Initial Environmental Examination

August 2015

Kingdom of Cambodia: Second Greater Mekong Subregion Corridor Towns Development Project

Prepared by Ministry of Public Works and Transport for the Asian Development Bank

CURRENCY EQUIVALENTS
(as of 17 August 2015)

Currency unit	–	kip (K)
K1.00	=	$0.00012
$1.00	=	K8199.50

ABBREVIATIONS

ADB	-	Asian Development Bank
DAFF	-	Department of Agriculture, Forestry and Fisheries
DOE	-	Department of Environment
DPWT	-	Department of Public Works and Transport
DOT	-	Department of Tourism
DOWRAM	-	Department of Water Resources and Meteorology
EA	-	Executing Agency
ECA	-	Environmental Compliance Audit
EIA	-	Environmental Impact Assessment
EMP	-	Environment Management Plan
GMS	-	Greater Mekong Subregion
Government	-	Government of Cambodia
IEE	-	Initial Environment Examination
IEIA	-	Initial Environmental Impact Assessment
MOE	-	Ministry of Environment
PAM	-	Project Administration Manual
PIC	-	Project Implementation Consultant
PIU	-	Project Implementation Unit
PPTA	-	Project Preparatory Technical Assistance
PPMU	-	Provincial Project Management Unit
REA	-	Rapid Environmental Assessment
RP	-	Resettlement Plan
GRC	-	Royal Government of Cambodia
SPS	-	Safeguard Policy Statement (2009)
WWTP	-	Wastewater Treatment Plant

WEIGHTS AND MEASURES

km	-	kilometer
kg	-	kilogram
ha	-	hectare

NOTES

(i) The fiscal year (FY) of the Government of Cambodia ends on 31 December

(ii) In this report, “$” refers to US dollars

Initial Environmental Examination

June 2015

Second Greater Mekong Subregion Corridor Towns Development Project (CTDP), PPTA 8425

Kampot and Sihanoukville Towns, Cambodia

CURRENCY EQUIVALENTS
(12 February 2015)

Currency Unit	–	Riel R
R1.00	=	$0.00025
$1.00	=	R3,983

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EXECUTIVE SUMMARY

Kampot and Sihanoukville are the towns in Cambodia that are participating in the Second Greater Mekong Subregion Corridor Towns Development Project[1]. The two town-subprojects consist of small infrastructure and environmental improvement investments that are being implemented with the immediate and ultimate goals of improving urban environments, and promoting socioeconomic development. Linked to the urban infrastructure investments of the subprojects is parallel development of Strategic Local Economic Development Plans (SLEDP) for each town. The selection of the urban infrastructure investments and the development of the SLEDPs are guided by the ADB Green City Agenda[2].

The initial environmental examination (IEE) presented herein addresses the two subprojects in Kampot and Sihanoukville. The IEEs of the other five town-subprojects in Lao PDR and Viet Nam have been prepared separately.

Project Summary

The components of the subprojects in Cambodia at the feasibility design stage are summarized below[3].

Kampot, Kampot Province
Wastewater Collection and Treatment
Solid Waste Management
Urban Drainage
Sihanoukville, Preah Sihanouk Province
Solid Waste Management
Urban Drainage

Potential Impacts

Both subprojects in Cambodia are Category B for environment. The examination of the subprojects indicates that potential environmental impacts are largely restricted to the construction phase of the subproject components. Construction-related disturbances such as noise, dust, soil erosion, surface water sedimentation, tree removal, solid and liquid waste pollution, worker camp disturbances, increased traffic and risk of worker and public injury can be managed with standard construction practices and guidelines (e.g., IFC/World Bank 2007).

Noise, dust, and traffic disruption created during construction of the new WWTP in Kampot, the drainage improvements in both towns can be minimized with standard construction management practices. Public safety measures in both towns can be managed with speed limits, cordoned off construction areas, and sufficient signage warning of construction activities.

[1] *Lao PDR and Viet Nam also participate in the Second GMS Corridor Towns Development Project*

[2] :http://www.adb.org/publications/enabling-greeen-cities-operational-framework-integrated-urban-development-southeast-asia

[3] From Interim Project Report 12-14

The construction of the new wastewater treatment plant in Kampot must include management measures to prevent or contain soil erosion and prevent sedimentation of the Teuk Chhou river. Standard mitigation measures such as berms or plastic sheet fencing should be used to contain loose soil created from the civil works. Similarly, erosion caused by construction of the pipelines to the Kampot WWTP must by managed and carefully contained closely to the sites. The treated effluent from the WWTP must meet the current government standards for effluent discharge, and be monitored regularly after the Kampot WWTP is commissioned.

The existing landfill in Kampot must be closed with an internationally accepted closure procedure which must be timed with the commissioning of the nearby replacement new landfill. Similar to the new WWTPs, construction of the new landfill must apply standard construction management techniques to prevent local solid and domestic waste pollution, erosion, and surface water sedimentation. Potential traffic disruption, noise, and dust caused from landfill construction and access road upgrades can be managed to a minimum. A tree replacement program should be implemented to offset the trees that must be removed for the subproject components. Drainage around the new landfills in both subproject towns also must be designed to accommodate increases in the frequency and severity of flood events. The new and upgraded drainages in both towns must be constructed large enough to be able to contain and convey increased flood volumes as a result of climate change-induced increases in rainfall.

The new WWTP in Kampot was screened with the REA and factors of AWARE to be the most sensitive to climate change as defined by projected sea level rise, and inland flooding from an increased frequency and severity of rainfall events. The coastal Kampot WWTP is considered the most sensitive subproject components to climate change due to exposure to sea level rise and typhoon storm surge. The grade elevation of the WWTP in Kampot needs to be resilient to the current seasonal flood events, and to climate change-induced increases in flooding from the Teuk Chhou river from basin rainfall and/or from sea level rise and storm surge from Kampot bay.

The results of REA and AWARE provides the basis for the more in depth CVRA of potential socioeconomic and financial impacts of climate change in both towns. The climate vulnerability and resilience assessment of the subproject indicated that climate change resilience and proofing measures such as elevated facility foundations, and adequate grading and drainage must be addressed by the final designs of the subproject components.

The subproject components with the greatest potential for generating GHGs are wastewater treatment, and the new and renovated landfills due to the production of methane (CH_4) from anaerobic digestion of wastewater, and the decomposition of organic solid waste in modern, managed landfills. Methane is 40-50 times stronger than CO_2 as a greenhouse gas. The Kampot WWTP will consist of a combination of anaerobic and aerobic WWT processes and thus will produce methane. Similarly, the new and renovated landfills will also generate methane as a result of the anaerobic decomposition of organic waste in the lined landfill cells. Moreover, at the feasibility design stage of the subprojects the technology to capture and flare or otherwise neutralize the methane produced from the new WWTP and landfills is not included which means the methane will dissipate to the environment.

The only perceived induced, or potential cumulative impacts of the two subprojects in Cambodia are increased resource consumption and pollution that may be caused by the decided goal of increased socioeconomic development in both town areas. Overall the subprojects will yield positive impacts on the environmental quality of both towns.

Conclusions

The IEE concludes that the description of the feasibility designs of the two subprojects combined with available information on the affected environments is sufficient to identify the scope of potential environmental impacts of the project. Providing that significant changes do not occur to the design of one or more of the subproject components, and that new sensitive environmental or social receptor data are not discovered, the subprojects will remain Category B for environment and will not require further detailed environmental impact assessment (EIA).

The EMPs developed for each town subproject provide impact mitigation plans, environmental monitoring plans, and specify the institutional responsibilities and capacity needs for the environmental management of the subprojects. The EMPs will need to be reviewed and updated at the detailed design phase to ensure that they fully address the potential impacts of the final subproject designs.

TABLE OF CONTENTS

I. INTRODUCTION

A. Background to IEE

1. The Second Greater Mekong Subregion (GMS) Corridor Towns Development Project (PPTA 8425) is a multi-sector urban development project in Viet Nam, Cambodia, and the Lao PDR. The project is comprised of small urban infrastructure and environmental improvement investments in seven subproject towns in the three participating countries. The project consists of two primary outputs as defined below:

1) Strategic Local Economic Development Plans (SLEDP) for the seven towns; and
2) Feasibility stage designs for urban infrastructure investments to improve the environmental quality of the towns and to ultimately strengthen socioeconomic development.

2. The selection of the urban infrastructure and environmental improvement investments, and the development of the SLEDPs are guided by the ADB Green City Agenda[4]. The seven SLEDPs are presented elsewhere in the main body of the report.

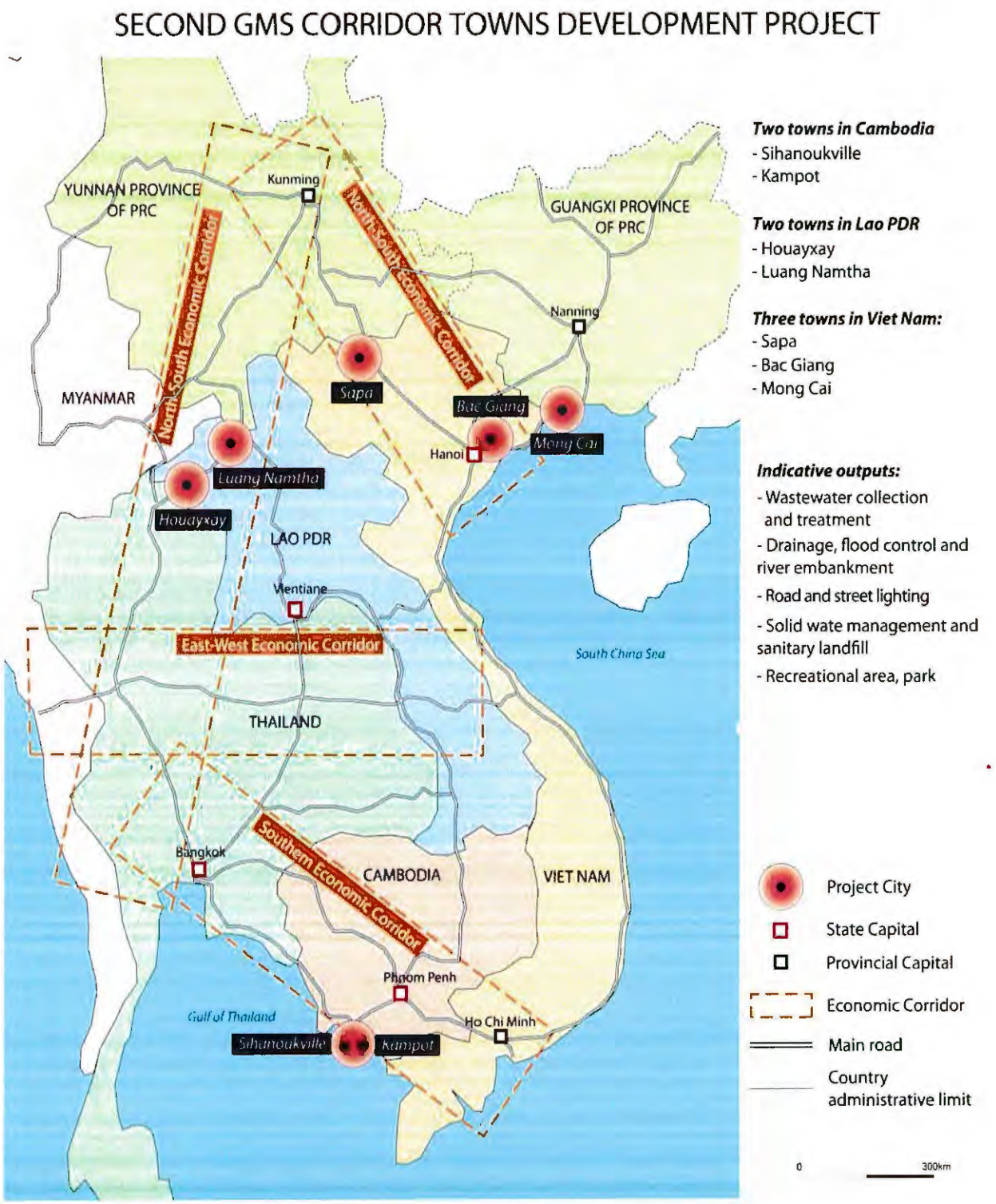
3. The subprojects in the towns of Kampot and Sihanoukville of Cambodia are the focus of the IEE presented herein. The IEEs for the subproject towns in Viet Nam and Lao PDR were prepared separately. The country-level IEE reporting structure for PPTA 8425 is the same safeguard reporting structure that was used for the first ADB Corridor Towns Development Project (CTDP) in the same countries in 2012. Table 1 summarizes the subproject components of both corridor towns of PPTA 8425.

Table 1. Cambodia subproject components

Kampot
Wastewater Collection and Treatment
Solid Waste Management
Urban Drainage
Sihanoukville
Solid Waste Management
Urban Drainage

[4]http://www.adb.org/publications/enabling-greeen-cities-operational-framework-integrated-urban-development-southeast-asia

Figure 1. Seven subproject towns of Second Corridor Towns Development Project



B. Assessment Context

4. The project is category B pursuant to ADB's 2009 *Safeguard Policy Statement*[5] and recent good practice sourcebook.[6] A category B project will have potential adverse impacts that are less adverse than those of a Category A project, are site-specific, largely reversible, and can be mitigated with an environmental management plan (EMP).[7] The initial rapid environmental assessments (REA) of the subprojects are found in Appendix A

5. The IEE was prepared for the subprojects of Cambodia in the feasibility design stage of the project using available data and information on sensitive ecological and cultural receptors that exist at the different subproject sites. Detailed designs of the subprojects will follow project approval. EMPs that have been prepared for the subprojects will be updated where necessary to meet the final detailed designs of the subprojects.

Impact Footprints

6. The town subproject components are located in established urban and peri-urban areas. Moreover, some subproject component sites already exist such as urban roads and landfills. Thus, the potential environmental impacts of the subprojects will be mostly marginal to the existing urban impacts.

C. Structure of report

7. The report on the IEE follows the format of an EIA in Appendix 1 of the SPS (2009). The IEE was conducted and the results presented by individual town in order to minimize redundancy of background information. The report structure is consistent with, and supports the individual subproject environmental management plans (EMPs) that have been prepared for each subproject town, and which are based on the results of the IEE.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Environmental Impact Assessment

8. Environmental impact assessment in Cambodia is guided by the Royal Government of Cambodia (RGC) sub-decree on EIA. In compliance with the sub-decree on EIA, all individuals, private companies, joint-venture companies, public companies, ministries and government agencies are obliged to conduct an environmental impact assessment for proposed projects or activities, which must be submitted for approval by the MOE. The decree provides a list of project types that proponents use to screen projects for requiring either an EIA or Initial EIA (IEIA). Consultations with the MOE and provincial Departments of Environment (DOE) indicated the final subprojects in Kampot and Sihanoukville will require either a Cambodian IEIA or EIA that will be administered by MOE. As dictated by No 72 ANRK.BK, the MOE is required to complete their review of a submitted IEIA or EIA within 30 days to conclude the approval process.

[5] ADB. 2009. Safeguard Policy Statement. Manila.
[6] ADB. 2012. Environmental Safeguards, A Good Practice Sourcebook, Draft. Manila.
[7] Footnote 2, pg 19.

9. The IEE presented herein exceeds the requirements of Sub-decree No 72 ANRK.BK on EIA. The scope of the assessment of the IEE required of the ADB SPS (2009) also exceeds the supporting RGC Prakas guideline IEIA/EIA.

B. Legal and Policy Framework for Environmental Protection

10. The Government of Cambodia has established specific laws and regulations for forests, protected areas, and land management to ensure sustainable development. The key elements of the legal and policy framework for the project include the following:

- Law on Environmental Protection and Natural Resources Management, , enacted by National Assembly, 1996, and promulgated by Preah Reach Kram/NS/RKM-1296/36;
- Law on Natural Protected Areas enacted by National Assembly, 2008 promulgated by Preah Reach Kram/NS/RKM/0208/007;
- Law on Fisheries Management and Administration(1989);
- Law on Forest enacted by National Assembly, 2002 promulgated by Preah Reach Kram/NS/RKM/0802/016;
- Law on Land enacted by National Assembly, 2001 promulgated by Prea Reach Kram/NS/RKM/0801/14;
- Law on Water Resource Management produced by Ministry of Water Resources and Meteorology (MOWRAM); and
- Circular No 01 SRNn issued on February 3rd, 2012, Royal Govemment Of Cambodia on Cambodia Coastal Zone Development

11. Key directives in support of the Law on Environmental Protection and Natural Resources Management include:

- Law on Protection of Natural Areas (2008); and
- Sub-decree on Water Pollution Control (1999):
  - Annex 2: Industrial effluent standards (including WWTPs);
  - Annex 4: Water quality standards for public water and biodiversity; and
  - Annex 5: Water quality standards for public waters and health.

12. Other pertinent regulations, policy, or guidelines for the project are as follows:

- Directive on Industrial Sludge Management (MOE, 2000);
- Directive on Industrial Hazardous Waste Management (MOE, 2000);
- Directive on Managing Health Wastes in the Kingdom of Cambodia (MOH, 2008)
- Preach Reach Kept on Creation of Fisheries Communities (2005); and
- Anklets on establishment of protected forests, natural resources conservations, wildlife protection areas, protected forest for biodiversity conservation (2002 and 2004).

13. Cambodia is signatory to many international environmental treaties and conventions which provide a comprehensive legal framework related to coastal management. These include: the Coordinating Body of the Seas of East Asia (1995), Association of South East Asian Nations (1999), MARPOL (1994), Biodiversity convention (1994), CITES convention (1997), Ramsar convention (1999) and Climate Change convention (1995) (MOE 2006). The closest Ramsar site to the subproject areas is more than 100 km away in Koh Kapok, Koh Kong province to the west.

14. Occupation and Community Safety and Health (OHS) guidelines for Government follow the recent OHS Programme for Cambodia (2010-2013) that was developed by the International Labour Organization (ILO). The draft guidelines provide the framework for instituting OHS at the workplace and in the community.

15. For all other applicable environmental standards and criteria such as ambient air quality, vibration, noise, contaminated soil, and workplace and community safety the standards and protocols of the Environment, Health and Safety Guidelines of the World Bank (2007) will apply.

C. Agencies Responsible for Environmental Management and Assessment

16. The national agencies that oversee environment and natural resources management are listed below. Most of Ministries have provincial counterpart departments.

- Ministry of Environment (MOE);
- Ministry of Agriculture, Forestry and Fisheries (MAFF);
- Ministry of Water Resources and Meteorology (MOWRAM);
- Ministry of Mine and Energy (MME);
- Ministry of Industry and Handicraft (MIH)
- Ministry of Land Management; and Urban Planning (MLUP);
- Ministry of Tourism (MOT);
- Ministry of Public Works and Transport (MPWT) and a cross-ministerial policy body of
- National Climate Change Committee (NCCC).

17. The MAFF is responsible for the management and protection of coastal mangrove forests, and wildlife and fisheries. The Fisheries Administration (FA) at the national and provincial levels is responsible for all fisheries related matters as summarized below:

- Prepare and establish fishery resource and aquaculture inventories;
- Enact laws, regulations, and orders for fishery protection, management and improvement of fishery resources and habitat;
- Manage fishery zones, fishery conservation and establish fishery resource development policies;
- Conduct scientific studies of fisheries and aquaculture; and
- Inspect and manage fishery resource exploitation and aquaculture activities.

18. The EIA Department of the MOE oversees and regulates EIA, and coordinates the implementation of projects in collaboration with project executive agencies (EA) and concerned ministries. The MOE has the following responsibilities:

1. Review, evaluate, and approve submitted environmental impact assessments in collaboration with other concerned ministries; and
2. Monitor to ensure a project owner (the executing agency of the project) satisfactorily implements the Environmental Management Plan (EMP) throughout pre-construction, construction and operational phases of the projects.

19. The ministries are represented and supported at the provincial, town, and district/commune levels by counterpart line departments, agencies, and sub-offices. The counterparts are responsible to extend and implement the mandate of their parent ministries to the commune level.

20. The IEE prepared for subprojects in Cambodia meets or exceeds the EIA requirements of the MOE. The IEE will provide guidance to the national consultants of the Ministry of Public Works and Transport who will prepare the IEIA or EIA for the MOE.

D. Climate Change Directives

21. The following initiatives have been undertaken to combat climate change in Cambodia. Theses have been derived in part by the Cambodia Climate Change Alliance (CCCA).

- Cambodia Climate Change Strategic Plan (2014 – 2023)
- National Strategic Development Plan (2014 – 2018) - Addressing Climate Change
- National Monitoring and Evaluation Framework for Climate Change (ongoing)
- Climate Change Education and Awareness Strategy

E. ADB Safeguard Policy

22. The ADB safeguard policy statement (ADB 2009) along with the recent *Good Practice Safeguard Sourcebook* clarify the rationale, scope and content of an environmental assessment and supported by technical guidelines (e.g., Environmental Assessment Guidelines, 2003). Projects are initially screened to determine the level of assessment that is required according to the following three environmental categories (A, B, or C).

23. Category A is assigned to projects that normally cause significant or major environmental impacts that are irreversible, diverse or unprecedented such as hydroelectric dams (an Environmental Impact Assessment is required). Category B projects have potential adverse impacts that are less adverse than those of category A, are site-specific, largely reversible, and for which mitigation measures can be designed more readily than for category A projects (an Initial Environmental Examination is required). Category C projects are likely to have minimal or no negative environmental impacts. An environmental assessment for Category C projects is not required but environmental implications need to be reviewed.

F. Environmental Due Diligence of Subprojects

24. The environmental due diligence (DD) of the subprojects in Kampot and Sihanoukville required by the ADB and the RGC[8] proceed in series with the ADB IEE and loan approval completed first. A significant difference in the DD of Cambodia and the ADB is the timing of the IEE for ADB and the EIA or IEIA for Cambodia. The ADB IEE is prepared for the feasibility design stage of the subprojects whereas the EIA/IEIA for Cambodia is prepared for the detailed - completed subproject designs. Thus, the ADB IEE is approved by the government EA[9] and the ADB long before the Cambodian EIA/IEIA is prepared. Table 2 summarizes the general DD processes and timelines of the two jurisdictions.

[8] Sub-decree No 72 ANRK.BK on EIA.
[9] Government appointed Project Executing Agency

25. The Cambodian government does not require the ADB IEE/EMPs prepared for a project to comply with any specific environmental regulations or guidelines, however, the draft IEE/EMPs must be reviewed and approved by the EA (not the MOE) after the initial review and approval by the ADB. The approval is by formal letter.

Table 2. Summary of environmental due diligence during project implementation

Design and Implementation	Environmental DD and Approvals			Milestones & Notes
	ADB / PPTA	Cambodia	PMIS[10] / Contractor	
Feasibility design				
Initial stakeholder disclosure & consultation	PPTA	EA assists		
Draft IEEs and EMPs	PPTA			Draft IEEs & EMPs completed
Finalize IEEs and EMPs	ADB review & approves IEE/EMPs			ADB approved IEE/ EMPs as per SPS (2009).
		EA reviews and approves IEE/EMPs		EA approved IEE/ EMPs with formal letter only. ***Compliance with specific RGC / EA regulations not required***
Loan documents (PAM/RRP)	Document preparation, approval by ADB	Review & approval of PAM		Loan approval
Detailed engineering design				
Continued stakeholder disclosure & consultation		IA/PIU[11] lead	ES[12] support to PMIS	As per PCP (2012)[13] stakeholder disclosure and consultations continue throughout construction phase coincident with initiation of GRM[14].
Update EMPs		Support to ES	Lead by ES	Approval of updated EMP by EA and ADB
Initiation of Cambodia environmental DD[15]		EA leads with oversight from MOE		DOE approved CAM IEE or IEIA follows independently

[10] International Project Implementation Management Support Consultant (see Environmental Management Plan EMP)
[11] Project Implementation Agency assigned by EA (see EMP) with supporting Implementation Unit
[12] International and national environment specialists of PMIS (see EMP)
[13] ADB Public Communication Policy (2012)
[14] Grievance Redress Mechanism (see EMP)
[15] Footnote 8

Design and Implementation	Environmental DD and Approvals			Milestones & Notes
	ADB / PPTA	Cambodia	PMIS[10] / Contractor	
Tendering / contract award				
EMPs included in tender documents		Lead by EA/IU	Support by ES	
Tenders let and bids prepared		Lead by EA	Contractor drafts CEMP[16]	CEMPs prepared and included in contractor bids
Construction packages	Input from ADB		CEMPs reviewed by ES/PMIS	Construction package awards
Construction & supervision				
Implementation of mitigation and monitoring plans		Support from IU/PIU	By contractor with support from ES	CEMP implemented by contractor, other aspects of EMP overseen by ES
Continued stakeholder disclosure and consultation		IA/PIU lead	Support from ES	As part of GRM
Monitoring reporting	To ADB	IA/PIU lead preparation of regular reports to ADB	Support from ES	Reports provide input for review missions

III. DESCRIPTION OF CAMBODIA SUBPROJECTS

26. Explicit with selection of the subproject components are the Strategic Local Economic Development Plans (SLEDP) for Kampot and Sihanoukville from the main PPTA report, and the inherent theme of the greening of the affected urban environments, vis-à-vis, ADB's Green City Agenda. Coupled to the objective socioeconomic-based urban infrastructure developments is the opportunity to improve and rehabilitate the natural urban environments. The selection criteria for the subproject components included improvements to green spaces.

27. The descriptions of the subproject components in Kampot and Sihanoukville are provided below[17]. The subproject components that are similar, or physically related are combined in order to prevent redundant assessment.

Kampot
Wastewater Collection and Treatment
Solid Waste Management
Urban Drainage

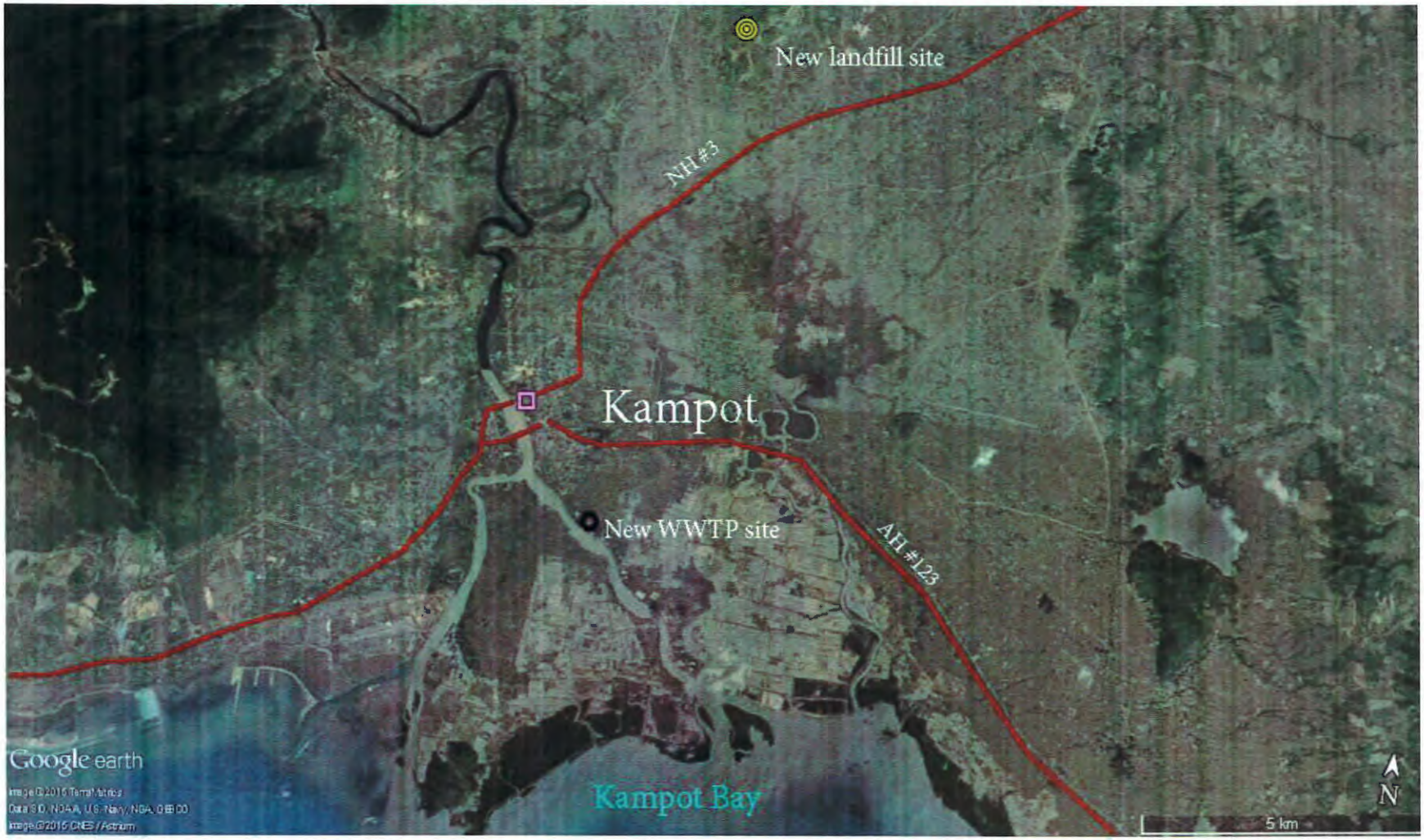
[16] Construction Environmental Management Plan based on EMP in tender documents (see EMP)
[17] Updated from Fact Finding Mission, 5/15

Sihanoukville
Solid Waste Management
Urban Drainage

A. Kampot

28. The major subproject components of Kampot from Table 1 are shown in Figure 2.

Figure 2. Location of major subproject components in Kampot



1. Wastewater Collection and Treatment

29. Wastewater in Kampot presently flows untreated directly to the Teuk Chhou river through combined road drains, or via a canal southeast of town. The proportion of some form of pumpable septic tank in use in the town is estimated at 70-80%. There are 8 drain outfalls to the river in the town centre area which smell badly particularly during the dry season and low tide conditions when dilution is minimal.

30. The subproject will separate wastewater at source and treat it at a new wastewater treatment plant (WWTP) 2 km south of the town on the east bank of the Teuk Chhou river. The three catchment areas for separate wastewater collection and treatment at new WWTP are described below, and shown in Figure 3 in different colours.

- A core area on the north side of town a block from the old town centre to the market area. This is the most densely populated area of Kampot;
- The city centre area east of National Road (NR) 3; and
- South of town in vicinity of provincial government buildings.

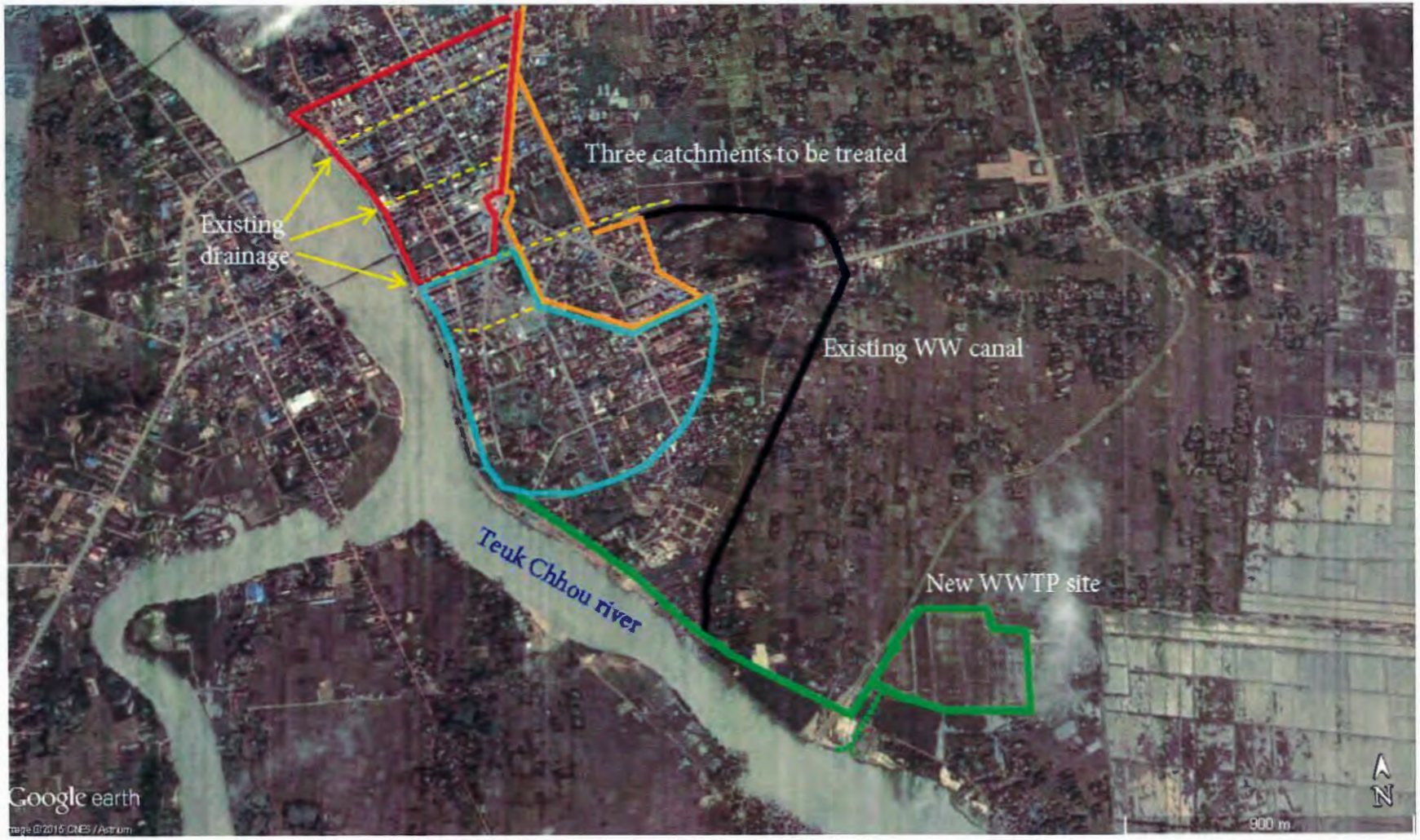
31. Because Kampot is a small town the extra work involved in including all three core areas instead one or two areas is small. Thus, it is recommended that all three core areas in Figure 3 are included in the subproject component. The type of the WWTP should be lagoon-based. The three catchment areas are divided approximately by NR#3. Wastewater will be gravity fed to strategically located pump stations which will deliver wastewater to the WWTP. The WWTP will require a capacity of 4,500 m^3/day to meet demands for a 20 year design life.

32. Sihanoukville subproject town has good experience with these WWTP systems from an earlier ADB project thereby allowing skills and experience transfer to benefit of Kampot. To learn from the Sihanoukville experience all connections to the system should be provided to property owners free of charge with a connection and grease trap chamber included for each household under project implementation.

33. The proposed WWTP site is an undeveloped wetland approximately 100m from the east bank of the Teuk Chhou river, 1.8 km south of the provincial government offices in town, or 2.5 km from the market square (Figure 3). The area is seasonally flooded, and as such the WWTP will need to be climate-proofed by sufficient grading with all lagoons bunded above recorded flood levels. The approximately 6.1 ha of land private and will need to be purchased. The previous 2.9 ha site identified in the town masterplan is too small, too close to town centre, and cannot be used for a lagoon based WWTP. Construction of the wastewater pipeline network should be carried out in the dry season to minimize erosion and spread of construction waste.

34. A septic tank septage treatment or storage facility is also required on site. Septage treatment could be by co-treatment in the proposed WWTP, however, due to the high solids content of the septage, the capacity of the primary lagoon will be reduced. The design of the primary lagoon will need to be enlarged to take this into account. The alternative is to dispose of the septage in lined storage pits at the WWTP site. The first option is recommended because the septage will be treated and as the WWTP is at pre-design stage, any additional measures that need to be incorporated into the design to treat septage can be taken (for example larger

Figure 3. Three wastewater catchments and new WWTP site in Kampot



primary lagoon, access ramps for vacuum trucks and odour reducing receiving well). Two vacuum trucks will be provided, one $6m^3$ and one $2m^3$ for access down smaller lanes.

35. In March 2015 a regional NGO GRET proposal a basic septage drying pilot plant for Kampot. No treatment (anaerobic or aerobic digestion in lagoons) would occur prior to drying. Land has been identified near the former airport ($1,000m^2$) and funding of Eur30,000 has been secured for construction of drying beds of capacity to $20m^2$ of septage per month. The project also aims to improve access to latrines through grants for poor households and to help develop the private sector in septage collection services. This is a small "pilot" project and will not affect the planning for the component, rather would supplement the WWTP to raise awareness and capacity for septage removal and treatment in advance of the subcomponent construction.

2. Solid Waste Management

36. The existing dump site (Figure 4) is in a flat and hilly area 10 km north of the town in Prey Khmom commune, Teuk Chhou district, and is accessed with a 3 km unsealed track off the main highway. A solid waste collection service currently is contracted by the Government with approximately 85% of houses on the collection route having garbage collected. The province reported that originally the 17.2 ha site was divided into three parts: a) dump site (15.2 ha); b) hazardous waste site (1 ha); and c) a composting area (1 ha).

37. The dump site was originally divided into 80m x 30m x 4m deep cells. However, the current facility as inspected in September and November 2014 is an uncontrolled dump with no leachate collection or cell management. The cells are not distinguishable. Garbage is dumped over a wide area close to the access road without organized compaction or regular covering with earth. Garbage is periodically burned. There is a separate composting facility operated by an NGO with a consultant project manager located in town. Collection and dump management are currently contracted out to Gaia, a private company.

38. A new landfill is proposed north of the existing landfill with a design that is between a controlled dump and a controlled landfill as opposed to a sanitary landfill (Figures 5 and 6). The design of the landfill includes clay lining, groundwater monitoring, planned cell development, leachate collection and storage, surface water management, cover soil storage, regular covering of waste and controlled waste picking. The proposed location of the landfill is 11.5km north of the city on 19ha of government land in Prey Khmum commune, Toek Chhou district. There are no people living on the proposed site. An improved 3.1 km access road connecting to (NR3) is included. The closure and restoration the existing dump site is included (Appendix D).

39. A separate pit for medical waste will be provided along with a small incinerator with shed for infectious waste. Provision of relevant equipment and machinery for collection and processing will be made and included in the subproject. Equipment will include one rear-loader compactor truck and one open $6m^3$ truck for waste collection, ten steel bins (skips) of $1m^3$, tem hand carts, and two skip-carrying trucks equipped with hydraulic lifting arms.

40. The mechanism proposed for improved waste collection from areas with difficult access will involve establishing transfer stations at each village with appointed community members contracted to collect waste from each household and deliver it to the skip located at the transfer stations. Either the province or a contractor will then collect the skip for transfer to landfill.

Figure 4. Existing and new landfill sites north of Kampot

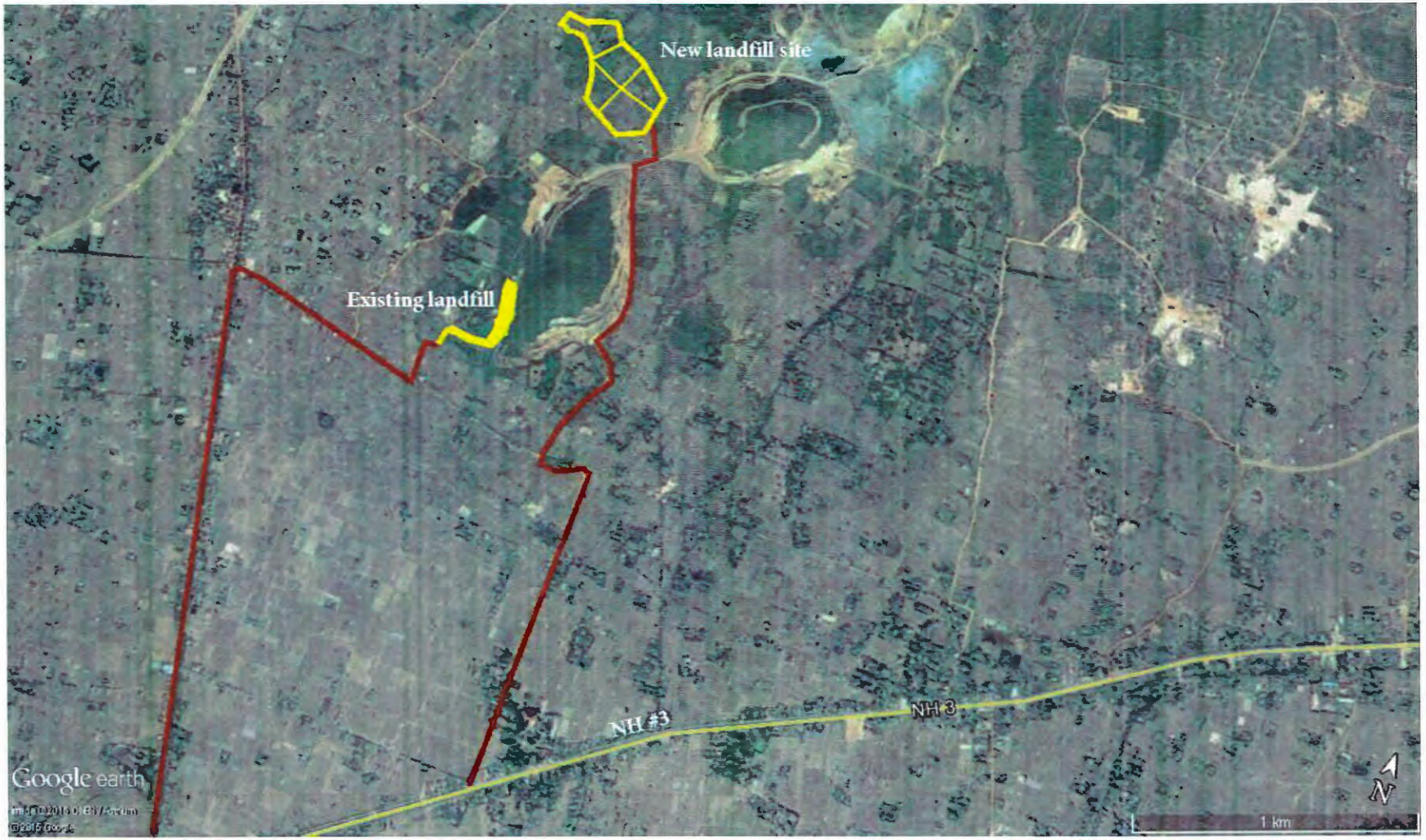


Figure 5. Plan view of new landfill in Kampot

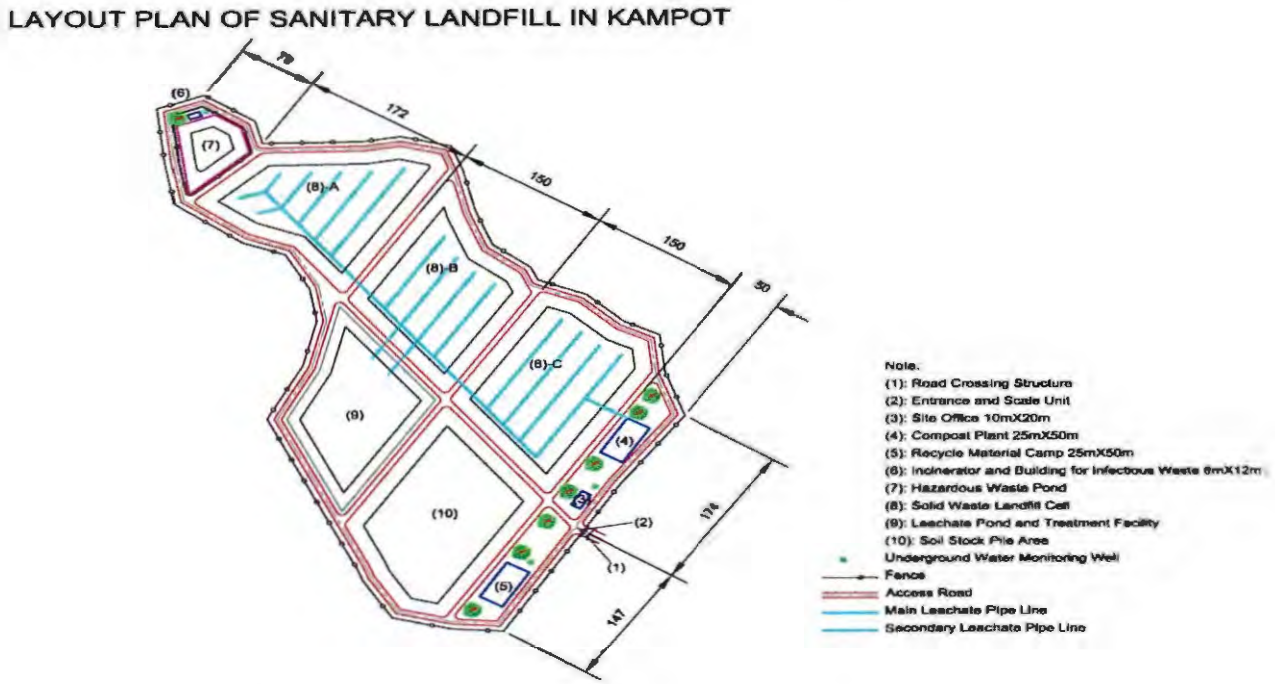
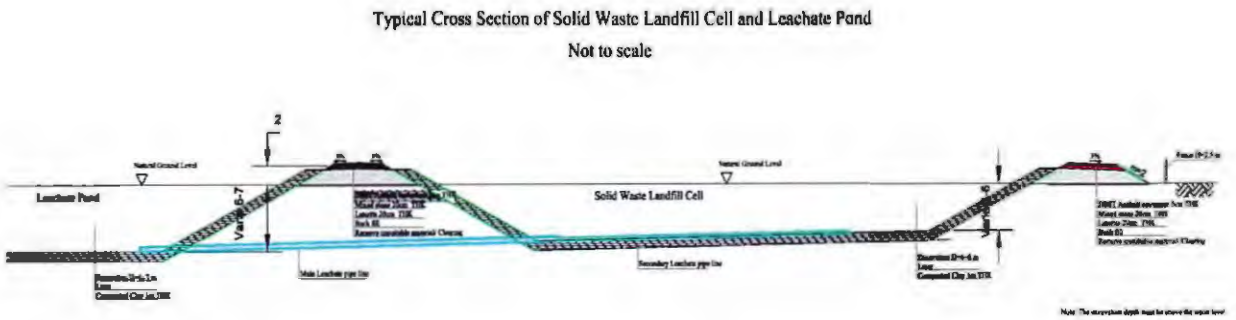
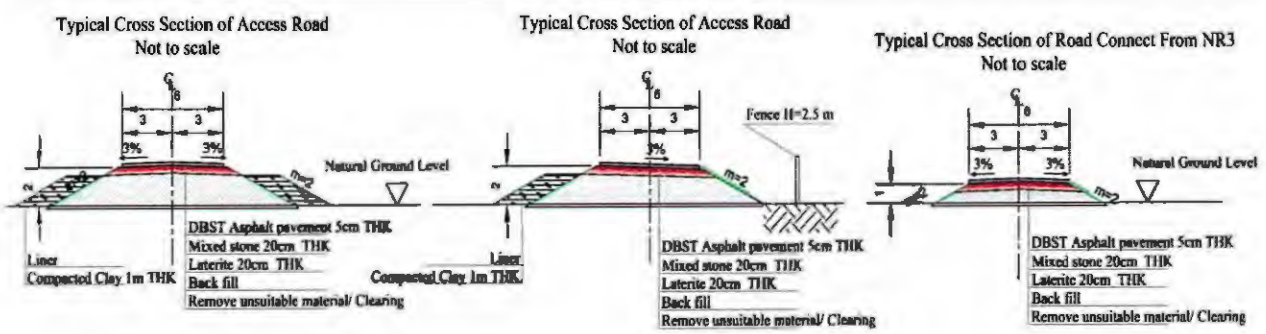


Figure 6. Cross sectional views of landfill cells and access road





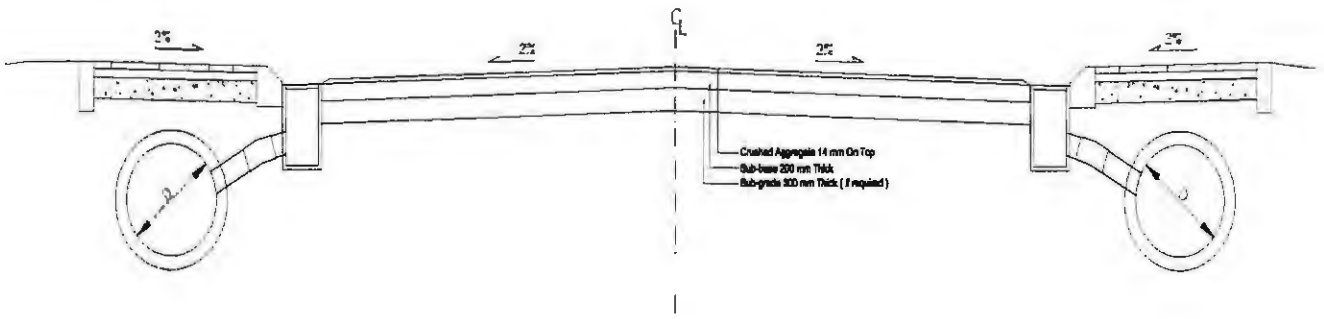
3. Urban Drainage

41. In Kampot roadside drains line the main sealed roads in the urban area with the main drains running down to outfalls at Teuk Chhou riverbank which create plumes of combined black water and stormwater. Some areas of the town are still susceptible to flooding as the undersized pipes are commonly blocked. The area around the market is particularly flood prone.

42. Separated wastewater system upgrades to the road drains and receiving channels are required to stop regular flooding. The areas of chronic flooding include the market area, one side of the main garden square, the road next to the hospital at the river, and the road from the southern-most roundabout to the river. There are also two collector channels on the west side of the river and one main channel on the east side that require dredging, re-defining, and installation of stone masonry banks where appropriate. Figure 7 shows the drains of the town that will be upgraded by the subproject, and Figure 8 provides a generic schematic of lateral upgraded roads drains that will be installed.

Figure 7. Locations of drainage network to be upgraded in Kampot.

Figure 8. Generic road upgraded drains for Kampot



B. Sihanoukville

43. Sihanoukville centre outlining the urban drainage network is shown in Figure 9.

1. Urban Drainage

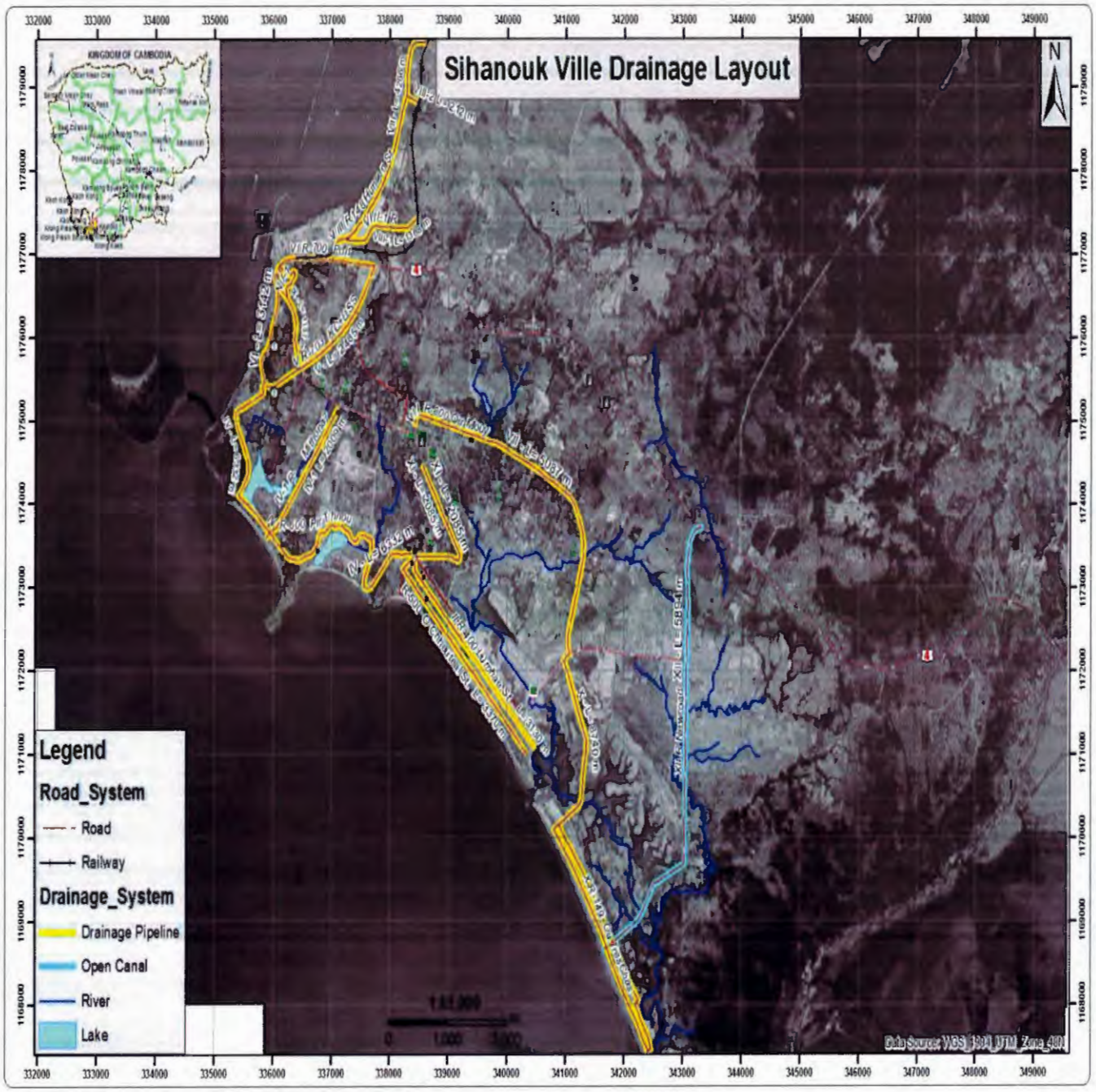
44. There are drains along some of the sealed roads in the urban area but others with drains along other roads either missing, blocked, or of a type that are difficult to maintain and require replacement.

45. Eleven areas have been identified for new drains. Concrete pipe drains with manholes every 25m are proposed for ease of maintenance. Existing drains will be removed and the same alignment will be used for the proposed drains. In order of priority the locations requiring drains are as follows (Figure 9):

Priority	Description	Length (m)
1	Occheuteal Rd No.500	3,370
2	Lumhe Preah Phomin Road No.400	3,130
3	Vithey No. 500	325
4	Pi Thnou Road No.600	8,340
5	Cambodia- Soviet Road No.703	2,485
6	Phe/port Rd No. 700	2,441
7	O'Pir Rd No. 800	5,087
8	Vithei Prampi Makara, Damban Montipet Bang Ek Krong No.200	2,085
9	Damban Tomnup Rolork-Samdech Hun Sen Road No.148	5,845
10	Damban Outoniyum/Meteorology region	1,357
11	Damban O'Tres Chah No.149	8,740
12	New Road from NR#4 at km188 to Otres Beach	5,894
13	Vithei Borei Kamakor,	3,000

46. Construction of as many of the drains as possible is proposed within the remaining $9.34M budget which is the estimated budget remaining from the ADB loan allocated to Sihanoukville after the solid waste and wastewater subprojects has been made budgeted.

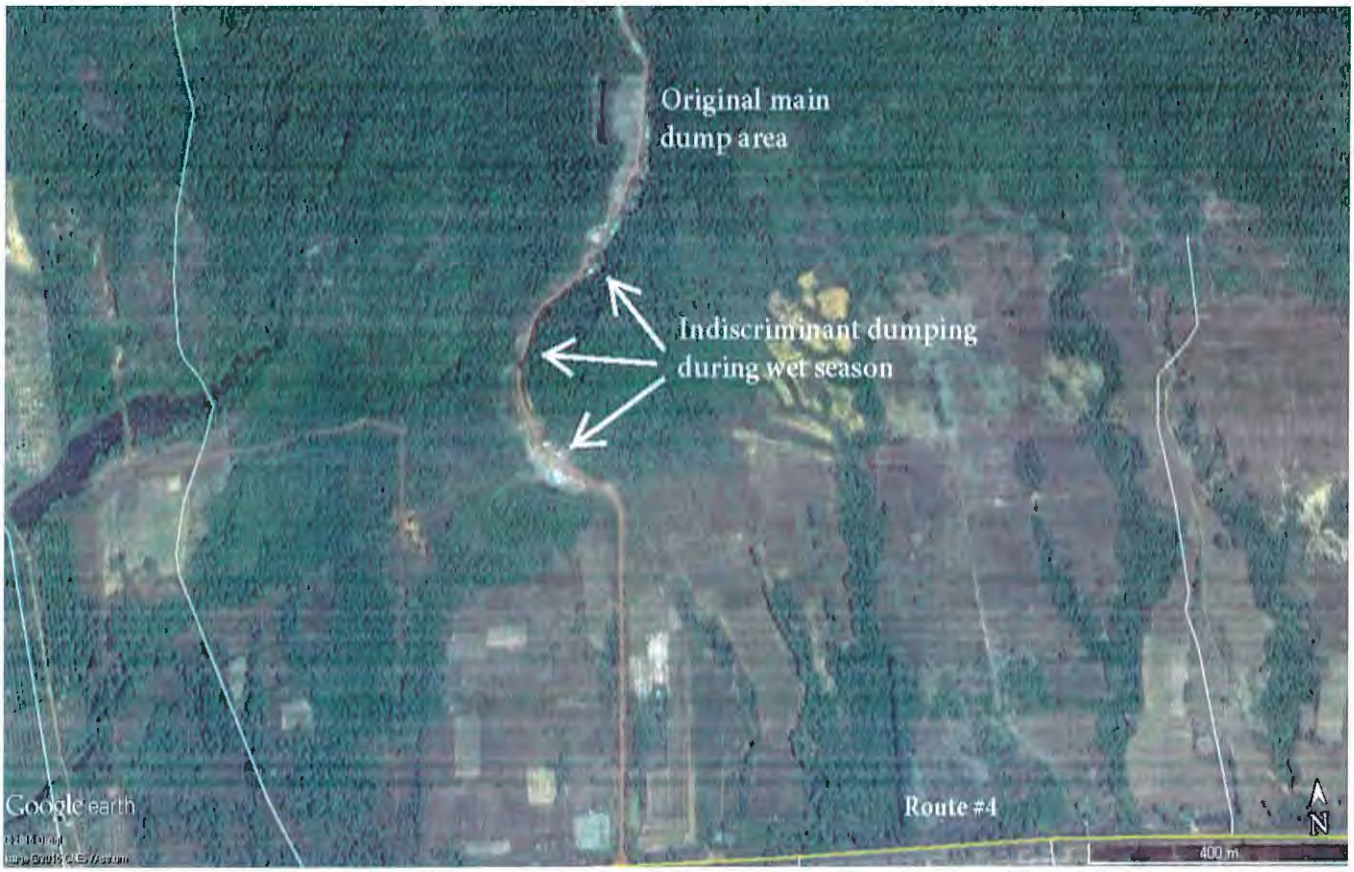
Figure 9. Sihanoukville centre showing drainage network



2. Solid Waste Management

47. The existing dump site is approximately 25km from the town (Figure 10). The state of the dump site is poor, and provides limited space and topography not suited to a landfill or dump site. Access is along a 1km dirt road from national road 4 which is difficult to access during the wet season. Waste is spread along the access road for a distance of 2-300m before the actual dump site due to difficulty with wet weather access. Waste is dumped at the side of the access road and is periodically pushed over the side of the hill. There is no leachate collection, periodical covering with earth or use of cells. There are approximately 168 people working on the dump site, many of which are day visitors, and the rest permanent residents. They earn up to $50/month collecting recyclables and selling on to a dealer.

Figure 10. Existing solid waste dump site in Sihanoukville



48. Currently collection is made by the private sector carrying 24 truckloads a day from some areas only. In the limited areas served collection rate is close to 100%. However, many areas do not have collection service due to difficult access by the large collection trucks. The private contract with CINTRI for dump site management expires in December 2015.

49. Originally, the plan was to close and replace the existing landfill with a new landfill site about 1 km further north in a densely forested area. However, this proposal was rejected because the new site was on sloping land, too far from town, and required a forest clear-cut equal to total footprint area of the new landfill.

50. Alternatively, the plan is to upgrade the existing solid waste management system in Sihanoukville which includes expand the urban collection service area, and renovate current landfill site as a controlled landfill. A controlled landfill is much better than the status quo but not as advanced as a sanitary landfill. The current dump will have solid waste moved into one confined area, compacted in layers, and covered with earth, leaving further area within the current boundary to be utilized as controlled landfill. The renovated landfill will include a clay lining, groundwater monitoring, planned cell development, leachate collection and storage, surface water management, regular covering of waste and controlled waste picking. A separate pit for medical waste will be provided, and a small incinerator with shed for infectious waste.

51. Equipment and machinery for collection and processing will be provided such as one rear-loader compactor truck and one open $6m^3$ truck for waste collection, ten steel bins (skips) of $1m^3$, ten hand carts, and two skip-carrying 4 X 4 trucks equipped with hydraulic lifting arms. An area outside of the landfill site will be set aside for resettlement of permanent residents of the existing dump, with water supply and sanitation provided.

52. The Provincial authorities requested that a package treatment plant be provided to treat the leachate prior to discharge to the environment. However, because the existing landfill will be renovated there is insufficient area for a package plant, and moreover, the expense of a package treatment plant is no longer viable.

53. The subproject will include a public awareness campaign to increase the collection service area, and capacity building for the DOE operators. The solution for improved waste collection from areas with difficult access will involve establishing transfer stations at each village, with appointed community members contracted to collect waste from each household and deliver it to a skip located at the transfer stations. Either the province or a contractor will then collect the skip for transfer to the landfill.

IV. DESCRIPTION OF AFFECTED ENVIRONMENTS

54. The description of the affected environments of Kampot and Sihanoukville focuses on the immediate subproject areas that could possibly be affected by the different infrastructure and environmental improvement investments in the two subproject towns, or the environmental features that could possibly influence the successful implementation and operation of the completed subprojects. Other regional environmental information is included for required context only.

55. Environmental baseline information was obtained primarily from recent provincial State of the Environment Reports (SOER) prepared by the provincial DOEs and supplemented with information from other reports where available. Because the provincial capitals of Kampot and Sihanoukville are close and share the same coastal environment as indicated by the overlapping SOERs, the description of the affected environments are presented jointly to prevent repetition. The data and information obtained for the two subproject areas, which target the natural environments and land use, is sufficient to obtain a sufficient understanding of the potential environmental impacts of the different subproject components. The detailed description of the socioeconomic and demographic profiles of Kampot and Sihanoukville areas is provided in the Social Assessment and Land Acquisition - Resettlement chapters of the draft final report.

A. Southern Cambodia Profile

1. Climate

56. Southern coastal Cambodia experiences a tropical monsoon climate with two distinct seasons defined by; (1) the dry season from approximately November to April associated with the northeast monsoon which provides drier and cooler air with February being the driest month; and (ii) the wet season from May to October during which rainfall is largely derived from the southwest monsoon drawn inland from the Indian Ocean.

57. The rainfall pattern is bi-modal with peaks in June and September/October. In the dry season, the temperature of the province is high in April with an average of 36.6°C and the coldest month is February with an average temperature of 21.10°C. The average annual rainfall in Kampot-Sihanoukville is 1,407 mm with the greatest recorded total annual rainfall of 2,604mm.

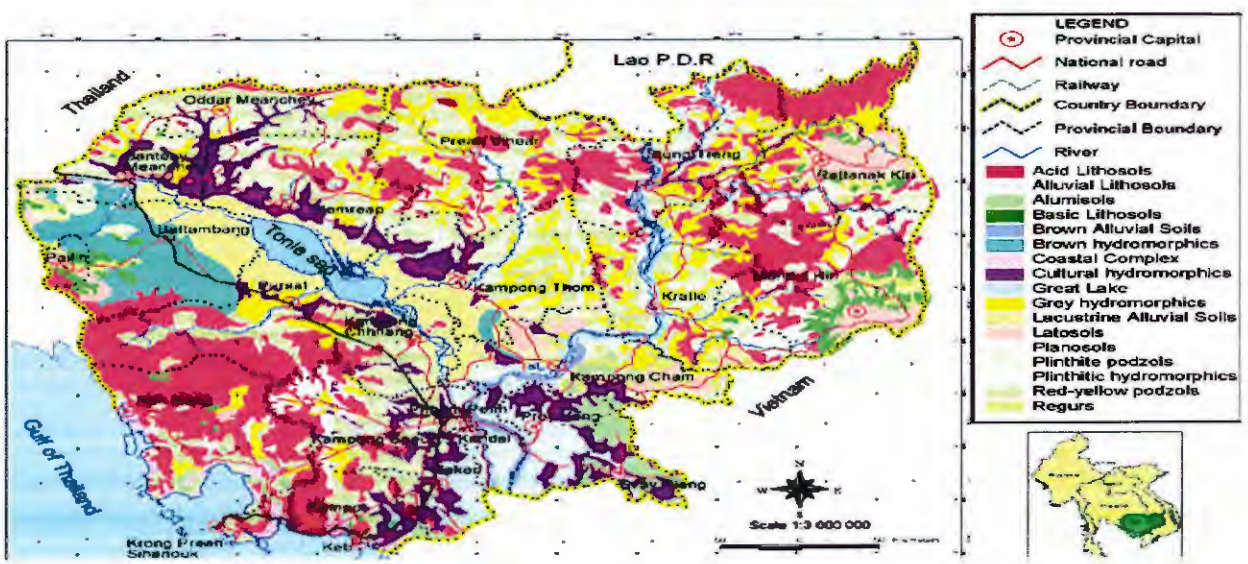
2. Soils

58. The soils of coastal Kampot and Sihanoukville are dominated by a mix of old and young alluvium soils of sediment deposits from rivers and streams (Figure 11).[18] These are mainly finer sediments, thus a high concentration of silt is found in the coastal and nearshore areas. Alluvial deposits normally result in fertile land.

3. Forest Areas

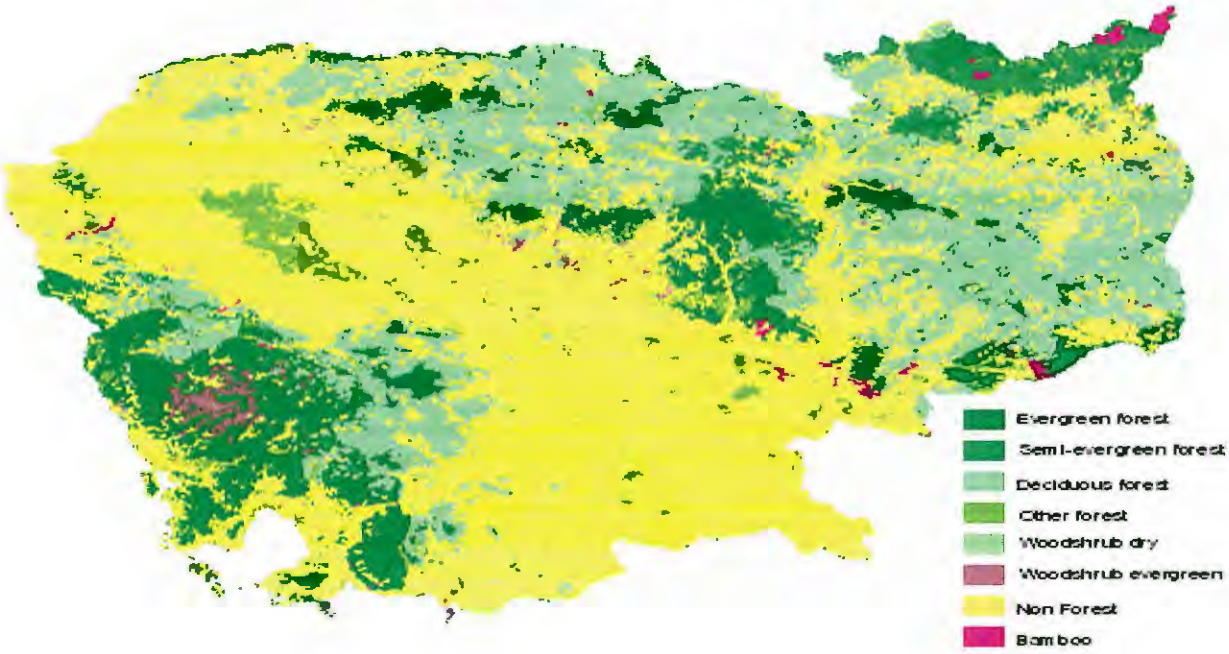
59. The forest types and areas of Cambodia are shown in Figure 122.[19] Most of the major forests are situated in the southeastern, central, and northeastern regions of the country. Forest cover in Kampot and Sihanoukville is relatively sparse due to long past land clearing deforestation with the closest major forests located in Bokor National Park northwest of Kampot

Figure 11: Soil types of Cambodia



[18] MOE 2004
[19] NREM DATA TOOL BOX -Royal Danish Embassy- Danida - Phnom Penh, Cambodia, March 2007.

Figure 12: Forest types of Cambodia



and in Ream National Park east of Sihanoukville (Figure 14). Other forested areas in the Preah Sihanouk province are located far north of Sihanoukville town.

B. Kampot and Sihanoukville Subproject Areas

60. The province of Kampot is located in southwestern Cambodia with a total coastline of 73 kilometers. The province occupies 4,873 km² and consists of 8 districts, 92 communes, and 104,993 households. The total population of the province is 528,405. The 8 districts are Kampong Bay, Kampot, Chhuk, Dang Tung, Chum Kiri, Kampong Trach, Banteay Meas, and Angkor Chey. Three of these districts – Kampong Bay, Kampot and Kampong Trach are located in the coastal area with 26 villages.

61. Sihanoukville town is also located on the coast approximately 100 km west of Kampot town. Preah Sihanouk province is bordered to north by Koh Kong province, and to the east with Kampot province. Sihanoukville municipality expands 868 km^2 and consists of three districts (Khan) and 22 communes (Sangkat)[20]

1. Physical Resources

62. The topography and land use of the coastal zone south of Kampot town is characterized by a mix of relatively sparse agriculture, salt harvesting fields, and mangrove forests which occur along the Teuk Chhou River which flows through Kampot town south to Kampot Bay. The salt producing operations (seawater evaporation) adjacent to the Teuk Chuu River are extensive

[20] 2002, MOE. State of Environment Report of Sihanoukville, 31pgs.

and dominate the peri-urban land use of the area. Kampot town lies in the flood plain and estuary of the Teuk Chhou river.

63. The topography of Sihanoukville consists of mix of lowland and upland areas. The lowland periphery of the town consists of coastal beaches, scattered mangrove forests extending east to Preah National Park, and scattered aquaculture. North from the beaches the town rises abruptly to an elevated plain area that has been designated as a water recharge zone. Across the elevated plain area is scattered agriculture and patchy forest. The economic zone and port lands area extends west and northwest around and along the coast.

a. Rivers

64. Many rivers drain to the coastal area some of which commonly dry up in the dry season. During the dry season the lower reaches of the rivers are brackish. Some rivers emptying to the sea are listed in Table 3.[21]

Table 3: Example rivers discharging to ocean from Sihanoukville and Kampot areas

Kampot Bay	Sihanoukville
Kbal Romeas River	Prektropaing River
Teuk Chhou River	Kountany River
Koh Toch River	Kountaveit River
Kdart River	Proh River
Smach River	Kampong Chen
	Preak Traeng stream

b. Surface Water Quality

65. The available surface and coastal water quality data of southern Cambodia is relatively good compared to other regions of Southeast Asia. However, the steadily increasing industrial development, intensive agriculture, and deforestation in Cambodia is reducing the quality of surface waters in different areas due pollution from untreated effluents, land erosion, and agriculture chemicals.

66. A summary of water quality during the dry season at river and coastal sites is summarized in Table 4 with water quality survey sites for Kampot and Sihanoukville shown in 3.[22]. Baseline to be updated during detailed design phase (see EMP).

Table 4. Dry-season river and coastal water quality 2005 – 2006

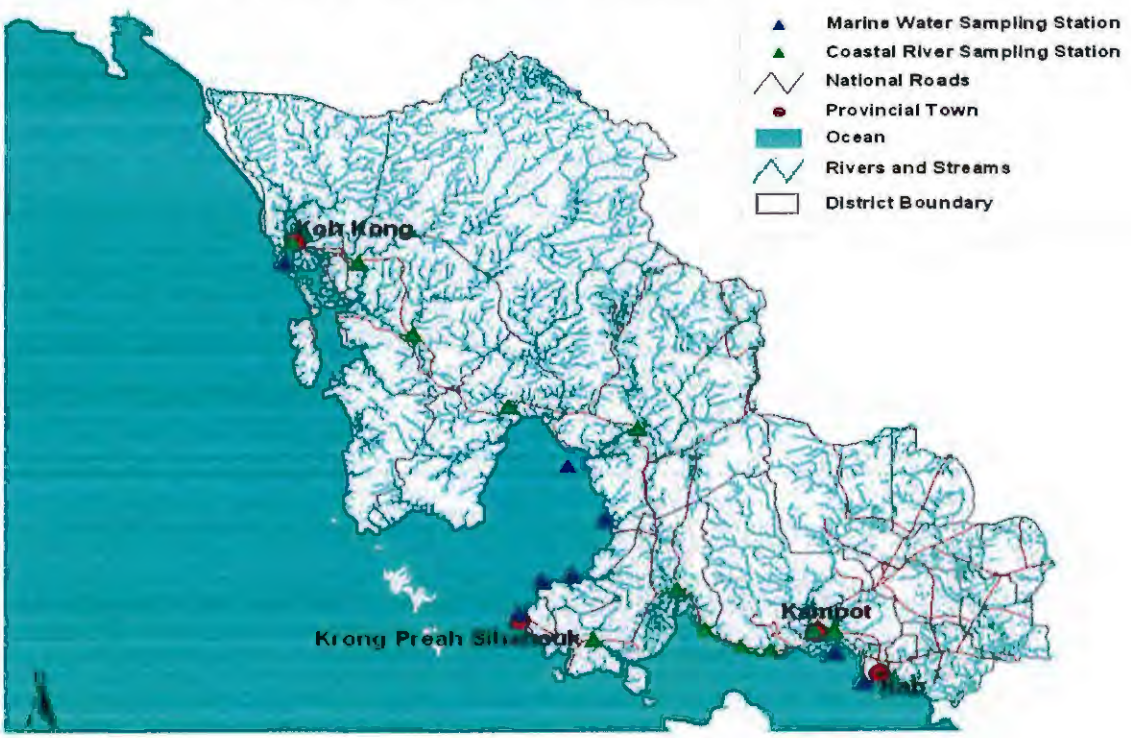
Variable	Average	Maximum	Minimum	Government Standard
River 288 samples from 12 sites				
Temp	30.5	33.2	27.6	
pH	7.7	8.1	7.3	6.5 - 8.5

[21] DOE and Danida, 2002. State of Environment Report for Kampot province

[22] DOE and Danida, 2006. Second Annual Monitoring Report for Coastal Rivers and Nearshore Coastal Waters of Cambodia.

Variable	Average	Maximum	Minimum	Government Standard
Salinity (%o)	12.9	20.3	3.8	
Secchi depth (m)	1.4	1.9	0.8	
total suspended solids (mg/l)	11.1	26.5	2.7	25-100
dissolved oxygen (mg/l)	5.2	6.1	4.5	2.0 - 7.5
biological oxygen demand mg/l)	0.7	1.2	0.4	1 - 10
total nitrogen (mg/l)	0.09	0.18	0.04	
total phosphorous (mg/l)	0.008	0.02	0.002	
Coastal 96 samples from 8 sites				
Temp	29.6	32.5	26.1	
pH	7.8	8.1	7.6	7.0 – 8.3
Salinity (%o)	25.8	30.1	20.8	
Secchi depth (m)	1.9	2.3	1.3	
total suspended solids (mg/l)	17.7	37.6	3.1	
dissolved oxygen (mg/l)	5.3	6.0	4.7	2.0 - 7.5
biological oxygen demand mg/l)	0.7	1.1	0.3	
total nitrogen (mg/l)	0.1	0.21	.05	0.1 - 1.0
total phosphorous (mg/l)	0.008	0.018	0.002	0.02 – 0.09

Figure 13. Water quality sampling sites in Kampot Bay and near Sihanoukville



c. Air quality

67. No air quality data are available for the subproject areas. Baseline data to be updated during detailed design phase (see EMP).

2. Biological resources

a. Protected Areas

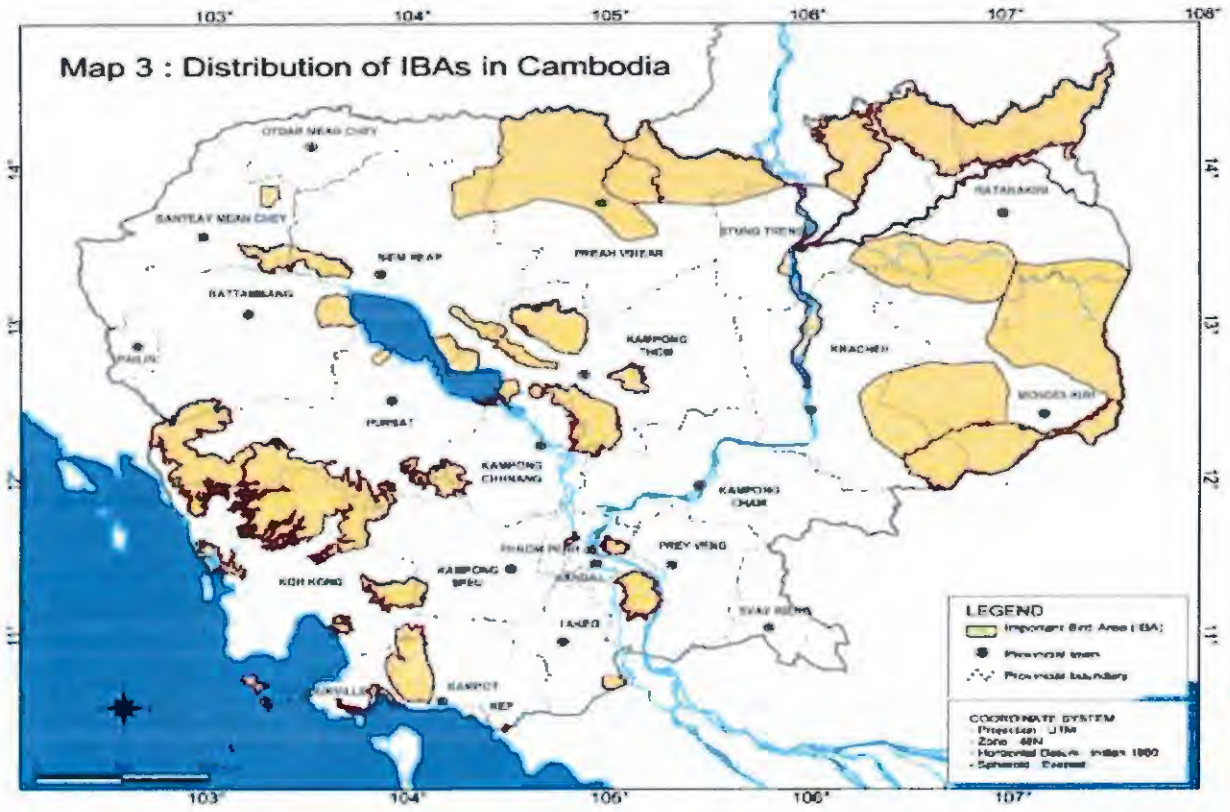
68. There are two ecological protected areas in the vicinity of the subproject areas (Figure 14). Bokor National Park in Kampot is located approximately 25 km northwest of Kampot. Ream National Park is located closer to Sihanoukville but still well away from the subproject areas which situated to the west in the town centre and north of Hwy #4.

69. The important bird areas (IBA)[23] in the region are located inside the two national parks and away from the subproject areas (Figure 15). There are no rare or endangered terrestrial wildlife in the subproject areas.

Figure 14: Location of Bokor and Ream National Parks near subprojects.

[23] http://birdlifeindochina.org/datazone/14

Figure 15. Important bird areas in National Parks of Kampot and Sihanoukville



b. Marine Coastal Zone of Kampot and Sihanoukville

70. Kampot and Sihanoukville along with the provinces of Koh Kong and Kep form Cambodia's coastal zone along the Gulf of Thailand. Cambodia's coastal resources play an important role in the country's development by supporting the fisheries, aquaculture, agriculture and tourism sectors. Of particular importance are the role of mangroves, seagrass, and corals in the fisheries and tourism industries.

i. Mangroves Forests

71. The area of mangrove forests along the coastline of Cambodia has declined significantly over the last two decades. However, the estimated 56,000 ha that remains represents a rich resource and area of critical habitat in relation to other areas in Southeast Asia. The largest mangrove areas in the subproject areas are situated in Koh Kong province north of Sihanoukville, and between Sihanoukville and Kampot (Figure 16). The remaining mangroves in Sihanoukville are situated just west of the town centre. In Kampot dense mangrove forests grow along the west bank of the Teuk Chhou River south of Kampot, and extend west along the coastline of Kampot Bay. Similar to seagrass, mangrove forests are critical habitat and play an essential role in the lifecycle of many marine organisms, and provide spawning or nursery grounds that support the rich biodiversity of fish species which include commercially important species. The mangroves forests of Koh Kong provide

Figure 16: Mangroves, coral reefs, and seagrass areas in Kampot and Sihanoukville.

Fig 16a: Mangroves

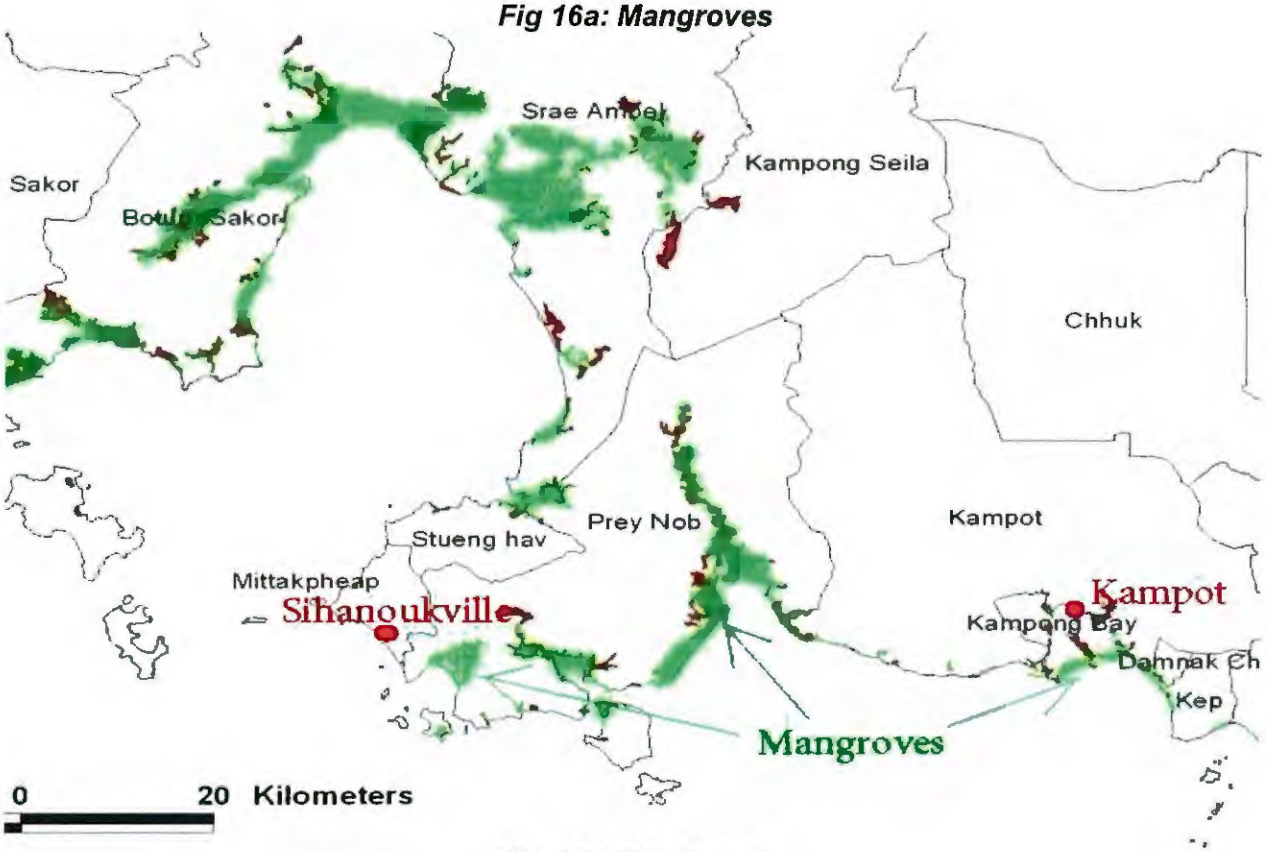


Fig. 16b: Coral reefs

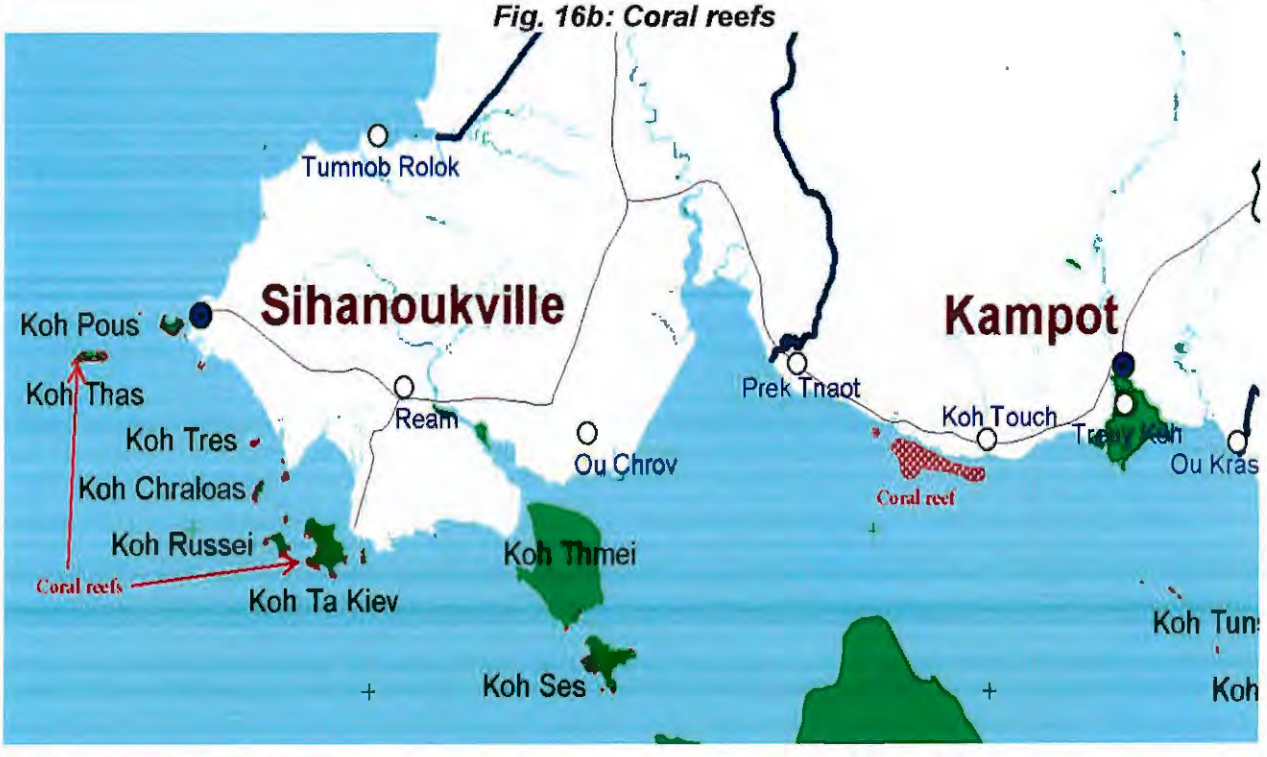


Fig 16c: Seagrass

habitat for the rare and endangered smooth-coated and the hairy-nosed otters.

72. Mangroves play an essential role in protecting the coastline and provide an effective buffer against climate change-related sea level rise, cyclonic activity and storm surges. Mangrove loss is due to shoreline infilling and development, illegal harvesting for fire wood and charcoal, and shrimp aquaculture among other uses.

a. Coral Reefs

73. Cambodia supports an estimated 2,700 ha of coral reefs with the most extensive coverage occurring in off Kampot and Sihanoukville[24] (Figure 16) Approximately 70 coral species are found within the coastal zone, though little is known about the relative distribution and composition of the reefs. These reefs are threatened by development, overfishing, coral harvesting degradation of the water quality, and destructive fishing practices such as dynamite.

b. Seagrass

74. Cambodia's coastal zone supports one of the world's largest areas of seagrass habitat in the shallow nearshore zone.[25] This critical habitat provides rich reproductive, nursery, and feeding habitat for many different species including rare and endangered species such as the Dugong marine mammal, sea turtles, seahorses, and an array of finfish and shellfish. The defined seagrass beds of Kampot and Sihanoukville (Figure 16) with particular reference to the estimated 25,420 ha seagrass off Kampot is also critical habit for inshore and offshore fisheries. There are indications that seagrass habitat is being lost to degraded water quality

[24] UNEP 2009
[25] UNEP 2009.

from increased turbidity caused by forest clearing, shoreline infilling, sand dredging. The Fisheries Administration of MAFF has produced a National Action Plan for Coral Reef and Seagrass Management in Cambodia (2006-2015).[26]

c. Marine Fisheries

75. Estimates of the average annual catch[27] of fish in Kampot province is between 7,000-8,000 tones, and over 450 tones in Kep. There has been a shift from smaller to bigger boats away from the inshore fishery. While overall fish catch has been increasing since about 1980 due to the increase in marine fishermen and industrial-scale technologies, fish catch per unit has been steadily declining, principally due to an increasing coastal population and unrestricted development in ecologically-sensitive habitats.

76. Early estimates indicated that there were over 416 motorized fishing boats in Kampot which will have increased significantly to date. The common groups of fishes caught include fishes, shrimps, and octopus. Coastal fishing communities may be boosted following the advent of Community Fishing Area Management Plans (CFAMP)[28] along the coastline. The plans detail activities and goals for improved resource management and community development but currently suffer a lack of a baseline understanding of current resources.

3. Land use at subproject sites

77. Land use in Kampot and Sihanoukville ranges broadly from the urban settlements of each town to mixed agriculture including the salt farms of Kampot, aquaculture, fishing, and the industrial development zone and portlands of western Sihanoukville. Managed forests exist to the north of Kampot and Sihanoukville with protected forests located inside Bokor and Ream National Parks. Kampot settlement areas such as Kampot town to barren areas commonly seen as such rock outcrops. Dense broad leafed forest is found within both National Parks.

C. Features of Subproject sites

1. Kampot

78. Figure 17 shows the site of the new WWTP south of Kampot just east of the Teuk Chhou river. The vegetated lowland site is inundated during the rainy season and will require infilling to isolate the lagoons and facilities from seasonal flooding. A densely treed fenced perimeter will be required to isolate negative aesthetics of the WWTP such as odour and noise from adjacent houses. Treated discharge pipe and outfall to Teuk Chhou river will be placed either south or north (foreground) of house in Figure 17.

[26] MAFF,2006.'NationalActionPlanforCoralReef andSeagrassManagement',2006-2015.
[27] MOE and Danida, 2002. State of Environment Report for Kampot
[28] The CFAMPs developed collaboratively by Fisheries Authority and communes. SorSarin, DAF pers comm. 2013

Figure 17. Site of new WWTP (left) east of Teuk Chhou river (on right)

Figure 18. Existing dumpsite, and site of new landfill north of Kampot

79. The existing dumpsite, and the site for new landfill just to the north are shown in Figure 18. The dumpsite will be closed after the waste field is consolidated to a smaller area (Appendix D). No data exist for the depth and quality of local groundwater which will need to be investigated during the detailed design in order to complete the detailed design of the new landfill and closure of dumpsite (Appendix C).

80. Figure 19 shows an example outfall of an urban drain to the Teuk Chhou river, and the existing raw WW canal that flows to the Teuk Chhou river south of town just north of site of new WWTP. The canal will not be used for WW after new WWTP and pipeline are commissioned.

Figure 19. Example town drain outfall to Teuk Chhou river, and WW canal

2. Sihanoukville

81. Figure 20 shows the main dumping area of the existing landfill site northeast of Sihanoukville, and a groundwater well located between the waste picker houses adjacent to dumping area. The operation of the well head will need to be checked as part of the groundwater study (Appendix C) required to finalize the planned renovations of the dumpsite to landfill status.

Figure 20. Main dumpsite of Sihanoukville, and onsite well head

Natural Hazards and UXO

82. Being coastal the subprojects in Kampot and Sihanoukville are sensitive to the same primary natural hazard which are typhoons and related typhoon surge from the Gulf of Thailand. Both areas experience heavy seasonal monsoon rains, however, coastal storms are more dominant.

83. The years of civil war during the 70s and earlier Viet Nam-American war has resulted in the continued risk of UXO harm especially in areas of new excavation. Both subproject sites need careful screening for UXO during the pre-construction phase.

V. PUBLIC CONSULTATION

84. The stakeholder consultation strategy during project preparation embodied the principles of meaningful engagement, transparency, participation, and inclusiveness to ensure that affected and marginalized groups such as women and the poor were given equal opportunities to participate in the design of the project, in accordance with the requirements ADB's *Safeguard Policy Statement* (2009), and the ADB Public Communication Policy (2012). Stakeholder consultations for the environment were conducted jointly with the parallel social impact assessment of the two subprojects in Kampot and Sihanoukville.

85. The approach to stakeholder consultation for environmental concerns or issues with the Kampot and Sihanoukville subprojects consisted of the following three avenues of inquiry and data collection:

1) As part of the household and village leader interviews conducted by the social development team;
2) Where possible separate consultations with provincial agencies and other stakeholders with by social development team; and
3) Individual interviews conducted by the International Environment Specialist during project meetings with provincial and national environmental management agencies.

86. Public Consultation will continue during the detailed design and construction phases as per the PCP (2012) and general requirements of Cambodia. Table 2 in section summarizes the insertion points for public consultation in the final design and implementation of the subprojects.

A. Identification of Stakeholders

87. Stakeholders were identified and engaged in a participatory manner. Stakeholder communication to date has focused on institutional stakeholders, affected communities, and persons directly affected by proposed subproject interventions. The stakeholders involved in the design of the project include:

- Institutional stakeholders invited including the (i) project EA and IUs (ii) provincial agencies (e.g., Environment, Women's Affairs, Commerce, Tourism, Water Resources, Public Works & Transport); private sector groups, and chambers of commerce;
- Communities living near the subproject areas who will benefit from the project, and who have an interest in identifying measures to enhance or maximize the benefits;
- Communities within the subproject area who may be directly and/or adversely affected, and who have an interest in the identification and implementation of measures to avoid or minimize negative impacts;
- Vulnerable and/or marginalized groups who have an interest in the identification and implementation of measures that support and promote their involvement and participation in the project; and
- Other institutions or individuals with a vested interest in the outcomes and/or impacts of the project.

B. Discussion Guide

88. Five open-ended questions, and information requests (**Error! Reference source not found.**) were posed guide discussions of the stakeholders.

Table 5. Guiding Questions and Information Requests for Stakeholder Consultations

1. What will be the benefits of the subproject?

   Please list benefits of project.

2. Do you have any environmental concerns with the subproject?

   Please list environmental concerns of project.

3. Do you any have environmental concerns with the **construction activities** of the subproject?

   Please list environmental concerns of construction phase activities.

4. Do you have environmental concerns with the **completed operation phase** of the completed subproject?

   Please list environmental concerns of the operation of completed subproject.

5. Do you think the subproject design or operation should be changed to prevent negative environmental, or community impacts?

   Please list changes to subproject that you think will prevent or reduce negative environmental, or community impacts?

89. To help orient the discussions on environmental issues and concerns of subprojects a list of environmental components (Table 6) was introduced to the stakeholders ahead of the question and answer period. The stakeholders were encouraged to add their own components of environment to the discussions.

Table 6. Example Environmental Components Used to Guide Stakeholder Discussions.

• drinking water quality and availability • surface water quality and quantity • groundwater quality and quantity • air quality • climate • land and soil quality • coastal zone, ocean, rivers, reservoirs, • mangroves, trees, other vegetation, • coastal and terrestrial resources e.g., seagrass beds, mangroves, forests, salt beds	• terrestrial and aquatic animals, e.g., fish, birds, small mammals • ecological protected areas (e.g., national parks, wildlife sanctuaries), • land and coastal zone uses (e.g., agriculture, fisheries, forestry, navigation, aquaculture, commercial, other), • public safety • public movement and access • physical cultural values (e.g., pagodas, cemeteries, monuments)

C. Summary of Public Consultation

The list of participants and recorded minutes and photographs of the public consultation meetings held in Kampot and Sihanoukville are found in Appendix B. provide below is a summary of the meetings.

1. Kampot

90. The environmental consultative meetings were conducted in Kampot City Hall on Feb 20, 2015. The meeting was separated between the provincial department levels, and community levels.

91. The provincial department level the meeting was conducted in the provincial hall office and chaired by the Vice Governor. Five provincial departments invited to participate defined by Environment, Tourism, Land Management, Public Works, and the Municipality of Kampot. The community level meeting was conducted in a different room. The participants of the community-level meeting represented all areas of the different subproject components. The forty (40) participants including individual villagers, representative of villages, and community level representatives for the entire subproject service area

2. Sihanoukville

92. The consultative meetings for environment were conducted in Sihanoukville town hall on February 17, 2015. Similar to the meetings in Kampot participants were invited from different provincial departments (Environment, Commerce, Womens Affairs, Tourism, Land Management, Public Works & Transport, and the Municipality of Sihanoukville), households/villages affected by the subproject components. The fifty (50) non-government participants consisted of individual villagers, and village representatives of the areas affected by the different subproject components.

93. The stakeholder consultations in both subproject towns showed overall positive support for the subprojects in Kampot and Sihanoukville. Table 7 summarizes the comments and concerns of the stakeholders in Sihanoukville and Kampot. The table also include input from the provincial DOEs obtained by the International Environment Specialist.

94. Also summarized in Tables 6 is how the EMPs for Kampot and Sihanoukville will respond to the environmental issues and concerns that were raised by stakeholders. The follow-up stakeholder consultations that may be required during the detailed design phase will begin with a review of the issues and mitigations initially identified by the stakeholders.

Table 7. Summary of Stakeholder Views in Kampot and Sihanoukville

Benefits of subprojects expressed by stakeholders	• Improved living standard of people in Kampot and Sihanoukville due to upgraded and construct new waste water treatment system; • Improve drainage system in the town with upgraded capacity; • Reduced flooding in rainy season due to improved drainage systems; • Rivers will be less polluted due to new waste water treatment plants; • Improved environments from new sanitation landfill in Kampot and improved existing landfill in Sihanoukville; • Kampot and Sihanoukville will be cleaner due to the new infrastructure of subprojects; • The provincial development plans of Kampot and Sihanoukville will be supported by subprojects; • Increased GDP in Kampot and Sihanoukville due to subprojects; • Reduce the disease from infection from drainage and sewage when systems are separated; • City is clean with good infrastructure;	
		Subprojects Safeguard Response
Construction phase issues	• Noise from construction activities; • Air pollution from dust during constructing; • Waste from the construction material; Remain some soils after construction in front of house; • Dust and noise from the construction activities; • Disturbance to the people living next to project site during the construction;	• For the construction phase of both subprojects in Kampot and Sihanoukville the EMPs specify mitigation sub-plans for constructions disturbances such as noise, dust, solid and liquid waste management, traffic congestion, public & worker safety, blocked access, and management of waste from worker camps. • The EMPs also prescribe

	• Traffic congestion may disturb to tourist and people living in Kampot and Sihanoukville city; • Traffic Accident during construction; • Block entrance road to home of people living along the project construction; • Wastewater from camp of workers; • Construction Workers may infect HIV/AIDS to local people; • Drug Traffic with workers; • Affect to income of people have shop in front of house when project construct the drainage and sewage system; • Affect to people income due to loss structure without compensate; • Affect to structures and tree along the road and proposed area of project.	measures to prevent or reduce social issues arising between the community and worker force such as HIV/Aids • The separate social impact and land acquisition assessments prescribe compensation measure for lost income or property due to subprojects • Tree loss mitigation, and site restoration plans are included in the two EMPs for the subprojects in Kampot and Sihanoukville. • All potential loss or damage to structures and cultural property will be avoided as per specifications of EMP.
Operational phase issues	• It may pollute the water in river due to wastewater treatment plant does not have the good capacity to treat. • It may affect to people living along the road to landfill due to waste collection truck. • It may obstruct/destroy the sewage system/pipe and drainage system during operating due to there is not good management and cooperation. • It may affect to waste collectors in landfill due to trucks drive so fast. • if landfill managed by company, they will not apply the technical management.	• Incorporated into the operational phase of the new WWTP in Kampot is regular monitoring of treated effluent quality to ensure effluent meets original design criteria for environmental protection • Included with the new and improved landfills in both towns is a re-designed operations and schedule of garbage trucks traveling to/from the landfills to increase safety and reduce costs.. This will include speed limits along access roads in and town. • The new drainage system that is installed will include new stormwater drain as and new WW drains so there is no risk of damaging existing drains during operation • The private companies that may operate the new/improved landfills will have to abide by the new rules of operations in order to obtain and then retain their government issued licenses to operate the

		landfills
Suggested impact mitigation measures	• Construction on roads for drainage and sewage system will be finished by block before starting to another place. • Traffic on the road should have facilitator to resolve during construction. • Sub-constructor has to spay water on road that they used during construction. • Good machineries should be used during construction to avoid air pollution. • Waste water and solid waste management system should be done in order to minimize the environmental impacts; • Keep the existing vegetation along the cannel/river bank as possible or plant more if not exist; • Standard construction management on both safety and environment should be applied; • Human resources development on the operation and management of waste water treatment plant and landfill should be applied. • Compensate affected people if there are lost assets. • For sewage and drainage system, it should have the responsible team to resolve all matters during operation; if the project doesn't establish this team, we will have the problem again. This team has to control and prepare the penalty for villager or who destroy the system. • All affection has to give the compensation; • Subcontractor has to spray water on used road regularly to avoid dust; • Solid waste generated from project has to collect to dispose every day; • In the operation phase, landfill has to management properly as	• The drainage upgrades will be done in discrete sections with the new drains of a section being completed and operational before the next section is started. • Throughout the construction phase and into the operational phase construction traffic will be managed to minimize congestions, and prevent accidents with the public. • As part of the mitigation sub-plans for dust, water or other wetting agents will be used on all construction roads to prevent dust • Similarly, contractors will have to keep all construction vehicles in good working order. • All construction wastewater will isolated and disposed according to DOE regulations. • The site restoration sub-plan of EMP includes riverbank vegetation. • Existing MoL and ILO regulations for worker and public safety will be applied to the subprojects during construction and operational phases. • The subprojects incorporate a large capacity development and training program for all agencies responsible for the operation and maintenance of the new infrastructure in Kampot and Sihanoukville. • Asset loss compensation is part of the pre0constructon phase of the subprojects as indicated above. • As part of capacity development and training, the roles and responsibilities of the operators of the new Kampot WWTP and drainage systems, and appropriate penalties for public violators will be clarified in order to ensure the sustainability of the new systems. • Solid waste will be collected daily according to the needs of each

	technical, thus monitoring from provincial level has to be done to avoid company does freely. During transport, waste must not be allowed to fall on to roads. • All waste collection trucks must be cleaned regularly.	sector in the towns. • Strict operating guidelines and rules for the new and upgraded landfill site will be identified and enforced to ensure the sustainability of effective solid waste management including operation of covered garbage trucks.

VI. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIONS

95. The assessment of potential impacts of the subprojects in Kampot and Sihanoukville towns is structured by the three development phases define by: a) *pre-construction; b) construction;* and c) *post-construction operational* in order to distinguish the important impact periods of subproject implementation, and to prevent redundancy in the assessment and reporting. This assessment structure is carried forward and is used to structure the environmental management plans (EMP) prepared for the subprojects.

96. To further prevent redundancy in the assessment potential impacts that are common to all subproject components are identified and discussed together. This enables clearer assessment and discussion of subproject component – specific potential impacts.

97. The area of influence combines direct and indirect effects of the subprojects. The area of influence is delimited by the area immediately affected by the infrastructure developments, and the "downstream" effects defined by for example receiving water quality, socioeconomic and cultural effects of centre-town enhancements and improved garbage management, expanded access to previously seasonally flooded areas, and reduced incidence of waterborne disease.

A. Subproject Benefits

98. Summarized below are the benefits of the subprojects mirrored by the output from the public consultations as well as from the targeted benefits of the entire PPTA.

1. Kampot

99. The addition of the first WWTP and collection system will greatly improve the urban environments for residents and visitors to Kampot. The incidence of water borne infection and disease should decrease as a result the collection and treatment of domestic waste. The quality of the Teuk Chhou river through the centre of town should improve from the removal of raw water discharges.

100. The new more modern landfill will improve the environment in the vicinity of both the old and new landfill sites. The closure of the existing, poorly operated landfill will put an end to large solid waste pollution, and a major aesthetic problem in the area. The new land fill will provide waste pickers with a more organized, clean, and safe operation with which to work with. The lined new landfill with leachate collection will prevent contamination of local groundwater.

101. The improved drainage network in town will greatly reduce the seasonal major flooding events that occur during heavy rainfall events. The absence of untreated sewage and flooding in the streets will enhance the natural beauty of the town, and enrich the tourist experience of Kampot. All of these infrastructure investments will lead to socioeconomic development of the town and immediate area.

2. Sihanoukville

102. The improvements to the solid waste management system in Sihanoukville including renovation of the landfill site, more efficient garbage transport, and better working conditions for waste pickers will improve environmental conditions of affected areas, and the life and livelihoods of solid waste management workers.

103. Similar to Kampot improved drainage in Sihanoukville will reduce chronic seasonal flooding thereby improving the urban environment, lives of residents, and the experience of tourists to the area.

B. Subproject Impacts and Mitigations

1. Pre-construction Phase

104. Potential negative impacts associated with the pre-construction phase of the subprojects concern land acquisition and resettlement. At the feasibility design stage the requirements for local resettlement and compensation are expected to vary amongst the subprojects in the two corridor towns. The details of the impacts and required management actions are addressed in the Resettlement Plans (RP) and inventory of Losses (IoL) (or Due Diligence Report in the case of Sihanoukville where there is no land acquisition and resettlement impacts) that have been prepared for both subprojects under separate cover. Involuntary resettlement and required compensation for land or asset loss identified at the feasibility design stage is summarized below:

- In Kampot 13 households (HH) will be required to give up some land for the new WWTP. No resettlement will be required from subproject.
- No land acquisition or resettlement will be required for the subproject components in Sihanoukville.

a. Groundwater study for landfill components

105. The depth and quality of the groundwater, and soil type at the existing and new landfill sites in Kampot, and at the existing landfill site in Sihanoukville are not well understood. The soil type and porosity, and the depth of the water table will be required for the design of the new landfill at Kampot and should be available for the renovation of the existing landfill at Sihanoukville. A local groundwater and soils investigation will be needed for both subproject components during the pre-construction-detailed design phase. A draft ToR for a groundwater study at the landfill sites in Kampot and Sihanoukville is provided in Appendix C.

b. Updating EMPs

106. The EMPs for the Kampot and Sihanoukville subprojects will need to be updated during the pre-construction detailed design stage to ensure the EMPs meet the final detailed designs of the subprojects. This will involve finalization of the mitigation sub-plans to manage potential impact areas such as erosion, sedimentation of surface waters, noise, dust and air quality, spoil disposal, traffic, UXO clearance, and worker and public safety at the project sites. The impact mitigations of the pre-construction phase are detailed in the EMPs for the subprojects which are prepared under separate cover.

107. Key impact mitigation measures of the pre-construction phase are:

1) Initiation of the project's resettlement and/or compensation plan;
2) Groundwater and soils investigation at landfill sites and at new Kampot WWTP site;
3) Completion of detailed designs of the subprojects; and
4) Updating and initiation of the EMPs.

108. Updating the EMPs also involves updating the environmental baseline descriptions of affected areas where needed to better understand potential impacts of subprojects and to maximize effectiveness of required mitigations. In particular water quality of Teuk Chhou river and beach area of drainages should be sampled to update published SOER (2006) data cited in IEE. The groundwater and soils investigation (Appendix C) is an important addition to the environmental baseline.

2. Construction Phase

a. Common potential impacts of subproject components

109. The potential environmental impacts of the subprojects in Kampot and Sihanoukville are primarily construction phase-disturbances of the individual subproject components. Common impacts of the civil works will consist of for example, reduced and/or blocked public access to areas, disrupted business and recreation, noise, dust caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, public and worker accidents, increased traffic congestion & traffic accidents, land erosion and surface water sedimentation such as Teuk Chhou river, localized drainage and flooding problems, solid waste and domestic pollution from worker camps, and communicable disease and community problems caused by migrant workers. These short-term impacts and disturbances will occur at different levels of magnitude depending on the civil works activity and the subproject site.

i. Mitigation measures

110. Management measures to mitigate common potential impacts associated with the construction phase of all subproject components are presented below. The mitigation measures are detailed further in the subproject EMPs.

1. Care must be taken to ensure that sites for earthworks (e.g., excavations, trenches) in the rural and urban sites in Kampot or Sihanoukville that are suspected to have unexploded ordnance (UXO) should be surveyed by the Government prior to construction. If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works.

2. Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross.
3. A cultural chance find management plan must be in place for cultural artifacts and property.
4. Regular use of wetting agents should be employed at construction sites to minimize dust.
5. All construction vehicles and equipment should be maintained in proper working order, and not operated at night if possible to minimize noise.
6. Speed limits should be posted and adhered to by construction vehicles, and the public.
7. Where possible construction vehicles should use different roads or dedicated lanes of roads shared by the public.
8. Trees and other vegetation at all construction sites and along road corridors such as access road to new landfill in Kampot should be protected. Tree removal must be minimized.
9. Present and past land use should be reviewed to assess whether excavated soils are contaminated. Contaminated spoil should be disposed at the existing landfills for Kampot and Sihanoukville, or locations approved by the DOEs.
10. Berms and/or silt curtains should be constructed around all excavation/trench sites and along all surface waters such as the Teuk Chhou river to prevent soil erosion and surface water sedimentation.
11. Local workers should be used as much as possible to prevent or minimize influx of migrant workers, and incidence of social disease and community unrest.
12. Worker camps must have adequate domestic waste collection facilities and sufficient pit latrines that are located away from public areas and surface waters.
13. Dedicated fuel storage areas must be established away from public areas and marked clearly.
14. To minimize the impact of construction on the public and workers the recent Cambodia Occupational, Health, and Safety (OHS) Programme guidelines developed for Cambodia by the International Labour Organization (ILO) should be followed. The IFC World Bank Environment, Health, and Safety Guidelines (2007) cited above should be followed to supplement the OHS if necessary.
15. Aggregates (e.g., sand, gravel, rock) that are transported by truck must be covered.
16. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion.
17. Sand extraction from rivers should be avoided, and only occur from licensed areas.
18. Storage of bulk fuel should be on covered concrete pads away from the public and worker camp. Fuel storage areas and tanks must be clearly marked, protected and lighted. Contractors should be required to have an emergency plan to handle fuel and oil spillage.

b. Kampot subproject

Solid waste management

111. The draft closure plan for the existing landfill (Appendix D) needs to ensure the safety of the public, prevention of environmental contamination, and the preservation of waste picker livelihoods. The closed landfill should be fenced to prevent access with clearly posted signage for the public indicating danger and no trespassing. The plan for waste pickers of the closed landfill is addressed by the separate social assessment of the PPTA.

112. The waste field of existing landfill (Figure 18) should be consolidated into appropriately sized areas [with a bulldozer], and covered, or conversely, excavated in whole or part and disposed of in a new unused cell of the new landfill. Consolidated waste left at existing landfill must be covered with a sufficient layer of natural material with or without methane flares to ensure either methane is contained or is flared off the heap naturally.

113. As part of the groundwater study for the new landfill bore holes should be drilled downslope below the closed landfill to determine extent of leachate contamination of groundwater, and to track groundwater quality following landfill closure.

114. The depth of water table, and quality of groundwater below and downslope of the new landfill site (Figure 18) needs to be conducted along with a soil permeability analysis to be able to complete the design of landfill cells, liners, and required leachate management system to prevent contamination of local groundwater.

115. The public must be kept out of the existing and new landfill sites during closure and construction periods with well signed fencing. Construction vehicle traffic along the new access road to the new landfill needs to be regulated speed limits, and wetting agents applied to control dust. All trees removed for new road and landfill must be replaced with 3 three trees for each tree removed.

Wastewater collection and treatment

116. The low lying area of the WWTP site in Kampot (Figure 17) suggests the water table is very shallow if not at the surface. The anaerobic lagoons with liners need to be designed at a depth that poses no risk of groundwater contamination. Temporary earth berms or plastic sheet fencing must be placed around the WWTP site to prevent erosion and sedimentation of the irrigation canal to the south and Teuk Chhou river to the west.

117. Infilling of the entire WWTP site is required to ensure that the WWTP facility is constructed at a grade that makes the facility insensitive to current and future seasonal flooding events. The isolation of all WWTP buildings and treatment facilities from the adjacent environment is necessary to protect the integrity of the WWTP operations, and to protect the adjacent environment from WWTP operations.

Urban drainage and WW network

118. The improvements to the drainage network and the installation of the new WW collection network and pipeline for the WWTP will cause major disturbances to the streetscapes in Kampot from the trench construction method that will be used. As requested during the public consultations, effort must be expended to start and finish improvements to drains a section at a time so that major disruptions to normal street activities will be a short as possible. Quiet civil works activities should be conducted at night if possible.

c. Sihanoukville subproject

Solid waste management

119. The renovation of the existing landfill (Figure 20) will cause short-term disturbances to the operation of the landfill. However, the performance of the renovated landfill including enhanced waste picker conditions and livelihoods far outweigh the disturbances. Similarly, the

improvements to other elements of the solid waste management system (e.g., more efficient collection and transport of garbage, improved access road) strongly offset any disturbances caused by the implementation of the improvements. The collection and handling of solid waste from source to landfill site will become more cost-efficient with reduced pollution.

120. In addition to better structuring and managing the existing dumpsite, an important environmental safeguard requirement is to better understand the fate of the current leachate stream from the landfill site. Similar to the landfills in Kampot groundwater bore holes should be installed at, and downslope of the landfill to determine if a leachate plume exists, whether local groundwater quality is affected. This information will enable a more effective renovation of the landfill site. The first step is to assess whether the well head that currently exists at the Sihanoukville dumpsite at the top of the dump area (Figure 20) yields groundwater for analysis.

Urban drainage

121. The same construction issues of the drainage improvements in Kampot apply to Sihanoukville. The major disturbances caused by the trench installation method need to be managed to be minimal as much as possible.

d. All subproject components

Protected Areas, Rare and Endangered Species, and Cultural Property and Values

122. There are no known rare or endangered terrestrial wildlife species or critical habitat in the immediate vicinity of the subprojects in Kampot and Sihanoukville. And, as indicated in 69.

The important bird areas (IBA) in the region are located inside the two national parks and away from the subproject areas (Figure 15). There are no rare or endangered terrestrial wildlife in the subproject areas.

, the subprojects are not near the Bokor and Ream National Parks. There are no physical cultural resources that are at risk of being damaged by the subprojects at the feasibility design stage. Thus, the construction phase activities that are implemented along with specified mitigation measures should not negatively affect sensitive ecosystem and cultural resources and values.

123. Because the final locations of facilities and components of the subprojects will only be determined at the detailed design phase, the potential exists for valued ecological and cultural resources to be negatively affected should subproject locations be altered significantly. Thus, as part of the detailed design stage when subproject siting and designs are finalized, and as part of updating the EMPs to meet the detailed designs, a review of the proximity and sensitivity of all valued eco-cultural resources of the subproject areas in relation to finalized infrastructure developments should be undertaken. Moreover, final siting and designs of all subprojects need to be reviewed to ensure that the targeted original subproject selection criteria are met.

3. Operation Phase

a. Kampot and Sihanoukville subprojects

Solid waste management

124. Posted speed limits along the access roads to the new and renovated landfill sites must be enforced to prevent accidents, and sufficient annual O&M budgets should be provided to maintain all garbage trucks and all other vehicles in good working order to reduce the air pollution. Wetting agents should be periodically applied to access roads and both landfill areas to control dust, and wind-blown debris.

125. Groundwater quality from the monitoring bore holes that are installed at the landfill sites should be monitored regularly to ensure local groundwater is not contaminated by the landfill cells or leachate streams of the landfills. The waste sorting facilities, and working conditions of the waste pickers need to be reviewed regularly to ensure that the original equipment, and the working and if appropriate living conditions of the pickers remain as originally designed or renovated.

Wastewater collection and treatment

126. The quality of treated effluents of new Kampot WWTP must be monitored to ensure they meet design criteria, and sludge from the WWTP must be disposed in a location acceptable by DOE which will be finalized during detailed design phase of the subproject.

127. Other issues with the creating new Kampot WWTP are aesthetics and public safety. The new and improved WWTP must not become negative extemalities in the urban and rural landscape. Potential impacts are as follows:

1. Production of odor, noise, and altered visual aesthetics of the WWTP facilities;
2. Contamination of land or surface water from spills, or uncontrolled discharge of untreated and treated wastewater, arising from pipeline or equipment failure;
3. Increased incidence of vector carried disease arising from the treatment ponds; and
4. Risk of public injury from exposure to the treatment pond operations.

The detailed design phase of the Kampot WWTP will address these issues including siting and O&M. The composite impact mitigation for the new WWTP and pipeline consists of:

a) Sustained, safe collection and transport wastewater to the WWTP;
b) Consistent treatment of wastewater to effluent quality design specifications;
c) Ability of Teuk Chhou river to assimilate the treated effluent year-round;
d) Safe sludge disposal; and
e) Ability of wastewater system not to impinge on the aesthetics of the area.

128. Additional mitigations for the potential impacts of the operation of Kampot WWTP and pipeline are provided below. All mitigation measures are detailed in the EMP.

a) A maintained fenced, treed perimeter berm built around entire WWTP property to isolate facility from the area, reduce noise and odor, and prevent negative aesthetics;
b) Enforced well marked speed limits will be posted on roads used by staff working at the WWTPs, and vehicles kept in good working order;
c) Designs ensure treatment lagoons do not contaminate groundwater and land, monitored by regular groundwater testing;
d) A regular effluent and sludge quality testing protocol;
e) All equipment and processes are kept maintained in good working order with back-up equipment and processes in place in critical areas;

f) Engineering and management systems are in place to prevent and address emergency spill and discharge situations; and
g) All staff are properly trained with regular refresher courses;

Urban drainage

129. Sufficient annual O&M budget must be provided to ensure all upgraded drains are kept clear, and in good working condition.

C. Induced and Cumulative Impacts

130. A potential induced spatial and temporal cumulative impact of the targeted increase in socioeconomic development of the subprojects in Kampot and Sihanoukville is an increase in consumption of natural resources, and production of pollution. Sihanoukville may be more sensitive than Kampot due to the comparatively large tourist industry and density that current exists in Sihanoukville that is, and will continue to be focused on the relatively small beach areas of the town.

D. Climate Change

1. Projections

131. Recent reports and summaries, e.g.,[29],[30],[31] of climate change scenarios for Cambodia based on the most recent climate change projections of the different Global Circulation Models (GCM) and Regional Climate Models (RCM) indicate that by 2060 average annual air temperature in the country may increase between 0.7 - 2.7C°, and total rainfall may increase between -11 and +31% during the rainy season but decrease between -11 and + 35% during dry season. By 2050 mean sea level is project to increase 0.5 m.

2. Climate Risk and Vulnerability

132. The vulnerability of the subprojects to climate change was assessed using a climate risk flowchart of increasing sensitivity analysis that was prepared for ADB infrastructure investments[32]. The initial rapid environmental assessment checklist (REA) of the subprojects (Appendix A) indicated that the sensitivity to climate change is variable between the subprojects. However, the climate risk screened at *Medium* (Appendix A) for the new WWTP in Kampot that subproject component is considered most sensitive to climate change due to the proximity of the facility at the coast, and at elevations close to sea level.

133. While all both subproject areas will experience increased rainy season rainfall and flooding, the Kampot WWTP will also be exposed to sea level rise, and likely most significantly increased typhoon storm surge up the tidal Teuk Chhou river in Kampot.

134. Following initial REA screening checklist the next more detailed screening of the climate risk flowchart was application of the factors of the AWARE climate sensitivity software. Once

[29] UNEP, 2010. Assessment of Capacity Gaps and Needs of Southeast Asian Countries Addressing Impacts, Vulnerabilities, and Adaption to Climate Variability and Climate Change, 215 pgs + references
[30] World Bank, GFDDR, 2011. Vulnerability, Risk Reduction, and Adaptation to Climate Change: Cambodia, 15 pgs.
[31] PenhPal, 2013. Climate Change Impact in Cambodia: Sea Level
[32] ADB (2014) Climate Proofing ADB Investment in the Transport Sector: Initial Experience, 88 pgs + Appendices

again the single climate-related factor on which the coastal WWTP in Kampot was judged to be sea level rise and potential typhoon storm surge.

135. The next step in the climate risk flowchart is application of the more in depth CVRA to obtain an understanding of the potential socioeconomic, stakeholder, and financial implications the risk of the new coastal WWTP. The CVRA represents a stand-alone detailed study that requires biophysical, financial, and stakeholder assessments in addition to the IEE.

3. Mitigation and Adaptation

136. The measures to protect the new WWTP in Kampot from climate change-induced increased flood events from by sea level rise and storm surge and/or overland flooding are in the design of the facility. As indicated by REA (Appendix A), the facility grading, use of berms and bunds, and placement of emergency pumping equipment at each site will result in the WWTP being resilient to climate change-induced increases in overland and ocean flooding. The alignments and foundations for the raw WW and treated effluent pipelines and outfalls of WWTP must be secure and erosion proof. The costs of the design of the WWTP must reflect the technical requirements to make both facilities resilient to climate change. As part of the capacity development and training program for the new WWTP training and skill development on must include managing wastewater collection and treatment during extreme flood events.

4. Contribution to Global Climate Change

a. Greenhouse gas emissions

i. Overview

137. The single potential major sources of GHGs of the subprojects in Kampot and Sihanoukville are the wastewater treatment (WWT) and solid waste management (SWM) components. The production and emission of GHGs - the most important of which is methane (CH_4) – by wastewater treatment processes and solid waste landfilling depends on the extent of anaerobic digestion processes and the capture of released methane[33],[34]. Methane is the key GHG because it is approximately 40-50 times stronger a greenhouse gas that carbon dioxide (CO_2). A bi-product of anaerobic digestion of wastewater or decomposition of organic matter (garbage) in landfills is methane which is emitted to the atmosphere unless captured and flared or otherwise neutralized.

ii. Feasibility design

WWT

138. Aerobic waste water treatment processes (e.g., the oxygen ditch-type WWT of subprojects in Viet Nam) produce little no methane and thus are more GHG friendly. However, the WWT process planned for the WWTP Kampot will use a combination of anaerobic and aerobic treatment lagoons, and therefore, will produce methane. The extent of methane

[33] Bogner et al. 2007. Waste Management, In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

[34] Doorn and Irving 2006. IPCC Guidelines for Greenhouse Gas Inventories, Wastewater Treatment & Discharge

production will depend on the extent of use of the anaerobic lagoons. At the feasibility design stage a plan to capture the methane produced did not exist so all methane produced will be released to the atmosphere.

139. The current practice in Kampot of discharging untreated wastewater into ditches and canals results in aerobic decomposition of the wastewater, thus at the feasibility stage the net effect of the WWT component in Kampot will be the production and release of methane. However, the detailed designs describing actual flow-through volumes of actual types of wastewater, and operational designs of the treatment lagoons are required before any attempt to quantify methane emissions can occur.

SWM

140. Similar to anaerobic digestion of wastewater, the decomposition of organic solid waste in managed landfills produces methane. The SWM subproject component in Kampot consists of closing an unmanaged dumpsite and replacing it with a new more modern managed landfill that is lined, has a network of covered cells, and a leachate collection system. The new landfill will produce more methane than the unmanaged dumpsite because by design the new solid waste cells will be more anaerobic[35] than the scattered piles of solid waste that comprise the current dumpsite.

141. At the feasibility design stage there is no plan to capture and flare, or otherwise neutralize the methane produced from the new managed landfill. Similarly, at feasibility design there is no plan to capture and flare/neutralize any residual methane that may be produced from the closed dumpsite.

142. The renovation of the existing unmanaged dumpsite in Sihanoukville to a more modern managed landfill will result in the same net production and release of methane. The feasibility design of the renovated landfill does not include active capture and flaring/neutralizing of methane.

143. Factors that will offset methane production from the anaerobic landfill cells in both towns will be increases in recycling, and use of new, larger garbage trucks. The SWM components in both towns include new trucks that will carry larger loads and produce lower GHGs per tonne of garbage transported. However, the SWM components do not include provision of modern Material Recycling Facilities (MRF) so any increase in recycling will be passive.

144. Consideration should be given at detailed engineering design stage of including methane flaring at the new and renovated landfills, and at the new WWTP in Kampot as well as developing more modern on-site MRFs at the landfills to actively promoting recycling. These technical options will act to offset the production of GHGs.

iii. Retroactive estimation of GHGs

145. A defensible, retroactive quantitative assessment of the effect of the SWM components on GHG production is strongly limited by the uncertainties and lack of information on key parameters such as biophysical features of the dumpsite areas, inventory of types and volumes of solid waste, unknown future changes to recycling, and final WWT process in Kampot. The GHG assessment parameters need to be explicit in the design of the PPTA otherwise only qualitative estimations of the impact of the subprojects on GHGs are defensible.

[35] Footnote 24

IGES Simulation Model

146. An example tool for estimating GHG production and emissions from landfills is the simulation model developed by the Institute for Global Environmental Studies (IGES). The model integrates the range of factors influencing GHG production and emissions of SWM activities from the literature into a commercial spreadsheet to allow simulation of the effects of different types of SWM techniques and activities for different combinations of solid wastes on GHG emissions including recycling and garbage truck transport. However, for credible estimations the model requires detailed information on biophysical conditions, accurate solid waste types and volumes, and transportation which were beyond the scope of the PPTA design.

147. Assuming that all activities of SWM at the dumpsite sites remain the same and only an increase in the anaerobic decomposition of solid waste occurred with the installation of the modern waste cells, the SWM IGES model would simulate a general marginal increase in GHG production from the renovated landfills. However, again the simulation is decidedly crude because of the absence of detailed input data for the simulation.

148. Consideration of climate change includes measures to reduce the carbon footprints of the subprojects. Effort needs to be taken to reduce carbon footprints by for example ensuring that posted speed limits along the new landfill access road are enforced, and all new garbage trucks are maintained in good working order. All lighting installed at the all new subproject facilities in both towns will use light bulbs that are energy efficient.

VII. ANALYSIS OF ALTERNATIVES

A. Kampot:

1. Wastewater treatment and collection

149. The first site for the WWTP was closer to the town centre, and too small for the area required for the planned anaerobic treatment lagoons. Moreover, the proximity to the town centre would have increased the risk of the facility becoming a major aesthetic environmental problem due to odour and noise. Management of that risk would have required increased expense with the design of the perimeter of the facility in order to buffer the town and residents from those negative externalities.

150. The second final site is farther from town in a much less dense area. However, the site is lower in elevation and will require infilling to bring the site up to a grade that will make the entire facility resilient to flooding. Both sites would discharge treated effluent at about the same location in the Teuk Chhou river.

2. Solid waste management

151. An alternate site for the new land fill site was not investigated.

B. Sihanoukville

1. Solid waste management

152. The alternative to renovating the existing landfill and improving the solid waste management system of Sihanoukville was to close the existing dumpsite and open a new more modern landfill just north of the existing site in a heavily forested area. That alternative was abandoned because the new landfill site would require clear-cutting of dense forest equal to entire footprint of the area for the new landfill. The loss of forest could not be justified given the vast areas of cleared land that exists between the existing dump site and Sihanoukville. Further, the proposed new landfill site was located farther from town than the existing dumpsite which is more 25km from town, and which retroactively cannot be justified due to the current high costs of garbage transport.

VIII. INFORMATION DISCLOSURE AND GRIEVANCE REDRESS MECHANISM

153. The subproject components were introduced to the public and stakeholders during consultation meetings which included verbal and visual presentations of all subproject components. Pursuant to the ADB Public Communication Policy (2012), the IEE must be easily available to the stakeholders contacted during project preparation, in written and verbal forms, and in local language. At a minimum the Executive Summary of the IEE should be translated to Khmer and distributed to all APs. The IEE should be available on the MOE/DOE and MPWT/DPWT web sites, at their respective offices, district offices, and subproject sites. Similarly, all project reporting with specific reference to stakeholder consultation minutes, environmental monitoring, and reports on EMP implementation released by the EA/PSC/IU should be available at the same offices and web sites. The IEE will also be available on the ADB web site. And after implementation of the subprojects begins, all environmental and EMP reporting submitted by the EA/IU will also be available on the project and ADB web site.

154. A well-defined grievance redress and resolution mechanism will be established to address all affected stakeholders lodge grievances and complaints regarding environment, land acquisition, and compensation and resettlement, in a timely and satisfactory manner. All stakeholders will be made fully aware of their rights, and the detailed procedures for filing grievances and an appeal process will be published through an effective public information campaign. The grievance redress mechanism and appeal procedures will also be explained in a project information booklet (PIB) that will be distributed to all stakeholders.

155. APs are entitled to lodge complaints regarding any perceived issue with the affected environment, or aspect of the land acquisition and resettlement requirements such as entitlements, rates and payment and procedures for resettlement and income restoration programs. APs complaints can be made verbally or in written form. In the case of verbal complaints, the committee on grievance will be responsible to make a written record during the first meeting with the APs.

156. A Grievance Committee that has experience with environmental and social issues will be organized in local communes, comprising local leaders designated for such tasks. The designated commune officials shall exercise all efforts to settle issues at the commune level through appropriate community consultation. All meetings shall be recorded by the Grievance Committee and copies of meeting minutes shall be provided to affected persons. A copy of the

minutes of meetings and actions undertaken shall also be provided to the DPWT, IU, and ADB upon request.

157. The procedures for environmental and social grievance redress are set out below. The procedure described below is consistent with the legal process for resolution of disputes in Cambodia.

i) Stage 1: Complaints from APs for the first time shall be lodged verbally or in written form with the village head or commune leader. The complaints shall be discussed with the APs and the designated Head of Grievance Committee or members of the committee. Because initial environmental issues will most likely be construction-related the Environment Officer/contractor and Safeguards Specialist/IU need to be notified immediately. It will be the responsibility of the Head of Grievance Committee to resolve the issue within 15 days from the date the complaint is received. All meetings shall be recorded and copies of the minutes of meetings will be provided to APs.
ii) Stage 2: If no understanding or amicable solution can be reached or if no response is received from the Grievance Committee within 15 days from filing the complaint, the APs can elevate the case to the District Grievance Committee. The District Grievance Committee is expected to respond within 15 days upon receiving the APs appeal.
iii) Stage 3: If the AP is not satisfied with the decision of the District Office, or in the absence of any response, the APs can appeal to the Provincial Grievance Committee (PGC). The PGC will review and issue a decision on the appeal within 30 days from the day the complaint is received.
iv) Stage 4: If the AP is still not satisfied with the decision of the PGC or in the absence of any response within the stipulated time, the APs, as a last resort may submit his/her case to the provincial court. The court will address the appeal by written decision and submit copies to the respective entities which include the DPWT, DGC/PGC and the APs. If however, the AP is still not satisfied the court's decision, the case may be elevated to the provincial court. If however, the decision of the provincial court is still unsatisfactory to the APs, the APs may bring the complaints to the Higher Court.

158. The PSC will be responsible for checking the procedures and resolutions of grievances and complaints. The sustainability and monitoring coordination unit of the PSC must have expertise and experience in social and environmental issues associated with infrastructure developments. The PSC may recommend further measures to be taken to redress unresolved grievances. The environmental specialists of the PIC will provide the necessary training to improve grievance procedures and strategy for the grievance committee members when required.

159. The executing agency will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints if the APs win their case. Other costs incurred by legitimate complaints will also be refunded by the project if the APs win their case.

160. In cases where APs do not have the writing skills or are unable to express their grievances verbally, APs are encouraged to seek assistance from the recognized local groups, NGOs, other family members, village heads, or community chiefs to have their grievances recorded in writing and to have access other documentation, and to any survey or valuation of assets, to ensure that where disputes do occur, all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned APs are provided with copies of complaints and decisions or resolutions reached.

161. If efforts to resolve disputes using the grievance procedures remain unresolved or are unsatisfactory, APs have the right to directly discuss their concerns or problems with ADB's Southeast Asia Department through the ADB Cambodia Resident Mission (CARM). If APs are still not satisfied with the responses of CARM and the Southeast Asia Department, they can directly contact the ADB Office of the Special Project Facilitator (OSPF).

IX. CONCLUSIONS AND RECOMMENDATION

162. The examination of the subprojects in Kampot and Sihanoukville indicates that the potential environmental impacts are largely restricted to the construction phase of the subproject components. The civil construction disturbances such dust, noise, traffic disruptions, erosion and sedimentation, and public and worker safety can be managed effectively with standard construction practices (e.g., IFC/World Bank 2007).

163. The description of the feasibility designs of the two subprojects combined with available information on the affected environment is sufficient to identify the scope of potential environmental impacts of the project. Providing that significant changes do not occur to the design of one or more of the subproject components, and that new sensitive environmental or social receptor data is not discovered, a further detailed environmental impact assessment (EIA) of the project is not required.

164. The separate EMPs developed for the subprojects provide impact mitigation plans, environmental monitoring plans, and specify the institutional responsibilities and capacity needs for the environmental management of the subprojects. The EMPs will need to be reviewed and updated at the detailed design phase to ensure that they fully address the potential impacts of the final subproject designs.

APPENDIX A: RAPID ENVIRONMENTAL ASSESSMENTS OF SUBPROJECTS

Kampot

Rapid Environmental Assessment (REA) Checklist: SEWAGE TREATMENT

Country/Project Title:	Second Corridor Towns Development Project, PPTA 8425 VIE **Kampot**
Sector Division:	Wastewater Collection and Treatment / Urban Development / SERD

Screening Questions	Yes	No	Remarks
B. Project Siting Is the project area in.			
▪ Densely populated?		X	
▪ Heavy with development activities?		X	
▪ Adjacent to or within environmentally sensitive areas?			
• Cultural heritage site		X	
• Protected Area		X	
• Wetland	X		Site of WWTP is a lowland area beside Teuk Chhou river. Mitigation measures including compensatory (or offset) measures will be included in the EMP and C/EMP to achieve no net loss of biodiversity will be applied.
• Mangrove		X	
• Estuarine	X		At low flow periods Teuk Chhou river adjacent to WWTP site is brackish. Teuk Chhou estuary approx.4-5 km downstream. Mitigation measures including compensatory (or offset) measures will be included in the EMP and C/EMP to achieve no net loss of biodiversity will be applied.
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay	X		Teuk Chhou river empties Kampot bay 5 kms downstream. Mitigation measures including compensatory (or offset) measures will be included in the EMP and C/EMP to achieve no net loss of biodiversity will be applied.

Screening Questions	Yes	No	Remarks
A. Potential Environmental Impacts Will the Project cause…			
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		X	
▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?		X	
▪ dislocation or involuntary resettlement of people?		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?	X		The quality of treated effluent must meet support water quality for sensitive aquatic habitat and marine species resources such as marine mammals seagrass and mangroves located at the mouth of Teuk Chhou river at Kampot bay
▪ overflows and flooding of neighboring properties with raw sewage?		X	
▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?	X		Unclear how sludge from lagoon-WWTP will be disposed. Expectedly into a MOE-approved sludge disposal area
▪ noise and vibration due to blasting and other civil works?	X		The EMP for project prescribes mitigation measures for construction noise. Blasting is not required.
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?		X	
▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		X	
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?	X		New WWTP site will include a treed buffer perimeter
▪ road blocking and temporary flooding due to land excavation during the rainy season?		X	
▪ noise and dust from construction activities?	X		As above the EMP for project prescribes mitigation sub-plans short-term noise, and dust disturbances
▪ traffic disturbances due to construction material transport and wastes?	X		The EMP for project prescribes mitigation measures for short-term construction-caused traffic problems

Screening Questions	Yes	No	Remarks
▪ temporary silt runoff due to construction?	X		The EMP for project prescribes mitigation measures to prevent or contain land erosion and sedimentation of Teuk Chhou river during construction phase
▪ hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		X	
▪ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		X	A MOE-approved site for sludge disposal will be selected where necessary
▪ contamination of surface and ground waters due to sludge disposal on land?		X	A MOE-approved site for sludge disposal will be selected when required
▪ health and safety hazards to workers from toxic gases and hazardous materials which may be contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and un-stabilized sludge?		X	
▪ large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		X	
▪ social conflicts between construction workers from other areas and community workers?	X		Migrant worker population is expected to be small, however, the EMP for project prescribes mitigation sub-plans for these social local issues.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: GMS Second Corridor Towns Development Project PPTA 8474 REG

Sector: Urban Development

Subsector: Wastewater Collection and Treatment

Division/Department: Urban development / SERD

Screening Questions		Score	Remarks
Location and	Is siting and/or routing of the project	1	The site for WWTP is at sea level near the coast at

Screening Questions		Score	Remarks
Design of project	(or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?		Kampot bay. The WWTP will require facility foundations, to be set at elevations resilient to increased flooding and sea level from climate change
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	1	As above, incoming pipelines up pump stations will require foundation elevations resilient to climate change-induced sea level rise, and increased rainfall/flooding events.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Result of Initial Screening (Low, Medium, High): Medium **Other Comments**: n/a

Rapid Environmental Assessment (REA) Checklist **SOLID WASTE**

Country/Project Title: Second Corridor Towns Development Project, PPTA 8425 VIE **Kampot**

Sector Division: Solid Waste Management / Urban Development / SERD

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area			
▪ Densely populated?		X	

Screening Questions	Yes	No	Remarks
▪ Heavy with development activities?		X	
▪ Adjacent to, or within any environmentally sensitive areas?			
• Cultural heritage site		X	
• Protected Area		X	
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay		X	
B. Potential Environmental Impacts Will the Project cause…			
▪ impacts associated with transport of wastes to the disposal site or treatment facility		X	
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		X	
▪ degradation of aesthetic and property value loss?		X	
▪ nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.?		X	Nearest settlement a few km away
▪ dislocation or involuntary resettlement of people?		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ risks and vulnerabilities related occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?		X	
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?		X	New landfill site between two hills away from settlements
▪ deterioration of water quality as a result of contamination of receiving waters by leacheate from land disposal system?		X	No surface water in site. However, leachate ponds will be constructed
▪ contamination of ground and/or surface water by leach ate from land disposal system?	X		New landfill will be lined with clay and include leachate collection and storage system which should protect qroundwater quality. A groundwater quality study in area is required
▪ land use conflicts?		X	

Screening Questions	Yes	No	Remarks
▪ pollution of surface and ground water from leachate coming form sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?	X		Site selection criteria included no surface water on or draining site. Upgraded landfill will be lined with clay and include leachate collection and storage system which should protect qroundwater quality. Methane gas produced by landfill will dissipate uncollected.
▪ inadequate buffer zone around landfill site to alleviate nuisances?		X	
▪ road blocking and/or increased traffic during construction of facilities?		X	
▪ noise and dust from construction activities?	X		The EMP prescribes mitigation measures for controlling noise and dust during construction at site and along access road
▪ temporary silt runoff due to construction?		X	
▪ hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?		X	
▪ emission of potentially toxic volatile organics from land disposal site?		X	Domestic waste is targeted waste for landfill
▪ surface and ground water pollution from leach ate and methane gas migration?		X	Clay liner and leachate collection system should prevent contamination of groundwater by leachate. Methane gas will dissipate freely
▪ loss of deep-rooted vegetation (e.g. tress) from landfill gas?		X	
▪ explosion of toxic response from accumulated landfill gas in buildings?		X	
▪ contamination of air quality from incineration?		X	
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?	X		Landfill located away from settlements
▪ health and safety hazards to workers from toxic gases and hazardous materials in the site?		X	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	Local worker force is expected
▪ social conflicts if workers from other regions or countries are hired?		X	Local worker force is expected
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	

Screening Questions	Yes	No	Remarks
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components (e.g., landfill or incinerator) of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: GMS Second Corridor Towns Development Project PPTA 8474 REG

Sector: Urban Development

Subsector: Solid Waste Management

Division/Department: Urban Development / SERD

Screening Questions		Score	Remarks
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	New landfill site is adequately sloped, and located at an elevation that is not susceptible to flooding
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Result of Initial Screening (Low, Medium, High): Low

Other Comments: A groundwater study to determine water table depth and groundwater quality will need to be conducted at detailed design phase. Existing dumpsite will need to be closed with internationally acceptable methods

Rapid Environmental Assessment (REA) Checklist **URBAN DEVELOPMENT**

Country/Project Title: Second Corridor Towns Development Project, PPTA 8425 VIE – **Kampot**

Sector Division: Drainage / Urban Development / SERD

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area			
▪ Densely populated?		X	
▪ Heavy with development activities?		X	
▪ Adjacent to or within any environmentally sensitive areas?		X	
• Cultural heritage site	X		Drainage upgrades will enhance heritage area intown
• Protected Area		X	
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay		X	
B. Potential Environmental Impacts Will the Project cause…			
▪ impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		X	
▪ deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity, and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		X	
▪ degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	

Screening Questions	Yes	No	Remarks
▪ dislocation or involuntary resettlement of people?		X	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable group?		X	
▪ degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	
▪ occupation of low-lying lands, floodplains and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to pollutive industries?		X	
▪ water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality , and pollution of receiving waters?		X	
▪ air pollution due to urban emissions?		X	
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical and biological hazards during project construction and operation?		X	
▪ road blocking and temporary flooding due to land excavation during rainy season?		X	
▪ noise and dust from construction activities?	X		The EMP for subproject prescribes mitigation measures for noise and dust during construction.
▪ traffic disturbances due to construction material transport and wastes?	X		The EMP for subproject prescribes mitigation measures for increased traffic and risk of traffic accidents during construction.
▪ temporary silt runoff due to construction?		X	
▪ hazards to public health due to ambient, household and occupational pollution, thermal inversion, and smog formation?		X	
▪ water depletion and/or degradation?		X	
▪ overpaying of ground water, leading to land subsidence, lowered ground water table, and salinization?		X	
▪ contamination of surface and ground waters due to improper waste disposal?		X	
▪ pollution of receiving waters resulting in amenity losses, fisheries and marine resource depletion, and health problems?		X	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	

Screening Questions	Yes	No	Remarks
▪ social conflicts if workers from other regions or countries are hired?		X	
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		X	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: GMS Second Corridor Towns Development Project PPTA 8474 REG

Sector: Urban Development

Subsector: Drainage

Division/Department: Urban Development / SERD

Screening Questions		Score	Remarks
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Result of Initial Screening (Low, Medium, High): Low, **Other Comments**: n/a

Sihanoukville

Rapid Environmental Assessment (REA) Checklist **SOLID WASTE**

Country/Project Title: Second Corridor Towns Development Project, PPTA 8425 VIE – **Sihanoukville**

Sector Division: Solid Waste Management & Drainage / Urban Development /

Screening Questions	Yes	No	Remarks
A. PROJECT SITING IS THE PROJECT AREA			
▪ DENSELY POPULATED?		X	
▪ HEAVY WITH DEVELOPMENT ACTIVITIES?		X	
▪ ADJACENT TO, OR WITHIN ANY ENVIRONMENTALLY SENSITIVE AREAS?			
• CULTURAL HERITAGE SITE		X	
• PROTECTED AREA		X	
• WETLAND		X	
• MANGROVE		X	
• ESTUARINE		X	
• BUFFER ZONE OF PROTECTED AREA		X	
• SPECIAL AREA FOR PROTECTING BIODIVERSITY		X	
• BAY		X	
B. POTENTIAL ENVIRONMENTAL IMPACTS WILL THE PROJECT CAUSE…			
▪ impacts associated with transport of wastes to the disposal site or treatment facility		X	
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		X	
▪ degradation of aesthetic and property value loss?		X	
▪ nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.?		X	Nearest village a few km away
▪ dislocation or involuntary resettlement of people?		X	

Screening Questions	Yes	No	Remarks
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	
▪ risks and vulnerabilities related occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?		X	
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?		X	Renovated landfill site located far from Sihanoukville. Only a few households are nearby.
▪ deterioration of water quality as a result of contamination of receiving waters by leachate from land disposal system?	X		Surface waters below landfill site will be protected from contamination with renovated leachate collection and storage facility design
▪ contamination of ground and/or surface water by leach ate from land disposal system?	X		Renovated landfill will be lined with clay and will include leachate collection and storage system which should protect qroundwater quality. A groundwater quality study in area is required
▪ land use conflicts?		X	
▪ pollution of surface and ground water from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?	X		Renovated landfill will be lined with clay and include leachate collection and storage system which should protect qroundwater quality, and the stream that drain the site. Methane gas produced by landfill will dissipate uncollected. However, a study of groundwater in the area will be needed at detailed design phase
▪ inadequate buffer zone around landfill site to alleviate nuisances?		X	
▪ road blocking and/or increased traffic durlng construction of facilities?		X	
▪ noise and dust from construction activities?	X		The EMP prescribes mitigation measures for controlling noise and dust during construction at site and along access road
▪ temporary silt runoff due to construction?		X	The EMP prescribes mitigation measures to contain soil erosion, and to prevent sedimentation of stream, and other surface waters.
▪ hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?		X	

Screening Questions	Yes	No	Remarks
▪ emission of potentially toxic volatile organics from land disposal site?		X	Domestic waste is targeted waste for landfill
▪ surface and ground water pollution from leach ate and methane gas migration?		X	Renovated clay liner and leachate collection system should prevent contamination of groundwater by leachate. Methane gas will dissipate freely. A study of groundwater in the area will be needed at detailed design phase
▪ loss of deep-rooted vegetation (e.g. tress) from landfill gas?		X	
▪ explosion of toxic response from accumulated landfill gas in buildings?		X	
▪ contamination of air quality from incineration?		X	
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?	X		Renovated landfill located away from major settlements
▪ health and safety hazards to workers from toxic gases and hazardous materials in the site?		X	
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	Local worker force is expected
▪ social conflicts if workers from other regions or countries are hired?		X	Local worker force is expected
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		X	
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components (e.g., landfill or incinerator) of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: GMS Second Corridor Towns Development Project PPTA 8474 REG

Sector: Urban Development

Subsector: Solid Waste Management & Drainage

Division/Department: Urban Development / SERD

Screening Questions		Score	Remarks
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	New landfill site is adequately sloped, and located at an

			elevation that is not susceptible to flooding
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	0	
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Result of Initial Screening (Low, Medium, High): Low

Other Comments: A groundwater study to determine water table depth and groundwater quality will need to be conducted at detailed design phase. Existing dumpsite will need to be closed with internationally acceptable methods.

APPENDIX B: PARTICIPANTS OF PUBLIC CONSULTATIONS

Kampot

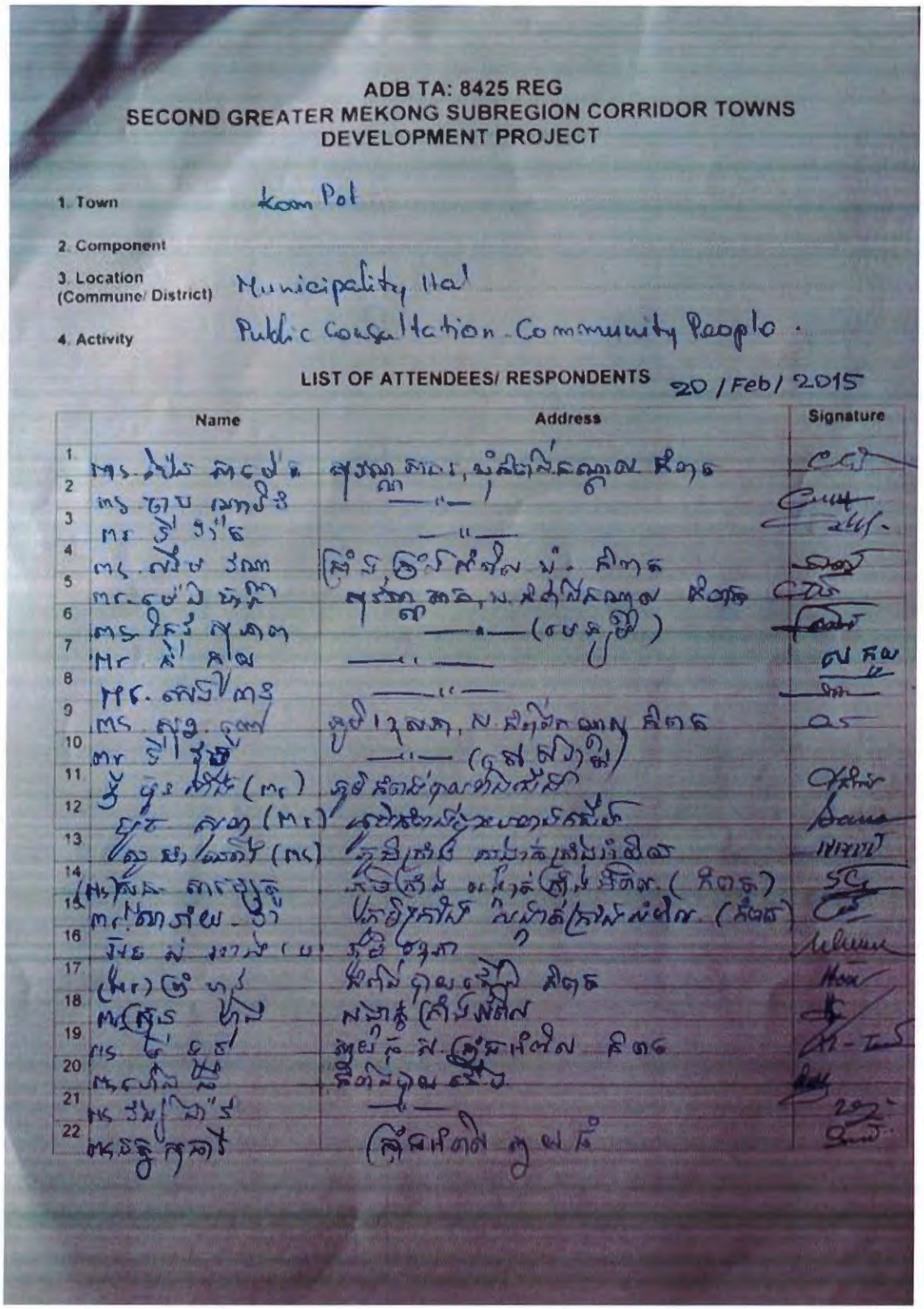
	
Subproject introduced by engineer	**Ideas and discussion of participants**

Example Environmental and Social Public Consultation Response Form

Province: Kampot	City/District: Kampot town	Commune: kampot town
Date: 20/Feb/15	Time: 2:00 – 4:30 pm	Attendance (no.): 40 (10 females)
Statements and Inquiries Provided by Attendees:		
No.1 Name: Mr. A Ly	Sex: Female Age: 60	Occupation: villager
Statement or Inquiry: My children usually get the skin disease whenever rain that it floods from sewage system, thus is project can improve this system I and my villagers will support 100%. But, I suggest to avoid construct in rainy season. I worry rain can disturb working.		
No.2 Name: Ms. Mi Toch	Sex: Female Age: 63	Occupation: Villagers
Statement or Inquiry: I worry leakage oil and dust from construct ion to affect children and family. So, please take care about oil and dust; please spray water on place that project construction. Also, some projects did not build the enough toilet for workers, they went to deficit in place next to local people's house; thus I hope this project will have enough toilet for them. Standard of construction has to apply in this project.		
No.3 Name: Mr. Ouch Sam Arng	Sex: Male Age: 65	Occupation: Villagers
Statement or Inquiry: I support these 4 subprojects, but I would like to suggest as: - All affection has to give the compensation; - Subcontractor has to spray water on used road regularly to avoid dust; - Solid waste generated from project has to collect to dispose every day; - In the operation phase, landfill has to management properly as technical, thus monitoring from provincial level has to be done to avoid company does freely. During transport waste, company has not to let the waste spill out on the road.		

- All waste collection tracks have to be clean regularly.		
No.4 Name: Mr. Pock Chea	Sex: Male Age: 40	Occupation: villager
Statement or Inquiry: For landfill location, it should be far from village and residential spots. We worry about some insects as fly and other to disturb our villagers. Fence has to be built surrounding the landfill to avoid cow and dog.		
No.4 Name: Mr. Seng Hean	Sex: Male Age: 63	Occupation: villager
Statement or Inquiry: I worry traffic congestion during construction the drainage, sewage and landfill. Also, entrance road in front of my house may be blocked during construction, thus I suggest to work as step. It means that finish by block with 10 or 20 meters for a step by keeping small road for owner of house.		
No.4 Name: Mr. Meng Huo	Sex: Female Age: 35	Occupation: villager
Statement or Inquiry: It is good that we have the project for conserve our old house, built in France Colony; however, project has to discuss with house owner. If they have enough money, they don't need this project, they will do it by themself. All work on the road should plan to finish daily to avoid disturbing us long time. I also suggest as the following: - For sewage and drainage system, it should have the responsible team to resolve all matters during operation; if the project doesn't establish this team, we will have the problem again. - This team has to control and prepare the penalty for villager or who destroy the system. - In construction phase, please select my villagers to be workers.		

Participants List for Public Consultation in Kampot



ADB TA: 8425 REG
SECOND GREATER MEKONG SUBREGION CORRIDOR TOWNS DEVELOPMENT PROJECT

1. Town: Kam Pot
2. Component:
3. Location (Commune/ District): Municipality Hall
4. Activity: Public Consultation - Community People

LIST OF ATTENDEES/ RESPONDENTS 20 / Feb / 2015

	Name	Address	Signature
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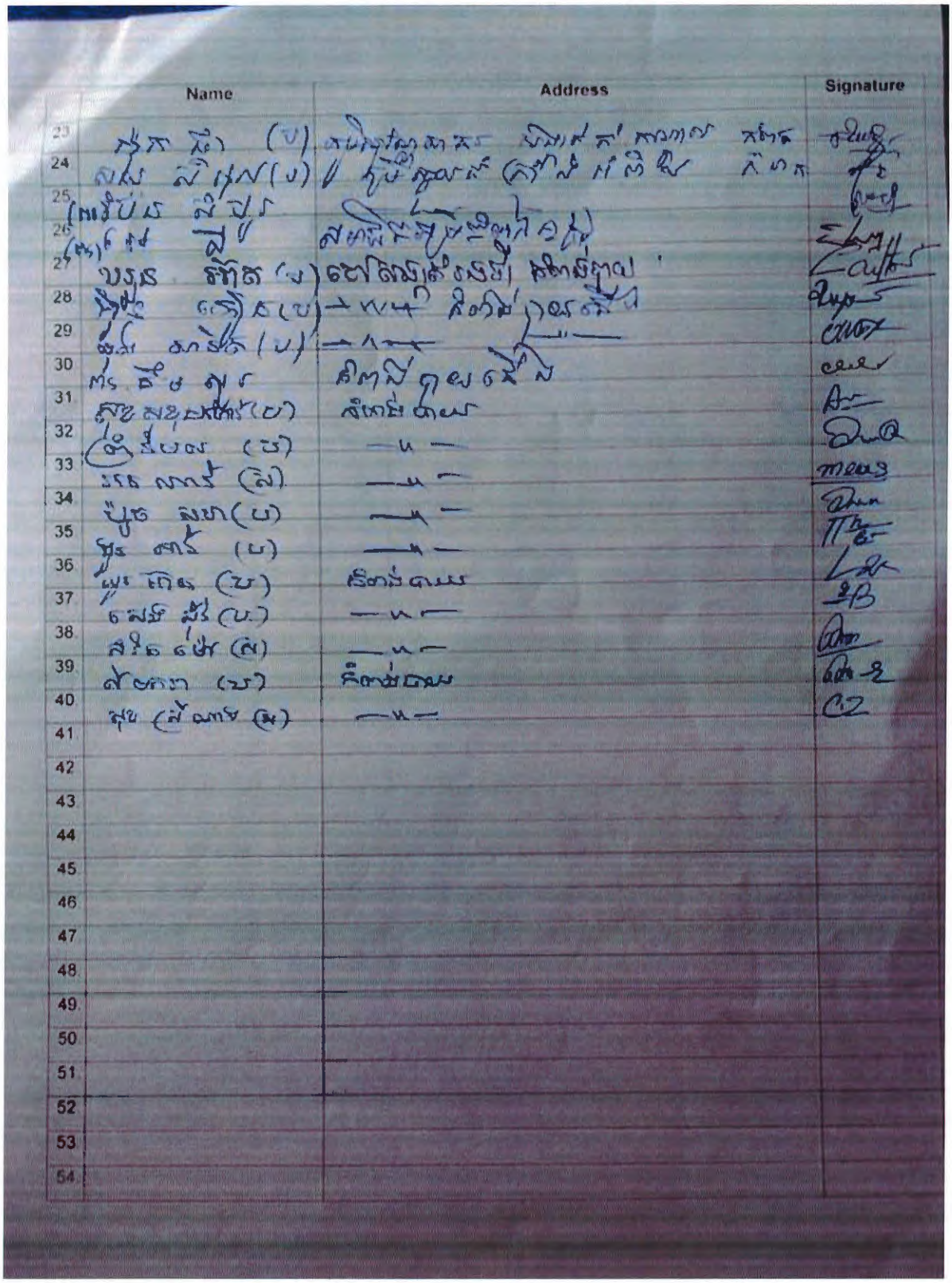

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Sihanoukville

Introduction of subproject by engineer

Ideas and discussion raised by participants

Example Environmental and Social Public Consultation Response Form

Province: Sihanouk ville	City/District: Sihanoukville City	Commune: Sihanoukville City
Date: 17/Feb/15	Time: 2:30 – 4:30 pm	Attendance (no.): 40 (10 females)
Statements and Inquiries Provided by Attendees:		
No.1 Name: Mr. Loy Chey	Sex: male Age: 67	Occupation: villager
Statement or Inquiry: my village always faced with the flood during raining, because there is no good drainage system. I suggest constructing in dry season to avoid any pollution to my living village and soil quality there.		
No.2 Name: Mr. Puon Than	Sex: Female Age: 56	Occupation: Villagers

Statement or Inquiry: I worry about remained soil after excavated. Moreover, if the project affect to my property, project has to give the compensation. All compensation has to be done before project implemented.		
No.3 Name: Mr. Nong Sopheap	Sex: Male Age: 33	Occupation: Villagers
Statement or Inquiry: For drainage system and sewage system construction along the road, constructor should have the symbol sign to avoid accident at night because it is along the road and some locations have no lamp at night.		
No.4 Name: Ms. Chan Vicheka	Sex: Male Age: 40	Occupation: villager
Statement or Inquiry: When excavate along the road side, it may break to existing clean water pipe line that it will affect to our community.		
No.4 Name: Mr. Towng Putheavy	Sex: Female Age: 39	Occupation: villager
Statement or Inquiry: All roads used by project have to pray water regularly to avoid air pollution by dust.		
No.4 Name: Ms. Suon Sina	Sex: Female Age: 33	Occupation: villager
Statement or Inquiry: All affected property need to give the compensation as the original price. - Tree and structures along the proposed area of project need to give compensation if they will be affected by the project. - Please inform us before implementing the project, because we are easy to prepare for this affection.		
No.4 Name: Mr. Tim Seng	Sex: Male Age: 78	Occupation: villager
Statement or Inquiry: After landfill were improved, provincial authority has to look for suitable place for waste collector to collect waste transport from source.		
No.4 Name: Mr. Prom Buoy	Sex: Male Age: 57	Occupation: villager
Statement or Inquiry: Landfill should have fence to avoid cow and dog to eat garbage.		
No.4 Name: Ms. Kem Srey Neng	Sex: Female Age: 21	Occupation: represent from Golden Sea hotel
Statement or Inquiry: During construction, please take care about quality and clean. When cut the path road in front of hotel has to keep a side of entrance road for my customer. The level of waste water system has to consider about level of land condition to avoid pumping that it waste much money. - If we don't have these system our beach will be pollute very soon in near future. - However, we need project to practice the safeguard for social and environment during construction.		
No.4 Name: Mr. Prom Buoy	Sex: Male Age: 57	Occupation: villager
Statement or Inquiry: Landfill should have fence to avoid cow and dog to eat garbage or other waste.		

Participants List for Public Consultation in Sihanoukville

ព្រះរាជាណាចក្រកម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងមហាផ្ទៃ

សាលាខេត្តព្រះសីហនុ

បញ្ជីវត្តមាន

កិច្ចប្រជុំពិគ្រោះយោបល់ជាមួយប្រជាពលរដ្ឋក្នុងក្រុងព្រះសីហនុ ស្តីពីផលប៉ះពាល់សារៈប្រយោជន៍នៃបរិស្ថាន និងសេដ្ឋកិច្ចសង្គម

ថ្ងៃទី ១៧ ខែ កុម្ភៈ ឆ្នាំ២០១៨ សាលាក្រុងព្រះសីហនុ

ល.រ No.	នាម និង គោត្តនាម Full Name	ភេទ Sex	មុខតំណែង/បន្ទុក-អង្គភាព Position and Agencies	លេខទូរស័ព្ទ Contact Number	ហត្ថលេខា Signatures
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ល.រ No.	ឈ្មោះ ទីប ភេទប្រជា Full Name	ភេទ Sex	មុខតំណែង/មន្ទីរ-អង្គភាព Position and Agencies	លេខទូរស័ព្ទ Contact Number	ហត្ថលេខា Signatures
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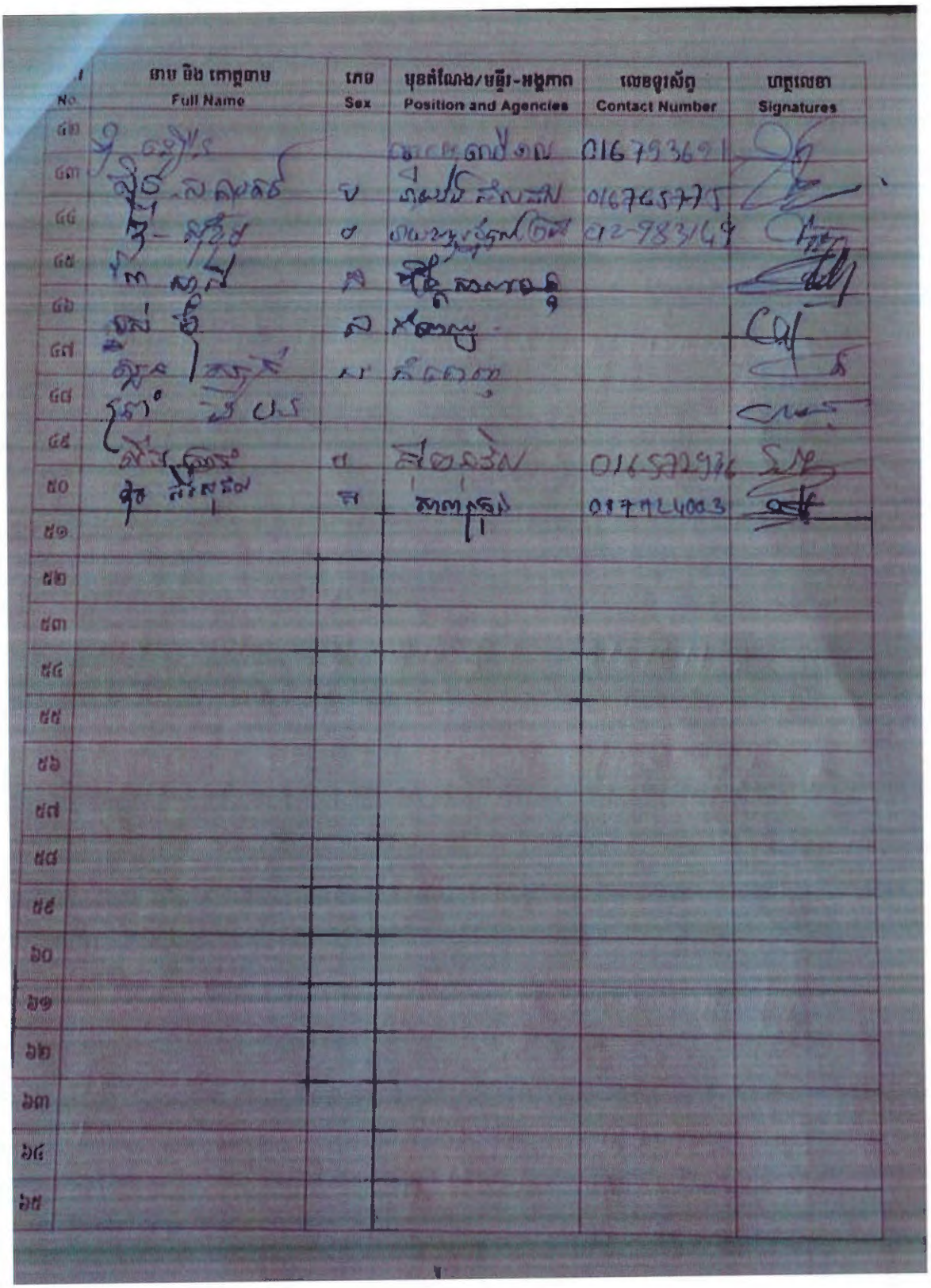

No	Full Name	Sex	Position and Agencies	Contact Number	Signatures
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APPENDIX C: DRAFT TOR FOR GROUNDWATER STUDY

GMS Second Corridor Towns Development Project
GMS PPTA 8425 REG

Groundwater Sampling and Analysis in Kampot and Sihanoukville, Cambodia

Terms of Reference

DRAFT

April, 2015

Introduction & Rationale

165. The Asian Development Bank (ADB) is supporting small infrastructure developments the towns of Kampot and Sihanoukville Cambodia with the objective to improve both urban environments and stimulate socioeconomic development. The project will construct a new landfill site and a new WWTP and collection system in Kampot (KPT). In Sihanoukville (SNL) a new WWTP will be constructed with improvements to an existing landfill site. The new and renovated landfills, and new WWTPs require information on local groundwater as well as the proximity of active domestic wells near the landfills and WWTP sites.

166. These draft ToRs were prepared to provide the basis for a Request for Quote (RFQ) for a groundwater study in Kampot and Sihanoukville as part of the ADB PPTA. The quote should include costs for all field and laboratory analyses, and costs for travel to/from Phnom Penh.

Objectives

167. The objective of the assignment is to determine the depth and quality of groundwater in the area of the sites of the new and renovated landfills, and new WWTPs in KPT and SNL.
The scope of the assignment includes:

1) Identification of existing active domestic wells near new WWTP sites, and at new and existing landfill sites;

2) Bore hole drilling at the WWTP and landfill sites to supplement existing active wells; and

3) Sampling and laboratory analyses of groundwater quality from domestic wells and from new bore hole sites;

4) Report preparation

1. Coordination with National Engineer

168. The assignment will be coordinated with the national engineers of the ADB project who is overseeing the siting and development of the WWTPs and landfill sites. The locations of all groundwater sampling locations will be determined in consultation with the engineers.

Detailed Requirements

The requirements of the assignment are as follows:

2. Landfill Sites

New (1) and Existing (2) Landfill Sites in KPT and SNL

1) Confirm the location of existing active domestic wells that are near the three sites. There appears to be a well at the existing landfill site in SNL.

2) Identify the number of supplementary bore holes that need to be drilled to provide a total of 4 equidistant sampling sites on an approximate 500-800 m radius around each site. Two of the sampling sites must be down-slope of the site. The sites chosen must also be useful for future groundwater monitoring;

3) Collect and preserve the groundwater samples from the 4 sites using accepted International procedures (e.g., AWWA)[36] to maintain the in situ quality of the samples while they are transported to laboratory in Phnom Penh.

4) Analyze samples in laboratory using accepted International procedures (e.g., AWWA).

New WWTPs (2) in KPT and SNL

1) Confirm the location of existing active domestic wells that are near the new WWTP site adjacent to Teuk Chhu river in KPT, and at northwest site at SNL.

2) Clarify whether 1-2 bore holes are needed to supplement the absence of domestic wells in the immediate area. Bore holes should be located over the location of the anaerobic lagoons. The sites chosen must also be useful for future groundwater monitoring;

3) Collect and preserve the groundwater samples from the 2 sites using accepted International procedures (e.g., AWWA) to maintain the in situ quality of the samples while they are transported to laboratory in Phnom Penh.

4) Analyze samples in laboratory using accepted International procedures (e.g., AWWA).

3. Groundwater variables to be sampled and analyzed at each site

169. The groundwater parameters that need to be sampled and analyzed at all sites are listed in Table 7.

[36] American Water Works Association AWWA, 2013). Standard Methods for Examination of Water and Wastewater: Water Wells.

Table 8. Groundwater variables to be determined at landfill and WWTP sites.

Groundwater Variable	Location of Analysis
depth of water table	at well site
temperature (C^{o})	at well site with meter
dissolved oxygen DO (mg/l)	at well site with meter
pH	at well site with meter
conductivity	at well site with meter
chemical oxygen demand COD (mg/l)	in laboratory
total dissolved solids DS (mg/l)	in laboratory
heavy metals: As, Cd, Fe, Pb, Zn, Cu (mg/l))	in laboratory
oil and grease (mg/l)	in laboratory
total and faecal coliform bacteria (mpn)	in laboratory
nitrogen: TN, NH_3, NO_3, NO_2 (mg/l)	in laboratory
phosphorus: TP, PO_4 (mg/l)	in laboratory
hydrogen sulphide H_2S, (mg/l)	in laboratory
surfactants (detergents) (mg/l)	in laboratory
Quality Control & Assurance Samples	
2 field sampling blanks with distilled water: 1 for existing landfill and 1 for new SLF 2 laboratory analysis blanks: 1 for samples from existing landfill, and 1 for new SLF samples	

4. Reporting

170. A report on the above field and laboratory investigations must be prepared.

a. Location of sampling sites

171. The report must provide simple maps indicating the location of the groundwater sampling sites in relation to the WWTP sites and landfill sites. Each sampling site must include a latitude and longitude coordinate. The maps should also indicate the location of the nearest houses or settlements. The sampling locations and data summary must distinguish the bore hole sites from existing domestic well sites.

b. Groundwater quality

172. In a table format the report must provide the groundwater quality variables from Table 7 that were determine in the field, and in the laboratory for both sites. The tables should also include the QA/QC samples for all variables from Table 7.

c. Sampling & Analysis Methodology

173. The report must include a brief description of all field and laboratory methods that were used to sample and analyze the groundwater samples.

APPENDIX D: INDICATIVE LANDFILL CLOSURE PROCEDURE

GMS Second Corridor Towns Development Project
GMS PPTA 8425 REG

Indicative Landfill Closure Procedure
in
Kampot, Cambodia

DRAFT

April 2015

Current Situation:

The existing landfill in Kampot is an unmanaged dumpsite of simplest design. It does not have segregated cells, or a liner, or a leachate collection system. The operation of the landfill appears unplanned and not well organised.

The following indicative criteria were adopted for the subproject for the decommissioning and closure of the existing landfill in Kampot:

a. Consolidate the waste field into a smaller area;
b. completely cover the consolidated field;
c. prevent rain water and surface water from penetrate into consolidated field; and
d. provide a solution for oxidation or removal of methane (CH_4) from the site.

Elements of the indicative closure procedure presented here are applicable to the renovation of the existing landfill in Sihanoukville.

Indicative Closure Procedure:

Based on a preliminary assessment the following indicative closure procedure has been identified:

1. Garbage pickers and sorters notified of closure and location of new landfill to the north of existing site.

2. A high perimeter fence and guarded gate installed around existing landfill site with signs indicating landfill closed.

3. Level & shape landfill made convex with a minimum slope of 2% letting rain water flow to the

adjacent perimeter.

4. Ensure open cut-off ditches capture & discharge rain water to outside the site area.
5. Lay down 40 cm of impermeable clay excavated from DOE-authorized areas at or near the site.
6. Add a 10 cm layer of sandy material excavated from DOE-authorized areas at or near the site that provides drainage for rainwater to the sides that distributes gas emanating from solid waste below.
7. Lay down a 20 cm top layer of soil suitable for grass re-vegetation, and for supporting bacteria oxidization of methane gas (local soil mixed with earth); and
8. Plant robust grass as top vegetation.
9. Monitoring of groundwater quality from existing or newly established bore holes biannually for 3 years.

The cost for this preliminary procedure has not been estimated in detail.