

# 資料集

[ 資料集 ]

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## 資料 1 調査団員氏名、所属

### 1-1 基本設計調査時

- ( 1 ) 山本 敬子：総括  
JICA 国際協力専門員
- ( 2 ) 渡辺 真樹子：計画管理  
JICA 無償資金協力部業務第 1 課
- ( 3 ) 芳賀 秀壽：業務主任 / 運営維持管理計画  
(株)東京設計事務所
- ( 4 ) 佐藤 弘孝：浄水場計画  
(株)東京設計事務所
- ( 5 ) 丹下 孝行：浄水場施設  
(株)東京設計事務所
- ( 6 ) 渡辺 潤一：社会・経済 (水需要予測)  
(株)日水コン
- ( 7 ) 田中 尚光：施工調達計画 / 積算  
(株)東京設計事務所
- ( 8 ) 糠澤 琢郎：浄水場施設 (CAD) / 積算補助  
(株)東京設計事務所

### 1-2 基本設計調査ドラフトレポート説明時

- ( 1 ) 山本 敬子：総括  
JICA 国際協力専門員
- ( 2 ) 渡辺 真樹子：計画管理  
JICA 無償資金協力部業務第 1 課
- ( 3 ) 芳賀 秀壽：業務主任 / 運営維持管理計画  
(株)東京設計事務所
- ( 4 ) 佐藤 弘孝：浄水場計画  
(株)東京設計事務所
- ( 5 ) 丹下 孝行：浄水場施設  
(株)東京設計事務所

資料 2 調査行程

2-1 基本設計調査（本格）

日順	日付	団員移動内容	主任 / 運営・維持管理計画	浄水場設計	浄水場施設	社会経済 (水需要量予測)	施工調達計画 / 積算	浄水場施設 (CAD) / 積算 (自社負担)
			芳賀 秀壽	佐藤 弘孝	丹下 孝行	渡辺 潤一	田中 尚光	糠沢 琢郎
1	10 (土)	丹下団員日本出発			日本 パソコン			
2	11 (日)	同上パナソニック着			土質調査準備			
3	12 (月)				水道公社表敬訪問・協議、土質調査準備			
4	13 (火)				土質調査準備			
5	14 (水)				測量 (平板・路線) 用地調査			
6	15 (木)				測量 (平板・路線) 用地調査			
7	16 (金)				測量調査準備			
8	17 (土)				測量調査準備			
9	6/18 (日)	山本団長、渡邊、芳賀、佐藤、渡辺 団員日本発	日本 パソコン	日本 パソコン	休日	日本 パソコン		
10	19 (月)	同上パナソニック着	日本大使館、JICA 事務所表敬	同左	同左	同左		
11	20 (火)		PPWSA 表敬、I/R レポート説明、サイト調査	同左	同左	同左		
12	21 (水)		PPWSA と協議	同左	同左	同左		
13	22 (木)		PPWSA と M/M 協議	同左	同左	同左		
14	23 (金)		パナソニック市表敬、M/M 調印	同左	同左	同左		
15	24 (土)		資料整理、サイト調査	同左	同左	同左		
16	25 (日)	休日		同左	同左	同左		
17	26 (月)	山本団長、渡邊団員パナソニック発	CDC 表敬、大使館、JICA 事務所報告	同左、団内会議	同左、団内会議	同左、団内会議		
18	27 (火)	同上日本着	事業内容確認、調査方針案検討	図面整理、事業内容確認、調査方針案検討	図面整理、事業内容確認、調査方針案検討	事業内容確認、調査方針案検討		
19	28 (水)		調査方針案検討	水源水量・水質調査	土質・測量調査契約準備	関連機関の情報収集		
20	29 (木)		調査方針案討議・決定	調査方針案討議・決定	調査方針案討議・決定	社会経済データ収集、環境調査		
21	30 (金)		測量契約、既存施設機能調査	水源、水道水量・水質調査	測量契約、既存施設機能調査	社会経済データ収集、環境調査		
22	7/1 (土)		資料整理	資料整理	資料整理	資料整理		
23	2 (日)	休日						
24	3 (月)	糠沢団員日本発	測量用地指示	水源、水道水量水質調査	測量用地指示	給水量データ収集、環境調査		日本 パソコン
25	4 (火)	同上パナソニック着	既存施設の機能・諸元調査	既存施設の機能・諸元調査	既存施設の機能・諸元調査	給水量データ収集		図面整理
26	5 (水)		既存施設の機能・諸元調査	既存施設の機能・諸元調査	既存施設の機能・諸元調査	給水量データ収集		CAD 準備
27	6 (木)		拡張施設の諸元検討	拡張施設の諸元検討	拡張施設の諸元検討	給水量データ収集		既存施設の CAD 入力
28	7 (金)		拡張施設の諸元討議・決定	拡張施設の諸元討議・決定	拡張施設の諸元討議・決定	需要量予測		拡張施設の諸元討議・決定
29	8 (土)		資料整理	資料整理	資料整理	需要量予測		既存施設の CAD 入力
30	9 (日)	休日						
31	10 (月)		運営・維持管理調査	区域別需要量予測補助	拡張施設の諸元討議・決定	区域別需要量予測		既存施設の CAD 入力

32	11 (火)	田中団員日本発	運営・維持管理調査	区域別需要量予測補助	受変電調査	区域別需要量予測	日本 バンコック	既存施設の CAD 入力
33	12 (水)	同上バンペン着	施工調達・積算団員打合せ	施工調達・積算団員打合せ	施工調達・積算団員打合せ	社会経済(需要量予測)の報告書作成	調査計画検討	既存施設の CAD 入力
34	13 (木)		運営・維持管理調査	水源水量・水質解析	受変電、電力調査	補足資料収集	輸送・搬入・調達/積算調査	既存施設の CAD 入力
35	14 (金)		社会経済分野の検討、浄水場の規模決定	社会経済分野の検討、浄水場の規模決定	受変電、電力調査	社会経済(需要量予測)分野の検討	輸送・搬入・調達/積算調査	既存施設の CAD 終了
36	15 (土)		資料整理	社会経済団員のデータ引継ぎ	資料整理	データ等の引継ぎ	資料整理	資料整理
37	16 (日)	渡辺団員バンペン発						
38	17 (月)	同上日本着	運営・維持管理調査	浄水場計画立案	概念施設設計		輸送・搬入・調達/積算調査	拡張施設の CAD 入力
39	18 (火)		運営・維持管理調査	浄水場計画立案	概念施設設計		輸送・搬入・調達/積算調査	拡張施設の CAD 入力
40	19 (水)		運営・維持管理調査	浄水場計画立案	概念施設設計		輸送・搬入・調達/積算調査	積算補助
41	20 (木)		運営・維持管理調査まとめ	市内配水管網解析	土質・測量結果まとめ		輸送・搬入・調達/積算調査	積算補助
42	21 (金)		概念施設設計まとめ	市内配水管網解析	概念施設設計		施工方法調査	積算補助
43	22 (土)		資料整理、団内会議	資料整理、団内会議	資料整理、団内会議		資料整理、団内会議	資料整理
44	23 (日)	休日						
45	24 (月)		補足資料の収集、事業内容の確認、まとめ	補足資料の収集、事業内容の確認	補足資料の収集、事業内容の確認		施工方法調査	積算補助
46	25 (火)		まとめ、技術協力に関する検討	技術協力に関する検討	技術協力に関する検討		施工方法調査	拡張施設の CAD 入力
47	26 (水)		まとめ、相手国負担範囲の確認	裨益効果分析	相手国負担範囲の確認		相手国負担金額の積算	拡張施設の CAD 入力
48	27 (木)		まとめ、団内会議	団内会議	団内会議		団内会議	団内会議
49	28 (金)		PPWSA に調査結果報告・協議	PPWSA に調査結果報告・協議	PPWSA に調査結果報告・協議		PPWSA に調査結果報告・協議	PPWSA に調査結果報告
50	29 (土)		資料整理・報告書作成	資料整理・報告書作成	資料整理・報告書作成		資料整理	資料整理
51	30 (日)	休日						
52	31 (月)	芳賀、佐藤、丹下、田中、糠沢団員バンペン発	JICA、日本大使館へ報告	JICA、日本大使館へ報告	JICA、日本大使館へ報告		JICA、日本大使館へ報告	JICA、日本大使館へ報告
53	8/1 (火)	同上日本着	-	-	-		-	-

## 2 - 2 基本設計調査 (ドラフトレポート説明・協議)

日順	日付	団員移動内容	業務内容
1	10/1(日)	日本発バンコック着	バンコック泊
2	2(月)	バンコック発プノンペン着	大使館、JICA、PPWSA 表敬、ドラフトレポート提出
3	3(火)	プノンペン市	ドラフトレポート説明、協議
4	4(水)	同上	サイト調査、CDC 表敬、ドラフトレポート協議
5	5(木)	同上	ドラフトレポート及び M/D 内容協議
6	6(金)	同上	M/M 署名、大使館、JICA 報告
7	7(土)	官団員プノンペン発	積算資料収集
8	8(日)	コンサル団員プノンペン市	資料整理
9	9(月)	コンサル団員プノンペン発 バンコック着	積算資料収集、PPWSA 報告
10	10(火)	コンサル団員バンコック発日本着	移動

### 資料 3 関係者（面会者）リスト

#### ◆ Phnom Penh Water Supply Authority (PPWSA)

Mr. EK SONG CHAN	General Director
Mr. Long Naro	Director of Technical and Project Department
Mr. Ma Noravin	Hydraulic and design engineer, Technical and Project Dept.
Mr. Tan Bounneth	Vice Chief, Phum Prek Water Treatment Plant
Mr. Sun Sokhe	Water and Wastewater engineer
Mr. Chia Shim	Dept of Sanitation
Mr. Sim Kheng Lin	Director of Commercial Dept.
Mr. 上田 哲也	短期専門家
Ms. 小橋川 安津子	青年海外協力隊（水質管理）
Ms. Amporn Kakanlaung	Third Country JICA Expert（タイ国首都圏水道公社）

#### ◆ Municipality of Phnom Penh

Mr. Chea Sophara	Governor
Mr. Mann Chhceurn	Chief Cabinet
Mr. Tauch Lavinoran	Assistant to H.E. Sengtong、Vice Governor of Phnom Penh Municipality
Mr. Ouch Vann	Director, Waste Water Cleaning
Mr. Chhorng Vautha	Chief of planning of Section of drainage and Sewage
Dr. Chhouv Kongphally	Chief of Health Promotion, Dept. of Health
Ms. Mom Sandap	Director, Dept. of Planning
Mr. Ean Narin	Project Manager, Project Management Unit

#### ◆ Ministry of Planning

Mr. San Sy Than	Director, National Institute of Statistics
San Sy Than	Director National Institute of
Mr. Son Seng Huot	Director

#### ◆ Ministry of Post and Telecommunication

Mr. Ly Sam An	Director of International Telecom Department
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#### ◆ Ministry of Industry, Mines and Energy

Mr. Son Seng Huot	Director
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◆ Council for the Development of Cambodia

Cambodia Rehabilitation and Development Board (CDC/CRDB)

Mr. Leaph Vannden	Deputy Secretary General
Ms. Heng Sokum	Deputy Director, Bilateral Aid Coordination Dept. Japan – Asia Pacific – America
Ms. Michiko Umezaki	JICA Expert on Aid Coordination & Management

◆ Asian Development Bank (ADB)

Mr. Anthony Jude	Project Officer, Cambodia Resident Mission
Mr. Tadayuki Kanazawa	Senior Project Engineer, Water Supply, Urban Dev. and Housing Div.

◆ Parsons (チュルイチャンワール浄水場施工管理コンサルタント)

Mr. Robert Board	Resident Project Manager
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◆ 在カンボディア日本大使館

斎藤 正樹	特命全権大使
山本 栄二	参事官
川口 正樹	二等書記官
野村 寛	二等書記官

◆ JICA カンボディア事務所

松田 教男	所長
原 智佐	次長
益田 信一	所員
小泉 幸弘	所員

資料 4 当該国の社会・経済事情

2001年2月23日

カンボディア王国
Kingdom of Kampuchea

一般指標					
政体	立憲君主制	*1	首都	プノンベン (Phnom Penh)	*2
元首	国王/ノロドム・シハヌーク	*1,3	主要都市名	シアヌークビル、バタンバン、シエムレア	*3
			雇用総数	5,979千人 (1998年)	*6
独立年月日	1953年11月9日	*3,4	義務教育年数	年間 (年)	*13
主要民族/部族名	クメール人93%、中国人3%、ウエイム人3%	*1,3	初等教育就学率	113.3% (1997年)	*6
主要言語	カンボディア語 (クメール語)	*1,3	中等教育就学率	24.3% (1997年)	*6
宗教	仏教 (小乗仏教)	*1,3	成人非識字率	% (年)	*13
国連加盟年	1955年12月14日	*12	人口密度	65.14人/km2 (1998年)	*6
世銀加盟年	1970年7月	*7	人口増加率	2.9% (1980年)	*6
IMF加盟年		*7	平均寿命	平均 53.40 男 51.50 女 55.00	*6
国土面積	181.00千km2	*6	5歳児未満死亡率	143/1000 (1998年)	*6
総人口	11,498千人 (1998年)	*6	カロリー供給量	1,974.0cal/日/人 (1996年)	*10

経済指標					
通貨単位	リエル(Riel)	*3	貿易量	(1998年)	
為替レート	1 US \$ = 3,850.00 (2000年12月)	*8	商品輸出	705.4百万ドル	*15
会計年度	Dec. 31	*6	商品輸入	-1,092.2百万ドル	*15
国家予算	(年)		輸入カバー率	(月) (1997年)	*14
歳入総額		*9	主要輸出品目	木材、ゴム	*1
歳出総額		*9	主要輸入品目	金、タバコ、石油製品、車輛	*1
総合収支	16.8百万ドル (1998年)	*15	日本への輸出	百万ドル (年)	*16
ODA受取額	337.1百万ドル (1998年)	*18	日本からの輸入	百万ドル (年)	*16
国内総生産(GDP)	2,870.94百万ドル (1998年)	*6			
一人当たりGNP	260.0ドル (1998年)	*6	粗外債準備額	0.0百万ドル (1998年)	*6
GDP産業別構成	農業 50.6% (1998年)	*6	対外債務残高	2,209.7百万ドル (1998年)	*6
	鉱工業 14.8% (1998年)	*6	対外債務返済率(DSR)	1.5% (1998年)	*6
	サービス業 34.6% (1998年)	*6	インフレ率	7.0%	*6
産業別雇用	農業 男 70.8% 女 79.0% (1992年)	*6	(消費者価格物価上昇率)	(1990-98年)	
	鉱工業 5.8% 3.3% (1992年)	*6			
	サービス業 23.4% 17.8% (1992年)	*6	国家開発計画		
実質GDP成長率	5.1% (1990年)	*6			*11

気象	(年～年平均) 観測地: プノンベン (北緯11度35分、東経104度55分)												*4,5
月	1	2	3	4	5	6	7	8	9	10	11	12	平均/計
降水量	9.0	8.0	28.0	73.0	146.0	129.0	129.0	147.0	231.0	250.0	134.0	36.0	1320.0mm
平均気温	26.1	27.5	28.9	29.4	28.8	28.1	27.6	27.7	27.3	27.2	26.7	25.4	27.6℃

- \*1 各国概況 (外務省)
  - \*2 世界の国々一覧表 (外務省)
  - \*3 世界年鑑2000 (共同通信社)
  - \*4 最新世界各国要覧10訂版 (東京書籍)
  - \*5 理科年表2000 (国立天文台編)
  - \*6 World Development Indicators2000
  - \*7 The World Bank Public Information Center, International Financial Statistics Yearbook 1998
  - \*8 Universal Currency Converter
  - \*9 Government Finances Statistics Yearbook1998 (IMF)
  - \*10 Human Development Report1999(UNDP)
  - \*11 Country Profile(EIU),外務省資料等
  - \*12 United Nations Member States
  - \*13 Statistical Yearbook 1999(UNESCO)
  - \*14 Global Development Finance1999(WB)
  - \*15 International Finances Statistics 1999(IMF)
  - \*16 世界各国経済情報ファイル1999(日本貿易振興会)
- 注: 商品輸入については複式簿記の計上方式を採用しているため  
支払い額はマイナス表記になる



カンボディア王国
Kingdom of Kampuchea

項目	暦年	1995	1996	1997	1998	1999
技術協力		14.86	23.66	27.08	18.50	
無償資金協力		64.19	71.78	41.84	78.23	
有償資金協力		0.00	8.03	0.00	0.00	
総額		79.05	103.47	68.92	96.73	

項目	暦年	1995	1996	1997	1998	1999
技術協力		17.14	20.12	25.52	23.05	
無償資金協力		134.90	55.40	36.11	58.35	
有償資金協力			-4.18			
総額		152.04	71.33	61.63	81.40	

	贈与 (1) (無償資金協力・ 技術協力)	有償資金協力 (2)	政府開発援助 (ODA) (1)+(2)=(3)	その他政府資金 及び民間資金(4)	経済協力総額 (3)+(4)
二国間援助 (主要供与国)	232.9	-2.3	230.6	6.7	237.3
1. Japan	81.4	0.0	81.4	8.9	90.3
2. United States	34.7	-2.2	32.5	-1.0	31.5
3. Australia	21.9	0.0	21.9	0.0	21.9
4. France	21.4	0.0	21.4	-0.7	20.7
多国間援助 (主要援助機関)	58.0	48.5	106.5	0.0	106.5
1. EC			32.9	0.0	32.9
2. AsDB			29.3	0.0	29.3
その他					
合計	290.9	46.2	337.1	6.7	343.8

技術協力：カンボディア開発評議会 (C.D.C)
無償：カンボディア開発評議会 (C.D.C)
協力隊：カンボディア開発評議会 (C.D.C)

\*17 我が国の政府開発援助1999(国際協力推進協会)

\*18 International Development Statistics (CD-ROM) 2000 OECD

\*19 JICA資料

**Minutes of Discussions**  
**on**  
**the Basic Design Study on the Project for Expansion of**  
**Phum Prek Water Treatment Plant**  
**in**  
**The Kingdom of Cambodia**

In response to a request from the Royal Government of Cambodia, the Government of Japan decided to conduct a Basic Design Study on the Project for Expansion of Phum Prek Water Treatment Plant (hereinafter referred to as "the Project"), and entrusted the study to Japan International Cooperation Agency (hereinafter referred to as 'JICA').

JICA sent to Cambodia the Basic Design Study Team (hereinafter referred to as 'the Team'), which is headed by Ms. Keiko Yamamoto, Senior Technical Adviser, JICA, and is scheduled to stay in the country from the 19th June to the 31st July, 2000.

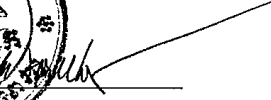
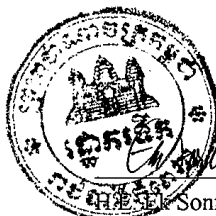
The Team held a series of discussions with the concerned officials of the Royal Government of Cambodia and conducted a field survey at the study area.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed to further work and prepare the Basic Design Study Report.

Phnom Penh, 23rd June, 2000



Ms. Keiko Yamamoto  
Leader  
Basic Design Study Team  
Japan International Cooperation Agency



Sonn Chan  
General Director  
Phnom Penh Water Supply Authority

## ATTACHMENT

### 1. Objective of the Project

The objective of the Project is to improve the health and living standard of the people in Phnom Penh City by improving the water supply condition through expansion of Phum Prek Water Treatment Plant.

### 2. Project site

The site of the Project is Phum Prek Water Treatment Plant, as shown in Annex-1.

### 3. Responsible and Implementing Organization

Responsible organization and the implementing organization is Phnom Penh Water Supply Authority (PPWSA). The organization chart is shown in Annex-2.

### 4. Items requested by PPWSA

After discussions with the Team, the items described in Annex-3 were finally requested by Cambodian side. However, both sides agreed that the final components of the Project will be determined by Japanese side after further studies in Japan.

### 5. Japan's Grant Aid Scheme

5-1. Cambodian side understood the system and characteristics of Japan's Grant Aid Scheme explained by the Team, as described in Annex-4.

5-2. Cambodian side will take necessary measures, as described in Annex-5, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

### 6. Schedule of the Study

6-1. The consultants will proceed to further studies in Cambodia until the 31<sup>st</sup> July, 2000.

6-2. JICA will prepare the draft report in English and dispatch a mission to Cambodia in order to explain its contents in or around October, 2000.

6-3. In case the contents of the report is accepted in principle by PPWSA, JICA will complete the final report and send it to PPWSA in or around January, 2001.

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7. Other relevant issues

7-1. Cambodian side promised to submit the land use permission for conveyance pipeline and the land use right for the reclaimed land for distribution water reservoir from the Municipality of Phnom Penh by 31<sup>st</sup> July, 2000.

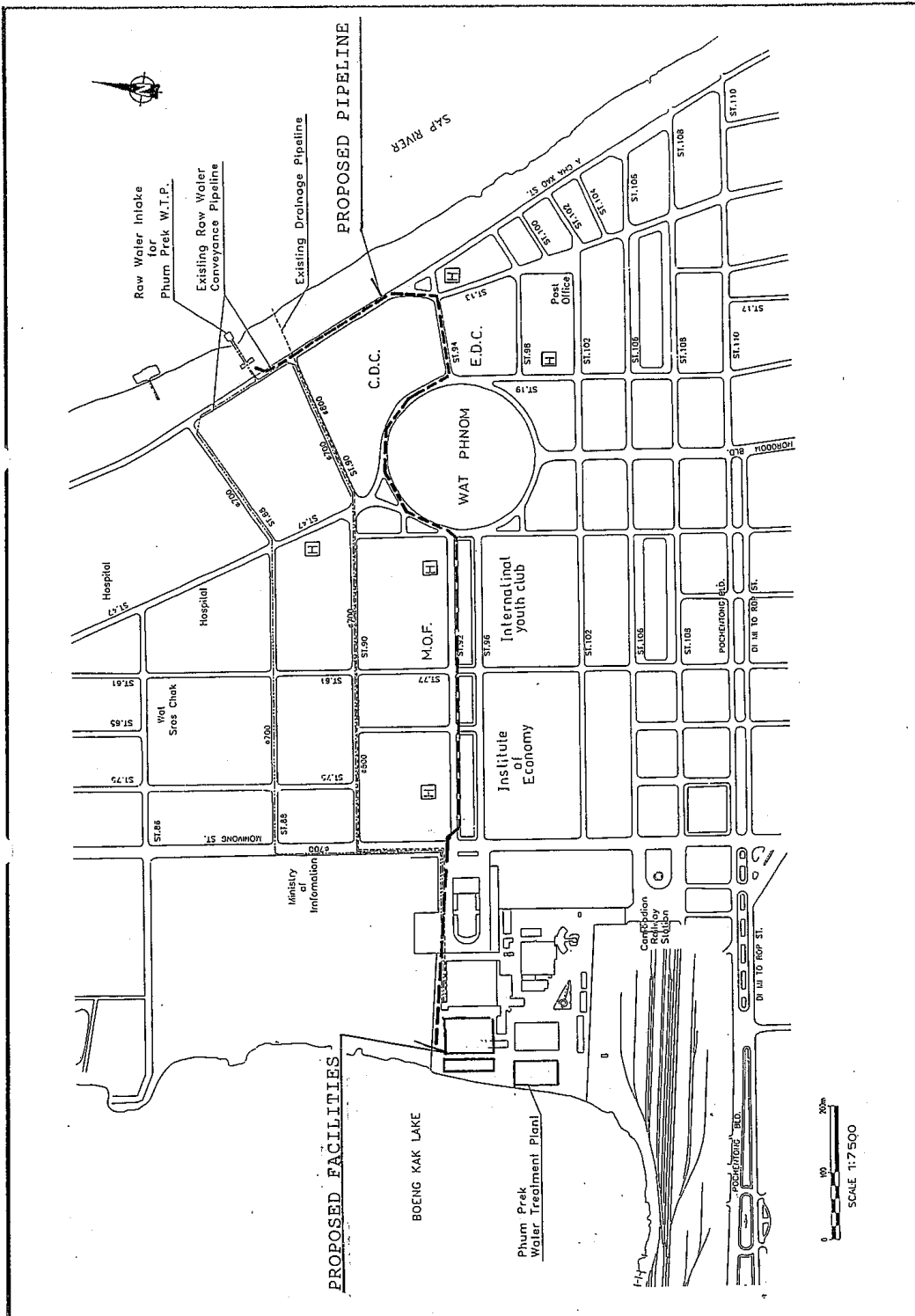
7-2. Both sides agreed to set the target year of the Project at the year 2005, and review the future water demand until the year 2015 in accordance with the action plan developed by PPWSA.

7-3. Cambodian side promised that PPWSA will allocate enough budget and staff with appropriate technical skills to ensure proper and effective operation and maintenance of the facilities and equipment provided under the Project.

7-4. With concern to the quality of water from existing treatment facility, PPWSA requested an assistance of a Japanese expert regarding the water treatment process.

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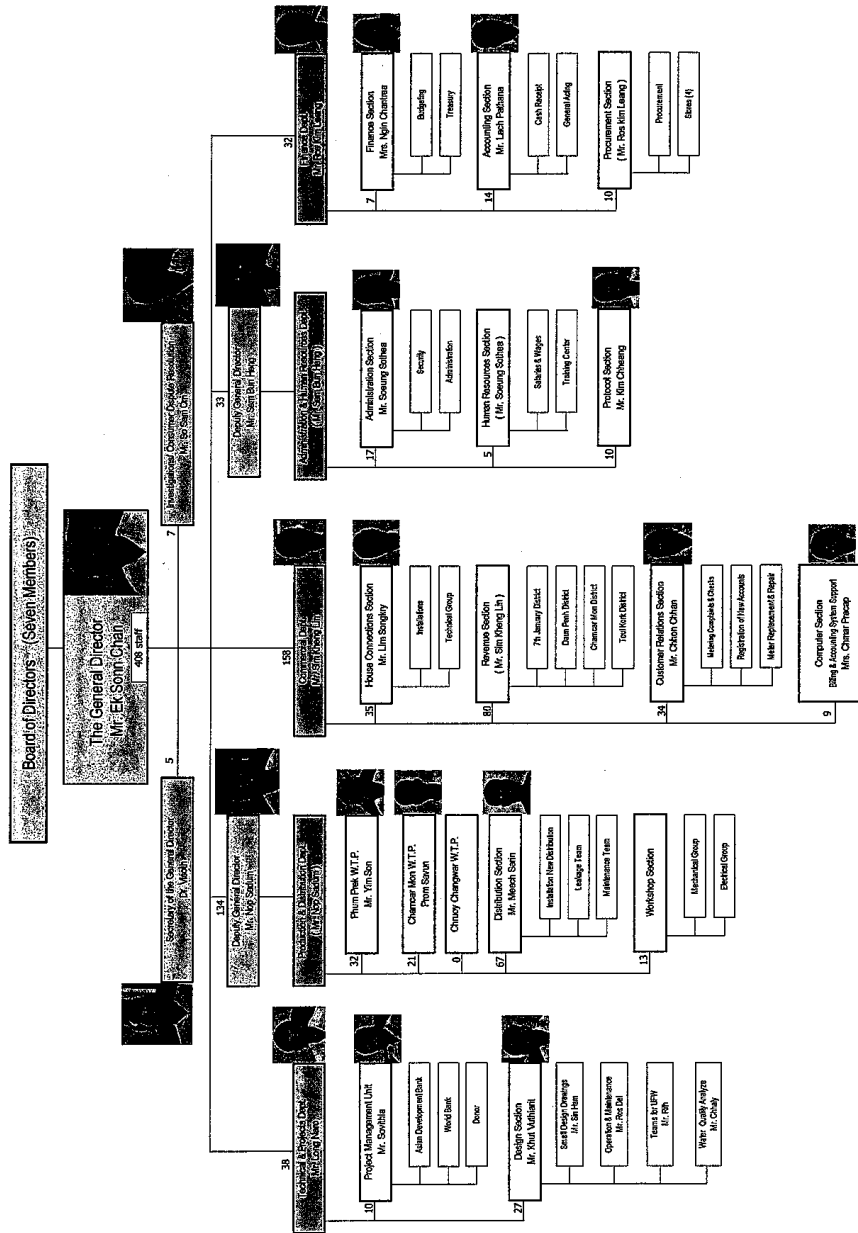
Annex-1 Site of the Project



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Organization Chart of Phnom Penh Water Supply Authority

Annex-2



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### **Annex-3 List of requested items**

#### **1. Expansion of the facilities**

- (1) Water treatment facility for 50,000m<sup>3</sup>/day
  - Receiving chamber
  - Rapid mixing chamber
  - Flocculation basin
  - Sedimentation basin
  - Rapid sand gravity filter
- (2) Chemical dosing system for 150,000m<sup>3</sup>/day
  - Chemical house including storage and laboratory with necessary equipment
  - Chemical dosing facilities
- (3) Distribution water reservoir for 10,000m<sup>3</sup>/day
- (4) Distribution pump (1 unit)
- (5) Conveyance pipeline of dia. 1200mm \* 1.5km
- (6) Raw water intake pumps (2 units)
- (7) Electrical instruments

#### **2. Rehabilitation of the existing facilities**

- (1) Distribution pumps (3 units)
- (2) Raw water intake pumps (3 units)

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## Annex-4 Japan's Grant Aid Scheme

### 1. Grant Aid Procedures

- a. Japan's Grant Aid Program is executed through the following procedures.
- Application (A request made by the recipient country)
  - Study (Basic Design Study conducted by JICA)
  - Appraisal & Approval (Appraisal by the Government of Japan and Approval by the Cabinet of Japan)
  - Determination of Implementation (Exchange of Notes between the Governments of Japan and the recipient country)

b. Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study) using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study Report prepared by JICA, and the results are then submitted to the Cabinet for an approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and recipient country.

Finally, for the implementation of the project, JICA will assist the recipient country in such matters as preparing tenders, contract and so on.

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## 2. Basic Design Study

### a. Contents of the study

The aim of the Basic Design Study (hereafter referred to as "the Study") conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows :

- a) Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- d) Preparation of a basic design of the Project.
- e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whether measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

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b. Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA select (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consultant firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

a. Grant Aid

The Grant Aid Scheme provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

b. Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

c. Period

"The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.

However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual

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agreement between the two Governments.

d. Purchase of the Products and or Services

Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, consulting, constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

e. Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

f. Undertakings required of the Government of the Recipient Country  
(As described in ANNEX 5)

g. Proper Use

The recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

h. Re-export

The products purchased under the Grant Aid should not be re-exported from the recipient country.

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i. Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

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## **Annex-5 Necessary Measures to be taken by the Cambodian side**

The following necessary measures should be taken by the Cambodian side on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.
2. To secure and provide cleared and leveled land for the Project and secure the authority to build facilities prior to the commencement of the construction, especially the land for a new distribution water reservoir.
3. To remove existing facilities such as the existing chemical storage.
4. To use and maintain properly and effectively all the equipment purchased and facilities constructed under the Grant.
5. To bear commissions to the Japanese bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
6. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid.
7. To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Cambodia with respect to the supply of the products and services under the verified contracts.
8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their work in accordance with the relevant laws and regulations of Cambodia.
9. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
10. To bear all the expenses, other than those to be borne by the Japan's Grant Aid within the scope of the Project.

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**Minutes of Discussions  
of  
Basic Design Study on the Project for Expansion of Phum Prek Water  
Treatment Plant  
in  
The Kingdom of Cambodia  
(Explanation on Draft Report)**


In June 2000, the Japan International Cooperation Agency (hereinafter referred to as JICA) dispatched a Basic Design Study Team on the Project for Expansion of Phum Prek Water Treatment Plant (hereinafter referred to as the Project), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the Study.

In order to explain and consult with the concerned officials of the Royal Government of Cambodia on the components of the draft report, JICA sent to Cambodia the Draft Report Explanation Team (hereinafter referred to as 'the Team'), headed by Ms. Keiko Yamamoto, Senior Technical Adviser, JICA, from 2nd October to 9th October, 2000.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Phnom Penh, 6th October, 2000

  
\_\_\_\_\_  
Ms. Keiko Yamamoto  
Leader  
Draft Report Explanation Team  
Japan International Cooperation Agency

  
  
\_\_\_\_\_  
H.E. Soan Chan  
General Director  
Phnom Penh Water Supply Authority

## ATTACHMENT

### 1. Components of the Draft Basic Design Report

The Cambodian side agreed and accepted in principle the components of the draft report explained by the Team.

### 2. Japan's Grant Aid System

The Cambodian side understood the Japan's Grant Aid System as explained by the Team and described in Annex-4 of the Minutes of Discussions signed by both parties on 23<sup>rd</sup> June, 2000.

### 3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Cambodian side in or around January 2001.

### 4. Other Relevant Issues

4-1 Both sides agreed that PPWSA will take necessary measures described in the draft report for smooth implementation of the Project. PPWSA promised to complete the following undertakings by the end of August 2001, prior to the commencement of the construction.

- Acquisition of necessary permissions for expansion of water treatment plant.
- Provision of construction site for air vessels and expanded water treatment facilities.
- Removal of pipe materials located at the construction site for the new reservoir.
- Removal the existing chemical storage located at the construction site for the new water treatment plant.
- Leveling the land for the construction of water treatment plant and reservoir.

4-2 Both sides agreed that PPWSA will secure enough budget for the above mentioned necessary undertakings.

4-3 Both sides agreed that PPWSA will take necessary measures such as utilization of other water treatment plants and explanation to the local community to minimize the influence of the reduction or cut-off of water supply during the construction.

4-4 Both sides agreed that PPWSA will ensure a good coordination with the Project during its construction stage to secure the daily operation of the water treatment plant and smooth implementation of the construction.

4-5 Both sides reconfirmed that PPWSA will allocate enough budget and staff with appropriate technical skills to ensure proper and effective operation and maintenance of the facilities and equipment provided under the Project.

4-6 Both sides agreed that PPWSA will continue to endeavor in strengthening the water quality control, extending the distribution pipeline, educating the local community and improving the water charge collection in order to maximize the effect of the Project.

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資料 6 参考資料・入手資料リスト

番号	分野	資料名	発行年月	サイズ	複製・北	入手先又発行先	備考
M1	土地利用図	PHNOM PENH EDITION 1-TRC SHEET 5932 II		A1	Copy		土地利用図
M2	配水管網	PHNOM PENH DISTRIBUTION NEWROK	7/2000	A1	Copy	PPWSA Technical and Project Department	
M3	配水管網図	7th JANUARY DISTRICT, PILOT ZONE	6/3/2000	A3	Copy	PPWSA Technical and Project Department	
M4	配水管網図	DISTRIBUTION – DAUN PENH DISTRICT	22/1/2000	A3	Copy	PPWSA Technical and Project Department	
M5	配水管網図	CHAM CAR MORN DISTRIBUTION NEWROK	7/1999	A3	Copy	PPWSA Technical and Project Department	
M6	配水管網図	PHNOM PENH DISTRIBUTION NEWROK	7/1999	A3	Copy	PPWSA Technical and Project Department	
M7	消火栓配置図	ブノンベン市街地域消火栓配置図		A3	Copy		
M8	配管図	配管図		A1	Original		
M9	下水管網図	ブノンベン市街地域下水管網図		A1	Copy	PPWSA, Section of Drainage & Sanitation	クメール語
M10	下水管網図	ブノンベン市街地域下水管網図		A1	Copy	PPWSA Section of Drainage & Sanitation	クメール語
M11	国政図 市政図	Cambodia Country Maps,Cambodia & Phnom Penh Area Maps Cambodia 1:1,100,000 Angkor Temples 1:95,000 City Plans,Phnom Penh 1:17,000		B2	Original	Peripulus Travel Maps Periplus Editions [HK] Ltd.	
M12	都市計画図	Ville de Phnom Penh Royaume du Cambodge Etude du patrimoine urbain Edifices et sites a proteger dans le Khan Daun Penh	12/1996	A3 14枚	Copy	Bureau des affaires urbaines de Phnom Penh Atelier parisien d'urbanisme	地域都市計画図
M13	給水区域図	PHNOM PENH PROVINCE LOCATION OF DISTRICTS AND SUB-DISTRICTS	7/3/2000	A3	Original	PPWSA Technical and Project Department	
M14	CD-ROM & USER'S GUIDE	PopMap for Windows Integrated Software Package for Geographical Information, Maps and Graphics Database	1998	A4	Original	United Nations (User's Guide)	CD-ROM 付
W1	ポンプの作動マニュアル	OPERATING INSTRUCTIONS TUBULAR CASING PUMP SNW WITH MIXED-FLOW IMPELLER	1988	A4	Copy	KSB Pumps Ltd	
W2	上水道施設維持管理	総合報告書	2/3/2000	A4	Copy	JICA 植野健治	
W3	上水道施設維持管理	総合報告書	20/10/1999	A4	Copy	JICA 久保田和也	
W4	上水道施設維持管理	Special Presentation on Evaluation of Operation Performance at Phum Prek Water Treatment Plant, Phnom Penh Water Supply Authority, The Royal Kingdom of Cambodia	23/4/1999	A4	Copy	JICA Termsak Chotwanwirach (JICA Third Country Expert)	
W5	浄水場データ	浄水場操業データ	7/2000	A4	Copy	PPWSA	クメール語
W6	漏水防止・配水コントロール	WATER LOSS REDUCTION AND DISTRIBUTION CONTROL PROGRAMME 1999-2000 Quarterly Report VOLUME 1 JANUARY TO MARCH 2000	2000	A4	Copy	Phnom Penh water Supply Authority	Mr. Rick Kamionko
W7	漏水防止	WATER LOSS SEMINAR Organized by Phnom Penh water Supply Authority (PPWSA) on 16 <sup>th</sup> January 1998	1998	A4	Copy	Phnom Penh water Supply Authority	
W8	Country Report	COUNTRY REPORT of PHNOM PENH WATER SUPPLY AUTHORITY OF KINGDOM CAMBODIA	1999	A4	Copy	Phnom Penh water Supply Authority	Mr. Ma
W9	Country Report	Country Report Presented before a Seminar on Water Supply Management 24-28	2000	A4	Copy	H.E.EK Sonn Chan General Director Phnom Penh Water Supply	



		January 2000 Tokyo, Japan				Authority (PPWSA)	
W10	Answers to Questionnaires	PREPARATION OF ANSWERS TO THE QUESTIONNAIRES OF THE BOARD OF AUDIT MISSION	5/2000	A4	Original	Phnom Penh water Supply Authority	
W11	Progress Report	QUARTERLY PROJECT REPORT JANUARY TO MARCH 2000	4/2000	A4	Copy	Phnom Penh water Supply Authority PROJECT MANAGEMENT UNIT	ADB FUNDED PROJECT
W12	Monthly Report	The Rehabilitation and Extension of Chruoy Chang War Water Treatment Plant	4/2000	A4	Copy	Phnom Penh water Supply Authority	WB Funded Project
W13	Bidding Documents	BIDDING DOCUMENTS SUPPLY, DELIVERY AND INSTALLATION OF WATER TRANSMISSION PIPELINES IN THE CITY OF PHNOM PENH Part 1 of 3	15/2/2000	A4	Original	Phnom Penh water Supply Authority	ADB FUNDED PROJECT
W14	Monthly Progress Report	THE REHABILITATION AND EXTENSION OF THE CHRUOY CHANG WAR WATER TREATMENT PLANT	18/4/2000	A4	Copy	Phnom Penh water Supply Authority	World Bank Funded Project
W15	水質	WORK PLAN OF JICA THIRD COUNTRY EXPERT (JICA TCE)	2000	A4	Copy	JICA Third Country Expert Ms. AMPORN KANKANLAUNG	
W16		HISTORY and FIVE YEARS DEVELOPMENT PLAN 1997-2001 OF PHNOM PENH WATER SUPPLY AUTHORITY	12/1996	A4	Original	Phnom Penh Water Supply Authority	
W17	Request for Proposals	AGENCE FRANCAISE SUBURB WATER SUPPLY SYSTEM REQUEST FOR PROPOSALS FOR SELECTION OF CONSULTANT SERVICES FOR FEASIBILITY STUDY AND PRELIMINARY DESIGN	6/2000	A4	Original	Phnom Penh water Supply Authority PROJECT MANAGEMENT UNIT	
W18	FINAL REPORT	URBAN WATER SUPPLY AND SANITATION PROJECT PHNOM PENH VOLUME 2 PRESENT SITUATION AND DEVELOPMENT FOR THE FUTURE FINAL REPORT	6/1996	A4	Original	ASIAN DEVELOPMENT BANK TECHNICAL ASSISTANCE CAMBODIA	ADB REPORT
W19	FINAL REPORT	URBAN WATER SUPPLY AND SANITATION PROJECT PHNOM PENH VOLUME 3 PRESENT SITUATION AND DEVELOPMENT FOR THE FUTURE FINAL REPORT	6/1996	A4	Original	ASIAN DEVELOPMENT BANK TECHNICAL ASSISTANCE CAMBODIA	ADB REPORT
W20	FINAL REPORT	URBAN WATER SUPPLY AND SANITATION PROJECT PHNOM PENH VOLUME 4 PROJECT PREPARATION FINAL REPORT	6/1996	A4	Original	ASIAN DEVELOPMENT BANK TECHNICAL ASSISTANCE CAMBODIA	ADB REPORT
W21	FINAL REPORT	URBAN WATER SUPPLY AND SANITATION PROJECT PHNOM PENH VOLUME 5 PROJECT PREPARATION ANNEXES FINAL REPORT	6/1996	A4	Original	ASIAN DEVELOPMENT BANK TECHNICAL ASSISTANCE CAMBODIA	ADB REPORT
W22	セクター概要	Resume for Presentation	23/5/2000	A4	Copy	Phnom Penh Water Supply Authority	プレゼン資料
W23	報告書	第3号(赴任12ヵ月目)報告書	10/12/1999	A4	Copy	青年海外協力隊隊員 小橋川安津子	
W24	浄水場水質資料	Water Quality Analysis (Physical & Chemical Test)	1998 ~ 2000	A4	Copy	PPWSA 小橋川安津子	浄水場データ
W25	浄水場水質管理	隊員活動報告書(抜粋)	2000	A4	Copy	青年海外協力隊隊員 小橋川安津子	
W26	水質	WHO Guideline for Drinking water quality	1993	A4	Copy	PPWSA 小橋川安津子	
W27	水質(浄水場)	Raw water Quality に関する表	2000	A4	Copy	Ms. Amporn (JICA Third Country Expert)	クメール語
W28	水質	Water Quality Analysis Physical & Chemical Test プンブレイク浄水場の水質基準	2000	A4	Copy	Mr. Tan, 小橋川安津子	クメール語
W29	ポンプ	(Phum Prek Raw Water Pump & Rising Main に関する資料)	2000	A4	Copy	(John Dymke (Brisbane City Enterprises) & Peter Cooper (ACTEW Corporation))	
W30	施設仕様書 O & M	薬品注入施設の機器の仕様書&維持管理マニュアル		A6	Copy	Mr. Tan	カードのコピー
W31	浄水場施設仕様のリスト	Municipalite De Phnom-Penh Installation De Traitement Des Eaux Schema De Fonctionnement	1964	A3	Copy	Mr. Long Naro	図面から抜粋

W32	施設の仕様リスト	PartIII: Study of Problems caused by algae in PPWSA 2.1 Introduction The existing Phum Prek Water Treatment Facilities	2000	A4	Copy	Ms. Anporn (JICA Third Country Expert)WORK PLAN より	
W33	浄水場維持管理記録 OM	Weekly Data Report	2000	A4	Copy	Mr. Tan 作成	クメール語
W34	浄水場維持管理記録 OM	Daily Data Report	2000	A4	Copy	Mr. Tan 作成	クメール語
W35	Questionnaire	PRESENT SITUATION OF THE PHNOM PENH WATER SUPPLY AND MANAGEMENT	1999 ~ 2000	A4	Copy	Questionnaire に対する回答	
W36	Study	Cambodia: Twinning Arrangement with Phnom Penh Water Supply Authority Project (PPWSA) Module 3 Energy Audit & Energy Management Plant	3/1999	A4	Copy	PPWSA, Actew Corporation	
W37	Design Drawings	Phnom Penh Water Supply Project Construction of Transmission Lines & Appurtenances	3/1998	A3	Copy	PPWSA, Safage Consulting Engineer	
W38	Expert report	Evaluation Report: JICA Expert on O & M of water treatment plant	3/2000	A4	Copy	JICA Expert Mr. Kenji Ueno	
W39	Water Quality	Report on Lime Dosing	5/2000	A4	Copy	Laboratory in PPWSA	
W40	Water Quality	Report on Evaluation of Operation at Phum Prek Water Treatment Plant	4/1999	A4	Copy	PPWSA, JICA Third Country Expert	
W41	Plan	Business Plan 2000-2002	4/2000	A4	Copy	PPWSA	
W42	Study	Water Pressure Measurement in the City		A4	Copy	PPWSA	
W43	Plan	Investment Programme for PPWSA from 1993 - 2004	7/2000	A4	Copy	PPWSA	
W44	Plan	PPWSA Presentation during the Mission of Board of Audit of Japan (OHP presentation)	5/2000	A4	Copy	PPWSA	
W45	Summary	Improvement in the State of PPWSA from 1993 to 1998		A4	Copy	PPWSA	
W46	Summary	Answering the Question of the Japanese Evaluation Mission	12/1999	A4	Copy	PPWSA	
W47	Policy	Cambodia Urban Water Supply Policy and Institutional Framework	4/1999	A4	Copy	PPWSA	
W48	Policy	Staff and Regulations of Phnom Penh Water Supply, Amendments - Internal Rules and Infrastructure	10/9/1997	A4	Copy	PPWSA	
W49	Plan	The Study on Phnom Penh Water Supply System: Final Report Vol 2: Main Report	11/1993	A4	Copy	JICA	
W50	Plan	The Study on Phnom Penh Water Supply System: Final Report Vol 4: Appendices	11/1993	A4	Copy	JICA	
W51		Phnom Penh Water Supply Authority Monitoring Ratio (Performance Indicators Technical & commercial sectors)	5/7/2000	A4	Copy	PPWSA	
W52		INCOME STATEMENT PLAN					
W53	流量・水位・水質	(Monthly Data of Water Quantity, Quality & Level of Tonle Sap & Mekong Rivers	2000	A4	Copy	Ministry of Water Resource & Meteorology	
S1	経済	ECONOMIC DEVELOPMENT OF CAMBODIA IN THE ASEAN CONTEXT Policies and Strategies	7/1998	A5	Original	Cambodian Institute for Cooperation and Peace (CICP)	
S2	経済	Socio Economic Survey of Cambodia 1996 VOLUME 1 Summary Results	7/1997	A4	Original	Ministry of Planning National Institute of Statistics	
S3	経済	Socio Economic Survey of Cambodia 1996 VOLUME II Summary Results	7/1997	A4	Original	Ministry of Planning National Institute of Statistics	
S4	経済	CAMOBODIA BUSINESS & INVESTMENT HANDBOOK 1997-1998	1998	A4	Original	The Ministry of Commerce	
S5	経済	NATIONAL ACCOUNTS OF CAMBODIA 1993-1998	5/1999	A5	Original	Ministry of Planning National Institute of Statistics	
S6	雇用	LABOR FORCE SURVEY OF PHNOM PENH Second Quarter 1998	3/1999	A5	Original	Ministry of Planning National Institute of Statistics	
S7	経済	Report on the Cambodia Socio-Economic Survey 1999	5/2000	A4	Original	National Institute of Statistics Ministry of Planning Phnom Penh,	

S8	経済	Cambodia Socio-Economic Survey 1999 Technical Report on Survey Design and Implementation	5/2000	A4	Original	National Institute of Statistics Ministry of Planning Phnom Penh, Cambodia	
S9	開発	CAMBODIA DEVELOPMENT REVIEW VOLUME 4, ISSUE 1 MARCH-MAY 2000	3/2000	A4	Original	Cambodia Development Resource Institute	
S10	人口統計	General Population Census of Cambodia 1998 Provisional Population Totals	7/1998	A4	Original	National Institute of Statistics, Ministry of Planning	
S11	人口統計	General Population Census of Cambodia 1998 Final Census Results	7/1999	A4	Original	National Institute of Statistics, Ministry of Planning	
S12	社会経済	FIRST FIVE YEAR SOCIOECONOMIC DEVELOPMENT PLAN 1996-2000	1/1997	A4	Original	The Royal Government of Cambodia	
S13	社会経済	SOCIO-ECONOMIC DEVELOPMENT REQUIREMENTS AND PROPOSALS	4/2000	A4	Original	Royal Government of Cambodia	
S14	開発	DEVELOPMENT COOPERATION REPORT (1999/2000) Main Report	5/2000	A4	Original	Council for the Development of Cambodia Cambodian Rehabilitation and Development Board	
S15	経済	Macro-Economic Management 1994-2002 - Overcoming Constraints, Addressing Challenges -	5/4/2000	A4	Original	Ministry of Economy and Finance	
S16	開発	Cambodia Human Development Report 1999 Village Economy and Development	10/1999	A4	Original	Ministry of Planning (Prepared with Funding from UNDP and NORAD)	
S17	財政	National Accounts of Cambodia 1996-1999 Bulletin No.4	5/2000	A4	Copy	Ministry of Planning National Institute of Statistics	Sponsored by ADB
S18		Aide Memorie of ADB Review Mission	29/6/2000	A4	Copy	ADB Agriculture and Social Sectors Department	
S19	計画	THE FIRST FIVE=YEAR PLAN (1996-2000) AND THE SECOND FIVE=YEAR PLAN (2001-2005) OF INDUSTRY, MINES AND ENERGY WORKS IN THE PHNOM PENH CITY	2000	A4	Copy	Phnom Penh City Industry, Mines and Energy Department	5ヶ年計画
S20	計画	THE FIRST FIVE=YEAR PLAN (1996-2000) AND THE SECOND FIVE=YEAR PLAN (2001-2005) OF INDUSTRY, MINES AND ENERGY WORKS IN THE PHNOM PENH CITY	2000	A4	Copy	Phnom Penh City Industry, Mines and Energy Department	クメール語 原本 5ヶ年計画
S21	経済	(List of Investment Factories)	1/2000	A4	Copy	Phnom Penh City Industry, Mines and Energy Department	クメール語
S22	人口統計	(2000年の都市人口)	2000	A4	Copy	Ministry of Planning	クメール語
S23	人口統計	General Population Census of Cambodia 1998 Analysis of Census Results Report 1 Fertility and Mortality	12/1999	A4	Original	National Institute of Statistics, Ministry of Planning	
S24	人口統計	General Population Census of Cambodia 1998 Analysis of Census Results Report 2 Nuptiality	12/1999	A4	Original	National Institute of Statistics, Ministry of Planning	
S25	開発	Working Paper 14 Cambodia: Enhancing Governance for Sustainable Development	5/2000	A4	Original	CAMBODIA DEVELOPMENT RESOURCE INSTITUTE	
S26	経済	Working Paper 13 Seasonality in the Cambodian Consumer Price Index	1/2000	A4	Original	CAMBODIA DEVELOPMENT RESOURCE INSTITUTE	
S27	経済	Working Paper 5 Cambodia: Enhancing Governance for Sustainable Development	9/1998	A4	Original	CAMBODIA DEVELOPMENT RESOURCE INSTITUTE	
S28	経済	A GUIDE TO INVESTING IN CAMBODIA	2000	A4	Original	COUNCIL FOR THE DEVELOPMENT OF CAMBODIA CAMBODIAN INVESTMENT BOARD	
E1	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH SECTOR F: SOCIOECONOMY	8/1999	A4	Copy	JICA	CTI&NK Report
E2	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH SECTOR E: ORGANIZATION AND INSTITUTION	8/1999	A4	Copy	JICA	CTI & NK Report

E3	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH (Tables and Figures)	8/1999	A4	Copy	JICA	抜粋
E4	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH SECTOR G: Environment	8/1999	A4	Copy	JICA	CTI & NK Report
E5	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH VOLUME 3 SUPPORTING REPORT	8/1999	A4	Copy	JICA	CTI & NK Report
E6	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH VOLUME 2 MAINREPORT	8/1999	A4	Copy	JICA	CTI & NK Report
E7	下水	THE STUDY ON DRAINAGE IMPROVEMENT AND FLOOD CONTROL IN THE MUNICIPALITY OF PHNOM PENH VOLUME 4 DATA BOOK	8/1999	A4	Copy	JICA	CTI & NK Report
E8	自然	1.4 Algae Examination in Tonle Sap River (2 Page)	2000	A4	Copy	Ms. Anporn (JICA Third Country Expert)WORK PLAN から	
E9	自然	Wind Velocity, Temperature, Rainfall, Evaporation, Humidity, Water Level, etc	1999・2000	A4	Copy	Ministry of Water Resource and Meteorology	
E10	下水	カンボジア国全国下水道・都市排水整備計画 (A5 2 Page)	1999	A5	Copy	IDI プロジェクト形成調査	IDI 建設計画事前調査
E11	廃棄物	SUB DECREE on SOLID WASTE MANAGEMENT	27/8/1999	A4	Copy	ROYAL GOVERNMENT Council of Ministers	Un-official Translation
E12	汚水処理	SUB DECREE on WATER POLLUTION CONTROL	6/8/1999	A4	Copy	ROYAL GOVERNMENT Council of Ministers	
E13	環境影響評価	SUB DECREE on ENVIRONMENTAL IMPACT ASSESSMENT PROCESS	11/8/1999	A4	Copy	ROYAL GOVERNMENT Council of Ministers	
E14	環境保護及び天然資源管理の法規	LAW ON ENVIRONMENTAL PROTECTION AND NATURAL RESOURCE MANAGEMENT	28/11/1998	A4	Copy	The Compendium of Cambodia Laws. Volume 2	
E15	衛生 下水	Strategic Sanitation Plan for Phnom Penh	8/1999	A4	Copy	Cambodia, Ministry of Industry, Mines and Energy	Second Draft
E16	環境	KINGDOM OF CAMBODIA NATIONAL ENVIRONMENTAL ACTION PLAN 1998-2002	1/1998	A4	Copy	Ministry of Environment	
E17	Policy	Cambodia National Policy on Urban Sanitation	9/1999	A4	Copy	PPWSA	
C1	Piling	Pile Plan & Piling Sequence Treated Water Reservoir The Rehabilitation & Extension of Chruoy Chang War Water Treatment Plant	16/12/1999年	A4	Copy	China International Water & electric Corp. (CWE)	
O1		Report on ground investigation	2/7/2000	A4	Original	Research and Design Enterprise	

## 資料 7 付属資料

資料 7 - 1 PPWSA の投資計画 (1993 年～2004 年)

Investment Program for PPWSA from 1993-2004

Name of project	term of project	Name of facility or district	budget		name of donor	kind of cooperation
			total	Cambodia input %		
Improvement of Distribution Network	1992-1993	Replacement of Water Distribution System in Sras Chak Sub-district, Don Penh District	\$ 1,630,000.00	10	French Protocol	Grant Aid
Improvement of Water Supply Facilities in Phnom Penh	1993-1994	Rehabilitation of Filter System in Phum Prek Water Treatment Plant	\$ 3,260,000.00	0	French Protocol	Grant Aid
Technical Assistance for the Rehabilitation of Water Utilities of Phnom Penh and Sihanoukville	1993-1995	Strengthen the Managerial and Operational Capacities of the Water Utilities of the cities of Phnom Penh and Sihanoukville by Expert	\$ 4,110,900.00	0	UNDP/ World Bank	Grant Aid
Improvement of Water Supply Facilities in Phnom Penh	1995-1996	Extension of 10,000m <sup>3</sup> /day in Chamcar Morn Water Treatment Plant	\$ 5,300,000.00	0	French Protocol	Grant Aid
Improvement of Distribution Network	1995-1996	Replacement of Water Distribution System in Don Penh District	\$ 4,906,650.00	10	World Bank and French Protocol	Loan and Grant Aid
Improvement of Water Supply Facilities in Phnom Penh	1996-1997	Rehabilitation of Existing Chamcar Morn Water Treatment Plant 10,000 m <sup>3</sup> /day	\$ 1,705,000.00	30	French Protocol	Grant Aid
Phnom Penh Water Supply and Drainage Project. Part A- Water Supply ADB Loan No.1468-CAM(SF)	1997-1999	Replacement of Water Distribution System in Chamcar Morn District	\$ 2,269,800.00	20	Asian Development Bank	Loan
Phnom Penh Water Supply and Drainage Project. Part A- Water Supply ADB Loan No.1468-CAM(SF)	1997-1999	Supply of Institutional Supporting Equipment (Vehicles and Machinery for Pipelaying Teams)& Office Equipment (Computer, Printer and etc.)	\$ 442,415.00	0	Asian Development Bank	Loan

Phnom Penh Water Supply and Drainage Project, Part A- Water Supply ADB Loan No.1468-CAM(SF)	1997-2001	Design and Supervision of Water Transmission Pipeline in the City of Phnom Penh (600 mm to 1600 mm, 15 Km)	\$ 1,065,951.00	30	70	Asian Development Bank	Loan
Phnom Penh Water Supply and Drainage Project, Part A- Water Supply ADB Loan No.1468-CAM(SF)	1999-2001	Supply, Delivery and Installation of Water Transmission Pipelines in the City of Phnom Penh (600 mm to 1600 mm, 15 Km)	\$12,200,000.00	15	85	Asian Development Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2001	Replacement of Water Distribution System in Toul Kork District	\$ 2,819,925.00	26	74	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2001	Construction Supervision Consultant for the Rehabilitation and Extension of Chruoy Chang War Water Treatment Plant	\$ 1,179,730.00	0	100	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2001	Rehabilitation and Extension of the Chtuoy Chang War Water Treatment Plant 65 000 m3/day	\$11,100,000.00	10	90	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2002	Technical Assistance to Improve of Operational ( Water Loss Control Expert, Training Expert) and Financial (Accounting Software Expert) Performance	\$ 1,064,900.00	0	100	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2002	Supply of Leakage Detection, Training Equipment, Computer for Accounting System Equipment	\$ 626,400.00	0	100	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2002	Pilot Program for financing domestic connections to the poor family as revolving Fund	\$ 260,000.00	0	100	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	1998-2002	Training to the PPWSA	\$ 380,000.00	0	100	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	2000-2001	Replacement of Additional Distribution System in Phnom Penh City	\$ 1,300,000.00	25	75	World Bank	Loan
Cambodia Urban Water Supply Project, IDA Credit No. 3041 KH	2001-2003	Extension of Distribution System to Suburban Area	\$ 4,700,000.00	25	75	World Bank	Loan

出所 : PPWSA

資料 7-2 人口及び需要水量予測結果

Scenario	1992	1994	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Density in 2015 (per/ha)	Average annual growth rate		
																						Population	Land Area (10 <sup>4</sup> ha)
<b>Scenario A</b>																							
Don Peith	105,897	118,344	118,501	120,121	121,712	123,272	124,799	126,294	127,764	129,219	130,670	132,118	133,565	135,013	136,461	137,910	139,358	140,808	142,260	144,330	150	1.16	
7 January	67,840	97,238	92,771	96,507	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	1.46	
Chamcar Mom	111,301	123,209	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	288	3.32	
Touk Kork	56,022	105,295	141,838	177,372	186,478	193,204	199,203	204,717	210,134	215,456	220,781	226,107	231,432	236,757	242,082	247,407	252,732	258,057	263,382	268,707	274,032	404	5.87
Ruseay Koo	120,108	132,959	148,515	163,071	177,627	192,183	206,739	221,295	235,851	250,407	264,963	279,519	294,075	308,631	323,187	337,743	352,299	366,855	381,411	395,967	410,523	58	7.45
Dang Kor	63,381	70,162	92,998	68,000	7,29	12,67	8	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	38	7.45
Total PHNOM PENH	37,377	107,195	159,589	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	187	10.13
Central Districts (Urban)	402,070	446,086	516,625	423,375	267	180	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	321	3.47
Suburbs	280,886	310,914	421,892	6,98	7,68	256,7	493,956	530,277	566,546	602,869	639,200	675,531	711,862	748,193	784,524	820,855	857,186	893,517	929,848	966,179	1,002,510	65	6.45
<b>Scenario B: Adopted</b>																							
Don Peith	105,897	118,344	118,501	120,121	121,712	123,272	124,799	126,294	127,764	129,219	130,670	132,118	133,565	135,013	136,461	137,910	139,358	140,808	142,260	144,330	150	1.05	
7 January	67,840	97,238	92,771	96,507	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	467	1
Chamcar Mom	111,301	123,209	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	311	3.58	
Touk Kork	56,022	105,295	141,838	177,372	186,478	193,204	199,203	204,717	210,134	215,456	220,781	226,107	231,432	236,757	242,082	247,407	252,732	258,057	263,382	268,707	274,032	580	4.99
Ruseay Koo	120,108	132,959	148,515	163,071	177,627	192,183	206,739	221,295	235,851	250,407	264,963	279,519	294,075	308,631	323,187	337,743	352,299	366,855	381,411	395,967	410,523	44	5.74
Dang Kor	63,381	70,162	92,998	68,000	7,29	12,67	8	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	144	8.47
Total PHNOM PENH	37,377	107,195	159,589	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	177	5.15
Central Districts (Urban)	402,070	446,086	516,625	423,375	267	180	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	304	3.13
Suburbs	280,886	310,914	421,892	6,98	7,68	256,7	493,956	530,277	566,546	602,869	639,200	675,531	711,862	748,193	784,524	820,855	857,186	893,517	929,848	966,179	1,002,510	52	7
<b>Scenario C</b>																							
Don Peith	105,897	118,344	118,501	120,121	121,712	123,272	124,799	126,294	127,764	129,219	130,670	132,118	133,565	135,013	136,461	137,910	139,358	140,808	142,260	144,330	150	0.94	
7 January	67,840	97,238	92,771	96,507	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	96,506	429	0.49
Chamcar Mom	111,301	123,209	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	122,555	324	3.89	
Touk Kork	56,022	105,295	141,838	177,372	186,478	193,204	199,203	204,717	210,134	215,456	220,781	226,107	231,432	236,757	242,082	247,407	252,732	258,057	263,382	268,707	274,032	34	4.12
Ruseay Koo	120,108	132,959	148,515	163,071	177,627	192,183	206,739	221,295	235,851	250,407	264,963	279,519	294,075	308,631	323,187	337,743	352,299	366,855	381,411	395,967	410,523	64	6.25
Dang Kor	63,381	70,162	92,998	68,000	7,29	12,67	8	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	92,998	102	4.72
Total PHNOM PENH	37,377	107,195	159,589	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	103,301	64	3.94
Central Districts (Urban)	402,070	446,086	516,625	423,375	267	180	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	516,625	266	2.79
Suburbs	280,886	310,914	421,892	6,98	7,68	256,7	493,956	530,277	566,546	602,869	639,200	675,531	711,862	748,193	784,524	820,855	857,186	893,517	929,848	966,179	1,002,510	53	5.13
<b>Projected growth rate</b>																							
Total PHNOM PENH	4.29	5.12	4.98	4.79	4.53	4.45	4.38	4.32	4.26	4.20	4.14	4.08	4.02	3.96	3.90	3.84	3.78	3.72	3.66	3.60	3.54	2.59	
Central Districts (Urban)	4.29	3.91	3.75	3.58	3.43	3.27	3.11	2.95	2.78	2.62	2.46	2.30	2.14	1.98	1.82	1.66	1.50	1.34	1.18	1.02	1.50		
Suburbs	6.78	6.57	6.37	6.16	5.96	5.75	5.55	5.34	5.14	4.93	4.73	4.52	4.32	4.11	3.91	3.70	3.50	3.30	3.10	2.90	Precondition		
<b>Increased population from the previous year</b>																							
Total PHNOM PENH	49,515	50,530	51,405	52,169	52,767	53,222	53,650	54,062	54,459	54,843	55,216	55,579	55,933	56,278	56,614	56,941	57,259	57,569	57,872	58,169	58,454	45,497	
Central Districts (Urban)	20,985	20,877	20,502	20,766	20,538	20,297	20,056	19,815	19,574	19,333	19,092	18,851	18,610	18,369	18,128	17,887	17,646	17,405	17,164	16,923	16,682	12,150	
Suburbs	28,530	29,653	30,903	31,402	32,229	33,353	34,567	35,839	37,165	38,549	39,981	41,465	42,996	44,574	46,199	47,871	49,589	51,353	53,165	55,026	56,934	30,347	
<b>Population Estimation using 1992-1998 average growth rate (%)</b>																							
Don Peith	118,501	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	128,571	159,623	
7 January	92,771	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	94,667	102,715	
Chamcar Mom	122,555	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	131,654	147,520	
Touk Kork	141,838	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	161,542	181,681	
Ruseay Koo	148,515	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	173,983	204,168	
Dang Kor	92,998	103,301	103,301	103,301	103,301	103,																	



Water Demand Analysis (Water Demand at the End of the Year)		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		
Year	Year	10,000	12,000	18,000	per year	18,000	per year	18,000	per year	18,000	per year	18,000	per year	18,000	per year	18,000	per year		
Connection increase rate																			
Conditions																			
Actual average household size (pers)	Phnom Penh (Census 1999)																		
Actual domestic connection ratio of total connections in 1999																			
<b>Population and water demand in Phnom Penh</b>																			
<b>Total (Urban and Suburban)</b>																			
Population																			
Total Population	(pers)	936,767	987,229	1,040,043	1,095,291	1,153,076	1,219,501	1,276,676	1,342,728	1,411,797	1,484,034	1,559,613	1,638,721	1,721,574	1,809,406	1,899,497	1,995,117	2,095,627	2,201,401
PPWSA piped supply	(pers)	234,234	283,932	332,287	390,426	477,638	554,950	652,055	739,270	826,476	919,685	1,000,698	1,088,107	1,175,317	1,262,550	1,349,737	1,436,946	1,524,180	1,611,369
Others including WS	(pers)	702,533	703,297	707,756	704,865	675,438	640,551	624,621	603,458	585,321	570,349	558,715	550,614	546,257	545,676	549,750	558,171	571,467	590,033
PPWSA piped service ratio	(%)	25	29	32	36	41	47	51	55	59	62	64	66	68	70	71	72	73	73
Number of connections at the end of year																			
Total connections	(Nos.)	48,714	58,345	68,345	80,345	98,345	116,345	134,345	152,345	170,345	188,345	206,345	224,345	242,345	260,345	278,345	296,345	314,345	332,345
Total connection increase	(Nos.)	9,631	9,631	10,000	12,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Domestic connections	(Nos.)	41,093	49,795	59,296	69,496	83,796	99,096	114,396	129,696	144,996	160,296	175,596	190,896	206,196	221,496	236,796	252,096	267,396	282,696
Domestic connection increase	(Nos.)	8,703	8,703	8,500	10,200	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300	15,300
Accounted for water																			
Per capita Demand	(l/c/d)	133	132	132	132	130	129	129	128	126	124	123	122	121	120	119	118	118	117
Commercial & Industrial Demand	(m3/d)	28,252	34,340	43,782	51,453	62,138	72,912	83,618	94,838	104,224	113,619	123,021	132,429	141,844	151,266	160,694	170,128	179,568	189,015
Administration Demand	(m3/d)	12,819	15,106	19,222	22,591	27,221	31,886	36,640	41,443	46,404	49,371	53,340	57,313	61,289	65,270	69,253	73,239	77,228	81,221
Whole-seller Demand	(m3/d)	5,407	6,595	8,682	10,769	12,856	14,943	17,030	19,117	21,204	23,291	25,378	27,465	29,552	31,639	33,726	35,813	37,900	40,000
Total Demand	(m3/d)	1,473	1,739	2,005	2,271	2,537	2,803	3,069	3,335	3,601	3,867	4,133	4,399	4,665	4,931	5,197	5,463	5,729	6,000
Per capita AFW 1	(m3/d)	47,951	57,180	67,635	79,132	95,057	111,134	127,439	143,940	157,816	171,709	186,612	199,527	213,453	227,383	241,341	255,300	269,270	283,252
Per capita AFW 2	(l/c/d)	205	201	204	203	199	197	195	195	191	188	185	183	182	180	179	178	177	176
Accounted for water Ratio	(%)	51	56	65	72	82	92	100	107	112	116	119	122	124	126	127	128	128	129
Water Demand																			
Daily Average water demand	(m3/d)	107,206	102,425	104,054	114,684	130,215	146,229	169,299	179,926	197,270	214,636	232,015	249,409	266,817	284,241	301,677	319,125	336,588	354,065
Per capita Average water demand	(l/c/d)	458	361	313	294	273	259	244	243	239	235	232	229	227	225	224	222	221	220
Daily Maximum water demand	(m3/d)	111,494	116,765	135,270	149,669	169,280	190,699	207,069	233,904	256,451	279,027	301,620	324,232	346,862	369,513	392,180	414,863	437,564	460,285
Per capita Maximum water demand	(l/c/d)	476	411	407	392	364	337	318	316	310	305	301	298	295	293	291	289	287	286
Peak factor (Daily-Max demand / Daily-Average dem)		1.04	1.14	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
<b>Water Production Capacity (m3/day)</b>																			
Year	Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Phnum Prek WTP		100,000	100,000	100,000	100,000	100,000	100,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Chhgar Mom WTP		20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Chruoy Chhngwar																			
Cham																			
		120,000	120,000	120,000	185,000	185,000	185,000	235,000	235,000	235,000	235,000	235,000	300,000	300,000	400,000	400,000	400,000	500,000	500,000

Notes: 1) Per capita AFW is calculated by dividing AFW into PPWSA piped water supply population.  
2) Per capita AFW is calculated by dividing AFW into total population.

Water Demand Analysis (Water Demand at the End of the Year)																																
Conditions	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Connection increase rate	10,000	12,000	10,000	12,000	18,000	per year	Average Daily Demand in Urban in 1988 (m3/day)																								
Actual average household size (pers) of Phnom Penh (Census 1998)					5.7 persons																											
Actual domestic connection ratio of total connections in 1989					85%																											
Actual water demand ratio of each category to domestic in 1988					100.0																											
Domestic demand					60.2																											
Commercial & Industrial					43.8																											
Administration					19.2																											
Whole-seller					2.9																											
Total					66.334																											
Population and Water Demand Forecast in Phnom Penh																																
Urban	Year		1988	1989	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015												
Population			(pers)	515,675	534,394	553,462	572,961	592,575	612,588	632,884	653,445	674,257	695,307	716,582	738,070	759,784	781,655	803,740	826,020	848,493	871,172											
PPWSA piped supply			(pers)	291,800	281,330	329,785	387,927	449,172	513,350	581,620	653,445	674,257	695,307	716,582	738,070	759,784	781,655	803,740	826,020	848,493	871,172											
Others including Wholeseller			(pers)	283,875	253,064	223,677	185,034	143,403	99,238	51,264	0	0	0	0	0	0	0	0	0	0	0											
PPWSA piped supply service ratio			(%)	45	53	59.6	67.7	75.8	83.8	91.9	100	100	100	100	100	100	100	100	100	100	100											
Number of connections at the end of year			(Nos.)	49,148	57,788	67,769	79,749	92,410	105,656	119,748	134,571	138,886	143,213	147,603	152,038	156,516	161,034	165,593	170,181	174,829	179,510											
Total connections			(Nos.)	9,821	10,000	11,980	12,661	13,246	14,092	14,824	4,298	4,345	4,391	4,435	4,478	4,518	4,559	4,599	4,638	4,681												
Domestic connections			(Nos.)	40,666	48,357	57,857	68,040	78,802	90,081	102,039	114,839	118,291	121,984	125,716	129,486	133,292	137,132	141,007	144,916	148,868	152,837											
Domestic connection increase			(Nos.)	8,691	8,691	8,500	10,183	10,762	11,269	11,878	12,600	3,652	3,693	3,732	3,770	3,808	3,840	3,875	3,909	3,942	3,978											
Accounted-for water			(l/c/d)	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132												
Domestic Demand			(m3/d)	27,900	33,932	43,632	51,193	59,291	67,762	76,774	86,255	89,002	91,781	94,689	97,425	100,288	103,178	106,094	109,035	112,001	114,985											
Commercial & Industrial Demand			(m3/d)	12,672	14,902	19,118	22,483	26,099	29,758	33,717	37,981	39,087	40,306	41,541	42,786	44,044	45,313	46,594	47,885	49,186	50,503											
Administration Demand			(m3/d)	5,315	6,516	3,671	4,317	5,000	5,715	6,475	7,274	7,506	7,740	7,977	8,216	8,458	8,702	8,947	9,195	9,446	9,698											
Whole-seller Demand			(m3/d)	1,264	984	820	656	492	328	164	0	0	0	0	0	0	0	0	0	0	0											
Total Demand			(m3/d)	47,171	56,334	67,141	78,649	90,822	103,584	117,130	131,410	136,595	139,828	144,107	148,427	152,781	157,193	161,635	166,115	170,635	175,196											
Per capita AFW 1)			(l/c/d)	203	200	204	203	202	201	201	201	201	201	201	201	201	201	201	201	201	201											
Per capita AFW 2)			(l/c/d)	91	105	121	137	153	169	185	201	201	201	201	201	201	201	201	201	201	201											
Accounted - for water Ratio			(%)	44	55	65	69	73	76	80	80	80	80	80	80	80	80	80	80	80	80											
Water Demand			(m3/d)	107,206	102,425	103,294	113,894	124,414	136,288	146,413	164,263	169,484	174,766	180,734	185,534	190,989	196,491	202,044	207,644	213,294	218,995											
Daily Average water demand			(l/c/d)	462	364	313	294	277	265	252	251	251	251	251	251	251	251	251	251	251	251											
Per capita Average water demand			(m3/d)	111,092	117,244	134,262	148,179	161,739	177,149	190,337	213,542	220,342	227,222	234,174	241,194	248,266	255,438	262,657	269,937	277,282	284,894											
Daily Maximum water demand			(l/c/d)	479	417	407	382	360	345	327	327	327	327	327	327	327	327	327	327	327	327											
Per capita Maximum water demand			(l/c/d)	1.04	1.14	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30											
Peak factor (Daily-Max demand / Daily-Average dem)																																
Notes: 1) Per capita AFW is calculated by dividing AFW into PPWSA piped water supply population																																
2) Per capita AFW is calculated by dividing AFW into total population																																

Water Demand Analysis (Water Demand at the End of the Year)																			
Case - A	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015			
Connection increase rate	10,000	12,000	16,000	per year															
Conditions																			
Actual average household size (pers) of Phnom Penh (Census 1998)																			
Actual domestic connection ratio of total connections in 1999																			
Actual water demand ratio of each category to domestic in 1999																			
Domestic demand	100.0	64.7	17.865																
Commercial & Industrial	41.5	26.9	7.414																
Administration	10.8	7.0	1.935																
Whole-seller	2.1	1.4	384																
Total	100.0																		
<b>Population and Water Demand Forecast in Phnom Penh</b>																			
Suburban	Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	(pers)	421,092	452,836	486,691	522,430	560,501	600,912	643,792	689,283	737,540	788,727	843,031	900,651	961,810	1,026,751	1,095,747	1,169,097	1,247,134	1,330,229
PPWSA piped supply	(pers)	2,434	2,502	2,502	2,599	26,466	51,500	70,435	85,825	152,219	216,378	284,316	350,037	415,553	480,875	545,397	610,926	675,667	740,196
Others including WS	(pers)	418,658	450,333	484,079	519,831	532,035	549,412	573,357	603,458	585,321	570,349	568,715	550,614	546,257	545,876	549,750	559,171	571,467	590,033
PPWSA piped supply service ratio	(%)	0.6	0.6	0.5	0.5	5.1	8.6	10.9	12.5	20.6	27.7	33.7	38.9	43.2	46.8	49.8	52.3	54.2	55.6
Number of connections at the end of year	(Nos.)	566	576	576	596	5935	10,689	14,597	17,774	31,477	45,132	58,742	72,307	86,829	99,311	112,752	126,154	139,516	152,895
Total connection increase	(Nos.)	10	0	20	5,339	4,754	3,908	3,176	13,704	13,655	13,609	13,609	13,555	13,522	13,482	13,441	13,401	13,362	13,319
Domestic connections	(Nos.)	427	439	439	456	4,994	9,035	12,357	15,057	26,705	38,312	49,860	61,410	72,904	84,354	95,789	107,160	118,538	129,859
Domestic connection increase	(Nos.)	12	0	17	4,538	4,041	3,322	2,700	11,648	11,607	11,607	11,568	11,530	11,494	11,460	11,425	11,391	11,359	11,321
Accounted-for water																			
Domestic	Per capita (l/c/d)	145	163	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Demand (m3/d)	362	408	250	260	2,847	5,150	7,044	8,893	15,222	21,839	28,432	35,004	41,555	48,098	54,600	61,093	67,557	74,020
Commercial & Industrial	Demand (m3/d)	147	204	104	106	1,182	2,137	2,923	3,662	6,317	9,063	11,799	14,527	17,245	19,957	22,669	25,354	28,040	30,718
Administration	Demand (m3/d)	92	79	11	12	128	291	316	385	682	979	1,274	1,589	1,862	2,155	2,447	2,738	3,028	3,318
Whole-seller	Demand (m3/d)	189	155	129	103	78	52	26	0	0	0	0	0	0	0	0	0	0	0
Total	Demand (m3/d)	780	846	494	483	4,235	7,570	10,309	12,530	22,221	31,880	41,505	51,100	60,662	70,200	79,705	89,185	98,635	108,056
Per capita AFW 1)	(l/c/d)	320	398	197	166	149	147	146	146	146	146	146	146	146	146	146	146	146	146
Per capita AFW 2)	(l/c/d)	2	2	1	1	8	13	16	18	30	40	49	57	63	68	73	76	79	81
Accounted - for water	Ratio			65	68	73	76	80	80	80	80	80	80	80	80	80	80	80	80
Water Demand																			
Daily Average water demand	(m3/d)			760	700	5,801	9,961	12,886	15,693	27,776	39,850	51,881	63,875	75,828	87,750	99,633	111,481	123,294	135,070
Per capita Average water demand	(l/c/d)			304	269	204	193	182	182	182	182	182	182	182	182	182	182	182	182
Daily maximum water demand	(m3/d)			968	910	7,541	12,949	16,752	20,362	36,109	51,805	67,445	83,036	98,576	114,075	129,523	144,925	160,282	175,591
Per capita maximum water demand	(l/c/d)			395	360	265	251	237	237	237	237	237	237	237	237	237	237	237	237
Peak factor (Daily-Max demand / Daily-Average demand)				1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30

Notes: 1) Per capita AFW is calculated by dividing AFW into PPWSA piped water supply population.  
2) Per capita AFW is calculated by dividing AFW into total population.

資料 7 - 3 水質試験結果

表 1 Monthly average of raw water characteristics in 1999

No.	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
1	Temp. (°C)	27.3	28.4	29.9	30.4	30.2	28.9	29.3	28.7	29.2	29.9	28.7	25.2	28.8
2	Colour (Pt/Co)	41	233	252	224	438	245	335	240	241	173	95	110	219
3	Cond. ( $\mu$ s)	90	84	77	78	82	113	113	90	126	106	80	67	92
4	TDS (mg/L)	45	42	39	39	41	57	57	45	63	53	40	34	46
5	SS (mg/L)	37	63	27	100	54	246	109	408	280	47	48	66	124
6	Turbidity (NTU)	30	45	35	99	100	216	148	360	250	49	50	74	121
7	pH-value	7.12	7.09	6.84	7.01	7.04	6.85	7.10	6.85	7.82	7.15	6.80	6.79	7.04
8	CO <sub>2</sub> (mg/L)	6	12	23	45	30	10	12	18	10	17	21	20	19
9	Alkalinity (mgCaCO <sub>3</sub> /L)	40	36	28	32	36	42	40	38	60	54	41	54	42
10	Total Hardness (mg/L)	35	32	32	24	32	40	44	34	54	50	22	21	35
11	Caicium (mgCaCO <sub>3</sub> /L)	31	20	20	22	28	36	36	28	38	42	21	16	28
12	Magnesium (mg/L)	4	12	12	2	4	4	8	6	16	8	1	5	7
13	Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Alminum (mg/L)	0.008	0.007	0.004	-	0.008	0.011	0.023	0.008	0.023	0.004	0.000	0.002	0.009
15	Iron (mg/L)	0.26	0.48	0.51	0.45	1.56	1.62	1.34	0.89	0.35	0.46	0.29	0.55	0.73
16	Manganese (mg/L)	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
17	Sulfate (mg/L)	0	0	0	0	1	8	8	2	8	0	0	0	2
18	Nitrate (mg/L)	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	Nitrite (mg/L)	0.011	0.012	0.105	0.017	0.009	0.004	0.002	0.000	0.010	0.002	0.002	0.001	0.015
20	N-Ammonium (mg/L)	2.37	0.49	-	-	-	-	-	-	-	-	-	-	1.43
21	Phosphate (mg/L)	0.01	0.14	0.64	0.30	0.00	0.49	0.16	0.16	0.06	0.22	0.17	0.01	0.20
22	Chloride (mg/L)	5.5	27.5	36.0	41.5	12.4	-	-	-	4.0	3.8	28.0	4.3	18.1
23	Fluoride (mg/L)	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.03
24	Sulfide (mg/L)	0.013	0.034	0.037	0.022	0.050	0.055	0.050	0.051	0.033	0.002	0.014	0.028	0.032
25	Cyanide (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Chromium (mg/L)	0.08	0.08	0.07	0.10	0.08	0.09	0.00	0.17	0.13	0.10	0.15	0.15	0.10
27	Copper (mg/L)	0.01	0.01	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
28	Zinc (mg/L)	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.10	0.01	0.00	0.00	0.01
29	COD (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Total Coliform (cfu/100mL)	12000	7000	5800	22000	7200	31800	13000	8600	18000	1600	2000	2800	10983 .3
31	Fecal Coliform (cfu/100mL)	800	12500	8400	11400	6600	13600	11800	5400	17400	2600	6200	2200	8241. 67

出所：PPWSA 水質分析ラボラトリー

表2 Monthly average of treated water characteristics in 1999

No.	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
1	Temp. (°C)	27.8	28.7	30.3	31.0	30.7	29.3	29.4	28.6	28.9	29.6	28.8	25.7	29.1
2	Colour (Pt/Co)	17	13	13	11	7	7	4	0	19	2	18	2	9
3	Cond. ( $\mu$ s)	95	90	77	85	96	129	125	104	134	114	85	70	100
4	TDS (mg/L)	48	45	39	43	48	64	62	52	67	57	42	35	50
5	SS (mg/L)	3	3	2	1	2	1	1	2	2	0	0	0	1
6	Turbidity (NTU)	1.5	1.6	1.2	1.5	6.0	1.2	1.2	1.4	1.2	0.4	0.9	0.5	1.6
7	pH-value	6.80	6.88	6.43	6.71	6.66	6.44	6.94	6.60	7.50	6.74	6.64	6.70	6.75
8	CO <sub>2</sub> (mg/L)	25	40	47	48	65	50	20	43	67	5	40	30	40
9	Alkalinity (mgCaCO <sub>3</sub> /L)	28	28	20	24	24	30	30	24	60	60	40	30	33
10	Total Hardness (mg/L)	22	24	20	23	28	36	40	30	54	52	21	21	31
11	Caicium (mgCaCO <sub>3</sub> /L)	12	20	16	16	20	30	34	24	38	40	20	16	24
12	Magnesium (mg/L)	10	4	4	7	8	6	6	6	16	12	1	5	7
13	Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Alminum (mg/L)	0.029	0.034	0.012	-	0.012	0.002	0.014	0.005	0.010	0.008	0.001	0.003	0.012
15	Iron (mg/L)	5.50	0.10	0.05	0.03	0.27	0.03	0.05	0.02	0.09	0.04	0.05	0.03	0.52
16	Manganese (mg/L)	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1
17	Sulfate (mg/L)	11	10	15	19	2	24	18	22	28	17	13	11	16
18	Nitrate (mg/L)	0.7	1.0	1.2	2.8	1.8	0.8	1.0	0.9	1.5	0.9	0.6	0.6	1.2
19	Nitrite (mg/L)	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.003	0.003	0.002	0.002	0.002
20	N-Ammonium (mg/L)	0.06	0.00	-	-	-	-	-	-	-	-	-	-	0.03
21	Phosphate (mg/L)	0.31	0.02	0.08	0.20	0.03	0.07	0.67	0.04	0.01	0.09	0.01	0.03	0.13
22	Chloride (mg/L)	8.0	43.5	40.5	46.0	10.4	-	-	-	5.0	4.9	45.0	4.5	23.1
23	Fluoride (mg/L)	0.18	0.00	0.13	0.00	0.00	0.00	0.00	0.18	0.32	0.07	0.24	0.13	0.10
24	Sulfide (mg/L)	0.001	0.001	0.011	0.000	0.006	0.004	0.006	0.004	0.000	0.004	0.001	0.004	0.004
25	Cyanide (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Chromium (mg/L)	0.08	0.07	0.08	0.13	0.12	0.10	0.12	0.14	0.16	0.13	0.16	0.19	0.12
27	Copper (mg/L)	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.03	0.01
28	Zinc (mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.01
29	COD (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Total Coliform (cfu/100mL)	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Fecal Coliform (cfu/100mL)	0	0	0	0	0	0	0	0	0	0	0	0	0

出所：PPWSA 水質分析ラボラトリー

表3 浄水場内の主要処理プロセスの水質（乾期の初め）

時間	水質項目	原水	急速攪拌	緩速攪拌	沈澱後	ろ過後	浄水場内 給水栓	
07:30	温度	28.2	27.8	27.8	27.3	28.7	27.8	
	pH	-	6.85		6.80	6.57	6.58	
	濁度(NTU)	NTU	21	18	16	10	2.3	1.8
	遊離塩素	mg/l						0.16
	総塩素	mg/l						0.64
	TDS	mg/l	35	36	36	36	32	37
	電気伝導度	μ s/cm	75	73	73	73	74	74
	SS	mg/l	15			9		3
10:30	温度	28.5	28.4	28.4	28.5	28.7	28.7	
	pH	-						
	濁度(NTU)	NTU	17	18	17	10	1.4	1.3
	遊離塩素	mg/l						
	総塩素	mg/l						
14:30	温度	28.8	28.8	28.6	28.9	29.0	29.6	
	pH	-	6.67		6.57	6.54	6.51	
	濁度(NTU)	NTU	19	18	19	9	1.2	1.4
	遊離塩素	mg/l						0.11
	総塩素	mg/l						0.68
	TDS	mg/l	35	36	36	36	37	36
	電気伝導度	μ s/cm	70	72	73	73	74	73
	SS	mg/l	19			9		3

凝集剤注入率：10 mg/l

出所：PPWSA 水質分析ラボラトリー

表4 浄水場内の主要処理プロセスの水質（乾期終り）

時間	水質項目	原水	急速攪拌	緩速攪拌	沈澱後	ろ過後	浄水場内 給水栓	
07:30	温度	28.5	28.2	28.1	28.1	28.7	29.0	
	pH	-	6.95		6.53	6.40	6.48	
	濁度(NTU)	NTU	60	50	50	4	0.4	1.7
	遊離塩素	mg/l						0.30
	総塩素	mg/l						0.50
	TDS	mg/l	30	32	33	33	33	33
	電気伝導度	μ s/cm	60	65	66	66	66	67
	SS	mg/l	72			13		1
10:30	温度	28.6	28.6	28.4	28.4	28.4	29.2	
	pH	-						
	濁度(NTU)	NTU	50	50	42	5	0.6	1.3
	遊離塩素	mg/l						
	総塩素	mg/l						
14:30	温度	29.2	29.3	29.4	29.3	28.7	29.4	
	pH	-	6.94		6.73	6.50	6.49	
	濁度(NTU)	NTU	55	60	64	9.5	1.8	1.4
	遊離塩素	mg/l						0.60
	総塩素	mg/l						0.70
	TDS	mg/l	31	33	33	34	34	34
	電気伝導度	μ s/cm	61	67	67	67	68	67
	SS	mg/l	66			10		1

凝集剤注入率：20 mg/l

出所：PPWSA 水質分析ラボラトリー

表5 浄水場内の主要処理プロセスの水質（雨期）

時間	水質項目	原水	急速攪拌	緩速攪拌	沈澱後	ろ過後	浄水場内 給水栓	
07:30	温度	27	27.1	27.1	26.9	27	27.1	
	pH	-	6.88		6.76	6.70	6.65	
	濁度(NTU)	NTU	385	432	456	10	2	1.3
	遊離塩素	mg/l						0.80
	総塩素	mg/l						0.90
	TDS	mg/l	45	46	53	51	51	50
	電気伝導度	μs/cm	89	93	106	101	102	100
	SS	mg/l	488			7		1
10:30	温度	28.2	28.1	28.0	27.9	27.6	27.6	
	pH	-						
	濁度(NTU)	NTU	462	426	396	22	6	5.6
	遊離塩素	mg/l						
	総塩素	mg/l						
14:30	温度	27.2	27.3	27.2	27.2	27.4	27.2	
	pH	-	6.80		6.54	6.51	6.54	
	濁度(NTU)	NTU	396	369	405	12	1.6	3.1
	遊離塩素	mg/l						1.4
	総塩素	mg/l						1.45
	TDS	mg/l	46	53	53	53	54	52
	電気伝導度	μs/cm	93	106	106	106	107	104
	SS	mg/l	412			13		8

凝集剤注入率：35 mg/l

出所：PPWSA 水質分析ラボラトリー

表6 プノンペン市内給水水質

番号	場所	温度 ( )	pH	濁度 (NTU)	電気伝導度 (μS/cm)	総塩素 (mg/l)	遊離塩素 (mg/l)	細菌 群	糞便性 細菌
1	No.1792	29.3	6.9	3	120.6	1.04	0.93	-	0
2	No.31	29.4	6.4	4	116	1.19	1.03	0	0
3	No.25	29.4	6.4	2	115	0.98	0.97	-	0
4	No.477	30.2	6.5	3	117	0.90	0.77	-	0
5	No.35	30.2	6.8	1	117.7	0.62	0.75	-	0
6	No.52	30.8	6.8	1	118	0.79	0.72	-	0

測定日：2000年6月29日

- 未測定

出所：PPWSA 水質分析ラボラトリー



表7 プノンペン市内の給水水質

番号	場所	日付	温度 ( )	pH	濁度 (NTU)	電気伝導度 ( $\mu$ S/cm)	総塩素 (mg/l)	遊離塩素 (mg/l)
1	No.5 St. 75	00 5/16	30	7.2	0.9	175	0.61	0.49
2	No.2248, St. 93	00 5/16	30	6.9	1.0	174	0.48	0.38
3	No. 265, St. 1	00 5/16	30	6.9	1.0	159	0.23	0.14
4	No. 120, St.3	00 5/16	30	7.0	1.7	172	0.42	0.26
5	No. 8, St. 242	00 5/16	31	6.9	1.0	172	0.36	0.26
6	No. 274, St. 93	00 5/16	30	6.8	1.1	173	0.04	0.04
7	Fish	00 5/16	29.5	6.9	1.8	174	0.76	0.60
8	No. 103C, St. 67	00 5/16	29.5	6.9	0.9	176	0.88	0.80
9	No. 97 St. Sihanuk	00 5/14	30.2	7.2	1.4	179	0.51	0.35
10	No. 198 St. Norodom	00 5/14	30.7	7.2	4.4	181	0.75	0.6
11	No. 447 St. 271	00 5/14	29.4	7.5	0.9	181	0.15	0.1
12	No. 25 St. 490		31.4	7.1	2.7	178	0.73	0.66
13	No. 90B St. 432		31.7	7.1	5.1	178	0.6	0.51
14	No. 158 St. 173		31.6	7.0	4.0	179	0.48	0.35
15	No. 40 St. 368		31.8	6.9	3.1	180	0.14	0.05
16	No. 202 St. 143		31.6	6.9	1.1	179	0.16	0.05
17	No. 13B St. 47	99 5/31	29.9	6.9	12.8	130.4	0.36	0.24
18	No.18 St. 5	99 5/31	29.6	6.8	12	124.4	0.46	0.39
19	No.203 St. 19	99 5/31	29.7	6.9	11.8	121.7	0.36	0.29
20	No.28 E0 St. Paster	99 5/31	29.8	7.0	19	124.7	0.04	0.02
21	No. 473 St.1	99 5/31	30.4	6.9	19	126	0.13	0.06
22	No.33D St.134	99 5/31	30.0	6.8	10	124.4	0.63	0.31
23	No.40 St.213	99 5/31	30.8	6.8	11	126	0.33	0.2
24	No.482 E0+E1 St.230	99 5/31	28.9	7.1	14	136.5	0.06	0.06
25	No.329 St.112	99 5/31	30.6	6.8	12	126	0.09	0.06
26	No.1792 St.5	99 6/29	29.3	6.9	3	120.6	1.04	0.93
27	No.31 St. Srisanud	99 6/29	29.4	6.4	4	116	1.19	1.04
28	No.36 St.136	99 6/29	29.4	6.4	2	115	0.98	0.97
29	No.477 St.51(?)	99 6/29	30.2	6.5	3	117	0.9	0.77
30	No.35 St.51	99 6/29	30.2	6.8	1	117.7	0.62	0.75
31	No.12 St.289	99 6/7	30	7.0	4.12	149	0.55	0.40
32	No.03 St.562	99 6/7	30.4	6.9	5.27	148	0.13	0.05
33	No.51 St.287	99 6/7	30.5	6.9	3.14	148	0.48	0.24
34	No.99 St.315	99 6/7	30	6.66	3.4	147	0.05	0.02
35	No.4 St.265	99 6/7	31.8	6.8	3.17	147	0.39	0.1
36	No.235A St.138	99 6/7	31.2	6.8	3.23	146	0.76	0.68
37	No.25E0 St.Paster	99 6/7	30.7	6.9	3.5	147.4	0.05	0.02
38	No.18 St.5	99 6/7	30.4	6.65	2.2	146	0.94	0.89
39	No.488 St.	99 6/7	31.0	6.8	3.36	146	0.92	0.8
40	No.6A St.27	99 6/7	31	6.64	1.2	148	0.11	0.16

出所：PPWSA 水質分析ラボラトリー

資料 7 - 4 配水量、日最大係数（ヒーク係数）及び不明水量率の解析

(m <sup>3</sup> /hour)									
District name Zone No.	7th January 1	7th January 2	7th January 3	7th January 4	7th January 5	7th January 6	7th January 7	7th January 8	7th January TOTAL
Hour/Date	02/15/00	02/15/00	02/28/00	02/29/00	03/01/00	02/17/00	02/15/00	02/02/00	
00:00-01:00	6.5	2.9	16.1	4.7	68.1	17.20	6.56	6.01	128.07
01:00-02:00	12.0	25.9	36.4	19.3	20.7	16.40	6.64	3.80	141.14
02:00-03:00	21.9	4.8	14.1	20.4	42.9	15.60	6.87	15.27	141.84
03:00-04:00	12.1	21.5	30.5	40.1	43.7	26.60	20.73	20.28	215.51
04:00-05:00	36.7	31.2	39.9	50.5	76.7	31.30	21.63	14.35	302.28
05:00-06:00	48.2	25.9	99.3	99.6	139.2	72.10	30.58	33.60	548.48
06:00-07:00	62.5	31.5	113.8	137.3	128.0	76.70	50.63	32.64	633.07
07:00-08:00	49.0	44.5	97.8	112.2	130.3	77.30	58.09	40.61	609.80
08:00-09:00	57.3	29.9	124.6	157.4	123.3	77.50	45.43	37.95	653.38
09:00-10:00	67.3	31.1	88.9	140.2	125.7	74.60	41.69	42.84	612.33
10:00-11:00	59.2	24.0	123.7	113.3	129.3	66.80	45.51	38.01	599.82
11:00-12:00	69.8	28.9	110.9	113.2	97.0	67.60	45.29	24.85	557.54
12:00-13:00	60.4	37.5	102.1	118.0	94.3	74.60	42.28	40.67	569.85
13:00-14:00	56.2	30.9	119.0	101.4	89.5	73.90	33.31	39.76	543.97
14:00-15:00	55.2	28.4	93.1	136.2	89.8	64.90	53.73	30.86	552.19
15:00-16:00	51.4	29.3	101.3	128.9	108.7	61.50	44.15	33.47	558.72
16:00-17:00	41.4	33.4	106.8	132.2	130.2	61.60	44.68	28.63	578.91
17:00-18:00	51.7	28.4	79.0	97.7	125.4	71.20	48.10	37.38	538.88
18:00-19:00	62.6	29.0	73.9	100.0	123.3	74.60	51.37	31.89	546.66
19:00-20:00	47.6	29.3	91.6	106.5	122.9	65.50	45.89	3.59	512.88
20:00-21:00	43.4	30.9	111.7	56.7	64.8	40.80	38.44	10.75	397.49
21:00-22:00	14.6	21.7	42.4	0.5	44.4	40.10	25.12	19.78	208.60
22:00-23:00	27.5	4.9	26.3	72.3	42.6	19.80	8.08	4.49	205.97
23:00-24:00	16.6	25.1	20.9	44.9	30.0	18.60	6.73	5.25	168.08
Max	69.80	44.50	124.60	157.40	139.20	77.50	58.09	42.84	653.38
Average	42.96	26.29	77.67	87.65	91.28	53.62	34.23	24.86	438.56
Total distribution	1031.10	630.90	1864.10	2103.50	2190.80	1286.80	821.53	596.73	10525.46
Hourly maximum dist./average dist. (Peak)	1.62	1.69	1.60	1.80	1.52	1.45	1.70	1.72	1.49
Hourly dist. - Average Daily dist.									
00:00-01:00	(36.46)	(23.39)	(61.57)	(82.95)	(23.18)	(36.42)	(27.67)	(18.85)	(310.49)
01:00-02:00	(30.96)	(0.39)	(41.27)	(68.35)	(70.58)	(37.22)	(27.59)	(21.06)	(297.42)
02:00-03:00	(21.06)	(21.49)	(63.57)	(67.25)	(48.38)	(38.02)	(27.36)	(9.59)	(296.72)
03:00-04:00	(30.86)	(4.79)	(47.17)	(47.55)	(47.58)	(27.02)	(13.50)	(4.58)	(223.05)
04:00-05:00	(6.26)	4.91	(37.77)	(37.15)	(14.58)	(22.32)	(12.60)	(10.51)	(136.28)
05:00-06:00	5.24	(0.39)	21.63	11.95	47.92	18.48	(3.65)	8.74	109.92
06:00-07:00	19.54	5.21	36.13	49.65	36.72	23.08	16.40	7.78	194.51
07:00-08:00	6.04	18.21	20.13	24.55	39.02	23.68	23.86	15.75	171.24
08:00-09:00	14.34	3.61	46.93	69.75	32.02	23.88	11.20	13.09	214.82
09:00-10:00	24.34	4.81	11.23	52.55	34.42	20.98	7.46	17.98	173.77
10:00-11:00	16.24	(2.29)	46.03	25.65	38.02	13.18	11.28	13.15	161.26
11:00-12:00	26.84	2.61	33.23	25.55	5.72	13.98	11.06	(0.01)	118.98
12:00-13:00	17.44	11.21	24.43	30.35	3.02	20.98	8.05	15.81	131.29
13:00-14:00	13.24	4.61	41.33	13.75	(1.78)	20.28	(0.92)	14.90	105.41
14:00-15:00	12.24	2.11	15.43	48.55	(1.48)	11.28	19.50	6.00	113.63
15:00-16:00	8.44	3.01	23.63	41.25	17.42	7.88	9.92	8.61	120.16
16:00-17:00	(1.56)	7.11	29.13	44.55	38.92	7.98	10.45	3.77	140.35
17:00-18:00	8.74	2.11	1.33	10.05	34.12	17.58	13.87	12.52	100.32
18:00-19:00	19.64	2.71	(3.77)	12.35	32.02	20.98	17.14	7.03	108.10
19:00-20:00	4.64	3.01	13.93	18.85	31.62	11.88	11.66	(21.27)	74.32
20:00-21:00	0.44	4.61	34.03	(30.95)	(26.48)	(12.82)	4.21	(14.11)	(41.07)
21:00-22:00	(28.36)	(4.59)	(35.27)	(87.15)	(46.88)	(13.52)	(9.11)	(5.08)	(229.96)
22:00-23:00	(15.46)	(21.39)	(51.37)	(15.35)	(48.68)	(33.82)	(26.15)	(20.37)	(232.59)
23:00-24:00	(26.36)	(1.19)	(56.77)	(42.75)	(61.28)	(35.02)	(27.50)	(19.61)	(270.48)
Necessary reservoir volume (m <sup>3</sup> )	197.36	79.89	398.54	479.41	390.92	256.15	176.05	145.08	2038.07
Necessary volume /average hourly dist. Volume (hour)	4.59	3.04	5.13	5.47	4.28	4.78	5.14	5.84	4.65

District name Zone No.	(m <sup>3</sup> /hour)								
	Chamcar Morn 1	Chamcar Morn 3	Chamcar Morn 4	Chamcar Morn 7	Chamcar Morn 8	Chamcar Morn 10	Chamcar Morn 11	Chamcar Morn 12	CHAMCAR MORN TOTAL
Hour/Date	05/18/00	03/27/00	04/07/00	06/15/00	04/03/00	03/27/00	05/02/00	05/03/00	
00:00-01:00	28.88	16.6	24.60	20.6	9.25	19.60	7.40	2.23	129.16
01:00-02:00	29.99	42.8	43.60	17.8	11.27	20.80	7.20	2.82	176.28
02:00-03:00	37.70	32.1	28.60	25.4	30.86	22.10	4.00	2.73	183.49
03:00-04:00	35.20	42.6	40.10	15.8	32.94	26.60	15.50	3.71	212.45
04:00-05:00	63.21	85.8	38.00	35.2	23.59	41.40	9.50	5.70	302.40
05:00-06:00	74.10	90.9	37.70	42.0	33.02	56.70	18.90	6.78	360.10
06:00-07:00	77.50	118.8	38.70	74.8	27.26	52.40	23.40	6.87	419.73
07:00-08:00	79.65	120.7	51.90	64.2	32.05	61.90	31.00	9.75	451.15
08:00-09:00	80.05	106.3	51.00	78.6	42.00	59.20	28.40	12.19	457.74
09:00-10:00	72.01	104.1	37.70	61.8	46.90	63.60	24.00	15.96	426.07
10:00-11:00	72.21	92.6	63.20	64.3	55.47	60.00	33.10	10.58	451.46
11:00-12:00	68.26	113.7	44.70	57.8	50.05	50.20	13.60	13.73	412.04
12:00-13:00	69.63	99.4	51.10	56.1	33.87	44.10	37.20	12.19	403.59
13:00-14:00	70.05	99.0	49.20	39.9	27.01	67.10	16.50	11.66	380.42
14:00-15:00	67.37	108.5	37.10	52.6	31.68	46.00	28.90	12.23	384.38
15:00-16:00	73.61	107.5	48.90	34.6	35.26	73.60	15.80	13.79	403.06
16:00-17:00	69.08	108.3	50.00	50.4	43.38	47.50	22.90	10.97	402.53
17:00-18:00	70.61	103.6	59.70	58.9	31.26	55.40	33.00	14.39	426.86
18:00-19:00	65.20	110.8	44.84	43.7	40.10	55.10	15.10	10.12	384.96
19:00-20:00	43.00	112.7	54.86	36.9	32.08	56.50	23.10	9.56	368.70
20:00-21:00	43.49	83.4	37.40	48.1	28.51	44.20	16.70	4.14	305.94
21:00-22:00	34.90	67.7	58.40	42.1	27.54	52.60	19.20	5.56	308.00
22:00-23:00	33.70	21.8	32.20	26.1	20.01	16.60	14.20	2.04	166.65
23:00-24:00	32.52	39.3	32.00	6.9	18.54	7.00	10.40	3.46	150.12
Max	80.05	120.70	63.20	78.60	55.47	73.60	37.20	15.96	457.74
Average	58.00	84.54	43.98	43.94	31.83	45.84	19.54	8.47	336.14
Total distribution	1391.92	2029.00	1055.50	1054.60	763.90	1100.20	469.00	203.16	8067.28
Hourly maximum dist./average dist. (Peak)	1.38	1.43	1.44	1.79	1.74	1.61	1.90	1.89	1.36

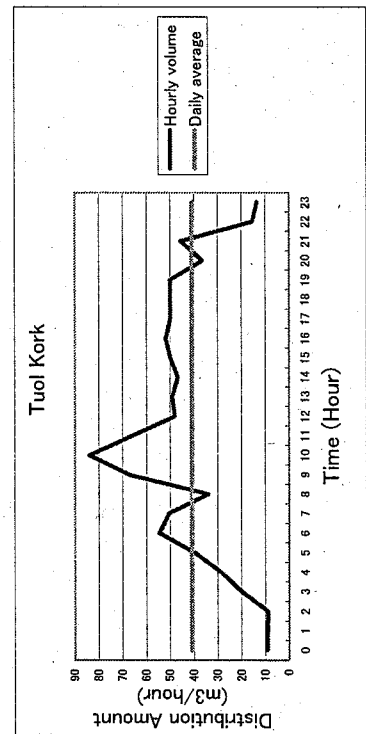
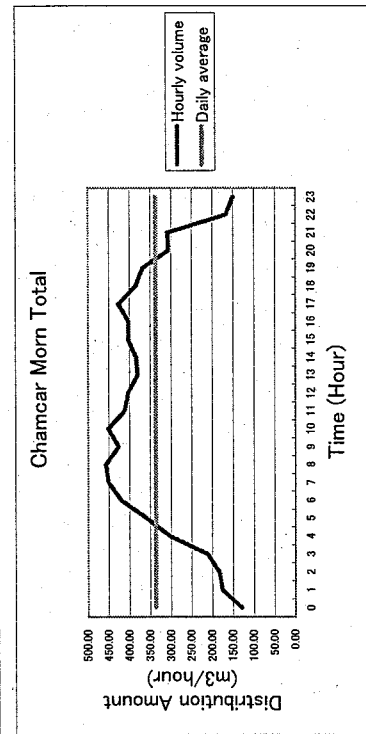
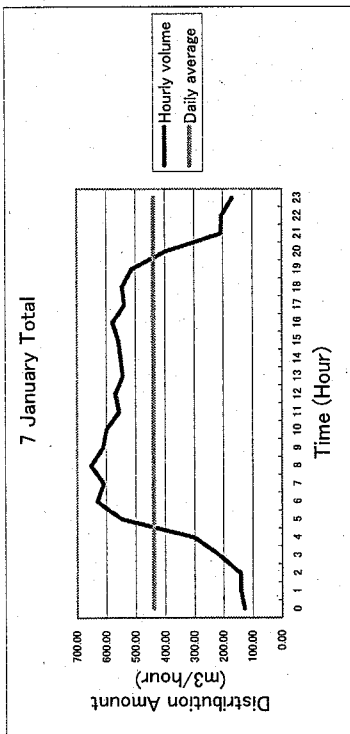
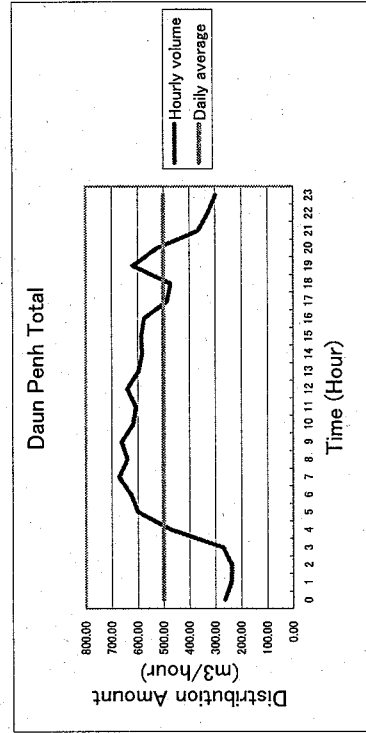
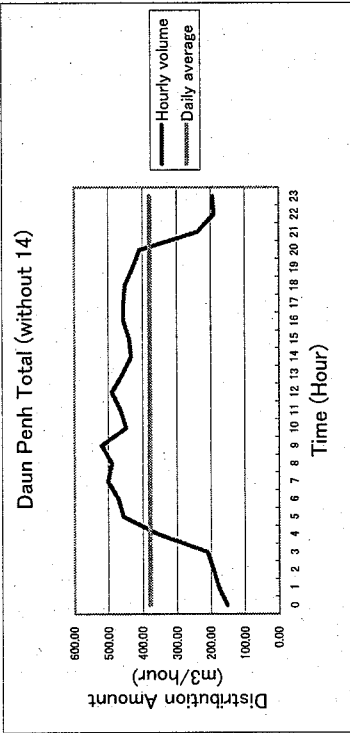
00:00-01:00	(29.12)	(67.94)	(19.38)	(23.34)	(22.58)	(26.24)	(12.14)	(6.24)	(206.98)
01:00-02:00	(28.01)	(41.74)	(0.38)	(26.14)	(20.56)	(25.04)	(12.34)	(5.65)	(159.86)
02:00-03:00	(20.30)	(52.44)	(15.38)	(18.54)	(0.97)	(23.74)	(15.54)	(5.74)	(152.65)
03:00-04:00	(22.80)	(41.94)	(3.88)	(28.14)	1.11	(19.24)	(4.04)	(4.76)	(123.69)
04:00-05:00	5.21	1.26	(5.98)	(8.74)	(8.24)	(4.44)	(10.04)	(2.77)	(33.74)
05:00-06:00	16.10	6.36	(6.28)	(1.94)	1.19	10.86	(0.64)	(1.69)	23.96
06:00-07:00	19.50	34.26	(5.28)	30.86	(4.57)	6.56	3.86	(1.60)	83.59
07:00-08:00	21.65	36.16	7.92	20.26	0.22	16.06	11.46	1.29	115.01
08:00-09:00	22.05	21.76	7.02	34.66	10.17	13.36	8.86	3.73	121.60
09:00-10:00	14.01	19.56	(6.28)	17.86	15.07	17.76	4.46	7.50	89.93
10:00-11:00	14.21	8.06	19.22	20.36	23.64	14.16	13.56	2.12	115.32
11:00-12:00	10.26	29.16	0.72	13.86	18.22	4.36	(5.94)	5.27	75.90
12:00-13:00	11.63	14.86	7.12	12.16	2.04	(1.74)	17.66	3.73	67.45
13:00-14:00	12.05	14.46	5.22	(4.04)	(4.82)	21.26	(3.04)	3.20	44.28
14:00-15:00	9.37	23.96	(6.88)	8.66	(0.15)	0.16	9.36	3.77	48.24
15:00-16:00	15.61	22.96	4.92	(9.34)	3.43	27.76	(3.74)	5.33	66.92
16:00-17:00	11.08	23.76	6.02	6.46	11.55	1.66	3.36	2.51	66.39
17:00-18:00	12.61	19.06	15.72	14.96	(0.57)	9.56	13.46	5.93	90.72
18:00-19:00	7.20	26.26	0.86	(0.24)	8.27	9.26	(4.44)	1.66	48.82
19:00-20:00	(15.00)	28.16	10.88	(7.04)	0.25	10.66	3.56	1.10	32.56
20:00-21:00	(14.51)	(1.14)	(6.58)	4.16	(3.32)	(1.64)	(2.84)	(4.33)	(30.20)
21:00-22:00	(23.10)	(16.84)	14.42	(1.84)	(4.29)	6.76	(0.34)	(2.91)	(28.14)
22:00-23:00	(24.30)	(62.74)	(11.78)	(17.84)	(11.82)	(29.24)	(5.34)	(6.43)	(169.49)
23:00-24:00	(25.48)	(45.24)	(11.98)	(37.04)	(13.29)	(38.84)	(9.14)	(5.01)	(186.02)
Necessary reservoir volume (m <sup>3</sup> )	202.59	330.03	100.05	184.24	95.17	170.18	89.58	47.08	1090.74
Necessary volume /average hourly dist. Volume (hour)	3.49	3.90	2.27	4.19	2.99	3.71	4.58	5.56	3.24

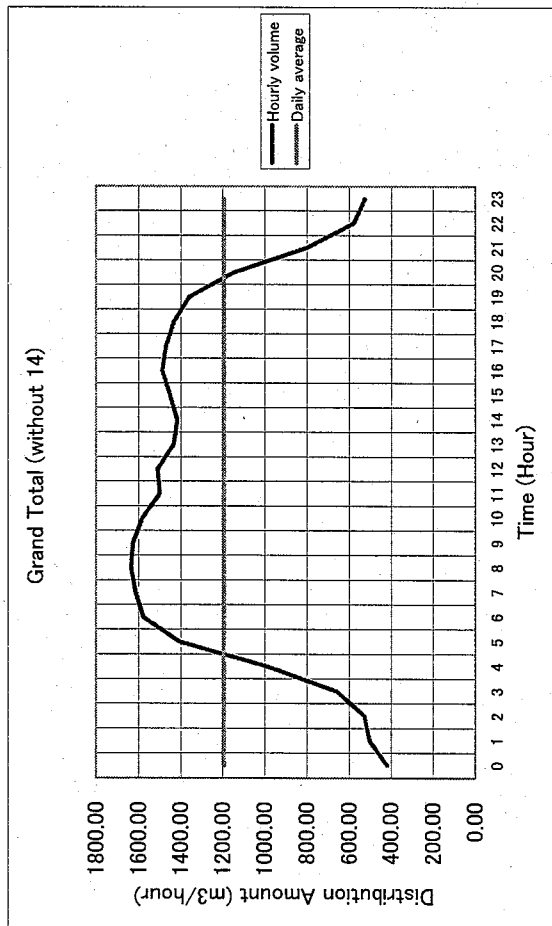
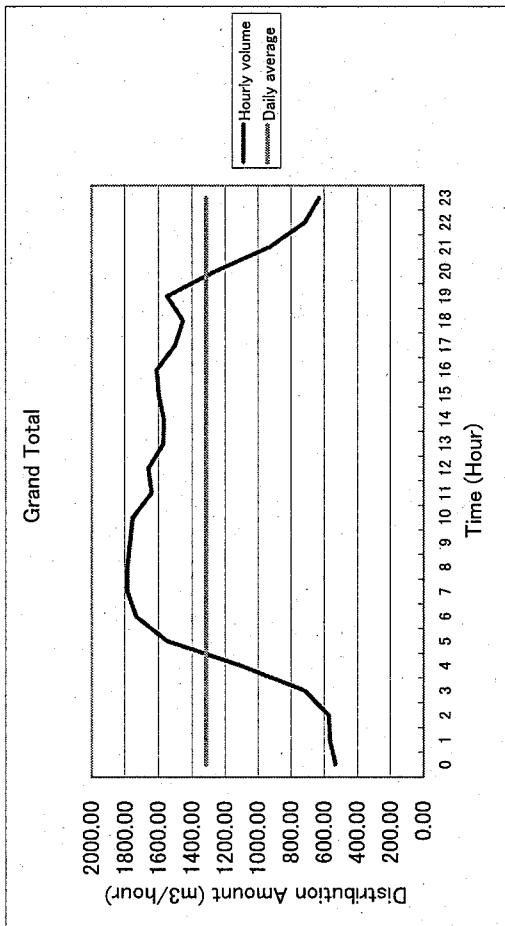
(m <sup>3</sup> /hour)									
District name	Tuol Kork	TUOL KORK	09h	Daun Penh	Daun Penh	Daun Penh	Daun Penh	DAUN PENH	DAUN PENH
Zone No.	2	TOTAL	5A	1	* 7B	12	14	TOTAL	TOTAL
Hour/Date	06/26/00		02/14/00	05/18/00	09/14/99	01/17/00	10/28/99	(without 14)	
00:00-01:00	9.2	9.2	14.49	57.94	77.9	2.19	112	264.52	152.52
01:00-02:00	9.1	9.1	8.01	49.18	118.0	2.10	62	239.29	177.29
02:00-03:00	8.8	8.8	14.98	53.74	121.4	2.98	43	236.10	193.10
03:00-04:00	19.9	19.9	20.08	66.57	120.9	3.14	60	270.69	210.69
04:00-05:00	28.4	28.4	31.82	72.75	247.0	3.06	117	471.63	354.63
05:00-06:00	39.7	39.7	57.07	151.23	241.0	8.29	142	599.59	457.59
06:00-07:00	54.5	54.5	72.89	142.55	248.3	8.18	154	625.92	471.92
07:00-08:00	50.7	50.7	80.66	166.06	243.7	11.65	170	672.07	502.07
08:00-09:00	33.9	33.9	62.82	168.42	249.0	10.08	150	640.32	490.32
09:00-10:00	67.1	67.1	81.04	175.57	254.3	9.92	142	662.83	520.83
10:00-11:00	83.9	83.9	58.10	148.37	231.7	10.36	170	618.53	448.53
11:00-12:00	65.8	65.8	78.97	155.31	222.0	9.79	140	606.07	466.07
12:00-13:00	48.0	48.0	73.19	162.39	243.9	11.07	150	640.55	490.55
13:00-14:00	49.1	49.1	70.81	152.46	230.1	6.89	138	599.26	460.26
14:00-15:00	46.7	46.7	78.89	135.93	214.7	4.12	150	583.64	433.64
15:00-16:00	49.9	49.9	66.20	142.41	224.8	5.57	148	586.98	438.98
16:00-17:00	51.9	51.9	79.40	149.09	222.8	4.92	120	576.21	456.21
17:00-18:00	49.9	49.9	71.42	152.44	227.1	4.76	30	485.72	455.72
18:00-19:00	49.9	49.9	75.91	145.19	224.6	5.69	21	472.39	451.39
19:00-20:00	50.1	50.1	75.57	122.80	223.9	6.21	189	617.48	428.48
20:00-21:00	36.5	36.5	83.50	71.77	247.7	5.17	118	526.14	408.14
21:00-22:00	45.5	45.5	27.92	88.06	120.5	2.97	126	365.45	239.45
22:00-23:00	15.4	15.4	23.72	53.00	111.3	2.71	137	327.73	190.73
23:00-24:00	13.5	13.5	17.56	43.17	131.0	2.44	104	298.17	194.17
Max	83.90	83.90	83.50	175.57	254.30	11.65	189.00	672.07	520.83
Average	40.73	40.73	55.21	117.77	199.90	6.01	120.54	499.43	378.89
Total distribution	977.40	977.40	1325.02	2826.40	4797.60	144.26	2893.00	11986.28	9093.28
Hourly maximum dist./average dist. (Peak)	2.06	2.06	1.51	1.49	1.27	1.94	1.57	1.35	1.37
00:00-01:00	(31.53)	(31.53)	(40.72)	(59.83)	(122.00)	(3.82)	(8.54)	(234.91)	(226.37)
01:00-02:00	(31.63)	(31.63)	(47.20)	(68.59)	(81.90)	(3.91)	(58.54)	(260.14)	(201.60)
02:00-03:00	(31.93)	(31.93)	(40.23)	(64.03)	(78.50)	(3.03)	(77.54)	(263.33)	(185.79)
03:00-04:00	(20.83)	(20.83)	(35.13)	(51.20)	(79.00)	(2.87)	(60.54)	(228.74)	(168.20)
04:00-05:00	(12.33)	(12.33)	(23.39)	(45.02)	47.10	(2.95)	(3.54)	(27.80)	(24.26)
05:00-06:00	(1.03)	(1.03)	1.86	33.46	41.10	2.28	21.46	100.16	78.70
06:00-07:00	13.78	13.78	17.68	24.78	48.40	2.17	33.46	126.49	93.03
07:00-08:00	9.98	9.98	25.45	48.29	43.80	5.64	49.46	172.64	123.18
08:00-09:00	(6.83)	(6.83)	7.61	50.65	49.10	4.07	29.46	140.89	111.43
09:00-10:00	26.38	26.38	25.83	57.80	54.40	3.91	21.46	163.40	141.94
10:00-11:00	43.18	43.18	2.89	30.60	31.80	4.35	49.46	119.10	69.64
11:00-12:00	25.08	25.08	23.76	37.54	22.10	3.78	19.46	106.64	87.18
12:00-13:00	7.28	7.28	17.98	44.62	44.00	5.06	29.46	141.12	111.66
13:00-14:00	8.38	8.38	15.60	34.69	30.20	0.88	17.46	98.83	81.37
14:00-15:00	5.98	5.98	23.68	18.16	14.80	(1.89)	29.46	84.21	54.75
15:00-16:00	9.18	9.18	10.99	24.64	24.90	(0.44)	27.46	87.55	60.09
16:00-17:00	11.18	11.18	24.19	31.32	22.90	(1.09)	(0.54)	76.78	77.32
17:00-18:00	9.18	9.18	16.21	34.67	27.20	(1.25)	(90.54)	(13.71)	76.83
18:00-19:00	9.18	9.18	20.70	27.42	24.70	(0.32)	(99.54)	(27.04)	72.50
19:00-20:00	9.38	9.38	20.36	5.03	24.00	0.20	68.46	118.05	49.59
20:00-21:00	(4.23)	(4.23)	28.29	(46.00)	47.80	(0.84)	(2.54)	26.71	29.25
21:00-22:00	4.78	4.78	(27.29)	(29.71)	(79.40)	(3.04)	5.46	(133.98)	(139.44)
22:00-23:00	(25.33)	(25.33)	(31.49)	(64.77)	(88.60)	(3.30)	16.46	(171.70)	(188.16)
23:00-24:00	(27.23)	(27.23)	(37.65)	(74.60)	(68.90)	(3.57)	(16.54)	(201.26)	(184.72)
Necessary reservoir volume (m3)	192.85	192.85	283.09	503.72	598.30	32.33	418.42	1535.88	1318.51
Necessary volume /average hourly dist. Volume (hour)	4.74	4.74	5.13	4.28	2.99	5.38	3.47	3.08	3.48

(m<sup>3</sup>/hour)

District name Zone No.	GRAND TOTAL	GRAND TOTAL (without14)
Hour/Date		
00:00-01:00	530.95	418.95
01:00-02:00	565.81	503.81
02:00-03:00	570.23	527.23
03:00-04:00	718.55	658.55
04:00-05:00	1104.71	987.71
05:00-06:00	1547.87	1405.87
06:00-07:00	1733.22	1579.22
07:00-08:00	1783.72	1613.72
08:00-09:00	1785.34	1635.34
09:00-10:00	1768.33	1626.33
10:00-11:00	1753.71	1583.71
11:00-12:00	1641.45	1501.45
12:00-13:00	1661.99	1511.99
13:00-14:00	1571.75	1433.75
14:00-15:00	1566.91	1416.91
15:00-16:00	1598.66	1450.66
16:00-17:00	1609.55	1489.55
17:00-18:00	1501.36	1471.36
18:00-19:00	1453.91	1432.91
19:00-20:00	1549.16	1360.16
20:00-21:00	1266.07	1148.07
21:00-22:00	927.55	801.55
22:00-23:00	715.75	578.75
23:00-24:00	629.87	525.87
Max	1785.34	1635.34
Average	1314.85	1194.31
Total distribution	31556.42	28663.42
Hourly maximum dist./average dist. (Peak)	1.36	1.37

00:00-01:00	(783.90)	(775.36)
01:00-02:00	(749.04)	(690.50)
02:00-03:00	(744.62)	(667.08)
03:00-04:00	(596.30)	(535.76)
04:00-05:00	(210.14)	(206.60)
05:00-06:00	233.02	211.56
06:00-07:00	418.37	384.91
07:00-08:00	468.87	419.41
08:00-09:00	470.49	441.03
09:00-10:00	453.48	432.02
10:00-11:00	438.86	389.40
11:00-12:00	326.60	307.14
12:00-13:00	347.14	317.68
13:00-14:00	256.90	239.44
14:00-15:00	252.06	222.60
15:00-16:00	283.81	256.35
16:00-17:00	294.70	295.24
17:00-18:00	186.51	277.05
18:00-19:00	139.06	238.60
19:00-20:00	234.31	165.85
20:00-21:00	(48.78)	(46.24)
21:00-22:00	(387.30)	(392.76)
22:00-23:00	(599.10)	(615.56)
23:00-24:00	(684.98)	(668.44)
Necessary reservoir volume (m <sup>3</sup> )	4804.17	4598.29
Necessary volume /average hourly dist. Volume (hour)	3.65	3.85





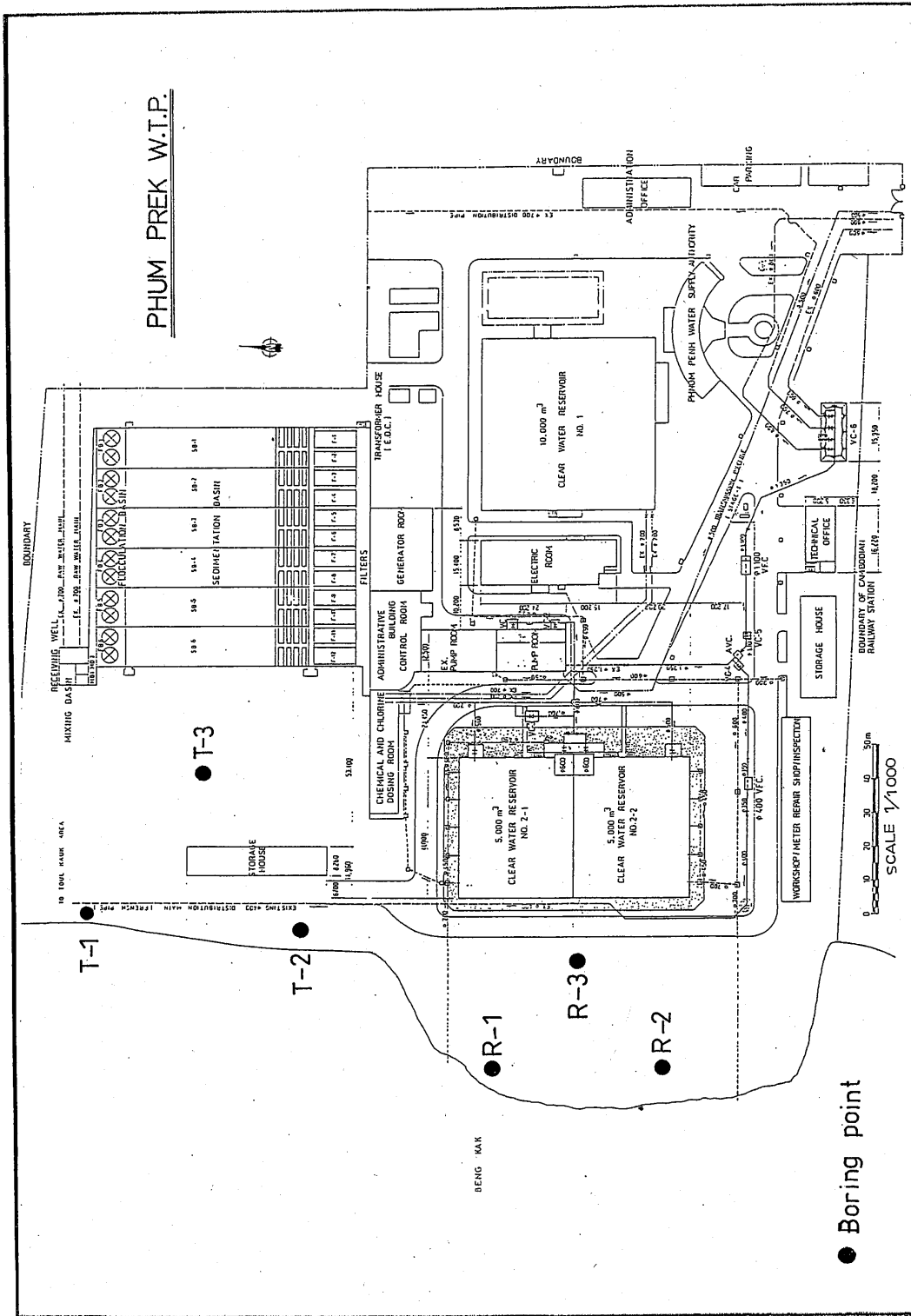
漏水率の算定

地域	ゾーン名	ゾーンメーター ディング (総配水量) m3/3日間	消費者メー ーディング(総 消費量) m3/3日間	漏水量 m3/3日間	漏水率 %	測定年月
Daun Penh	Zone 1	8,479	6,549	1,930	23	1999年11月
	Zone 5A	4,260	3,746	514	12	1999年10月
	Zone 5B	1,892	1,598	294	16	1999年9月
	Zone 6	3,316	2,726	590	18	2000年1月
	Zone 7A	3,358	2,635	723	22	1999年8月
	Zone 12	373	287	86	23	2000年2月
	Zone 14	8,268	7,623	645	8	2000年3月
	Zone 15	1,985	1,628	357	18	1999年12月
	小計/平均	31,931	26,792	5,139	16	
7th January	Zone 1	3,118	2,829	289	9	2000年2月
	Zone 2	1,907	1,761	146	8	2000年2月
	Zone 7	2,813	2,477	336	12	2000年2月
	Zone 8	1,997	1,690	307	15	2000年2月
	Zone 10	2,656	2,474	182	7	2000年3月
	小計/平均	12,491	11,231	1,260	10	
合計/平均		44,422	38,023	6,399	14	

データの出所：PPWSA



資料 7-5 ボーリングデータ (位置図)



ボーリング結果 (柱状図)

RESEARCH AND DESIGN ENTERPRISE		FIELD BORING LOG		SHEET 1			
SOIL TESTING LABORATORY		BOREHOLE No..R-1					
STANDARD PENETRATION TEST							
Project: W.T.P		Date started..13/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.			
Owner :		Date finished 13/06/2000		Size 120mm ,Elevation: + 11.645			
Contractor :		Method :Rotary Auger		On 13/06/2000 Time...07h30 am			
sub contractor :		Depth to water flow : 4.50m.		On 13/06/2000 Time. 10 h30 am			
sub contractor :		Depth to water level: 2.70m.					
DEPTH and TYPE OF SAMPLE			DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D U No					
0			1/ Made ground( brown silt, clay, sand, crushed stone, crushed brick and plastic bag, encountered from ground surface to 1.00m depth.	0.00			
1							
2		D 1	Dark-grey, brown silt, clay, silt and sand encountered from 1.00 to 4.00m depth.	(4.00)		1.50 to 1.95m = 1, 2, 4, N-6	200/450
3							
4		D 2		4.00		3.00 to 3.45m = 1, 1, 2, N-3	300/450
5							
6		D 4	2/ Medium brown silty lean CLAY(CL).	(3.00)		5.00m to 5.45m = 1, 3, 2, N-5	300/450
7							
8		D 5		7.00		6.00m to 6.45m = 2, 3, 5, N-8	300/450
9							
10		D 6	3/ Stiff red, grey fat CLAY(CH).	(1.00)		7.50m to 7.95m = 2, 4, 6, N-10	300/450
11							
12		D 9	4/ Medium dense yellow and grey very clayey fine to medium SAND(CS), with gravel.	(3.00)		9.00m to 9.45m = 3, 5, 10, N-15	320/450
13							
14		D 10		11.00		10.50m to 10.95m 6, 10, 11, N-21	300/450
15							
		D 11	5/ Dense grey and yellow very clayey fine to medium SAND(CS), with gravel.	(2.00)		12.00m to 12.45m 9, 20, 22, N-42	450/450
		D 12	6/ Dense yellow and very clayey medium to coarse SAND(CS), with gravel.	(3.00)		13.50m to 13.95m 10, 20, 20, N-40	330/450
consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test	
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test	
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test	
Medium 4 to 8		Medium 10 to 30				qu = .....Kgf/cm <sup>2</sup>	
Stiff 8 to 15		Dense 30 to 50				K Permeability	
Very stiff 15 to 30		Very dense Over 50				Figure 2	
Hard 30 to 50							

RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..R-1				SHEET 2	
STANDARD PENETRATION TEST									
Project: W.T.P		Date started..13/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.					
Owner :		Date finished 13/06/2000		Size 120mm ,Elevation: + 11.615					
Contractor :		Method :Rotary Auger		On 13/06/2000		Time:..07h30 am			
sub contractor :		Depth to water flow : 4.50m.		On 13/06/2000		Time. 10 h30 am			
Depth to water level: 2.70m.									
DEPTH and TYPE OF SAMPLE					DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)	
(M)	(M)	D	U	No					
15		D		13	16.00 (1.00)		15.00m to 15.45 = 9, 13, 20, N-33	450/450	
16									
17		D		14	17.00		16.50m to 16.95m 25, 25,15,N>50	250/400	
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST			
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test			
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test			
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test			
Medium 4 to 8		Medium 10 to 30				q <sub>b</sub> = .....Kgf/cm <sup>2</sup>			
Stiff 8 to 15		Dense 30 to 50				K Permeability			
Very stiff 15 to 30		Very dense Over 50				Figure 2a			
Hard 30 to 50									

RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..R-2				SHEET 1	
STANDARD PENETRATION TEST									
Project: W.T.P		Date started..12/06/2000			Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.				
Owner :		Date finished 12/06/2000			Size 120mm ,Elevation: + 11.250				
Contractor :		Method :Rotary Auger			On 12/06/2000 Time...10h0am				
sub contractor :		Depth to water flow : 4.50m.			On 12/06/2000 Time. 15 h15pm				
sub contractor :		Depth to water level: 2.50m.							
DEPTH and TYPE OF SAMPLE				DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	SPT (N) BLOWS/300MM	RECOVERY RATIO (MM)	
(M)	(M)	D	U						No
0					0.00				
1				1/ Made ground ( Brown silt, clay, sand, crushed stone and crushed brick, encountered from surface to 2.00m depth.					
2		D		1			1.50 to 1.95m = 1, 1, 2, N-3	200/450	
3				Dark-grey, black clay, silt, sand and peat, encountered from 2.00m to 4.50m depth.	(4.50)				
4		D		2			3.00 to 3.45m = 0, 0, 0, N<1	250/450	
5		D		3	4.50				
6				2/ Stiff trace sandy fat CLAY(CH).	5.00		4.50m to 4.95m = 2, 3, 7, N-10	250/450	
7		D		4	(1.50)				
8				3/ Very soft dark-grey clay, silt, sand and peat.	6.50		5.50m to 5.95m = 1, 1, 1, N-2	300/450	
9		D		5	(1.00)				
10				4/ Stiff yellow and grey fine sandy lean CLAY (CL).	7.50				
11		U		6	8.00				
12		D		7	8.50		7.90m to 8.35m = 6, 8, 43, N-51	400/450	
13				5/ Medium dense yellow F-M SAND, gravel.	(1.00)				
14		D		8	9.50		9.00m to 9.45m = 5, 10, 10, N-20	400/450	
15				6/ Very dense yellow F-M SAND, gravel.	(1.50)				
16		D		9	11.00		10.50m to 10.95m 8, 13, 15, N-28	350/450	
17				7/ Medium dense grey, yellow fine to medium SAND(CS), with gravel.	(3.00)				
18		D		10	14.00		12.00m to 12.45m 11, 14, 15, N-29	370/450	
19				8/ Medium dense grey and yellow very clayey					
20		D		11			13.50m to 13.95m 9, 13, 14, N-27	350/450	
21				9/ Very stiff grey and yellow fine to medium sandy lean CLAY(CL).					
22		D		10/ Dense yellow and grey very clayey medium to coarse SAND(CS), gravel.					

consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test	
Very soft	0 to 2	Very loose	0 to 4	U-Undisturbed sample		VT	Shear vane test
Soft	2 to 4	Loose	4 to 10			PT	pocket penetrometer test
Medium	4 to 8	Medium	10 to 30			q <sub>u</sub>	= .....Kgf/cm <sup>2</sup>
Stiff	8 to 15	dense	30 to 50			K	Permeability
Very stiff	15 to 30	Dense	30 to 50				
Hard	30 to 50	Very dense	Over 50				






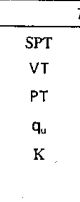

Figure 3

RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..R-2 STANDARD PENETRATION TEST				SHEET 2	
Project: W.T.P		Date started..12/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.					
Owner :		Date finished 12/06/2000		Method :Rotary Auger		Size 120mm ,Elevation: + 11.250			
Contractor :		Depth to water flow : 4.50m.		On 12/06/2000		Time...10h0am			
sub contractor :		Depth to water level: 2.50m.		On 12/06/2000		Time. 15 h15pm			
DEPTH and TYPE OF SAMPLE				DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)	
(M)	(M)	D	U						No
15	-	D		12	10/ Dense yellow and grey very clayey medium to coarse SAND(CS), gravel.		15.00m to 15.45m = 25, 20, 21, N-41	450/450	
16	-						16.50		
17	-	D		13	11/ Hard grey mottled yellow fine to medium sandy lean CLAY(CL).		16.50m to 16.95m 10, 20, 19, N-39	300/450	
18	-						17.50		
19	-	D		14	12/ Dense yellow very clayey medium to coarse SAND(CS), with gravel.		18.00m to 18.45m 10, 19, 19, N-38	320/450	
20	-	U		15			19.50m to 19.95m 25, 22, 22, N-44	330/450	
20	-	D		16					
				End of borehole No R-2 at 20.00m depth.					
21	-								
22	-								
23	-								
24	-								
25	-								
26	-								
27	-								
28	-								
29	-								
30	-								
consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST			
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test			
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test			
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test			
Medium 4 to 8		Medium dense 10 to 30				q <sub>u</sub> = .....Kgf/cm <sup>2</sup>			
Stiff 8 to 15		Dense 30 to 50				K Permeability			
Very stiff 15 to 30		Very dense Over 50							
Hard 30 to 50									

Figure 3a

STANDARD PENETRATION TEST

Project: W.T. P	Date started..13/06/2000	Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.
Owner :	Date finished 13/06/2000	Size 120mm ,Elevation.: + 11.575
Contractor :	Method :Rotary Auger	On 13/06/2000 <span style="float: right;">Time...11h00Am</span>
sub contractor :	Depth to water flow : 6.00m.	On 13/06/2000 <span style="float: right;">Time. 18 h00 Pm</span>
	Depth to water level: 2.60m.	

DEPTH and TYPE OF SAMPLE					DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
0	-				1/ Made ground( Reddish-brown sand, clay, silt and gravel(laterite), encountered from ground surface to 0.30m and crushed stone encountered from 0.30m to 0.50m depth.	0.00		1.50 to 1.95m = 1, 2, 3, N-5	350/450
1	-				Medium brown silt, clay and sand from 0.5m to..	(2.50)			
2	-	D		1	2/ Stiff brown mottled grey fat CLAY(CH).	2.50		3.00 to 3.45m = 1, 2, 2, N-4	350/450
3	-		U	2		3.00			
4	-	D		3		4.50		4.50m to 4.95m = 2, 4, 6, N-10	270/450
5	-		U	4		5.50			
6	-	D		5	3/ Soft dark-grey clay, silt, sand and peat.	(1.00)		6.00m to 6.45m = 1, 1, 2, N-3	400/450
7	-			6		6.50			
8	-	D		7	4/ Medium dense yellow, grey very silty fine medium SAND(MS). with gravel.	(4.50)		7.50m to 7.95m = 4, 9, 11, N-20	300/450
9	-			8		9.00m to 9.45m = 8, 18, 12, N-30			
10	-	D		9	5/ Medium dense grey, yellow very clayey fine to medium SAND(CS).	10.00		10.50m to 10.95m 6, 10, 13, N-23	300/450
11	-		U	10		11.50			
12	-	D		11	6/ Dense greenish-grey very clayey medium to coarse SAND(CS), with gravel.	(4.50)		12.00m to 12.45m 10, 17, 24, N-41	350/450
13	-			12		13.50m to 13.95m 7, 13, 17, N-30			
14	-	D		13	END OF BOREHOLE No R-3 at 15.00m.	15.00		14.50m to 14.95m 7, 18, 19, N-37	300/450

consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test	
Very soft	0 to 2	Very loose	0 to 4	U-Undisturbed sample		VT	Shear vane test
Soft	2 to 4	Loose	4 to 10			PT	pocket penetrometer test
Medium	4 to 8	Medium				q <sub>s</sub>	= .....Kgf/cm <sup>2</sup>
Stiff	8 to 15	dense	10 to 30			K	Permeability
Very stiff	15 to 30	Dense	30 to 50				
Hard	30 to 50	Very dense	Over 50				

Figure 4

STANDARD PENETRATION TEST

Project: W.T.P	Date started..15/06/2000	Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.
Owner :	Date finished 15/06/2000	Size 120mm ,Elevation:: + 10.395
Contractor :	Method :Rotary Auger	On 15/06/2000 Time...07h00Am
sub contractor :	Depth to water flow : 3.20m.	On 15/06/2000 Time. 11 h30am
	Depth to water level: 1.70m.	

DEPTH and TYPE OF SAMPLE					DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
0					1/ Made ground( brown silt,clay and sandy) encountered from ground surface to 1.00m.	0.00			
1					Medium brown clay and lean SILT(ML), encountered from 1.00m to 3.50m depth.	(3.50)		1.50 to 1.95m = 1, 2, 3, N-5	200/450
2		D		1				3.00 to 3.45m = 1, 2, 3, N-5	250/450
3									
4					2/ Very loose dark-grey silty fine SAND(MS).	(1.50)		4.50m to 4.95m = 1, 1, 1, N-2	400/450
5		D		4					
6					3/ Very soft brown clay, SILT(ML).	(2.00)		6.00m to 6.45m = 0, 1, 1, N-2	300/450
7		D		6					
8					4/ Stiff grey, yellow and brown fat CLAY(CH).	(1.00)		7.50m to 7.95m = 3, 4, 7, N-11	350/450
9		D		8					
10					5/ Very stiff orange, grey and yellow fine to medium sandy lean CLAY(CL).	(1.50)		9.00m to 9.45m = 6, 12, 14, N-26	300/450
11		D		10				10.50m to 10.95m 10, 11, 11, N-22	320/450
12					6/ Medium dense yellow and grey very clayey medium to coarse SAND(CS), gravel.	(3.50)		12.00m to 12.45m 8, 13, 16, N-29	370/450
13		D		11					
14					7/ Dense greenish-grey very clayey medium to coarse SAND(CS), with gravel.	(2.50)		13.50m to 13.95m 9, 18, 29, N-47	300/450
15		D		12					

consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT	Standard penetration test
Very soft	0 to 2	Very loose	0 to 4	U-Undisturbed sample		VT	Shear vane test
Soft	2 to 4	Loose	4 to 10			PT	pocket penetrometer test
Medium	4 to 8	Medium	10 to 30			q <sub>u</sub>	= .....Kgf/cm <sup>2</sup>
Stiff	8 to 15	dense	30 to 50			K	Permeability
Very stiff	15 to 30	Dense	Over 50				
Hard	30 to 50	Very dense.					

Figure 5

RESEARCH AND DESIGN ENTERPRISE		FIELD BORING LOG		SHEET 2			
SOIL TESTING LABORATORY		BOREHOLE No..T-1		STANDARD PENETRATION TEST			
Project: W.T.P		Date started..14/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.			
Owner :		Date finished 14/06/2000		Size 120mm ,Elevation:: + 10.395			
Contractor :		Method :Rotary Auger		On 14/06/2000 Time...07h00Am			
sub contractor :		Depth to water flow : 3.20m.		On 14/06/2000 Time. 11 h30am			
DEPTH and TYPE OF SAMPLE		DESCRIPTION OF STRATA		DEPTH and THICK.	LEGEND of SOIL	SPT (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No			
15	-	D		13		15.00m to 15.45 = 10, 15, 30, N-45	270/450
16	-						
17	-	D		14	8/ Very dense grey, yellow very clayey medium to coarse SAND(CS), with gravel.	16.50m to 16.95m 12, 26, 25, N-51	250/450
18	-	D		15		16.50m to 16.95m 6, 20, 30, N-50	270/450
19	-				End of borehole No T-1 at 18.00m depth.		
20	-						
21	-						
22	-						
23	-						
24	-						
25	-						
26	-						
27	-						
28	-						
29	-						
30	-						
Consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test	
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test	
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test	
Medium 4 to 8		Medium 10 to 30				q <sub>u</sub> = .....Kgf/cm <sup>2</sup>	
Stiff 8 to 15		Dense 30 to 50				K Permeability	
Very stiff 15 to 30		Very dense Over 50				Figure 5a	
Hard 30 to 50							



RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..T-2 STANDARD PENETRATION TEST				SHEET 1	
Project: W.T.P		Date started..14/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.					
Owner :		Date finished 14/06/2000		Size 120mm ,Elevation:. + 11.240					
Contractor :		Method :Rotary Auger		On 14/06/2000				Time...06h30Am	
sub contractor :		Depth to water flow : 3.20m.		On 14/06/2000				Time. 12 h30pm	
sub contractor :		Depth to water level: 1.40m.							
DEPTH and TYPE OF SAMPLE					DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	S P T (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
0					1/ Made ground ( Brown clay, silt, sand and crushed brick, crushed stone, encountered from ground surface to 2.00m depth.	0.00			
1						(2.00)			
2		D		1	2/ Medium brown clay lean SILT(ML).	2.00		1.50 to 1.95m = 2, 3, 3, N-6	200/450
3			U	2		(1.00)			
4		D		3	3/ Soft brown silt, fat CLAY(CH).	(1.00)		3.00 to 3.45m = 1, 2, 2, N-4	350/450
5					4/ Very loose black peat, clay and fine SAND. (MS).	(1.00)			
6		D		4	5/ Soft brown fat CLAY(CH).	5.00		4.50m to 4.95m = 1, 0, 1, N-1	400/450
7			U	5		(1.00)			
8		D		6	6/ Very loose dark-grey silty fine SAND(MS).	(1.00)			
9					7/ Medium brownish-grey fat SILT(MH).	7.50		6.50m to 6.95m = 1, 0, 0, N<1	400/450
10		D		7				7.50m to 7.95m = 4, 6, 9, N-15	250/450
11					8/ Medium dense yellow, grey very clayey fine to coarse SAND(CS), with gravel.	(4.50)		9.00m to 9.45m = 5, 8, 12, N-20	300/450
12		D		10		12.00		10.50m to 10.95m 5, 10, 12, N-22	270/450
13					9/ Dense yellow, grey very clayey medium to coarse SAND(CS), with gravel.	(1.50)		12.00m to 12.45m 11, 16, 17, N-33	300/450
14		D		12		13.50		13.50m to 13.95m 6, 12, 16, N-28	450/450
15					10/ Medium dense greenish-grey very clayey fine to coarse SAND, with gravel.	(1.50)			
consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST			
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test			
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test			
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test			
Medium 4 to 8		Medium 10 to 30				q <sub>u</sub> = .....Kgf/cm <sup>2</sup>			
Stiff 8 to 15		Dense 30 to 50				K Permeability			
Very stiff 15 to 30		Very dense Over 50				Figure 6			
Hard 30 to 50									

RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..T-2				SHEET 2	
STANDARD PENETRATION TEST									
Project: W.T.P		Date started..14/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.					
Owner :		Date finished 14/06/2000		Size 120mm ,Elevation: + 11.240					
Contractor :		Method :Rotary Auger		On 14/06/2000			Time...06h30Am		
sub contractor :		Depth to water flow : 3.20m.		On 14/06/2000			Time. 12 h30pm		
DEPTH and TYPE OF SAMPLE		DESCRIPTION OF STRATA				DEPTH and THICK.	LEGEND of SOIL	SPT (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
15	-			13	11/ Very dense grey and yellow very clayey medium to coarse SAND(CS), with gravel.	(1.00)		15.00m to 15.45 = 14, 29, 21, N>50	350/400
16	-				12/ Dense grey and yellow very clayey medium to coarse SAND(CS), with gravel.	(1.00)		1blow = 5mm.	
17	-	D		14		17.00		16.50m to 16.95m 8, 19, 25, N-44	330/450
18	-				End of borehole No T-2 at 17.00m depth.				
19	-								
20	-								
21	-								
22	-								
23	-								
24	-								
25	-								
26	-								
27	-								
28	-								
29	-								
30	-								
consistency		RELATIVE DENSITY		TYPE OF SAMPLE			TYPE OF FIELD TEST		
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample			SPT Standard penetration test		
Very soft	0 to 2	Very loose	0 to 4	U-Undisturbed sample			VT Shear vane test		
Soft	2 to 4	Loose	4 to 10				PT pocket penetrometer test		
Medium	4 to 8	Medium					q <sub>u</sub> = .....Kg/cm <sup>2</sup>		
Stiff	8 to 15	dense	10 to 30				K Permeability		
Very stiff	15 to 30	Dense	30 to 50				Figure 6a		
Hard	30 to 50	Very dense	Over 50						

RESEARCH AND DESIGN ENTERPRISE SOIL TESTING LABORATORY				FIELD BORING LOG BOREHOLE No..T-3 STANDARD PENETRATION TEST				SHEET 1	
Project: W.T.P		Date started..14/06/2000		Location:Phum prek W.T.P, khan toul kork, Phnom Penh Kingdom of Cambodia.					
Owner :		Date finished 14/06/2000		Size 120mm ,Elevation:.. ± 11.39C					
Contractor :		Method :Rotary Auger		On 14/06/2000				Time...13h0pm	
sub contractor :		Depth to water flow : 3.30m.		On 14/06/2000				Time. 18 h30pm	
DEPTH and TYPE OF SAMPLE		DESCRIPTION OF STRATA				DEPTH and THICK.	LEGEND of SOIL	SPT (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
0					1/ Made ground( reddish-brown clay, silt, sand , gravel(laterite) and crushed stone, encountered from ground surface to 0.50m depth.	0.00			
1						(2.00)			
2		D		1	Brown silt, clay and sand from 0.50m to 2.00m.	2.00		1.50 to 1.95m = 2, 3, 3, N-6	370/450
3			U	2	2/ Medium brown, grey and yellow fat CLAY.	2.50			
4		D		3	3/ Soft brown silty lean CLAY(CL).	3.00			
5			D	4	4/ Very loose dark-grey silty fine SAND(MS).	(1.00)		3.00 to 3.45m = 1, 3, 1, N-4	300/450
6			U	5		4.00			
7		D		6	5/ Medium brown, dark-grey silty lean CLAY (CL).	(4.00)		5.00m to 5.45m = 1, 2, 2, N-4	250/450
8			D	7		6.00m to 6.45m = 2, 3, 3, N-6	200/450		
9			D	8		7.50m to 7.95m = 2, 3, 3, N-6	350/450		
10			D	9		9.00m to 9.45m = 3, 4, 4, N-8	350/450		
11			D	10	6/ Stiff yellow and grey fine to medium sandy lean CLAY(CL).	(3.50)		10.50m to 10.95m 4, 5, 8, N-13	300/450
12			D	11		11.50			
13			D	12	7/ Medium dense greenish-grey very clayey fine to coarse SAND(CS), with gravel.	(2.00)		12.00m to 12.45m 6, 10, 16, N-26	350/450
14			D	13		13.50			
15				14	8/ Dense greenish-grey, light-grey very clayey medium to coarse SAND(CS), with gravel.			13.50m to 13.95m 8, 11, 15, N-26	450/450
				15					
consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST			
SPT(N),Blows/300mm		SPT(N),Blows/300mm		D-disturbed sample		SPT Standard penetration test			
Very soft 0 to 2		Very loose 0 to 4		U-Undisturbed sample		VT Shear vane test			
Soft 2 to 4		Loose 4 to 10				PT pocket penetrometer test			
Medium 4 to 8		Medium dense 10 to 30				q <sub>b</sub> = .....Kgf/cm <sup>2</sup>			
Stiff 8 to 15		Dense 30 to 50				K Permeability			
Very stiff 15 to 30		Very dense Over 50				Figure 7			
Hard 30 to 50									

STANDARD PENETRATION TEST

Project: W.T.P	Date started: 14/06/2000	Location: Phum prek W.T.P, Khan Toul Kork, Phnom Penh Kingdom of Cambodia.
Owner :	Date finished: 14/06/2000	Size 120mm, Elevation: + 11.390
Contractor :	Method: Rotary Auger	On 14/06/2000 Time: 13h0pm
sub contractor :	Depth to water flow: 3.30m	On 14/06/2000 Time: 18 h30pm
	Depth to water level: 2.60m	

DEPTH and TYPE OF SAMPLE					DESCRIPTION OF STRATA	DEPTH and THICK.	LEGEND of SOIL	SPT (N) BLOWS/300MM	RECOVERY RATIO (MM)
(M)	(M)	D	U	No					
15		D		13	8/ Dense greenish-grey, light-grey very clayey medium to coarse SAND(CS), with gravel.	(4.50)		15.00m to 15.45 = 11, 16, 19, N-35	400/450
16				14					
17		D		14					
18				15	9/ Very dense grey, yellow very clayey medium to coarse SAND(CS), with gravel.	18.50		16.50m to 16.95m 6, 13, 30, N-43	450/450
19		D		15					
20		D		16		20.00		18.00m to 18.45m 13, 18, 24, N-42	370/450
21					End of borehole No T-3 at 20.00m depth.			19.50m to 19.95m 3, 17, 35, N-52	350/450
22									
23									
24									
25									
26									
27									
28									
29									
30									

consistency		RELATIVE DENSITY		TYPE OF SAMPLE		TYPE OF FIELD TEST	
SPT(N),Blows/300mm		SPT(N),Blows/300mm					
Very soft	0 to 2	Very loose	0 to 4	D-disturbed sample	SPT	Standard penetration test	
Soft	2 to 4	Loose	4 to 10	U-Undisturbed sample	VT	Shear vane test	
Medium	4 to 8	Medium			PT	pocket penetrometer test	
Stiff	8 to 15	dense	10 to 30		q <sub>w</sub>	= .....Kgf/cm <sup>2</sup>	
Very stiff	15 to 30	Dense	30 to 50		K	Permeability	
Hard	30 to 50	Very dense	Over 50				

Figure 7a

資料 7 - 6 計画施設・機材概要

本計画で建設される取水施設、導水施設、浄水施設、配水施設およびその工事中機材及び水質分析機器の調達機材の内容は以下のとおり。

1) 工事中機材

施設/設備	内容・仕様
<b>1. 取水施設</b>	
1.1 取水ポンプ (新設)	3 基 立軸斜流ポンプ 36.7m <sup>3</sup> /分 × 21.0m × 185kW × 50Hz × 3kV
1.2 取水ゲート (改修)	4 組 1.0m × 1.0m 角形ゲートの開閉台ロッドの取り替え ベベルギヤー付開閉台 (内ネジ式) 4 台 ロッド (SUS316) 50mm × 7.16m 2 本 50mm × 13.42m 2 本
1.3 天井走行クレーン (改修)	1 基 トロリ部分の取り替え 吊上荷重 : 6.0ton 吊上高 : 8.0m 電動機 : 吊上 5.5kW × 380V 横行 0.75kW × 380V
1.4 空気弁 (改修)	1 基 既存を撤去、75mm 急排気弁を新設
1.5 空気設備 (改修)	1 式 18m <sup>3</sup> × 2 器 既存を廃止、新設備を地上に設置 1200mm 新設管及び 700mm 既存管に接合
<b>2. 導水施設</b>	
2.1 導水管分岐弁室 (新設)	1 室 既存導水管ヘッダーパイプより分岐 (900mm × 2 条)、 分岐弁室 (RC 造り、幅 5.10m × 長さ 3.90m × 高さ 3.33m) 分岐弁 900mm バタフライ弁 2 基設置
2.2 導水管 (新設)	1,500m 1,200mm 内面モルタルライニング・ダクタイル鋳鉄管
2.3 導水管連絡管 (新設)	約 50m 1,200mm 内面モルタルライニング・ダクタイル鋳鉄管
<b>3. 着水井施設</b>	
3.1 着水井築造 (新設)	1 池 RC 造り、幅 5.30m × 長さ 15.90m × 高さ 6.60m (平均水深 5.00m)
3.2 原水流量調節弁 (新設)	1 基 1,200mm 整流板付バタフライ弁 (開閉台、ロッド含む)
3.3 原水流量計 (新設)	2 基 既存、新設浄水施設用堰 / フロート式流量計 (SUS316 製堰板む) を着水井に設置する。 堰長 : 新設浄水施設用 1.8m、既存浄水一説用 3.15m

<b>4.凝集・薬品沈澱池施設</b>	
4.1 急速攪拌池築造（新設）	既存、新設浄水場施設用・各1池 既存用； RC造り、幅3.15m×長さ5.00m×水深4.55m 新設用； RC造り、幅1.80m×長さ5.00m×水深4.55m
4.2 急速攪拌機	堰よりの落差を利用した水流エネルギーによる攪拌
4.3 連絡管（新設）	2式 急速攪拌池～フロック形成池原水渠間 既存用； 1,350mm内面モルタルライニング・ダクティル鑄鉄管 新設用； 1,000mm内面モルタルライニング・ダクティル鑄鉄管
4.4 フロック形成池築造：	8池 RC造り、幅5.50m×長さ7.00m×高さ3.70m（平均水深3.46m）
4.5 フロッキュレータ（新設）	8基 機械式フロッキュレーター 径4.5m×3.7KW×380V
4.6 フロック形成池流入ゲート（新設）	8基 手動式角型ゲート 450mm×450mm
4.7 薬品沈澱池築造（新設）	4池 横流式沈澱池、RC造り、幅11.30m×長さ50.00m平均深2.54m
4.8 流入・中間・流出整流壁（新設）	4池 排泥作業用開口扉付整流壁を設置
4.9 既設流入整流壁（改造）	6池 旋回流流入整流壁を排泥作業用開口扉付整流壁に改造
4.10 排泥弁（新設）	8基 350mmトップバルブ（こま形弁）を設置
4.11 作業用圧力水管（新設）	1式 75mm内面モルタルライニング・ダクティル鑄鉄管
4.12 集水トラフ（新設）	24本 オリフィス・ノチ式集水トラフ
4.13 沈澱水渠排水弁（新設）	3基 100mmトップバルブ（こま形弁）を設置
<b>5.急速ろ過池施設</b>	
5.1 ろ過池築造（新設）	8池、RC造り 幅4.50m×長さ10.85m=48.825 m <sup>2</sup> /池
5.2 ろ過池流入ゲート（新設）	16基 幅630mm×高さ380mm 電動・外ネジ式ゲート（SUS316）
5.3 ろ過流量調節器（新設）	8基 サイフォン型ろ過流量調節機（SUS316製） QNor.=300 m <sup>3</sup> /時、QMax=399 m <sup>3</sup> /時 接続口径300mm
5.4 ろ過水弁（新設）	8基 空圧式アクアチェーター付フランジレスバタフライ弁 300mm
5.5 水逆洗弁（新設）	8基 空圧式アクアチェーター付フランジレスバタフライ弁 450mm
5.6 空気逆洗弁（新設）	8基 空圧式アクアチェーター付フランジレスバタフライ弁 250mm
5.7 ろ過池排水弁（新設）	8基 手動ハンドル付仕切弁 150mm
5.8 調節機室排水弁（新設）	8基 手動ハンドル付仕切弁 75mm
5.9 ろ過砂（新設）	8池 シリカ砂、有効径1.0mm、均等係数1.5以下、砂層厚1.0m
5.10 下部集水装置（新設）	391 m <sup>2</sup> （8池分） 水・空気逆洗方式集水装置

5.11 操作台（新設）	4 台 2 池操作型操作台
<b>6. 薬品注入設備</b>	
6.1 薬品注入棟構造（新設）	1 棟 1 階 = 540 m <sup>2</sup> 、2 階 = 396 m <sup>2</sup> 、中 2 階 = 144 m <sup>2</sup> 薬品注入室、塩素注入室、水質分析室、塩素中和装置室、 薬品 / 塩素倉庫より構成される。
6.2 硫酸バンド溶解・注入設備 （新設）	溶解槽 4 槽 内径 2.0m × 高さ 2.6m、FRP 製 攪拌機 4 種 縦型電動攪拌機 450mm × 2 段 × 3.7KW × 380V × 50Hz 液位計 4 基 電極式液位スイッチ（3 接点） 注入装置 2 槽 幅 0.8m × 長さ 1.5m × 高さ 0.7m 三角堰 30 度流量表示板付
6.3 消石灰注入設備（新設）	攪拌槽 2 槽 幅 2.0 × 長さ 3.0 × 高さ 2.5m（有効水深 2.0m） RC 造り 攪拌機 2 基 800mm × 2 段 × 5.5KW × 380V × 50Hz 液位計 4 基 電極式液位スイッチ（3 接点） サチュレイタ用攪拌機 1 基 縦型電動攪拌機 250mm × 1 段 × 0.4kW × 380V × 50Hz 消石灰乳液槽用サチュレイタ 1 基 350mm × 950mm 給水用流量計 1 基 100mm オリフィス式流量計 20 ~ 100 m <sup>3</sup> / 時 給水管 150mm 内面珪素ライニング・ダクタイル鉄管
6.4 塩素注入設備（新設）	塩素ガス注入装置 4 基（前塩、後塩用各 2 基） 自立キャビネット型 真空調整器 2 台（前・後塩用各 1 台） 壁掛式マニホールド管取付型 注入量；最大 40kg / 時 注入圧力；最大 1.0Mpa エジェクター 4 台（前・後塩用各 2 台） 作動流量；400 l / 分 作動圧力；0.6Mpa 口 径；50mm 流量計 4 台（前・後塩用各 2 台） キャビネット内蔵型 流量範囲；0 ~ 40kg / 時 給水ポンプ 4 台 流 量；0.4 m <sup>3</sup> / 分 揚 程；23 ~ 25m 配管材； 100mm 内面珪素ライニング・ダクタイル鉄管 塩素ポンペ 30 本

6.5 塩素ガス中和装置（新設）：	1 式 中和能力；1,000kg 排風機；FRP 製耐蝕性ターボファン風量 60 m <sup>3</sup> /分、静圧 250mmAg 5.5KW × 380V × 50Hz 中和塔；PVC 製円筒型屋内 2 塔式充填塔 1.05m × 2 筒 × 高さ 1.2m 苛性ソーダ溶液槽；鋼板製角形内面 PVC ライニング槽 4.5m × 2.0m × 1.5m × 1 槽 苛性ソーダポンプ；PVC 製ポンプ 1.2 m <sup>3</sup> /分 × 10mAg × 7.5KW × 380V × 50Hz × 1 台 塩素ガス漏洩検知器；6 台（発信器、受信器付） 検知範囲：0～3ppm
<b>7. 配水施設</b>	
7.1 配水池築造（新設）	5,000 m <sup>3</sup> 1 池、RC 造り 幅 24.8m × 長さ 66.8m × 高さ 3.85m（有効水深 3.10m）
7.2 配水池流入連絡管（新設）	1 条 700mm 内面珪藻土ライニング・ダクタイル鋳鉄管
7.3 流量計（新設）	1 基 流入連絡管に挿入形圧電式流量計を設置。口径 700mm
7.4 配水池流出連絡管（新設）	1 条 700mm 内面珪藻土ライニング・ダクタイル鋳鉄管
7.5 配水ポンプ（改修）	3 台 既設 NO.1 ポンプ室に設置する。 35.0 m <sup>3</sup> /分 × 42m × 320KW × 3KV × 50Hz サクシオンパイプ、デリバリーパイプも改修
7.6 配水ポンプ（新設）	1 台 既存 NO.2 ポンプ室に設置する。 17.5m <sup>3</sup> /min × 42m × 180kw × 3kv × 50Hz
7.7 配水本管連絡管（改修）：	1 条 既存配水本管 800mm を廃棄し、ポンプレック浄水場内 配水本管 1,350mm と ADB 送水本管との連絡管 1,000mm 内面珪藻土ライニング・ダクタイル鋳鉄管
<b>8. 水質分析設備</b>	
8.1 水質分析室（新設）	薬品注入棟の一部に設置
8.2 水質分析機器（新設）	1 式 最小必要機器類、ガラス器具類および試薬類（別表参照）
8.3 サンプリンポンプ（新設）	原水ウパリングポンプ（横型ポンプ）2 台（内一台予備） 既存、新設沈澱水ウパリングポンプ（水中ポンプ）各 2 台（内各一台予備） 既存、新設ろ過水ウパリングポンプ（水中ポンプ）各 2 台（内各一台予備）
<b>9. 電気・計装設備</b>	
9.1 取水ポンプ用ポンプ起動盤（新設）	2 面 既存取水電気室に設置
9.2 同上用補助継電器盤（新設）	1 面 既存取水電気室に設置
9.3 制御線（新設）	1 式 新設導水管に沿って埋設
9.4 配水ポンプ起動盤（新設）	1 面 Q = 17.5 m <sup>3</sup> /分の新設ポンプ用、既存電気室内に設置
9.5 中央監視デスク盤（改造）	1 式 モザイク変更、デスク内改造



9.6 中央監視盤用リレー盤(増設)	1面 中央監視室に設置
9.7 薬品注入棟電灯/避雷針設備(新設)	1式
9.8 取水水位計(改修)	1式 超音波式指示計
9.9 原水流量計(新設)	2基 既存、新設浄水施設用フロート式流量指示・積算計
9.10 ろ過池損失水頭計(新設)	8基 差圧式損失水頭指示計
9.11 配水池水位計(新設)	1基 新設配水池水位指示計

## 2) 機材

機材	数量	内容・仕様
ドラフトチャンパ- (フ-ワ-付)	1台	間口 1500mm、排気風量 16m <sup>3</sup> /min
中央実験台(流し台付)	1台	w3600xL1500xh800 カットユニット 2 個、 水栓 3 方口 x 1、埋込みコンセント 4 個
中央実験台試薬棚	2台	w1800xd300xh1080 重さ 41kg
ジャーテスター6 連用	1台	ビ-カー容量：100~1000ml 25w
デジタル温度計	1台	測定範囲-100~+1250、精度+0.5 電源 DC6V
デジタル pHメ-タ-	1台	温度補償自動：自動、pH 測定範囲：0~14 pH、 pH 再現性：+0.01+-1deg.、pH 分解能：0.01
温湿度露天計	1台	湿度測定範囲：5~98%RH、温度測定範囲：-10 ~ 70 露天測定範囲：-30 ~ 70、出力：0~1V(DC)
電気伝導度計	1台	測定項目：電気伝導率、低効率、濁度、 表示器：バックライト付グラフィック LCD 繰り返し性：+0.5%フルスケール、 レンジ設定：自動/手動 出力：0~1V フルスケール
直読デジタル濁時計 2100N	1台	最低測定濁度：0.001NTU、再測定性能：+-1% 電源：115/230V 50/60Hz、測定方法：手動/自動
定温乾燥機	1台	外形寸法：w710xd650xh870、内容積：62L 棚板耐荷重：約 15kg/枚、棚受段数：13 段 電源：単相 220V
オートクレーブ	1台	方式：自動式高圧蒸気滅菌 使用温度範囲：105~128 最高使用圧力：0.2MPa、外形寸法：w440xd530x965
重ね金具付きラック	1組	寸法：246x162 (2 個組)
マグミキサー	1台	スターラ：6 個単独回転調節付 攪拌台材質：アルミ製セラミックコーティング 攪拌容量：100~2000ml x 6 個 回転数：約 300~1500rpm、重さ：約 14kg
オートスチル	1台	採取方法：蒸留法、採取純水：蒸留水 蒸留水製造量：約 2L/h 蒸留水採取量：2.2L/min
必要ビ-カー・フラスコ類	1式	
必要試薬類	1式	

## 資料 7 - 7 維持管理費（電気代と薬品費）の検討

### （ 1 ） 電気量

#### 1 ) 取水ポンプの電気消費量

##### 取水ポンプ

$$185\text{kw} \times 3 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = \underline{4,861,800 \text{ kWh/年}}$$

#### 2 ) 水処理に必要な電気消費量計算

##### フロキュレーター

$$2\text{kw} \times 12 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 210,240 \text{ kWh/年}$$

$$3.7\text{kw} \times 8 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 259,296 \text{ kWh/年}$$

##### 逆洗ポンプ

ろ過池全 20 池を 36 時間（1.5 日）に 1 回洗浄すると 1 日当りのろ過池洗浄池数は

$$20 \text{ 池} \times 24/36=13.4 \text{ 池}$$

1 池当りの水逆洗時間を 24 分間とすると

$$45\text{kw} \times 13.4 \text{ 池/日} \times 24/60 \times 365 \text{ 日/年} = 88,038 \text{ kWh/年}$$

##### 逆洗エアブロー

1 池当りの空気逆洗時間を 5 分間とすると

$$45\text{kw} \times 13.4 \text{ 池/日} \times 5/60 \times 365 \text{ 日/年} = 18,342 \text{ kWh/年}$$

##### 硫酸バンド溶解用攪拌機

1 日の溶解槽 3 槽溶解する。1 槽当りの攪拌機の運転時間を 1 時間とする。

$$3.7\text{kw} \times 3 \text{ 回/日} \times 1 \text{ 時間/回} \times 356 \text{ 日/年} = 4,052 \text{ kWh/年}$$

##### 消石灰溶解用攪拌機

消石灰の沈澱を考慮し、24 時間/日運転とする。

$$5.5\text{kw} \times 2 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 96,360 \text{ kWh/年}$$

$$0.4\text{kw} \times 1 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 3,504 \text{ kWh/年}$$

##### 塩素注入用給水ポンプ

$$7.5\text{kw} \times 1 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 65,700 \text{ kWh/年}$$

##### 塩素中和装置用ポンプ/ブロー

非常時のみ運転のため、電気消費量には計上せず。

##### サンプリングボール

$$0.75\text{kw} \times 5 \text{ 台} \times 24 \text{ 時間/日} \times 365 \text{ 日/年} = 32,850 \text{ kWh/年}$$

その他（コンプレッサー、空調、照明等）

上記計の約 1 %

$$5,640,182 \times 0.01$$

$$\div 55,818 \text{ kWh/年}$$

$$\underline{\underline{\text{計： } 834,200 \text{ kWh/年}}}$$

### 3) 送・配水に必要な電気消費量計算

150,000m<sup>3</sup>/日を送・配水するポンプ運転計画は以下のとおり。

配水ポンプ (2,100 m <sup>3</sup> /hr、320kw) 2台	4,200 m <sup>3</sup> /hr = 100,800 m <sup>3</sup> /日
"    (1,050 m <sup>3</sup> /hr、180kw) 2台	1,050 m <sup>3</sup> /hr = 25,200 m <sup>3</sup> /日
送水ポンプ (1,050 m <sup>3</sup> /hr、180kw) 2台	<u>1,050 m<sup>3</sup>/hr = 25,200 m<sup>3</sup>/日</u>
	計 6,300 m <sup>3</sup> /hr = 151,200 m <sup>3</sup> /日

$$320\text{kw} \times 2 \text{台} \times 24 \text{時間/日} \times 365 \text{日/年} = 5,606,400 \text{ kWh/年}$$

$$180\text{kw} \times 2 \text{台} \times 24 \text{時間/日} \times 365 \text{日/年} = 3,153,600 \text{ kWh/年}$$

$$\underline{\underline{\text{計 } 8,760,000 \text{ kWh/年}}}$$

### (2) 水処理に必要な薬品消費量計算

硫酸バンド (注入率は1999年のジャーテストによる最適注入率の年平均値 23.5mg/L とする)

$$158,400\text{m}^3/\text{日} \times 23.5\text{mg/L} \times 10^{-3} \times 365 \text{日/年} = \underline{\underline{1.359\text{ton/年}}}$$

消石灰 (注入率を 10mg/L とする)

$$158,400\text{m}^3/\text{日} \times 10\text{mg/L} \times 10^{-3} \times 365 \text{日/年} \times 1/2 \text{年} = \underline{\underline{579\text{ton/年}}}$$

塩素

前塩素 (乾期 12月～5月の藻類の発生期間に 2mg/L を注入)

$$158,400\text{m}^3/\text{日} \times 2\text{mg/L} \times 10^{-3} \times 180 \text{日/年} = 57\text{ton/年}$$

後塩素

$$158,400\text{m}^3/\text{日} \times 1.5\text{mg/L} \times 10^{-3} \times 365 \text{日/年} = \underline{\underline{87\text{ton/年}}}$$

$$\text{塩素計： } 144\text{ton/年}$$

表 1 概算運転・維持管理費（電気費と薬品費）

		年間消費量	概算年間費用
電	水処理	834 千 kWh/年	400 百万 Riel
	取水	4,862 千 kWh/年	2,334 百万 Riel
気	送・配水	8,760 千 kWh/年	4,205 百万 Riel
	小計	14,456,000 kWh/年	6,939 百万 Riel
薬 品	硫酸バンド	1,359ton/年	326 千 US\$
	消石灰	289ton/年	35 千 US\$
	塩素ガス	144 ton/年	158 千 US\$
	小計	-	519 千 US\$ = 1,998 百万 Riel
合計		-	8,937 百万 Riel

（積算条件）

1.0 US \$ = 3,850 リエル

電気料金 : 480 リエル/kWh = 0.09 US \$ /kWh (ポンプレック浄水場用電気料金)

硫酸バンド : 240 US \$ /ton (輸送費含む)

消石灰 : 120 US \$ /ton (輸送費含む)

塩素ガス : 1,100 US \$ /ton (輸送費含む)

**KINGDOM OF CAMBODIA**  
**NATION RELIGION KING**

\*\*\*\*\*

Phnom Penh, Dated: 22nd June, 2000

**PHNOM PENH WATER SUPPLY AUTHORITY**  
**(PPWSA)**

No: \_\_\_\_\_

To:

**GOVERNOR OF PHNOM PENH MUNICIPALITY**

Objective: Request for Installation of Transmission Pipe sized 1,200mm from Raw Water Pumping Station to Phum Prek Water Treatment Plant.

- References:
- Minutes of Discussion on the Basic Design Study on the Project for Expansion of Phum Prek Water Treatment Plant in the Kingdom of Cambodia between Japan International Cooperation Agency and Phnom Penh Water Supply Authority dated on 23 June 2000.
  - Letter of Japan International Cooperation Agency to Kingdom of Cambodia No. JC 11-177 on Basic Design Study on the Project for Expansion of Phum Prek Water Treatment Plant in the Kingdom of Cambodia.

Refer to the mentioning in the above objective and references, Phnom Penh Water Supply Authority has the honor to inform the Governor that Government of Japan has entrusted to Japan International Cooperation Agency for Basic Design Study on the Project for Expansion of Phum Prek Water Treatment Plant which has been requested of Grant from Government of Japan in 1997. Japan International Cooperation Agency has revealed that for this basic design, it is necessary that the Transmission Pipe sized 1,200mm from Raw Water Pumping Station in front of Council for Development of Cambodia to Phum Prek Water Treatment Plant should be installed as mentioned in attached Drawing.

To smoothly implement the Grant, Phnom Penh Water Supply Authority request to Governor of Phnom Penh Municipality's kind cooperation to officially permit as above request.

Yours faithfully  
General Director of Phnom Penh Water Supply Authority  
EK SONN CHAN

Response from Governor of Phnom Penh Municipality

Agreed to install pipe crossing the Garden except two places can be escaped.

Signature of Governor  
23-June-2000

ព្រះរាជាណាចក្រកម្ពុជា  
ជាតិ សាសនា ព្រះមហាក្សត្រ



រដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ

1.2.55.5

ភ្នំពេញ, ថ្ងៃទី ២២ ខែ មិថុនា ឆ្នាំ ២០០០

លេខ: ២១២ ល.ស	សូមគោរពជូន
ថ្ងៃទី ២២ ខែ ០៦ ឆ្នាំ ២០០០	ឯកទុត្តមប្រតិភូរាជរដ្ឋាភិបាលទទួលបន្ទុកអភិបាលរាជធានីភ្នំពេញ
367	
28.6.00	
3/3	

កម្មវត្ថុ: សំណើសុំអនុញ្ញាតដឹកដាក់បំពង់ទឹក ទំហំ ១.២០០មម ប្រវែង ១.៥០០ម ចេញពីស្ថានីយ៍ បូមទឹកល្អក់ មកទល់ និងអាងទទួលទឹករោងចក្រភូមិព្រែក ។

យោង: - កិច្ចពិភាក្សា នៃការសិក្សាគម្រោងពង្រីករោងចក្រផលិតទឹកស្អាតភូមិព្រែក រវាងភាគីភ្នាក់ងារសហប្រតិបត្តិការអន្តរជាតិ នៃប្រទេសជប៉ុន និងរដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ ចុះថ្ងៃទី ២៣ ខែកក្កដា ឆ្នាំ ២០០០ ។

*Handwritten notes:*  
សេចក្តីជូនដំណឹង  
ស្តីពីការសិក្សាគម្រោង  
ពង្រីករោងចក្រផលិតទឹកស្អាត  
ភូមិព្រែក  
លេខ ១១៤ ម.ក.ក.ស. ១០០០

- សារលិខិតរបស់ភ្នាក់ងារសហប្រតិបត្តិការអន្តរជាតិ នៃប្រទេសជប៉ុន ប្រចាំព្រះរាជាណាចក្រកម្ពុជា លេខ JC 11-177 ចុះថ្ងៃទី ១២ ខែ កក្កដា ឆ្នាំ ២០០០ ស្តីពីការមកដល់របស់គណៈប្រតិភូជប៉ុន លើការសិក្សាគម្រោងពង្រីកសមត្ថភាពរោងចក្រផលិតទឹកស្អាតភូមិព្រែក ។

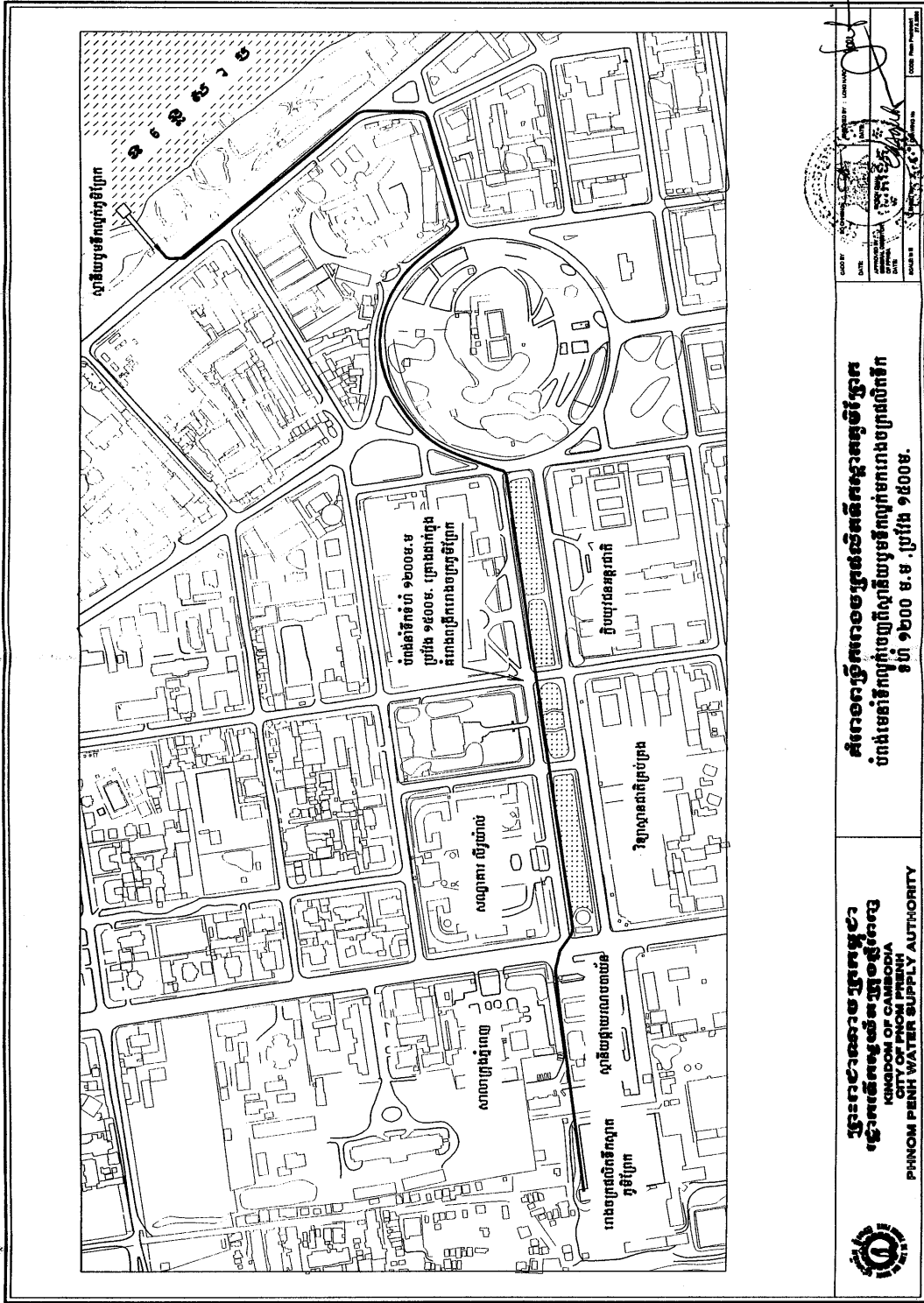
សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុខាងលើ រដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ សូមជំរាបជូនឯកទុត្តមប្រតិភូ មេត្តាជ្រាបថា ៖ រដ្ឋាភិបាលជប៉ុន បានបញ្ជូនប្រតិភូរបស់ភ្នាក់ងារសហប្រតិបត្តិការអន្តរជាតិ នៃប្រទេសជប៉ុន ដើម្បីធ្វើការសិក្សាគម្រោងពង្រីករោងចក្រផលិតទឹកស្អាត (Basic Design) ទៅលើគម្រោងពង្រីកសមត្ថភាពផលិតទឹកស្អាតរោងចក្រភូមិព្រែក ដែលភាគីកម្ពុជាបានស្នើសុំជំនួយឥតសំណងពីរាជរដ្ឋាភិបាលជប៉ុន នាឆ្នាំ ១៩៩៧ ។ ក្នុងការសិក្សានេះ ភាគីជប៉ុនបានដឹងថា ចាំបាច់ត្រូវដាក់បំពង់មួយទំហំ ១.២០០មម ប្រវែង ១.៥០០ម ពីស្ថានីយ៍បូមទឹកល្អក់នៅមុខទិសភាគក្រុមប្រឹក្សាអភិវឌ្ឍន៍កម្ពុជាមករោងចក្រភូមិព្រែកដូចដែលមានប្លង់គំនូសបំព្រួញភ្ជាប់ជាមួយនេះ ។

ដើម្បីអនុវត្តបាននូវគម្រោងជំនួយឥតសំណងនេះ យើងខ្ញុំសូមឯកទុត្តមប្រតិភូ រាជរដ្ឋាភិបាលទទួលបន្ទុកអភិបាលរាជធានីភ្នំពេញ មេត្តាអនុញ្ញាត ដោយក្តីអនុគ្រោះ ។

សូមឯកទុត្តមប្រតិភូ មេត្តាទទួលនូវការគោរពដ៏ខ្ពង់ខ្ពស់ពីយើងខ្ញុំ ។

*Signature and stamp:*  
អគ្គនាយក  
ហក សុខចាន់

ទីស្នាក់ការ: ខាងលើស្ថានីយ៍បាយស្វាយយានកម្ពុជា ខ្នងវត្ត: ០២៣-៧២៤ ០៤៦ ខ្នងវត្ត-ខ្នងវត្ត: ៧៥៥ - ២៣-៧២៥ ៧៦៦



**គម្រោងស្ថាបនាប្រព័ន្ធប្រតិបត្តិការផ្តល់ទឹកស្អាត**  
**បំពង់ទឹកថ្នាំប្រវែង ១២០០ម.ម ប្រវែង ១៩០០ម.**

**ក្រសួងសាធារណៈប្រកាស**  
**រដ្ឋាករទឹកស្អាតភ្នំស្រីប្រាសាទ**  
 KINGDOM OF CAMBODIA  
 CITY OF PHNOM PENH  
 PHNOM PENH WATER SUPPLY AUTHORITY





24/08/00

07:52

PHNOM PENH WATER SUPPLY → 81335802793

NO.001

001



**KINGDOM OF CAMBODIA**  
**NATION-RELIGION-KING**

**PHNOM PENH WATER SUPPLY AUTHORITY**  
**PROJECT MANAGEMENT UNIT**

ADDRESS: North of Cambodia Railway Station  
PHNOM PENH  
TEL: 855-23 427 657. Fax: 855-23 427 657

Date: 23 August 2000

Message No.: 093 - PMU-GR/00

Total Page: 3 including this cover sheet

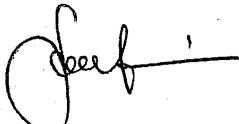
To: Tokyo Engineering Consultants Co. Ltd.  
Fuji Building, 3-7-4 Kasugasaki  
Chiyoda-Ku, Tokyo, Japan

Attention: Mr. Hirotaka SATO  
M.E (Environment & Sanitary)  
M.W.R.A (Water Resources Administration)  
Overseas Department  
Fax: 813-3580-2793

Subject: Request for the installation of 1,200mm water pipe crossing Bayon  
Satellite Station

Dear Sir,

Please find the attached letter from Ministry of Posts and Telecommunications on the approval of pipe installation crossing Bayon Satellite Station together with its translation into English.

Best regards, 

Long Naro  
Director of Technical and Project DPT  
PPWSA



ព្រះរាជាណាចក្រកម្ពុជា  
Kingdom of Cambodia  
ជាតិ សាសនា ព្រះមហាក្សត្រ  
Nation - Religion - King

ទិស្តីការ

ក្រសួងប្រៃសណីយ៍ និង ទូរគមនាគមន៍  
Ministry of Posts and Telecommunications

លេខ : 1391 បទ បណ

រដ្ឋាករទឹកស្អាតក្រុងភ្នំពេញ  
លេខ: 115  
ទីស្នាក់ការ: 116.08.00.311.30

ក្រសួងប្រៃសណីយ៍ និង ទូរគមនាគមន៍  
លេខ: 085 GR រាជធានីភ្នំពេញ ថ្ងៃទី 15 ខែ 08 ឆ្នាំ 2000  
ពេលវេលា: 17:00 ព្រឹក 7:30  
ទីស្នាក់ការ: STPD

រដ្ឋមន្ត្រី ក្រសួងប្រៃសណីយ៍ និង ទូរគមនាគមន៍  
ជំរះ ឯកបត្រ  
លោកអគ្គនាយករដ្ឋាករទឹកស្អាតក្រុងភ្នំពេញ

រដ្ឋាករទឹកស្អាតក្រុងភ្នំពេញ  
លេខ: 434  
ថ្ងៃទី: 15-8-00  
ឈ្មោះ: អ្នកប្រឹក្សា  
លេខ: 16:00

**កម្មវត្ថុ:** អំពីការណែនាំស្តីអំពីការដាក់បំពង់ទឹកទំហំ 1.200 មម ក្នុងកាត់ស្ថានីយ៍ផ្កាយរណបយ៉ែន ។  
**យោង:** លិខិតលេខ 223 ល.ស ចុះថ្ងៃទី 10.07.2000 របស់រដ្ឋាករទឹកក្រុងភ្នំពេញ.

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុនិងយោងខាងលើ ខ្ញុំមានកិត្តិយសសូមជំរះលោកអគ្គនាយកជ្រាបថា :  
ផ្អែកតាមលទ្ធផលនៃការពិភាក្សារវាងមន្ត្រីនាយកដ្ឋានទូរគមនាគមន៍អន្តរជាតិនៃក្រសួងប្រៃសណីយ៍និងទូរគមនាគមន៍  
និងតំណាងរដ្ឋាករទឹកស្អាតក្រុងភ្នំពេញរួមជាមួយជំនាញបច្ចេកទេសជប៉ុន ក្រសួងប្រៃសណីយ៍និងទូរគមនាគមន៍បាន  
ឯកភាពអនុញ្ញាតដោយការណែនាំក្នុងការស្ថាបនាដាក់បំពង់ទឹកតាមបណ្តោយផ្លូវក្នុងស្ថានីយ៍ផ្កាយរណបយ៉ែនខាង  
ជើងអាគាររដ្ឋបាល ដោយតម្រូវឱ្យមានវិធានការណែនាំដូចខាងក្រោមនៅមុនពេលសំរេចបើកការដ្ឋាន :

- 1- រដ្ឋាករទឹកស្អាតក្រុងភ្នំពេញសិក្សាលទ្ធភាពនៃគំរោងនិងបង្ហាញលទ្ធផលថាមិនចំពាលដល់ដំណើរការនៃ  
ស្ថានីយ៍ផ្កាយរណប ។
- 2- ត្រូវធ្វើកិច្ចសន្យាជាមួយស្ថិតិភាពនិងជួសជុលរាល់ការខូចខាតក្នុងស្ថានីយ៍ដែលបង្កឡើងដោយ  
ការដ្ឋានដាក់បំពង់ទឹកនេះ ។

អាស្រ័យហេតុដូចបានជំរះជូនខាងលើ សូមលោកអគ្គនាយកជ្រាបនិងចាត់ចែងអនុវត្តន៍តាមអនុលោមតាម  
ជោគជ័យ ។

សូម លោកអគ្គនាយក ទទួលនូវសេចក្តីរាប់អានដ៏ជ្រាលជ្រៅបំផុត ។ វ

**ចម្លងជូន:**

- សាលាក្រុងភ្នំពេញ " ដើម្បីជូនជ្រាប "
- នាយកដ្ឋានផែនការហិរញ្ញវត្ថុ " ដើម្បីមុខការ "
- នាយកដ្ឋានទូរគមនាគមន៍អន្តរជាតិ " ដើម្បីមុខការ "
- ឯកសារ កាលប្បវត្តិ.

ស្រុក ៤៩២  
ស្រុក  
ស្រុក

កាត់ត្រូវលិខិតលេខ ១៣ នីក ១០២ សហគមន៍ភ្នំពេញ ខែសីហា  
ទូរស័ព្ទ : 855-23.426993 / 426510  
ទូរសារ : 855-23.426992 / 426011

Corner street 13 and 102 Wat Phnom  
Section - Daun Penh District P.Penh  
Tel : 855-23.426993 / 426510  
Fax : 855-23.426992 / 426011

**KINGDOM OF CAMBODIA  
NATION RELIGION KING**

\*\*\*\*\*

Phnom Penh, Dated: 15 August, 2000

**Cabinet**

**Ministry of Posts and Telecommunications**

No.: \_\_\_\_\_

**Minister of Posts and Telecommunications**

**officially informs**

**General Director of Phnom Penh Water Supply Authority**

**Objective:** The request for the installation of 1,200mm water pipe crossing Bayon Satellite Station

**Reference:** Letter No. 223 \_\_\_\_\_ of Phnom Penh Water Supply Authority dated on 10 July 2000

In accordance with the objective and reference mentioned above, we have the honor to inform General Director that based on the results of the discussion between International Telecommunication Department of Ministry of Posts and Telecommunications and representative of Phnom Penh Water Supply Authority including Japanese expert, Minister of Posts and Telecommunications has officially permitted for the installation of water pipe along the road at the north of Administration Building in Bayon Satellite Station. Some below measures shall be taken prior opening the site:

1. Phnom Penh Water Supply Authority shall study on the feasibility of the project indicating that there is no any bad affect to the operation of Satellite Station.
2. Phnom Penh Water Supply Authority shall ensure the safety and repair all the damage parts in the station resulting from the installation of water pipe.

This above description is informative to General Director and we wish you implementing it successfully.

Best regards,

Copied to:

- Phnom Penh Municipality
- Financial Planning Department "Official"
- International Telecommunication Department "Official"
- Document, file

**MINISTER**

**SO KHUN**

資料 7 - 10 浄水場埋立地登記簿

PHNOM PENH LAND DEPARTMENT  
 ភ្នំពេញ រដ្ឋបាលដីធ្លី  
 ការិយាល័យរដ្ឋបាលដីធ្លី  
 LAND OFFICE, DAUN PENH  
 \*\*\*\*\*

KINGDOM OF CAMBODIA  
 ព្រះរាជាណាចក្រកម្ពុជា  
 ជាតិ សាសនា ព្រះមហាក្សត្រ  
 NATION RELIGION KING  
 \*\*\*\*\*

DRAWING OR LOCATION OF HOUSE No. 45, ROAD No. 106

ក្រុមប្រឹក្សាភិបាលសង្កាត់ស្រះចក ខណ្ឌដាច់ពេជ្រ លេខ ៤៥ ផ្លូវលេខ ១០៦

SANGKAT SRAH CHAK, KHAN DAUN PENH

សង្កាត់ស្រះចក ខណ្ឌដាច់ពេជ្រ លេខ ៤៥ ផ្លូវលេខ ១០៦

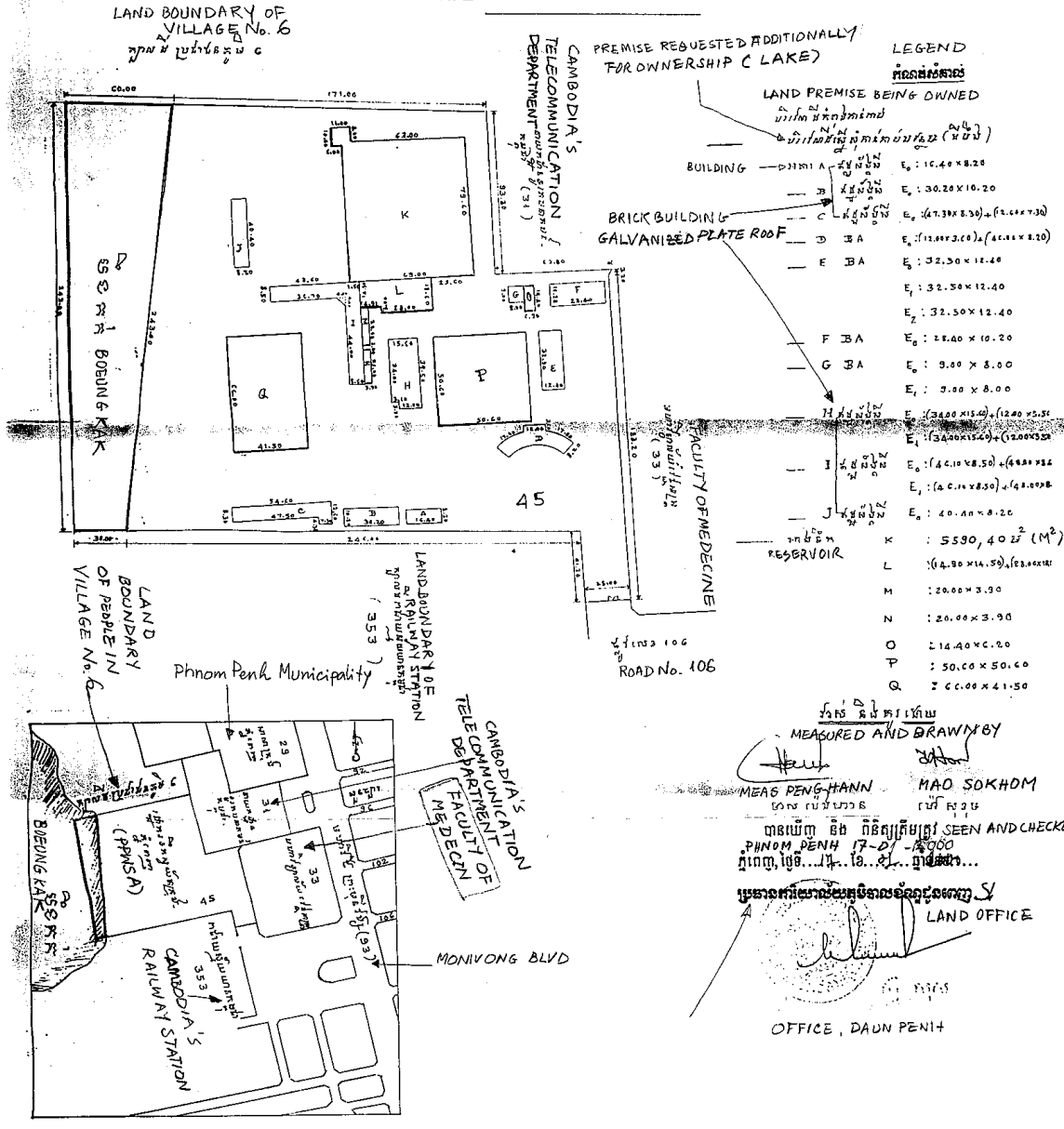
លេខផ្ទះលេខ ៤៥ ផ្លូវលេខ ១០៦

LOT No. ១១២០០០

SHEET No.

REQUESTED BY PPSA

SCALE



ប្រទេសកម្ពុជា  
PHNOM PENH LAND DEPARTMENT  
No. ....

ប្រទេសកម្ពុជា  
REAL ESTATE TITLE DEEDS (ORIGIN)

ព្រះរាជាណាចក្រកម្ពុជា  
KINGDOM OF CAMBODIA  
ជាតិ សាសនា ព្រះមហាក្សត្រ  
NATION RELIGION KING  
នរោត្តម សីហមុនី  
RELAND DEPARTMENT

LIST No. SHEET No. LOT No. HOUSE No. ROAD No. SANKATS RAS CHAIK DAUN PENH ID No. RE LAND DEPARTMENT

Lot Identification			House Identification			Vital Record of Owner			Exchange		
Border	Soil Type	Size (L x W x D)	Border	Type of House	Floor	Used	Building Area (A)	Plot Area (B)	History	Nationality	Other
		①		12.71.1A		E <sub>0</sub>	134.48	134.48	① NAME AND FAMILY NAME (HUSBAN/WIFE) ② BIRTH DATE AND PLACE		
		②		B		E <sub>0</sub>	308.04				
		③		C		E <sub>0</sub>	484.57				
		④		D		E <sub>0</sub>	420.40				
				E		E <sub>0</sub>	403.00		① NORTH LOT OF VILLAGE No 6 LOT No. 31		
						E <sub>1</sub>	413.00		② EST LOT No. 31, LOT No. 33		
						E <sub>2</sub>	407.00				
				F		E <sub>0</sub>	289.48		③ SOUTH LOT No. 353, ROAD No. 106		
				G		E <sub>0</sub>	72.00				
						E <sub>1</sub>	72.00		④ WEST BOEUNG KAK (LAKE)		
				H		E <sub>0</sub>	596.40				
						E <sub>1</sub>	596.40				
				BUILDING		E <sub>0</sub>	804.65				
						E <sub>1</sub>	804.65				
				J		E <sub>0</sub>	331.28				
						E <sub>0</sub>	5590.40				
				RESERVOIR			736.88				
							78.00				
				M			78.00				
				N			78.00				
				O			89.28				
				P			2560.36				
				Q			2739.00				

BRIEF RECORD AND COURT DECISION

IN CHARGE OF REAL ESTATE

SEEN AND APPROVED  
MEAS FENG HANN  
24-04-2000  
DAUN PENH GOVERNOR  
SUON RINDY

MAO SOKHOM  
17-01-2000  
LAND OFFICE, DAUN PENH

RIGHT THUMB PRINT OF OWNER  
LACH PATANA  
PPNSA'S REP.