

Cambodia Municipal Wastewater Treatment System

By

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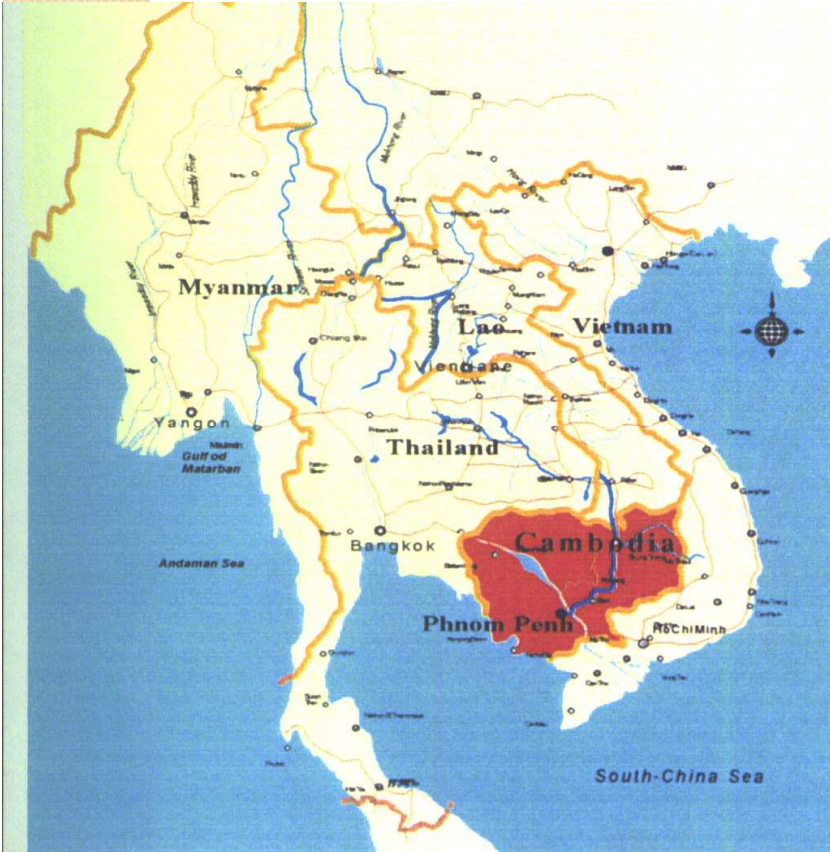
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1. CAMBODIA PROFILE



- ✦ South-East of Asia- North connected by the Loas,the East to the Vietnam, the South-by the Gulf Sea of Thai and the West- by the Thailand.
- ✦ Land Area 181.035 Km2 .
- ✦ Population : 14.8 million
- ✦ The main religion is Buddhism.
- ✦ Capitalcity : Phnom Penh
Population: 2,614,440
- ✦ Total Number of Provinces and Municipality: 24*
- ✦ Total of district: 159*
- ✦ Total Communes: 1406*
- ✦ GDP Annual Growth Rate: 7.20% (Average)

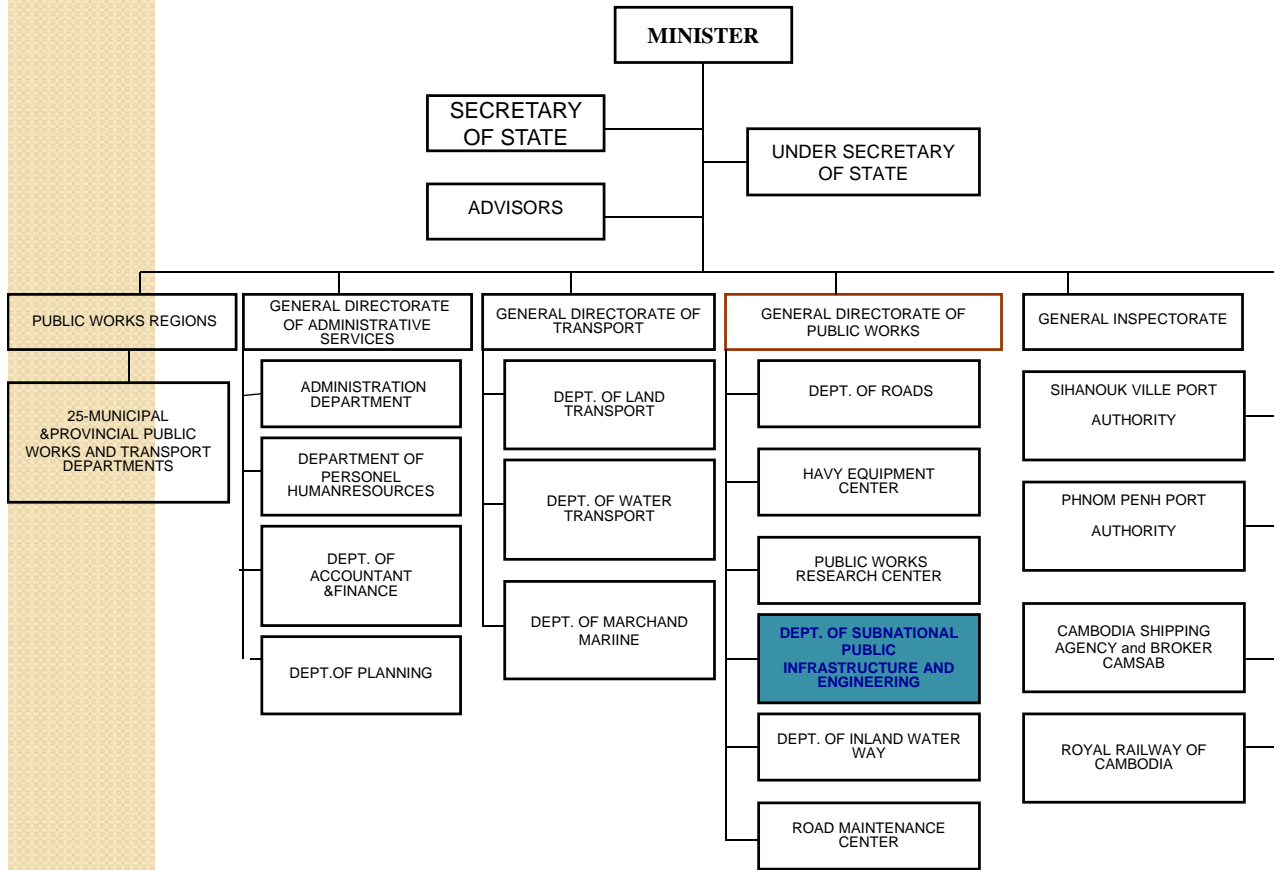
* data sources 2012

2. Strategy and Goal

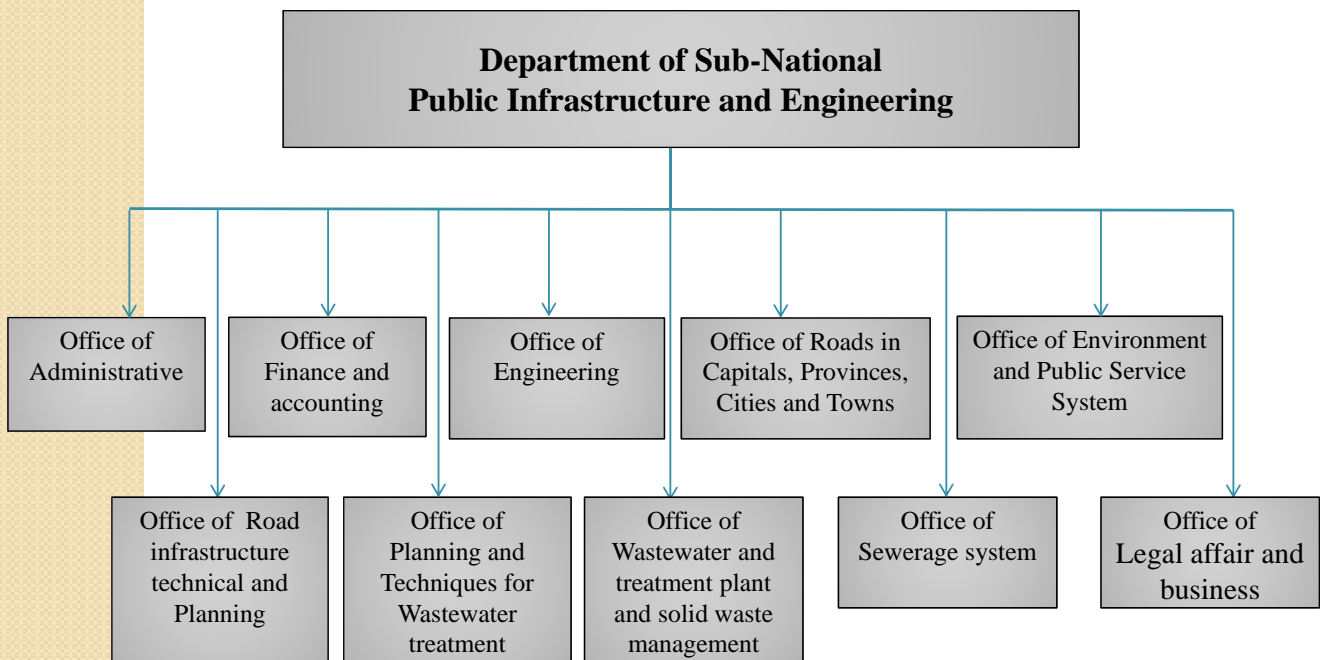


- Rectangular Strategy-Good Governance: **Promotion of Economic Growth**; **Generation of Employment**; **Implementation of Governance AP**; and **Enhancing Efficiency and Effectiveness in implementing the reform programs.**
- **The Government of Cambodia (GOC) has adopted the Millennium Development Goal (MDG) targets** for water supply and sanitation, specifying that, by 2015, 80% of the urban population and 50% of the rural population should have access to safe water, and that **74% of the urban population and 30% of the rural population should have access to improved sanitation.**

3. ORGANIZATION CHART OF THE MINISTRY PUBLIC WORKS AND TRANSPORT



Organization Chart Of Sub-National Public Infrastructure and Engineering Department



4. Relevant Environmental Laws & Regulation

➤ Relevant Environmental Laws and Regulation in Cambodia

Title	Objectives	Provisions
1993 Royal Decree on Creation and Designation of Protected Areas	Protect the environment, manage natural resources, conserve biological diversity and ensure sustainable development in the national system of protected areas.	Prescribes the responsibility for the national protected areas system, which includes planning, development, and management; designation of national parks, wildlife sanctuaries, protected landscape, and multiple use areas; amendment and application.
1996 Law on Environmental Protection and Natural Resource Management	Protect, manage and enhance the environment, and to promote socioeconomic development in a sustainable way.	National and regional environmental plans; environmental impact assessment; natural resources management; environmental protection; monitoring, record-keeping and inspection; public participation and access to information; environmental endowment fund; and penalties.
1997 Sub-Decree No. 57 on the Organization and Functioning of the Ministry of Environment	Supervise and manage the environment throughout the Kingdom of Cambodia. In particular: protect and promote environmental quality and public health through the prevention, reduction and control of pollution; assess the environmental impact of all proposed projects prior to the issuance of a decision by the Royal Government; ensure the rational and sustainable conservation, development, management and use of the natural resources of the Kingdom of Cambodia; encourage and enable the public to participate in environmental protection and natural resources management; suppress acts that cause harm to the environment.	A National Environmental Plan and Regional Environmental Plans are required to be decided by the Royal Government and reviewed and revised once every five years. Planning and management of protected areas, supervision and coordination of protection and conservation of the environment are the responsibility of the Dept. of Nature Conservation and Protection. Provincial department of environment is under the direct control of the Ministry of Environment, responsible for the supervision and management of environment in its province/municipality.
1999 Sub-Decree No. 27 on Water Pollution Control	Determine water pollution in order to prevent and mitigate water pollution in public waters, and thus ensures human health and conservation of biodiversity.	Prescribe disposal of waste and hazardous substance, permit of effluent, pollution control, and procedures of inspection; the standards of discharge/disposal of waste.

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➤ Relevant Environmental Laws and Regulation in Cambodia

1999 Sub-Decree No. 72 on Environmental Impact Assessment	Determine environmental impact assessment on private and public projects and activities, which are reviewed and assessed by the Ministry of Environment before the Royal Government's approval; determine type and size of proposed, existing projects and activities of both private and public sectors which are subjected to EIA; promote public participation in EIA process and public hearings in the process of project approval.	Prescribes institutions' responsibility; EIA requirements for proposed project, procedures for the process of review and assessment of proposed projects, and existing activities, and terms of project approval. Note subsequent 2000 Prakas on Guidelines for Conducting EIA Report.
1999 Sub-Decree on Solid Waste Management	Regulate solid waste management to ensure the protection of human health and the conservation of biodiversity.	Applies to all activities relating to the disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste, and includes household waste management, hazardous waste management and monitoring and inspection of hazardous waste management.
2007, 29 June Water Resources Management Law in Kingdom of Cambodia	For managing and monitor the use of Water Resources on Land, under ground and in the Climate.	Applies to all activities relating with water resources in Cambodia.

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Water quality standard in public water areas for bio-diversity conservation in Cambodia

No.	Parameters	Unit	Standard value
River			
1	pH		6.5-8.5
2	BOD ₅	mg/l	1-10
3	Suspended Solid	mg/l	25-100
4	Dissolved Oxygen	mg/l	2-7.5
5	Coliform	MPN/100ml	<5000
Lakes and Reservoirs			
1	pH		6.5-8.5
2	COD	mg/l	1-8
3	Suspended Solid	mg/l	1-15
4	Dissolved Oxygen	mg/l	2-7.5
5	Coliform	MPN/100ml	<1000
6	Total Nitrogen	mg/l	0.1-0.6
7	Total Phosphorus	mg/l	0.005-0.05
Coastal water			
1	pH		7-8.3
2	COD	mg/l	2-8
3	Dissolved Oxygen	mg/l	2-7.5
4	Coliform	MPN/100ml	<1000
5	Oil content	mg/l	0
6	Total Nitrogen	mg/l	0.2-1
7	Total Phosphorus	mg/l	0.02-0.09

Source: Annex 4, Sub-Decree on Water Pollution Control, 1999

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5. ROLE AND FINANCIAL RESPONSIBILITIES OF PLANNING DEVELOPMENT AND MANAGEMENT OF MUNICIPAL WASTEWATER TREATMENT

Key Ministries

Ministry of Economic and Finance

Ministry of Environment

Ministry of Public Works and Transport

Ministry of Interior and municipalities

Multilaterals involved in sanitation in Cambodia

Key Schemes

- Allocating budgets

- Environmental planning ; monitoring of effluent discharged to waterways / water drains
- Involve in Master plans

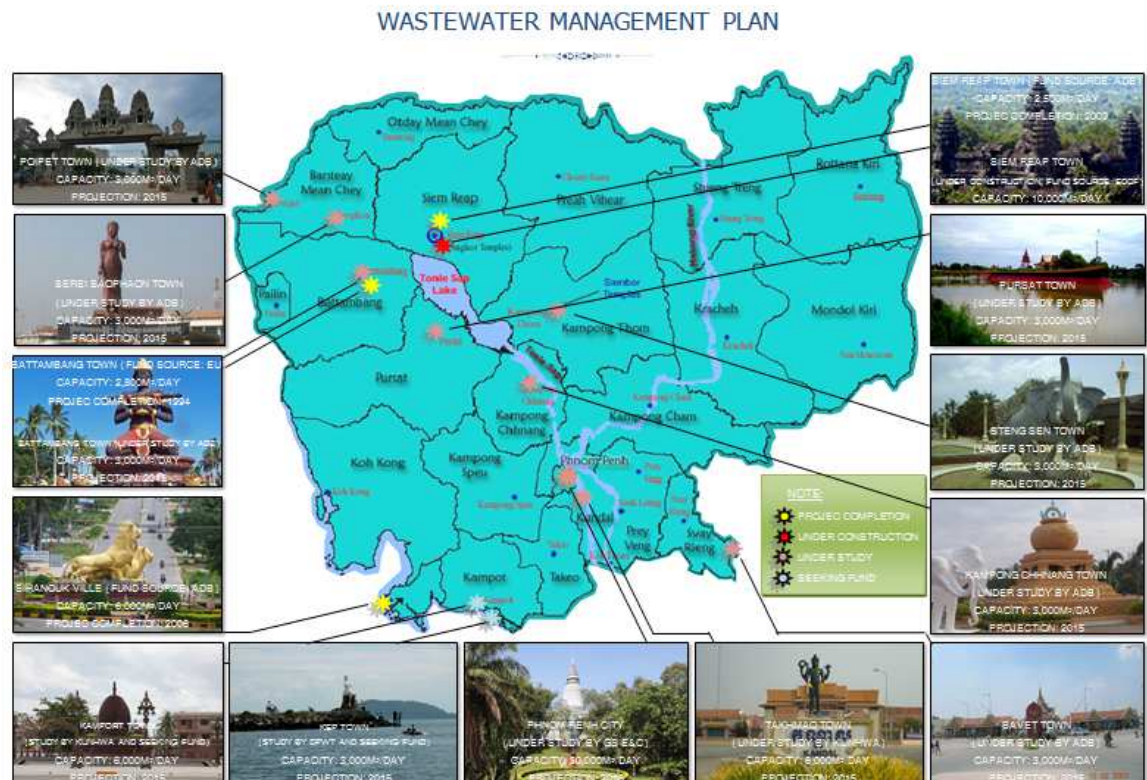
- Developing scientific national policy concerning all public works construction
- Master plan.

- Involve in Master plans.
- Operation and maintenance wastewater treatment system



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6. PLANNING AND ON GOING PROJECTS FOR MUNICIPAL WASTEWATER TREATMENT



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Concept Wastewater Management

•Geographical Relief

1. The water network in Cambodia is divided into three systems: The Mekong River system, the Tonle Sap Lake system and the Coastal Zone. The hydrological systems are central to life in Cambodia and Phnom Penh itself is located on the confluence of three important rivers; the Mekong, the Tonle Sap and the Bassac.
2. The Tonle Sap System includes the Tonle Sap Lake, the Tonle Sap River and their Tributaries. The Tonle Sap Lake is the greatest source of fish in Cambodia and as a result experiences the greatest population density as many people rely on the lake as a form of income.

•Treats to Wetlands in Cambodia

1. Point source of pollution to wetlands comes from industry and urban sewerage. Regardless of the relatively small amount of raw sewerage, its direct discharge into the environment without primary treatment raises concerns over pollution loads in associated waters.

•The Tonle Sap Biosphere Reserve

1. Biosphere Reserves (BR) are areas of terrestrial coastal ecosystems promoting solutions to reconcile the conservation of biodiversity which it's sustainable use. They are intended to fulfill three basic functions including conservation, development and logistic function. The Tonle Sap Lake was designated a Biosphere Reserve upon approval for its inclusion in the World Network of Biosphere Reserves by the International Coordinating Council for UNESCO's Man and Biosphere (MAB) reserve programmed in 1997. The designation reflects the importance of the Tonle Sap Lake ecosystem for its ecological function and for supporting socio-economic development and the maintenance of associated cultural values.

•The Coastal Zone

1. The coastal zone (CZ) of Cambodia extends for 435km and consists of estuaries, bays and 64 islands of various sizes. Most of the coastal population is concentrated in Sihanoukville where urban services and employment opportunities are available and in Kampot, where good soil conditions and access to water enables rice culture. Cambodia does not yet a complement of coastal and marine environmental policies. As development pressures are rapidly mounting there is an urgent need for safeguards to be put in place that will allow economic development while ensuring the sustained quality of coastal and marine environments and the resources they provide.

•Development Plan

1. Development strategy which contributes to the regional development and poverty reduction. The long term plan to develop the Multiple Economic Development Zones.
2. The priority wastewater management plan: *Short term plan:* Sihanoukville and Siem Reap Town; *Medium term plan:* Kampot, Keo, Poipet, Battambang, Bavet, Pursat, Serei Sakhon and Stung Saen Town; *Long term plan:* Phnom Penh City, Takhmao Town and some other towns along the Mekong River and around the Tonle Sap Lake.

•Target Plan

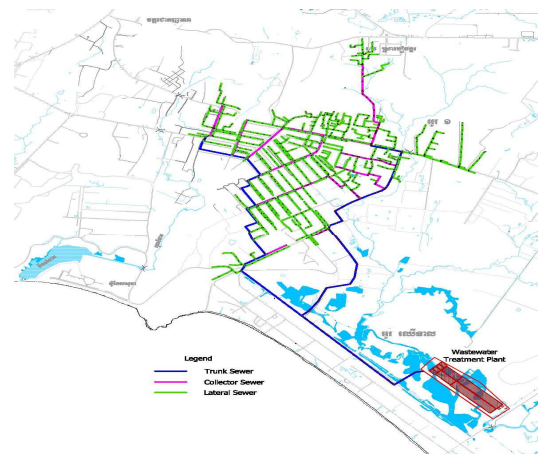
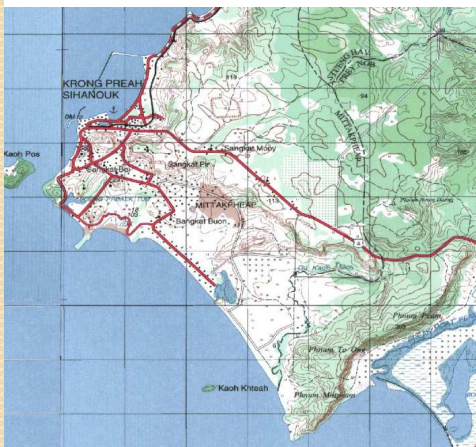
1. The National Program outlines priorities and projects for each sector of the economy. Regarding the physical infrastructure, one main priority is said to be linking of the three designated growth poles Phnom Penh, Coastal Zone and Siem Reap. The CZ is a priority not only tourism and also for industrial development, while the areas around *Kampot* and *Sihanoukville* Town will be target for the wastewater management as a priority.

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Previous & Ongoing Projects

No.	Project Name	Funding Agency	Loan Amount for Civil Works only	Project Cover Area	Loan Agreement Year	Completion Year
1	Emergency Rehabilitation Project for Water Supply and Sanitation in Battambang	EU	Grant (N.A)	East Part of Town Center about 200 ha.	1992	1994
2	Provincial Towns Improvement Project, (Part C: Wastewater Management System, and Part D: Local Governance and Resource Mobilization, in in Sihanoukville	ADB Loan No.: 1725 - CAM (SF) and 2013 - CAM (SF)	USD 11.19 M	Cover an area of 221.5 ha with 3,368 service connections	02 Feb. 2000	31 March 2007
3	Mekong Tourism Development Project, Part A1: Siem Reap Wastewater Management System	ADB Loan No.: 1969 - CAM (SF)	USD 14.37 M	About 530 ha	7 Feb. 2003	31 Dec. 2009
4	Siem Reap Urban Development Project Drainage & Wastewater Master Plan Study, Priority Works	AFD, French	Grant:US\$4M	East Part Siem Reap Town Drainage	2008	2009
5	Siem Reap Sewerage System and Improvement of Siem Reap River	Korea Eximbank	USD 26 M	Cover total area of 934 ha (East 365ha+ West 569ha)	2011	2014
6	GMS: Southern Economic Corridor Towns Development	ADB	USD 55 M	Cover 4 Corridor Towns	2014	2018
7	Integrated Urban Environmental Management in the Tonle Sap Basin	ADB	USD 52 M	Cover Pursat & Kampong Chhnang Town	2016	2021
8	GMS: Second Corridor Towns Development	ADB	USD 38 M	Cover Kampot & Sihanoukville Town	2016	2020
9	Provincial Water Supply & Sanitation Project	ADB	USD 30 M	Battambang, Pursat, Svay Rieng & Kampong Thom	2017	2022

➤ Sihanoukville Wastewater Management



➤ Sihanoukville Wastewater Management

Wastewater treatment plant was constructed in may 2003 under ADB loan and completed July 2005. The wastewater unit is currently operated under the administration of department of public works and transport and financial management is under the Ministry of Public Works and Transport and Ministry of Economy and Finance in the form of semi-autonomous entity.

Sewage collection system: 65.80 Km

- 7.348 Km of trunk,
- 6.126 Km of collector sewer lines
- 42.165 Km of main lateral
- 10.1 Km branch lateral lines for 3,344 service connections.

The system covers an area about 221.5 ha and serves about 30,000 people partly in Sangkat 1,2 and 4 of Prah Sihanouk City, Prah Sihanouk Province plus 1,200 m³/day wastewater from brewery (CAMBREW). The System is Separate System .

Sulfide generation about 300 mg/L BOD₅ at 30°C, effective BOD₅ of about 738 mg/L. Slope requirements is 1.25 times the values for and effective BOD₅ of 500 mg/L. All sewer components be protected from sulfide related corrosion. The sludge is keep to dry on free surface area after that are collected out for the agriculture using.

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➤ Siem Reap Surface Water Quality

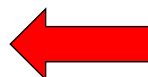
Parameter	Sampling Location								
	Siem Reap River			Canals & ponds					
	1	2	3	4	5	6	7	8	9
Date	February 2004			July 2004					
pH	6.07	5.71	6.17	6.83	7.15	6.70	6.74	6.95	6.90
TSS	58.9	31.2	42.5						
TDS				540	460	660	990	270	240
BOD	1.4	3.6	6.1	195	73	260	186	42	40
COD-Cr	15.1	7.8	15.7	457	139	550	398	81	624
DO	5.7	3.9	3.7						

Quality Standards: pH, 6.5-8.5; TDS, 200; TSS, 25-100; BOD 1-10; COD-Cr, 1-8; DO, 2-7.

Values shown in bold font indicate non compliance. Shaded locations and values are for the TCD.

Notes: All values in mg/l except pH

Data abstracted from Application for Grant Aid from the Japanese Government (undated)



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➤ Siem Reap Wastewater Management

■ Service Area

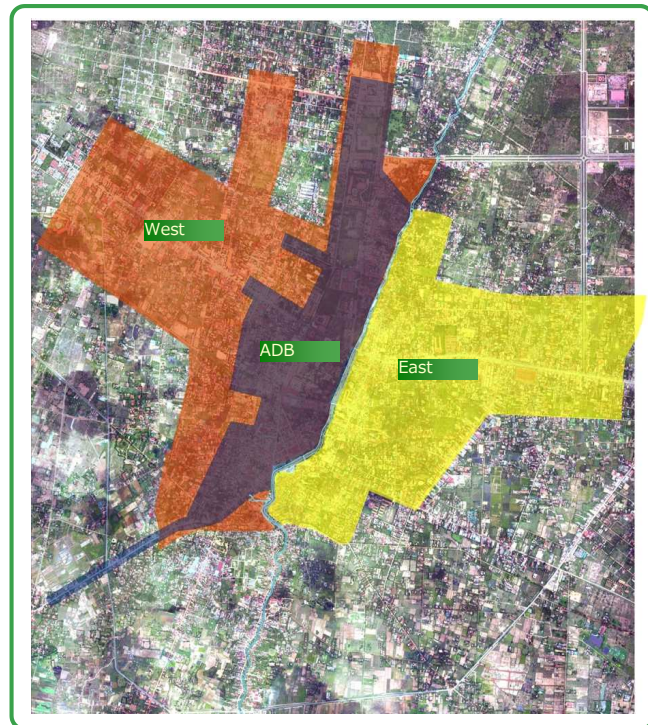
Existing ADB Area

Areas with high population density

Water Supply area

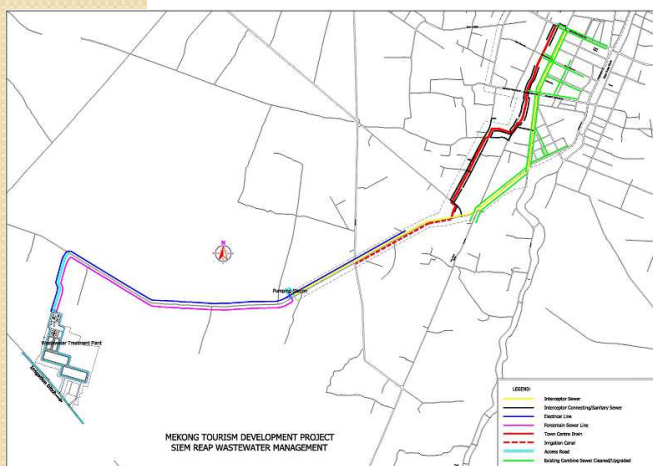
Areas with a large concentration of hotels and tourism activity

District	ADB	EXIM
Total	264 ha	1,083
West	264 ha	686 ha
East	-	397 ha



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➤ Siem Reap Wastewater Management



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➤ Siem Reap Wastewater Management

Wastewater treatment plant was constructed in June 2007 under ADB loan and completed December 2009. The wastewater unit is currently operated under the administration of department of public works and transport and financial management is under the Ministry of Public Works and Transport and Ministry of Economy and Finance in the form of semi-autonomous entity.

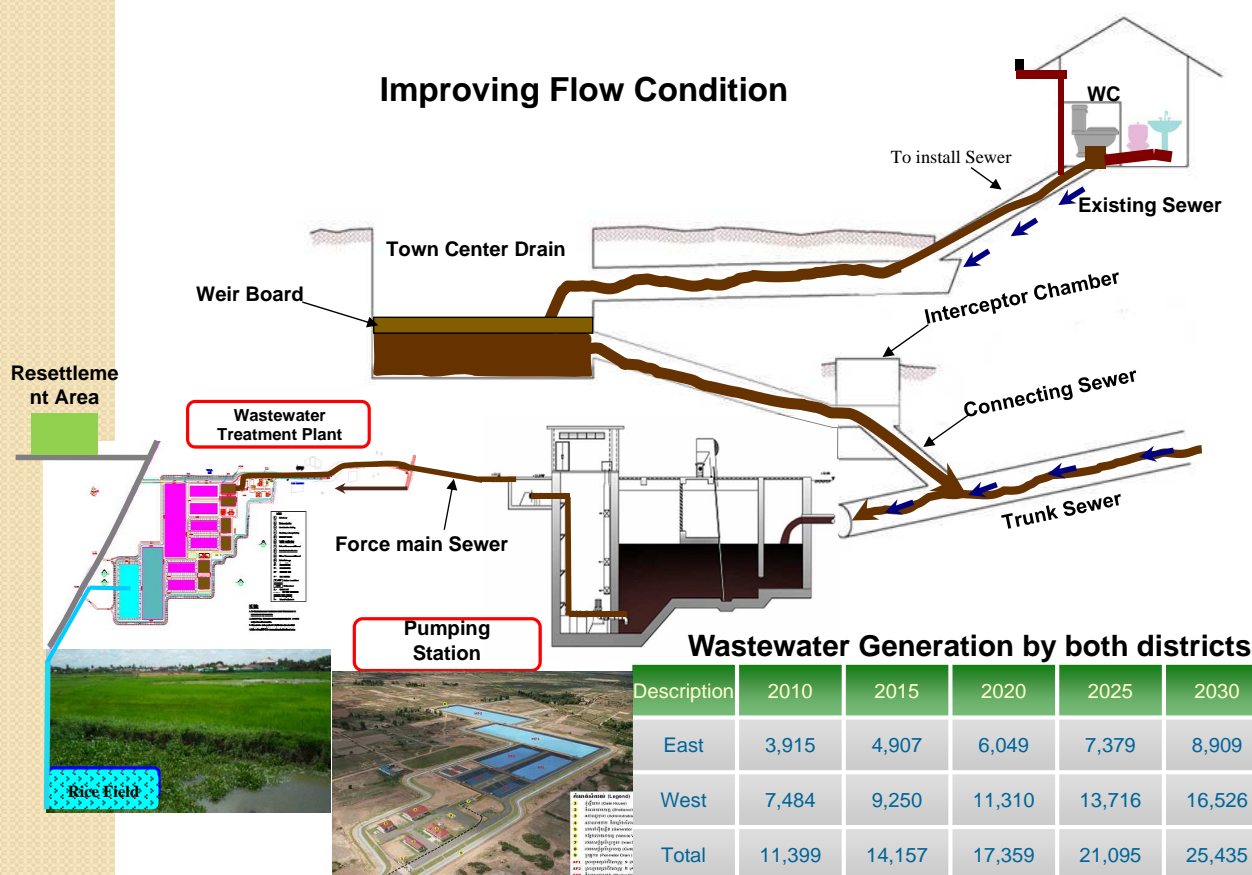
The treatment plant operated by natural gravity flow . Sanitary and storm sewers come from public go to pumping station ,capacity 14,000m³ per day and to 6 difference pond system which the operation system as mention bellow :

- two anaerobic pond
- sludge drying bed
- two facultative pond
- two large maturation pond which size is totally 120,000m². Please see the attached photos.

The treatment capacity is 3000m³ per day , cover area 264 hectares in areas with high population density. The water quality percentage from treatment plant is about 60 to 80 %.

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➤ Siem Reap Sewer Flow Process



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➤ Siem Reap Sewerage System

Wastewater Generation by both districts

(Unit : m³/d)

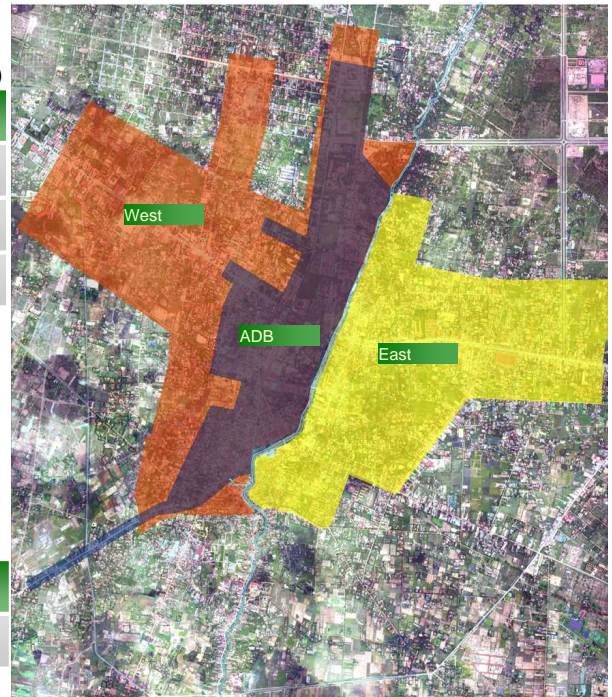
Description	2010	2015	2020	2025	2030
East	3,915	4,907	6,049	7,379	8,909
West	7,484	9,250	11,310	13,716	16,526
Total	11,399	14,157	17,359	21,095	25,435

Proposed Construction Plan by Phase

- West one can cover almost of wastewater generation

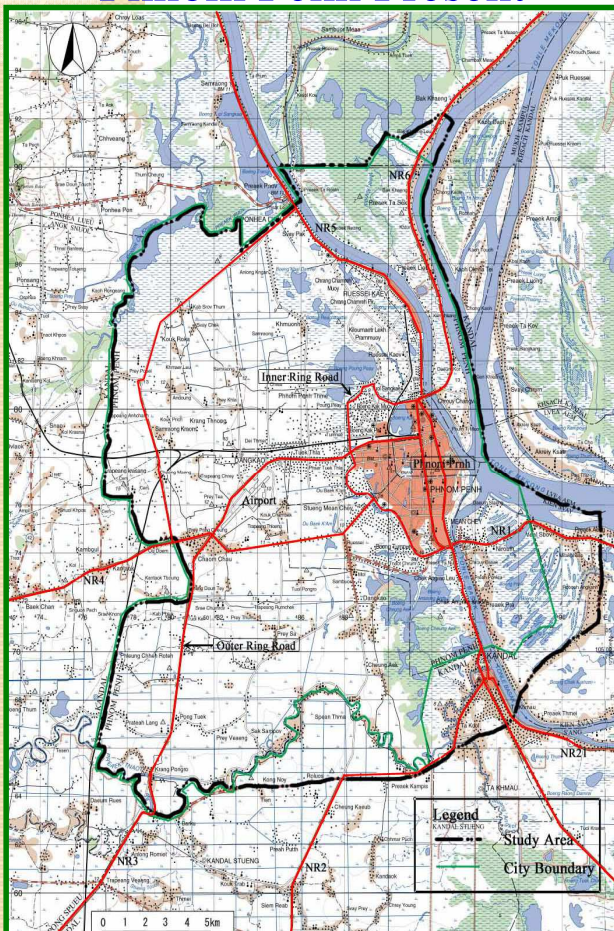
from the west until 2030.

Description	2020	2030	Remark
Capacity (m ³ /d)	6,000	9,000	36ha

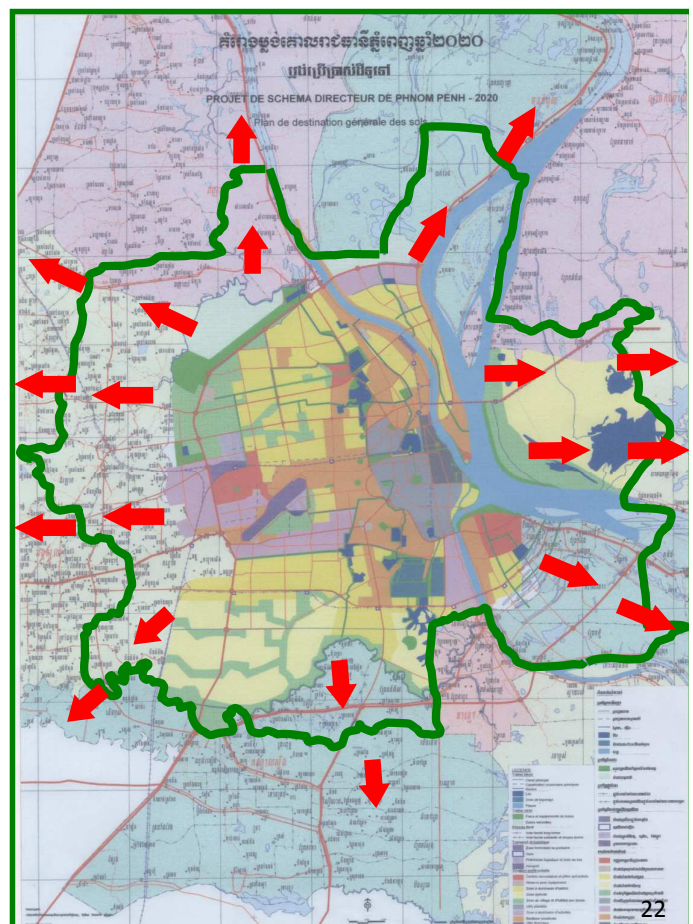


SR Waste Stabilization Pond System

Phnom Penh Present

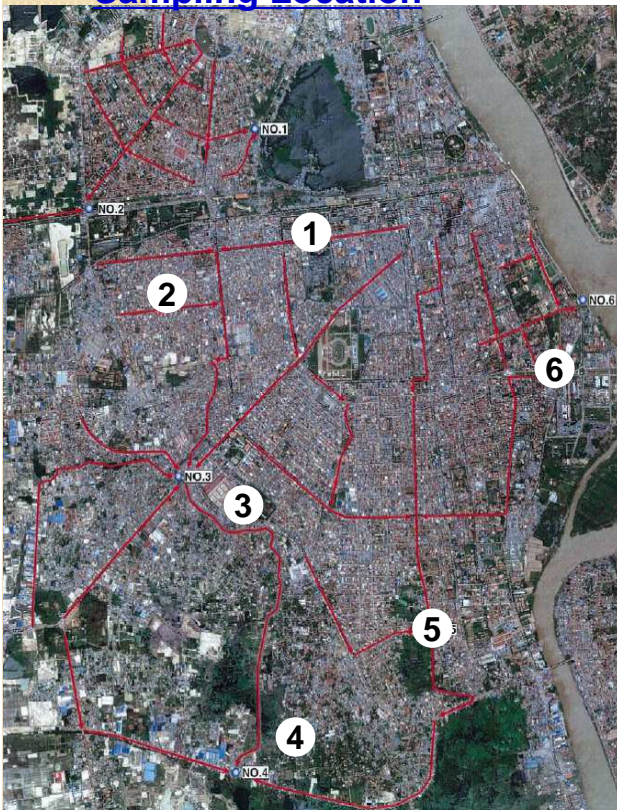


Phnom Penh in 2020



➤ Phnom Penh Surface Water Quality

Sampling Location



Water quality

	BOD	SS	COD	T-N	T-P
1	103.2	183.0	56.1	38.8	4.0
2	24.6	32.5	23.4	15.5	1.6
3	27.3	68.0	24.0	20.6	2.3
4	26.7	67.0	25.3	19.3	2.1
5	147.6	142.0	54.1	30.9	3.3
6	110.4	56.0	52.2	40.8	4.1

Sampling date : 2010.08.08

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7- Issues and challenges

- The present situation of sewerage and drainage is alarming, **flooding during the raining season, climate resilience** and requires urgent intervention to address the issues;
- A further deterioration is expected through rapid town development, land use & zoning development and **the basic infrastructures** (flood protection, water flow regulation system, town center drain, diver channel...);
- At present, there is no sewerage and drainage **sector master plan** for the towns or country,
- Not adequate human resources, empowerment and financial resources for O&M and management of the sewer system;

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Necessary Countermeasure

- Establishment of legislation and laws for wastewater management institutions for the empowerment/ enforcement, Capacity building and resources mobilization.
- Master plan for the wastewater management & related basic infrastructure of each urban area and towns throughout the country is urgently required;
- Encouragement of private sector to participate.
- People awareness to importance of wastewater management.

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Thank you