were rented. Of all dwellings, 72.6 percent were one-room dwellings, 21.8 percent were two-room dwellings, 3.0 percent were three-room dwellings, and 2.6 percent of dwellings had four or more rooms.

Over 80 percent of Cambodian households had neither toilets nor electricity, around 10 percent had both toilets and electricity, 5.3 percent had electricity but no toilet, and 4.6 percent had toilets but no electricity.

2-2-2 Environment

2-2-2-1 Solid Waste

The Department of Public Works and Transport (DPWT) of the Municipality of Phnom Penh (MPP) is responsible for municipal solid waste management (MSWM). The MSWM services were provided by the municipal cleansing section under DPWT until June 1994. Since then, due to the extremely limited capability of MSWM, the MPP entrusted its MSWM service to mainly private contractors with franchise agreements.

The MPP established Phnom Penh Waste Management Authority (PPWM) by merging the Cleansing Authority of Phnom Penh (CAP) and the Wastewater Authority of Phnom Penh (WAP) in 2001.

Waste collection has generally improved in Phnom Penh by this arrangement. However there are many areas of the city still without an adequate waste collection service and many tons of waste are dumped into rivers and ponds, burnt, left uncollected to be scattered by animals which results in blocked drains and the creation of unsanitary conditions. Waste collection is especially weak in

outlying areas and in the many unplanned settlements within the city that are home for thousands of the city's poorest families.

Phnom Penh has a landfill site at Stueng Mean Chey, located 5 km south of the city. In 2002, about 800 tons of solid waste was collected everyday. The fee for solid waste collection (US\$1.13 per household/month) is included in the electricity bill. Since the land area is very limited (only 6.8 ha) and waste is piled up to a height of more than 5 meters on average, the landfill operation is becoming more and more difficult. The estimated remaining service life of the landfill is less than two years. At present, the residential area approaches 100 meters away from the site due to rapid urbanization.

Generation Source	Unit	Number of generation Source (x 1000)	Average generation ratio	Average daily generation amount (tons/day)
Household Waste	g/person/day	1,200	487	582
Commercial Waste	g/day	61	6,166	194
Market waste	g/stall/day	52	1,823	95
School waste	g/student/day	385	20	7.5
Street sweeping waste	g/kg/day	0.056	53,373	3.1
Hotel waste	g/room/day	13	231	3.1
Office waste	g/office/day	0.36	3,560	1.2
Total				891

Source: Draft final report for the Study on Solid Waste Management in the Municipality of Phnom Penh in the Kingdom of Cambodia, JICA

The daily waste generation in Phnom Penh was investigated in 1993 under a Master Plan study assisted by the Government of Japan, from which the above data was obtained.

2-2-3 Public Service

2-2-3-1 Transportation

The main sources of data on transport are the Ministry of Public Works and Transport, Phnom Penh Municipality Traffic Police, and Phnom Penh Port Authority.

There are four main transport systems in the Study Area, namely:

(1) Road Transport

The estimated number of motor vehicles in Phnom Penh in 2002 was over 680 thousand, an increase of 36 percent compared to the approximately 500 thousand vehicles in 1997 and an increase of 195 percent over the estimated 350 thousand vehicles in 1992. Motorcycles accounted for 490 thousand vehicles or 72 percent of the 2002 total, followed by cars, minibuses and pickups for approximately 160 thousand or 24 percent, trucks for 28 thousand or 4.0 percent, buses for 2.7 thousand or 0.4 percent, and over 400 were special vehicles.

Year	1992	1997	2002
Car, minibuses, and pickup	112,573	141,561	162,997
Bus	1,873	2,336	2,736
Trucks	8,080	17,192	27,830
Other vehicles	3	296	421
Motor cycles	225,903	339,009	487,217
Total vehicles	348,432	500,394	681,201
(% change)	(-)	(44%)	(36%)

(2) Rail Transport

Cambodia has 601 kilometers of railway track. The railway transported 409,700 tons of freight and 223,000 passengers in 2001, reflecting an increase of 20.6 percent freight and a decrease of 33.6 percent in passengers compared to 2000.

(3) Cargo and Shipping

A total of 820 ship movements were recorded in 2002 for Phnom Penh Port, an increase of 4.6 percent since 2001. Of these movements, international shipping accounted for 782 movements (209 vessels and 573 tankers) or 95.4 of total and local shipping for 38 movements or 4.6 percent of total. A total of 503,322 tons of cargo were shipped through Phnom Penh Port in 2001, an increase of 7.6 percent since 2000. International cargo accounted for 496,157 tons or 98.6 percent of total cargo. There were 7,165 tons of local general cargo. The quantity of imported cargo was 462,473 tons, with fuel imports of 401,050 tons and general cargo of 61,423 tons. Export cargo was 33,684 tons.

2-2-3-2 Telecommunications

There were 357,040 telephones in use in Cambodia in 2002, an increase of 39.0 percent over the 256,952 telephones in use in 2001. Units per 100 persons increased from 1.96 units in 2001 to 2.66 units in 2002. Of the total units in use, 321,621 or 90.0 percent were mobile phones and 35,419 or 10 percent were fixed phones. The number of mobile phones increased by 43.9 percent from 223,458 units in 2001. By comparison, the number of fixed phones only increased 5.7 percent from 33,494 in 2001. Use of mobile units increased from 1.63 per 100 persons in 2001 to 2.39 per 100 persons in 2002, whilst the use of fixed phones remained unchanged at 0.26 units per 100 persons.

2-2-3-3 Power Supply

The main producer and source of data on electric power generation in Cambodia is Electricite du Cambodge (EDC). A number of smaller BOT and private operators also provide electric power in the provinces. According to the available data, electric power generation increased from 107.1 million kWh in 1991 to 477.6 million kWh in 2002. Electricity generation increased 10.3 percent in 2002 from 433.0 million kWh in 2001. This follows an increase of 18.0 percent in 2001 from 366.9 million kWh in 2000.

Chapter 3. Review of the Phase 1 Master Plan

Chapter 3. Review of the Phase 1 Master Plan

The Phase 1 Master Plan Study was conducted with assistance from the Government of Japan in 1993, following the end of the internal war and the Paris Accords agreed in November 1991. The objectives of the study were to i) formulate a master plan for the water supply of the Municipality of Phnom Penh, ii) to formulate an urgent rehabilitation project for the existing facilities, and iii) to conduct a feasibility study for the priority project identified in the master plan study. However, the feasibility study was not carried out since the priority project originally considered as the candidate for the feasibility study was adopted as urgent rehabilitation work in the Master Plan.

The following table summarizes the current situation of PPWSA operations in comparison to the survey results of the previous Master Plan Study Team in 1993.

Table 3-1 Comparison of PPWSA's Performance Indices Between 1993 and 2004

Indicator	1993	2004
Production capacity (m ³ /day)	65,000	235,000
Coverage (%)	50	85
Distribution network (km)	280	1,084
Supply pressure (bar)	0.2	2.0
Supply duration (hr/day)	10	24
Nos. of connections	26,881	120,000
Nos. of staff/1,000 connections	22	4
Illegal connections	more than 300/year	less than 5/year
Metering ratio (%)	12	100
Collection ratio (%)	50	99.9
NRW (%)	72	15
Total income (billion Riels)	0.7	34
Operating expenditure (billion Riels)	1.4	9.4
Total expenses (billion Riels)	N/A	27

Source: PPWSA

3-1 Proposed Water Supply Scheme in Phase 1 Master Plan

3-1-1 Target Year

The Phase 1 Master Plan had the target year of 2010. A relatively short period was adopted due to unforeseen and unstable factors in projecting long term scenarios such as population increase, city development plan, etc.

The Phase 1 Master Plan recommended that the master plan itself may need to be reviewed to reflect more reliable data/information when the situation became more stable.

3-1-2 Service Area

In the Phase 1 Master Plan (M/P), existing 1993 service areas totalling 77.5 km² were selected as the target service area until the target year 2010. The service area for the Phase 1 M/P covered four districts, including Don Penh, Chamkar Mon, Tuol Kouk, and 7 January, all located in the central urban area. The remaining three districts, including Mean Chey, Russey Keo, and Dang Kor, were partially included within the Study Area.

By the efforts of PPWSA, the service area set in the Phase 1 M/P was completed in 2003, ahead of the scheduled time in the Master Plan. At present, the service area is being extended to adjacent areas in Kandal Province due to rapid economic development and urbanization.

Table 3-2 Service Area and Population of Phase 1 Master Plan

Districts	Service areas	1993 Phase 1 M/P	Present situation
		Service area (km ²)	service area (km ²)
Doun Penh	whole areas were included	7.60	In 2003, 1993 Master Plan area was completed. Presently, expanding towards Kandal Province.
Chamcar Mon		9.50	
Tuol Kouk		9.25	
7 January		2.35	
Sub-total for the inside of urban areas		28.70	
Mean Chey	Peri-urban areas only of the above districts were selected.	17.01	
Ruessei Kaev		26.67	
Dang Kao		5.37	
Sub-total for Suburban area		49.05	
Total		77.75	

Source: Phase 1 Master Plan

3-2 Planning Framework

In the Phase 1 M/P, the planning framework and water demand projection were set as shown in Table 3-3 as the basis for analysis of the financial (the minimum expense), economic (benefits, large and small), technological (particularly ease of O & M and management), social, and environmental aspects as well as in relation to coverage and reducing NRW.

Through the site survey conducted by the study team, the leakage ratio and unit consumption rate in 1992 was estimated at 50 percent and 100 lpcd respectively. Water pressure was improved from 0.2 bar to 2.0 bar. In the non-supplied areas, completion of a piped water supply meant serving the greatest number of people within the shortest time frame giving due attention to the areas' social and economic importance as well as its investment efficiency and effectiveness.

The target level of leakage ratio for the year 2010 was set at 20 percent based on reference to other Asian countries. The unit consumption rate was set at a much higher level, 200 lpc/d, in order to raise the water supply service level.

Intermittent water supply or fluctuation of pressure causes operational problems. It is also one of the causes of unsafe water. A 24-hour water supply was to be provided through rehabilitation of power supply systems.

Table 3-3 Planning Framework for Phase 1 Master Plan

Year	1992	1995	2000	2005	2010
Daily ave. per capita consumption	100	120	150	175	200
Peak factor	1.3	1.3	1.3	1.3	1.3
Daily max. per capita consumption	130	156	195	227.5	260
Leakage Ratio (%)	50	50	40	30	20
Daily max. per capita demand	260	312	325	325	325
Daily ave. per capita demand	200	240	250	250	250
Daily max. demand (m ³ /d)	138,362	189,606	244,533	311,161	407,596
Daily ave. demand (m ³ /day)	106,432	145,850	188,103	239,355	313,536
Served population	532,160	607,710	752,410	957,418	1,254,143
Total population	682,936	793,635	1,020,500	1,352,796	1,851,458
Service ratio (%)	78	77	74	71	68
Nos. of served households	87,278	99,552	123,168	156,597	204,959

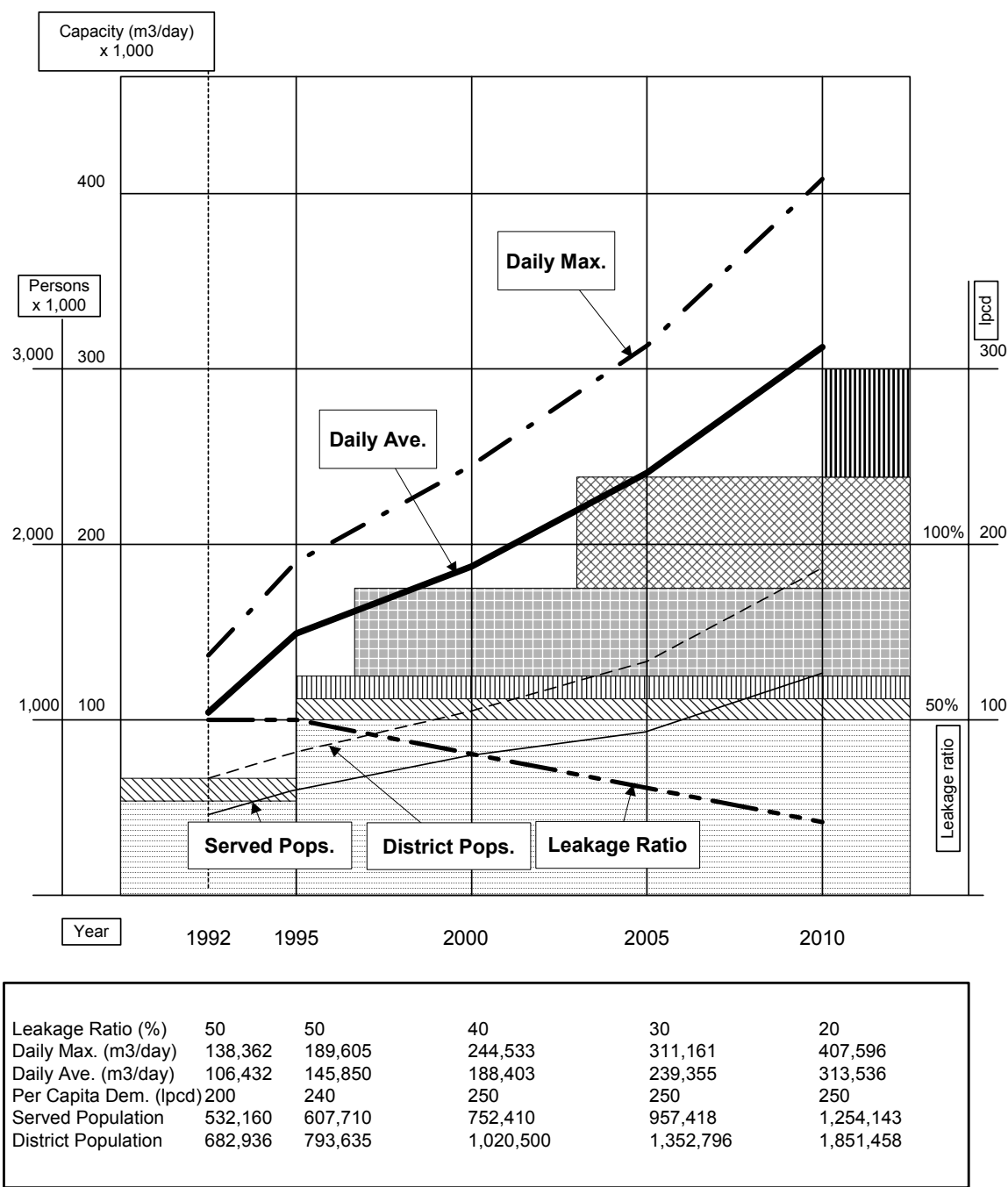
Source: Phase 1 Master Plan

3-2-1 Population Projection

In the circumstance that only limited population data was available in the course of the previous master plan study, from 1.0 percent to 7.9 percent growth was forecast for each district or an average of 5.6 percent population increase overall, as shown below. One million population in 2000, 1.35 million in 2005, and 1.85 million in 2010 were the respective estimates.

Doun Penh	Chamkar Morn	Tuol Kouk	7 January	Mean Chey	Ruessei Kaev	Dang Kao	Average
2.5%	2.6%	5.4%	1.0%	7.4%	7.9%	6.5%	5.6%

The recorded population data shows that the 1998 population of the entire municipality was almost one million and the present population is estimated to be approximately 1.3 million. The projected and actual data are therefore in close agreement.



LEGEND

	Chroi Changwa (Expansion; 65,000)		Chamcar Morn (Existing 10,000)
	Chroi Changwa (Expansion; 65,000)		Existing Chamcar Morn 7,000 to 10,000
	Phun Prek (Expansion; 50,000)		Existing Phum Prek 56,000 to 100,000

Figure 3-1 Water Demand Projection and Development Scheme of Phase 1 Master Plan

3-2-2 Served Population

The served population was estimated by applying the same rate as the assumed population growth rate in each district. The projected served population was approximately 750 thousand in 2000, 957 thousand in 2005, and 1.25 million in 2010, respectively.

The service coverage was computed to be 78 percent in 1992 as a percentage of the total population based on the actual record of 520,000 served out of a total of 700,000 in the Study Area. Supply coverage is estimated at 78 percent in 1992 and 68 percent in 2010.

The record of year 2004 shows that the current supply coverage is 85 percent or over 800 thousand service populations, exceeding the projected coverage.

3-2-3 Water Demand and Leakage Control

Based on a field survey, prevailing water use per capita per day in combining all water uses such as domestic, commercial, and industrial was estimated to be 100 liters and leakage ratio was almost 50 percent of the production capacity. In establishing the daily maximum per capita consumption rate to be applied for design of production facilities, 1.3 times the peak factor was applied, taking expected economic development into consideration. Per capita demand was therefore calculated to be $100 \times (1/0.5) \times 1.3 = 260$ lpcd in 1992.

The Master Plan targeted improvement of per capita consumption from 100 lpcd through 1995, 150 lpcd in 2000, and 200 lpcd in 2010, based on reference to the economic activities and living standards of other southeast asian countries such as Thailand and Indonesia.

The leakage ratio was planned to decrease from 50 percent in 1992 to 20 percent level in 2010, based on appropriate measures being taken to improve transmission and distribution systems.

The water demand was estimated to increase from 145,850 m³/day in 1995 to 313,536 m³/day in 2010 as shown in Table 3-3.

Current production capacity is improved to be 235,000 m³/day in total after rehabilitation of Phum Prek WTP from 1995 to 1996, rehabilitation and expansion of Chamkar Mon WTP from 1997 to 1999, and construction of Chrouy Chang War WTP from 1999 to 2002, in close coordination with the development of transmission and distribution systems as planned in the Phase 1 M/P.

3-2-4 Service Connection and NRW Reduction

One of the remarkable achievements of PPWSA is the expansion of service connections and decrease of NRW. PPWSA data shows that service connections were only 40 thousand in 1997 and increased to over 100 thousand in 2004, while NRW was recorded to be over 50 percent but was reduced to just over 10 percent by 2004, as shown in Figure 3-2.

Likewise, supplied pressure surveyed by the Phase 1 Master Plan study team was only 0.2 bar in 1992, now improved to the level of 2.0 bar. As transmission and distribution pipelines are improved and extended, the rate of NRW is remarkably reduced by 6 percent per year over the last seven years. Illegal connections were also controlled from over 300 found in 1993 to negligible today. Metered connections were only 12 percent in 1993 but reached substantially 100 percent by 2003.

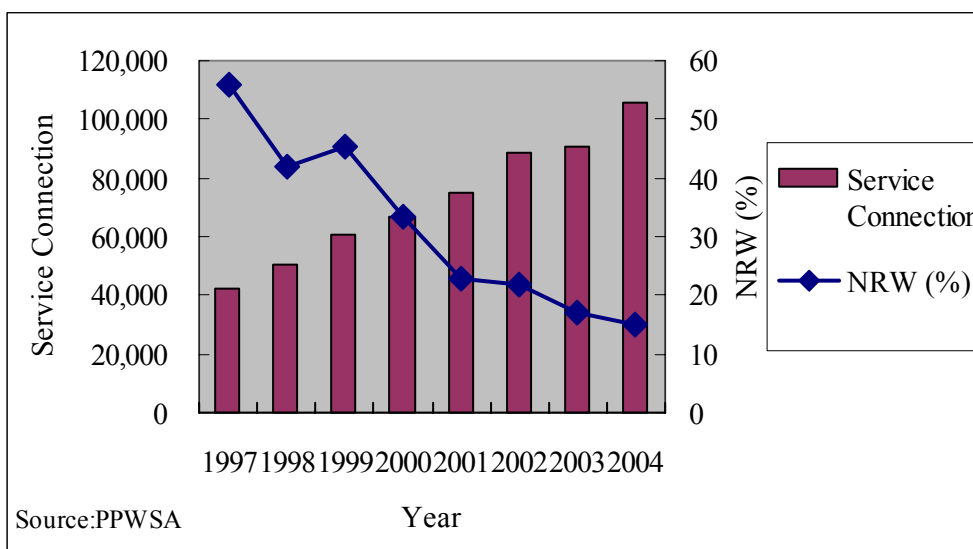


Figure 3-2 Increase of Service Connection and Decrease of NRW

3-3 Institutional Improvements

Principally resulting from the sector reforms, the decisive leadership, and the renewed sense of ownership and teamwork among the staff of PPWSA, the company has flourished and developed into a vibrant and dynamic water supply utility company. All aspects of operations experienced dramatic leaps in performance resulting in improvements in water supply access and coverage among the residents of the city, financial viability of the company and service reliability.

The previous Master Plan envisaged that general improvements in organizational capacity needed to accompany the facilities improvements, as follows:

Master Plan Institutional Recommendations

- Enlightenment of Employees. There are various important basic principles to be firmly understood by PPWSA's employees: the raison d'etre of water supply in the society, the social obligation and responsibility as a public servant, and the significance of order and discipline in a public service organization. Methods for saving costs, improving performance and raising productivity need to be taught.
- Training. The importance of vocational training needs to be understood as it is essential to improve the employees' capability and eventually the organization's performance.
- The training program participants need to be evaluated for implementing and realizing improvements due to their training; need to be given more responsible posts. New middle-level managers need to be compensated and rewarded for the increased responsibility, within the framework of the remuneration rules for public servants.
- Organizational Changes. PPWSA management structure needs to be rebuilt at four levels - director, deputy directors, division managers and subdivision managers. At least three Deputy Directors need to be appointed to manage Technical, Customer Services and Administrative/Financial.
- Abolish seniority system and introduce a new responsibility and capability-based system for appointing managerial staff. Promotion and assignment of staff to the office-chief level and division manager level chief's position, should be strictly based on performance and capability.
- Internal Regulations for Motivating Employees. PPWSA should motivate ambitious, aspiring staff by rewarding them with more authority, promotions and better salaries. The present personnel management system and payroll system needs to be changed after a systematic review.

Results & Action Taken (2005)

One finds a very different culture and pride within the company. A culture which values transparency, team work, cost consciousness and customer service is promoted.

An Assistant to the General Director is now responsible for organizing and implementing training activities. Activities still need to be further accelerated. External support through JICA is underway.

These recommendations have basically been implemented. Management team has been restructured and revitalized.

This has also been implemented. Continuing review and upgrading of personnel incentives policies are underway.

Chapter 4. Project Framework

Chapter 4. Project Framework

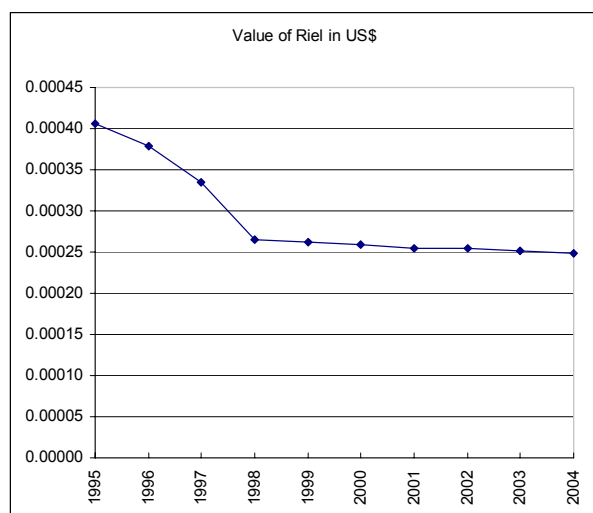
4-1 National Economy

4-1-1 General Economy

Cambodia is one of the poorest countries in the world, with a per capita income of only US\$ 290. The economy is largely agrarian, supported in recent years by rapid growth in tourism and garment exports, the primary foreign exchange earners. Moderate progress has been made over the past decade in reducing the rate of poverty from an estimated 39 percent to about 36 percent, but this is still extremely high and most of the gains are limited to Phnom Penh and other provincial towns. More than 70 percent of the labor force remains in agriculture. Ninety percent of the poor live in rural areas, where child mortality is actually rising. Despite efforts to increase revenue and reorient spending toward development and the social sectors, the government desperately lacks resources for essential public investments in social and economic infrastructure and faces the prospect of rising debt service obligations in the near future.

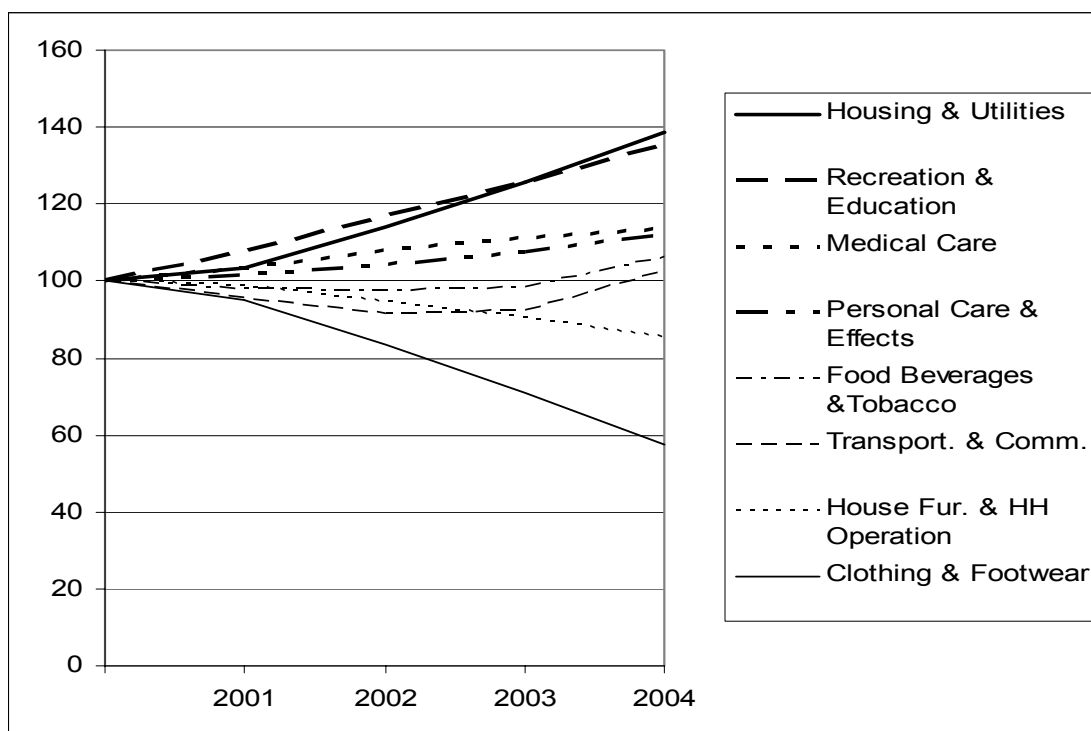
The Cambodian Riel lost about 40 percent of its value during 1994 to 1998. In 1998, the Central Bank decided to largely refrain from further financing the fiscal deficit. Since then the Riel has stabilized at its current level, around 4000 per US dollar, and the Central Bank has continued to pursue an active policy to minimize inflation of the riel by maintaining a broadly stable exchange rate. However, owing to past monetary instability and lingering lack of private sector confidence, the economy remains heavily dollarized.

The combination of dollarization and low monetization of transactions in the countryside means that relative price movements for the most part reflect the movement of world market prices, especially for basic commodities such as rice and oil. Domestic food prices, generally a function of weather and yields, are also affected by the cost of oil/fuel for internal transportation. In Phnom Penh, growing demand for real estate is a



significant factor affecting the (rising) relative cost of urban housing. The decline in costs of clothing and footwear reflect an ample supply as a side benefit of burgeoning export production.

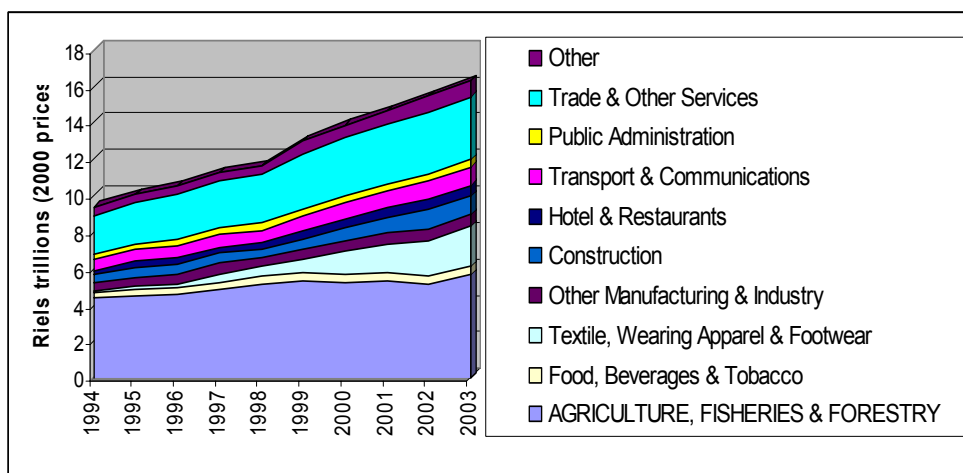
The following figure provides a snapshot of relative price movements since 2000. Unfortunately, housing and utilities are not disaggregated so this indicator is distorted by the recent rise in real estate prices.



Source: National Institute of Statistics <www.nis.gov.kh>

Figure 4-1 Cumulative Movement of CPI (Phnom Penh) since 2000

With the achievement of a stable political environment following elections in 1998, economic growth has been a robust 5 to 7 percent (1999 – 2003), with negligible inflation. Garment exports went from nothing a decade ago to US\$ 1 billion in 2004, and visitor arrivals grew from a trickle to one million. Large aid flows, of which about half were grants, added some 12 percent to GDP.



Source: National Institute of Statistics <www.nis.gov.kh>

Figure 4-2 Composition of GDP (at constant 2000 prices)

The anticipated downturn during 2005 due to the loss of preferential US garment quotas at the beginning of the year failed to materialize and, despite higher oil prices and weaker agricultural prospects, overall growth continues to be surprisingly robust. The IMF¹ revised its estimate of real GDP growth for 2004 from 4.3 percent to 7.7 percent, and for 2005 from 1.9 percent to 6.3 percent. The World Bank is further projecting 2006 growth on the order 6.1 percent.² However, both institutions have doubled their CPI inflation forecasts for the same years to slightly above 5 percent.

4-1-2 Industrial Development Policy

The RGC has set out a comprehensive policy to increase Cambodia's international competitiveness by focusing on development and improvement in physical infrastructure to effectively respond to the increasing needs for basic services, such as low-cost water and power supply, financial, information and telecommunications services. Overall, the RGC's industrial policy concentrates on the following:

- First, continue to develop labor-intensive industries, such as garment, toys and footwear;
- Second, promote the development of agribusiness by strengthening legal framework for longer-term land management. Moreover, the government will provide tax incentives to establish factories to process agricultural products, such as cotton, jute, sugar, palm oil, cashew nuts, rubber, cassava and fruits;
- Third, develop industries based on the utilization of basic natural resources, mainly by processing the existing natural resources in the country such as fish, meat, cement production, brick and tile;
- Fourth, promote small and medium enterprises (SMEs), micro-enterprises, and handicraft;
- Fifth, promote industries that produce appliances and electronics products for domestic and industrial uses and improve product quality. It is necessary to establish a system of quality control of export products to meet international standards and enforce the intellectual property laws.
- Sixth, establish industrial and export processing zones by developing infrastructure, improving service quality and encouraging investments. These zones can be established on the outskirts of Phnom Penh, Sihanoukville, Banteay Meanchey, or Koh Kong. The RGC will build road network, develop power and water supply, ensure waste management and environmental protection, provide education and vocational training, upgrade health services, establish warehouses and reduce customs procedures and other actions to ensure an environment conducive to business profitability and growth;
- Seventh, increase the production of goods for import substitution to some extent by encouraging the development of paper, chemical industries, such as the production of

¹ Results of October 2004 Article IV Consultation are available on the IMF's web site, <www.imf.org>, revised estimates are on Representative Office site <<http://imf.org/external/country/KHM/rr/>>.

² *East Asia Update: Countering Global Shocks*, The World Bank, November 2005.

fertilizers, acid, as well as daily consumption goods such as soap, paint, electrical appliance, water pump, and agricultural inputs, etc.; and

- Finally yet importantly, the RGC's policy is to promote "cultural and natural tourism" development in Cambodia.

4-2 Sector Plans and Policies

4-2-1 National Plans

Development planning in Cambodia is carried out through a constitutionally-mandated five-year planning process. The 2006-2010 Plan, entitled National Strategic Development Plan (NSDP), is currently under preparation. The NSDP will be based on the Action Plan for Harmonization and Alignment 2004-2008 (also known as "the Rectangular Strategy") and will consolidate the existing Socio-economic Development Plan II (2nd five-year plan) and the National Poverty Reduction Strategy (NPRS), both of which reflect the overarching aims expressed in the Cambodia Millennium Development Goals (CMDGs). The relevant aspects of the national plans that are presently in effect are summarized in the following sub-sections, as follows:

- the Socio-Economic Development Plan (SEDP)
- the National Poverty Reduction Strategy (NPRS)
- the Cambodia Millennium Development Goals (CMDGs)
- the Action Plan for Harmonization and Alignment 2004-2008 (Rectangular Strategy)

Prior national programs and plans since 1993 that form the antecedents to the present plans discussed in this section include the *National Program to Rehabilitate and Develop Cambodia* (1994); *Implementing the National Program to Rehabilitate and Develop Cambodia* (1995); *First Socio-economic Development Plan, 1996-2000* (SEDPI); *Royal Government's Political Platform for its Second Term, 1998-2003* (the "Triangle Strategy"); and the *Interim Poverty Reduction Strategy Paper* (2001).

4-2-1-1 Socio-economic Development Plan

The first five-year Socio-Economic Development Plan (SEDP) covered the period 1996 to 2000. SEDP (II) was prepared in 2001 and approved by the National Assembly in 2002, covering 2001 to 2005. SEDPII presents the national development objectives, strategies and policies of the Government for the period 2001 to 2005. The strategies are: (1) to foster broad-based sustainable economic growth with equity, with the private sector playing the leading role; (2) to promote social and cultural development by improving the access of the poor to education, health, water and sanitation, power, credit, markets, information and appropriate technology; and (3) to promote sustainable management and use of natural resources and the environment; and (4) to improve the governance environment through effective implementation of the Governance Action Plan (GAP).

Under SEDP-II, the RGC has committed to a long-term goal of providing access to potable drinking water and environmental sanitation for the entire population. This needs coordination and support from various government agencies for coordinated policy and administration. Water (management and supply for drinking and irrigation) is given top priority with respect to infrastructure development in rural areas. The development targets for water and sanitation are shown in the following Table 4-1. The targets are also reflected in the NPRS, but are considerably more ambitious than the CMDGs described below. Note that the CMDGs were established later and may be considered more realistic, even though they also are considered to be highly ambitious, particularly with respect to rural targets. The upcoming five-year NSDP is expected to adopt the CMDG targets. An update on recent progress toward achievement of the targets will be known when the results of the 2004 Cambodian Socio-Economic Survey (CSES), which is conducted every five years, are released in mid-2005 (not available as of this writing but may be incorporated into final report).

Table 4-1 SEDP-II Water and Sanitation Targets

Objective and Indicator	Baseline (year)	Target for 2005
Real GDP average annual growth rate	5.4 (2000)	6-7 (2001-2005)
Share of the population with access to safe drinking water		
Rural	29 (1999)	40
Urban	69.5 (1999)	87
Share of the population with access to sanitation facilities		
Rural	8.6 (1999)	20
Urban	49 (1999)	90

Source: SEDP-II

4-2-1-2 National Poverty Reduction Strategy (2003-2005)

The NPRS is the government's Poverty Reduction Strategy Paper (PRSP), prepared in 2003 in fulfillment of World Bank and IMF requirements for accessing their concessional resources. An Interim PRSP was prepared in 2001 in parallel with SEDP-II. The NPRS rests on the foundation of the Millennium Development Goals and SEDP-II but adds specificity with respect to performance monitoring and integration with the budget, among others. With respect to quantitative targets for water supply and sanitation, it does not set additional targets but generally follows SEDP-II. The next NPRS will not be a free-standing document but instead will be integrated into the NSDP (2006-2010), currently under preparation.

4-2-1-3 Cambodia Millennium Development Goals

The Millennium Development Goals (MDGs), unanimously adopted by the UN General Assembly in 2000, have been localized with specific targets for Cambodia. The RGC has adopted and localized the MDGs into the Cambodia MDGs (CMDGs). MDG Seven aims to reverse the loss of environmental resources, maintain forest coverage, promote access to safe drinking water and secure land tenure. The following table, from the *Cambodia Millennium Development*

Goals Report 2003, shows the derivation of the relevant CMDG overall targets and indicators for the relevant parts of MDG Seven.

Table 4-2 Cambodia Millennium Development Goal 7

Global MDG7	Cambodia MDG7
Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water	Overall target 14: Halve by 2015 the proportion of people without sustainable access to safe drinking water
Indicator 29: Proportion of population with sustainable access to an improved water source	Indicator 7.10: Proportion of rural population with access to safe water source
	Indicator 7.11: Proportion of urban population with access to safe water source
Target 11: By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers	Overall target 15: Halve by 2015 the proportion of people without sustainable access to improved sanitation
Indicator 30: Proportion of people with access to improved sanitation	Indicator 7.12: Proportion of rural population with access to improved sanitation
	Indicator 7.13: Proportion of urban population with access to improved sanitation

Source: Cambodia Millennium Development Goals Report 2003

The following table shows the quantitative benchmarks and targets for the relevant CMDG7 indicators.

Table 4-3 CMDG7 Indicators, Benchmarks and Targets

Indicators	Benchmarks		Targets		
	Value	Year	2005	2010	2015
7.10: Proportion of rural population with access to safe water source	24*	1998	30	40	50
7.11: Proportion of urban population with access to safe water source**	60*	1998	68	74	80
7.12: Proportion of rural population with access to improved sanitation	8.6	1998	12	20	30
7.13: Proportion of urban population with access to improved sanitation	49	1998	59	67	74

Source: Cambodia Millennium Development Goals Report 2003

* NPRS 2004 Progress Report cites respective 1999 values of 29% and 69.5% from "MOP Socio-Economic Household Survey, Census". Other figures agree.

** Access to piped water in Phnom Penh is estimated at 85%, 15% for provincial towns (but 5 of 24 have none).

The population with access to safe drinking water increased from 20 percent in 1995 to 26 percent in 2000. An update on progress toward further achievement of the targets will be known when the results of the 2004 Cambodian Socio-Economic Survey (CSES), which is conducted every five years, are released in mid-2005 (not available as of this writing but may be incorporated into final report).

4-2-1-4 Action Plan for Harmonization and Alignment 2004-2008 (Rectangular Strategy)

The government has also adopted a “Rectangular Strategy” for continued implementation during 2004 to 2008 of selected priorities established in the SEDP-II and NPRS. The strategy focuses on improving governance; maintaining a stable environment for growth; and investing for growth in agriculture, infrastructure, employment generation and human resource development.

4-2-2 Sector Plans and Policies

Since 1999, the Ministry of Industry, Mines and Energy (MIME) has been working on an urban water supply policy. The policy calls for (i) a demand-responsive approach in developing new water supply systems in the urban centers, (ii) a wide range of private sector participation in providing the services, (iii) full cost recovery and improvement in tariff collection efficiency, (iv) access of the poor to improved water supply systems, (v) financial autonomy of public utilities, and (vi) establishment of an independent regulator for the water supply sector. This policy was later combined with the rural water supply and sanitation policy and became the National Policy on Water Supply and Sanitation, which was approved by the Council of Ministers in February 2003. MIME has been working with the Asian Development Bank (ADB), World Bank (WB), World Health Organization (WHO), and other development agencies in establishing national drinking water quality standards; MIME has also been working, with assistance from WB, on setting up the standards for designing and constructing piped water supply systems in both urban and rural areas, and on establishing a regulatory framework for the water supply sector.

4-2-2-1 National Policy on Water Supply and Sanitation (Feb 2003)

The National Policy on Water Supply and Sanitation was prepared with assistance from the World Bank’s Cambodia Urban Water Supply Project and approved by the Council of Ministers 9 June 2000. It was amended on 7 February 2003 in order to incorporate the Rural Water Supply Policy Framework prepared with assistance from Sweden and the WB-administered Water and Sanitation Program.

The Policy defines a national vision in which “everyone has sustained access to safe water supply and sanitation services and lives in a clean, healthy and sustainable environment.”

Basic policy on approach to water supply is that “supply driven or demand responsive approaches should be carried out based on local conditions.” In general, demand responsive approaches should be favored in the interest of tailoring costs and specifications to local demand, affordability and circumstances, as compared with traditional “supply driven” process of developing investment requirements from engineering designs based on international norms which may result in overly expensive solutions.

Private sector participation (PSP) shall be encouraged but it is necessary to define clear guidelines specifying the rights and obligations of private parties.

Tariffs should cover all costs and ensure billing collection efficiencies. Long-run marginal cost (LRMC) or average financial cost should be the basis for full cost recovery. There should be a clearly defined tariff policy for subsidies so that the poor can gain access to water supply networks. The focus of such cross-subsidies or credit or community standpipes is to allow the poor to connect to networks with the objective of providing good quality and adequate quantities of water to consumers at appropriate prices that they are able and willing to pay for. Cross subsidy using block tariffs (large consumers subsidize small) are to be favored. In addition, ways should be found to subsidize the costs of connection for poorer households unable to pay.

Only PPWSA operates under the Law on Public Enterprises. Among the other 19 provincial towns that have systems (out of total 24, 5 have nothing), 3 are private and the others operate under “financial autonomy or revenue balancing expenses.” Policy calls for establishing mechanisms for decentralization and financial autonomy of public utilities should be pursued in the interest of ensuring service sustainability, financial accountability, cost recovery, management efficiency and consumer confidence. MIME and Provincial Authorities shall cooperate in defining their respective roles and responsibilities, including provisions for building local public utility capacity and assuring their independence (i.e., from political interference).

4-2-2-2 Proposed Water Supply and Sanitation Law

The draft law proposes a basic framework for provision of water and sanitation services in the country. Compared to the present situation, the key implications of the draft law are that it would transfer responsibility for sewerage from MPWT to MIME, redefine the role of MIME to be overall water and sanitation sector planning and policymaking, and create a new sector regulatory body, the Water & Sanitation Authority, to issue operating licenses and regulate tariffs, among other regulatory functions.

Specifically, the law aims to establish:

- The principles of operation of water and sanitation services (public and private);
- A favorable climate for investment in, and commercial orientation of the sector;
- The bases for regulatory arrangements for the sector;
- Principles for consumer rights and the promotion of private investment and competition among service providers;
- Principles for granting of rights to, the obligations of, and sanctions (penalties) on water service providers; and the obligations of water service customers;
- The Water and Sanitation Authority of Cambodia, as the sector regulator.

4-2-2-3 Others

(1) Draft Water Resources Law

The proposed water resources law establishes the rights and obligations of water users; the basic principles for water resources management; establishes the institutional arrangements for implementation and enforcement; and defines the role of water user groups. Under the proposal, MOWRAM shall: maintain a central inventory of water resources and prepare the national water resources plan.

The draft also establishes basic right of citizens to use water for normal domestic purpose. Water diversion, abstraction and use for other uses; the discharge of wastewater onto natural water bodies, the extraction (and filling) of materials from the beds and banks of natural water bodies will require the approval or license from MOWRAM. The construction of structures over the bed, banks and along the shores of natural water bodies, including bridges, ports and buildings will also require a MOWRAM license.

Water use licenses shall be time-bound and may be renewed prior to expiry; are transferable (with MOWRAM approval). Licenses may be revoked for various reasons, including violation of the conditions; non-use for a period of 2 consecutive years or non-payment of license fees.

MOWRAM shall also issue wastewater discharge licenses for discharge, disposal or deposition of polluting substances onto natural water bodies. Discharge license shall specify treatment requirements and will be subject to payment of pollution fees. MOWRAM shall establish discharge standards in consultation with other agencies.

(2) Private Sector Participation

Cambodia has been testing the appropriateness of private sector participation in water supply provision. In some provincial towns, private sector operators have been operating under Build-Operate-Transfer (BOT) agreements. Private operators are active in several province, including:

Name	PSP form	License	Issued	Status
Banteay Mean Chey	BOT	30	10-6-97	Operating
Kampong Spueu	BOT	23	3-10-97	Operating
Kampong Spueu (Odingk)			21-3-00	Operating
Kandal (Kien Svay)			5-6-98	Operating
Takaev	BOT	40	21-11-97	Operating
Poi Pet			16-6-00	
Srae Ambel		30	13-12-00	
Barray (Kampong Thum)			20-2-01	

4-3 City Planning and Population Projection

4-3-1 Legal and Institutional System of City Planning in Cambodia

4-3-1-1 Main Legal Documents

The main legal documents related to city planning in Cambodia are as follows:

- i. Constitution of Cambodia of 1993
- ii. Law on Organization of Provinces and Municipalities (1994)
- iii. Law on Protection of Patrimony (1996)
- iv. Law on Land Management, Urban Planning and Construction of May 23 1994
- v. Law 699/1999 on creation of the Ministry of Water Resources and Meteorology and the Ministry of Land Management, Urban Planning and Construction (MATUC)
- vi. Circular No. 2 of January 15 1996 issued by the Bureau of Council of Ministers

According to the Constitution, the State is in charge of planning and land management. Provinces and Municipalities are placed administratively under the Ministry of Interior (MOI) and have to work out the measures for the preservation and protection of national and cultural patrimony. The urban development master plan of a Municipality is based on the Law on Land Management, Urban Planning and Construction of May 23, 1994, and on the Circular No. 2 of January 15, 1996.

4-3-1-2 Present Situation of City Planning of the Municipality of Phnom Penh

The Bureau of Urban Affairs (BAU) of the Municipality of Phnom Penh (MPP) is at present preparing the Urban Development Master Plan for the target year of 2020. The draft plan will be submitted to the MOI, the MATUC and the Council of Ministers. After the Council of Ministers approves the plan, it will become legally effective. The Master Plan is a document showing urban development strategies and does not regulate individual interests. These documents will be prepared afterwards in the form of detailed zoning plans by the Department of Land Management, Urban Planning, Construction and Cadastre (DATUCC) of the Municipality in collaboration with Districts and Communes.

As described above, MPP has no authorized urban development plan at present. It is necessary, however, to assume future population distribution in the Study Area for the estimation of water demand for this Study. Accordingly, a series of meetings with the BAU and the DATUCC were held and the future development scenarios were discussed.

4-3-1-3 Relevant Plans and Studies on Urban Development in Greater Phnom Penh

In Greater Phnom Penh, several studies and plans on future land use have been conducted. The following summarizes recent studies.

1) *Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh*; JICA, 1999

Under this Study, a future land use plan for MPP was prepared in 1999.

2) *Study on the Transport Master Plan of the Phnom Penh Metropolitan Area*; JICA, 2001

This Study reviewed the above-mentioned land use plan and prepared a land use plan for 2015, in collaboration with the BAU. It covers the entire administrative area of MPP and the adjacent areas of Kandal Province.

The area by land use category in 2000 and population distribution in 2000 and 2005, estimated in the study, were utilized as basic information for the present Study.

3) *Urban Development Master Plan of Phnom Penh for 2020*; BAU, MPP, 2004 (BAU Master Plan)

This plan shows a general land use designation in 2020 for MPP and a part of Kandal Province located east of the Mekong River. According to the BAU, this part of Kandal Province will be incorporated into MPP in the near future. Communes included in the area are Preaek Ta Kov and Svay Chrum in Khsach Kandal District, and Akreiy Ksatr and Sarikakaev in Lyea Aem District. The Plan is to be approved. At present, the BAU and a French consultant team are carrying out various studies to complete a more detailed land use plan based on target population distributions at the commune level.

The land use map for 2020 and preliminary studies on future population distribution constitute the base for the present Study's future development scenarios.

4) *Ta Khmau Land Management Project*; Ministry of Land Management, Urban Planning and Construction, 2002

This Study analyzed the topography, land use and socio-economic conditions of Ta Khmau District, Kandal Province and recommended the preparation of a land use plan for the District, with careful studies on flooding, drainage and infrastructure.

4-3-2 Development Scenarios for Greater Phnom Penh

Future socio-economic targets in development plans are generally described in terms of future population and economic level (for example, GDP per Capita). For urban planning, a future land use map is prepared for the presentation of urban structure, including residential areas, industrial areas, commercial/service centers and protected areas. It also shows main roads and other transport facilities. For Phnom Penh, there is a population projection for 2020 made by the National Institute of Statistics (NIS) and a draft land use map for 2020 by the BAU. Future

development scenarios for Greater Phnom Penh have been prepared for the present Study based on these existing data and the Study Team's projections.

Development scenarios for the Study Area encompass the following three aspects:

- i. Future Population Growth
- ii. Future Economic Activities
- iii. Future Urban Development within the Study Area
 - Future Image of the Central Area
 - Main Areas for Industrial Development
 - Location of Sub-centers for Commercial/Service Activities
 - Residential Development Policies
 - Agricultural Development/Protection Policies
 - Environment Protection Policies

4-3-2-1 Applied Scenarios for Population Growth

- (1) Future population projections are carried out based on the "First Revision, Population Projections for Cambodia 1998-2020" published by NIS, Ministry of Planning (MOP) in June 2004 (hereinafter referred to as NIS Projections).
- (2) Future Population of the Study Area is expected to increase from 1.3 million in 2000 to 2.3 million in 2020.
- (3) This scenario assumes that the annual natural increase of population will be mostly attributable to decreasing mortality rates and increasing life expectancy at birth.
- (4) The total fertility rate (TFR) of Phnom Penh was already at the reproduction level of 2.10 in 1998, and NIS Projections assume that the TFR will be constant at 2.10 until 2020.
- (5) The number of net migrants to Phnom Penh is limited to about 22,000 persons annually (NIS Projections assume that the annual net migration to Phnom Penh will be constant at 21,834 until 2020).

4-3-2-2 Applied Scenarios for Economic Activities

- (1) GDPs at the province/municipality level are not officially estimated. The Study Team estimated the GDP by sector for 1998 and 1999, utilizing the number of employed persons by sector obtained from the 1998 Census and the 1999 Cambodia Socio-Economic Survey.

- (2) From 2000 to 2020, the Study Team projected the GDP of Phnom Penh, based on the future population, labor force participation rate, unemployment rate and labor productivity by sector.
- (3) The percentage share of GDP of the Study Area to Cambodia is expected to increase from 20 percent in 2000 to nearly 30 percent in 2020. Study Area GDP per capita will rise from US\$ 600 to US\$ 1,400 in 2020.
- (4) This scenario assumes that the industrial sector will continue to lead the national and regional economy, generating new types of manufacturing activity beyond the garment industry and that the construction industry will be stimulated by foreign direct investment (FDI) and infrastructure development by the government.

4-3-2-3 Applied Scenarios for Future Urban Development

(1) Present Urban Structure

- a) The Study Area can be classified into two areas in accordance with the types of land use. One is the area enclosed by the Inner Ring Road (hereinafter referred to as "the central area") and the other is outside of the central area (hereinafter referred to as "the suburban area"). Administratively, the central four Districts coincide with the central area, while the other three Districts and parts of Kandal Province constitute the suburban area.
- b) The Royal Palace, government offices, embassies, commercial/business buildings and cultural facilities are concentrated in the central area. Typical existing buildings in the central area are four- to five-story buildings. The ground floor of these buildings is used for shops and people live on the upper floors.
- c) In the suburban areas, factories and commercial/service buildings are located along the trunk roads. Sporadic housing development and large-scale subdivisions are in progress, especially in Ruessei Kaev District.
- d) It is noted that much of the lakeshore areas is occupied by informal and makeshift settlements. Many lakes and swamps are being filled in for urban development projects.
- e) Population densities of communes within the central area are highest around the Ou Ruessei Market and the Central Market where density reaches about 1,000 persons per hectare.

(2) Future Urban Development

In November 2004, BAU completed a General Land Use Map for 2020 as part of the Master Plan (see Figure 4.3). According to the BAU, the Land Use Map shows the future urban structure of Phnom Penh and, after authorization by the Council of Ministers, it will be used as a guideline for

detailed zoning plans to be prepared by DATUCC. The Master Plan leads other sector plans including transportation, water supply and other infrastructure improvement plans. The Study Team had discussions with the BAU and concluded that it was appropriate to adopt the Plan as the basis for the present Study. The scenarios for future urban development are based on this Land Use Map. These are summarized as follows:

- a) For the central area, commercialization will be promoted and relocation of residents living in sub-standard dwelling units and squatters will be strongly enforced through appropriate legal and institutional means.
- b) Industrial development will be accelerated, mainly in Dangkao District of Phnom Penh and Angk Snuol District of Kandal Province along National Road No. 4.
- c) Sub-centers for service sector activities will be developed around Kakab Commune in Dangkao District, Nirouth Commune in Mean Chey District and Khmuonh Commune in Ruessei Kaev District.
- d) In Mean Chey District, which is adjacent to the central area, population density will increase up to the planned level through adequate measures for housing and improvement of infrastructure.
- e) Ruessei Kaev District, located in the northern part of Phnom Penh, will become the largest suburban residential area. For the realization of quality residential zones, it is required to control various ongoing and planned housing and subdivision projects under detailed land use plans and infrastructure improvement plans.
- f) For Dangkao District, residential zones should be sited through a land use plan in relation to an agricultural development plan and agricultural land protection plan.
- g) An agricultural zone will be planned at the southern part of Dangkao District. The agricultural zone will be structured by a network of farm roads and village settlements.
- h) Natural zones will be located outside the outer ring road in the northern part of Dangkao District and Ruessei Kaev District. A lake protection zone will be planned around Tumpon Lake.

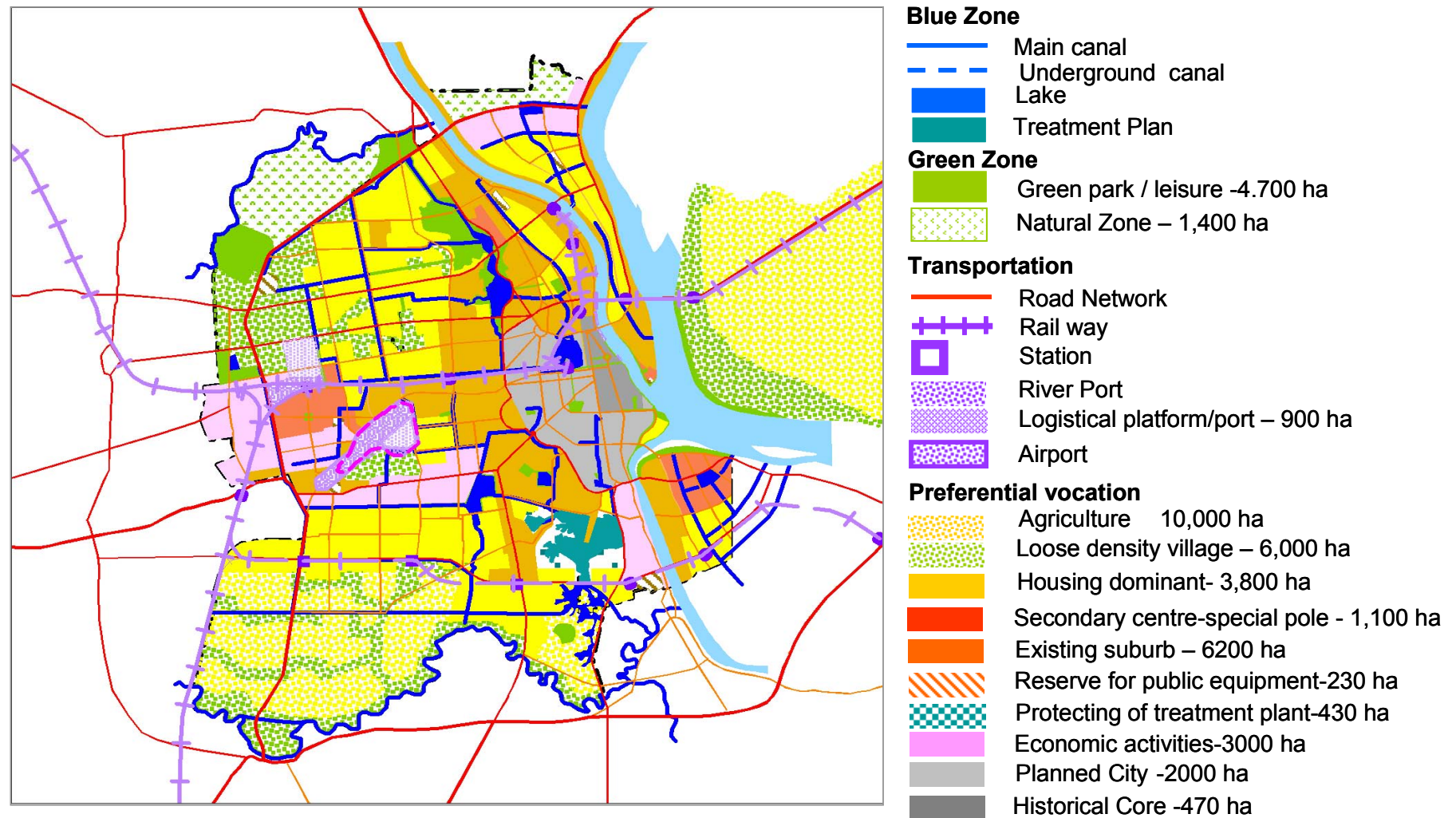


Figure 4-3 General Land Use Plan for 2020

4-3-3 Population Projection

The distribution of population and numbers of households at the commune level were estimated based on the future urban development scenarios. The results are shown in Tables 4.4 and 4.5 and Figure 4.4. The methodology and results are summarized hereunder.

4-3-3-1 Bases for Population Projection

- (1) Basic data of population and the number of households by commune are provided by the 1998 General Census.
- (2) For MPP, it is assumed that the population of each commune increased up to 2005 in accordance with the growth trend adopted in the Transport Master Plan Study. (An adjustment is carried out to reconcile the forecasted trend with the NIS forecast.)
- (3) From 2005 to 2020, it is assumed that the population of each commune will change (increase or decrease) to reach the targeted population density set for 2020.
- (4) The targeted or planned population densities are determined based on the values obtained from the BAU.
- (5) For communes belonging to Kandal Province, percentages of migrants during the period from 1993 to 1998 (obtained from the commune data of the 1998 General Census) are utilized to differentiate the growth trend by commune.
- (6) Population of the central area is expected to decrease from 715,500 in 2005 to 683,400 in 2020 as shown in Table 4-4. The average population density will drop from 264 persons per hectare in 2005 to 252 persons per hectare in 2020. The population density of Prampir Meakkara District, the most densely populated District at present, is expected to fall from 540 persons per hectare in 2005 to 440 persons per hectare in 2020. Within the central area, only Tuol Kouk District will show a slight increase in population in future.
- (7) In the suburban areas of MPP, the population will more than double. The 2005 population of about 620,000 will increase to about 1,320,000 in 2020. This increase of some 700,000 will be distributed among Dangkao District (270,000), Mean Chey District (160,000) and Ruessei Kaev District (270,000).
- (8) In Kandal Province, a part of Angk Snuol District located along National Road No. 4 will absorb a population increase of 46,700 between 2005 and 2020, which is nearly half of the population increase of 102,700 for Kandal Province during the same period. The Commune of Kamboul will grow rapidly at an annual average rate of about 8 percent.
- (9) Ta Khmau District, most of which is already urbanized, is expected to grow moderately in the future, considering its physical characteristics as a floodplain.

Based on these assumptions, the following population projections have been developed.

Table 4-4 Population Projection 2005-2020

Year	2005	2010	2015	2020
Phnom Penh	1,334,892	1,551,479	1,776,646	2,006,009
Chamkar Mon	237,822	235,775	233,728	231,680
Doun Penh	156,691	151,587	146,483	141,380
Prampir Meakkara	118,664	111,507	104,350	97,190
Tuol Kouk	202,355	205,941	209,527	213,110
Central Areas	715,532	704,810	694,088	683,360
Dangkao	118,466	206,458	296,599	387,948
Mean Chey	233,348	285,361	339,983	395,779
Ruessei Kaev	267,546	354,850	445,976	538,922
Suburban Areas	619,360	846,669	1,082,558	1,322,649
Kandal within Study Area	195,107	223,412	258,222	297,817
Kandal Stueng (part)	16,068	18,726	21,926	25,459
Kien Svay (part)	57,765	63,382	69,666	76,093
Angk Snuol (part)	37,892	49,314	64,930	84,546
Ponhea Lueu (part)	14,427	16,215	18,276	20,451
Ta Khmau	68,955	75,775	83,424	91,268
Study Area Total	1,529,999	1,774,891	2,034,868	2,303,826

Source: Study Team Estimates based on the NIS Projections and BAU's Targeted Population Density by Commune

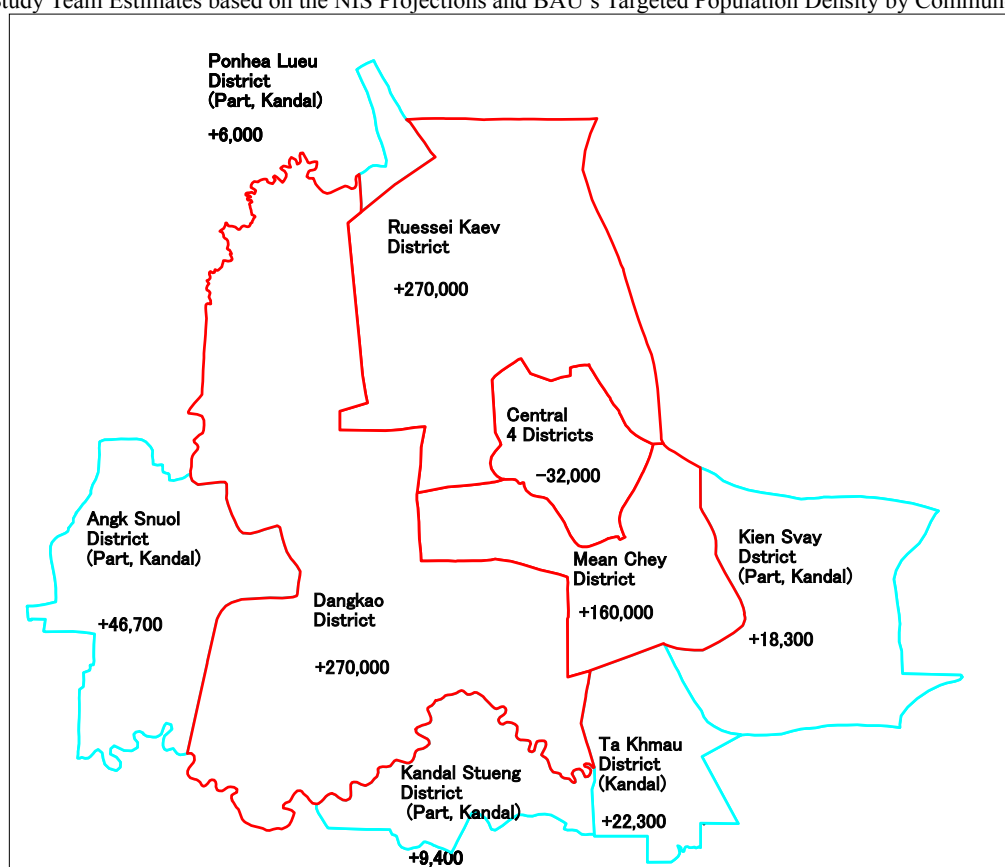


Figure 4-4 Population Change by District between 2005 and 2020

4-3-3-2 Number of Households

According to the 1998 General census, the average household size of Phnom Penh was 5.76 (5.86 in the central area and 5.63 in the suburban area) and 5.35 in the part of Kandal Province within the Study Area.

For the projection of future household size, an analysis was conducted in the Transport Master Plan Study in accordance with relationship to the central area, land use and proximity to arterial roads. Based on this analysis, the study estimated that the average household sizes in 2000 were 5.79 in the central area and 5.61 in the suburban area. It is assumed that the household size of the central area will decrease from 5.79 in 2000 to 5.47 in 2015 and that of the suburban area will increase a little from 5.61 in 2000 to 5.63 in 2015.

Changes in household size obtained from the Cambodia Socio-Economic Surveys are shown in Table 4-5. Household sizes generally decreased from 1993/4 to 1997, but increased a little in 1999. The values of 1999, however, were smaller than those obtained from the 1998 Census.

Table 4-5 Changes in Household Size

	1993/94	1996	1997	1999
Cambodia	5.61	5.27	4.94	5.33
Phnom Penh	5.92	5.30	5.19	5.53
Other Urban Areas	5.94	5.27	5.20	5.40
Rural Areas	5.55	5.27	4.88	5.30

Source: Cambodia Socio-Economic Surveys

Considering the above-mentioned facts, it is assumed that the household size in the central area will decrease along the lines of the projection by the Transport Study, from 5.79 in 2000 to 5.42 in 2020. In the suburban area of Phnom Penh it will also decrease from 5.61 in 2000 to 5.41 in 2020. For Kandal Province, it is assumed that household size will decrease in accordance with the tendency of the suburban area of Phnom Penh. The results are summarized in Table 4-6.

Table 4-6 Future Number of Households and Household Size by District and Commune, 2000-2020

Year	2000		2005		2010		2015		2020	
District	Number of Households	Household Size	Number of Households	Household Size	Number of Households	Household Size	Number of Households	Household Size	Number of Households	Household Size
Phnom Penh	198,472	5.71	238,039	5.61	281,343	5.51	325,161	5.46	370,563	5.41
Chamkar Mon	37,140	5.71	42,677	5.57	43,345	5.44	43,409	5.38	43,474	5.33
Doun Penh	25,476	5.87	27,380	5.72	27,113	5.59	26,438	5.54	25,749	5.49
Prampir Meakkara	18,965	5.75	21,150	5.61	20,324	5.49	19,172	5.44	18,000	5.40
Tuol Kouk	30,062	5.84	35,436	5.71	36,901	5.58	37,871	5.53	38,858	5.48
Dangkao	19,967	5.25	22,813	5.19	39,720	5.20	57,299	5.18	75,412	5.14
Mean Chey	31,196	5.71	41,363	5.64	50,654	5.63	60,624	5.61	71,009	5.57
Ruessei Kaev	35,666	5.72	47,220	5.67	63,286	5.61	80,348	5.55	98,061	5.50
Kandal Study Area	32,464	5.33	37,115	5.26	42,768	5.22	49,800	5.19	57,870	5.15
Kandal Stueng (part)	2,888	4.84	3,360	4.78	3,927	4.77	4,627	4.74	5,401	4.71
Kien Svay (part)	10,200	5.20	11,238	5.14	12,372	5.12	13,688	5.09	15,047	5.06
Angk Snuol (part)	5,770	5.18	7,384	5.13	9,621	5.13	12,713	5.11	16,644	5.08
Ponhea Lueu (part)	2,396	5.41	2,697	5.35	3,042	5.33	3,448	5.30	3,888	5.26
Ta Khmau	11,210	5.64	12,436	5.54	13,806	5.49	15,324	5.44	16,890	5.40
Study Area Total	230,936	5.66	275,154	5.56	324,111	5.48	374,961	5.43	428,433	5.38

Source: Study Team Estimates

4-4 Organization and Management of PPWSA

As a public utility, the Phnom Penh Water Supply Authority (PPWSA) is subject to various laws and regulations defining its status and relationship with other agencies and governing its water supply operations. Historically, PPWSA was an agency of the Municipality of Phnom Penh. In June 1996, the Government passed the law on the General Status of Public Enterprises, defining their operation, governance and supervision, and granting them independent legal status and a degree of financial autonomy. Then, in December 1996, the Government approved Decree No. 52, which defined PPWSA as a Public Enterprise under the recently approved law. The Decree mandates PPWSA to process and distribute water for public use in Phnom Penh City and suburban areas; and to expand, improve and rehabilitate the water production and distribution systems. PPWSA is obliged to operate according to commercial practices. However, like all such Public Enterprises, it remains subject to various State controls and is overseen by a supervisory Ministry. In PPWSA's case, this was originally the Municipality of Phnom Penh under the Ministry of Interior. Specifically, the Decree was designed to:

- a) End the pooling of PPWSA's revenues and expenditures with the municipality, which was a major disincentive to the utility;
- b) Make Government financial support to the utility more transparent, as PPWSA would now be a specific item in the national budget;
- c) Empower the utility to cut off all public and private customers for nonpayment;
- d) Enable PPWSA to charge Government/administrative consumers prevailing tariffs; and
- e) Empower it to develop its own personnel policies, including incentives for higher productivity.

In 2004, the Decree was amended to transfer PPWSA from the Municipality to MIME, ostensibly in order to permit it to provide services in neighboring provinces beyond the territory of the Municipality of Phnom Penh.

This section presents a basic description of the institution – its mission, current policies and priorities, business plan and key operations and management systems. The institutional analysis of PPWSA is taken up in Chapter 9.

4-4-1 Key Corporate Policies of the Phnom Penh Water Supply Authority

PPWSA today is a fully autonomous public enterprise created under Article 26 of the Royal Kram 0696/03 on 17 June 1996. The mission of PPWSA is to “continuously and adequately meet the water supply needs of the residents of Phnom Penh, including the poorest families, and to extend its safe coverage to the other areas bordering Phnom Penh.” Much of the basic corporate policies

and decisions of PPWSA observe, as applicable, the principles and instructions found in the National Policy on Water Supply and Sanitation. PPWSA policies are established by a Board of Directors which includes:

- Ministry of Industry, Mines and Energy (MIME) - chairperson
- Ministry of Finance (MOF)
- Ministry of Interior (MOI)
- Cabinet of Government
- PPWSA General Director
- Representative of PPWSA

4-4-1-1 Regulatory Arrangements and Policy

In Phnom Penh, there are three somewhat fragmented areas of regulation over the delivery of water supply in effect.

(1) Water tariff (or economic) regulation

At present, tariff adjustment requires the de facto consent of the national cabinet. The process is considered to be very difficult and politically sensitive.

(2) Environmental regulation

This function is within the domain of two (2) agencies - the Ministry of the Environment and the Ministry of Water Resources and Meteorology. The extent to which these regulatory functions are consistently exercised is unclear. Environmental impact assessments are required and complied with for new capital investments of PPWSA. Any adverse environmental impact due to PPWSA operations and the public health impact (water quality) do not seem to be subject to external checks and is mainly left as an internal responsibility of PPWSA. The draft law on Water and Sanitation contains clearer provisions with respect to securing water rights.

(3) Operations regulation

This area of regulation is currently not done externally, but the Board of Directors, mostly external, receives and reviews operational reports from management. MIME, who is represented on the Board, has broad discretionary supervisory authority that, at least in the case of PPWSA, is rarely exercised.

4-4-1-2 Key Management Policies

The company policy is to match the growth of its service capacity with the growth of demand in the service area. At the same time, PPWSA is deeply concerned with the promotion of environmental protection and resource conservation. Public health and safety is also a key policy of the company.

(1) Planning

The company believes in careful planning of all critical activities. Planning, to the extent possible, is done with the participation of everyone who will be involved in implementation or affected by the proposed plans.

(2) Sustainability of efficient and effective services

The company believes that all the improvements that are introduced should be sustained. Management systems and independent performance review for quality assurance needs to be further developed. The company seeks to provide efficient and effective services which can be sustained.

(3) Human resources management and development

The company has embarked on a policy of developing and training capable and highly-motivated staff. The planning and implementation of human resources activities is led by the Training Center, which is headed by the Assistant to the Director General. Plans have been developed and are slowly coming on stream for management development, professional development and technician-level training programs. JICA has been providing assistance in formulating the long term human resources development program for the company, with which this Master Plan is coordinated.

4-4-1-3 Customer Service Policies

(1) Affordability

The company policy is to keep the operating costs as low as possible and consistent with growth of household incomes. All operating costs are borne by the customers. The company has adopted a policy of cross-subsidization – high volume consumers subsidizing low-volume consumers; commercial-industrial consumers subsidizing residential customers.

(2) Low-income groups

A specific policy of the company is the extension of services to low-income communities. When the services improved in 2000, PPWSA was able to vigorously implement its program to provide water services to low-income areas and communities. Conditions include: community agrees to control their illegal connections, report leakages to PPWSA, assist PPWSA in making the connection of the distribution pipes in the area; not resell water; not resettle. In turn, a new monthly-installment payment plan was introduced for the connection fees.

(3) Coverage and service levels

PPWSA has adopted policies and programs to increase the customer base. Its policy is to extend service to everyone within the service area equitably. At present, PPWSA provides 24-hour piped water services.

(4) Customer service

Policy is to attend to customer complaints on water quality, low pressure, faulty or inaccurate metering within 24 hours. The company has also embarked on a public education on water.

4-4-1-4 Financial Management Policies

(1) Capital financing

Currently, much of the capital financing requirements of the company is mostly available through external loans or grants. An increasing amount of small capital investments is however being financed from internally generated funds.

(2) Financing and cost recovery

The company seeks to provide for all operation and maintenance costs from the water sales. Provisions are now made for depreciation of assets.

(3) Tariff setting process

Tariff studies are usually prepared by the PPWSA Finance Department; recommendations for adjustments are recommended by the General Director to the PPWSA Board of Directors. The Board reviews the proposal and endorses it to the Ministry of Finance. Final approval of tariff adjustments is taken by the Council of Ministers.

(4) Accounting and auditing standards

The company meets the basic government requirements for financial and audit reports. More comprehensive reports are prepared to meet commercial accounting and management accounting standards.

4-4-1-5 Technology, Research and Development Policies

(1) Water loss control

With World Bank assistance, PPWSA launched an intensive and successful effort in to control water losses and establish a system (using block meters) to monitor water losses. At the same time, PPWSA's capacity to detect and repair leaks was strengthened. These systems are in place and functioning well.

(2) Technical service standards

PPWSA has adopted the WHO Drinking Water Standards.

(3) Operation and maintenance standards

These standards are still under preparation led by the Training Center and the Technical Department.

(4) Bidding and procurement regulations

The PPWSA generally follows the standard procedures approved by government for pre-qualification, bidding and award for procurement of goods and services. As required, international or local competitive bidding procedures are followed.

4-4-2 Current Status of PPWSA Operations and Organization

4-4-2-1 Function and Staffing Chart

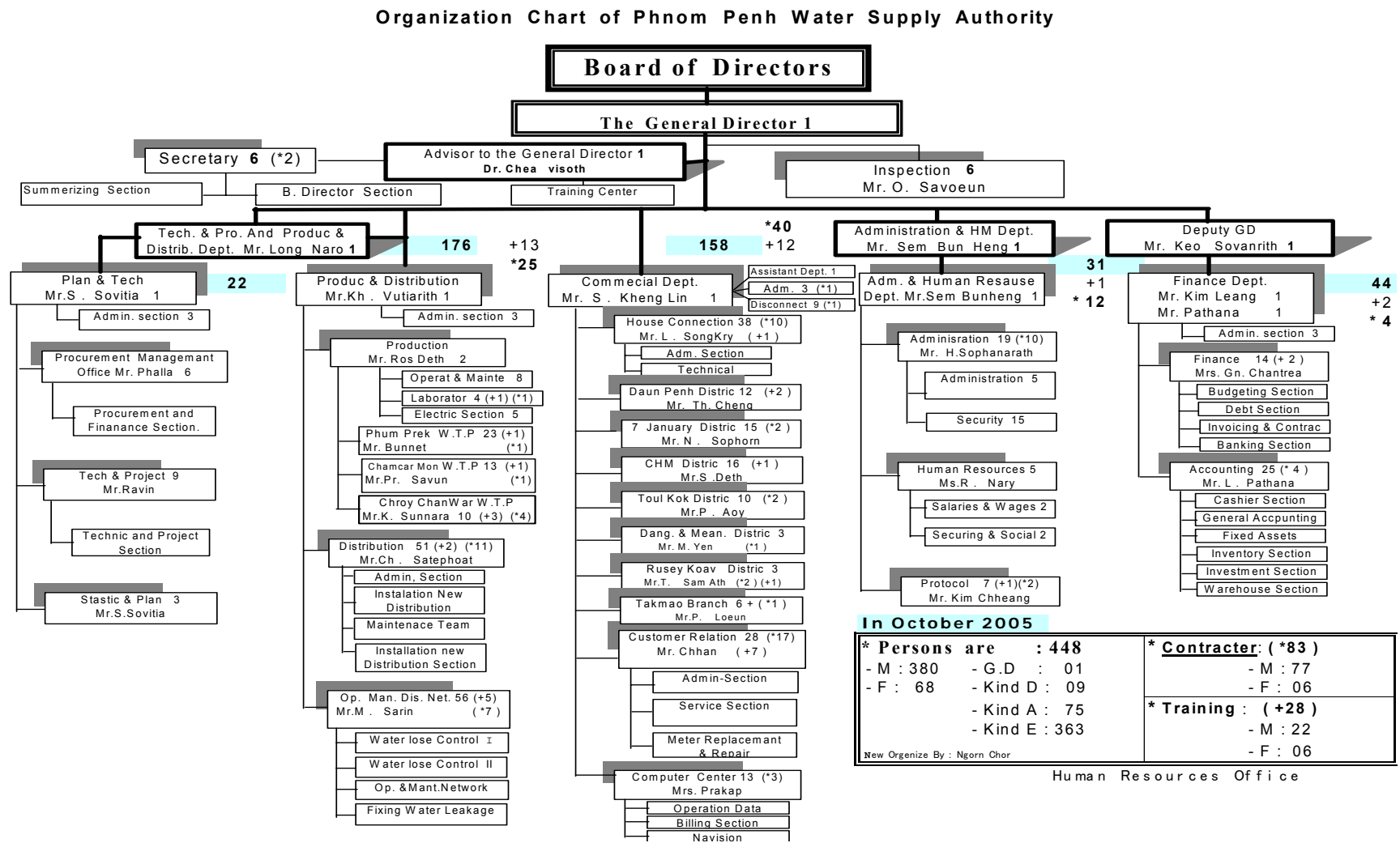


Figure 4-5 PPWSA Organization Chart

4-4-2-2 Management

The PPWSA General Director is assisted by three (3) Deputy General Directors, an Assistant to the General Director and five (5) Department Directors. These officials are responsible for managing their respective departments and report directly to the General Director or one of his three deputies.

4-4-2-3 Departments and Sections

PPWSA is divided into the following five departments:

- Administration and Human Resources;
- Accounting and Finance;
- Commercial;
- Production and Supply;
- Technical and Projects

4-4-2-4 Staff Profile

As of October 2005, the PPWSA consisted of 448 regular, 83 contractual and 28 trainee staff (Total: 559) of which 363 were in level E staff positions; 75, in level A (or supervisory) positions; 9, in level D (or managerial) positions and one (1) position as General Director. 479 employees (or 85.7%) are male; and 80 (14.3%) are female. Contractual staff are persons who are paid based on their output or performance – no regular salary or wage.

Table 4-7 Profile of Age and Educational Attainment of Staff at PPWSA (October 2005)

Age and Educational Attainment	< 26 years	27-35	36-45	> 46	Total	
					Number	%
Doctorate	0	0	1	0	1	0.18%
Masters Degree	0	4	7	0	11	1.97%
Bachelor/Engineer	23	32	9	6	70	12.52%
Under Bachelor (BST)	23	32	12	2	69	12.34%
Baccalaureate/Train Short Term	27	21	12	27	87	15.56%
Technician	12	28	16	10	66	11.81%
Worker > 10 years experience ³	0	32	45	38	115	20.57%
Worker < 10 years experience	59	45	22	14	140	25.04%
Total	144	194	124	97	559	100%
	25.76%	34.70%	22.18%	17.35%	559	

Source: PPWSA Administration and Human Resources Department. October 2005

³ Includes staff with little or no formal educational attainment, but with work experience.

4-4-3 Management Processes and Capacities

4-4-3-1 Strategy and Business Planning

The business plan is prepared by the Planning Department in consultation with all Departments of the company. Final plan is reviewed and approved by the Board of Directors. The Part A of the Plan starts out with a description of the mission and goals of the company. It then presents a quick review of the performance over the period of time and an analysis of the strengths and weaknesses and the opportunities and threats currently faced by the company. The Business Plan (2005-2009) consists of:

- Operations Plan
- Human Resources Development Plan
- Investment Plan; and an
- Implementation Plan.

4-4-3-2 Human Resources Management and Development

(1) Wage and Salary Administration

PPWSA is implementing an 11-grade/25-step system for job classification. The minimum salary at entry level on the lowest grade is 167,000 Riels. Allowances, ranging from 78,000 Riels up, are paid. Some overtime pay is also allowed. Average salary is in the order of 600,000 Riels.

Grade 11	Entry Level, Step 1 1,246,925→	Step 25 1,947,515
↑			↑
Grade 1	167,000→	388,43

(2) Human Resources Development

Training and development activities are the responsibility of the Training Center, which is headed by the Assistant to the General Director.

Recruitment of personnel is done by general advertisement in the newspaper. Approved requests for personnel are received by the Administrative Department. Review of applicants and recommendations are made by a “recruitment committee” which includes the head of the requisitioning department and the Personnel Department. Appointments are approved by top management.

(3) Personnel Incentives and Rewards

PPWSA awards bonuses based on enterprise financial performance. An incentive payment is given to staff that provide formal training to others, e.g., workshop presentation. Contracted meter

readers are paid according to their collection rate and face a steeply declining payment schedule for failure to achieve the target of 100 percent.

(4) Personnel Performance Evaluation System

PPWSA implements a fairly rigorous system of monthly performance evaluation. The Human Resources Department reports that the system involves a monthly procedure whereby all employees are required to complete an Evaluation Sheet (Score Sheet)

4-4-3-3 Information System and Communications

The company is using an Accounting Management Information System (Navision Financials) which integrates the various subsystems in accounting and operations among departments and offices in PPWSA. System is automated and in real-time.

4-4-3-4 Customer Services

The company has started to decentralize customer service operations. The Commercial Department is now divided into District offices. Although they are still all physically located at the main office, there are plans to relocate the district offices within the areas they operate in order to make it more convenient for customers to transact business with the company. The company follows a two-month billing cycle.

4-4-3-5 Operation and Maintenance, including Logistics

Operation and maintenance is a responsibility of the Technical Department – principally the Production and Distribution Section. Management systems are in place for monitoring status of operations and maintenance requirements.

The company also has an ongoing program for control of unaccounted for water led by the Distribution Network Section.

4-4-3-6 Project Management

Project management activities are undertaken by the Technical Department, specifically the Planning Section. All investment projects and technical assistance projects, including coordination with external support agencies, are managed by the Section.