Water and Wastewater Experiences in Cambodia

By James Donison, P.E, Town of Hooksett

Cambodia Water and Wastewater

- **Contects:**
- Sponsoring Organizations
- Cambodia Information/Overview
- Phonm Penh Wastewater Study
- Siem Reap WWTF
- Your Responsibility as a Wastewater Operator

ICMA

PROFESSIONAL FELLOWS

YOUNG SOUTHEAST ASIAN LEADERS INITIATIVE

Visitors to Hooksett: I CMA, with funding from the U.S. State Department, Bureau of Educational and Cultural Affairs, will bring professionals to the United States from ten East Asian/Pacific countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar (Burma), Philippines, Singapore, Thailand, and Vietnam. The countries are members of the Association of Southeast Asian Nations (ASEAN).

The Fellowship has two tracks: 1) Environmental Sustainability and 2) Legislative Process, Good Governance and Civic Engagement. Fellows in the Environmental Sustainability theme will build their capacity to address environmental sustainability challenges in their communities, specifically on climate change, sustainable energy and environmental justice. Fellows in the Legislative Process and Governance theme will focus on municipal governance processes and will learn practical skills focusing on local government's role and responsibility in civic engagement and promoting transparency while fostering interaction with leaders from the federal, state, and local organizations.

Over the course of the next 12 months, over 100 international Fellows, in two cohorts, will spend four weeks working with a local government, organization or company in the United States, in addition to a week and a half enrichment and debriefing program in Washington, DC. In return, 20 selected U.S. Fellows will travel for two weeks to their international counterparts' communities to deliver technical assistance and consultation in meaningful Fellowships with local governments to help them engage citizens and civil society organizations in addressing community challenges to adapt quickly to create more resilient communities.


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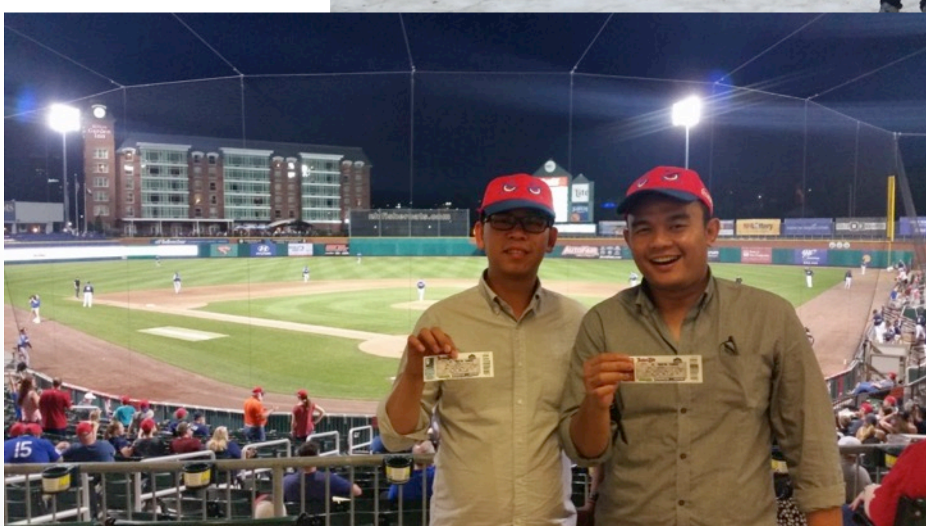


Itenerary – 4 weeks

Dr Zul Ilhame – assist prof Univ of Malaya

Chandath Him – Assist Director of MOE Cambodia

-Environmental Sustainability; meetings included

- NHDES (water/WW/Storm); Peterborough Solar Arrays; NH Ball Bearings; Hooksett WWTF/DPW/Landfill/Town Council; ASCE annual Mtg; Bild Diesel facility No haverhill; Manchester WWTF and LED Street Lights; NH Stormwater MS$ Coalition; SNHU MBA sustainability program and LEED buildings; Harvard and MIT; Rochester waste management landfill; GE Solar Panels; Eversource initiatives; NH Ball bearings inititiaves; Stonyfield Yogart initiatives; Maine Conference Green infrastructure for coastal resiliancy; NHDES source water protection conf; UNH stormwater center and program on Sustainability and env conservation; claremont Voices of water for Climate Change;

Cambodia

- Presentation by Eaknguon Chea (Robert) from Cambodia

YSEALI Professional Fellowships

COUNTRY PRESENTATION

KINGDOM OF CAMBODIA

BY: EAKNGUON CHEA

FALL 2017


Russia
Mongolia
China
South Korea
Japan
Thaila
1
North Pacific Ocean
Canada
2
United States
Mexico
Venezuela
Colombia
Indonesia
Papua New Guinea
Brazi
Peru
Bolivia
dian cean
Australia
South Pacific Ocean
Chile
Argentina
New Zealand
Google

Overview - Geography

- ពះរាជាណាចក្រកម្ពុជា Kingdom of Cambodia

- Cap.: Phnom Penh
- Total: 181,035 km2
  - Water: 2.5%
- Pop.: 15 millions (2016)
- Ethnic Groups:
  - 97.6% Khmer
  - 1.2% Muslim
  - 0.1% Chinese
  - 0.1% Vietnamese
  - 0.9% Others

Overview - Society

- Language: Khmer (ភាសាខ្មែរ)
- Official Currency: Riel (KHR)
  - Usable Currency: USD $
- Official Religion: Buddhism

History

- 1941-1945: Under Japanese occupation
- 1863-1953: Under French Colonization
- Independence: 09 September 1953
- 1975-1979: Khmer Rough Regime

=> Genocide/Crime against humanity

=> Hybrid Court: Khmer Rough Tribunal (ECCC)

History

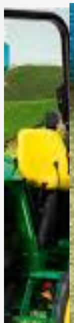
- 1991-1993: United Nations Transitional Authority in Cambodia (UNTAC)
- Monarchy restored: 24 September 1993
- 1993-Present: Kingdom of Cambodia

Economy

- In 2017 Cambodia's per capita (nominal) income is 1,308USD
- and Total: 20.953 billions USD.
- Cambodia graduated from the status of a Least Developed Country to a Lower Middle Income country in the same year 2016.
- While per capita income remains low compared to most neighboring countries, Cambodia has one of the fastest growing economies in Asia with growth averaging 07 % over the last decade.

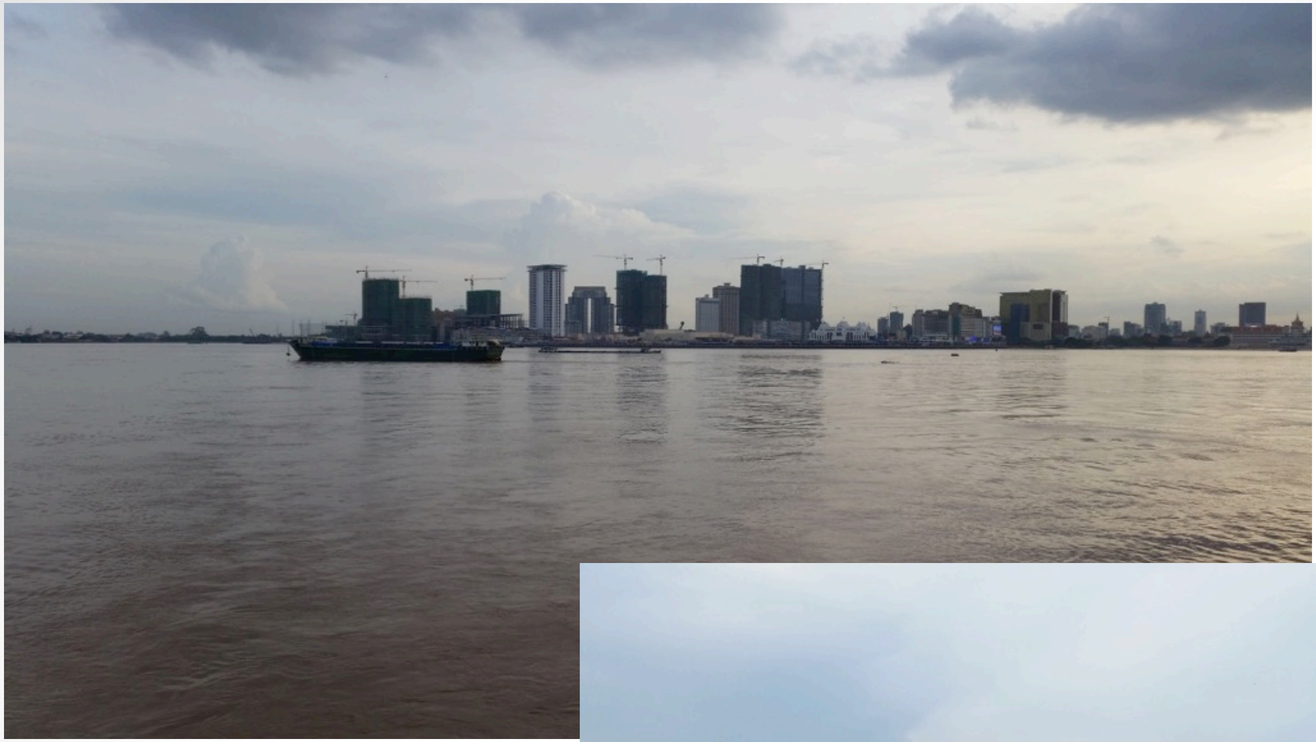
Economy

- Agriculture used to be the dominant economic sector; however, lately strong growth in textiles, construction, garments, and tourism leading to increased foreign investment and international trade.





Traffic in Phonm Penh





amco


Dulux
let's colour
Weathershield
Maybank
Smart
4X4


THE PROJECT
FOR
THE IMPROVEMENT OF WATER SUPPLY FACILITIES
IN PHNOM PENH
DONATED BY
THE GOVERNMENT OF JAPAN
AS A TOKEN OF FRIENDSHIP AND COOPERATION
BETWEEN
THE KINGDOM OF CAMBODIA AND JAPAN
1996

JICA

Flocculation -pac

Coagulation

Sand Filters

DIP >10", PE pipe<8"


30 11:47AM

3300 low income subsidized – favor with world bank/asian dev bank

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Low-Income	101	474	2,134	1,257	2,540	2,806	2,059	2,800	1,343	2,076	1,272	2,690	6,155	1,429	1,441	1,149	887	32,613
Domestic	16,606	10,439	8,658	13,629	14,602	13,815	16,038	11,630	9,601	15,216	13,042	10,208	11,665	15,018	17,154	18,571	19,033	234,925
Total	16,707	10,913	10,792	14,886	17,142	16,621	18,097	14,430	10,944	17,292	14,314	12,898	17,820	16,447	18,595	19,720	19,920	267,538

A3. Conclusion

This program does contribute to eradicating the poverty of Phnom Penh habitants and meet the goals of Poverty Reduction Policy of the Government.

The water people are using is clean and drinkable from tap directly. The service is available 24/7 whenever they need with sufficient pressure. They no longer need to wait to collect and transport water over distance as well as spend 3 to 9 times less than before. They have time to engage other jobs to make more income for their families. Now, the children who used to help transport water every day over distance can relax and have time to play and study for their body and mind improvement. In addition, health has been better improved due to clean water.

Pursuant to the dynamic result, PPWSA has been extremely enthused and supported by the Government, development partners for self-reliance, and the poor as well as NGOs, donors and loan providers, in particular, the World Bank, the Asian Development Bank and the Mairie de Paris.

Avg annual income - $500-$1000- water bill $0.25-0.40/month for 250 gal

Reason of Clean Water Supply to the Poor

The Kingdom of Cambodia has a total population of about 13 millions. Almost one million Cambodians are residing in Phnom Penh, mostly in the four central districts. Like other developing countries, the poor are living in Phnom Penh City in communities and some are scattered.

Their jobs are motorbike taxi drivers, cyclo-drivers, laborers, inner-tube pitchers, cars and motorbike cleaners, etc. with an average daily income between 3,500 to 10,000Riels (USD0.85-USD2.50) per household. Every day, they have to allocate the tiny the tiny income for basic like food, electricity, water, etc.

The poor without direct connections from PPWSA have to purchase water from sellers at a high price of 1,500 to 3,500 Riels per cubic meter, which geographically varies. In addition to the high price, they have to sacrifice their manpower and time to bring water to their homes in the distance of hundreds of meters. The cost is therefore increased.

In general, water transport is the children's workload reducing the school and play time for improving their own spirits and bodies.

Moreover, the water they purchase is safe because of its sources- lakes or wells without any protection. Even water from PPWSA's distribution networks (in case of re-sales) is not ensured due to the unsafe transport facilities like unclean buckets and pushcarts.

Quite the reverse, the people having direct connections from PPWSA do not need to transport water because they have indoor water for easy use.

They also have to pay only 550 Riels/m^3 for a monthly consumption up to 7m^3 (approximately 230 l/day) and only 770 Riels/m^3 for a monthly consumption between 8 to 15 m^3.

With regard to this, those who do not have direct connections from PPWSA, mostly the poor, have to pay 3 to 9 times for water

Rural Water WHO

- 2015, 71% of population (5.2 billion) used a safely managed drinking-water service free from contamination.
- 89% of the population (6.5 billion) used at least basic service. A basic service is improved drinking-water source within a round trip of 30 minutes to collect water.
- 844 million people lack basic drinking-water service, including 159 million people who are dependent on surface water.
- Globally, at least 2 billion people use a drinking water source contaminated with faeces.
- Contaminated water can transmit diseases such diarrhoea, cholera, dysentery, typhoid, and polio. Contaminated drinking water is estimated to cause 502 000 diarrhoeal deaths each year.
- 2025, half of world's population will live in water-stressed areas.
- In low- and middle-income countries, 38% of health care facilities lack an improved water source, 19% do not have improved sanitation, and 35% lack water and soap for handwashing.

Many NGO's

CAMBODIA

With the Cambodian NGO TEUK SAAT, 1001fontaines installs 2 fountains per month in villages… and the pace keeps getting stronger!

2 500 000
LITERS/MONTH

240 000
BÉNÉFICIARIES

90 000
SCHOOLCHILDS

102
ENTREPRENEURS

In the villages, inhabitants have been very scarcely informed about hygiene and drinking water quality, and medical facilities are close to non-existent. Ancient habits of using stagnant water, river or rain depending on the season are deeply routed with all the sanitary consequences.

Sokha
Beneficiary of Prek Luong village

"Children are hardly ever sick
and I make money and save time …"

Before having 1001fontaines' water at home, I used to boil stagnant water, otherwise it brings illnesses to my children and to all of my family. But boiled water, even after letting it rest, stays warm for a long time… so the kids kept drinking stagnant water. I couldn't prevent them from doing it. Now, they prefer to come back home to drink when they play. They take the water from the container and are hardly ever sick. I am happy for them, because they can benefit from school, and when they grow up they will have a job, and I save time, I don't have to boil water anymore, ... and money, I don't have to bring them to a health center and pay for medication.

6 mil of 15 mil – no access to affordable water

What we do

In Cambodia, inadequate water supply is a daily reality for millions of rural residents. According to WHO (2011), more than 6 million rural Cambodians do not have access to an affordable source of treated water leading to a high prevalence of water borne diseases.

Rural populations rely on solutions available locally such as untreated surface water (ponds, rivers) with its associated risks of bacterial diseases or groundwater (wells).

Between 1999 and 2000, the presence of natural arsenic was confirmed in Cambodian groundwater (Cambodia Drinking Water Quality Assessment conducted jointly by the Ministry of Rural Development and the Ministry of Industry, Mines and Energy). According to a report published by UNICEF in 2009, 2.25 million people are estimated to live within arsenic affected areas.

Cambodian NGOs and institutions therefore face a significant challenge with one the one hand a high reliance of rural populations on untreated surface water and on the other hand a significant contamination of shallow ground-waters with arsenic and the associated risks of arsenicosis and cancer.

Tuek Saat 1001's approach: provide a high quality service to rural communities. Our mission is to improve the health of rural communities in rural Cambodia by establishing and supporting sustainable social enterprises, which produce and distribute safe-drinking water locally within their villages and guarantee the quality of the water. Inspired by the idea that "we drink 90% of our diseases" as Louis Pasteur used to say, we believe that focusing on drinking water (1.50L /day /person) can significantly improve people's health and complement standard water and sanitation infrastructure approaches.

Teuk Saat 1001 is active in Cambodia since 2007, where all projects are implemented and managed by Mr. Chay Lo, also a co-founder of 1001 fontaines, the main NGO in France.

The initiative relies on 3 key principles:

- QUALITY: The system purifies water that is available locally (mainly surface water) with very light infrastructure. The purified water is delivered to the beneficiaries' homes in 20L bottles, which are disinfected and sealed, thereby guaranteeing water quality at the point of consumption. A rigorous treatment process ensures water quality according to international standards. Monthly controls are performed in the NGO laboratory and twice a year at the Ministry of industry, mines and energy.
- ACCESSIBILITY: This starts by providing water at an affordable price for the poor (1,200 riels for 20L) in addition to social marketing actions to foster changes in behavior related to water and hygiene. Safe water is produced in the village, for the sole benefit of the village. By using water available locally, as well as a simple technology (UV disinfection) relying on solar energy, and by limiting transportation, production costs remain very low.
- SUSTAINABILITY: The business model consists of entrusting local villagers to operate the water treatment units, and training them so they can build entrepreneurial capacities. Once a production site is operational, water sales provide enough revenues to cover all field expenses, including operators' income, maintenance costs, and shared services costs. This ensures that each village is self-sufficient and that the solution is durable. Operational sustainability is comforted by the local support team ("platform"), which provides assistance to the operators for maintenance, spare parts supply and water quality control, and receives in exchange monthly fees from each site, according to a micro-franchise approach.

Impact on most vulnerable lives of infant (0-5years old)

Despite claims that the Millennium Development Goals (MDG) targets on access to safe drinking water have been met, many 100s of millions of people still have no access. The challenge remains how to provide these people and especially young children with safe drinking water.

Impact on quality of basic education of children (6-12 years old)

Education is one of the most important drivers behind helping people in developing countries lift themselves out of poverty. However, even when schooling is available absenteeism rates can be high. Recent interest has focused on whether or not WASH interventions can help reduce school absenteeism in developing countries. However, none has focused exclusively on the role of drinking water provision. We report a study of the association between school absenteeism and provision of treated water in containers into schools.

Our Objectives

- To install 143 new water treatment kiosks in order to reach 250 kiosks by 2020, in at least 15 provinces of Cambodia, with 1 million beneficiaries.
- To increase 99% of awareness through social marketing, distribution channel, and academy training at national and commune level by 2020.
- To ensure 99% sustainable activities at national and commune level in Cambodia through Grant-Fund, Organization, and Program Sustainability.

THE IMPORTANCE AND LIFE CYCLE IMPACT OF WASH* FOR MATERNAL, NEWBORN, AND CHILD HEALTH

1.8 billion people drink fecally contaminated water [1], which causes diarrheal disease.

Diarrhea kills 842,000 people yearly, including 1,000 children under 5 each day. [2]

50% of malnutrition in the world is caused by WASH-related diseases such as diarrhea and intestinal worms.
25% of stunting can be attributed to 5 or more episodes of diarrhea before age 2. [3]

Globally, WASH has a significant impact on the health of pregnant women, newborns and children

Basic training in WASH helps health workers make sound decisions, promote solutions appropriate to the local context and improve the health of mothers and children in their care. Similarly, if WASH practitioners and decision makers know what the primary threats are to maternal and child health in a particular area, they can better tailor interventions to protect health.

Health and WASH practitioners play an important role:
- increasing awareness
- educating on solutions
- motivating action, and
- supporting sustained use and practices

Examples of simple, affordable steps:
- **Water** Use the safest source of water available, treat it (e.g. boiling, using locally available filters, chlorine), and store it safely to prevent recontamination
- **Hygiene** Wash hands at critical times (after coming into contact with feces and before preparing or eating food)
- **Environmental sanitation** Wear shoes to prevent the transmission of some parasites
- **Sanitation** Use and maintain a latrine

WASH-related diseases are preventable, and there are low-cost solutions that people can undertake themselves

A study in Nepal found that when the person delivering a baby had washed their hands, the baby was 25% less likely to die. When both the person delivering the baby and the mother washed their hands, the baby was 56% less likely to die [4]

Access to improved water sources within the community can decrease maternal mortality by decreasing the risk of intestinal worms and thus anemia and diarrheal diseases, which lead to nutritional deficiencies and hepatitis.

Simple actions (in the home and by health practitioners) make a difference

PREGNANCY

DEATH
MISCARRIAGE
MALABSORPTION
ANEMIA

Approximately 10% of maternal deaths in developing countries during non-epidemic conditions may be due to Hepatitis E. [5]

In one study, toxoplasmosis infection increased the rate of miscarriage by more than six times. [6]

Persistent Giardia infection can lead to malabsorption in pregnant women. [7]

Hookworm infections increase the prevalence of anemia in pregnant women. [8] In a recent study Ethiopian study, women infected with hookworm were more than 5 times more likely to be anemic, once other risk factors had been taken into account .[9]

FETUSES

STILLBIRTH OR MISCARRIAGE
PREMATURE BIRTH
FETAL ABNORMALITY

In four studies from four different countries, an average of 30% of fetuses died when their mother was infected with cholera. [10]

In one study, the risk of premature birth was more than three times greater for pregnant women with toxoplasmosis. [11]

Pregnant women with toxoplasmosis have a higher risk of fetal abnormality. In one study, the risk of fetal abnormality was six times higher for pregnant women infected with Toxoplasma than women who were not infected. [11] Fetal abnormalities include severe eye infections, mental disability, and seizures.

NEWBORNS

LOW BIRTH WEIGHT
DEATH
SEPSIS

Pregnant women with schistosomiasis have a 45% increased chance of having a low birth weight baby. [12]

In one study, nearly one third of newborns born to women with Hepatitis E died. [13]

Newborns born to women who had been exposed to arsenic during their pregnancies had an 80% greater risk of dying in their first 30 days. [14]

In one study in Bangladesh, 11% of children less than one year old infected with typhoid fever died. [15]

15% of newborn deaths are due to sepsis. [16] Sepsis is linked to unhygienic conditions at birth. [17]

CHILDREN UNDER 5

DEATH
ANEMIA
DIARRHEA
MALNUTRITION
STUNTING
DEVELOPMENTAL IMPACTS

Diarrheal disease is the 2nd leading cause of death for children ages 1 month to 5 years. That is more than AIDS, malaria, and measles combined. [18]

In children, Rotavirus causes an estimated 40% of hospital admissions for diarrhea. [19]

Repeated and persistent intestinal infections (with or without diarrhea) cause intestinal damage. This results in reduced nutrient absorption and malnutrition. Once infected and undernourished, the body is more vulnerable to further infections, continuing the cycle. Severe infection causes greater health impacts, in both the short and long-term. Overall, the long-term impact on children is poor growth (stunting) and cognitive development. [20]

Malnourished children with Giardia commonly experience persistent diarrhea leading to stunting. [21]

Children with schistosomiasis have a 40% higher rate of anemia than children who do not have the disease. [22]

Some studies have found that persistent diarrhea can significantly increase the risk and severity of pneumonia infections in young children, especially if linked with malnutrition. [23]; [24] Pneumonia is the leading cause of death for children between the ages of 1 month and 5 years.

MNCH TRAINER COLLECTION
Reproductive, Maternal, Newborn and Child Health Resources
caw.st/MNCHCollection

HWTS KNOWLEDGE BASE
Household Water Treatment and Safe Storage
hwts.info

[1] to [24] References at cawst.org/WASHandMNCH

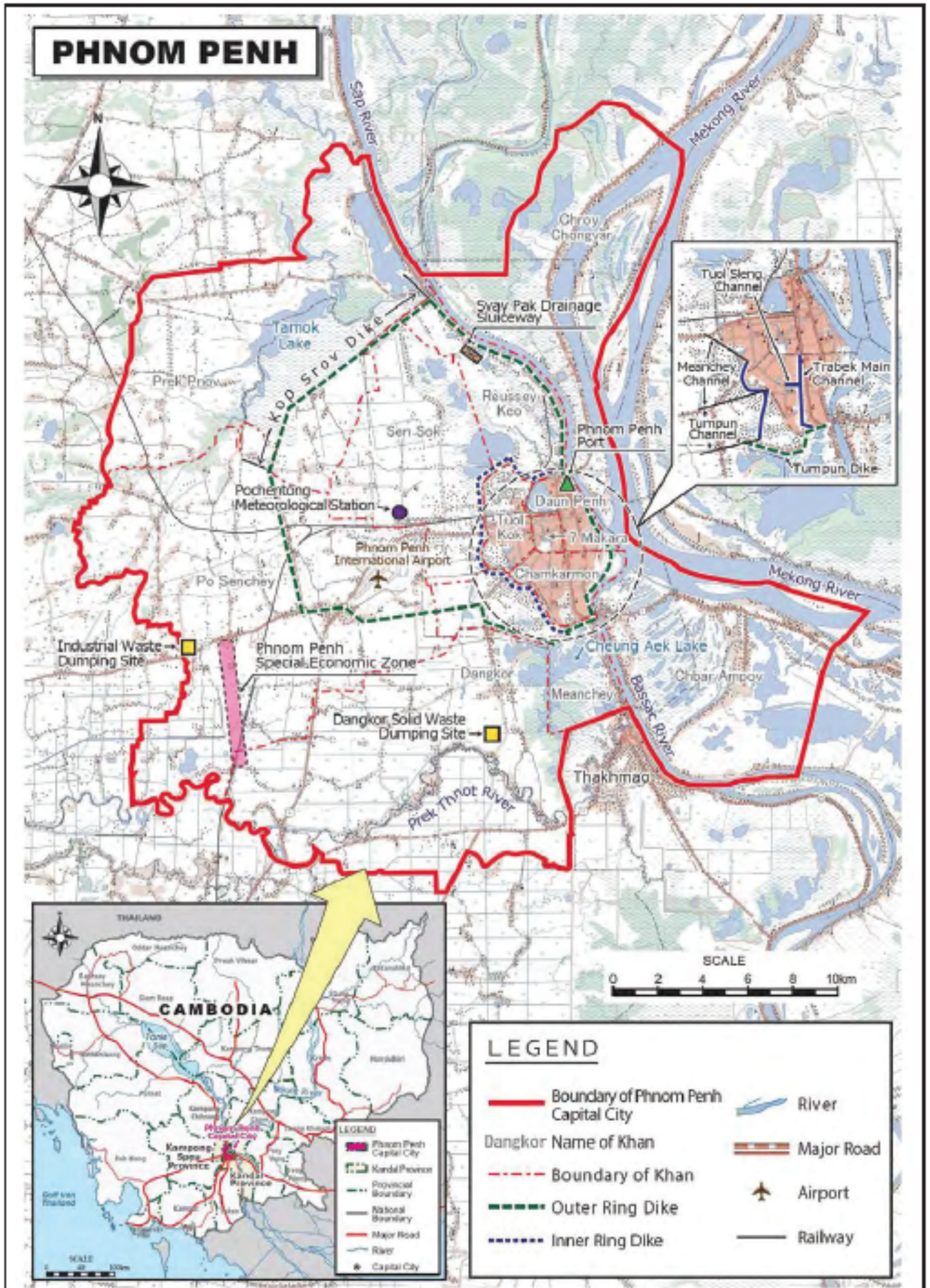
* WASH

"Creating equitable and sustainable access to safe water and improved sanitation and hygiene can dramatically benefit reproductive, maternal, neonatal and child health."

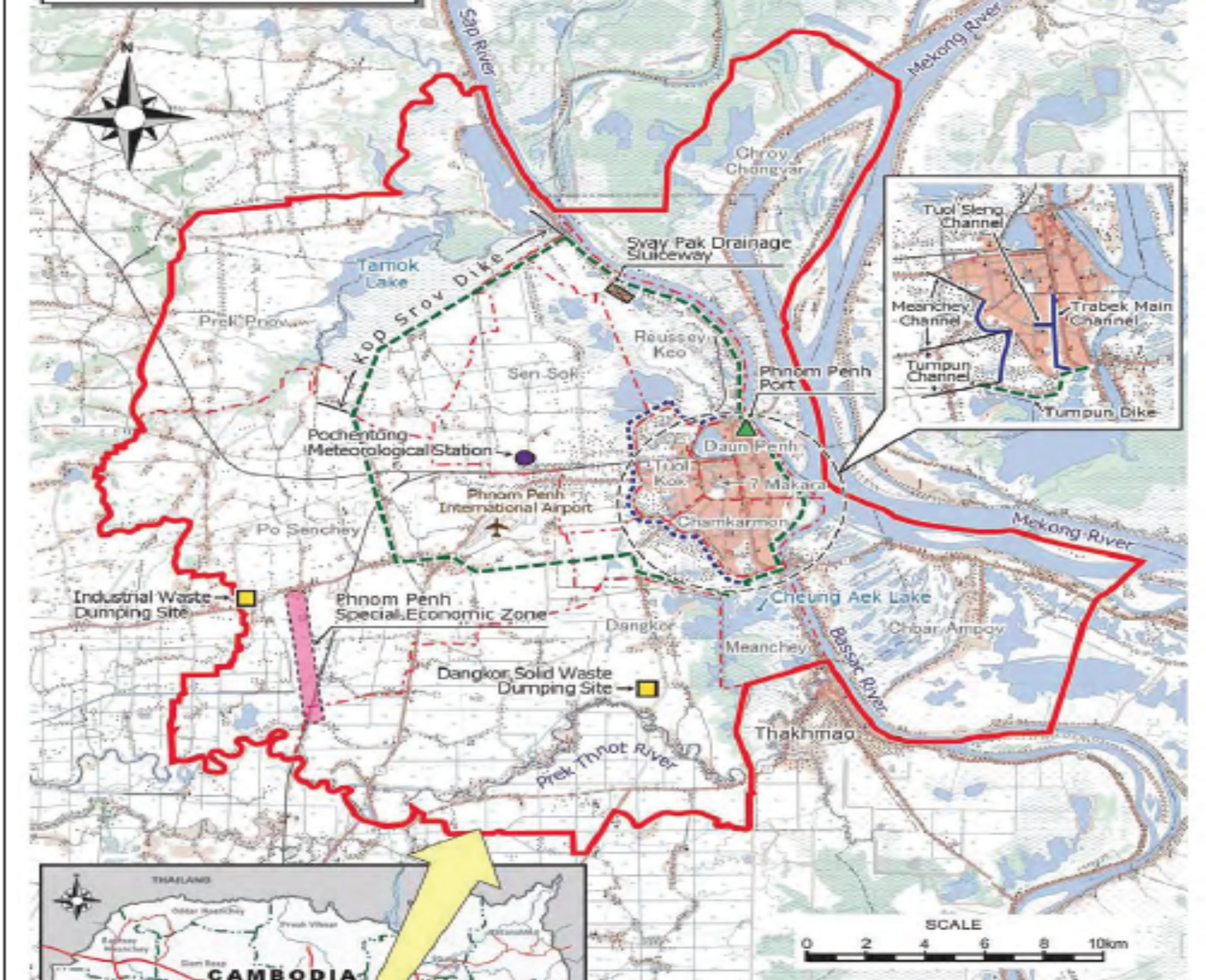
...ip for Maternal, Newborn and Child Health. [3]

CAWST
cawst.org

Wastewater conveyance



LOCATION MAP



Sap River
Mekong River
Chroy Chongvar
Tuol Sleng Channel
Meanchey Channel
Trabek Main Channel
Tumpun Channel
Tumpun Dike
Svay Pak Drainage Sluiceway
Tamok Lake
Kop Srov Dike
Prek Pnov
Reussey Keo
Sen Sok
Phnom Penh Port
Pochentong Meteorological Station
Daun Penh
Tuol Kok
7 Makara
Phnom Penh International Airport
Chamkarmon
Po Senchey
Mekong River
Industrial Waste Dumping Site
Phnom Penh Special Economic Zone
Cheung Aek Lake
Dangkor
Chbar Ampov
Meanchey
Bassac River
Dangkor Solid Waste Dumping Site
Thakhmao
Prek Thnot River
SCALE
0 2 4 6 8 10km
THAILAND
CAMBODIA

1.1 Background

Since 2008 the administrative area of Phnom Penh Capital City (hereinafter referred to as "PPCC") has been expanding and reached up to 678.46 km^2 in 2011. PPCC's population has been also increasing from about 1.0 million in 1998 to 1.5 million in 2010. The city is often threatened by floods from the Mekong River due to the insufficient safety from the flood dikes.

Urban drainage facilities are not also functioning well. The facilities were constructed from the beginning of 1960's and thus superannuated. Poor maintenance during the civil war in the 1970's has worsened the situation. As a result, the city habitually suffers from inundation by local rainfall, especially, in the rainy season.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), in response to the request from the Royal Government of Cambodia (hereinafter referred to as "RGC"), conducted "The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh" in 1999. Based on the Master Plan formulated in that study, the Government of Japan (hereinafter referred to as "GOJ") conducted grant aid projects (Phase I, II and III) for the purpose of strengthening the drainage capacity in the city area and to protect the city from flooding. In spite of these efforts, drainage problems are still generated in areas other than the areas of Phase I, II and III, due to the rapid urbanization and changes in land use.

As for sewage management in PPCC, only human excreta are held on plot in septic tanks. On the other hand, overflow effluent from the septic tanks as well as domestic wastewater, flows directly to the drainage pipes or open channels and runs into the ponds/swamps located in the downstream of the watersheds, in which wastewater is purified by the natural purification function to some extent.

However, the ponds/swamps have been invaded by houses, factories and other activities, and they no longer demonstrate their natural purification functions. Since the amount of wastewater increased due to the population growth and city development, the ponds and swamps have become black and smell terribly. As a result, outbreak of insects and waterborne diseases are anticipated, and the water quality of Mekong River, Sap River and Bassac River, which are the final disposal bodies of wastewater from the city, are also pollute

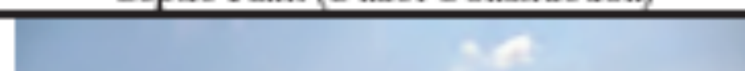
150%

Cheung Aek Lake

Discharged Water from Kop Srov Pumping Station

Trabek Channel

Tamok Lake

Trabek Channel	Tamok Lake
	
Wastewater Treatment Facilities in Dye House	Wastewater Treatment Facilities in Aeon Mall
	
Water Quality Monitoring at Prek Thnot River	Septic Tank (Under Construction)
	

	
Septage Vacuum Truck	Candidate Site of Cheung Aek STP

	
Inundation in Wat Phnom Northern Area	Inundation in Trabek Channel
	
House near Trabek Pumping Station (In inundation)	House near Trabek Pumping Station (No Inundation)
	

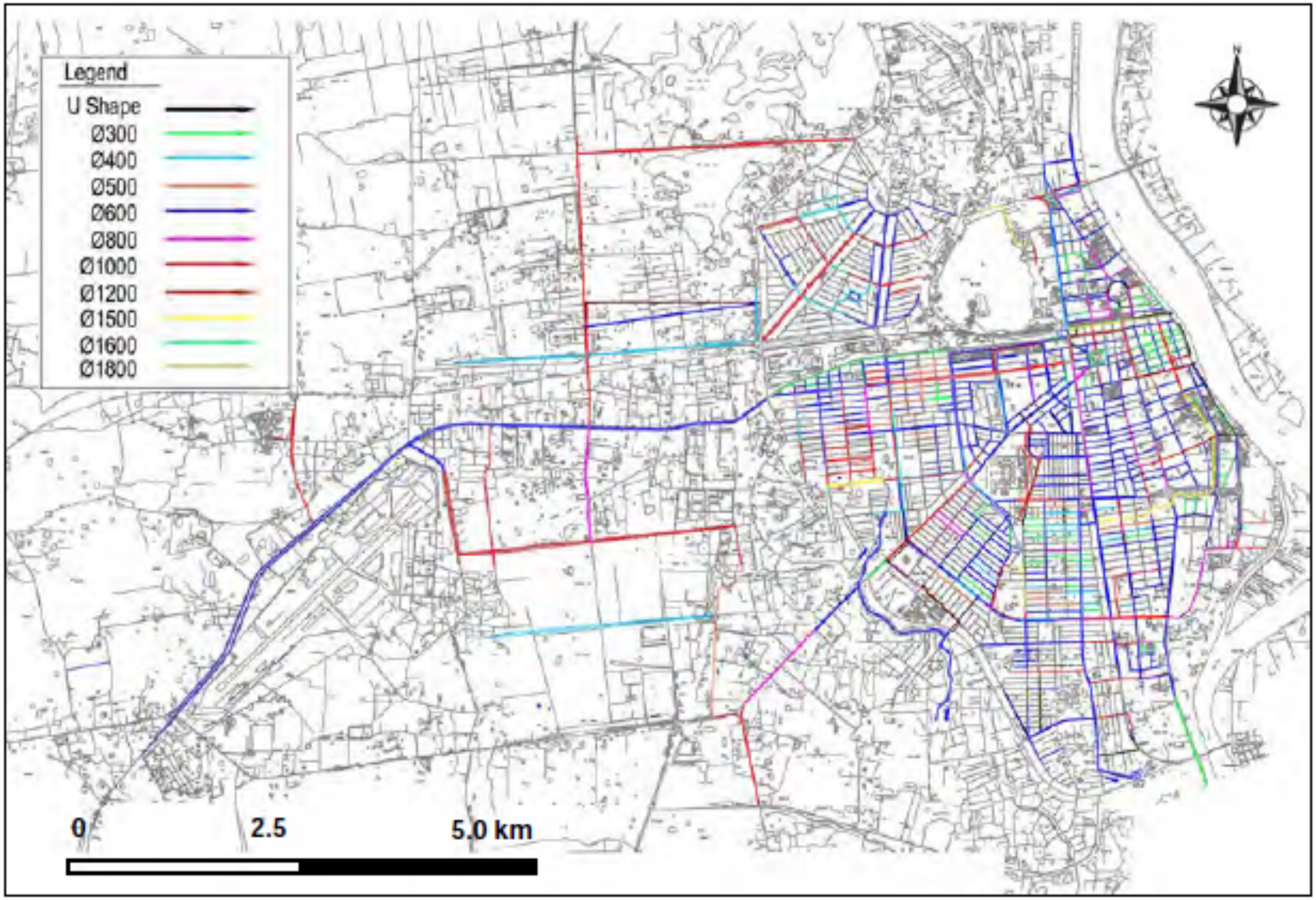
House near Trabek Pumping Station (In inundation)	House near Trabek Pumping Station (No Inundation)
	
Existing Drainage Channel (1/2)	Existing Drainage Channel (2/2)
	
Existing Pumping Station (Kop Srov Pumping Station)	Existing Pumping Station (Tuol Sampeo Pumping Station)
	

	
Box Culvert in Development Area (Under Construction)	Pipe Cleaning by DSD

Phonm Penh - Wastewater

Education - sanitation


HƯỚNG DẪN SỬ DỤNG



Source: DPWT/PPCC

Fig. 2.4.3 Drainage Pipe Location Map from Database

Table 2.4.7 Total Length of Open Channels Managed by DPWT

No.	Name	Total length (m)	Improved Length (m)	Canal Type
1	Boeng Trabek Upper Canal	2,410	2,410	Reinforced Concrete Canal
2	Boeng Trabek Downstream Canal	850	0	Earth Canal
3	Boeng Tumpun Canal	3,710	3,710	Improved Earth Canal
4	Stoeng Mean Chey Canal	1,900	0	Earth Canal
5	East & West Tuol Sen Canals	1,118	1,118	Improved to Reinforced Concrete Canal
6	Boeng Salang canal	1,260	887	Improved Earth Canal (887m)
7	Canal Baraing (France)	3,700		Earth Canal
8	Canal Lou Pram	1,700		Earth Canal
9	Tuol Poung Ror Canal (South Prey Pring)	7,500		Earth Canal
10	Prey Spoeu Canal	7,000		Earth Canal
11	O Akuch Canal	4,200		Earth Canal
12	598 Canal	1,850		Earth Canal
13	Tuol Sampoeuv Canal (Philippines Canal)	5,000		Earth Canal
14	Kop Srov Canal	4,700		Earth Canal
15	Bak Touk Canal	3,800		Earth Canal
16	O Veng Canal	4,150		Earth Canal
	Total	**54,848**	**8,125**	
	Improved to Reinforced Concrete Canal	**3,528**		
	Improved in Earth Canal	**4,597**		
	Normal Earth Canal	**46,723**		

Source: DPWT/PPCC

Table 2.4.8 List of Pumping Stations Managed by DPWT

No.	Station Name	Electrical Engine Driven				Diesel Engine Driven				Total Discharge Capacity [m³/sec.]	Observation (Date of Equipment)
		Nos	Pump type	Power /Unit [kW]	Capacity /Unit [m³/sec.]	Nos	Pump type	Power /Unit [HP]	Capacity /Unit [m³/sec.]		
1	Boeng Trabek	8	Horizontal	132	1.0	1 unit of Backup Generator, 1000 KVA				8.0	Operation since 2003 (ADB Loan)
2	Boeng Tumpun	5	Submergible Pump	280	3.0	2 units of Backup Generator, 700 KVA each				15.0	Operation since 2004 (Japan's Grant Aid)
3	Tuol Kork I	2	Vertical shaft	45	0.47	2	Vertical shaft	145	0.69	2.32	Constructed in 1970's
4	Tuol Kork II	1	Vertical shaft	45	0.47	2	Vertical shaft	145	0.69	1.85	Constructed in 1970's
5	Chak Tomuk	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation since 2010 (Japan Grant Aid)
6	Preah Kumlung 1	1	Pump Gate		0.2	-				0.2	Operation since 2004 (Joint Research with Kubota)
7	Preah Kumlung 2	2	Pump Gate	22	0.35	-				0.7	Operation since 2010 (Japan's Grant Aid)
8	Phsar Kandal	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation Since 2010 (Japan's Grant Aid)
9	Phsar Chaas	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation since 2010 (Japan's Grant Aid)
10	Svay Pak Km No.9	4	Submergible Pump	75	0.13	3	Vertical shaft	190	0.38	1.66	Operation since 2006
11	Kop Srov	5	Vertical shaft	400	2.8	-				14.0	Operation since 2010
12	Tuol Sampeo	3	Submergible Pump		0.66	-				1.98	Operation since 2014

Source: DPWT/PPCC

(9) Financial Issues

The financial issue at first is that DPWT or PPCC does not have sufficient budgets and the government does not have budget surplus either as described in **Item (8)** above. Therefore, the fund for implementation of this drainage and sewerage Master Plan must be grants or soft loan from the donors. Furthermore, if the entity uses revenues, it is preferable that the entity is independent or semi-independent and the account is separated from the government general account. Nevertheless, in that case, it is considered that there are three issues as follows:

- (a) Separation of drainage and sewerage costs
- (b) Securing users
- (c) Possibility of difficult management with tariff setting
- (d) Measures to collect tariff revenues

Table 3.2.1 Candidate Sites for Construction of Sewage Treatment Plant

No.	Name	Area (ha)	Depth (m)		Owner/Administrator	Remarks
			Dry Season	Rainy Season		
1	Tamok Lake	3,270	3.0-4.5	2-3 m plus that of dry season, at maximum	Owner: PPCC Administrator: PPCC/ MOWRAM	
2	Trabek Lake	Unknown	1.0-2.0	Same as that of dry season	Owner: PPCC Administrator: PPCC	Definite boundary is not defined in laws such as Sub-Decree
3	Tumpun Lake	Unknown	1.0-2.0	Ditto	Owner: PPCC Administrator: PPCC	Ditto
4	Cheung Aek Lake	520	2.0-3.0	2-3 m plus that of dry season, at maximum	Owner: PPCC Administrator: PPCC/ MOWRAM	

Source: JICA Study Team, based on information from PPCC

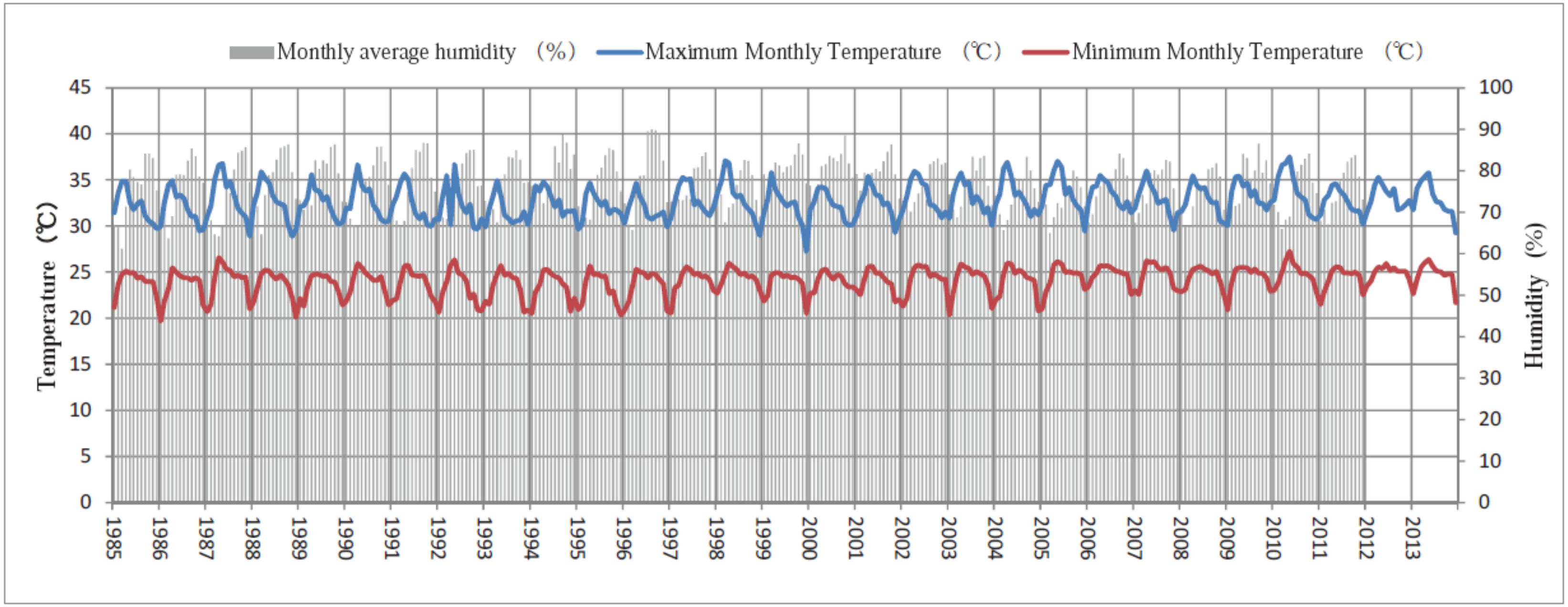
Source: JICA Study Team

Fig. 3.2.2 Target Area for Selection of Off-site Treatment Area

Outline of Master Plan and Pre-Feasibility Study

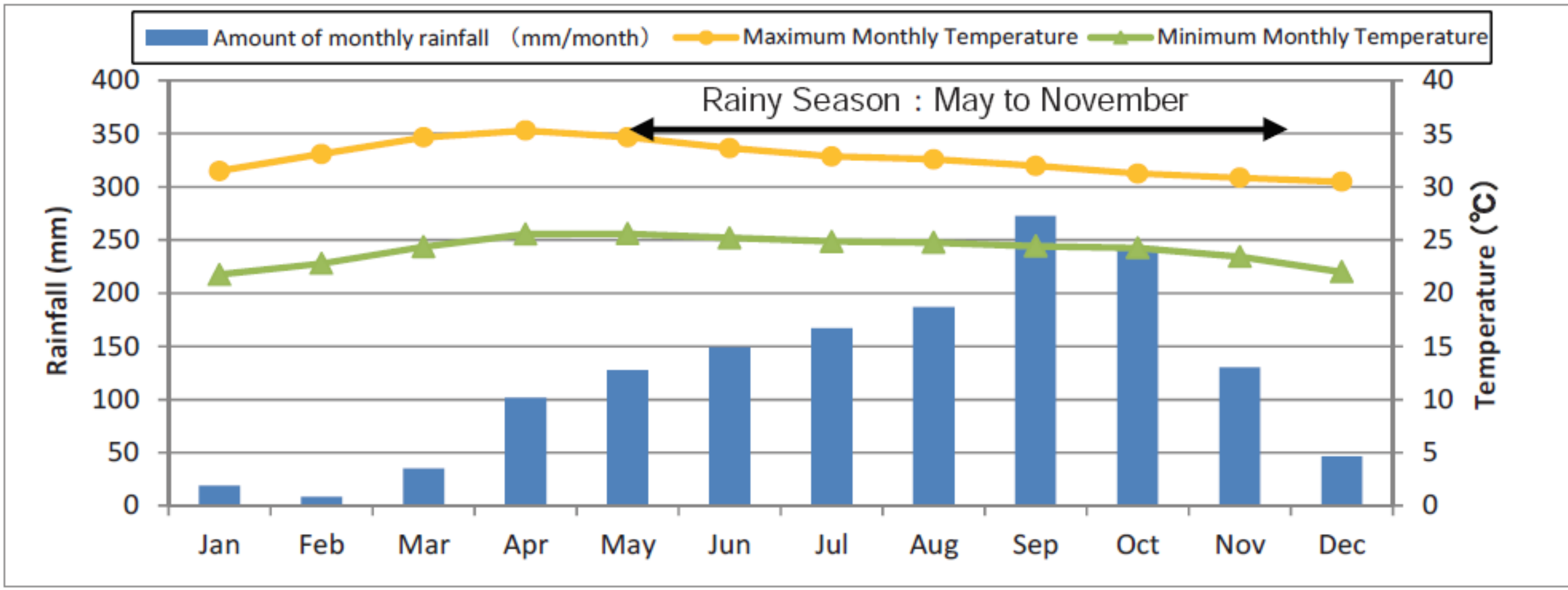
Item	Contents
Sewage Management (M/P)	
Target year	2035
Planning strategy	PPCC is subdivided into three areas (Cheung Aek, Tamok and Other areas) and applicability of on-site and off-site treatment for the target year 2035, is evaluated.
Planning frame	Cheung Aek area: Population of 1,093,155 in the planning area of 4,701.9 ha. Tamok area: Population of 481,423 in the planning area of 6,019.2 ha. Other area: Population of 1,292,522 (Total Population of 2,867,100-1,093,155-481,423)
Treatment system	Cheung Aek area: Off-site treatment with combined system is applied. A STP is proposed with capacity of 282,000 m^3/day. Conventional Activated Sludge Process (CASP) is applied for the STP. Tamok area: On-site treatment (Johkasou) is applied. Other area: Installation of septic tank, which is most popular sanitary device in PPCC, is recommended especially in households in which no toilet or pit latrine is equipped.
Legal and institutional set-up	Sewerage and Drainage Advancement Office under the director of DPWT/PPCC is proposed in the M/P, with the approach of "Start small and grow big". After the establishment of the Advancement Office, phased implementation plan for establishing independent sewage implementing body, in parallel with human resource development, is proposed.
Phased implementation schedule	Phased implementation schedule is proposed up to year 2040 to equalize volume of projects implemented in each period, as follows. Cheung Aek area: Phased implementation, consisting of (i) Preparatory Project, (II) Phase 1 Project, (iii) Phase 2 Project and (iv) Phase 3 Project, is proposed. Tamok area: Installation of Johkasou is commenced in Medium-term and ended in 2040, the last year of Long-term period, to equalize number of installation of Johkasou.
Project cost and O&M cost	Project cost: 1,025 million USD Breakdown is as follows. Construction cost in Cheung Aek area : 450.1 million USD Construction cost in Tamok area : 396.2 million USD Administration cost and so on : 178.7 million USD O&M cost: 30.692 million USD/year Breakdown is as follows. Cheung Aek area : 14.895 million USD Tamok area : 15.797 million USD
Financial and economic evaluation	Financial evaluation: Sewerage charge, which is equivalent of 75% of water tariff, will be required in the ultimate stage of implementation of Cheung Aek and Tamok area to cover O&M cost. Economic evaluation: EIRR is estimated at 26.31% in the combination of treatment of Cheung Aek and Tamok area.
Environmental and social considerations	Significant environmental and social impacts such as resettlement are not anticipated because proposed sewerage facilities in the M/P are installed in vacant public land or under public roads. Negative impacts such as traffic interruption, noise, dust and vibration would be unavoidable during the construction stage. However, the impacts could be minimized by introducing counter measures such as setting up diversion road, sprinkling water and selecting low-noise and/or low-vibration type construction equipment as far as practicable.

Maximum and minimum monthly temperature is shown in **Fig.2.1.12** and annual maximum and minimum temperature is shown in **Fig.2.1.13**.



Source: DOWRAM (Department of Water Resource and Meteorology)

Fig. 2.1.12 Maximum and Minimum Monthly Temperature and Monthly Average Humidity (1985-2013)



Source: DOWRAM (Department of Water Resources and Meteorology)

Fig. 2.1.14 Monthly Average Rainfall (2004-2013)

Table 2.2.2 Household Income Composition, Average per Month in Cambodia

Source of income	Value in thousand Riels				
	2009	2010	2011*	2012*	2013*
Cambodia					
Primary income	727	877	862	984	1,183
Wage and Salary	241	292	340	403	505
Self-employment Income	482	582	520	576	675
Agriculture	162	205	209	229	195
Non Agriculture	250	290	224	249	369
Owner occupied house	70	88	86	98	111
Property income	4	3	2	5	3
Total transfers received	19	24	26	35	53
Total Income	**747**	**901**	**888**	**1,019**	**1,236**
Total transfers paid	11	24	17	5	95
Disposable Income	**736**	**877**	**871**	**1,014**	**1,141**

Note: * Preliminary results
Source: National Institute of Statistics
(http://www.nis.gov.kh/index.php/en/find-statistic/social-statistics/cses/cses-tables.html)

Table 2.2.3 Household Income Composition, Average per Month in Phnom Penh

Source of income	Value in thousand Riels				
	2009	2010	2011*	2012*	2013*
Phnom Penh					
Primary income	1,986	1,940	1,770	1,847	2,478
Wage and Salary	765	910	991	930	1,135
Self-employment Income	1,203	1,023	769	909	1,326
Agriculture	22	20	8	22	11
Non Agriculture	878	650	423	560	935
Owner occupied house			338	327	381
Property income	17	7	10	8	17
Total transfers received	54	47	50	40	38
Total Income	**2,039**	**1,987**	**1,819**	**1,886**	**2,517**
Total transfers paid	24	44	26	17	138
Disposable Income	**2,016**	**1,944**	**1,793**	**1,870**	**2,378**

Note: * Preliminary results

Incidence of waterborne diseases is shown in **Table 2.8.4**. Diarrhea and others (itch, etc.) showed high incidence. Chamkamon is the highest in incidence by district (khan).

Table 2.8.4 Incidence of Waterborne Diseases

District (Khan)		Diarrhea	Hepatitis	Typhoid	Cholera	Malaria	Dengue Fever	Dysentery	Others	Total
1	Daun Penh	2	0	0	0	0	0	1	3	9
2	7 Makara	3	2	3	0	1	1	0	1	14
3	Chamkarmon	6	0	1	2	1	1	1	6	19
4	Tuol Kok	2	0	0	0	0	1	0	0	3
5	Sen Sok	0	0	0	0	0	1	0	1	2
6	Reussey Keo	2	0	2	0	0	1	2	1	14
7	Meanchey	3	0	1	0	0	0	0	3	12
8	Prek Pnov	0	0	2	0	0	0	0	1	3
9	Dangkor	1	0	1	0	0	0	1	2	12
10	Po Senchey	0	0	0	0	0	0	0	0	0
11	Chroy Changvar	1	0	1	0	0	0	0	1	8
12	Chbar Ampov	1	0	0	0	0	0	0	3	10
Total		21	2	11	2	2	5	5	22	106

Source: JICA Study Team

Table 2.5.7 Minimum, Maximum and Average Values at Monitoring Points in the Study

No.	Location		pH (-)	DO (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	COD_{Mn} (mg/L)	COD_{Cr} (mg/L)	T-N (mg/L)	T-P (mg/L)	Total Coliform (MPN/100 ml)
1	Tonle River	Min	6.17	3.44	72.0	2.79	3.98	22.64	0.09	0.01	1.1E+04
		Max	7.73	5.51	214.0	5.18	8.14	43.12	0.91	0.06	9.3E+05
		Average	6.91	4.47	124.3	4.05	6.04	32.40	0.43	0.04	2.2E+05
2	Mekong River	Min	4.20	4.37	98.0	0.90	2.79	19.60	0.13	0.04	2.9E+03
		Max	7.54	5.82	364.0	3.06	6.20	37.50	1.67	0.28	7.5E+05
		Average	6.41	5.15	179.5	2.04	4.51	27.67	0.54	0.09	1.8E+05
3	Bassac River	Min	5.83	4.18	95.0	0.50	3.05	15.68	0.48	0.05	4.6E+03
		Max	7.40	5.71	332.0	3.75	6.80	27.44	1.67	0.28	2.4E+06
		Average	6.71	4.83	165.2	2.06	4.38	22.30	0.84	0.14	4.4E+05
4	Tamok Lake	Min	6.61	4.72	59.0	2.90	4.31	33.80	0.66	0.12	2.3E+04
		Max	9.16	7.59	102.0	6.44	12.29	62.40	4.86	0.51	2.4E+05
		Average	7.64	6.06	85.8	5.17	9.76	49.43	1.74	0.30	9.8E+04
5	Cheung Aek Lake	Min	6.37	0.64	26.0	3.60	6.95	35.27	1.78	0.31	2.3E+04
		Max	7.38	4.85	164.0	9.69	18.24	74.16	4.76	0.76	7.5E+05
		Average	6.85	2.06	95.7	7.13	13.11	54.48	3.45	0.53	2.3E+05
6	Kop Slov Pumping Station	Min	6.10	0.13	84.0	10.80	-	36.84	2.23	0.99	1.5E+04
		Max	7.42	6.10	154.0	26.73	-	59.00	6.65	2.17	1.1E+06
		Average	6.92	2.82	106.5	18.05	-	46.00	3.49	1.47	3.2E+05
7	Svay Pak Sluiceway	Min	5.82	0.00	134.0	88.00	-	50.96	3.44	0.36	2.1E+04
		Max	7.23	3.57	640.0	156.62	-	90.16	8.80	2.10	2.4E+07
		Average	6.73	1.59	315.0	121.35	-	74.21	5.75	1.19	4.2E+06
8	Trabek Pumping Station	Min	6.66	0.00	72.0	89.00	-	116.52	2.74	1.17	2.1E+04
		Max	7.06	0.07	740.0	299.85	-	247.61	26.31	4.01	9.3E+06
		Average	6.85	0.03	254.5	243.05	-	195.71	11.13	2.18	1.8E+06
9	Tumpun Pumping Station	Min	6.09	0.00	142.0	112.00	-	92.18	3.32	0.59	2.3E+04
		Max	7.27	0.73	480.0	249.50	-	196.37	21.90	4.95	1.5E+07
		Average	6.79	0.13	237.5	164.09	-	132.06	10.62	2.01	2.7E+06
10	Prek Thnot River	Min	6.18	0.98	170.0	7.38	-	31.32	1.84	0.19	3.5E+03
		Max	7.39	5.10	474.0	20.69	-	48.12	6.96	1.83	9.3E+06
		Average	6.77	3.02	248.5	12.84	-	41.32	4.06	0.77	1.6E+06
11	Men Sarun (Noodle Factory)	Min	4.30	2.60	108.0	36.40	-	48.80	0.75	0.16	2.8E+04
		Max	7.25	6.12	478.0	127.50	-	595.84	4.10	1.04	1.1E+06
		Average	6.15	4.83	218.8	79.70	-	251.24	2.91	0.56	6.1E+05
12	SKD (Liquor Factory)	Min	3.35	1.03	52.0	30.75	-	48.76	0.59	0.14	7.5E+03
		Max	7.32	6.78	98.0	47.06	-	104.16	5.96	1.58	2.4E+05
		Average	6.34	3.09	79.2	39.34	-	71.36	2.33	0.54	1.4E+05
13	SL (Garment and Washing Factory)	Min	6.30	2.60	52.0	36.95	-	70.68	4.87	0.18	1.5E+03
		Max	7.51	6.35	128.0	65.52	-	160.72	14.75	2.18	7.5E+05
		Average	6.96	4.38	80.8	45.17	-	112.29	8.61	0.57	1.9E+05
14	Phnom Penh Tower (Office Building)	Min	5.48	0.00	86.0	15.70	-	49.60	4.08	2.55	2.3E+04
		Max	7.21	3.10	302.0	72.54	-	101.40	10.88	3.63	7.5E+05
		Average	6.63	1.67	201.7	37.37	-	79.90	7.56	3.01	1.7E+05
15	Intercontinental Hotel	Min	5.38	4.70	64.0	21.06	-	58.82	7.92	1.09	2.1E+04
		Max	7.83	5.72	268.0	75.58	-	84.88	26.14	2.96	2.1E+07
		Average	7.03	5.10	149.2	41.41	-	74.37	13.10	2.13	3.6E+06
16	Central Market	Min	4.70	0.00	144.0	135.62	-	202.80	7.21	2.24	2.3E+04
		Max	6.95	0.34	276.0	292.50	-	356.72	22.08	5.81	7.5E+07
		Average	6.17	0.07	190.0	212.91	-	283.35	11.19	3.38	1.3E+07
Standard for Monitoring Point											
	No. 1 to 3		6.5-8.5	>2.0	<100	<10	-	-	-	-	5.0E+03
	No. 4 to 5		6.5-8.5	>2.0	<15	-	<8	-	<1.0	<0.05	1.0E+03
	No. 6 to 16		5.0-9.0	>2.0	<120	<80	-	<100	-	-	-

Source: JICA Study Team

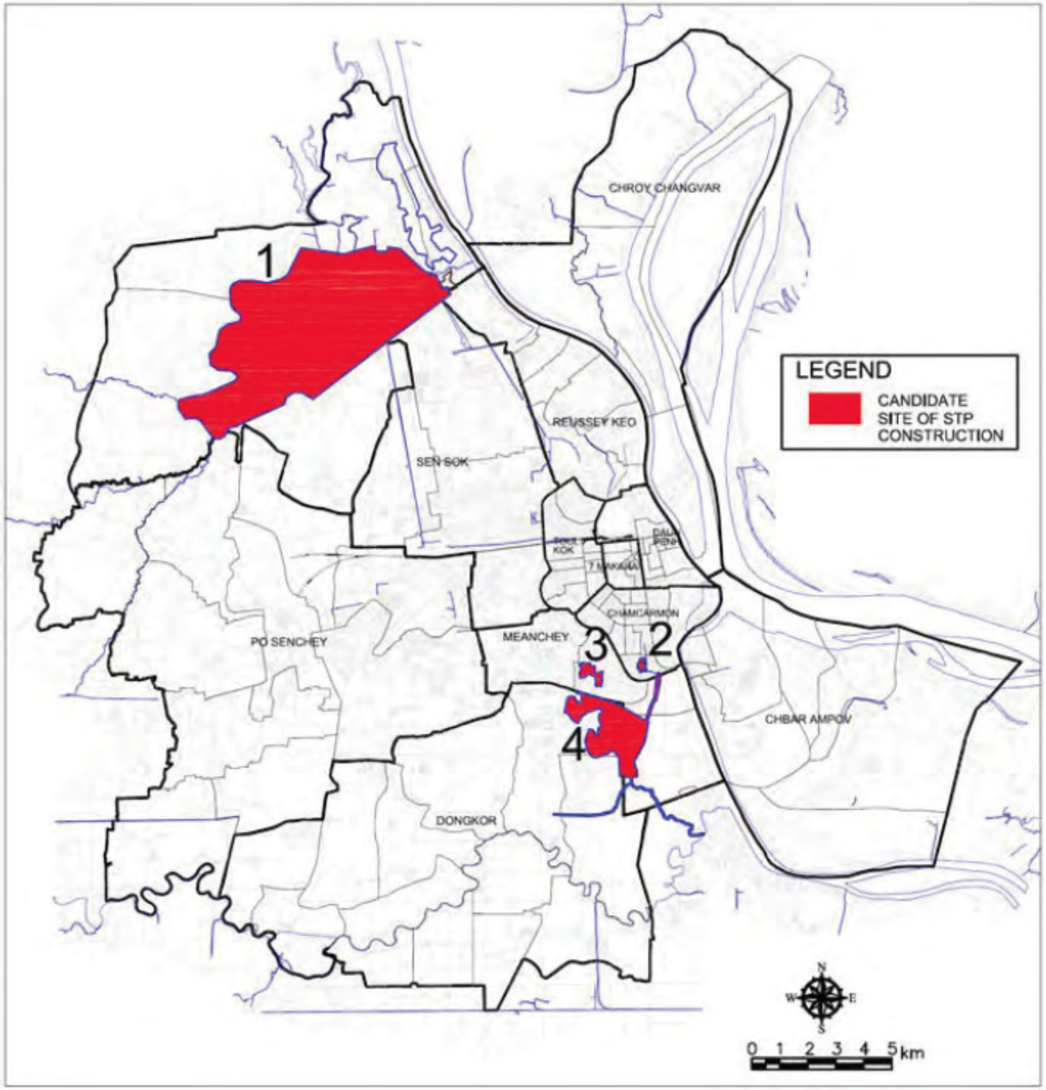
Table 2.4.8 List of Pumping Stations Managed by DPWT

	Station Name	Electrical Engine Driven				Diesel Engine Driven				Total Discharge Capacity [m³/sec.]	Observation (Date of Equipment)
		Nos	Pump type	Power /Unit [kW]	Capacity /Unit [m³/sec.]	Nos	Pump type	Power /Unit [HP]	Capacity /Unit [m³/sec.]		
1	Boeng Trabek	8	Horizontal	132	1.0	1 unit of Backup Generator, 1000 KVA				8.0	Operation since 2003 (ADB Loan)
2	Boeng Tumpun	5	Submergible Pump	280	3.0	2 units of Backup Generator, 700 KVA each				15.0	Operation since 2004 (Japan's Grant Aid)
3	Tuol Kork I	2	Vertical shaft	45	0.47	2	Vertical shaft	145	0.69	2.32	Constructed in 1970's
4	Tuol Kork II	1	Vertical shaft	45	0.47	2	Vertical shaft	145	0.69	1.85	Constructed in 1970's
5	Chak Tomuk	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation since 2010 (Japan Grant Aid)
6	Preah Kumlung 1	1	Pump Gate		0.2	-				0.2	Operation since 2004 (Joint Research with Kubota)
7	Preah Kumlung 2	2	Pump Gate	22	0.35	-				0.7	Operation since 2010 (Japan's Grant Aid)
8	Phsar Kandal	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation Since 2010 (Japan's Grant Aid)
9	Phsar Chaas	2	Pump Gate	45	0.7	1 unit of Backup Generator, 200 KVA				1.4	Operation since 2010 (Japan's Grant Aid)
10	Svay Pak Km No.9	4	Submergible Pump	75	0.13	3	Vertical shaft	190	0.38	1.66	Operation since 2006
11	Kop Srov	5	Vertical shaft	400	2.8	-				14.0	Operation since 2010
12	Tuol Sampeo	3	Submergible Pump		0.66	-				1.98	Operation since 2014

Source: DPWT/PPCC

DPWT is responsible for operation and maintenance work of drainage pumping stations. They carry out daily maintenance only. Repairing work of pump equipment is outsourced.

Most serious problem at pumping stations is related to solid waste. Excessive amount of garbage flows down to inlet channel and pumping station, and get stuck on the trash screen and impeller of pump. Staff of the pumping stations spends most of their day doing garbage collection and cleaning of impeller of pump.

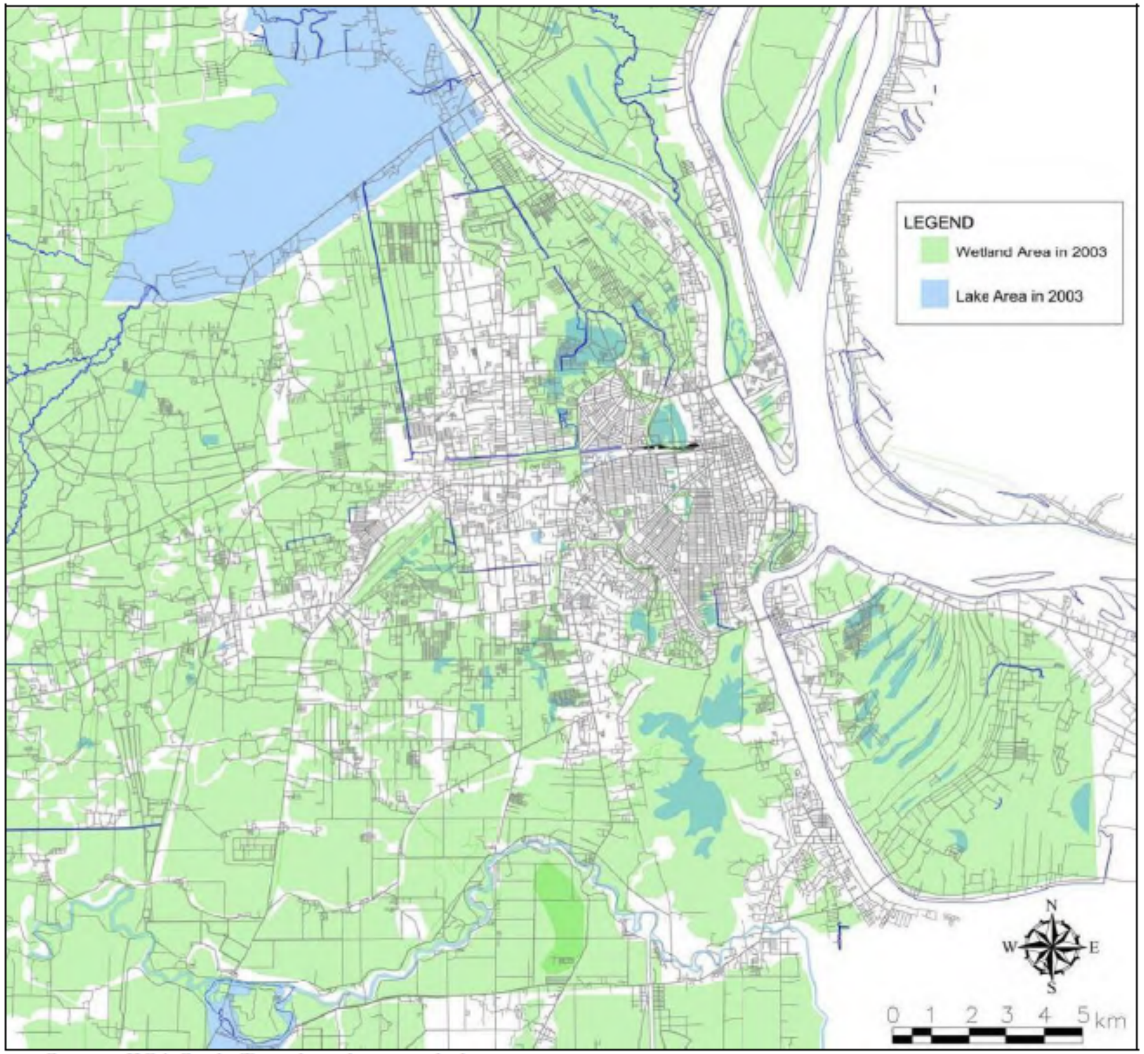


Source: JICA Study Team, based on information from PPCC

Fig. 3.2.1 Location of Candidate Sites for Construction of Sewage Treatment Plant

(2) **Reduction of Lakes and Swamps**

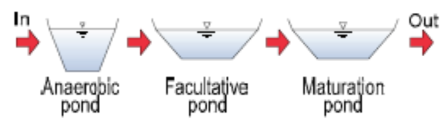
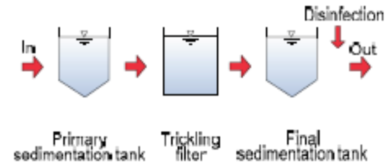
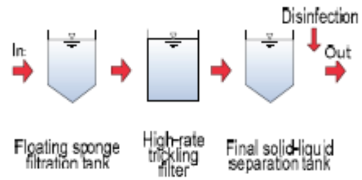
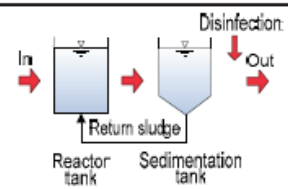
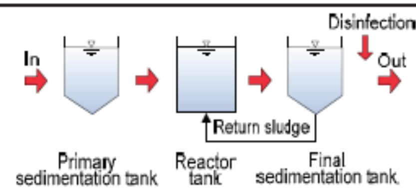
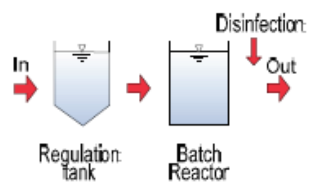
Lakes and swampy areas have drastically decreased due to urbanization and industrialisation in PPCC. As shown in **Figs. 2.2.5** and **2.2.6**, which presents lakes and swampy areas in years 2003 and 2015, the area decreased almost by half and consequently natural purification function decreased. In addition, reclamation of lakes and swampy areas in PPCC are in progress and further decline of natural purification function is anticipated[8].



Source: JICA Study Team based on aerial photo.

Fig. 2.2.5 Area of Lakes and Swamps in Phnom Penh (2003)

Table 3.3.5 Off-site Treatment Methods Evaluated

Method	Typical Flow Sheet	Salient Features
Lagoon		• Wastewater is treated without machinery. Oxygen is introduced into the lagoon by photonic synthesis and thus wastewater is purified. • Among the four methods, O&M is the easiest and unit cost for treatment is the lowest. On the other hand, land requirement is the largest.
Trickling Filter (TF)		• Wastewater is treated by sprinkling them to filter bed in the trickling filter. • Energy consumption is much smaller than treatment methods using blower. • Land requirement is larger than that of CASP. • It is difficult to control offensive odor and generation of flies from filter bed.
Pre-treated Trickling Filtration (PTF)		• This is new Japanese technology upgrading trickling filter by introducing new media to save processing time and space. • Filter bed can be easily washable and thus prevent offensive odor and generation of flies from filter bed. • Land requirement is smaller than CASP.
Oxidation ditch (OD)		• Endless channel is employed for wastewater circulation. Equipment is simplified and easier O&M is achieved compared with activated sludge process. • Land requirement is smaller than that of aerated lagoon, while bigger than that of activated sludge process.
Conventional Activated sludge process (CASP)		• Among the four methods, the highest efficiency in pollution load reduction and the smallest land requirement is achieved. • On the other hand, machinery equipment is large in number and unit cost of treatment is the highest. Further sophisticated technique is required.
Sequential Batch Reactor (SBR)		• All the processes of (i) feeding/mixing, (ii) aeration, (iii) sedimentation and (iv) decant, are executed in batch reactor. • Land requirement is smaller than that of CASP since primary and final sedimentation tanks are not required. • Skilled techniques are required to control the batch reactor, in particular sludge sedimentation and withdrawal.

Note: This table only summarizes technical features of each treatment method and the number of application of the method is discussed in Chapter 4.
Source: JICA Study Team

Phnom Penh WWTF Study

- 2035 flow 260,000 cu meter/day (68 MGD)
- Alternatives evaluated included:
- 1- Lagoons $509M (0.75M/yr O&M)
- 2-Activated Sludge $598M ($6.7M/yr O&M)
- 3-Trickling Filters $601M ($5.06M/yr O&M)
- 3-SBR $568M ($7.5M /yr O&M)
- 4-Oxidation Ditch $635M ($8.0M/yr O&M)

- PRE f/S Recommended to proceed with a small scale AST system at 5,000 cu M/day (1.3MGD) at $24M ($0.4M/yr O&M)

Alternative That may be considered

- Aerated Lagoons to operate similar to activated sludge process with baffle walls
- Manufactured by Parson “Biolac” process or equal
- May be able to save 50% of the capital costs and the O&M costs will be lower

System Construction

- A–major–advantage–of–the–Biolac®–system–is–its–low–installed–cost.–
- Most– systems– require– costly– in–ground– concrete–basins– for– the– activated–sludge–portion–of–the–process.
- A–Biolac®–system–can–be installed–in–earthen–basins,–either–lined–or–unlined.
- The–BioFuser® fine– bubble– diffusers– require– no–mounting– to– basin– floors– or associated–anchors–and–leveling.
- These–diffusers–are–suspended from– the– BioFlex–floating– aeration– chains
- The– only– concrete–structural–work– required– is– for–the– simple– internal– clarifier(s)– and blower/control–buildings.

For Earth, For Life
Kubota | United States

Kubota has been committing itself to offering optimal water treatment solution by utilizing all its technologies and expertise available since 1962.

Wastewater treatment tanks (Johkasou), which can be set up in areas where sewage infrastructure is not available, help treat household and industrial wastewater and conserve the water environment.

Kubota offers a broad range of products, including its proprietary membrane separation systems capable of advanced and stable treatment, and compact moving bed systems to meet required treatment levels, applications and purposes.

Today, Johkasou tanks uniquely developed in Japan are used worldwide. There are many regions in Asia where sewage treatment infrastructure is not yet in place; this has led to pollution of rivers and other water sources due to untreated wastewater. As part of its wastewater treatment plant business, Kubota has promoted sales of Johkasou tanks package solutions. Kubota has developed its advanced wastewater treatment expertise built into a series of sewage treatment processes. Johkasou tanks are possible to be set up in a short span of time and deliver excellent wastewater treatment performance, bringing highly effective solutions to factories, hospitals and housing development areas, especially in sparsely populated regions.

In addition to already increasing orders for large wastewater treatment tanks (Johkasou) from Vietnam, Kubota is promoting these tanks in other countries and regions of Southeast Asia, including China and Myanmar.

* Product availability and specifications may vary by country or region. For more information, please contact the nearest Kubota from Global Network.

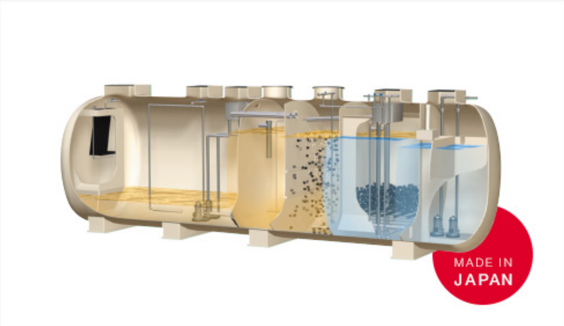
Global Network (Global Site)

VIETNAM

Septic Tanks that Respond to the Needs of Clean Water in the Rapidly Growing Southeast Asia

Wastewater Treatment Plant (Johkasou)

Features



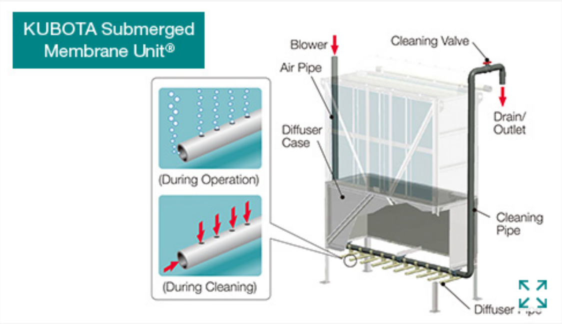
Give priority to quality in development & manufacturing

Kubota Johkasou, which has been developed and manufactured in Japan, is one of the best solutions of wastewater treatment in areas where sewage infrastructure has not yet been improved worldwide.

Plant Package

Kubota offers plant package incorporating its advanced water treatment engineering expertise. Treatment solutions are available in locations and in sizes our customers require.

Combination of wastewater treatment plants are introduced to serve our customers' needs.



Membrane Biorector System for Highly Advanced Water Treatment

Kubota's wastewater treatment plants are installed to preserve the environment in areas where sewage systems are rarely installed. Specifically, this is Kubota's proprietary membrane bioreactor system, a highly-concentrated activated sludge system is coupled with submerged fine-pore membranes to perform advanced water treatment. Treated water can be reused, without post-treatment, as flush water for toilet and spray water.

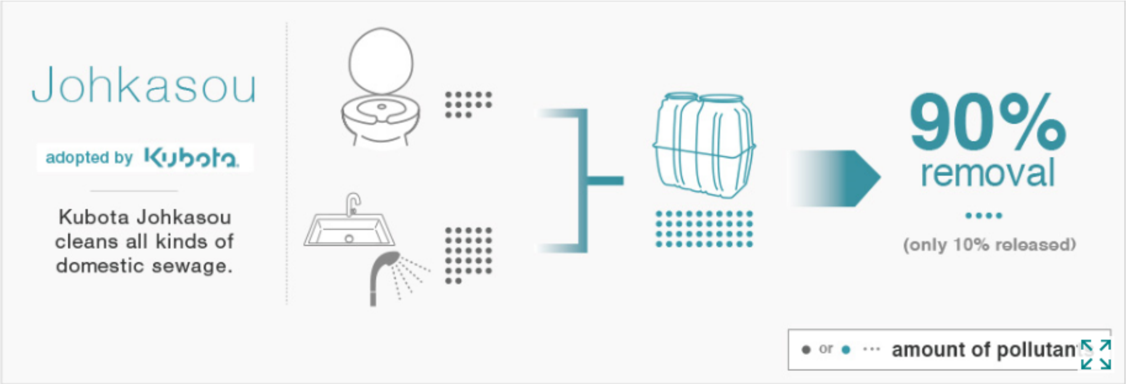
Application ›

Small-Size Johkasou ›

Middle-Size Johkasou ›

Large-Size Johkasou ›

Basics >



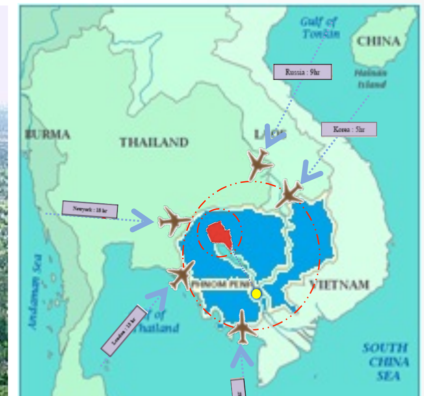
Kubota's environmental friendly wastewater treatment plants (Johkasou)

Kubota wastewater treatment plants, which have achieved 90% or higher BOD removal rate, deliver excellent treated water quality with BOD of 20 mg/l or less (in case influent BOD is 200 mg/l). Their compact body fits any installation place while providing powerful treatment performance comparable to a sewage system.

Training – abandoned well

Department of Public Works and Transport

Sewerage and Wastewater Treatment Plant Unit (SR-SWTPU)



August 14, 2017

Table 2.4.4 Outline of Sewerage System in Battambang, Sihanoukville and Siem Reap

Item	Battambang	Sihanoukville	Siem Reap
Fund	EU	ADB	ADB/EDCF
Project cost (million USD)	4.00	11.19	44.36
Sewage collection system	Combined	Combined /separate	Combined
Planning population	200,000	100,000	170,000
Population serviced (person)	20,000	7,844	47,260
Serviced area (ha)	300	221.5	1,082
Treatment capacity (m^3/day)	2,800	6,900	8,000
Actual inflow (m^3/day)	Unknown	6,270	17,696
Treatment method	Lagoon	Lagoon	Lagoon
Domestic wastewater generation per person (L/person/day)	120	150	150
BOD generation per person (g/person/day)	Unknown	40	BOD=200 mg/L

Source: MPWT

Existing Storm Drainage System

No	Drainage Typical	Total Length(M)
1	Old pipe (1950's)_RC/Clay : Ø 400 mm – Ø 1000 mm	12,788.00
2	New RC Pipe (at present) : Ø 400 mm – Ø1300 mm	43,213.00
3	Town Center Drain (TCD): 5.00 m x 2.00 m	10,030.00
4	Open Drainage Canal in Urban Area	17,537.00

	TCD Typical (Town Center Drain)	RC Pipe Typical	Open canal Typical
Present Situation			

Existing Sewage Facilities

No	Facilities Typical	Total
1	Sewer pipe (uPVC/GRP/ID) : Ø 150 mm – Ø 700 mm	21,761 m
2	Pumping Station (ADB)	13,824 m3/day
3	Relay Pumping Station (EDCF)= 2EA	42,562 m3/day
4	Wastewater Treatment Plant (Pound Stabilization), ADB +EDCF	8,000.00 m3/day

Present Situation

Trunk sewer MH

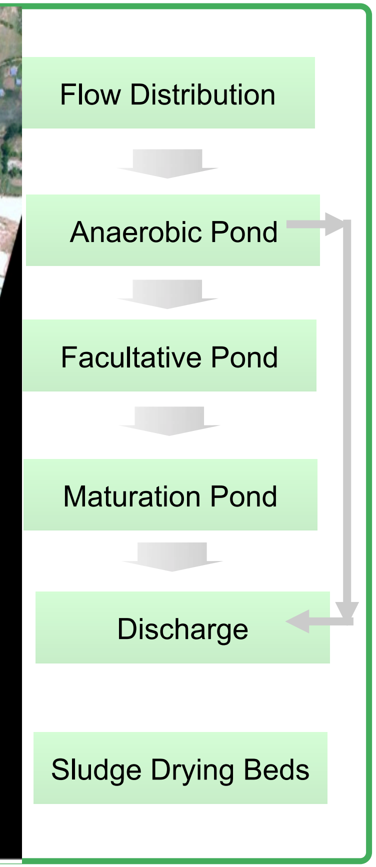
Relay Pumping Station

WTP

Existing Waste Stabilization Ponds

- Treatment is essentially by action of sunlight
- Large surface-area, shallow ponds
- Simple to operate
- Low operating cost with minimum energy requirement
- Same as the existing process

Layout of WWTP



Flow Diagram

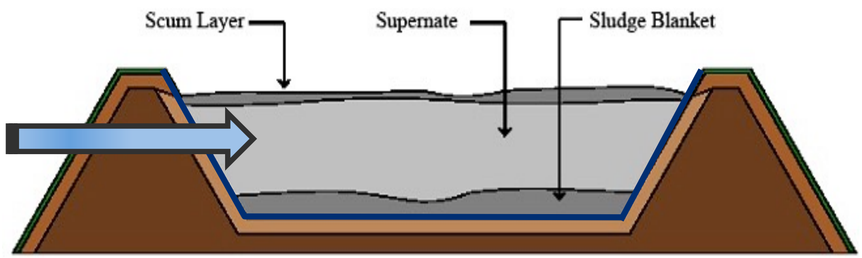
Effluent Standard

Parameters	Unit	Allowance limits
BOD_5	mg/L	< 80
COD	mg/L	< 100
TSS	mg/L	< 80
Nitrate (NO_3)	mg/L	< 20
Phosphate (PO_4)	mg/L	< 6.0

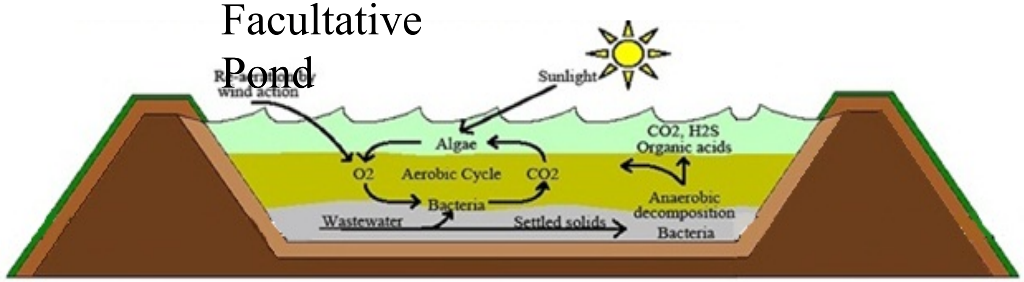
※ Sub Decree on Water Pollution Control♪

Basic Concept Design

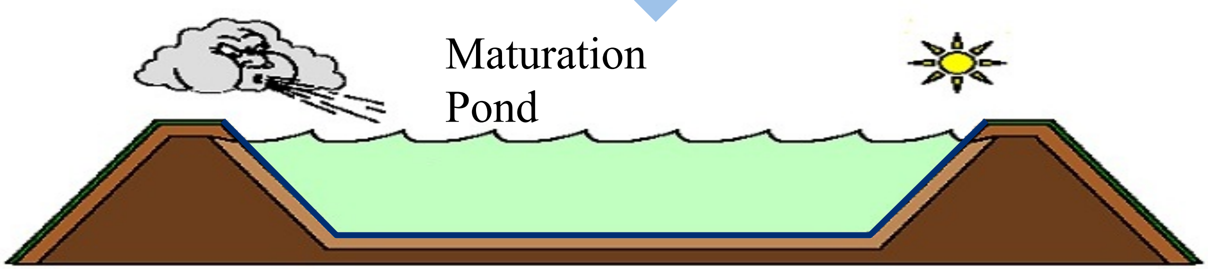
Anaerobic Pond



Facultative Pond



Maturation Pond



Anaerobic Pond

- Min. Water temp: 24 °C
- Retention Time: 2days
- Removal BOD Rate: 65%
- Effective Depth: 4.0m
- Size: 30m x 60m = 1,800m^2

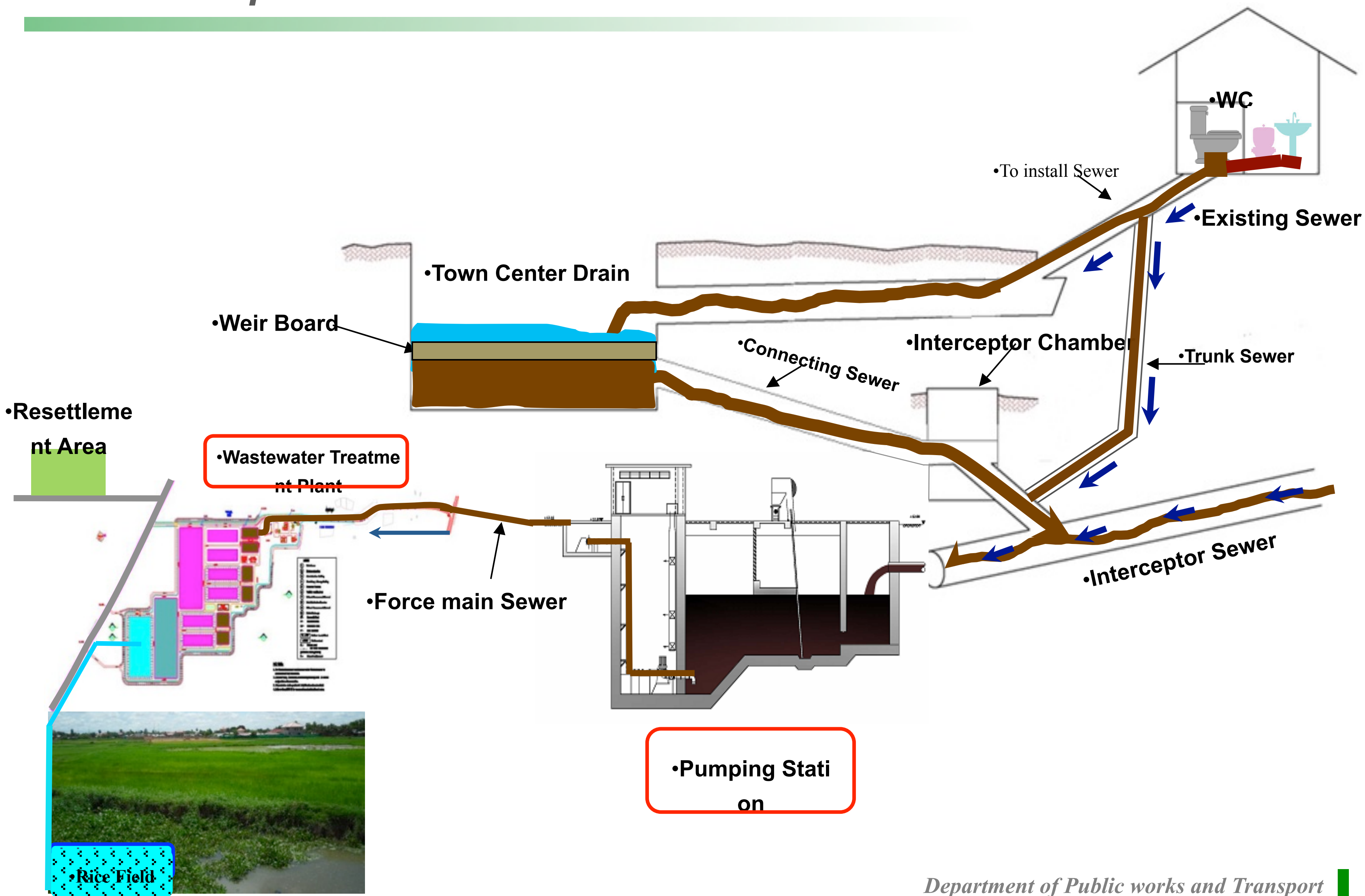
Facultative Pond

- Min. Water temp: 24 °C
- Retention Time: 7-15 days
- Removal BOD Rate: 90%
- Effective Depth: 1.75m
- Size: 50m x 120m = 6,000 m^2

Maturation Pond

- Min. Water temp: 24 °C
- Retention Time: 5days
- Removal BOD Rate: 94%
- Effective Depth: 1.5m
- Size: 80m x 220m = 17,600 m^2

Sewer flow process:



Existing Storm Drainage Issue

- Even though ADB & EDCF project, but still lack of proper material, tools & equipment to maintain the O&M,
- Old pipe almost full of sedimentation because not enough budget planning, no guideline & appropriate method of O&M.
- Most of open drains are serious clogging because of solid waste management

Present Situation

Insufficient tool & equipment

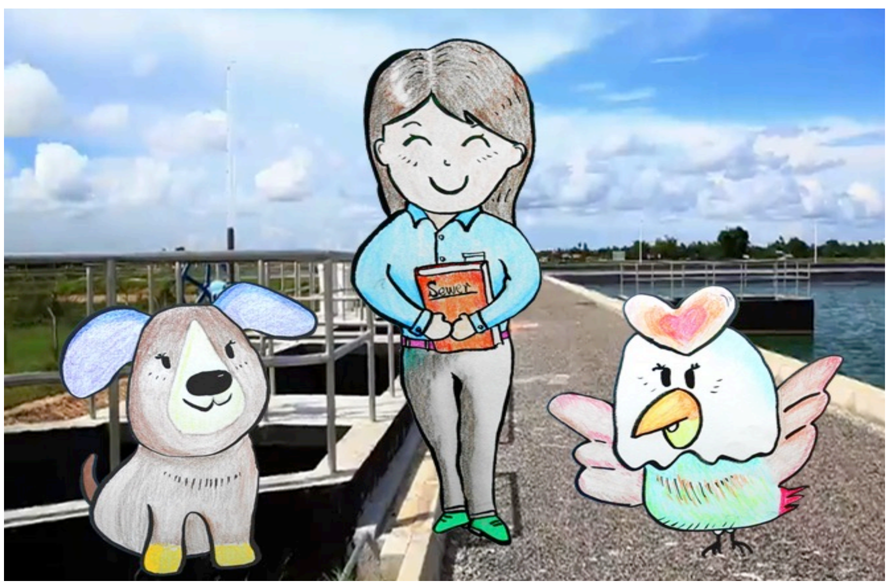
Open drain filled with garbage

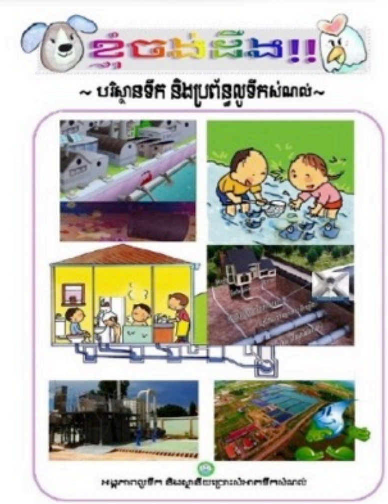
Pipe full of sedimentation

4. Public Awareness

- Create a sewage and water environment campaign
- Improve and increase education tool

  media, book, brochure, game
- Cooperate with more partner





គណបក្សប្រជាជនកម្ពុជា
CAMBODIAN PEOPLE'S PARTY
សម្តេចអគ្គមហាពញាចក្រី
ហេង សំរិន
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- **Cambodia moves to dissolve opposition party CNRP**
- Interior ministry files lawsuit asking CNRP be dissolved on ground that it was involved in plot to topple government.
- CNRP supporters stand outside the Appeal Court during a bail hearing for jailed opposition leader Kem Sokha
- The government of Cambodia has taken the first legal steps seeking to disband the country's main opposition party, the latest in a series of moves that would help it gain an advantage ahead of a general election next year.

Killing Fields/genocide museum

First they killed my father

Anchor wat


សូមកុំសម្រាក និង ឈរក្រោមដើមដូង
Do Not Stay Under Coconut Trees

QUESTIONS?

- Get Involved
- Many organization NGO’s
- You are a Wastewater Professional