

# Initial Environmental Examination

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April 2021

## Cambodia: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project

### Kep, Cambodia

(Updated based upon the Revised Detailed Design of Kep Solid Waste Improvement Subproject)

Prepared by the Ministry of Tourism with the province of Kep for the Asian Development Bank. This is an updated version of the draft originally posted in May 2020 available on <https://www.adb.org/projects/documents/cam-49387-002-iee-1>.

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## **CURRENCY EQUIVALENTS**

(March 2021)

Currency Unit	–	Riel R
R1.00	=	\$0.00024
\$1.00	=	R4,004

## **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
EIA	-	Environmental Impact Assessment
EMI	-	Environmental Monitoring Institute
EMP	-	Environment Management Plan
GMS	-	Greater Mekong Subregion
IEE	-	Initial Environment Examination
IEIA	-	Initial Environmental Impact Assessment
mbgs	-	meters below ground surface
MOE	-	Ministry of Environment
MOT	-	Ministry of Tourism
PAM	-	Project Administration Manual
PMCES	-	Project Management and Civil Engineering Support Consultant
PIU	-	Project Implementation Unit
PPTA	-	Project Preparatory Technical Assistance
PMU	-	Project Management Unit
REA	-	Rapid Environmental Assessment
RGC	-	Royal Government of Cambodia
GRM	-	Grievance Redress Mechanism
SPS	-	Safeguard Policy Statement (2009)

## **WEIGHTS AND MEASURES**

km	-	kilometer
kg	-	kilogram
ha	-	hectare

In this report, "\$" refers to US dollars.

## EXECUTIVE SUMMARY

The Second Greater Mekong Sub-region (GMS) Tourism Infrastructure for Inclusive Growth Project will develop small scale infrastructure to improve tourist facilities and develop and strengthen management capacity to enhance tourism at selected locations in Cambodia, Lao PDR and Vietnam. In Cambodia, one subproject is being implemented in Kep Province.

The subproject in Kep Province, Cambodia is Kep Solid Waste Management Improvements covering on 13.39-hectare controlled landfill and improvement of 3.5-km access road. The controlled landfill locates in the existing dumpsite in the Damnak Chang Ae Village, Sangkat Prey Thom, Kep City in Kep Province, about 6km north of the municipality of Kep. The improvements to solid waste management in Kep consist of the following two main components: upgrading of existing Kep dumpsite to a modern controlled landfill and its access road; and improvements to solid waste collection and management in Kep and its vicinity.

The original IEE<sup>1</sup> completed in January 2018 was prepared during the feasibility design stage of the project using available data and information on sensitive environmental receptors. The 2018 IEE document has been updated and submitted in May 2020 based on the DED and on the actual definition of the perimeter of the area assigned by Kep Government to the SLF. The previous IEE dated May 2020<sup>2</sup> has been updated herein to reflect improved design of the Leachate Treatment Plant to treat 4 cells up to the year 2040, the modification of the SLF area and the improvement of the access road.

### Subproject Benefits

#### Kep Solid Waste Management Improvements

The existing arrangements for solid waste management in Kep are inadequate, characterized by low coverage, lack of sanitation awareness, and an open, unmanaged dumpsite. The subproject will address these problems by expanding the quality and coverage of solid waste collection and treatment services, construct a new controlled landfill on the existing 9-ha dumpsite located on public land, and support sanitation and waste management awareness programs. The upgraded solid waste management system will increase, and make more efficient solid waste removal from the streets and beach areas in Kep town.

The DED of the upgraded solid waste management system in the municipality Kep will assist implementation of the Sub-decree No. 36 on Solid Waste Management (1999), Sub-decree No.113 on Garbage and Urban Solid Waste Management (2015), which *inter alia*, prescribes implementation responsibilities for solid waste management. The location of the existing dumpsite has been reviewed in respect of Ministry of Environment Technical Guidelines on Garbage and Urban Solid Waste Management (2016). The subproject will benefit the Kep's urban core (Sangkat, Sangkat Kep and around half of Sangkhat Prey Thom) with a residential population of 9,000, 95 hotels, and 52 restaurants/cafes, and various other commercial outlets. It will also support Kep city's environmental goals, which were recognized in 2016 through an ASEAN Environmentally Sustainable Cities Award and in 2017 an ASEAN Clean Tourism Award. Options

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<sup>1</sup> Cambodia: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project. Initial Environmental Examination. ADB, 2018.

<sup>2</sup> Cambodia: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project - Initial Environmental Examination. ADB, May 2020

for waste collection tariffs and/or an environmental tax are being considered to support operational and maintenance costs of the landfill.

The materials recovery facility (MRF) to be constructed at the new SLF facility in Kep will be organized, compliant to health and safety guidelines and more efficient compared to the current limited practice of solid waste recycling at the existing dumpsite. The MRF will improve and provide more sanitary working conditions of garbage pickers while improving the efficiency and opportunities for reduction, recycling and reuse of solid waste. The MRF will increase the volume of recyclables using sanitary facilities and practices. The revised design of the SLF and its MRF will reduce pollution at the SLF and along the access road to the SLF. The managed network of modern waste cells overlying an impermeable HPDE liner, leachate collection and treatment facility, and landfill gas (LFG) capture system will protect groundwater, reduce GHG emissions if LFG flare required, improve local air quality, and reduce litter at the site thereby improving the natural environment and working conditions of SLF workers including the waste pickers who will be employed inside the new MRF. The provision of new waste compactor trucks will prevent spillage of garbage along the access road to the new SLF, and odor that was reported by residents along the road during the public consultations.

A major O&M and training program will be developed with the municipality and residents of Kep and outlying villages to create awareness and to institute and support the requirement that wet and dry solid waste is separated at source. The function of the new MRF at the new SLF requires that wet waste must not be mixed with solid waste when the solid waste arrives at the MRF for separation and recycling. Thus, the improvements to solid waste management will need to include separate or dual compartment compactor trucks to collect separated dry and wet solid waste, as well as placement of roadside bins that separate wet from dry solid waste.

The septage treatment facility (STF) and hazardous waste cell at the new SLF will contribute to overall environmental improvement in Kep town, and especially the crab market, by providing a location for septic tank sludge to be deposited and treated safely.

## **Potential Impacts**

The Kep Solid Waste Management Improvement is confirmed as Category B for environment pursuant to ADB's safeguards Policy Statement (SPS) 2009.

### Pre-construction Phase

The following baseline information was considered and included in the DED of Kep subproject for the upgraded controlled landfill to ensure that risks of groundwater contamination and storm water run-off impacts are understood and prevented with the DED:

- depth and quality of the groundwater at the existing dumpsite;
- depth of the water table; and
- local hydrological regimen.

Major activities which follow the pre-construction phase of the Kep Solid Waste Management Improvements included updating EMP<sup>3</sup> to meet the DED included in the

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<sup>3</sup> ADB. Cambodia: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project – Environmental Management Plan, 2020 May.

construction package tender documents and procurement of contractors. The safeguard due diligence for the DED of the Kep solid waste subproject confirmed no requirement for resettlement or land acquisition/ compensation, and has prepared the construction tender documents to which the separate updated EMP for the DED will be appended.

At the date this update report is prepared, the UXO clearing was already completed<sup>4</sup> in 2020 June for the entire construction sites, including the access road and the controlled landfill.

### Construction Phase

The potential environmental impacts of the Kep subproject are primarily construction phase-disturbances of the individual subproject component areas. Common impacts of the civil works will be, for example, reduced and/or blocked public access to areas, noise and dust caused by increased truck traffic and heavy equipment use, soil and surface water quality pollution caused by equipment operation and maintenance (leakage oil and hazardous construction materials), public and worker accidents, increased traffic congestion and traffic accidents, land erosion, localized drainage and flooding problems, solid waste and domestic pollution from worker camps and construction waste, and communicable disease and social problems caused by migrant workers.

The short-term construction impacts and disturbances will occur at different levels of magnitude depending on the civil works activity and the subproject site. Impact mitigation measures are prescribed which follow standard accepted construction practices as well as IFC/World Bank EHS sector guidelines for different construction.

### Operation Phase

The potential impacts of the operation of the completed subprojects arise from increased vehicle traffic along the upgraded landfill access road. Enforced speed limits must be clearly posted along the roadway. The sustainability of the operation of upgraded landfill according to design specifications and resultant reduction in solid waste pollution in Kep is dependent on sufficient annual operation and maintenance (O&M) support for solid waste management. As an example, there is a small risk that the liner of the landfill, stormwater drainage system, or septage treatment could fail or require repair during operation. Such a problem event would require sufficient budget to correct. Also, while reduced at the new SLF, long term impacts from dust and odour will arise from the landfill site.

### **Climate Change**

A separate Climate Risk and Vulnerability Assessment (CRVA) guided civil works and preliminary designs and IEE preparation of Kep subproject. The CRVA adopted climate change projections for rainfall and temperature prepared in 2015 for the subproject area and modified subproject component designs such as road surface type, drainage capacity, and civil works construction from national construction norms as the means to increase subproject climate resilience.<sup>5</sup> The estimated marginal increase in cost to make the road and pier subproject components resilient to climate change is approximately \$2.7 million. The Kep subproject will generate greenhouse gas (GHG) emissions from anticipated increased vehicle traffic on

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<sup>4</sup> Certificate of UXO clearance issued 2020 June 18

<sup>5</sup> Thoeun Hang Sen, 2015. Observed and Projected Changes in Rainfall and Temperature in Cambodia. Water and Climate Extremes.

subproject access road, however, the increase in vehicles is not expected to exceed the 100,000CO<sub>2</sub>e/a threshold for action, set by ADB<sup>6</sup>.

### **Climate mitigation and resilience of DED of Kep subproject**

The separate CVRA prepared for the FS design of the Kep subproject identified key climate change mitigation and resilience measures for Kep subproject that have been addressed by the DED. Greenhouse gas (GHG) emissions from the SLF will be minimized with the installation of a landfill gas (LFG) flare, and stormwater drainage at the SLF and along the upgraded access road will be designed to accommodate projected increases in maximum rainfall in climate change. The concrete surface of the SLF access road will be resilient to projected increased maximum summer air temperatures with climate change.

The subproject's initial indicative sensitivity to climate change is classified "Medium" to "High" by the AWARE<sup>TM</sup> software tool due primarily to potential sensitivity to increased rainfall intensity. The AWARE software combines geographic information on current site-specific climate, climate hazards from topography, elevation, and the latest climate change projections for each area. The subproject is designed to be resilient to present-day climate extremes. Future changes in climate are defined primarily by rainfall intensity and flooding for adoption of design criteria for upgraded access roads to include road surfaces that do not absorb water and are not vulnerable to flooding and surface runoff. Road surfaces will be resistant to elevated air temperatures, with sufficient cross and lateral road drainage to prevent lateral ponding and flooding, and road bed aggregates used will shed water and be resistant to erosion.

### **Conclusions**

The EMPs developed for each province including the updated EMP for Kep subproject provide impact mitigation plans, environmental monitoring plans, and specify the institutional responsibilities and capacity needs for the environmental management of each subproject.

The IEE concludes that the description of the subproject feasibility designs and the DED of the Kep subproject combined with available information on the affected environments is sufficient to identify the scope of the project's potential environmental impacts. Provided that significant changes do not occur to the design of any 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.

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<sup>6</sup> ADB (2016) Guidelines for GHG Emissions Transport Projects

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## I. INTRODUCTION

### A. Background

1. The second Greater Mekong Sub-region (GMS) Tourism Infrastructure for Inclusive Growth Project will develop small scale infrastructure to improve tourist facilities and develop and strengthen management capacity to enhance tourism at selected locations in Cambodia, Lao PDR and Vietnam. In Cambodia, one subproject is being implemented in Kep Province.

2. The subproject in Kep Province, Cambodia is Kep Solid Waste Management Improvements covering on 13.39-hectare controlled landfill and improvement of 3.5-km access road. The area of the new improved controlled landfill is within the pre-existing 9-ha dumpsite in the Damnak Chang Ae Village, Sangkat Prey Thom, Kep City in Kep Province, about 6km north of the municipality of Kep.

The improvements to solid waste management in Kep consist of the following two main components: upgrading of existing Kep dumpsite to a modern controlled landfill and its access road; and improvements to solid waste collection and management in Kep and its vicinity. Improved solid waste collection will consist of: (a) segregated recyclable waste collection created by a major O&M program and awareness campaign; (b) new compactor and vacuum trucks; (c) urban garbage bins of various sizes; (d) expanded catchment for solid waste collection; (e) new staff to work with operator (Kep Municipality) of SLF; and (f) training and capacity development of existing and new solid waste management staff.

3. The expected impact is sustainable, inclusive, and more balanced tourism development, as envisaged in the *ASEAN Tourism Strategic Plan 2016–2025*. The expected outcome is to increase the tourism competitiveness of secondary towns in Cambodia. Outputs include: (i) urban-rural access infrastructure and urban environmental services improved, (ii) capacity to implement ASEAN tourism standards strengthened, and (iii) institutional arrangements for tourism destination management and infrastructure operations and maintenance (O&M) is strengthened.

### B. Assessment Context

4. The Project has been categorized by ADB as environment category B and this IEE was prepared consistent with the environmental assessment requirements of ADB's 2009 *Safeguard Policy Statement*<sup>7</sup> and ADB good practice sourcebook.<sup>8</sup> 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 effective implementation of an environmental management plan (EMP).<sup>9</sup>

5. The original IEE completed January 2018 was prepared during the feasibility design stage of the project using available data and information on sensitive environmental receptors. The 2018 IEE document has been updated and submitted in May 2020 based on the DED and on the actual definition of the perimeter of the area assigned by Kep Government to the SLF. The previous IEE dated May 2020 has been updated herein to reflect improved design of the Leachate Treatment Plant to treat 4 cells up to the year 2040, the modification of the SLF area and the improvement of the access road.

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<sup>7</sup> ADB. 2009. Safeguard Policy Statement. Manila.

<sup>8</sup> ADB. 2012. Environmental Safeguards, A Good Practice Sourcebook, Draft. Manila.

<sup>9</sup> Footnote 4, pg. 19.

**Table 1. IEE versions**

<b>IEE Versions</b>	<b>Inclusions</b>
2018 January (original)	Prepared during the feasibility design stage of the project using available data and information on sensitive environmental receptors
2020 May IEE	Published in ADB website. Included all details, environmental baseline data, Public Consultation reports and other requirements contained in the IESIA prepared by PMCES and approved by MOE on 10 April 2020 as requisite for issuing the Construction License by MOE. The IEE is included in the Environmental Protection Contract which defines the obligations of the EA with regard to the adoption of the established environmental impact mitigation measures, monitoring and reporting to MOE.
2021 February	Reflected improved design of the Leachate Treatment Plant to treat 4 cells up to the year 2040, the modification of the SLF area and the improvement of the access road

### **Impact Footprints**

6. The solid waste subproject in Kep is located within the existing dumpsite area including operational 3.5-km access road. Thus, the potential environmental impacts of the subprojects are expected to be beneficial in mitigating the impacts of ongoing tourism, and solid waste management at the subproject sites.

### **C. Structure of report**

7. The IEE follows the outline provided in Appendix 1 of the SPS (2009). The results of the IEE are presented by the subproject in Kep Province to minimize redundancy of background information. The Environmental Management Plan (EMP) for the Kep subproject is based on and support 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 No 72 ANRK.BK on environmental impact assessment (EIA). In compliance with the sub-decree, 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 pre-submitted for approval from the Ministry of Environment (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 subproject design in Kep will require either a IEIA or EIA that will be submitted and approved by MOE. As dictated by, the MOE is required to complete their review of a submitted IEIA or EIA within 30 days to conclude the approval process.

9. The IEE presented herein meets the requirements of Sub-Decree No 72 ANRK.BK on EIA and the supporting Prakas Guideline Conducting IEIA/EIA Reports, BRK-BST, September 2, 2009. For implementation of IEIA/EIA the Prakas on Requirement of National EIA Firms to be

registered with MOE, No. 215 BRK-BST, 19 May 2014 has been taken account of in the costs during detailed engineering design.

## **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, enacted by National Assembly, 2006 and promulgated by Preah Reach Kram/SN/RKM/0506/011 (2006);
- Law on Forestry, enacted by National Assembly, 2002 promulgated by Preah Reach Kram/NS/RKM/0802/016;
- Law on Land enacted by National Assembly, 2001 promulgated by Preah Reach Kram/NS/RKM/0801/14;
- Law on Water Resource Management, enacted by National Assembly, 2007 and promulgated by Preah Reach Kram/SN/RKM/0607/016;
- Land Law on Traffic, enacted by National Assembly 2014, promulgated ny Preah Reach Kram/SN/RKM/0115/001 (2015)
- Law on Expropriation 2010, enacted by National Assembly 2009 and promulgated by Preah Reach Kram /No. NS/RKM/0210/003;
- Land Law on Traffic enacted by National Assembly, 2014 promulgated by Preah Reach Kram/SN/RKM/0115/001; and
- Circular No 01 SRN issued on February 3<sup>rd</sup>, 2012, Royal Government 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 Protected Areas (2008)
- Sub-decree on Water Pollution Control (2009):
  - Annex 2: Effluent standard for pollution sources discharging wastewater to public water areas or sewer;
  - Annex 4: Water quality standard in public water areas for biodiversity conservation; and
  - Annex 5: Water quality standard in public water areas for public health protection.
- Sub-decree on Solid Waste Management (1999)
- Sub-decree on Air Pollution Control and Noise Disturbance (2000)
- Sub-decree on Garbage and Urban Solid Waste Management (2015)
- Sub-Decree on Urban Solid Waste Management, No. 113, NKR-PR 2015
- Sub-decree on No. 235 on Drainage System Management and Waste Water Treatment Plan (Mol, MPWT and MoE, 2017)

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

- Technical Guidelines on Garbage and Urban Solid Waste Management (MOE, 2016)
- 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 (Kep) Creation of Fisheries Communities (2005); and
- Guidelines on establishment of protected forests, natural resources conservations, wildlife protection areas, protected forest for biodiversity conservation (2002 and 2004).
- Management of Means of Water Transport 00067, RGC, MPWT Circular #003 (2011)

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 subproject areas is more than 100 km away in Koh Kapok, Koh Kong province to the west.

14. Government Occupational and Community Safety and Health (OHS) guidelines follow the 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. The guidelines are included in EMPs. The OHS guidelines for Cambodia will likely need to be supplemented with the international the IFC EHS/OHS Guidelines for Construction and Decommissioning, Waste Management Facilities, and Toll Roads. The contractor will have to identify the appropriate national and IFC OHS guidelines in their bid documents for joint review by the contractor and PMCES.

15. For all other applicable environmental standards and criteria such as ambient air quality, vibration, noise, contaminated soil, national standards will apply and also where necessary supplemented by the standards and protocols of the Environment, Health and Safety Guidelines of the World Bank (IFC, 2007).

### **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, Urban Planning and Construction (MLMUPC);
- Ministry of Tourism (MOT);
- Ministry of Public Works and Transport (MPWT)
- 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 executing 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 most of the EIA requirements of the MOE. Further, the subproject in Kep is endorsed by the National Committee on Coastal Area Management and Development.<sup>10</sup> The IEE will provide guidance to the MOT and consultants who will prepare the IEIA or EIA for the MOE.

#### **D. ADB Safeguard Policy**

21. The ADB safeguard policy statement (ADB 2009) along with the *Good Practice Safeguard Sourcebook* (2012) clarify the rationale, scope and content of an environmental assessment and identify required supporting technical guidelines (e.g., World Bank/IFC EHS Guidelines 2007). Projects are initially screened to determine the level of assessment that is required according to the environmental classification, Category A, B, or C.

22. 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.

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<sup>10</sup> NS/RKT/0212/079 Preah Reach Kret on Establishment of National Committee on Coastal Area Management and Development.





### III. DESCRIPTION OF SUBPROJECT

23. The description of the subproject in Kep province is provided below. This was prepared by engineer and tourism specialist to estimate benefits of the subproject. The DED of Kep subproject was prepared by Norconsult Ltd.<sup>11</sup> under a subsequent, separate consultancy with PM Group Ltd.

#### A. Kep Province - Kep Solid Waste Management Improvements

24. The principle detailed engineering designs (DED)<sup>12</sup> of the Kep Solid Waste Management Improvements subproject are presented below. Improvements to solid waste management in Kep consist of two main components defined by:

- (1) Upgrading existing 9-ha dumpsite to a 13.39- ha controlled landfill including access road (Figure 1 and Figure 2);
- (2) Improved solid waste collection in Kep town and vicinity.

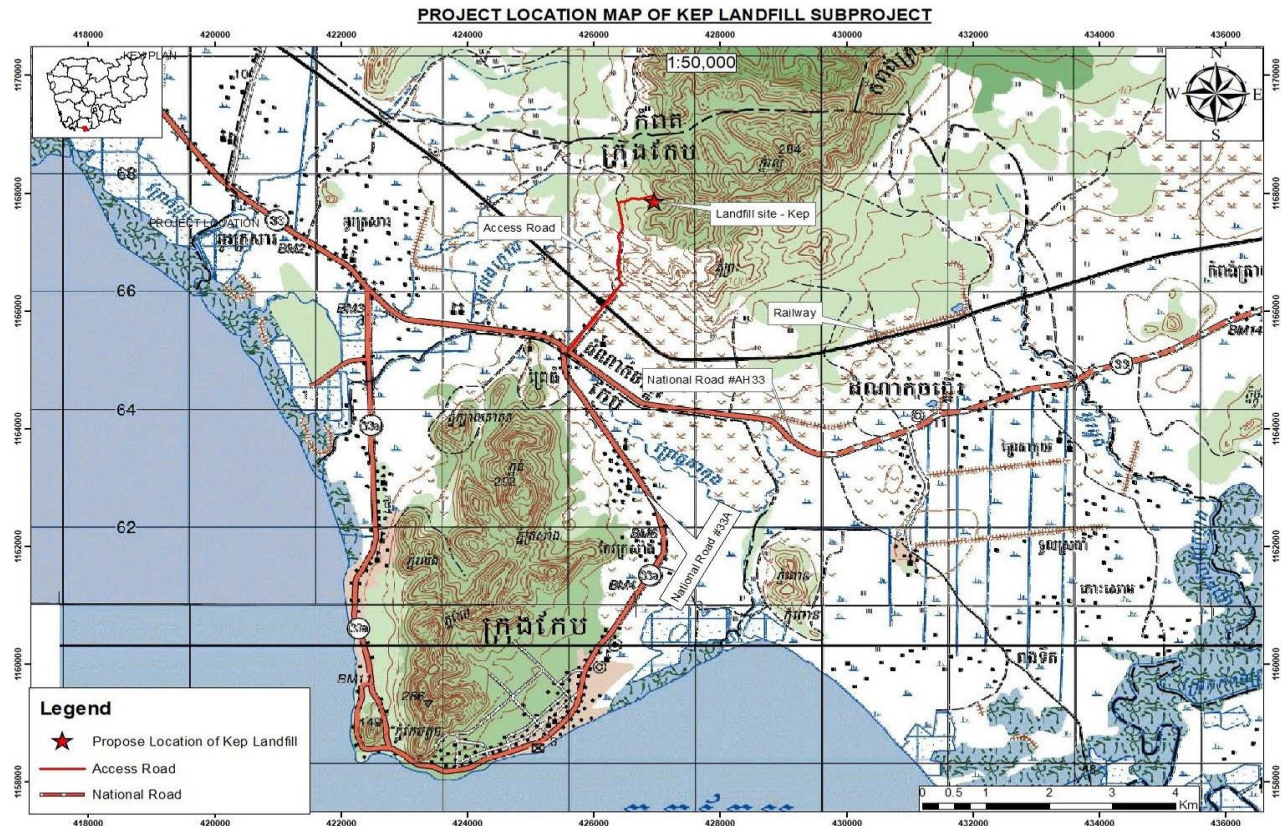


Source: Google Earth image

**Figure 1. Location of existing Kep dumpsite**

<sup>11</sup> Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

<sup>12</sup> Description and drawings adapted from Footnote #5 including Annex A: Solid Waste Management Memo.



Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

**Figure 2. Topo map of existing Kep dumpsite**

25. The SLF site (existing dumpsite) is located 6 km north of the Municipality of Kep. It will occupy a small, gently to moderately sloping valley underlain by weathered and fractured metamorphic rocks. The SLF will be constructed within a valley where various borrow pits were exploited since 2014 up to June 2020. One borrow pit was utilized since various years for informal dumping of solid waste collected in Kep town. The existing waste, which has been partially burned, will be removed and dumped in the cell No. 1 as soon this will be completed, lined and ready for the permanent disposal of wastes existing in the area as well the new waste collected in Kep during the construction period.

26. Small catchments areas drain the steep to very steep areas northeast, east and southeast of the site. Two stream courses entering the valley in the eastern end of the site, shall be collected by a lined channel that will cross the entire SLF. Small unlined drains will be excavated upstream of the cells, in order to intercept and convey to the proper discharge outlets the runoff coming from the hill slopes and from few smaller streams existing in the valley incisions on the Southern side of the SLF.

27. Large portions of the areas of the Cells for the waste dumping were interested by extensive borrow pit excavations that have removed the soil cover, leaving the exposed the fractured rocks strata. Figure 3 taken in June 2020 from a drone, shows the extent of the borrow pit excavations at the date when the construction started, which completely modified the site morphology from the one existing at the date of the original design made in 2018 by Norconsult.





**Figure 3. Drone view of site, June 2020**

28. On the slope sides, the soil cover ranges in depth from  $< 1\text{m}$  to  $7\text{m}$ , as illustrated in Figure 3, which also shows the current disposal and open burning practices. The adoption of a HDPE liner is therefore envisaged to ensure the imperviousness and avoid the infiltration of leachate in the ground and the contamination of the groundwater.

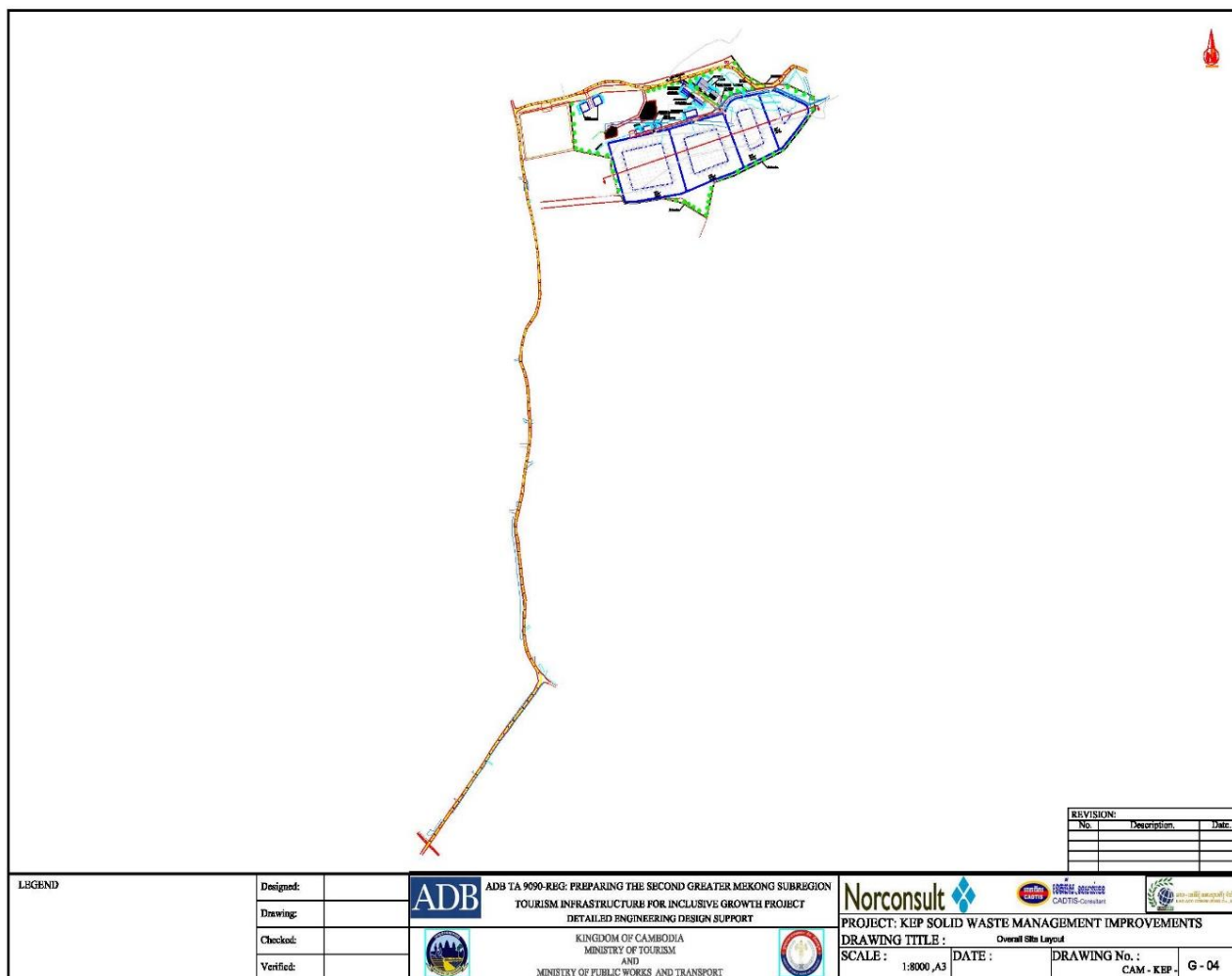


**Figure 4. Excavated soil and existing waste at Kep dumpsite**

29. As per the original design made in 2018, the SLF would consists of the following major components:

- (i) Four (4) lined waste cells to be constructed in 4 stages, starting with Cell 1;
- (ii) Existing waste moved and contained in a capped closed cell;
- (iii) Leachate treatment system, suitable to treat leachate produced in Cell 1 and formed by one aerated pond, one sedimentation pond and one constructed wetland;
- (iv) No. 2 Septage treatment ponds;
- (v) Hazardous waste cell;
- (vi) Material Recovery Facility (MRF);
- (vii) Administration and service buildings; and
- (viii) Upgraded access and internal roads.

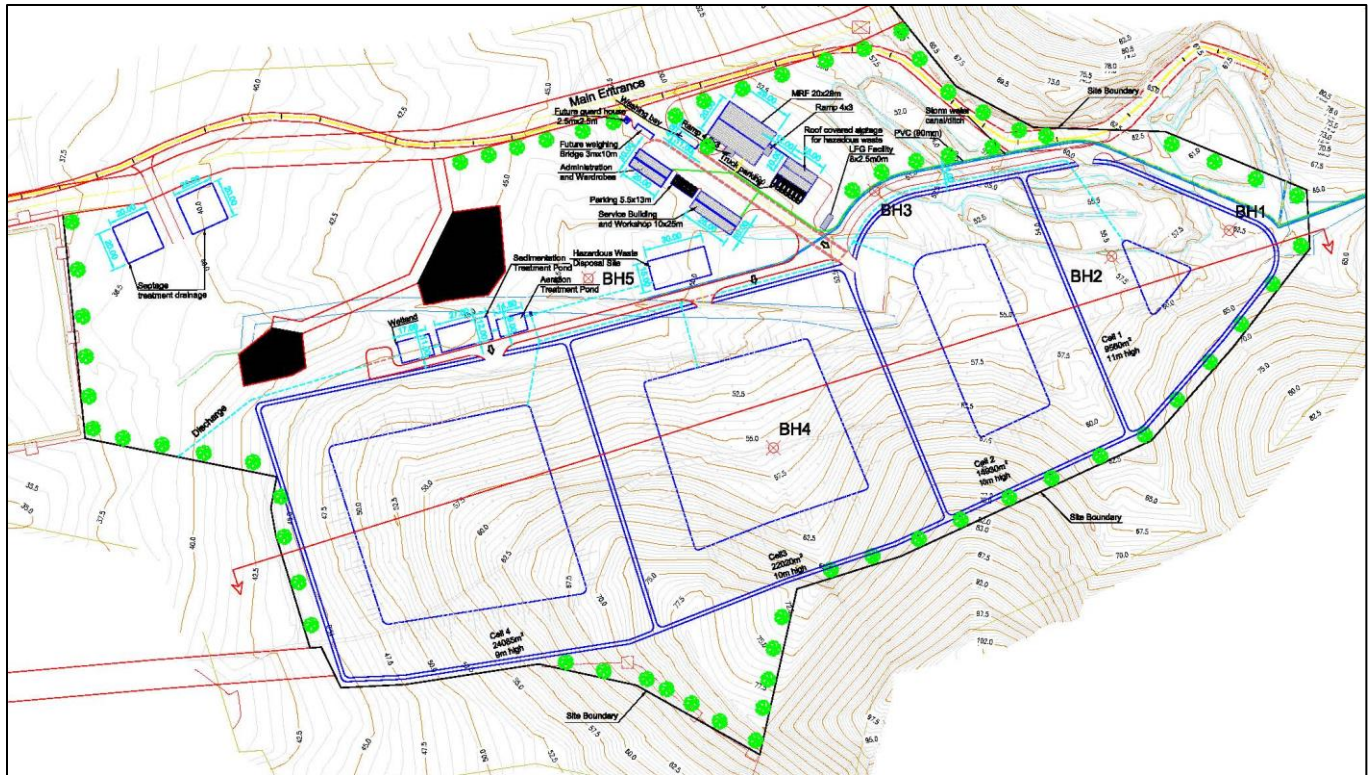
30. **Figure 5** shows the alignment of the 3.5 km long access road and **Figure 5** shows the SLF general layout. Also shown in **Figure 6** are the five test boreholes (BH1 – BH5) from which soil and groundwater samples were extracted. The drilling results indicate a soil/weathered rock cover which ranges from 3 to 7m in thickness. The underlying rocks are fractured, so the site will require an artificial liner of HDPE. The groundwater quality and soil type data are presented in next chapter on the Description of Affected Environment.



Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

**Figure 5. Plan view of access road and new SLF (from Fig 1b)**





Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

**Figure 6. Plan view of SLF**

31. The principal design of the SLF including facilities and infrastructure has been developed with consideration of the existing site conditions based on topo-surveys made in June 2018. The SLF, at its ultimate development stage, will have four (4) waste cells with a combined estimated footprint of 68,000 m<sup>3</sup> and a capacity of about 600,000 to 700,000 m<sup>3</sup> depending on the final height of the landfill. This will allow for minimum 20 years of operation. At the first stage only the Cell 1 will be constructed, whereas the others cells will be built in three subsequent stages as the previous cell is getting close to its saturation. As soon as the first cell shall be completed, including the lining and the piping for leachate collection, the existing waste will be removed and bulldozed and reshaped into the completed cell and permanently capped

32. A Landfill Gas (LFG) extraction system (see below) which consists of extraction wells/channels, pipeline system and processing facility, will be installed at the reshaped capped cell of old waste at the same time, and it will be included as a part of tendering and construction.

33. Waste cell development will be from the east to west. The soil and weathered rock materials that will be excavated from the side slopes of the SLF shall be temporarily deposited in the area of Cell 4. The stored materials will partly be used for the required backfill works in the project and the excess may be used for the intermediate capping of the dumped waste layers.

34. The cells will be lined using synthetic liner of HDPE with minimum 2 mm thickness. The local soil will serve as the initial base of the liner when levelled, compacted and trimmed from larger rocks and stones. On top of this the sub-base for the liner will be sand or fine gravel (0-8 mm). The liner must be anchored in ditches at the edges of the cells as presented in cross section details. Maximum slope for the liner foundation will be 1:3. The original design BOQ, based on

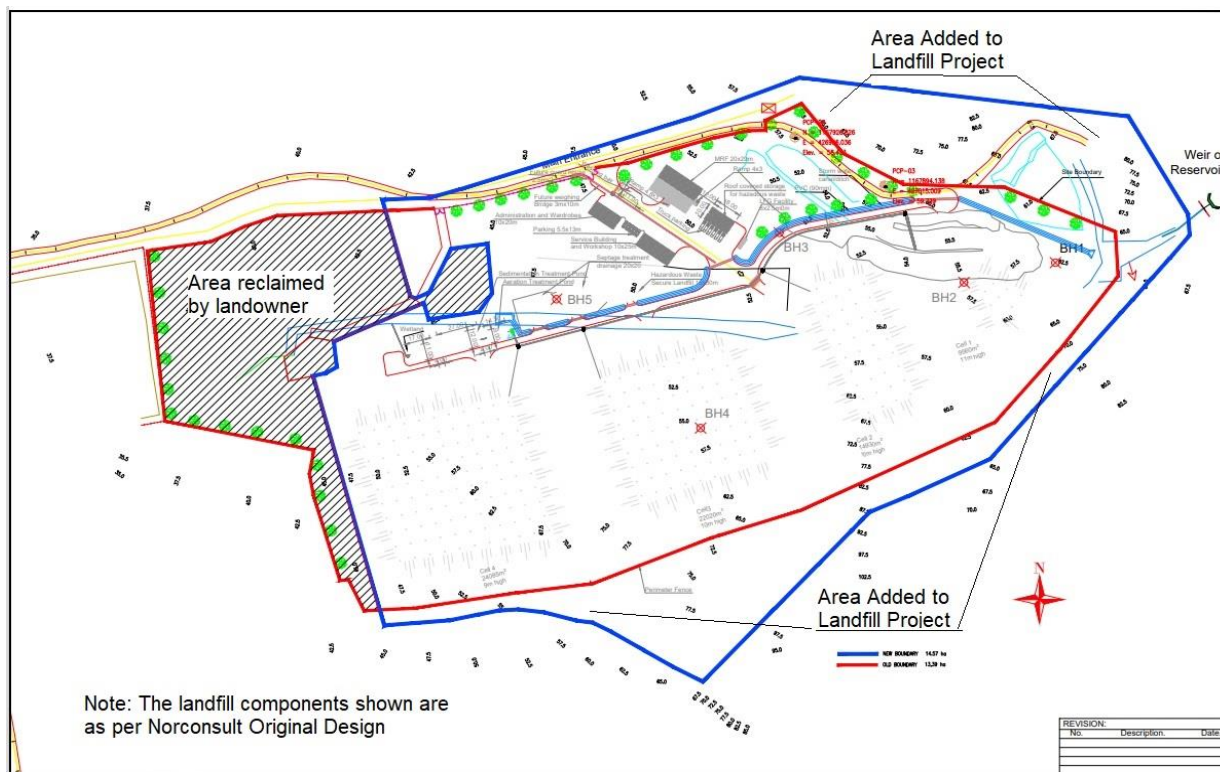
the assumed the staged development of the Cells, only included the quantities of the lining work for the Cell 1.

35. The present improved design modified some of the original design concepts. In particular the present design envisages that: 1) the complete SLF will be built in one stage with the development of the 4 cells, 2) the leachate collection piping and the related treatment plant shall be developed in one stage and it will be able to treat the leakage produced in the 4 cells; 3) in order to preserve the liner of the cells which will be not filled by waste over a long of period of time, a further protection layer consisting of laying precast concrete slabs 10 cm thick has been envisaged to be placed on the layers of sand and gravel in the cells no. 2-3-4.

## 1. Change of the Area for the SLF

36. On 23 July 2020 the Kep Government, called a meeting with MPWT requesting a change of the project area due to the claim by a landowner who disclosed his property right on an area of about 1.9 ha close the Cell No. 4. **Figure 7** shows the original layout of the SLF with the original perimeter indicated by a red line. The new perimeter of the area assigned to the SLF is indicated by the blue line. It is remarked that the area reclaimed by the landowner was a rather flat area at lower level grounds more suitable for the creation of SLF facilities such as the constructed wetlands, whereas the new areas assigned to SLF are on the high grounds of the hill slopes in the Northeast and Southern sides of the SLF area.

37. The area change imposed to move eastward the treatment plant and the various building facilities in more elevated grounds in the hill slopes located in the North East portion of the project. This new site location for the treatment plant obviously increases the amount of earthworks required to create a flat area suitable for installing the leachate treatment facilities



**Figure 7. Change of the area assigned to the Landfill Subprojects**

## **2. Leachate Treatment**

### **a. Treatment options**

38. Leachate must be minimized through strict and planned separation of rain and surface runoff water from waste cell seepage. Several treatment methods are available from advanced and expensive membrane technologies to simple biological treatment. From practical experience under similar conditions, low-tech, biological methods such as aeration and subsequent sedimentation is suitable under the local conditions of Kep. Anaerobic treatment is also an option but this may require a substantial area for implementation which is not available at the site.

39. Based on review of many relevant studies and practical results in various leachate treatment plants, it is concluded that the most suitable, feasible and appropriate treatment will be a combination of the following measures:

- Initial retention/evaporation
- Priority recirculation to landfill cells when appropriate (dry season)
- Optional pH adjustment and addition of chemicals when applicable – allow for future introduction
- aeration ponds/lagoons
- Subsequent settling/sedimentation ponds/lagoons
- Final polishing in wetland pond

40. In the original design, the leachate treatment plant facility was designed to serve only the Cell no.1 included in the first development stage. The treatment facility was located north of Cell 4 as shown in **Figure 8**. **Figure 9** and **Figure 10** provide plan and cross sections of the leachate treatment system, respectively. The proposed plant will have one pond with aeration, followed by a sedimentation pond and then by a wetland with phito-plants. Provision for leachate recirculation is included in the design. Leachate quantity and quality shall be regularly measured and sampled ahead of the aeration pond and after the wetland. The above selection of the basic treatment typology to adopt was confirmed in the present improved design.

### **b. Design Criteria adopted for the Leachate Treatment in the Original Design**

41. The following criteria governed the design of leachate treatment at the Kep SLF:

- The treatment plant will be designed for leachate from the initial cell with 5 years of operation.
- The dimensioning water volume will be equal to the average maximum rainfall per month over the last 8-10 years multiplied with the landfill area.
- The landfill body represents a substantial retention volume distributing the water volumes from rainfall over time. Observations from other landfills indicate that the retention will even the flow out to approximately a month average.
- The retention time in the aerated lagoon will be a minimum of 1 day at maximum flow and will be equipped with aerators based on raft-mounted propellers (This method has been proven as the simplest and effective to operate under local conditions).
- The retention time in the sedimentation lagoon will be 3 days at maximum flow



- The aeration lagoon will be 2m deep and the sedimentation lagoon 2.5m deep, and both will have a length to width ratio of approximately 3 to 1.
- The final wetland polishing lagoon with plants will be 0.8m deep and with 1-day retention time at peak flow.
- The aeration and sedimentation lagoons will be lined in the bottom and protected with a filter fabric all over. A layer of gravel will be placed on the flat bottom area and on the end with slope 1:3 to allow a pay loader to enter to excavate sludge when required.
- The sides of the lagoons may have a 1:1.5 slope with one access side/ramp having 1:3 slope allowing access for vehicles or pay loaders.

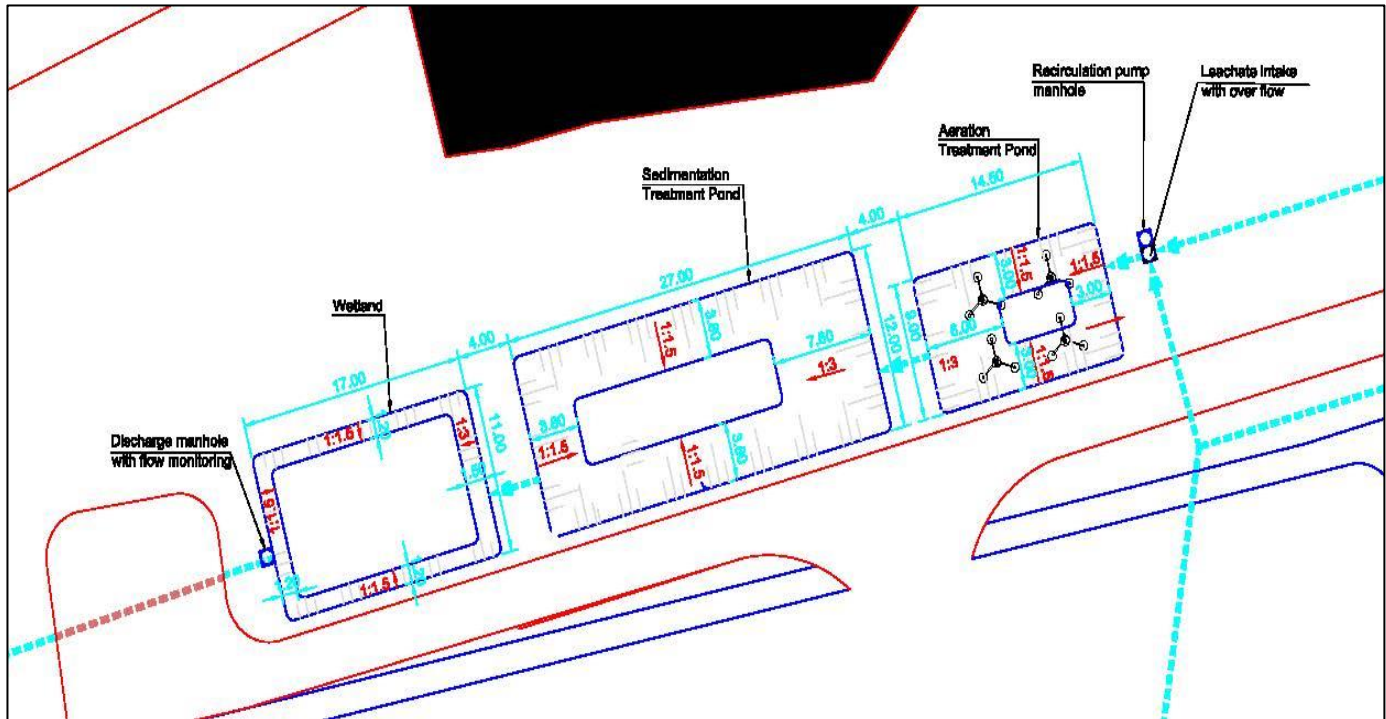
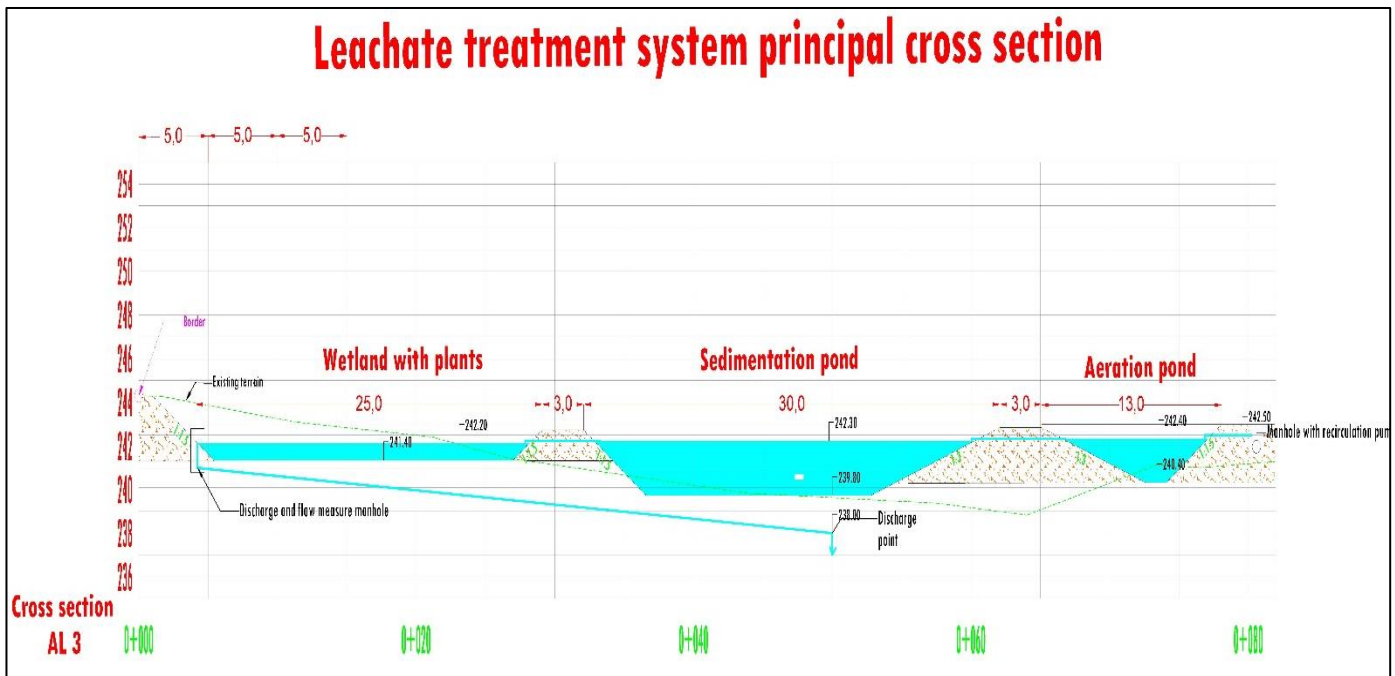


Figure 8. Plan view of leachate treatment system of Kep SLF



**Figure 9. Cross section of leachate treatment system**

**c. Design Criteria adopted for the present improved Leachate Treatment Plant**

42. **The present improved Leachate Treatment Plant design assumed the following more conservative criteria:**

- The treatment plant will be designed for the leachate from all four cell, estimated for the entire operation lifetime of the SLF.
- The estimated daily volume of leachate was computed for the entire period of operation. It resulted to vary in the range from 107 m<sup>3</sup>/d in the first year of operation increasing up to 350 m<sup>3</sup>/d after 15 years of operation (the first year of operation of cell 4),
- In order to cover the wide range of leachate quantities the treatment plant is composed by two lines that will work in parallel when the leachate is about or above 200 m<sup>3</sup>/d. During the first year of SLF operation when the leachate inflow is lower, only one treatment line will be kept in operation, while the second is kept in stand-by.
- Two aerated ponds in series are envisaged in each of the two treatment lines. The design retention time in the proposed aerated lagoons is over 5 days at maximum flow. The amount of oxygen and the energy consumed by mechanical aerators was evaluated based on the requirement for the nitrification process.
- the proposed aerator equipment consists of a series of rubber membrane pipes installed at the bottom of the ponds that allow the oxygen to be uniformly diffused in the entire pond depths, ensuring a better oxygenation effect and higher energy efficiency with respect to the raft mounted propellers of the original design. The rubber pipes can be very easily lifted in order to allow cleaning and maintenance of the aerated lagoons.
- One sedimentation pond for each line of treatment was envisaged with 2 days of retention time at maximum leachate flow. The assumed depth of the pond is 2 m and the sediment should be removed when the depth of sediment reaches 0.6m.

- The finishing treatment process shall be provided by a series of 5 large constructed wetlands (CW), of type of Vegetative Submerged Bed (VSB) with horizontal flow in a porous media formed by fine gravel and coarse sand 0.60 m thick. Phito-tropic plants shall be planted and will contribute to the purification process in the wetlands. Each of the two lines of the treatment plant will have 3 CWs in series, having a total liquid surface of some 8,400m<sup>2</sup>, with a total retention time of over 5 days at the max leachate flow. The sizing of the CWs was defined adopting the recommended EPA criterion of surface area or volumetric loading approach, which consider a maximum estimated pollutant loading on the surface CWs.
- **Figure 10** shows the layout of the improved leachate treatment plant defined in the present design.

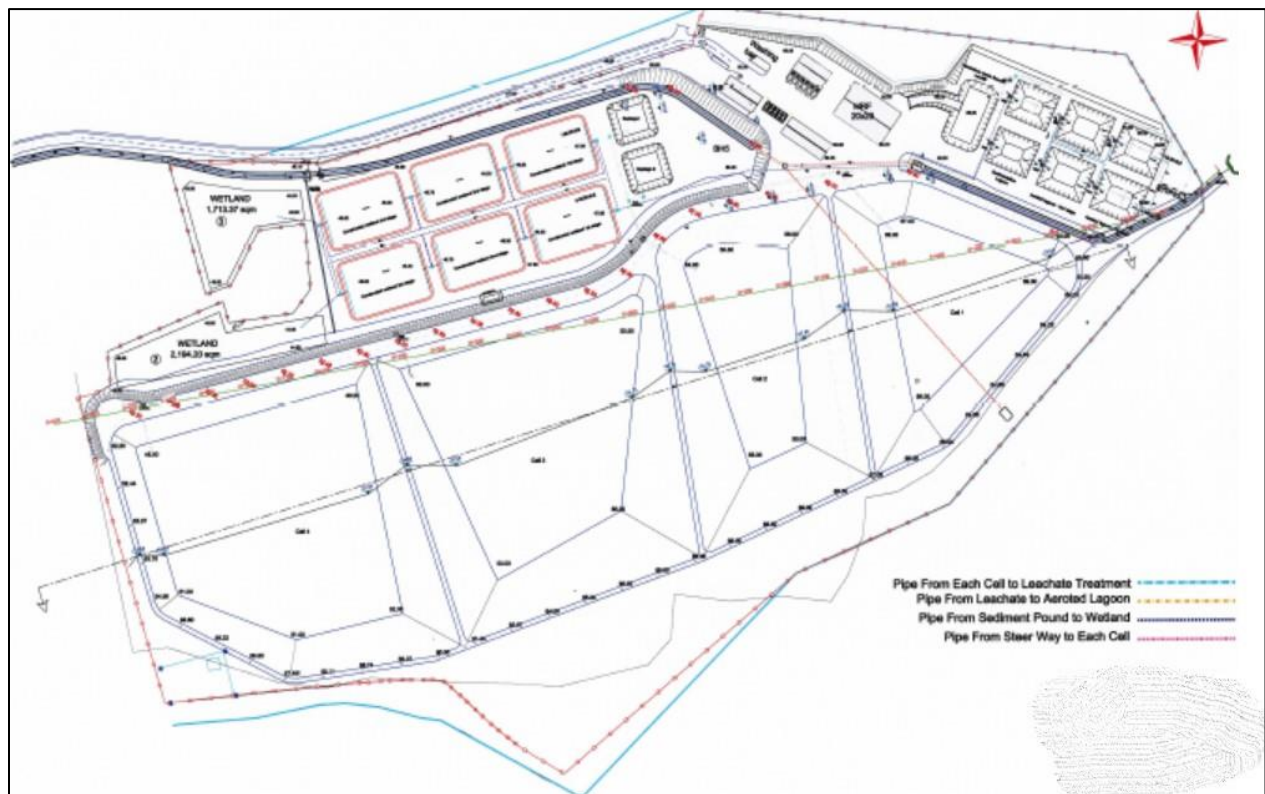


Figure 10. Landfill Layout and the present improved leachate treatment plant

### 3. Septage Treatment

43. The design concept for the septage treatment was maintained in the present design without modifications, with exception for the changed location of the septage ponds that were originally located in the low area that was reclaimed by the land-owner. Figure 9 shows the selected location of the two ponds located North of Cell 2, while Figure 10 shows the cross section of the septage ponds.

44. Septage is the accumulated sludge in septic tanks and is characterized by a very high content of organic pollution which is potentially infectious due to a high bacteria content. Normally it has a bad odor when fresh. Septage normally has a TSS (dry matter) of 1-5 % requiring de-watering as an important treatment step.

45. In Kep most houses have their own septic tanks with large septic tanks existing at most hotels. The tanks are not emptied on regular basis, rather mainly when the owner reports tanks to be full. Private companies provide clean-out services with a roaming septic truck in each town. The collected sludge is reportedly emptied into the lot owned by the septage collector.

#### a. Design Criteria for the Septage treatment

46. **Table 2** shows the projected number of household septic tanks in Kep.

**Table 2. Projected number of septic tanks in Kep**

No. of HHs	2020	2020	2030	2035	2040
Sangkat Kep	5,011	6,256	7,810	9,750	12,171
Kep City/Town	5,240	6,541	8,166	10,195	12,727
Kep Province	10,251	12,797	15,976	19,944	24,898

Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

47. Assuming an average collected volume of septage from each HH of about 2m<sup>3</sup>, the projected total volume for households can be calculated (**Table 3**). For Kep it is assumed that the collection of septage from individual households and large establishments will be undertaken an interval of about five (5) years.

**Table 3. Projected total septage from HH in Kep**

Septage Collection (m <sup>3</sup> )/year	2020	2025	2030	2035	2040
Sangkat Kep septage	3,506	4,377	5,464	6,822	8,516
Kep Urban Core septage	594	618	926	1,156	1,443
Kep Province septage	4,100	4,995	6,390	7,978	9,959

Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

#### b. Treatment of septage

48. Various treatment and disposal methods are available for the treatment of septage such as stabilization lagoons, aerobic and anaerobic digestion, other biological and chemical treatment, and composting. Based on the local conditions and review of relevant studies and practical results in various septage treatment plants, it is concluded that the most feasible and appropriate treatment is passive in a constructed wetland with vertical filtered flow in two (2) septage treatment ponds (Figure 11).

49. In the dual cell treatment system septage will be drained through a filter material to the bottom of the system. Special (narrow leaved) cattail plants will enhance the evaporation and treatment of the sludge. The liquid that drains from the system will be transferred to the leachate treatment plant for co-treatment. The septic treatment facility has been located away from the other facilities to avoid potential odor problems.

#### a. Assumed capacity

50. The constructed wetland should be emptied for dried septage sludge every second year. With an initial TSS of 1-5%, it is assumed that approx. 5% of the original septage volume is left after 2 years. The site will allow for a limited size of the septage treatment ponds. The septage ponds will each have a planned volume capacity of 200m<sup>3</sup>, 400m<sup>3</sup> in total and 200 m<sup>3</sup>/year. This will allow an annual flow of 4000m<sup>3</sup> of septage to the ponds. For Kep this will allow for receiving septage from most of the Kep province initially, being reduced to 50 % of the province after 15 years. Kep urban core will be covered for the whole 20 years period.

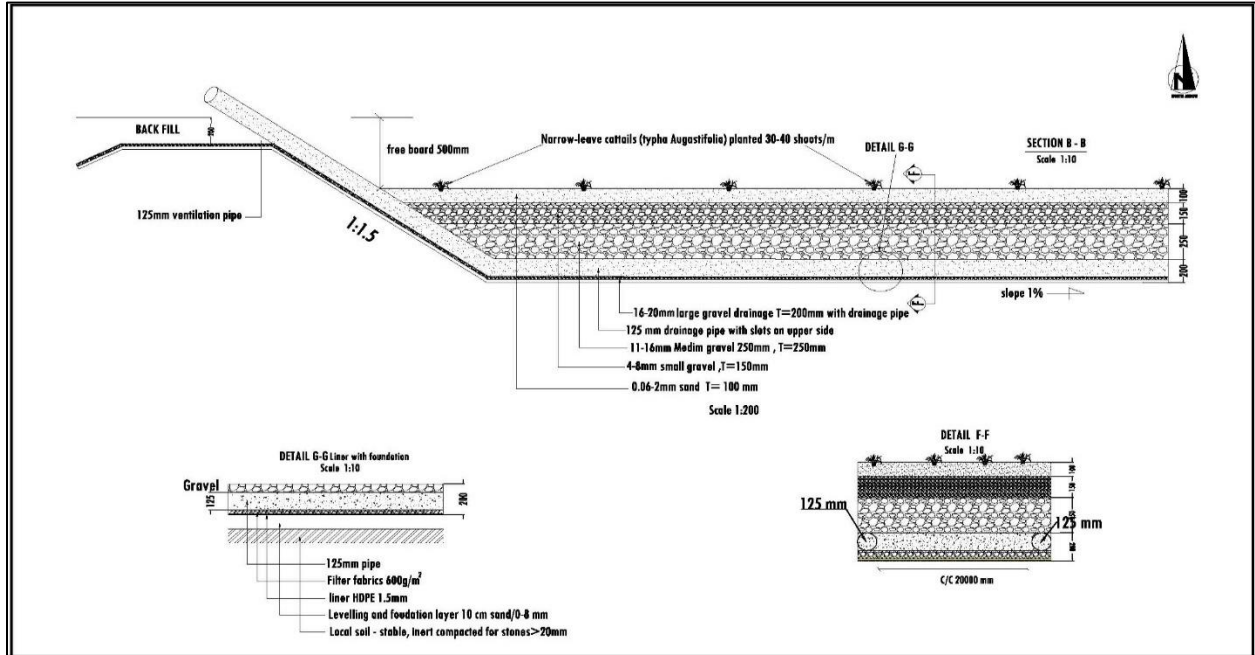


Figure 11. Cross section of septage pond treatment facility at Kep SLF

#### 4. Material Recovery Facility, hazardous waste, and utility buildings

51. Figure 12 provides an expanded plan view of the location of the MRF, hazardous waste storage, and service and administration buildings.

#### 5. Material Recovery Facility

52. The Materials Recovery Facility (MRF) will be housed in a single-story building (Figure 13 and Figure 14). The MRF will be established based on the assumption that a segregated waste collection system will be implemented. This system of segregation will ensure that only dry, potentially recyclable materials will be delivered to the MRF. Recycling facilities which receive mixed waste subsequently turn into smelly and unsanitary stockpiles of unprocessed, poorly segregated biodegradables and dirty recyclables. A major O&M and training program will be developed and implemented to create awareness and educate the Kep municipality and local community on the need to separate wet and dry solid waste at source to ensure the new MRF only receives dry solid waste for sorting and recycling. The planned MRF will not be able to handle wet waste which is intended to be dumped directly into the waste cells upon arrival at the SLF. The improvements to solid waste collection for the SLF will need to include separate or dual



compartment trucks to collect and transport separated dry and wet waste. Roadside garbage bins also need to separate wet and dry solid waste

53. The MRF will have the following functions:

1. Facilitate recovery of recyclable materials from the collected waste for subsequent sale to recycling buyers/centers.
2. Reduce the amount of waste that will be disposed into the controlled landfill and therefore contribute to the extension of the operational life of the disposal facility.
3. Provide a safe, sanitary environment, and systematic means of recovering the recyclables in contrast to the current dirty method of sorting mixed waste in an exposed environment.
4. After required training, provide employment for current waste pickers in MRF. Waste picking on the waste cells will likely be disallowed following recent Cambodian directive. However, the MRF makes waste picking unnecessary.

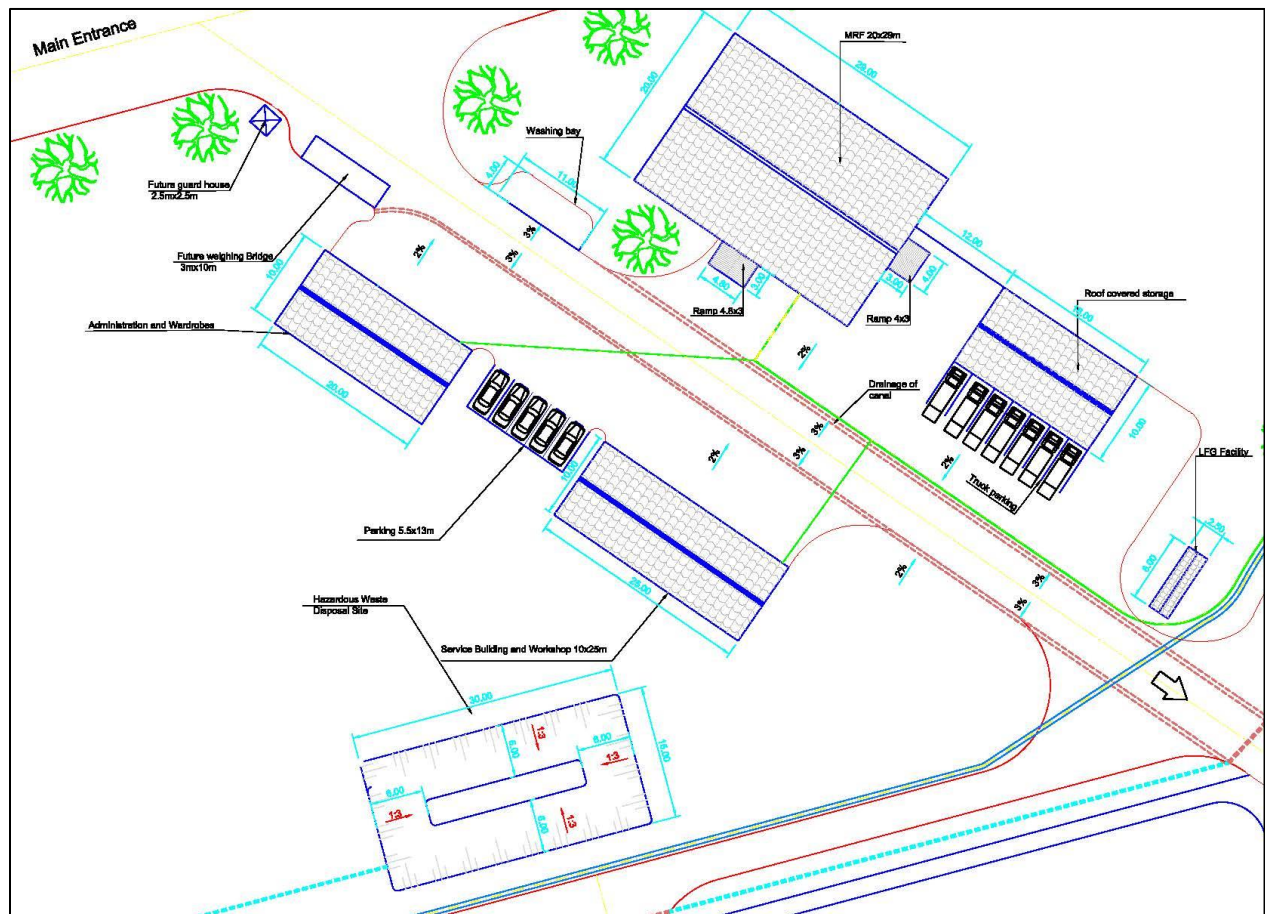


Figure 12. Layout of utility buildings, MRF, and hazardous waste storage

**a. Observations at Kep dumpsite**

54. The waste pickers recover PET, hard plastics, plastic sheets and carton and metal cans. With the exception of glass, these materials comprise about 20% of the waste generated in Kep. Paper is not recovered at the dumpsite and this condition is attributed to the likely recycling of this item at source and mixed waste collection which degrades the quality. The pickers do not recover the glass bottles in response to the low price and/or nearly absence of demand for this material.

55. The MRF will be designed in accordance with the following criteria:

- The MRF will have a floor area of at least 500 m<sup>2</sup>. This will facilitate the processing of 3 to 5 tons of dry, potentially recyclable waste. The higher end will allow it to handle the expanded collection coverage 5 years after the establishment of the landfill.
- The MRF will only accept dry, potentially recyclable waste. Mixed waste will not be accepted into the MRF.
- The MRF will record of the amount of incoming and outgoing waste for monitoring purposes and for regular validation of the facility mass balance.
- The MRF is part of an integrated solid waste management system and should not be established as a stand-alone facility.
- The MRF will operate 8 hours a day from Mondays through Fridays.

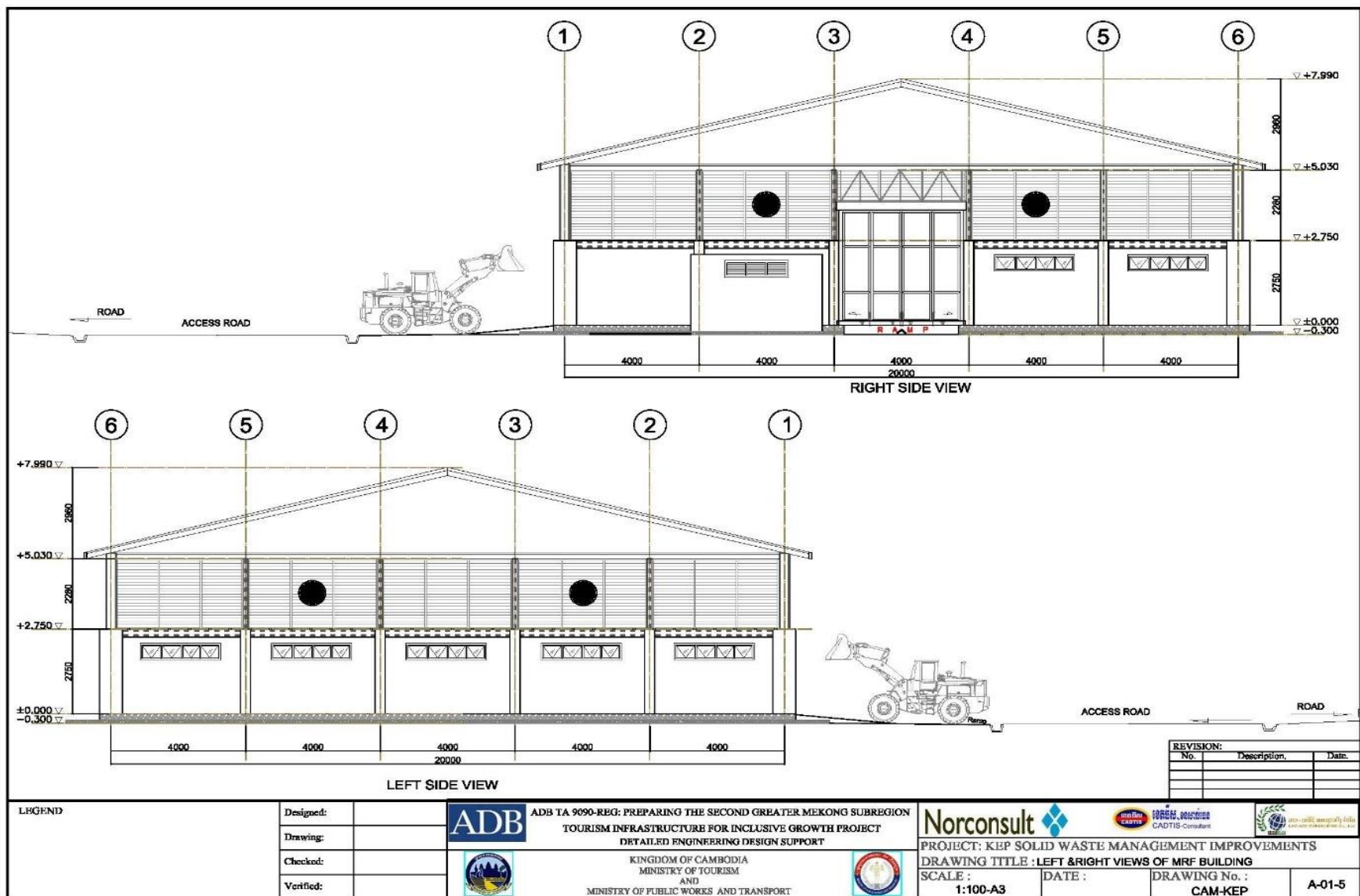
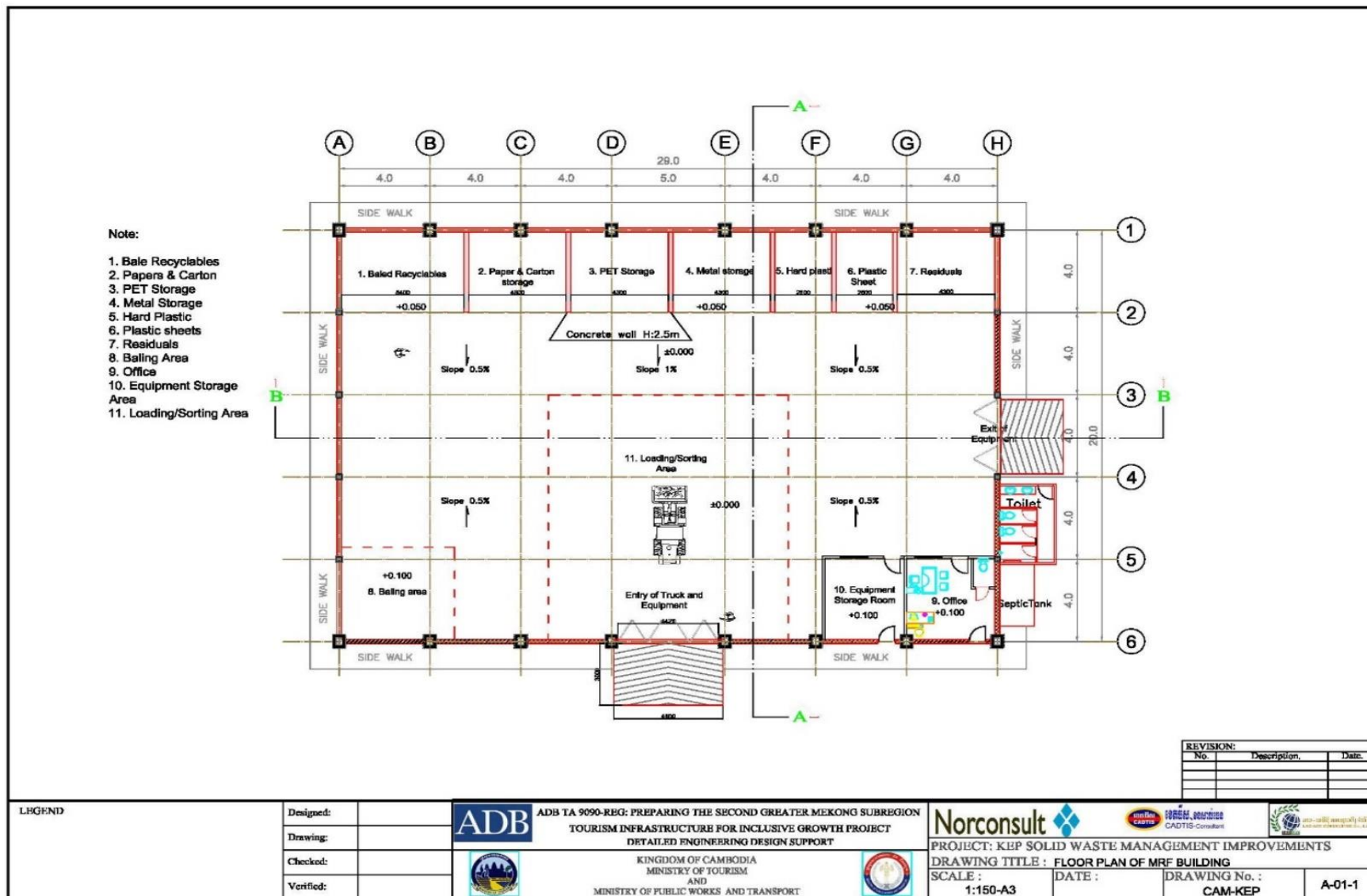


Figure 13. Building housing MRF



56. The general layout of the MRF (**Figure 14Error! Reference source not found.**) includes the following features:

- Centrally located waste loading and sorting area,
- Separate storage for the metals, plastics, carton and residuals,
- Baling area,
- Equipment room,
- Small office,
- Peripheral drainage system,
- Washroom area for waste pickers including septic system,
- Basic equipment such as baler, pay loader, weighing scales and wheeled bins,
- Recording system for the weights of the incoming waste and outgoing residual and recyclable materials,
- Firefighting equipment needs to be available in MRF.



Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

**Figure 14. Plan view of MRF and Kep SLF**

## **6. Hazardous Waste**

57. A separate secure area for inorganic (non-reactive) hazardous waste will be established at the SLF. The SLF area is too small for a separate treatment facility for hazardous waste. However, a covered storage area and a small secure disposal area has been included at the SLF for organic and reactive hazardous waste (Figure 15**Error! Reference source not found.**) allowing for storage of such waste until more centralized solutions are available in the country. The actual scope of the two types of hazardous waste produced by Kep municipality defined above must be determined. Infectious and chemical waste (syringes etc.) from the Kep healthcare facilities should be pre-treated at source before being transported to SLF. Hospitals also incinerate some of their waste on site.

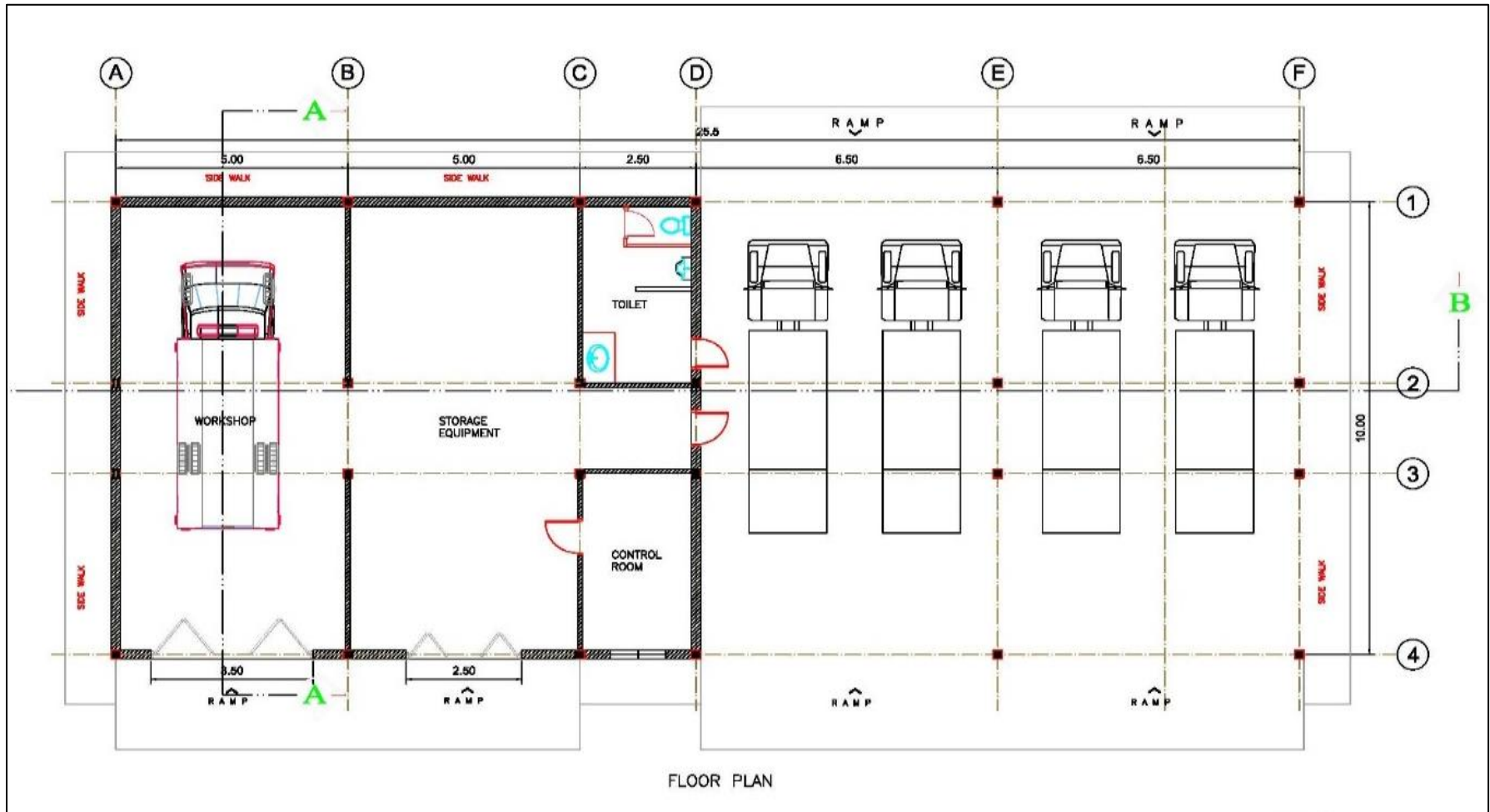
## **7. Storm Water Diversion**

58. Runoff from the adjacent hilly areas including flow through adjacent streams during rainy season will be diverted away and around SLF and waste cells through a peripheral network of collection canals which will eventually discharge into the natural drainage below the landfill site. The length and dimensions of these canals are determined through a comprehensive analysis of the terrain of the site and prevailing hydrometeorological conditions including climate change (see below).

## **8. Administration and Services**

59. The SLF will have separate administration and services support buildings (Figure 15 and Figure 16**Error! Reference source not found.****Error! Reference source not found.**). Support facilities will include offices, a small laboratory, kitchen, staff wardrobes and washrooms with septic system, a workshop, equipment storage, and waste collection truck parking and maintenance area. Record keeping of incoming waste will be kept in the administration building which will be equipped with filing cabinets, printers and audiovisual technology.





Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

**Figure 16. Service building of SLF**

#### **a. Reception of waste**

60. Upon arrival at the SLF all waste trucks will register at the gate and then at the administration area with the types and volumes (m<sup>3</sup>) of waste inspected and recorded before proceeding to the active cell tipping area. It is at reception where the waste content will be visually assessed to ensure that only permitted waste types are accepted for disposal. Non-permitted materials will be rejected. A traffic system shall be devised to regulate movement of vehicles and equipment. An area at the SLF has been allocated for the future installment of weighing bridge.

#### **9. Access roads**

61. The project envisages to improve the existing 3.5-ha earth road from NR 33 reaching the SLF site: the carriageway shall be paved by concrete pavement 7 m wide with two side shoulders of 1m. The existing road has a Right of Way of 15 m and the alignment will not be modified in the improvement design in order to avoid any resettlement issue. The drainage shall be substantially improved by new and adequately sized culverts for crossing streams.

62. The following basic assumption underly the SLF access and internal road upgrades designs:

- The road design in Cambodia in general will follow the National Road Design Standard of 1999 with Part 1 for geometry, Part 2 for pavement and Part 3 for drainage, which will include design considerations for climate change (see below).
- The present design has further upgraded the features of the access road to SLF. Complying with the request of Kep Provincial Government, which plans to extend the road improvement further North of the SLF location in order to serve a large area and to allow this road to be part of an interprovincial road network which will ultimately reach the Provincial road N41 in the Kampot Province. In order to be able to sustain the foreseeable traffic increase the concrete pavement thickness was increased to the standard 25 cm and the paved carriageway was also increased to 7 m (**Figure 17**). The drainage design was also substantially improved. The cost related to this upgrading of the original design were considered in a Variation Order VO1.

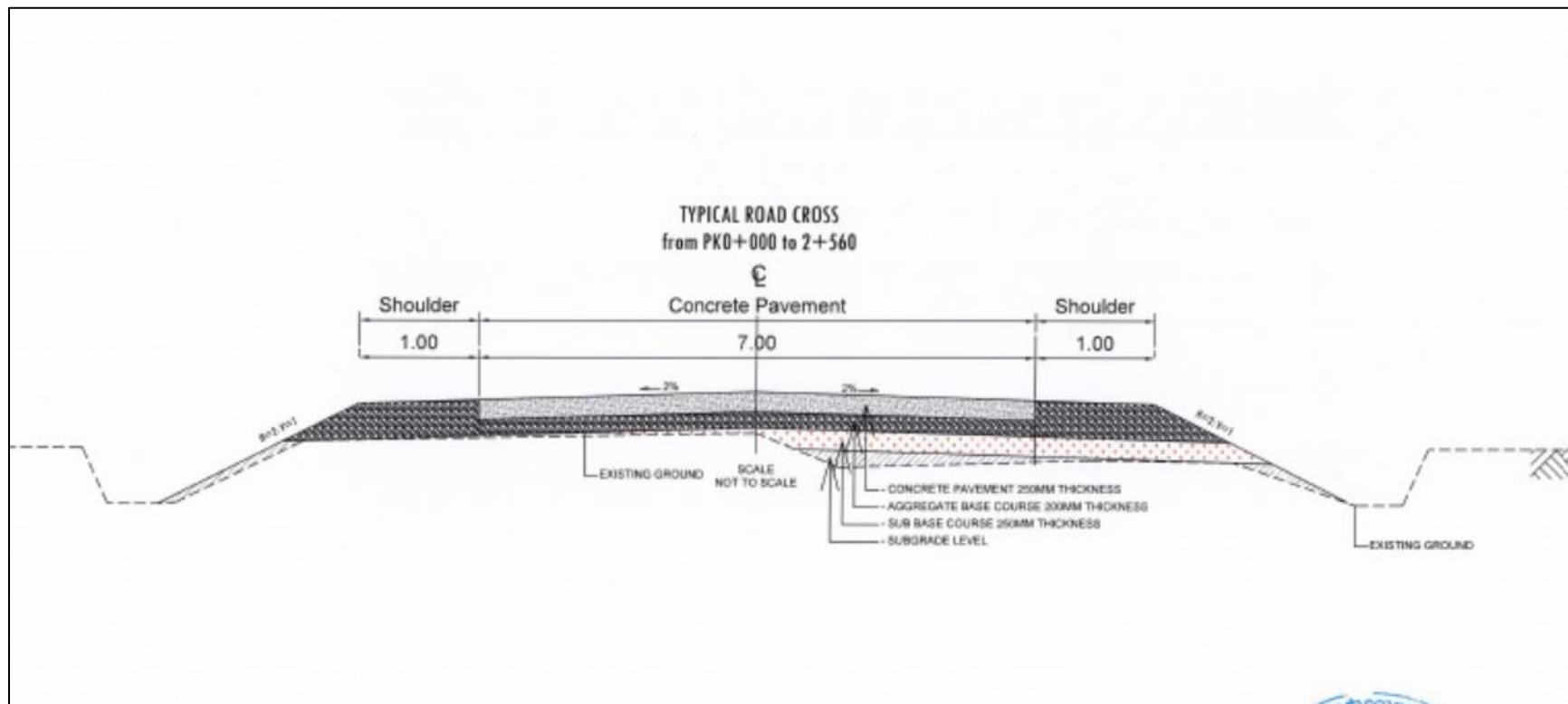


Figure 17. Cross sections of upgraded access road to SLF

## **10. Ancillary**

63. The following other components of the SLF included in the principal designs were not modified in the present Detailed Design:

1. Gate with guard
2. 2 m high Perimeter Fence with barbed wire on top
3. Monitoring wells (2) at either BH5 (initial baseline comparison), BH3, and BH1 from the drilling surveys.
4. Washing bay at the entrance
5. Water source (surface water reservoir upstream the site giving 15 m pressure)
6. 22 kV transmission line from the National Highway No. 33.

### **B. Climate Change Mitigation and Resilience of DED of Kep Subproject**

64. The detailed designs of the Improvements to Solid Waste Management in Kep have addressed the key required climate change mitigation and resilience measures that were identified by the Climate Risk and Vulnerability Assessment<sup>13</sup> (CRVA) of the feasibility design of this subproject of the TIIG.

65. The key climate change mitigation of the SLF is installation of a landfill gas (LFG) extraction system to capture and remove greenhouse gases (primarily methane). Climate change resilience addresses the design and operation of vulnerable components of the SLF including peripheral stormwater drainage around/away from SLF, and adequate drainage for the upgraded access and internal SLF roads.

#### **1. Landfill Gas Extraction**

66. A Landfill Gas (LFG) extraction system consisting of extraction wells & channels, pipeline system and processing facility will be installed for the closed capped waste cell of the SLF (Figure 4) as a part of the tendering process and construction. This will be included as an optional item depending on test pumping indicating LFG of adequate volumes and quality.

##### **a. Background to landfill gas capture and utilization**

67. In many countries extraction and utilization of landfill gas (LFG) is a widespread. LFG is normally generated from solid waste when the conditions for anaerobic degradation are present and with a sufficient content of organic matter. Basic conditions for LFG generation are as follows:

- Organic material degraded over 50-100 years, most during first 15-20 years
- Process starts rapidly - LFG available after 1-2 years
- Requires favourable conditions - not too wet and not too dry
- Require strictly anaerobic conditions with minimum of air sifting into the landfill, particularly when suction in an extraction plant is established.
- Require the use of adequate landfill equipment, compacting the waste properly
- Sufficient height/depth of the landfill, an extraction plant will e.g. require min. 7-8 m

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<sup>13</sup> ADB 2018, Supplementary Appendix of TA9090: Climate Risk and Vulnerability Assessment (CRVA) of TIIG subprojects in Cambodia and Lao PDR.



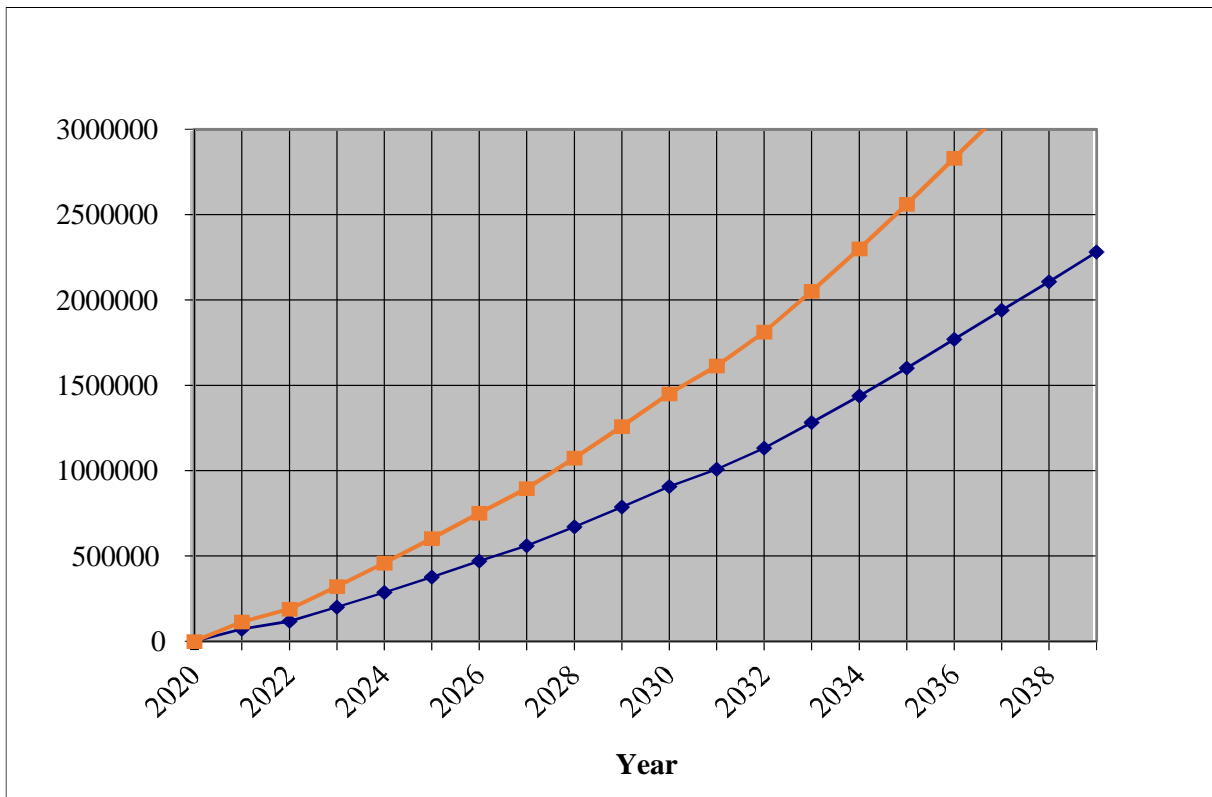
depth to avoid extensive suction of air (oxygen). In extraction facilities, typical LFG consists of: 35-50% CH<sub>4</sub>, 25-40% CO<sub>2</sub>, 10-20% N<sub>2</sub>

- LFG contains a number of environmentally hazardous trace gases, but in very low concentrations
- GHG effect - CH<sub>4</sub>: 21 times the effect of same quantity of CO<sub>2</sub>
- Causes risk of fire and explosions (5-15% CH<sub>4</sub>)
- Causes bad odour - H<sub>2</sub>S and aromatic gases
- Causes health risks - CO<sub>2</sub>, H<sub>2</sub>S and trace gases

#### **b. Landfill gas generation and potential extraction**

68. There are several theoretical models for estimating LFG quantities generated over time and for estimating how much can be extracted. The models are based on assumed solid waste quantities that are landfilled every year in a certain period. A model developed by Norconsult for IPCC for LFG estimates has been used for a theoretical LFG generation at the Kep SLF. Almost all LFG knowledge and practical/operational experience indicate that the accuracy of theoretical model estimates are limited because there are so many unexpected results and conditions occurring in the actual operation of a SLF over time. As a consequence, the DED of Kep SLF has based assumptions on extensive operational experience from a large number of LFG plants in operation for more 20 years. From this experience, the realistic potential for LFG extraction is in the range of 40 -75 % of the theoretically generated LFG quantities. When the landfill is designed for LFG extraction it is assumed that approximately 60% of the total LFG being generated can be extracted.

69. **Figure 18** illustrates the projected annual total LFG quantities (Normal m<sup>3</sup>) potentially generated together with the estimated quantities extracted (and potential utilized) in a LFG facility under optimized conditions for Kep SLF. Figure 14 can be used to select the time when it is relevant to start a LFG extraction plant in the Kep SLF.



**Figure 18. Estimated LFG volume (Nm<sup>3</sup>) generated and maximum extraction in Kep**

70. As indicated in **Figure 18**, the initial LFG quantities produced in the *new* cells of the Kep SLF will initially be limited. From practical - operational experience it is generally not recommended to start installing a LFG facility until the LFG production is above 200,000 Nm<sup>3</sup>/year or 20-30 Nm<sup>3</sup>/hour due to operational and adequate flaring concerns, and until the landfill contains minimum 60-80,000 tons of solid waste. Before this condition is reached the LFG facility will be difficult to operate continuously and with stable production. This condition will not be reached in the Kep SLF until after 2024. Thus, LFG schemes are not initially included at the new cells, though it is highly recommended to implement LFG extraction and utilization at the new cells when the gas quantities are adequate.

71. However, an LFG extraction system is justified at the existing waste cell after it is reshaped and capped. In addition to LFG collection, the installation of an LFG system to the capped waste cell will also act to provide an important introduction of a new and complex system and operations to the Kep municipality and DPWT authorities ahead of the need for LFG systems at the new waste cells. The time for implementation of LFG system to existing capped cell will depend on initial test pumping following waste replacement and capping which will indicate LFG of adequate volumes and quality.

### c. LFG Extraction Systems

72. An LFG extraction facility in general will include the following components (**Figure 19** and **Figure 20**):

- Wells/canals
- Horizontal canals to be established in layers during operation which is cheapest, but require very careful and planned landfill operation
- Vertical wells (35-50 m apart) to be drilled after finishing a section, which is easiest and option with best operation over time
- Preferably transport pipelines between each well/canal and a central monitoring and regulation facility
- Monitoring/regulation central(s) with suction pumps, process equipment, etc. This should be containerized and supplied in a complete unit to be connected to the LFG pipelines and electricity input
- Flare



**Figure 19. Installation of a LFG extraction system**



**Figure 20. Central processing unit of LFG extraction system**

#### **d. Landfill gas utilization**

73. Some considerations and comments on LFG utilization are provided below.

- 1 Nm<sup>3</sup> (normal m<sup>3</sup>) of LFG = 3.5 - 5 kWh - on CH<sub>4</sub> content
- In 2020 the annual gross energy content in the LFG may be in the range of 1.8 GWh, increasing to approx. 8,7 GWh in 2030
- Direct feed to a gas burner that is connected to boiler is best and cheapest application but requires nearby consumer(s) with continuous heat consumption which not the situation in Kep.
- Gas is relatively cheap to transfer to users
- The Kep SLF is remotely located with limited adjacent activity/customers
- Consequently, electricity production in gensets (generators) is most relevant but electricity energy produced is only 30-40% of the gross energy content.
- Substantial economy-of-scale for specific production costs of electricity, e.g., 150 kW engine at 0.07 USD/kWh, or a 1000 kW engine at 0.03 USD/kWh
- In the future (2020-2025), a genset of 100-150 kW with electrical output of 0.8 - 1,2 GWh annually is relevant in Kep.

74. From practical operational experience, due to a balance between costs and potential income, the future LFG utilization will probably be a non-profit measure without significant financial contribution to the solid waste management system of Kep. However, such LFG utilization is highly encouraged, because it will be a significant climate resilience measure, and possibly a good local source of sustainable energy.

## 2. Vehicle emissions

75. The GHG emissions from roads was established based on the guidance provided in the ADB Environment Safeguards - a Good Practice Sourcebook (2012). If the traffic expressed as passenger car units per day (PCU/day) is below the numbers indicated in Table 4 in a representative year, the emissions in that year are unlikely to exceed the 100,000 tons CO<sub>2</sub>e threshold.

**Table 4. Maximum Number of PCU per km to Trigger 100,000CO<sub>2</sub>e/a**

Length of Road. (km)	PCU/day	Length of Road. (km)	PCU/day
10	76,000	50	23,000
20	57,000	60	19,000
30	38,000	70	16,000
35	33,000	90	13,000
40	28,000	100	11,000

*Source: ADB Environment Safeguards - a Good Practice Sourcebook (2012)*

76. The total length of the upgraded access road is only 3.0 km. Increased traffic in Kep, along NR 33 and the access road from the increased trip frequencies of the new compactor and vacuum trucks, and SLF staff will be well below 50,000 PCU/day, which produces well under the 100,000 tons/a GHG threshold.

## 3. Climate change resilience

77. The objective of the DED was to provide cost effective, climate-resilient measures for the Kep solid waste improvements subproject by adapting the infrastructure to the impacts of climate change and climate variability. The climate resilience activities fall under two outputs:

- Output 1: Infrastructure adapted to extreme weather conditions due to climate change,
- Output 2: Increased resilience of project infrastructure to long term climate change.

### a. Caveat

78. Factors considered in making engineering adjustments for Kep subproject for climate change included cost-effectiveness, current climate variability and potential future risk. It is important to note that existing climate change impact assessments are insufficient to provide a scientific probability of future climate change, and therefore, the civil engineering adjustments based on expected future changes are difficult to calculate quantitatively. A margin of safety risk factor is therefore applied instead.

79. The following are relevant: (i) climate change trends and projections; (ii) impacts of climate change on hydrology, ecology, and soil; (iii) natural environment including topography, geology, land use, and climate hazards; (iv) social environment including poverty levels and population density; (v) built environment; and (vi) hazards risk mapping.

80. Engineering designs, standards and guidelines are selected to withstand climate change along with proposed amendments. The Cambodia Ministries currently use a set of standards and guidelines for engineering design which may not fully consider long-term implications of climate change. Available materials and studies of climate change scenarios and consequences in the Kep region were assessed and conclusions and recommendations addressed.

#### **b. Climate change resilience for Kep subproject**

81. The Kep subproject considers climate resilience adaptation measures to reduce adverse impact of climate risk through:

- a) The improvement and upgrading of storm water drainage for the SLF for access and internal SLF roads; and
- b) Establishment of adequate leachate treatment plant.

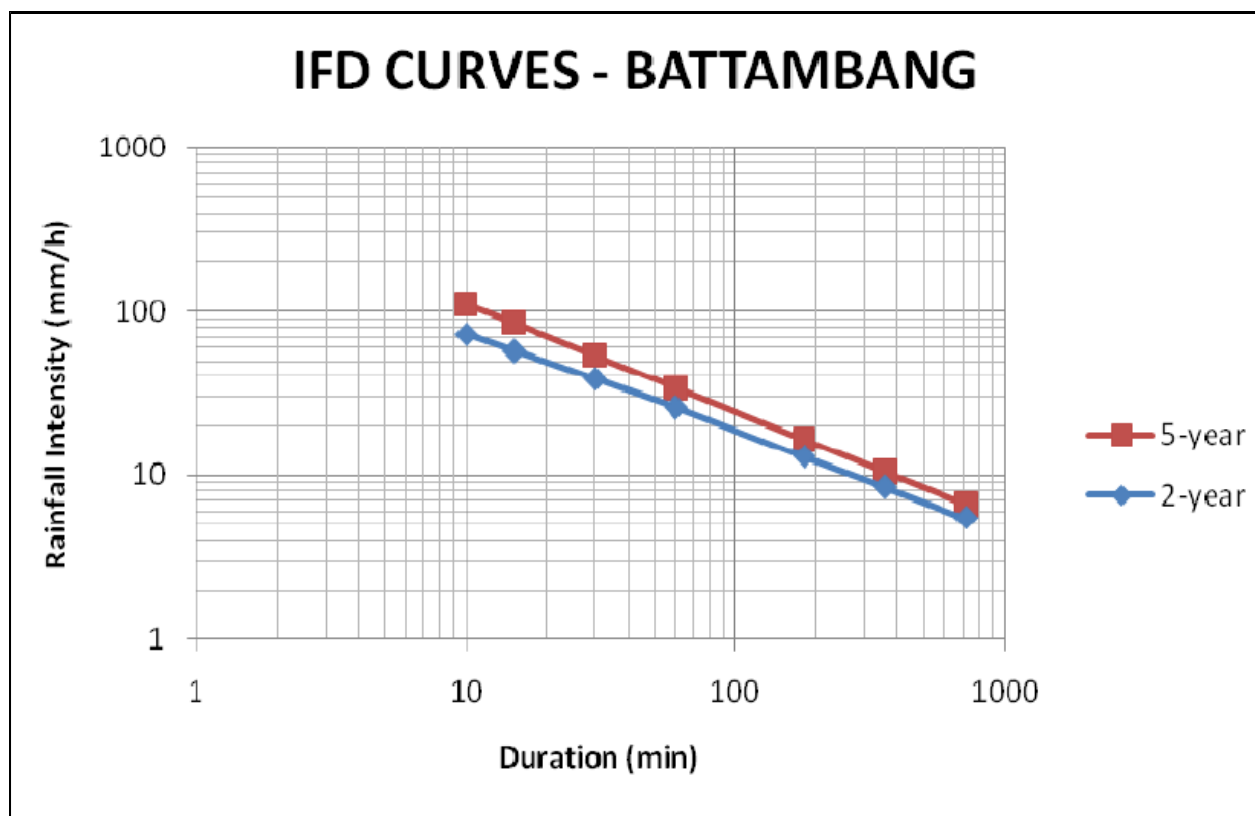
82. As a summary, adaptation of climate change for the storm drainage and the leachate treatment plants in general has been designed according to the following criteria:

- An increase of annual precipitation of 5% (climate change portion)
- Flooding of structures for 50-year return period + a freeboard of 50cm (dependent on local conditions) reflecting an increase of annual precipitation of 5% (climate change portion)
- Design of storm water culverts and canals for 10-year return period
- All infrastructure should have a lifespan of minimum of 100 years

#### **c. Rainfall**

83. The available data for the design of the storm water drainage are the Intensity - Frequency - Duration (IFD) curves. The IFD however has not been available for Kep. For this purpose, the IFD curves derived for Battambang (**Figure 21**) were used as an indicative guideline for Kep. Battambang IFD curves should be used until such curves become available for Kep. The curves are to be used only for designing of drainage canals and culverts due to intense short rain. The MPWT is using the IFD curves as contained in the Cambodia Road Design Manual for the design of storm water canals, pipes and culverts.





**Figure 21. IFD curves for Battambang which may also be used for Kep**

84. Rainfall data for Kep have been collected for the period 2011 - 2018. The average annual rainfall was 1886 mm/year and the extreme maximum was 702 mm/month (July 2018) while the average max. rainfall pr. month of that period is 447 mm/month.

#### **d. Computation of storm water drainage flow**

85. The Rational Method is used for the calculation of peak discharges for the design of the road drainage for the subproject. The Rational Method is the most commonly method used internationally for calculation of run-off in urban and rural areas.

86. The Rational Method Equation is defined as:  $Q = c \cdot I \cdot a \cdot k$ ,

where,

$Q$  = peak discharge, l/sec

$c$  = runoff coefficient

$I$  = rainfall intensity (l/sec/ha)

$a$  = area of contributing basin (ha)

$k$  = climate factor for future increase in precipitation.

87. The future annual increase in precipitation is assumed to be 5% ( $k=1.05$ ) according to Appendix 7 of ADB CTD4: Climate Proofing of Infrastructure.

#### **e. Computation of storm water drain sizes**

88. The Manning Formula is used for calculation of storm water drain sizes. The Manning's Formula is one of the most commonly method used internationally as follows:

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

where,

V = mean velocity (m/sec)

N = Manning coefficient

R = hydraulic radius (m)

S = friction slope (m/m)

#### **f. Design Criteria for components**

89. The lifetime of the culverts, canals, buildings and infrastructure should not be less than 100 years. The following design parameters for stormwater have been applied:

- i) Monthly average temperature 24°C
- ii) 10-year return period for precipitation to be used to calculate the required capacity of the peripheral storm water drainage canals.
- iii) Minimum slope of 0.5 per cent for gravity transfer as a general requirement

### **C. Improved Solid Waste Collection**

90. Current solid waste management in Kep province is limited and includes only Kep City. The province generates approximately 42 tons of solid waste daily but only about 15 - 17 tons of mixed waste are collected and disposed.

91. The present collection system covers 15% of the Kep City/Town households and nearly 100% of the establishments which support the tourism industry namely restaurants, hotels, guesthouses and market. The private waste collector operates two (2) compactor trucks which make one (1) trip per day from Monday to Sunday. Prior to collection, waste is placed in HDPE bins and containers and bags of various capacities. Kep recently received 70 HDPE bins with each with a capacity of 120 liters from the Asian Development Bank (ADB).

92. The following criteria should be adopted for the waste collection system of Kep Province:

1. The system should have a collection coverage in accordance with the following schedule: 50% from 2021-2025; 70% from 2026 to 2030 and 90% from 2031 and beyond.
2. Segregated waste collection should be implemented once the proposed SLF becomes operational. Waste shall be classified into wet/biodegradable and dry/potentially recyclable. Appropriately colored bins will be used to hold the corresponding waste types.



3. Collection of biodegradable waste for Kep City/Town should be carried out twice a week. Collection of biodegradables for Sangkat Kep should be at least once a week. The frequency of collection may be increased depending on the volume of waste.
  4. Collection of dry waste should be carried out once a week in Kep City/Town and once every 2 weeks for Sangkat Kep.
  5. Kep Province should have three  $3 \times 10 \text{ m}^3$  compactor trucks to allow it to expand collection coverage and a payload for MRF (and general) operation
  6. Different levels of collection services should be introduced, with doorstep collection in areas paying higher fees, and fewer, centralized collection points in low-income areas, paying lower fees.
  7. Communal collection will be employed at the outer districts of central Kep. The arrival of the collection vehicle at the collection points will be announced at short intervals through an acoustic signal (special horn, bell etc.),
  8. Collection will be done only at designated points in the city and district the locations of which must be made known to local residents and establishments.
  9. The schedule and route of the collection trucks must be disseminated to the entire Sangkat Kep and Kep City/Town.
  10. The use of compaction trucks should be encouraged due to improved loading and consequently collection efficiency, enclosed SW transport and improved working conditions.
  11. In addition,  $1 \times 8\text{m}^3$  and  $1 \times 5\text{m}^3$  septage collection trucks will be included in the tender.
93. Recommended Collection System for Kep Province
1. A privately-run, segregated waste collection system is recommended for Kep City/Town and Sangkat Kep. As cited above, the government shall progressively deploy waste bins which will accommodate the two (2) types of wastes namely: wet/biodegradable and dry/potentially recyclable.
  2. The City and the District government should progressively support containerization of solid waste through the deployment of wheeled HDPE bins for the next three years. The minimum capacity of these bins should be 240 liters. The new bins which will be acquired must be compatible with the truck collection fleet.
  3. Plastic bins on wheels will be included for the core area with a range of bin sizes from 120 l to 660 liters. The bigger 660 l will be for rural areas and low-income urban areas to be deployed at central collection points.
  4. Bins and trucks will be with provisions for mechanical loading into the compactor trucks.
  5. Collection of wet biodegradable waste shall be done twice a week for urban Kep City/Town and once a week for rural Sangkat Kep. Collection of dry and potentially recyclable waste shall be done once a week at Kep City/Town and once in two (2) weeks shall be done for Sangkat Kep.

7. Waste will be collected at the designated times and locations along the curb except for establishments with door-to-door arrangements.
8. The system shall utilize a fleet of compactor trucks for waste collection.
9. Recovery of recyclables from waste bins and collection trucks shall not be allowed.
10. Mixed waste shall not be collected.
11. As introduced above, a major O&M program and education campaign will be needed to create and to sustain awareness with the municipality and the community for the need for waste segregation at source, and to establish knowledge of what constitutes recyclable material.

#### IV. DESCRIPTION OF AFFECTED ENVIRONMENT

##### A. Overview of Physical Southern-coastal Cambodia

##### 1. Physical Resources

##### a. Climate

94. Southern Cambodia experiences a tropical monsoon climate with two distinct seasons defined by; (i) 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.

**Table 5. Rainfall data from 2011-2015**

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	No	De	
2011	1.2	12.8	12.6	119.8	97	277.6	355	442.8	732.5	131.9	44.7	5.4	2346.7
2012	47	126.6	97.4	108.1	394.9	273.3	397.4	271.8	714.9	169	145.8	12.2	2758.4
2013	6.6	27.4	69.8	187.6	237.2	312.7	608.4	319.5	459.5	294.3	114.2	44.8	2682.2
2014	00	0.4	23.4	49.6	121	491.6	591.9	412.3	513.1	252.9	165	104.4	2725.6
2015	2.8	16	27.4	50.8	190.4	459.2	321.1	458.2	636.4	146.2	184.5	25.7	2504.3
Ave	11.5	33.8	68.8	103.2	208.1	362.9	454.7	381	611.3	198.9	130.8	38.5	2603.4

(Source: Ministry of Water Resources and Meteorology, 2015)

95. The average highest rainfall is in July 454.7 mm and the lowest rain fall is in Jan 11.5 mm (Table 6). The average annual rainfall in Preah Sihanouk City is 2,603.4 mm with the greatest recorded total annual rainfall of 2,758.4 mm in 2012.

**Table 6: Humidity levels (%) from 2011-2015**

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	No	De	
2011	76.5	80.8	87.1	81.0	80.6	82.5	84.1	85.5	86.3	83.5	81.4	76.3	82.1
2012	56.3	60.1	61.6	65.1	61.9	65.5	79.0	75.4	86.2	80.2	77.6	71.2	70.0
2013	68.3	70.9	59.7	70.8	71.0	78.3	82.0	82.0	81.8	80.7	72.9	64.3	73.6
2014	76.9	77.4	78.4	78.1	78.8	81.1	80.9	80.0	80.8	79.3	78.8	75.9	78.9
2015	80.1	82.3	81.6	80.2	79.5	81.8	81.5	83.6	85.0	85.7	82.0	77.0	81.7
<b>Average</b>	<b>71.6</b>	<b>74.3</b>	<b>73.7</b>	<b>75.0</b>	<b>74.4</b>	<b>77.8</b>	<b>81.5</b>	<b>81.3</b>	<b>84.0</b>	<b>81.9</b>	<b>78.5</b>	<b>72.9</b>	<b>77.3</b>

(Source: Ministry of Water Resources and Meteorology, 2015)

96. The average highest humidity is in September 84 % and the lowest is in January (71.6 %) (Table 7). The average annual humidity in Preah Sihanouk City is 77.3 % with the greatest recorded total annual 82.1 % in 2011.

**Table 7: Average temperature from 2010-2014**

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	No	De	
2010	27.75	28.75	30.25	30.25	29.75	28.75	28	26.5	26.5	27.25	27.25	27.25	28.19
2011	26.75	29	25.75	28.45	28.25	27.25	27.75	26	27.25	28	27.75	25	27.27
2012	28.35	26.5	28.25	28.75	30.75	28.75	27.75	26.5	26.65	27.75	26.75	27.25	27.83
2013	27.7	28	29	29.75	29.25	28.5	25.5	27.75	27.5	28	28.1	25.5	27.88

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	No	De	
2014	25.95	26.95	28.05	29.15	29.7	28.3	27.2	27.85	27.45	28.4	28.35	27.45	27.9
<b>Average</b>	27.30	27.84	28.26	29.27	29.54	28.31	27.24	26.92	27.07	27.88	27.64	26.49	27.81

(Source: Ministry of Water Resources and Meteorology, 2015)

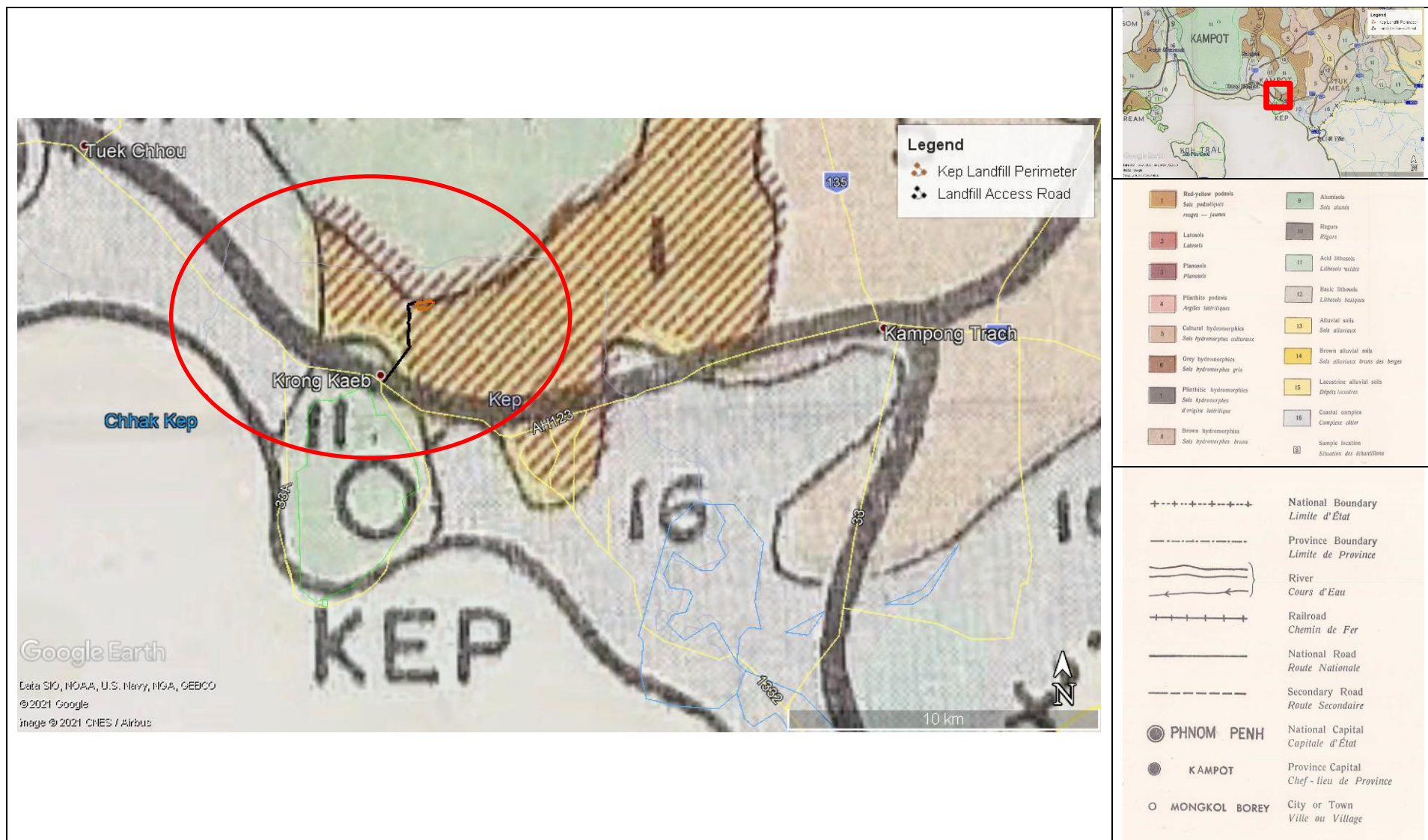
97. Average highest temperature is in April (29.5°C) and the lowest temperature is in December (26.5 °C) (Table 8). Average annual temperature in Preah Sihanouk City is 27.8 °C.

## b. Soils

98. The soils of coastal Kep are dominated by a mix of old and young alluvium soils of sediment deposits from rivers and streams (Figure 22). These are mainly finer sediments. A high concentration of silt is found in the coastal and nearshore areas. Alluvial deposits normally result in fertile land. The soil type at the Kep dumpsite was determined as part of the DED of the new SLF which is provided below.

## 2. Forest Areas

99. The forest types and areas of Cambodia are shown in Figure 23**Error! Reference source not found..** Most of the major forests are situated in the southeastern, central, and northeastern regions of the country. Forest cover in Kep is relatively sparse due to long past land clearing deforestation with the closest major forests being evergreen and located in Kep National Park north of Kep town (**Error! Reference source not found.**Figure 23**Error! Reference source not found.**). The vegetation at the Kep dumpsite is comprised of low scrub trees, shrubs, and grasses.



Source: Panagos P., Jones A., Bosco C., Senthil Kumar P.S. European digital archive on soil maps (EuDASM): Preserving important soil data for public free access (2011) International Journal of Digital Earth, 4 (5), pp. 434-443. [https://esdac.jrc.ec.europa.eu/ESDB\\_Archive/EuDASM/Asia/lists/ckh.htm](https://esdac.jrc.ec.europa.eu/ESDB_Archive/EuDASM/Asia/lists/ckh.htm)

**Figure 22. Soil types of Cambodia**



**Figure 23: Forest cover in Cambodia**



## B. Kep province

100. Kep province is coastal but is situated inside Kampot province. Kep town consists of 4 main Sangkats.

### 1. Topography

101. The topography of Kep province consists of a mix of lowland and upland areas. The lowland periphery of Kep consists of coastal beaches, scattered mangrove forests extending east to Kep province (surrounded by Kampot province), and scattered aquaculture. North of the coast of Kep town topography rises abruptly to an elevated plain that has been designated a water recharge zone. Across the elevated plain area is scattered agriculture and patchy forest.

#### a. Soil quality at Kep dumpsite

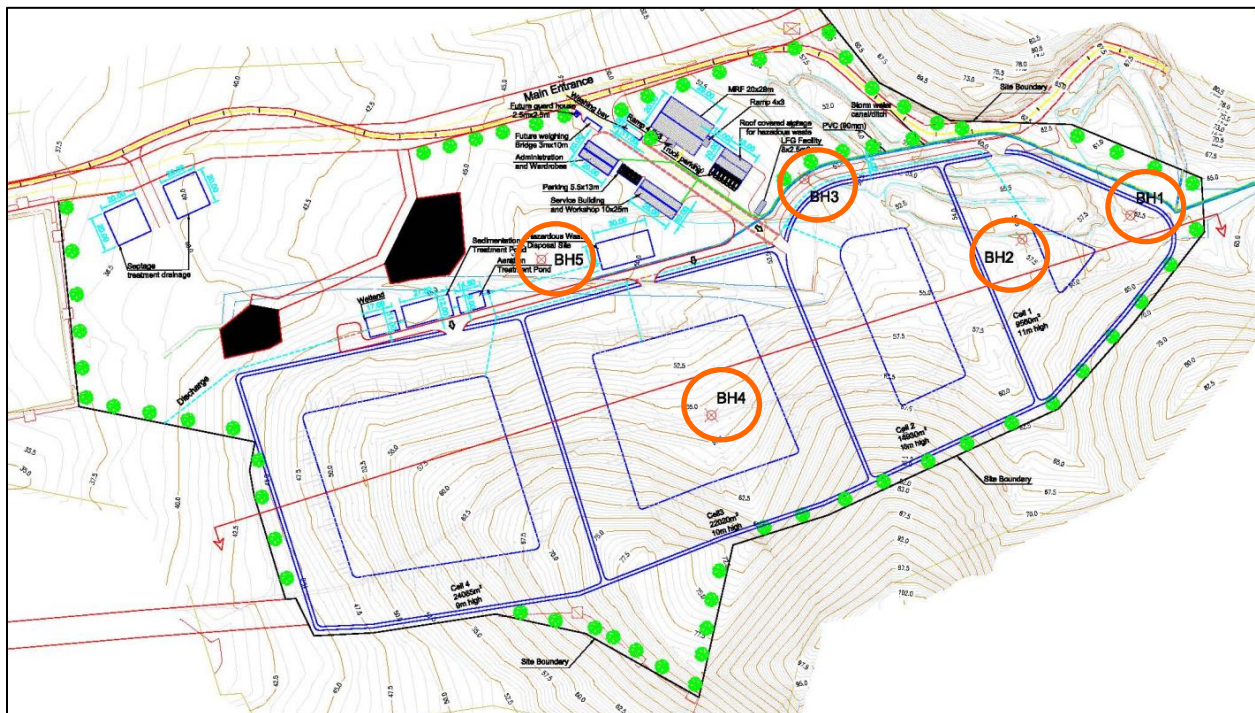


Figure 24: Borehole location

102. As part of the preparation of the DED of Solid Waste Management Improvements in Kep five test boreholes (BH1 – BH5) were drilled to determine the soil type and permeability. The water table depth and groundwater quality were also determined at the borehole sites. Table 9 summarizes the location and purposes of the test boreholes.

**Table 8. Summary of test boreholes at Kep dumpsite (future SLF)**

Borehole Designation	Depth (m)	Latitude	Longitude	Purpose	Remarks
BH1	20	10.563942°	104.333908°	Observation well, water quality sampling	Hole should extend 5 meters after the water table
BH2	20	10.563821°	104.333359°	Foundation, water quality sampling	
BH3	20	10.564120°	104.332249°	Foundation, water quality sampling	
BH4	20	10.562934°	104.331779°	Foundation, water quality sampling	
BH5	20	10.563714°	104.330912°	Foundation, water quality sampling	

Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.

103. **Table 9** presents a summary of the results of the drilling results at Kep SLF site and the range of the indicative unconfined compressive strengths of the subsurface materials. These were based on the standard penetration tests performed at the soil sections and the rock quality designation of the recovered core fragments. Also included in **Table 9** is the depth (m) of the water table below ground surface (mbgs).

**Table 9. Summary of soil type and water table depth at test boreholes**

Bore hole	Depth (m)	Soil type	N Value	Unconfined Compressive Strength KN/m <sup>2</sup>	Static Water Table Depth (mbgs)
BH1	0 to 4	Clayey fine to coarse gravel	13 to 20	400 to 900	3.32
	4 to 20	Weathered metamorphic rock		1520 to 1650	
BH2	0 to 3.5	Clayey fine to coarse gravel	15 to 67	800 to 1700	1.67
	3.5 to 20	Weathered metamorphic rock		1700 to 2040	
BH3	0 to 3.5	Clayey fine to coarse gravel	69 to 77	1500 to 1700	0.9
	3.5 to 20	Weathered metamorphic rock		1530 to 2810	
BH4	0 to 6	Clayey fine to coarse gravel	28 to 42	900 to 1100	3.3
	6 to 20	Weathered metamorphic rock		1330 to 2800	
BH5	0 to 8	Clayey fine to coarse gravel interlayered with	10 to 45	300 to 350	3.13
	8 to 20	Weathered metamorphic rock		1380 to 3600	

Source: Norconsult, 2018. Detailed Engineering Design Support, Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project, Interim Report.



104. **Table 9** indicates that the site is underlain by two types of soil material, namely an upper layer of clayey fine to coarse gravel and a lower layer of weathered and fractured metamorphic rock. The clayey gravels range in thickness from 3.50 to 8 meters. The thickest section occurs within the vicinity of BH5. The unconfined compressive strength ranges from a low of 300 to a high of 1700 KN/m<sup>2</sup>. The low numbers correspond to the sections where the clay fractions are dominant as in the upper 2 meters of BH1 to BH4 and the upper 6m of BH5.

105. The weathered metamorphic rock extends from the bottom of the clay layers down to the drilled bottoms of the respective boreholes. As shown, it has a thickness ranging of at least 14 m - BH5 to 16.5m at BH2 and BH3. The unconfined compressive strength ranges from 1330 to 3600 KN/m<sup>2</sup>. These values are correlated to the remaining rock portions of the drilled materials.

106. Overall, the weathered metamorphic rock corresponds to the more stable foundation in the area. During site development, the upper layers could be partially stripped and used as foundation subject to proper compaction. For the MRF, administrative building and service building, the clayey gravels should be compacted to attain the desired bearing capacity. If predominantly clayey materials will be encountered during site grading, then these could selectively be replaced with engineered fill.

107. Permeability tests have not been conducted for the drilled layers. The predominant presence of the gravels from the ground surface to the depth range of 4 to 8 meters have imparted a degree of permeability to the upper soil layer. This condition would require the use of an HDPE liner which would satisfy the international requirements for the design and construction of a controlled landfill. The upper clayey gravels would serve as the supplementary geological layer prior to the placement of an HDPE liner. The clayey gravels and underlying weathered metamorphic rocks could be used for soil cover of the landfill cells.

108. Table 9 indicates that the water table is relatively close to the surface in the vicinity of BH2 and BH3. This condition limits the depth of excavation for the proposed Cell 1 and in the northern section of Cell 2. In such a case, the waste cell height could be increased to attain the desired design volume for the waste. Water table at BH4 and BH5 is deeper which will allow a deeper excavation for the cells which will translate to additional space for the waste.

## **2. Groundwater quality at Kep dumpsite**

109. Groundwater quality was determined at BH1, BH2, BH3 and BH5 (Figure 24). BH1 was drilled on the old waste piles, whereas BH2, BH3 and BH5 were located away from the current waste piles. As indicated above (Table 9) groundwater in these boreholes occur at shallow depths within the fractured metamorphic rocks. Table 10 summarizes the groundwater quality analyses that were conducted by the Ministry of Environment (MOE) of Cambodia.

**Table 10. Groundwater quality at test boreholes and Kep SLF site**

Parameter	Units	Cambodia Standard	WHO Standard	BH1	BH2	BH3	BH5	Remarks
pH		6.5-8.5	6.5-8.5	6.5	5.94	6	5.8	Passed
Electrode Conductivity (EC)	µS/cm	No guideline	No guideline	382	279	574	184	
Total Dissolved Solids (TDS)	mg/l	800	No guideline	248	275	252	119	
Dissolved Oxygen (DO)	mg/l	No guideline	No guideline	1.79	0.8	1.43	2.64	
Chemical Oxygen Demand(COD)	mg/l	No guideline	10	ND	ND	ND	ND	
Oil & Grease	mg/l	No guideline	No guideline	3.6	6.7	1.2	3.4	
Ammonia (NH <sub>3</sub> )	mg/l	< 0.5	No guideline	0.35	0.19	0.41	0.22	Passed
Ammonium(NH <sub>4</sub> )	mg/l	No guideline	No guideline	0.38	0.22	0.51	0.31	
Detergents(MBAS)	mg/l	No guideline	No guideline	ND	ND	ND	ND	
Nitrite(NO <sub>2</sub> )	mg/l	< 3.0	< 3.0	ND	ND	ND	ND	Passed
Nitrate (NO <sub>3</sub> )	mg/l	< 50	< 50	0.18	0.15	1.8	0.9	Passed
Phosphate(PO <sub>4</sub> )	mg/l	No guideline	No guideline	0.28	0.13	0.3	0.54	
Total Nitrogen	mg/l	No guideline	No guideline	0.26	0.22	0.37	0.32	
Total Phosphorus(TP)	mg/l	No guideline	No guideline	0.01	0.13	0.02	0.01	
Arsenic(As)	mg/l	< 0.05	0.01	0.001	0.001	0.0006	0.001	Passed
Cadmium (Cd)	mg/l	< 0.003	< 0.003	0.0002	0.0004	ND	0.0009	Passed
Copper (Cu)	mg/l	< 0.001	1	0.02	0.01	0.007	0.03	Passed
Iron (Fe, total)	mg/l	< 0.3	No guideline	5.59	3.83	2.9	11.64	Exceeded national standard/ limit
Lead(Pb)	mg/l	< 0.01	0.1	0.006	0.004	0.006	0.008	Passed
Zinc (Zn)	mg/l	< 3.0	3	0.02	0.02	0.02	0.04	Passed

110. In general, groundwater quality meets Cambodian and WHO standards for the parameters tested except for total Iron (Fe). The pH is indicative of the slightly acidic nature of the groundwater in the area which may have increased the solubility of Fe and become more released from the soil. The low concentrations of heavy metals reflect the low mineral content of the drilled metamorphic rock. pH falls, heavy metal solubility increases, and then they become more released. The detected oil and grease values are believed to be contamination from the lubricants used with borehole drilling rig.

111. The area has not been used for cultivation and it is very likely that fertilizer has not been applied on the ground. This condition explains the absence of or low values of the typical fertilizer components such as nitrite, nitrate, ammonia, ammonium, phosphorus and phosphate. The low DO values are typical of groundwater. The uninhabited condition of the site explains the absence

of detergents, low levels of nitrite and nitrate. The latter two nitrogen ions are usually discharged from septic tanks.

112. The electrical conductivity and TDS levels are typical of fresh groundwater. The values of the electrical conductivity (EC) and TDS of BH2 and BH 5 are unusual in the sense that TDS generally correspond to 50 to 70% of the numerical value of the EC. The value of the EC and TDS are inferred to correspond to the more realistic values of these parameters in the landfill area.

113. The laboratory test results of BH1 are essentially within the same range as those of BH2, BH3 and BH5. This suggests that the waste pile through which BH1 has been drilled has not affected the water quality in the area. Thus, the clayey fraction below the dumpsite likely forms a natural barrier or trap which will minimize the down gradient movement of leachate from BH1 to BH3.

### 3. Surface Water Quality

114. 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 to pollution from untreated effluents, land erosion, and agriculture chemicals.



Figure 25: Sampling site in Koh Pou

**Table 11. Water quality in Koh Pou Kep.**

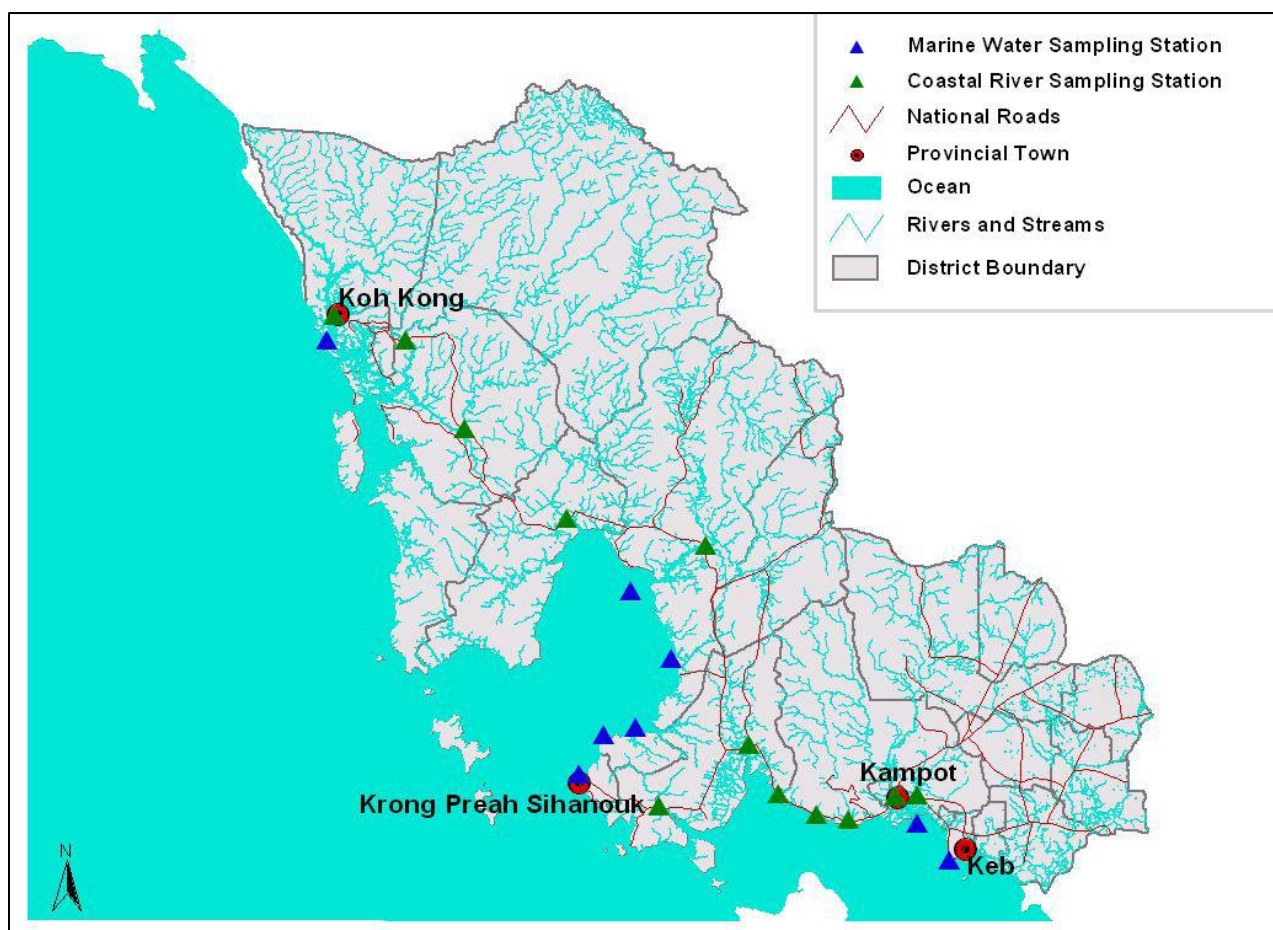
No	Parameters	Unit	Government Standard	Results				Remarks
				L1	L 2	L 3	L 4	
1	pH		7-8.3	7.56	7.72	7.64	7.75	Passed. Within local standard
2	Temperature	°C	< 45	21.80	21.65	22.01	22.08	Passed
3	TDS	mg/l	<1000	11.59	11.63	11.95	11.49	Passed
4	DO	mg/l	2.0-7.5	6.35	6.49	6.65	5.88	Passed
5	TSS	mg/l	25-100	220	230	250	220	Elevated TSS. Above local standard
6	Chloride (Cl)	mg/l	<500	561	573	540	573	Elevated Cl. Above local standard
7	Nitrate	mg/l	< 10	0.52	0.57	0.58	0.63	Passed
8	Phosphate	mg/l	<3.0	ND	ND	ND	ND	Passed
9	Sulphate	mg/l	< 300	0.39	0.49	0.58	0.82	Passed
10	Ammonium	mg/l	<1.0	0.10	0.15	ND	ND	Passed
11	BOD5	mg/l	1-10	0.86	0.91	0.89	0.93	Passed
12	COD	mg/l	2-8	2.19	2.86	2.98	3.19	Passed
13	Total Nitrogen	mg/l	0.2-10	0.60	0.60	0.53	0.59	Passed
14	Total phosphorus	mg/l	0.02-0.09	0.03	0.02	0.03	0.04	Passed
15	Arsenic (As)	mg/l	<0.01	ND	0.001	ND	ND	Passed
16	Iron (Fe)	mg/l		0.07	0.10	0.13	0.16	
17	Lead	mg/l	0.01	ND	ND	ND	ND	Passed
18	Mercury	mg/l	0.005	ND	ND	ND	ND	Passed
19	Total Coliform	mg/l	<1000	6.4x10 <sup>2</sup>	4.3x10 <sup>2</sup>	9.3x10 <sup>2</sup>	1.5x10 <sup>2</sup>	Passed
20	E-Coli	mg/l		36	30	74	110	
21	Detergent	mg/l	0.02	ND	ND	ND	ND	Passed
22	Oil and Grease	mg/l		0.48	0.78	1.39	1.60	

115. For completeness a summary of earlier sampled water quality during the dry season at river and coastal sites is in Table 12. Recent water quality survey sites for Kep are shown in **Figure 26**<sup>14</sup> and summarized in **Table 12**. Comment. Note that the landfill site north of Kep town is not near surface waters (lake, river and stream).

<sup>14</sup> DOE and Danida, 2006. Second Annual Monitoring report for Coastal Rivers and Nearshore Coastal Waters of Cambodia.

**Table 12: Dry-season River and Coastal Water Quality 2005 - 2006**

Parameters	Unit	Government Standard	Average	Maximum	Minimum	Remarks
288 samples from 12 river sites						
Temp	°C		30.5	33.2	27.6	
pH		7 - 8.5	7.7	8.1	7.3	Passed
Salinity	%		12.9	20.3	3.8	
Secchi depth	m		1.4	1.9	0.8	
total suspended solids (mg/l)	mg/l	25-100	11.1	26.5	2.7	Passed
dissolved oxygen (mg/l)	mg/l	2.0 - 7.5	5.2	6.1	4.5	Passed
biological oxygen demand mg/l)	mg/l	1 - 10	0.7	1.2	0.4	Passed
total nitrogen (mg/l)	mg/l	0.2-10	0.09	0.18	0.04	Passed
total phosphorous (mg/l)	mg/l	0.02-0.09	0.008	0.02	0.002	Passed
96 samples from 8 Coastal sites						
Temp	°C		29.6	32.5	26.1	
pH		7.0 – 8.5	7.8	8.1	7.6	Passed
Salinity	%		25.8	30.1	20.8	
Secchi depth	m		1.9	2.3	1.3	
total suspended solids	mg/l	25-100	17.7	37.6	3.1	Maximum reading is above standard
dissolved oxygen	mg/l	2.0 - 7.5	5.3	6.0	4.7	Passed
biological oxygen demand	mg/l	1 - 10	0.7	1.1	0.3	Passed
total nitrogen	mg/l	0.2-10	0.1	0.21	0.05	Passed
total phosphorous	mg/l	0.02 – 0.09	0.008	0.018	0.002	Passed



**Figure 26. Water quality sampling sites in Kampot and near Kep**

#### **4. Air quality**

116. Air quality for Kep is provided in Table 13. The sample was taken in Koh Pou (see Figure 25).

**Table 13. Air quality in Koh Pou, Kep**

No	Parameters	Unit	Standard	Koh Pou	Remarks
1	Carbon monoxide	mg/m <sup>3</sup>	20	0.47	Passed
2	Nitrogen Dioxide	mg/m <sup>3</sup>	0.1	0.013	Passed
3	Sulfur Dioxide	mg/m <sup>3</sup>	0.3	0.07	Passed
4	Total Suspended Particle (TSP)	mg/m <sup>3</sup>	0.33	0.076	Passed
5	Ozone (O <sub>3</sub> )	mg/m <sup>3</sup>	< 0.2	0.02	Passed

(Source: IEIA report, 2017)

### **C. Biological Resources**

#### **1. Protected Areas**

117. There are three ecological protected areas near the three subproject areas (Figure 27 and Figure 28). Kep national park and Ream national park are close to Kep and Preah Sihanouk City towns but well away from the subproject areas. Important bird habitat areas exist in Cambodia,

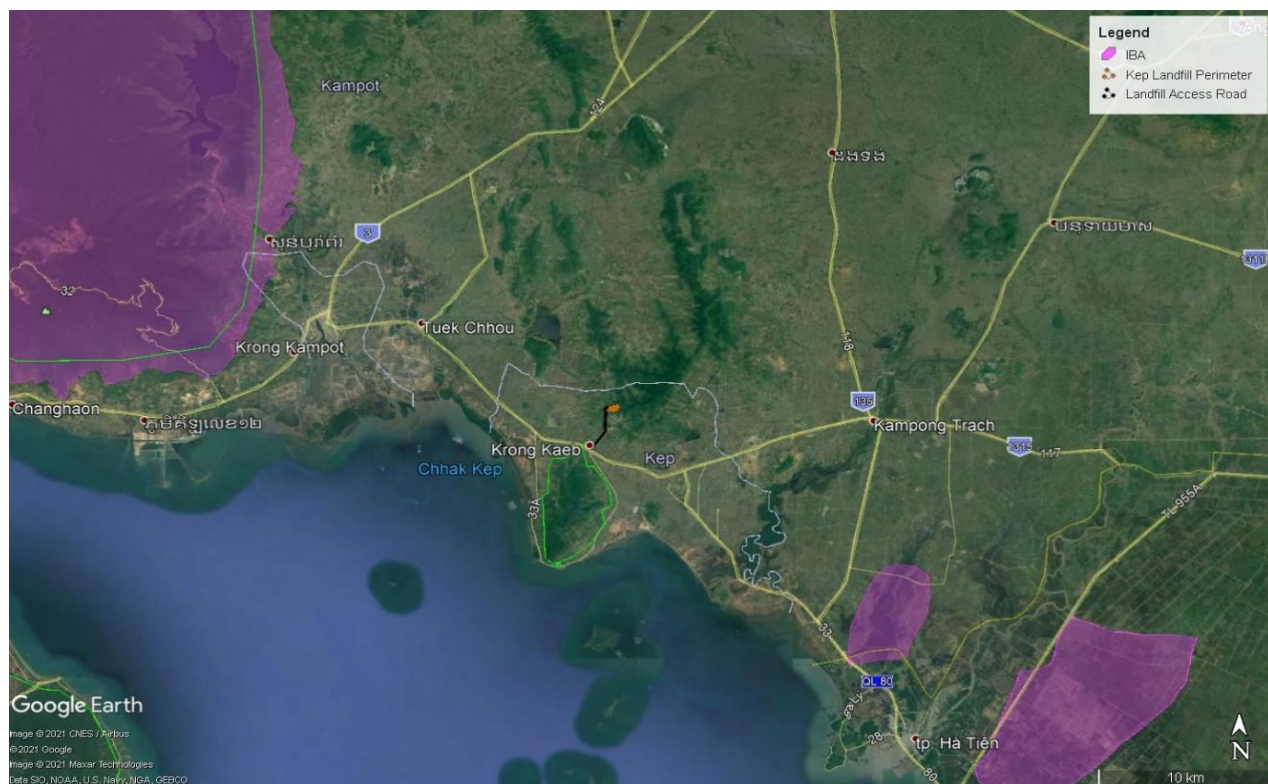


which includes Preah Sihanouk province (Figure 28). shows nearest IBAs to Kep SLF site are well outside the province located in Takeo and Kampot provinces.

118. The Integrated Biodiversity Assessment Tool (IBAT) used by ADB was applied to the Kep subproject area. The output of the software tool (Appendix D) supports the reality that the subproject site in Kep is not inside ecological protected areas.



**Figure 27. Kep National Park**



Source: Data from <https://www.ibat-alliance.org/> and overlaid in google earth image.

**Figure 28. Important Bird areas in national parks near Kep**

#### **D. Land Use & Socio-economy**

119. Land use in Kep Province ranges broadly from the urban settlements of each town to mixed agriculture including the salt farms, aquaculture, fishing. Urban areas rely heavily on tourism.

#### **E. Features of subproject affected areas**

120. The area influenced<sup>15</sup> by subprojects in Kep province are shown in Figure 29. Kep Solid Waste Management subproject is defined by a relatively isolated dumpsite. The environmental quality of Kep urban-suburban areas will be influenced by improvements to Kep solid waste management. The target impact of the subproject is defined by a cleaner and healthier urban and peri-urban Kep environment. The Kep crab market and nearby beach hotels will benefit directly from improved solid waste management. Indirectly, improved solid waste management should increase tourism in the town and vicinity and strengthen the urban socio-economy. There are no facilities associated with the existing dumpsite. The nearest building to the dumpsite is a single hut located about 700m south in a mango plantation which is used as a guard post for the plantation. The nearest village is Damnak Chang'aur village which is located 2km south of the dumpsite just south of the railway crossing on the access road. The nearest school is in Damnak Chang'aur village. The nearest clinic/hospital, pagoda, and other cultural resources are located 5-6 km south of the dumpsite in Kep. There are casual day waste pickers at the dumpsite who transport their recycled material to Kep town. There are no buildings on the landfill site and it was confirmed that the waste pickers live off-site.

<sup>15</sup> As per SPS (2009), Appendix 1, para 6



Access road into dumpsite north of Kep town.



Dumpsite north of Kep town.

**Figure 29. Existing dumpsite north of Kep town.**



## **V. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIONS**

121. The assessment of potential impacts is structured by the three development phases: a) *pre-construction*; b) *construction*; and c) *post-construction operational* 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.

122. 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.

### **A. Subproject Benefits**

123. The environmental benefits of the subprojects which also reflect input from the public consultations, are summarized below:

#### **1. Detailed Engineering Design (DED) of Kep Solid Waste Management Improvements**

124. The existing arrangements for solid waste management in Kep Province are inadequate, characterized by low coverage, lack of sanitation awareness, and an open, unmanaged dumpsite. The subproject will address these problems by expanding the quality and coverage of solid waste collection and treatment services, upgrade the dumpsite to a managed landfill (9ha) on public land, and support sanitation and waste management awareness programs. The upgraded landfill and solid waste management system will increase, and make more efficient solid waste removal from the streets and beach areas in Kep City/Town.

125. The upgraded landfill and MRF design will also reduce pollution at the landfill site and along the access road to the landfill. The managed waste cells overlying an impermeable liner, leachate collection and recycling, and gas capture and flaring at the landfill will protect groundwater, improve air quality, and reduce litter at the site thereby improving the natural environment and working conditions of the operators of the SLF including the current waste pickers who will be moved inside to work in the MRF. No waste picking on the engineered waste cells is anticipated. The provision of new waste compactor trucks will prevent spillage of garbage along the access road to the landfill and odor that was reported by residents along the road during the public consultations.

126. The upgraded solid waste management system will assist implementation of the sub-decree on Solid Waste Management (April 1999), sub-decree on Garbage and Urban Solid Waste Management (2015) and Technical Guideline on Garbage and Urban Solid Waste Management (2016). The sub-decree and guideline provide technical standards for all activities related to disposal, storage, collection, transportation, recycling, dumping of municipal and hazardous waste as well as landfill site selection. The subproject will benefit Kep urban core with a residential population of 9,000, 95 hotels, 52 restaurants/cafes, and various other commercial outlets.

#### **a. Materials Recovery Facility**

127. The materials recovery facility (MRF) to be constructed at the upgrade SLF in Kep will be organized, compliant to health and safety guidelines and more efficient compared to the current limited practice of solid waste recycling at the existing dumpsite. The MRF will improve and

provide more sanitary working conditions of garbage pickers while improving the efficiency and opportunities for reduction, recycling and reuse of solid waste. The MRF will increase the volume of recyclables using sanitary facilities and practices.

128. The revised design of the SLF and its MRF will reduce pollution at the SLF and along the access road to the SLF. The managed network of modern waste cells overlying an impermeable HPDE liner, leachate collection and treatment facility, and landfill gas (LFG) capture system will protect groundwater, reduce GHG emissions if LFG flare required, improve local air quality, and reduce litter at the site thereby improving the natural environment and working conditions of SLF workers including the waste pickers who will be employed inside the new MRF. The provision of new waste compactor trucks will prevent spillage of garbage along the access road to the new SLF, and odor that was reported by residents along the road during the public consultations.

#### **b. Septage Treatment Facility**

129. The septage treatment facility at the upgraded controlled landfill will contribute to overall environmental improvement in Kep town, and especially the crab market, by providing a location for septic tank sludge to be deposited and treated safely.

### **B. Subproject Impacts and Mitigations**

#### **1. Pre-construction Phase**

130. The DED of the Kep subproject addressed the key climate change mitigation and resilience measures that were identified by the CRVA as presented in Chapter III.

131. The Kep Landfill and related access road improvement do not present negative impacts associated with land acquisition. The potential social impacts of the DED of Kep subproject were reviewed. The second series of public consultations conducted in Kep province as part of the DED in October /18 confirmed that no resettlement or land acquisition compensation will be required.

#### **a. Unexploded ordnance (UXO)**

132. Kep Province specifically in the district of Damnak Chang'aeur is included in the list<sup>16</sup> of areas known or suspected to contain UXO. At the time of updating this IEE document, UXO clearing activity has been conducted at the project site. UXO clearance was issued on 2020 June 18 (Please see Appendix C).

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<sup>16</sup> Sophakmonkol, Prum. Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction. 30 April 2018.

## **b. Updating EMPs**

133. The EMP for Kep the subproject has been updated to meet the DED of the Improvements to Solid Waste Managements at Kep province. This report 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.

134. Key impact mitigation measures of the pre-construction, DED phase for Preah Sihanouk subprojects will be:

- 1) Initiation of the resettlement and/or compensation plan, and GRM for the two subprojects;
- 2) Completion of detailed designs of both subprojects; and
- 3) Updating the IEE and EMP accordingly.

135. The DED of the Kep subproject, including the soil type/permeability analyses, and the water table depth and groundwater quality analyses (Tables 10 and 11) as expressed in the updated IEE and updated EMP. The DED of the Kep updated SLF including the soil and groundwater analyses together serve as the comprehensive corrective environmental action for the existing Kep dumpsite as dictated by the ToR for Environmental Compliance Audit (ECA) of the dumpsite that was appended to the original IEE for Cambodia. Additionally, the DED of SLF complies with the key siting and operation criteria of (MOE 2016) with which the existing dumpsite did not comply (see below).

## **2. Construction Phase**

### **a. Common potential impacts of components of subprojects**

136. Potential environmental impacts of the Kep Landfill subproject occur during construction phase from short-term disturbances and impacts caused by the construction of individual subproject components. Common impacts of the civil works will consist as the following: reduced and/or blocked public access to areas, disrupted business and recreation, noise disturbance, dust emission and air pollution caused by increased truck traffic and heavy equipment used, soil and surface water pollution caused by equipment operation (construction activities) and maintenance and liquid leakage, public and worker accidents, increased traffic congestion and traffic accidents, land erosion and shoreline sedimentation and marine pollution at the sites of the two piers, localized drainage and flooding problems, solid waste and domestic pollution from worker camps and construction materials, and communicable diseases and other social problems caused by migrant workers, interrupted local communities and tourism activities. 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**

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

138. The mitigation measures below will be applied as appropriate in the EMP for the Kep subproject. These generic construction mitigation measures are comprehensive at the feasibility design stage to ensure that a mitigation measure for the impact of a final design feature whether



the Kep landfill, and road or associated facilities is not overlooked during the detailed design stage. The contractors will be required to include these measures in their site-specific construction EMPs (CEMPs) which will be submitted to the project management and civil engineering support consultant (PMCES) and the PMUs for review and approval prior to construction. Monitoring will be carried out by the PMCES during the construction period.

**139. Air pollution control.** Contractors shall be included all necessary measures and existing relevant laws/regulations to prevent or minimize air pollution and dust development by implementing the following air quality control measures. Most of these generic measures are applicable to all construction sites and construction activities as good practice, and are also described in the World Bank Group/IFC's EHS guidelines.

- (i) Assign daily haulage schedules along NR 33 and up Kep SLF access road to avoid high local traffic times (e.g., early morning late day), and develop the dust control management plan as well.
- (ii) Set enforced speed limit on the access road to Kep dumpsite in front of Damnak Chang'aeur village at 40km/h
- (iii) Spray water or other wetting agents such as calcium chloride ( $\text{CaCl}_2$ ) regularly on unpaved haul roads and access road (at least once a day) to suppress dust; and erect hoardings around dusty activities. Have a water truck on site at all times. Cover material stockpiles with dust shrouds or tarpaulin. For the backfill earthwork management measures will include surface press and periodic spraying and covering. The extra earth or dredge material should be cleared from the project site in time to avoid long term stockpiling.
- (iv) Minimize the storage time of construction and demolition wastes on site by regularly removing them off site.
- (v) Regularly monitor air quality at construction site boundaries in order to ensure that the air quality at all constructions sites are not exceeded the Cambodian standard.
- (vi) Site asphalt mixing and concrete batching stations at least 300 m downwind of the nearest air quality protection target.
- (vii) Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions.
- (viii) Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads.
- (ix) Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use.
- (x) Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.
- (xi) In periods of high wind, dust-generating operations shall not be permitted within 200 m of residential areas. Special precautions need to be applied near sensitive receptors such as schools, kindergartens and hospitals.
- (xii) To avoid odor impacts caused by shoreline sediment dredging for pier or bridge foundations, transport dredged sediment in closed tank wagons to contain odor and prevent scattering along the way.
- (xiii) Unauthorized burning of construction and demolition waste material and refuse is prohibited.

140. **Construction noise.** Contractors should be required to implement the following mitigation measures and relevant laws/regulations for construction activities to meet Cambodian and IFC/WHO recommended environmental noise standards and to protect sensitive receptors. Some measures are generic and are applicable to all construction sites and activities. They represent good practice and are effective measures and are in line with IFC's EHS guidelines.

- (i) During daytime construction, the contractor will ensure that: (1) noise levels from equipment and machinery conform to the IFC EHS Standards, and properly maintain machinery to minimize noise; (2) equipment with high noise and high vibration are not used near residences and only low noise machinery or the equipment with sound insulation is employed; (3) sites for concrete-mixing plants and similar activities will be located at least 300 m away from the nearest noise protection target; and (4) temporary noise barriers or hoardings will be installed around the equipment to shield residences when there are residences within 20 m of the noise source.
- (ii) No construction should be allowed between the night time hours of 20:00 to 07:00.
- (iii) Regularly monitor noise levels at construction site boundaries. If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation. Especially, the noise level within the project sites are based on Cambodian laws/regulations as well as MoE.
- (iv) Provide the construction workers with and ensure the use of suitable hearing protection (ear muffs) according to the worker health and safety requirements of Cambodia.
- (v) Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition.
- (vi) Limit the speed of vehicles travelling on site (less than 8 km/h), forbid the use of horns unless absolutely necessary, minimize the use of whistles.
- (vii) Maintain continual communication with Damnak Chang'aur village in Kep near the construction sites, and avoid noisy construction activities during affected school examination periods.

141. **Surface water & coastal pollution.** The contractors should be implemented the following mitigation measures to prevent water pollution:

- (i) Portable toilets and small package wastewater treatment plants will be provided on construction sites and construction camps for the workers and canteens. If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers.
- (ii) Sedimentation tanks will be installed on construction sites to treat process water (e.g. concrete batching for pier construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide will be used to facilitate sedimentation.
- (iii) Construction machinery will be repaired and washed at dedicated repairing shops. No onsite machine repair and washing shall be allowed.
- (iv) Material stockpiles will be protected against wind by being covered and runoff waters which might transport them to surface waters.
- (v) Dedicated fuel storage areas must be established away from public areas and marked clearly.
- (vi) Storage of bulk fuel should be on covered concrete pads away from the public and worker camp, and 300m from surface waters. 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.
- (vii) Regularly monitoring the surface water quality within the project sites and vicinities area in order to meet with the requirement laws/regulations
- (viii) Worker camps have to build far away from the water sources and well as from the ground water sources,
- (ix) Berms and/or silt curtains will be used around all excavation/trench sites and along all surface waters to prevent soil erosion and surface water sedimentation.

142. **Earthworks & soil erosion mitigation.** The contractors should be implemented the following mitigation measures related to earthwork management:

- (i) Present and past land use should be reviewed to assess whether excavated soils are contaminated spoil. Contaminated spoil should be disposed at a nearby landfill or a location approved by DOE.
- (ii) Confirm location of the borrow pit and temporary spoil storage and final disposal sites, securing permits from relevant DOE.
- (iii) Develop borrow pit and spoil disposal site management and restoration plan, to be approved by responsible authority; obtain permit for the clearance of excavated earthworks.
- (iv) Construct intercepting ditches and drains to prevent runoff entering construction sites, and diverting runoff from sites to existing drainage.
- (v) Construct hoardings and sedimentation ponds to contain soil loss and runoff from the construction sites.
- (vi) Limit construction and material handling during periods of rains and high winds.
- (vii) Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are going on.
- (viii) Stockpiles shall be short-termed, placed in sheltered and guarded areas near the actual construction sites, covered with clean tarpaulins, and sprayed with water during dry and windy weather conditions.
- (ix) All earthwork disturbance areas shall be stabilized with thatch cover within 30 days after earthworks have ceased at the sites.
- (x) Immediately restore, level and plant landscape on temporary occupied land upon completion of construction works.
- (xi) Implement all soil erosion protection measures as defined in the soil and water conservation reports.
- (xii) At borrow pits site, there need to build fence and make a gentle slope in order to avoid children and animals go into the site

143. **Ecological impacts.** The contractors should be implemented the following mitigation measures to prevent ecological impact during construction:

- (i) Preserve existing vegetation where no construction activity is planned.
- (ii) Protect existing trees and grassland during construction; where a tree must be removed, or an area of grassland disturbed, replant trees and re-vegetate the area after construction.
- (iii) Remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works.
- (iv) Prior to commencement of construction, tag and conspicuously mark all the trees to be preserved to prevent damage to these trees by construction workers.

- (v) Construction workers are prohibited from capturing any wildlife in the project areas.
- (vi) Regularly monitoring and check with the ecology (fauna and flora) within the proposed project and nearby areas.

144. **Occupational health and safety.** The construction industry is considered hazardous. The civil works contractors should be implemented adequate precautions to protect the health and safety of construction workers and the public. Contractors must be managed the occupational health and safety risks by applying the following mitigation measures:

- (i) Care must be taken to ensure that sites for all earthworks (e.g., excavations, trenches) and dredging that are suspected to have unexploded ordnance (UXO) are surveyed by the military prior to construction. If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works.
- (ii) Construction site sanitation: (1) Each contractor has to provide the adequate and functional systems for sanitary conditions, toilet facilities, waste management, labor dormitories and cooking facilities. Effectively clean and disinfect the site. During site formation, spray with phenolated water for disinfection. Disinfect toilets and refuse piles and timely remove solid waste; (2) Exterminate rodents on site at least once every 3 months, and exterminate mosquitoes and flies at least twice each year; (3) Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and appoint designated staff responsible for cleaning and disinfection; (4) Work camp wastewater shall be discharged into the municipal sewer system or treated on-site with portable system.
- (iii) Occupational safety: (1) Provide safety hats and safety shoes to all construction workers; (2) Provide safety goggles and respiratory masks to workers doing asphalt road paving and tunnel blasting; (3) Provide ear plugs to workers working near noisy PME; and 4) living saving (drown prevention) equipment placed at all pier construction sites.
- (iv) Food safety: Inspect and supervise food hygiene in canteen on site regularly. Canteen workers must have valid health permits. Once food poisoning is discovered, implement effective control measures immediately to prevent it from spreading.
- (v) Disease prevention, health services: (1) All contracted labor shall undergo a medical examination which should form the basis of an (obligatory) health/accident insurance and welfare provisions to be included in the work contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged; (2) Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents; (3) Specify (by the PIUs and contractors) the person(s) responsible for health and epidemic prevention responsible for the education and awareness on food hygiene and disease prevention to raise the awareness of workers.
- (vi) Social conflict prevention: No major social risks and/or vulnerabilities are anticipated because of the project. The project construction workers will be engaged locally. Civil works contracts will stipulate priorities to (1) employ local people for works, (2) ensure equal opportunities for women and men, (3) pay equal wages for work of equal value, and to pay women's wages directly to them; and (4) not employ child or forced labor.

145. **Community health and safety.** Temporary traffic diversions, continual generation of noise and dust on hauling routes, and general hindrance to local access and services are common impacts associated with construction works within or nearby local settlements. The project may also contribute to road accidents by heavy machinery on existing roads, and temporarily blocking

pavements for pedestrians. The potential impacts on community health and safety will be mitigated through activities defined in the EMPs. The contractors shall be implemented the following mitigation measures:

- (i) Temporary traffic management: A traffic control and operation plan will be prepared together with the local traffic police prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning in advance.
- (ii) Information disclosure: Residents and businesses will be informed in advance through media of the construction activities, given the dates and duration of expected traffic disruption, installation sign boards on project description.
- (iii) Construction sites: Clearly marked signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues. Heavy machinery will not be used at night and all such equipment will be returned to its overnight storage area/position before nightfall. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate. Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross.

**b. Construction of Kep solid waste management improvements**

146. The temporary environmental impacts of the construction phase of the DED to improve solid waste management in Kep will primarily occur from the civil works at the dumpsite, and from the civil works required to upgrade the access road to the landfill. Of particular importance is the potential risk of injury or disruption of normal work activity of three waste pickers who currently work part-time at the dumpsite, and who travel along the access road to the dumpsite. Short-term increased odour while existing waste is moved to cell to be capped will also occur. The social team determined that the three waste pickers spend little time at the dumpsite because most of the sorting of recyclables is done in Kep before the solid waste is transferred to the dumpsite. Nonetheless, the safety and continued ability of the waste pickers to work during construction of upgraded landfill will be managed as part of their transition to work inside the new MRF. The upgrading of the Kep dumpsite and access road will not affect coastal mangroves, seagrass beds, or coral reefs.

147. Noise and disturbance mitigation measures consist of well-maintained vehicles and machinery that are not used between 20:00 and 07:00; dust and regular use of wetting agents (e.g., water  $\text{CaCl}_2$ ) and careful covering of all excavate or aggregate piles. Increased traffic congestion and risk of traffic accidents, and well signed construction areas, enforced speed limits, and special temporary pedestrian walkways and vehicle road lanes. Local pollution from the exhaust of trucks and heavy equipment can be minimized by ensuring all vehicles and equipment is kept in good working order and left idling for extended periods. Solid and domestic construction waste to be managed with a formal waste management plan that creates solid waste depots on site that are emptied with waste disposed regularly offsite according to DOE requirements. Pit latrines for workers should be placed away from public areas including eating/sleeping areas of temporary worker camps, and limed regularly. When worker camps close latrines are to be buried according to direction from DOE. All construction sites must have clearly marked telephone hot line phone numbers to the PIU as part of the GRM (Appendix B) for the subprojects. Civil works on the access road should be conducted between 07:00 and 20:00. Households of Damnak Chang'aour village along the southern section of the access road just south of railway line should

be given regularly updated construction schedules and locations where heavy (noisy) equipment will be operated. The civil works schedules must include the periods when specific road sections may be partially blocked creating travel impediments must be identified.

148. The first major step toward the physical upgrading of the dumpsite is to bulldoze and consolidate the existing waste field into appropriately sized area(s), and covered, or conversely, excavated in whole or part and disposed of in a new unused cell of the upgraded landfill. Management of leachate is not anticipated because it is assumed the upper layers of the relatively thin waste field will be dry. The consolidated waste must be covered with a sufficient layer of natural material with the planned gas capture technology.

149. Further to above, the public must be kept out of the existing dumpsite area during construction, with well signed fencing. Only regular solid waste disposal should occur, and to a specially allocated area in dumpsite. The site of the e construction workers camp must be restored to original condition upon closure.

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

150. There are no known rare or endangered terrestrial wildlife species or critical habitat in the immediate vicinity of the subproject in Kep. The subproject is not near National Parks. The results of the IBAT screening of the sites (Appendix D) also show the absence of rare or endangered wildlife in the immediate subproject areas.

151. 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.

## **3. Operation Phase**

### **a. Kep solid waste management**

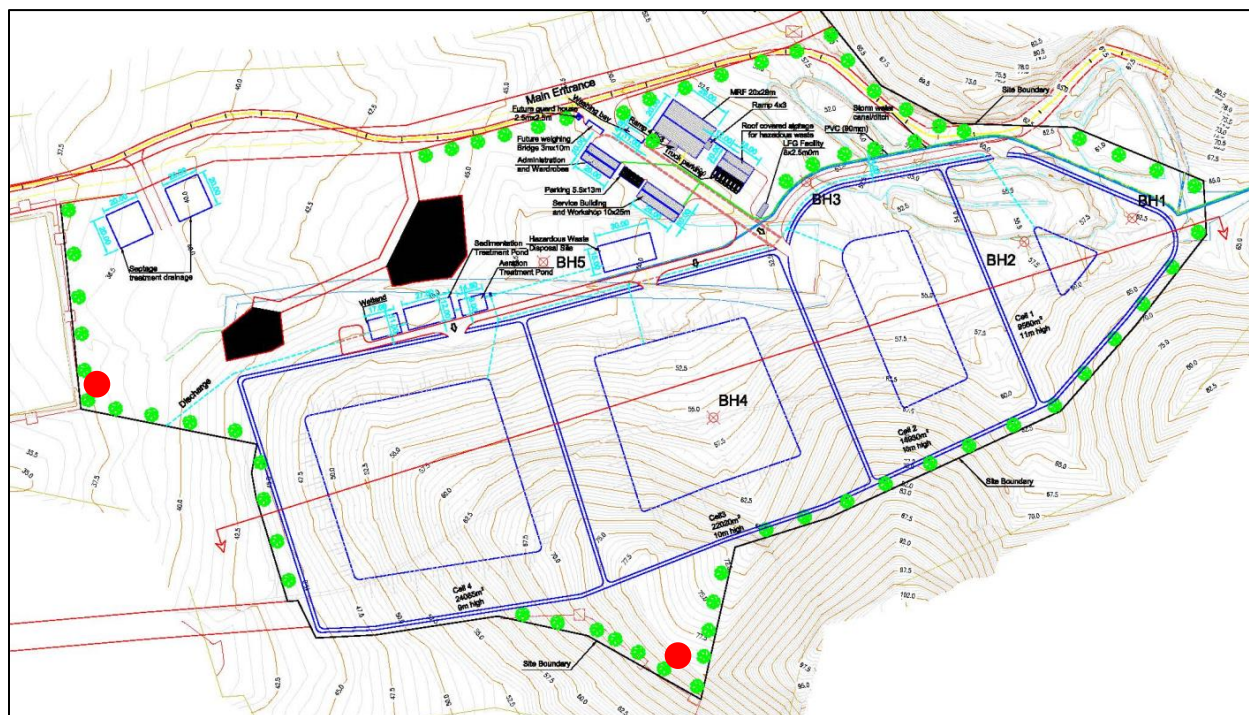
152. The potential impacts of the operation of the completed SLF will arise from: (i) increased vehicle traffic along the upgraded access road, (ii) potential groundwater pollution from waste cells or leachate treatment system; (iv) dust and odour that cannot be avoided, and (iii) worker injury from operation of new trucks and equipment at the SLF. Solid waste and domestic wastewater from the MRF and worker offices could become a problem if required operations and maintenance (O&M) budgeting is not provided to maintain the septic tank systems of the facilities.

153. The increased vehicle traffic along upgraded access road and NR 13 will increase risk of vehicle accidents and potentially increase noise and dust. Sufficient clear signage must be installed at intersection of access road and NR 13 that warn motorists that trucks turn in/out of landfill access road.

154. Posted speed limits along the upgraded access road to the SLF must be enforced to prevent accidents. Sufficient annual O&M budget should be provided to maintain all compactor and vacuum trucks and all other gas-powered vehicles and equipment in good working order to reduce air pollution and occupational hazards. Wetting agents (such as water and calcium chloride) should be periodically applied to the access road and landfill areas to control dust and wind-blown debris.



148. Groundwater quality at boreholes at BH1, BH5, and BH3 downstream of the SLF (Figure 24) should be monitored regularly and additional groundwater monitoring site may be established at the eastern part of the SLF for at least 15 years to ensure local groundwater is not contaminated by the waste cells, or leachate treatment system, septage treatment cell or hazardous waste cell. Monitoring at BH2 and BH4 will be phased out after the construction of the cells 1 and 3. The MRF and working conditions of any waste pickers including worker health at the landfill site need to be reviewed regularly to ensure that the original equipment, and the working conditions of the pickers are safe. Methane production at the LFG collection system on the closed capped existing waste cell should be monitored to determine LFG production, and to ensure the LFG capture system is working properly.



**Figure 30. Proposed Additional groundwater monitoring stations during operation**

155. Capacity development for the subprojects in Preah Sihanouk includes training for operators of the new SLF. The proposed technical training, as set out in the Project Administration Manual, will include general management of landfill, and controlled landfill features and lifetime operation including: (i) landfill gate control and cell management; (ii) leachate collection and confinement; (iii) medical waste – handling & disposal; (iv) on-site sorting & recycling; (v) gas collection, gas safety & flaring. Similarly, the waste pickers and possibly additional persons will be trained to operate and manage the MRF facility at the upgraded landfill. Training on receiving, sorting and packaging, and storage of incoming solid waste to develop the capacity of operators of the MRF will occur. As part of the above major O&M program, the municipality and community must be educated and be supported to be able adopt waste segregation at source to separate wet and dry solid waste.

156. Landfill and solid waste management, and employee working conditions must meet the requirements of RGC Decree Management of Urban Garbage and Solid Waste, No. 113, NKR-PR 2013, and the Government Occupational and Community Safety and Health (OHS) guidelines (OHS Programme for Cambodia, 2010-2013) that was developed by the International Labour

Organization (ILO). As per SPS (2009) landfill operations working conditions must also meet the ICF EHS Guideline for Solid Waste Management Facilities and other relevant laws/regulations. Opportunities for formalizing the roles of informal waste pickers and providing employment at the MRF must occur well before MRF is constructed.

157. The mitigation measures should support the comprehensive IFC EHS guidelines (2007) for solid waste management facilities. The guidelines address the full cycle of solid waste management starting with waste prevention and minimization, collection and transport, recycling and reuse, treatment, storage and disposal, and monitoring. The EMP will further elaborate the requirements of the IFC guidelines.

### **C. Climate Change for Kep Subproject**

158. A Climate Risk and Vulnerability Assessment (CRVA) was prepared separately. Provided below are excerpts from the CRVA, climate change adaptation measures and initial estimates of the project's greenhouse gas emissions (GHG).

As noted above the DED of the Kep solid waste management improvement subproject responded to the key issues of climate change mitigation and resilience of the subproject that were identified in the separate Climate Vulnerability and Risk Assessment (CVRA) that was prepared for the FS of the subproject. The details of which are described in full in Chapter III.

#### **1. Projections**

159. Reports and summaries 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 0.5–2.7°C, and total rainfall may change between -11% and +31% during the rainy season, and change between -11 and +35% during dry season.<sup>17</sup> By 2050 mean sea level is projected to increase by almost 1.0m. The recent assessment of regional climate change in Koh Kong province<sup>18</sup> for two Representative Concentration Pathway (RCP) scenarios shows GHG emissions of 4.5 and 8.5, with increases in air temperature against the baseline of 1980-1999 of 0.7–1.0 °C by 2025. However, contrasting projected changes to air temperature and the longer-term projections of rainfall from other studies above show annual precipitation decreases by -1 to -2.5% by 2025.

#### **2. Greenhouse gas emissions**

160. The project will generate greenhouse gas (GHG) emissions from vehicles on the access road to the Landfill. The emissions of methane (CH<sub>4</sub>) from the new SLF will be minimal because of the landfill gas (LFG) capture facility that will be installed. The project will generate greenhouse gas (GHG) from anticipated increased vehicle traffic on subproject access roads, however, the increase in vehicles is not expected to exceed the 100,000CO<sub>2</sub>e/a.<sup>19</sup> GHG emissions from project roads was established based on the guidance provided in *ADB's Environment Safeguards - a*

<sup>17</sup> IPCC 2014. IPCC Fifth Assessment Report: Working Group 2 Impacts, Adaptation and Vulnerability Chapter 24 Asia Intergovernmental Panel on Climate Change; UNEP, 2010. Assessment of Capacity Gaps and Needs of Southeast Asian Countries Addressing Impacts, Vulnerabilities, and Adaption to Climate Variability and Climate Change; ADB TA - 7459 REG: Greater Mekong Subregion Biodiversity Conservation Corridors Project Pilot Program for Climate Resilience Component, Cambodia, Supplementary Appendix M.

<sup>18</sup> Thoeun Hang Sen, 2015. Observed and Projected Changes in Rainfall and Temperature in Cambodia. Water and Climate Extremes.

<sup>19</sup> ADB (2016) Guidelines for Greenhouse Gas Emissions Transport Projects.

*Good Practice Sourcebook* (2012). If the traffic expressed as passenger car units per day (PCU/day) is below the numbers indicated in Table 21 (in a representative year) the emissions in that year are unlikely to exceed the 100,000 tons CO<sub>2</sub>e threshold.

**Table 14. Maximum Number of Passenger Car Units per Km to Trigger 100,000CO<sub>2</sub>e/a**

Length of Road. (km)	PCU/day	Length of Road. (km)	PCU/day
10	76,000	50	23,000
20	57,000	60	19,000
30	38,000	70	16,000
35	33,000	90	13,000
40	28,000	100	11,000

Source: ADB Environment Safeguards - a Good Practice Sourcebook (2012)

161. The total length of the new roads is estimated less than 4 km. Only road upgrades will occur. Traffic flows in a representative year of 2030 are expected to be below the 76,000 PCU/day traffic to reach 100,000 tons/a of GHGs.

162. The project also supports adoption of ASEAN Tourism Standards (e.g., Homestay Standard, Clean Tourist City Standard, Green Hotel Standard, and Clean Public Toilet Standard). This will reduce the carbon footprint of the subproject areas through increased energy efficiency (e.g., use of LED lighting), and reduce GHG emissions.

### **3. Climate Risk and Vulnerability**

163. The indicative sensitivity of the subproject Kep to climate change was classified mostly as “LOW” by the AWARE™ software tool which is used to assess climate change sensitivity of proposed infrastructure projects. The software combines geographic information on current site-specific climate, climate hazards from topography, elevation, and distance to ocean, and the latest climate change projections for the project area.

### **4. Climate Proofing Project Infrastructure**

164. The subproject is designed to be resilient to the impacts of present-day climate extremes defined primarily by rainfall intensity and wind on flooding and erosion. The sensitive components consist of for example; (1) access road foundation, (2) drainage capacity; and (3) road bed grade and pavement type. These design factors must be resilient to climate change for the individual components to be sustainable without premature, major retrofits. Provided below is an indicative estimate of the cost design criteria for climate proofing the subproject.

## **D. Comprehensive Corrective Environmental Action for Kep Subproject**

165. The DED of the new SLF along with improved solid waste collection (including septage and hazardous waste) for Kep and vicinity provides a corrective action that meet the requirements of the current national SWM directives listed below.

- Technical Guidelines on Garbage and Urban Solid Waste Management (MOE, 2016);
- Sub-decree on Management of Urban Garbage and Solid Waste, No. 113, ANRK.BK (2015);

- Sub-decree on No. 235 on Drainage System Management and Waste Water Treatment Plan (MoI, MPWT and MoE, 2017)

166. The components of the DED of the new SLF and improved solid waste collection in Kep provide significant improvements to environmental protection and management of the affected environment that meet the key requirements specified by MOE (2016) which are summarized in Table 15 with the following comments. Item #2 is not possible because Kep province is too small and well drained locations are within 10km of Kep town. The updated ADB EMP will be submitted to MOE as per due process which will assist with item #11 of Table 15.

**Table 15. Summary of key requirements of landfill siting and design\*\***

- 1) Landfill site selection should be done based on district land use plan, if available, and have City Hall (provincial authorities) approval for the site.
- 2) Landfill sites should be preferably over 10km away from town centers in the most suitable available location to allow for urban expansion.
- 3) A thorough geotechnical study is required to confirm depth to groundwater for each site and should identify the complex nature of groundwater and the direction of flow which is essential for groundwater monitoring. Groundwater cleanup when contaminated is difficult so contamination prevention in the landfill design is essential.
- 4) Regarding landfill site selection and distance to airports, the key concern is increase in number of birds which may impact on aircraft safety, whereas for residential housing and places of worship it is odor and flies.
- 5) Appropriate mitigation measures include on-site measures on landfill, covering and compacting waste, and improving houses against flies and odor.
- 6) Acceptance that the sites need to be operated within available budgets so operation of a controlled landfill is not possible and application of daily cover is cost prohibitive. Distance to receptors depends on the landfill design, daily management, O&M, mitigation measures and landfill closure procedures.
- 7) Flooded areas are generally defined in the guidelines as areas connected to permanent water bodies through inundation and flooding originating from the permanent waterbody. Areas occasionally inundated by rainfall caused run-off, lacking natural drainage, are not regarded as flooded areas in the guidelines.
- 8) Flooded or periodically flooded run-off areas can be used for landfill with appropriate design preventing flooding of the landfill site, specified in the EMP.
- 9) Priority for landfill site design and management is to avoid environmental damage, especially groundwater contamination. This is to be minimized using liners to prevent water entering and leaving the landfill cell and leachate collection and treatment before release to environment if suitable for the site.
- 10) Clay layer thickness depends on the exact conditions of each landfill site.
- 11) IEIA/EIA under Cambodian law and the associated EMP, is required to be submitted to MOE for each landfill site. It was recommended by MOE to submit separate IEIA/EIAs for each sub-projects so if one IEIA/EIA is not approved, the remaining projects do not get delayed.
- 12) For future ADB projects, ADB should invite MOE to comment preliminarily on landfill site selection in feasibility study stage, but EIA can be submitted after detailed engineering design.
- 13) Waste pickers are no longer allowed to work in controlled fashion in a separate waste separation site, only in a Material Recovery Facility (MRF), for their own and others

safety. Health and safety procedures have to be followed. Recycling of waste materials is to be encouraged for longevity of the landfill site.

- 14) Public consultations are highly important to improve public acceptance of the landfill, establish affected households' priorities, and identify suitable mitigation measures.
- 15) Option to relocate away from the landfill should be provided for the affected households too close to the site that wish to relocate.
- 16) New Environment Code is too far from adoption to consider at the moment. It will be submitted to the Council of Ministers for debate at the end of 2017.

\*\*Tabled at a joint meeting with MOE & ADB safeguards for landfill siting in Phnom Penh, 31/10/17

167. Compliance with the above directives plus other site and waste type information, views of local community of existing dumpsite, and new groundwater and soil quality from DED that is provided in Chapters II and IV of this updated IEE were specified in environmental compliance audit (ECA) and ground water quality study that were identified in the original IEE of the FS design of the subproject. The DED of improvements to solid waste management in Kep and this updated IEE represent the comprehensive corrective action of the subproject, and main result of ECA.

168. Among the various action recommended by ADB in the AM Review Mission Dec 2020 reference is made to the following:

- to liaise with Ministry of Environment (MOE) on changes in design/site and if updating of IEIA/ construction permit will be required.

169. Accordingly, MPWT-PMU consulted MOE, the change in design will ensure the positive impacts of the system at landfill on the environment, so it is not necessary to updated IESIA report. Also, a written formal request would have required a long and possibly complex procedure for getting a written determination on this subject, due to the busy schedule of the MOE officials. The consultation was conducted with Mr. Duong Samkeat, Deputy Director of EIA Department of MOE and Team Leader of the IESIA appraisal mission of the Landfill Project.

170. The MOE answer was: "*The minor change in the design will provide and ensure the preventing negative impacts and the whole system/design and location of the sub-project are still the same, thus it is not necessary to get a written response from MoE on this change*". Based on this statement, it was considered advisable to not proceed on further more formal requests for an official reply by MOE.

## VI. ENVIRONMENTAL MANAGEMENT PLAN

171. The environmental management plan (EMP) will serve as the framework for the Project's environmental management. The EMP features the Environmental Mitigation Plan, Environmental Monitoring Plan, Implementation Arrangements and Performance Indicators.

### A. Environmental Mitigation Plan

172. The recommended mitigation measures consist of actions, activities, plans and documents that need to be undertaken, observed, obtained, prepare to prevent and/or mitigate the Project's adverse environmental impacts. The broad measures are outlined below while the specific measures are presented in the Environmental Mitigation Plan.

**Table 16. EMP prior to Pre-Construction Phase**

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>20</sup> (USD)	Responsibility	
							Supervision	Implementation
Disclosure, & re-engagement of community	No community impacts	1. Confirm initiation Information Disclosure and Grievance Redress Mechanism of IEE and distribute construction activity schedule to affected community and businesses including waste pickers at dumpsite to allow continued waste picking/recycling.	For all construction sites.	A few weeks before construction starts	once	No marginal cost <sup>21</sup>	IA/PIU	PIU
Government approvals	No negative impact	2. Confirm with DOE for required project permits and certificates.	Entire subproject,	Before construction begins	once	No marginal cost	PIU/DOE	DOE
Contact current waste pickers at dumpsite	No negative impact on waste pickers	3. Inform waste pickers of future training and placement at future new MRF.	Existing dumpsite	Before construction	As required	No marginal cost	PMCES/PIU	PMCES/PIU
Final design of	Minimize	4. PMCES <sup>22</sup> to ensure the following management	Final siting	Before	Once with	No marginal	PMCES/EA	PMCES/PIU

<sup>20</sup> Costs will need to be updated by contractors.

<sup>21</sup> No marginal cost indicates that costs to implement mitigation are to be built into cost estimates of contractor bid documents

<sup>22</sup> PMCES is Project management and supervision consultant



Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>20</sup> (USD)	Responsibility	
							Supervision	Implementation
subproject,	negative environmental impacts	<p>measures are organized and in place:</p> <p>a) identification of spill management prevention plans, and emergency response plans for all construction activities at new SLF site and along access road;</p> <p>b) locate possible concrete batch plant location for access and internal roads at least 2km from local villages, i.e., Damnak Chamour village, and surround batch plants with fencing and access barriers.</p> <p>d) ensure no disruption to water supply, utilities, and electricity to local villages with set contingency plans for any unavoidable disruptions planned;</p> <p>e) no disruption to normal pedestrian and vehicle traffic along all access road to SLF and NR-33 with planned contingency alternate routes;</p> <p>f) erect/install signage at intersection of access road and along NR-33 to warn public and motorists of construction schedule along access road and at new SLF site, and of increased vehicle traffic along NR-33.</p>		construction initiated	final designs documents	cost		
		<p>5. Review and ensure climate change mitigation and resilience measures of DED are integrated with subproject implementation</p>	Capped existing waste cell. Peripheral drainage of SLF and access road drainage					
Finalize EMP	Positive environmental impacts	<p>6. Finalize IEE and this EMP where necessary to meet any late changes to subproject final design to protect affected environments. If changed submit final IEE and EMP to ADB to review and approval prior to bidding.</p>	All sites	Before construction initiated	Once with detailed designs documents	No marginal cost	PMCES	EA/PIU
Confirm Government approved	No negative impact	<p>7. Notify DOE, DPWT to confirm locations of sites for disposal areas for construction waste for subproject,</p>	Entire subproject	Before construction	As required	No marginal cost	PIU/DOE/ /DOT	PIU

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>20</sup> (USD)	Responsibility	
							Supervision	Implementation
construction waste disposal sites		and obtain required permits.						
UXO survey, & removal	Injured worker or public	8. Ensure Government and military is consulted and clears areas where necessary at SLF property and along access road	All construction sites.	Beginning of subproject	Once	See Monitoring Plan below	EA/PIU	Government, military
Develop bid documents	No negative environmental impact	9. Ensure this updated EMP is included in contractor tender documents, and that tender documents specify requirement for site-specific, budgeted CEMP. 10. Specify in bid documents that contractor must have experience with implementing EMPs and provide designated environment, health and safety staff with experience.	All subproject areas	Before construction begins	Once for all tenders	No marginal cost	PMCES/EA	PIU
Obtain & activate permits and licenses	Prevent or minimize impacts	11. Contractors to comply with all statutory requirements of Government for use of construction equipment, and operation construction plants such as concrete batching.	For all construction sites	Beginning of construction	Once	No marginal cost	PMCES	PIU & contractors
Capacity development	No negative environmental impact	12. Finalize and schedule training plan for (PIU/SS) to be able to fully implement EMP, and to manage implementation of mitigation measures by contractors. 13. Create awareness and training plan for contractors whom will implement mitigation measures.	All subproject areas	Before construction begins	Initially, refresher later if needed	No marginal cost	PMCES	PMCES/PIU
Recruitment of workers	Spread of sexually transmitted disease	14. Use local workers as much as possible thereby reducing number of migrant workers. This proviso should be included in contractor tender documents 15. The local workers has to have women at least 20 to 30 % of the total workers 16. The training on sexually transmitted and HIV/AIDs to workers need to be done prior commencement of work in regularly	All construction areas and communities nearby.	Throughout construction phase	Worker hiring stages	No marginal cost	EA/PIU	Contractor's bid documents

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>20</sup> (USD)	Responsibility	
							Supervision	Implementation
Prepare CEMP	Prevent or minimize impacts	<p>17. Prepare site-specific CEMP(s) for different potential impacts of construction of new SLF, and access road upgrades. The CEMP is subject to updates and revisions whenever revision has been made to this IEE and post incident lesson indicates the need for the changes to the plan.</p> <p>18. The CEMP need to be attached with other management plan such as: solid waste and waste water management plan, dust and air monitoring plan, health and safety management plan and other relevant management plan</p>	All construction sites	Ahead of construction	Once	No marginal cost	PMCES/PIU	Contractors

**Table 17. EMP during Construction Phase**

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
Worker camps	Pollution and social problems	<p>19. Locate worker camps at least 1km away from nearby villages, i.e., Damnak Chamour village.</p> <p>20. Must be informed in advance to the local authorities on the worker camp construction and work closely with competencies authorities</p> <p>21. Ensure adequate housing and waste disposal facilities including pit latrines and garbage cans.</p> <p>22. A solid waste collection program must be established and implemented that maintains clean worker camps, and which separates recyclables from waste for landfill</p>	All worker camp sites	Throughout construction phase	Monthly	No marginal cost	PMCES/PIU	contractor

<sup>23</sup> Costs will need to be updated by contractors.

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		23. Locate separate pit latrines for male and female workers away from worker living and eating areas. 24. A clean-out or infill schedule for pit latrines must be established and implemented to ensure clean operable latrines are available at all times. 25. Worker camp must have adequate drainage. 26. Local food should be provided to worker camps. Guns and weapons not allowed in camps. 27. Interaction of transient workers with local community should be discouraged. HIV Aids test and education should be given to workers. 28. Camp areas must be restored to original condition after construction completed.						
Training & capacity	Prevention of impacts through education	29. Implement training and awareness plan for PIU/SS and contractors.	PIU office, construction sites	Beginning of construction	After each event	No marginal cost	PMCES	PMCES/PIU
Construction materials acquisition, transport, and storage sub-plan	Pollution, injury, increased traffic, disrupted access	30. All topsoil and overburden removed for waste cells should be stockpiled on site for later restoration. 31. Remaining unstable slope conditions on SLF property should be rectified with tree planting, or initially with quicker growing local grasses if necessary. 32. Define & schedule how material from slopes on northern boundary of SLF are extracted, moved, and stored on site. 33. All piles of aggregates on SLF property and along access road must be covered. 34. All aggregate loads on trucks transported from outside SLF boundary must be covered. 35. Limited the speed for transportation of construction material and soil 36. Installation safety sign board and all kind of traffic sign	For all construction areas.	Throughout construction phase	Monthly	No marginal cost	PMCES/PIU	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		boards at construction sites and access road  37. At storage site, there must be concrete in order to avoid leakage oil and hazardous material, especially, must equipped with the adequate firefighting equipment						
Excavated spoil management sub-plan	Contamination of soil and adjacent seasonal stream from excavated spoil, and construction waste	38. Any uncontaminated excavated spoil that needs to be disposed outside SLF property or from access road must be preferably reused on another construction site, or disposed of in DOE-designated sites. 39. A record of type, estimated volume, and source of disposed spoil must be recorded. 40. Any excavated contaminated spoil must be handled following DOE regulations including transport, treatment (if necessary), and disposal.	All excavation areas	Throughout construction phase	Monthly	See Monitoring Plan for contaminated soil analyses	PMCES & PIU & DOE	contractor
Solid and liquid construction waste sub-plan	Contamination of land and surface waters from construction waste	41. Management of general construction solid and liquid waste from SLF site and access road construction sites must follow DOE regulations, and will cover, collection, handling, transport, recycling, and offsite disposal of waste created from construction activities and work force. 42. Offsite disposed of construction waste should be catalogued for type, estimated weigh, and source. 43. Construction sites should have enough large garbage bins that enable separation of recyclable waste from waste that needs to be disposed at landfill. 44. A schedule of solid and liquid construction waste pickup and disposal from SLF and along access road must be established and implemented to ensure construction sites are clean as possible. <u>Hazardous Waste</u> 45. Collection, storage, transport, and disposal of	All construction sites and worker camps	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU & DOE	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		<p>hazardous waste such as used oils, empty drums, gasoline, paint, and other toxics must follow MOE regulations and work closely with local authorities in regularly.</p> <p>46. Wastes should be separated (e.g., hydrocarbons, batteries, paints, organic solvents)</p> <p>47. Wastes must be stored above ground in closed, well labeled, ventilated plastic bins in good condition at least 30m from construction activity areas, adjacent stream, and nearby villages.</p> <p>48. All spills must be cleaned up completely with all contaminated soil removed and handled as contaminated spoil.</p>						
Noise and dust sub-plan	Dust & Noise	<p>49. Regularly apply wetting agents (e.g., water, CaCl<sub>2</sub>) to exposed soil, access road, and approach sections NR-33. Water truck must be on site for immediate watering as needed.</p> <p>50. Cover or keep moist all stockpiles of construction aggregates, and all truckloads of aggregates.</p> <p>51. Minimize time that excavations and exposed soil are left open/exposed. Backfill immediately.</p> <p>52. As much as possible restrict working time between 07:00 and 17:00. In particular are activities such as pile driving.</p> <p>53. Maintain vehicles and equipment in proper working order with a monthly check/service schedule</p> <p>54. Replace unnecessarily noisy vehicles and machinery.</p> <p>55. Vehicles and machinery to be turned off when not in use.</p> <p>56. Construct temporary noise barriers around excessively noisy activity areas.</p> <p>57. Clean mud from access road off construction trucks at</p>	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor



Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		<p>the end of each day to reduce dust and skid risk.</p> <p>58. Provide watering on the access road in regularly to ensure that the dust is not come out.</p> <p>59. Transportation of soil and construction material must be limited the speed</p>						
Implement utility and power disruption sub-plan	Loss or disruption of utilities and services to local villages such as water supply and electricity	<p>60. Develop plan of days and locations where outages in utilities and services will occur, or are expected.</p> <p>61. Contact local utilities and services with schedule, and identify possible contingency back-up plans for outages.</p> <p>62. Contact affected villages to inform them of planned outages.</p> <p>63. Try to schedule all outages during low use time such between 24:00 and 06:00.</p>	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU & Utility company	contractor
Tree and vegetation removal, and site restoration sub-plan	Damage or loss of trees, vegetation, and landscape	<p>64. Contact provincial forestry department for advice on how to minimize damage to trees and vegetation.</p> <p>65. Restrict tree and vegetation removal to within SLF property and along RoW of access road.</p> <p>66. Minimize tree removal, and install protective physical barriers around trees that do not need to be removed.</p> <p>67. SLF property and ROW of access road needs to re-vegetated and landscaped after construction completed. Consult provincial forestry department to determine the most successful restoration strategy and techniques.</p>	All construction sites.	Beginning and end of subproject	Monthly	No marginal cost	PMCES & PIU	contractor
Erosion control sub-plan	Land erosion	<p>68. Berms, and plastic sheet fencing should be placed around all excavations and earthwork areas to contain erosion.</p> <p>69. Earthworks should be conducted during dry periods if possible and not during wet season.</p> <p>70. Protect exposed or cut slopes with planted vegetation,</p>	All construction sites	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		and have a slope stabilization protocol ready. 71. The slope of landfill and embankment of access road must compacting in properly manner						
Implement worker and public safety sub-plan	Public and worker injury, and health	72. Prohibit entry of local residents into construction site 73. Proper fencing, protective barriers, and buffer zones should be provided around all construction sites to protect public. 74. Sufficient signage and information disclosure, and site supervisors and night guards should be placed at all sites. 75. Conduct pre-mobilization orientation workshop on health and safety and emergency response and evacuation procedures 76. Worker and public safety guidelines of the Government should be followed. See draft Occupational Safety & Health Master Plan of Ministry of Labor & Vocational Training. Supplement as needed with IFC EHS guidelines for Waste Management Facilities, Toll Roads, and Construction and Decommission 77. Set up a sufficiently equipped first response and health care team, linked to an ultimate response team or local hospital 78. Speed limits suitable for the size and type of construction vehicles, and current traffic patterns should be developed, posted, and enforced on all roads used by construction vehicles. 79. Standing water suitable for disease vector breeding should be filled in. 80. Worker education and awareness seminars for construction hazards should be given at beginning of construction phase, and at ideal frequency of monthly. A construction site safety program should be	All construction sites.	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		<p>developed and distributed to workers.</p> <p>81. Appropriate safety clothing and footwear should be mandatory for all construction workers. Enforce use of protective gears when at work.</p> <p>82. Adequate medical services must be on site or nearby all construction sites.</p> <p>83. Provide safe housing with adequate 'basic services. Drinking water must be provided at all construction sites.</p> <p>84. The contractor should include in its CEMP or in its Health and Safety Plan and implement actions in response to various major events such as: major disasters or emergencies such as severe heavy rains, fires, flood or explosion regardless of cause; and catastrophic incidents that leave extraordinary levels of mass casualties, damage and disruption severely affecting the population, infrastructure and environment. Such disruption may include spread of diseases (outbreak or pandemic such as COVID-19) infection among worker and surrounding community. The Health and Safety Plan or an equivalent document should be in place and is the official procedural document for organizing, coordinating and directing available resources toward the mitigation, preparedness, response and recovery in the event of emergency. The Health and Safety Plan or its equivalent document is subject to updates and revisions at least annually or whenever post incident lesson indicates the need for the changes to the plan.</p> <p>85. A protocol on the control of spread of COVID-19 should be drafted and implemented in all project areas including worker camps. The sets of procedures and guidelines specified in the protocol shall conform to WHO, national and local government protocols to ensure protection and safety of all workers, staff and the general public. This set of procedure may include</p>						

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		but not limited to the following: <ul style="list-style-type: none"> <li>- declaration of current state of health of all workers and visitors including state of health of persons whom the workers have interaction in the past 2 weeks.</li> <li>- Provision of facemasks, handwashing area, thermal screening prior to site entry</li> <li>- Designation of temporary disposal of medical waste, used gloves, masks and other medical PPEs used at the project site.</li> <li>- The medical team or safety personnel should be in close coordination with local health personnel in the implementation of COVID-19 protocols of Cambodia</li> <li>- Face to face meeting shall be avoided if possible. Use of teleconferencing and any other online means shall be encouraged</li> </ul>						
Civil works	Degradation of water quality of adjacent streams	86. Sufficient lighting must be used during necessary night work. 87. All construction sites should be examined daily to ensure unsafe conditions are removed. Unsafe situations should be recorded in site diaries for subsequent preventive maintenance 88. Protective berms, plastic sheet fencing, or silt curtains should be placed between all earthworks and the streams near boundary of SLF property 89. Erosion diversion channels and collector ponds must be built around and adjacent to aggregate stockpile areas to contain rain-induced erosion. 90. Earthworks should be conducted during dry periods. 91. All construction fluids such as oils, and fuels should be stored and handled well away from streams near boundary of SLF property 92. No waste of any kind is to be thrown in the adjacent streams.	SLF construction sites	Throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		93. No washing or repair of machinery near the adjacent streams. 94. Pit latrines to be located well away from the adjacent streams. 95. The earth work and excavation must be done in the dry season only						
	Degradation of groundwater quality	96. Ensure the established depth of water table at SLF site is clearly understood by excavators when the first waste cell is excavated including rainy season depth	Area of waste cell #1					
Cultural chance finds sub-plan	Damage to cultural property or values, and chance finds	97. Contractor has to work closely with provincial department of Cultural, Fine and Art in case of finding heritage sites 98. Chance finds of valued relics and cultural values should be anticipated by contractors. Site supervisors should be on the watch for finds. 99. Upon a chance find all work stops immediately, find left untouched, and PIU notified to determine if find is valuable. Culture section of DOT notified by telephone if valuable. 100. Work at find site will remain stopped until DOT and DoCFA allow work to continue.	All construction sites	At the start, and throughout construction phase	Monthly	No marginal cost	PMCES & PIU	contractor
Construction and urban traffic sub-plan	Traffic disruption, accidents, public injury	101. Create adequate traffic detours, and sufficient signage & warning lights along access road and on NR-33 if necessary. 102. Post speed limits, and create dedicated construction vehicle roads or lanes along access road if possible. 103. Install signages on NR-33 and access road to inform community of location of construction traffic areas and provide them with directions on how to best co-exist with construction vehicles on their roads. 104. Create safe pedestrian walkway areas around	All construction sites	Fulltime	Monthly	No marginal cost	PMCES & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>23</sup> (USD)	Responsibility	
							Supervision	Implementation
		construction sites.						
Construction drainage sub-plan	Loss of drainage & flood storage	<p>105. Provide adequate short-term drainage away from construction sites to prevent ponding and flooding.</p> <p>106. Install temporary storm drains or ditches on construction sites where necessary</p> <p>107. Ensure natural stormwater runoff around SLF site and along access road is maintained.</p> <p>108. The landfill must be located in high ground and provided by adequate drainage system and protection from flooding.</p>	All areas with surface waters	Design & construction phases	Monthly	No marginal cost	PMCES & PIU	contractor



**Table 18. EMP during Operation Phase**

Subproject Activity	Potential Environmental Impacts	Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>24</sup> (USD)	Responsibility	
							Supervision	Implementation
Operation of completed SLF	Pollution of groundwater and downstream area	109. Regularly monitor groundwater quality from test boreholes BH1, BH3, & BH5 that were established as part of the DED and to establish additional stations located at the eastern and southern portion of the SLF to ensure waste cells and leachate treatment system are operating properly. BH4 will be phase out as waste cells are developed.	SLF	Quarterly	Annually	O&M	Kep Municipality	
Operation of upgraded access road	Increased traffic accidents & air pollution	110. Enforce clearly post speed limits along road. 111. Mandate regular SLF vehicle inspections to ensure all vehicles kept in good working condition. 112. Upgraded access road drainage culverts or ditches must be regularly cleaned and maintained	SLF access road	Biannually	Annually	O&M	DPWT	

<sup>24</sup> Costs will need to be updated by contractors.

## B. Institutional Arrangement

### 1. Institutional Capacity Review and Needs

Currently understanding and experience with the operation of controlled landfills is absent in Kep, and there is insufficient understanding, experience and capacity for environmental management among provincial and municipal authorities responsible. i.e., DOT/PIU, and Kep municipality for overseeing successful implementation of the EMP, and for environmental management of the completed SLF. The required capacity development and training of KEP municipality and DPWT staff on SLF operation and management will be developed from by the future PMCES that will be retained by the project (Norconsult pers. communication, 2018) and beyond the scope here. Training and awareness for the critical understanding of the need for segregated wet and dry solid waste at source is also included. This will form a major part of the extensive O&M and program that needs to be developed for the solid waste collection component of the subproject.

173. No dedicated environmental experts are currently appointed to Kep Municipality and PIU. The PMCES with assistance from the SS of the subproject will develop and deliver training courses to the DOT/PIU staff responsible for the implementation of the subproject. The purpose of the course(s) is to strengthen the ability of the PIU/PMU to oversee implementation of the EMP by construction contractors.

174. The SS who will be full-time environmental member of the PIU as well as the EO of the contractor should attend training courses as required. Costs for training should be included with costs for implementation of the EMP.

175. Training on the implementation of an EMP should address two thematic areas. The first area should introduce principles environmental management focused on the potential impacts of subproject activities on the natural and social environment. The second area should be environmental safeguard requirements of the ADB and the Government with specific focus on the preparation of an EMP, and contractor EMPs (CEMP). Table 8 lists the indicative course topics and target participants. The estimated budget of USD \$5.000 is listed in Table 7.

**Table 19. Indicative training on EMP Implementation**

Course Topic Areas	Target Participants	Period
Introduction to EIA, Cambodia EIA policy framework & procedures, and environmental standards, and ADB Safeguard Policy	EA, KEP Municipality*, PIU/SS,	Pre-construction phase: shortly after PMCES is hired
Purpose and content of an EMP. Development and implementation of the EMP for Kep solid waste management improvements, including review of contractor CEMPs	EA, PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Protection of aquatic and terrestrial environment from road and landfill construction	PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Grievance Redress Mechanism, & public consultation	EA/PIU/SS, contractor EOs, village leaders, business representatives	Construction phase shortly after construction packages are let

Course Topic Areas	Target Participants	Period
Occupational and community health and safety	PIU/SS, contractor EOs	Construction phase shortly after construction packages are let
Traffic management and safety on roads	PMU	Operation phase shortly before subprojects are completed

\* Not included is special course for Kep Municipality for the operation and maintenance of the New SLF and waste collection service improvements

176. Separate to the training plan in Table 8 will be the development of the capacity and programming of the DPWT and Kep Municipality for monitoring water table and groundwater quality at the SLF. The scope and details of the capacity development will be finalized by PMCES.

## 2. Proposed arrangements for Environmental Management

177. For the detailed design (DED) the main management framework for implementation of the environmental management plan (EMP) for the Kep solid waste management improvements subproject is summarized below.

178. The Ministry of Public work and Transport (MPWT), which is the executing agency (EA) for the project, will take overall responsibility for successful implementation of the EMP. The EA will establish a Project Management Unit (PMU) based in Phnom Penh, which will be responsible for general project implementation. The Implementation Agency is the Provincial Department of Public Work and Transport (PDPWT) for this subproject in Kep province. The PDPWT will establish a Project Implementation Unit (PIU) in this subproject in Kep province, comprising relevant provincial departments/government representatives including provincial department of environment (PDoE) and provincial department of tourism (PDoT). The PIU with support from the IA will implement the EMP. The PIU will include an Environmental Safeguards Specialist (ESS) who will lead the implementation of the EMP in conjunction with the designated Environmental Officer(s) (EO) of the construction contractor(s). The tender documents for construction packages will specify the requirement for an experienced EO.

179. A Project Steering Committee (PSC) will be created to provide policy and technical guidance for subproject implementation. The PSC is chaired by the EA and comprising relevant agency representatives including Ministry of Environment, General Department of Resettlement (GDR), Ministry of Tourism and Ministry of Labor as a minimum.

180. The Safeguards Coordination Unit of the PCU as indicated in PAM will provide operational guidance to the PIU for EMP implementation and will liaise with the ADB on safeguard reporting and issues. The PIU's Safeguards Specialist will oversee the work of the EO to implement the CEMP.<sup>25</sup>

181. External support to the IA/PIU for implementation of the EMP will be provided by the International and National Environment Specialists (I/N-ES) of the Project Management and Civil Engineering Support Consultant (PMCES) and an external Environmental Monitoring Institute (EMI) which will conduct the field sampling and laboratory analyses of environmental quality (e.g.,

<sup>25</sup> Contractor Environmental Management Plan prepared by contractor, based on updated EMP

water quality, air quality) that cannot be performed by the contractor or PMCES. The ToR for the EMI is appended to EMP.

182. ADB is responsible for monitoring in order to ensure that the component meet the environmental safeguards of the SPS (2009)

183. The responsibilities of different agencies in the management framework are listed in Appendix A. Provided below is a summary of responsibilities for EMP implementation.

**Table 20. Institutional Responsibilities for EMP implementation**

<b>Institution</b>	<b>Responsibilities</b>
The Ministry of Public work and Transport (MPWT), the EA will hold overall accountability of the project implementation and operation on behalf of the Royal Government of Cambodia.	<p>The responsibility of EA in relation to the environment safeguards requirement are summary in below:</p> <ul style="list-style-type: none"> <li>• Overall responsibility for subproject implementation and establish of Project Management Unit (PMU)</li> <li>• Approval procurement plans, bidding documents, bid evaluation and contract awards including EMP</li> <li>• Submit regular quarterly and annual subproject reports to ADB including the EMP implementation reports</li> <li>• Ensure compliance of subproject/component implementation with ADB's social and environmental policies and guidelines;</li> <li>• Approve proposed actions in the event of adverse audits or monitoring and evaluation reports.</li> <li>• Ensure compliance of Loan Covenants</li> </ul>
The responsibility of PMU, which is established by Ministry of Public work and Transport (MPWT)	<ul style="list-style-type: none"> <li>• Undertake day to day management of subproject activities</li> <li>• Implementation approval annual rolling work and financial plan</li> <li>• Prepare and submit regular quarterly and annual subproject/component report including environmental safeguard report</li> <li>• Liaise with ADB on the EMP implementation and supervise civil work of the contractor;</li> <li>• Ensure that EMP are incorporated in the detail designs and include in civil work contracts</li> <li>• Review and approve the Contractor's EMP against the IEE and ensure that CEMP updates and revisions has been made in case revisions to IEE and post incident lesson indicates the need for the changes to the CEMP.</li> <li>• Ensure EMP implementation and submit regular monitoring report to IA and EA</li> <li>• With assistance from PMU submit semi-annual environmental monitoring reports to ADB;</li> <li>• Dissemination and coordination of Grievance Redress Mechanism (GRM), and</li> </ul>

	<ul style="list-style-type: none"> <li>Resolve with the PMU, and ADB if necessary, issues arising from the implementation of EMP.</li> </ul>
The key responsibilities of the PMCES international and national environmental specialists for the EMP	<ul style="list-style-type: none"> <li>Update the EMP to meet final detailed designs of subprojects;</li> <li>Assist PIU add EMP requirements to construction tender documents;</li> <li>Assist PIU review submitted CEMPs</li> <li>Provide technical direction and support to the PMU/PIU for implementation of the EMP;</li> <li>Oversee the design and delivery of capacity development and training for the PIU and EO of contractor(s);</li> <li>Provide advice and support to the EMI to conduct their monitoring activities;</li> <li>Review all reports prepared by the PIU, EMI, and PCU; and</li> <li>Review the location of any possible contaminated sites near subprojects</li> </ul>
the contractor's Environmental Officer (EO)	<ul style="list-style-type: none"> <li>Prepare and update the CEMP to be approved by the Engineer</li> <li>Implement the CEMP during construction; and</li> <li>Prepare and submit monthly reports on mitigation and monitoring activities of the CEMP and any environmental issues at construction sites.</li> </ul>
Environmental Monitoring Institute (EMI)	<ul style="list-style-type: none"> <li>Implement the environmental sampling required in the EMP monitoring plan, which cannot be conducted by the contractor or PIU.</li> <li>Perform required laboratory analyses for the EMP monitoring program; and</li> <li>Prepare and submit quarterly reports to the PIU on monitoring activities.</li> </ul>
The Department of Environment (DOE)	<ul style="list-style-type: none"> <li>The provincial agency which oversees environmental management of Kep.</li> <li>The DOE with District staff provides direction and support for environmental protection-related matters including application of the Law on Environmental Protection and Natural Resources Management, Preah Reach Kram/NS-RKM-1296/36, enacted by Minister of Environment, 1996; EIA, and environmental standards</li> </ul>
ADB	<ul style="list-style-type: none"> <li>provides guidance to EA/PCU with any issues related to EMP and reviews quarterly and semi-annual safeguards monitoring reports on EMP activities compiled and submitted by PCU</li> </ul>

### 3. Worker and Community Health and Safety

184. In 2003 the International Labour Organization (ILO) created the New Global Strategy for Occupational Safety and Health (OSH). Based on the OSH<sup>26</sup> the Ministry of Labour and Vocational Training (MLVT) through the Department of Occupational Safety & Health, developed the Occupational Safety and Health Master Plan (OSHM; 2009-2013) of Cambodia.

185. The OSHM, *inter alia*, addresses worker and public safety in the construction and operation of small-medium enterprises and notably rural roads. The EA/PCU as supported by the PIUs must obtain and implement the directives of the OSH Master Plan. The pertinent associated law and directives is the Labour Law of Cambodia (1997), with specific reference to chapter VIII governing health and welfare of workers and the public. However, The OSH directives for Cambodia will need to be supplemented with the international the IFC EHS/OSH Guidelines for Construction and Decommissioning, Waste Management Facilities, and Toll Roads. The contractor will have to identify how they will use the appropriate national and IFC OHS guidelines in their bid documents for joint review by the PMCES and PIU.

186. In January 2020 the World Health Organization (WHO) declared the outbreak of a new coronavirus disease in Hubei Province, China to be a Public Health Emergency of International Concern. WHO and public health authorities around the world are taking action to contain the COVID-19 outbreak. WHO considered COVID19 a pandemic<sup>27</sup> in March 2020. In response to the prevailing COVID-19 pandemic, the project shall implement protocol on the control of spread of COVID-19. Health and safety plan shall be drafted and implemented in all project areas including worker camps. The sets of procedures and guidelines specified in the and plan and related protocol shall conform to WHO, national and local government protocols to ensure protection and safety of all workers, staff and the general public.

### 4. Regulatory Framework for Kep Subproject

187. Applicable national regulations and guidelines for the improvements to solid waste management drawn from the IEE are summarized in Table 1. The regulations and guidelines identify how solid waste should be managed to prevent or minimize negative impacts on the environment. The current environmental standards for Cambodia are provided in Appendix B. See the IEE for the complete legal and regulatory framework for environmental management in Kep province.

**Table 21: Regulations and Guidelines Applicable to the Subproject**

Solid Waste Management
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<sup>26</sup> ILO. 2009. Asean-Oshnet, Occupational Safety and Health Practices.

<sup>27</sup> WHO made the assessment that COVID-19 can be characterized as a pandemic. (<https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19>)



- Law on Environmental Protection and Natural Resources Management, Preah Reach Kram/NS-RKM-1296/36, enacted by Minister of Environment, 1996;
- Sub-decree No. 72 ANRK.BK on EIA process (MoE, 1999)
- Sub-decree No. 36 ANRK.BK on Solid Waste Management (MoE, 1999)
- Sub-decree No. 27 ANRK.BK on Water Pollution Control (MoE, 1999)
- Sub-decree No. 42 ANRK.BK on Air Pollution Control and Noise Disturbance (MoE, 2000)
- Technical Guidelines on Garbage and Urban Solid waste Management (MOE 2016)
- Sub-decree No. 113 ANRK.BK on Management of Urban Garbage and Solid Waste (Mol and MoE, 2015)
- Sub-decree on No. 235 on Drainage System Management and Waste Water Treatment Plan (Mol, MPWT and MoE, 2017)
- Directive Managing Health Wastes in the Kingdom of Cambodia (MOH, 2008)
- Directive on Industrial Sludge Management (MOE, 2000); and
- Directive on Industrial Hazardous Waste Management (MOE, 2000);

188. The operation and management of the upgraded solid waste management system of Kep including garbage generation, collection, transport, treatment and disposal at the upgraded landfill must also follow the IFC EHS Guidelines for Waste Management Facilities and Tourism & Hospitality.

### **C. Environmental Monitoring Plan**

The environmental monitoring plan for the subproject is provided in Table 22. The monitoring plan consists of environmental indicators, the sampling locations & frequency, method of data collection, responsible parties, and estimated costs. The purpose of the monitoring plan is to determine the effectiveness of the impact mitigations, to document any unexpected positive or negative environmental impacts of the subproject, and to determine the proper functioning of select components of the SLF. The indicative costs of monitoring are shown in Table 24.

#### **1. Monitoring strategy**

189. The strategy for monitoring some environmental parameters such as dust levels is to conduct continuous or daily *qualitative* observations, not periodic (e.g., quarterly) quantitative measurements that provide limited information and which require expensive laboratory analyses. When the common occurrence of dust on construction sites and along roads is observed by contractor staff or the public from for example truck traffic, excavation operations, or from wind-blown aggregate piles, the problem should be remediated immediately by the contractor with wetting agents that are on standby for quick and immediate application. Similarly, when noise levels are considered too high either qualitatively or from a portable onsite sound meter the equipment/vehicle producing the noise should be immediately checked for working condition and repaired. Or the equipment operation rescheduled.

190. Environmental standards for ambient water quality for Cambodia are found in Appendix D. The environmental standards provided by the Environmental, Health and Safety Guidelines of the IFC/World Bank (2007) (e.g., ambient air quality and noise) should be followed to supplement standards that are not provided by the Government.

191. An independent environmental monitoring institute (EMI) will be required to perform the groundwater sampling and laboratory analyses that cannot be conducted by the IA, PMCES or

contractors. The SS will coordinate with the EMI under the direction of the PMCES/PIU who will provide logistical support to the EMI where necessary. The PMCES will be given a budget for the EMI which will come from the loan. The budget for the work of the EMI will become the costs for monitoring which are estimated in Table 24.

**a. Performance Monitoring**

192. Performance monitoring is required to assess the overall performance of the EMP. A performance monitoring system is normally developed by the EA for the entire subproject. Select indicators of major components of the environment that will be affected primarily by the construction phase are drawn from the mitigation and monitoring plans and summarized in Table 24.

**Table 22. Environmental Monitoring Plan**

Environmental Indicators	Location	Means of Monitoring	Frequency	Reporting	Responsibility		Estimated Cost <sup>28</sup> (USD)
					Supervision	Implementati on	
Just before Construction Commences - Update Baseline							
Remaining public and stakeholder issues and concerns of construction activities including construction schedule.	Villages, in particular Damnak Chamour village near existing dumpsite and on NR-33.	Repeated community consultations	Once	Once	EA/PIU	PIU	\$500.
Construction Phase of SLF and Access Road							
A) Qualitative dust and noise levels, and ground and surface water  B) Qualitative turbidity levels in surface water and other parameters such as oil and grease, pH, TSS  C) Operational health and Safety (OHS)  D) Qualitative level of unmanaged and uncontained worker (domestic) and construction solid waste.  E) Public comments and complaints  F) Incidence of worker or public accident or injury	A) Along access road and on SLF boundary and nearest residential receptors.  B) In streams adjacent to SLF property  C) All construction sites, worker camp living and pit latrine areas  D) From all project-affected community areas, from hotline telephone number placed along access road and at gate to SLF.  E) At all construction areas	A – B): Using simple visual field observation methods approved by DOE and water quality laboratory results  C) Visual inspections including complaints from local community or workers.  D) Information transferred by hotline telephone number, through GRM, and direct public complaint at construction site.  E) Regular reporting by contractors	Continuous ly daily observation s recorded in site diary	Monthly	A – C): PMCES/PIU  D): EA/PIU  E): EA/PIU	Contractor, & contractor to mitigate issue immediately  PIU and contractor, with issue addressed immediately  PIU and contractor, with issue addressed immediately	Management overhead cost
Operation of Completed SLF and Upgraded Access Road							

<sup>28</sup> Units costs of parameter analyses conducted for DED by MOE

Environmental Indicators	Location	Means of Monitoring	Frequency	Reporting	Responsibility		Estimated Cost <sup>28</sup> (USD)
					Supervision	Implementati on	
Proper function of waste cells, and leachate treatment system of SLF: groundwater quality at SLF: 20 parameters analyzed as part of DED:	1) Borehole wells BH5, BH4, and BH3 at SLF,  2) effluent (below wetland) of leachate treatment system	Using field and analytical methods approved by DOE and MOE	Quarterly for 3 years then, if the lab results show measures are within standard, biannually for next 12 years	Biannual	Kep Municipality	1): \$26,676.  2): \$8,892.	
Proper function and operation of LFG extraction system	LFG system	Monitoring procedure of equipment manufacturer	Biannually			O&M to be determined	
Improved solid waste collection: decreased solid waste litter on streets, and at households/businesses	Entire solid waste collection catchment	Observation					
Vehicle traffic accidents	Upgraded / improved subproject roads.	Regular record keeping.	Continuous			For each event	DPWT
Good health of SLF workers	All workers at SLF			Kep Municipality			

**Table 23. Performance monitoring indicators for Kep subproject**

Major Environmental Component	Key Indicator	Performance Objective	Data Source
<b>Pre-construction Phase</b>			
Public Consultation and Disclosure	Affected public and stakeholders	Continued meetings with stakeholders contacted during DED and through GRM	Minutes of meeting, and participants list
EMP	EMP finalized	No significant environmental contamination or problems	Contractor, EMI, and Kep municipality reports
Bid Documents	Completed with appended EMP <sup>29</sup>	EMP appended to bidding documents with clear instructions to bidders for CEMP	Bid documents

<sup>29</sup>Contractor Environmental Management Plan developed from EMP in contractor bidding document

<b>Major Environmental Component</b>	<b>Key Indicator</b>	<b>Performance Objective</b>	<b>Data Source</b>
CEMP(s)	CEMP(s) prepared by contractor(s)	CEMP(s) reviewed and approved by PMCES/PIU	Bid documents and PMCES/PIU
Training of PIU/SS	Training course(s) & schedule	By end of preconstruction phase, required course(s) that will be delivered are designed and scheduled	Course(s) outline, participants, and schedule
Background groundwater quality at SLF	Parameters analyzed for DED	Clearer understanding of impact of existing dumpsite	EMI
<b>Construction Phase</b>			
Air quality at SLF	Qualitative dust, noise	Levels managed to minimum, within acceptable local or applicable international standard	contractor monitoring reports,
Surface and ground water quality at SLF and vicinity	Quality of surface and ground water	Levels managed to minimum, within acceptable local or applicable international standard	contractor monitoring report
Public and worker safety	Frequency of injuries	Adherence to Government policy and site-specific procedures to prevent accidents	Contractor reports
Traffic, Safety and Health as well as OSH	Frequency of disruptions, accidents, and blocked access	Disruptions, stoppages, or detours are managed to minimum.	Public input, contractor reports,
<b>Operation of Improved Solid Waste Management</b>			
Proper function of waste cells and leachate treatment system of SLF	Groundwater parameters analyzed for DED at boreholes BH5, BH4, BH3, and effluent of leachate treatment system (below wetland)	SLF operating properly	EMI/Kep municipality reports
Public safety	Incidence of traffic accidents on access road	No deviation from baseline frequency	DPWT
Cleaner community	Reduced solid waste litter throughout Kep municipality	Improved solid waste collection and management	Kep Municipality or outsourced operator

## 2. Reporting

193. Regular reporting on the implementation of mitigation measures, and on monitoring activities during construction phase of the subproject is required. Reporting is the responsibility of PIU and should include regular meetings with stakeholders as part of the continuation of stakeholder communications. The mitigation and monitoring plans summarize proposed timing of reporting. A report on environmental monitoring and implementation of EMP will be prepared quarterly for the EA/PCU by the PIU. For the quarterly report the PIU report will compile monthly reports provided by the EO of contractor, the reports of the EMI on monitoring, and input from the IES/NES of the PMCES. The PIU reports will be compiled into the semi-annual environmental safeguards monitoring report that the EA/PIU submits to the ADB and DOE.

## 3. Estimated Cost of EMP

The marginal costs for implementing the EMP are primarily for environmental monitoring because the costs for implementing impact mitigation measures are included with the construction costs in contractor bid documents. From Table 22 the estimated costs for the implementation of the EMP for solid waste management improvement in Kep are summarized in Table 24. The costs of the qualitative environmental monitoring during construction phase is easily assumed by management overhead.

194. An estimated budget of \$5,000.00 is required for capacity building for environmental management in conjunction with other capacity development activities of the subproject. The costs will need to be updated by the PMCES in conjunction with the PIU during the pre-construction, detailed design phase of the subproject.

**Table 24: Estimated costs for environmental monitoring plan of EMP**

Activity Type	Estimated Cost <sup>30</sup> (USD)
Pre-construction Phase	\$500.
Construction Phase	management overhead cost
Post-construction Operation Phase	\$35,568
Capacity development and training	\$5,000.00
<b>Total</b>	<b>\$41,068.00</b>

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<sup>30</sup> To be updated with EMP at Detailed Design Phase



## VII. PUBLIC CONSULTATION

195. The stakeholder consultation strategy during project preparation adopted 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). Stakeholder consultation for the environment was conducted jointly with the parallel social impact assessment.

196. The approach to stakeholder consultation for environmental concerns or issues with the Kep subproject consisted of the following three avenues of inquiry and data collection:

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

### A. Identification of Stakeholders

197. 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 IAs (ii) provincial agencies at all levels (e.g., Provincial Department of Environment (DoE), Women's Affairs, Provincial Department of Commerce (DoC), Provincial Department of Tourism (DoT), Provincial Department of Water Resources and Meteorology (DOWRAM), Provincial Department of Public Works & Transportation (DPWT);
- 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

198. Five open-ended questions and information requests (

Table 25) guided stakeholder discussions.

**Table 25. Guiding Questions and Information Requests for Stakeholder Consultations**

<p>1. What will be the benefits of the subproject? Please list benefits of project.</p> <p>2. Do you have any environmental concerns with the subproject? Please list environmental concerns about subproject.</p> <p>3. Do you any have environmental concerns with the <b>construction activities</b> of the subproject? Please list environmental concerns of construction phase activities.</p> <p>4. Do you have environmental concerns about the <b>completed operation phase</b> of the completed subproject? Please list environmental concerns about the operation of completed subproject.</p> <p>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?</p>
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199. To help guide the discussions on environmental issues and concerns of subprojects a list of environmental components (Table 26) was introduced to the stakeholders ahead of the question and answer period. Stakeholders were encouraged to add their own components of environment to the discussions.

**Table 26. Example Environmental Components Used to Guide Stakeholder Discussions.**

<ul style="list-style-type: none"> <li>• drinking water quality and availability</li> <li>• surface water quality and quantity</li> <li>• groundwater quality and quantity</li> <li>• air quality</li> <li>• climate</li> <li>• land and soil quality</li> <li>• coastal zone, ocean, rivers, reservoirs,</li> <li>• mangroves, trees, other vegetation,</li> <li>• coastal and terrestrial resources e.g., seagrass beds, mangroves, forests, salt beds</li> </ul>	<ul style="list-style-type: none"> <li>• terrestrial and aquatic animals, e.g., fish, birds, small mammals</li> <li>• ecological protected areas (e.g., national parks, wildlife sanctuaries),</li> <li>• land and coastal zone uses (e.g., agriculture, fisheries, forestry, navigation, aquaculture, commercial, other),</li> <li>• public safety</li> <li>• public movement and access</li> <li>• physical cultural values (e.g., pagodas, cemeteries, monuments)</li> </ul>
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### **C. Summary of Public Consultation in Kep Town**

200. The list of participants and recorded minutes and photographs of the public consultation meetings held in Preah Sihanouk and Kep are in Appendix A. Below is a summary of discussions.

201. The second series of consultative meetings for environment for the DED of the solid waste management improvements were conducted in Town/City (Sangkat Kep), Sangkat Prey Thum and Sangkat Ou Krasa. The meetings were conducted in Kep with local authorities and villagers on 22-24 October 2018. Different provincial departments (Environment, Tourism, Agriculture and Public Works & Transport) and households / villages affected by the subproject components were invited. The 2<sup>nd</sup> stakeholder consultations in Kep again revealed overall positive support for the subproject. Table 27 summarizes the comments and concerns raised. The environmental issues and concerns identified by the consultations were similar to the issues and concerns identified by the consultations for FS designs, and similarly, are addressed by the Mitigation and Monitoring Plans (see below).

**Table 27. Summary of Stakeholder Views of DED of Kep Subproject**

Benefits of subprojects expressed by stakeholders	<ul style="list-style-type: none"> <li>• Improved environment because of new landfill in Kep province</li> <li>• Improved living standard of people in Kep city/town due to improvement of new landfill</li> <li>• The provincial development plans will be supported by subprojects</li> <li>• Reduce the disease from infection from waste in the city</li> </ul>
<b>Results of public consultations for affected Sangkats - Kep</b>	
<b>Meeting Location</b>	<b>Individual Concern or Issue</b>
Sangkat Kep	<ul style="list-style-type: none"> <li>• Current practice is villagers burn and bury their dry waste on their property</li> <li>• Smell is a problem from garbage trucks during collection</li> <li>• Provide adequate waste bins for villages</li> <li>• Must prevent villagers from dumping garbage along the road and near the sea</li> <li>• Request extension activities for local people on waste management</li> <li>• The service price is 10,000 Riel/month</li> </ul> <p>Request low price for waste collection service and free for poor people (poor level 1 &amp;2)</p>
Sangkat Prey Thum	<ul style="list-style-type: none"> <li>• During raining season the common dumping of waste access road to dump site must stop</li> <li>• Don't pollute local environment with leachate from landfill</li> <li>• There are many flies from dumpsite due to marine wastes (shrimp, crab, etc...)</li> <li>• Want the access road to landfill to wider to be able to eventually become another road to Phnom Penh</li> <li>• Enlarge width of access road to 8m wide</li> <li>• Improve waste collection in the Kep city/town to prevent aesthetic garbage problems for tourists and tourism especially from waste plastic bags</li> <li>• Agree with the DED of landfill, and support the project</li> <li>• Request closed drain pipes along access road in front of houses so households can easily cross to access their houses</li> <li>• Dust is currently is a big problem along access road</li> <li>• Soil trucks that use existing borrow pit must drive slowly and be covered to prevent dust, and reduce risk of accidents</li> <li>• There are many flies from the dumpsite</li> <li>• Compensation should be provided for all lost as trees and land from access road upgrades</li> <li>• Adequate drainage on both side of the access road is required to prevent rainy season flooding over the road</li> </ul>
Sangkat Ou Krasar	<ul style="list-style-type: none"> <li>• Request that garbage trucks enter villages to collect garbage, just collect along major roads.</li> <li>• Provide sufficient waste bins for villages</li> <li>• Don't pollute local environment with leachate from landfill</li> </ul>

	<ul style="list-style-type: none"> <li>• Request low price for waste collection service, and free service for poor people (poor level 1 &amp;2)</li> <li>• Request training and awareness for village on proper solid waste management</li> <li>• Service provider for waste collection must collect waste regularly as needed</li> <li>• Village agrees with separation of waste at source</li> <li>• Must stop current practice of septic vacuum trucks dumping on the road side</li> <li>• Must educated and prevent villagers from throw waste to streams.</li> </ul>
<b>Meeting at Kep Provincial Governor's office Kep 22-102018</b>	
Governor of Kep DPWT-3 DOT-2 DOE-2 DOLM-1 Kep Municipality-1 Dept of Land Management, Urban Planning and Construction-1	<ul style="list-style-type: none"> <li>• All agree with, and support detailed design of upgraded landfill and solid waste collection</li> <li>• Questioned next steps after landfill is full after projected 20yr lifespan</li> <li>• Request that width of the access road increased from 6m to 7m</li> <li>• Initially unsure of location at landfill where waste would separated. MRF identified and explained including MRF requirement that wet waste must be separated at source before arrival at MRF</li> <li>• Request a place along access road be established where newly married couples can go to go to plant a trees, and not be negatively affected by garbage trucks.</li> <li>• Adequate side drains are needed along access road</li> <li>• Open drains along road must be 1m - 2 m wide</li> <li>• Training is required on solid waste management and operation of landfill for Kep municipality staff, and Sangkat and village personal as per SWN sub-decree 113</li> <li>• Provide traffic signage at intersection of access road and NR 33 to indicate location landfill.</li> <li>• Does the administration building in landfill have a medical services for employees?</li> <li>• Request for finished landfill to become tourist site with garden area for</li> <li>• Tourists to visit and relax.</li> <li>• Will landfill have a place for composting wet waste for production of good soil for agriculture? Or only for dumping waste into cells?</li> <li>• Must provide construction schedule to DLMUPC prior to construction of the landfill cells</li> </ul> <p>Construction company must inform local community of schedule of construction of access road upgrade, and landfill</p>

## VIII. ANALYSIS OF ALTERNATIVES

202. Alternatives subproject design considered use of bitumen road surfaces and different landfill liner types. Engineering solutions selected are appropriate options in terms of cost, durability, climate resilience, environmental and social impacts, and O&M capacities of project owners. Preliminary designs are compatible with Cambodia's construction standards and local contracting industry capabilities. Climate adaptation measures include stronger road-base and pavement structures and higher-capacity transverse and longitudinal drainage.

## IX. INFORMATION DISCLOSURE AND GRIEVANCE REDRESS MECHANISM

203. The subproject components were introduced to the public and key stakeholders during initial consultation meetings for the FS designs of all three subprojects, and then again for the DED for Kep subproject which included verbal and visual presentations of all subproject components.

204. The current and final IEE must be made easily available to the stakeholders contacted during project preparation, in written and verbal forms, and in local language. At minimum, the Executive Summary of the IEE and EMP should be translated to Khmer and distributed to all persons affected by the project. The IEE should be available on the MOE/DOE and MOT/DOT websites, 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/PCU/PIU should be available at the same offices and websites. The IEE and EMP will also be available on the ADB web site. After implementation of the subprojects begins semi-annual safeguards monitoring reports will be prepared by the PCU and PIUs, and posted on the project and ADB website.

205. A well-defined grievance redress and resolution mechanism will be established to address grievances and complaints regarding environment, potential impacts of construction activities and compensation and resettlement, in a timely and satisfactory manner. All stakeholders will be made fully aware of their rights, the detailed procedures for filing grievances, and appeal process. These will be publicized 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.

206. A Grievance Committee that has experience with environmental and social issues will be organized in communes, comprising local leaders designated for such tasks, and representatives of the contractor and PIU. 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 MOT/DOT, PCU, PIU and ADB upon request.

207. Affected persons (APs) are entitled to lodge complaints regarding any perceived issue with the affected environment, or aspect of any potential 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 grievance committee will be responsible to make a written record during the first meeting with the APs.

#### **A. Informal Approach**

208. Informally, APs can lodge complaints directly to the contractor during construction or PIU<sup>31</sup> established by Provincial Department of Public Work and Transport (PDPWT) for this subproject in Kep Province during operation. The contractor/PUI shall document and assess the complaint immediately. If assessment validates the complaint as within the scope of the GRM/eligible, the contractor/PUI shall act on the complaint within three days from receipt of complaint. If assessment invalidates the complaint (i.e., reveals the complaint as ineligible or not associated with the Project's environmental performance), the contractor/PUI shall direct the AP to the Grievance Committee<sup>32</sup> for confirmation, triggering the formal approach.

209. The contractor/PUI shall report the following to the EA which is the Provincial Department of Public Work and Transport (PDPWT) within 2 days from receipt of complaint: (i) complaint received, eligible or ineligible, duly referenced; and (ii) actions to be taken/taken including

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<sup>31</sup> comprising relevant provincial departments/government representatives including provincial department of environment (PDoE) and provincial department of tourism (PDoT)

<sup>32</sup> The Grievance Committee will consist of local leaders designated for such tasks, and representatives of the contractor and PIU

timeline. The EA shall obtain a written confirmation of satisfaction from the AP, 7 days from completion of resolution by contractor/PIU.

## **B. Formal Approach**

210. If complaint lodged informally is eligible but is not acted on within three days from receipt of complaint, or if AP is not satisfied with the resolution undertaken by the Contractor/PIU, the APs can access the formal approach.

211. The procedures are set out below. A hotline telephone number should be placed at each construction site for community to easily contact the PIU to report an environmental issues or disturbance during construction phase. The PIU will then contact contractor. 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 or screening and validation. Should the complaint is found valid and most likely be construction-related, the Environment Officer/contractor and Safeguards Specialist 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 DOT, DGC/PGC and the APs. If the decision of the provincial court is still unsatisfactory to the APs, the APs may bring the complaints to the Higher Court.

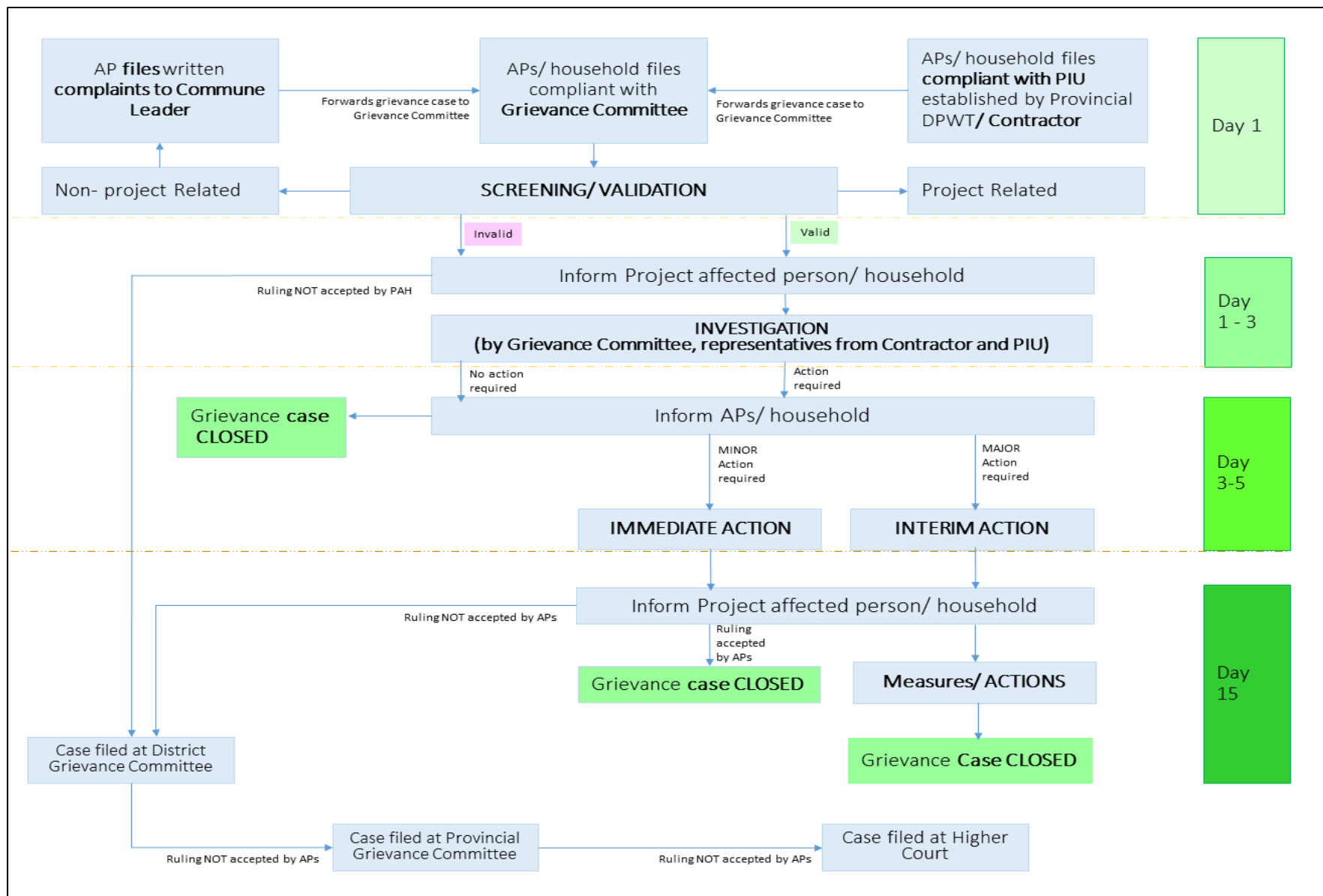


Figure 31. Grievance Redress Mechanism Diagram



212. The PCU will be responsible for checking the procedures and resolutions of grievances and complaints. The PCU safeguards focal staff must have expertise and experience in social and environmental issues associated with infrastructure developments. The PCU may recommend further measures to redress unresolved grievances. The consultant environmental specialists will provide the necessary training to improve grievance procedures for the grievance committee members when required.

213. 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 reimbursed by the project if the APs win their case.

214. 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 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.

215. If efforts to resolve disputes using the grievance procedures remain unresolved or are unsatisfactory, APs have the right to directly submit their concerns or problems to 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 ADB's Office of the Special Project Facilitator.

# APPENDIX A: PUBLIC CONSULTATIONS IN KEP

## List of Participants, Kep Public Consultations

PPTA 9090-REG: Preparing the Second Greater Mekong Sub region  
Tourism Infrastructure for Inclusive Growth Project

### List of Participants in Meeting

Time and Date: 05.07.2017

Place: ក្រុង ស្អាតស្អាត

Component: គម្រោង កែលម្អ ប្រព័ន្ធ

No	ឈ្មោះ Name	តំណាង Position and Agency	ហត្ថលេខា Signature
01	គ្រូ ឧបនិស្សិត	អគ្គនាយកដ្ឋាន	
02	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
03	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
04	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
05	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
06	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
07	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
08	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
09	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
10	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
11	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
12	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
13	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	
14	លោក គឹម ឌី	អគ្គនាយកដ្ឋាន	

PPTA 9090-REG: Preparing the Second Greater Mekong Sub region  
Tourism Infrastructure for Inclusive Growth Project

List of Participants in Meeting

Time and Date: 05.09.2017

Place: ភ្នំពេញ, កម្ពុជា

Component: គម្រោងបង្កើនសេវាទេសចរណ៍

No	ឈ្មោះ Name	តំណាង Position and Agency	ហត្ថលេខា Signature
15	កញ្ញា កាត្រីន		
16	គ្រូ វ៉ាន់		
17	លោក វ៉ាន់ ហ៊ុន		
18	លោក វ៉ាន់ វិធី		
19	លោក វ៉ាន់ វិធី ធាន		
20	លោក វ៉ាន់ វិធី		
21	លោក វ៉ាន់ វិធី		
22	លោក វ៉ាន់ វិធី		
23	លោក វ៉ាន់ វិធី		
24	លោក វ៉ាន់ វិធី		
25	លោក វ៉ាន់ វិធី		
26	លោក វ៉ាន់ វិធី		
27	លោក វ៉ាន់ វិធី		
28	លោក វ៉ាន់ វិធី		

List of Participants in Meeting

Time and Date: 05.09.2017

Place: ក្នុង សាលា ក្រុង ភ្នំពេញ

Component: គម្រោង កែលម្អ ប្រព័ន្ធ

No	ឈ្មោះ Name	តំណាង Position and Agency	ហត្ថលេខា Signature
1	ត្រី គន្ធី	នាយកក្រុមប្រឹក្សាភិបាល	
2	សេដ្ឋី ចេតី	ប្រធានក្រុមប្រឹក្សាភិបាល	
3	វ៉ាន់ យ៉ា	អគ្គនាយកដ្ឋានទេសចរណ៍	
4	បុត ឆ័យ	អគ្គនាយកដ្ឋានទេសចរណ៍	
5	ហ៊ុន ឈាន	— 11 —	
6	ប៊ុន គន្ធី	— 11 —	
7	ប៊ុន គន្ធី	— 11 —	
8	ប៊ុន គន្ធី	— 11 —	
9	ប៊ុន គន្ធី	— 11 —	
10	ប៊ុន គន្ធី	— 11 —	
11	ប៊ុន គន្ធី	— 11 —	
12	ប៊ុន គន្ធី	— 11 —	
13	ប៊ុន គន្ធី	— 11 —	
14	ប៊ុន គន្ធី	— 11 —	



## Tourism Infrastructure for Inclusive Growth Project

Time and Date: 08.09.2017

Place: শ্রী নন্দী মন্দির

Component:..... ANALYSIS OF DATA

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PPTA 9090-REG: Preparing the Second Greater Mekong Sub region

Tourism Infrastructure for Inclusive Growth Project

List of Participants in Meeting

Time and Date: 05.09.2017

Place: ក្រសួងវប្បធម៌ និង រចនាសម្ព័ន្ធ

Component: ការស្រាវជ្រាវ និង គម្រោង

No	ឈ្មោះ Name	តំណាង Position and Agency	ហត្ថលេខា Signature
01	លោក ហ៊ុន ម៉ាណែត	ប្រធាន	[Signature]
02	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
03	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
04	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
05	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
06	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
07	លោក ហ៊ុន ម៉ាណែត	អគ្គនាយក	[Signature]
08	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
09	លោក ហ៊ុន ម៉ាណែត	នាយកដ្ឋាន	[Signature]
10	លោក ហ៊ុន ម៉ាណែត	នាយកដ្ឋាន	[Signature]
11	លោក ហ៊ុន ម៉ាណែត	ប្រធាន	[Signature]
12	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
13	លោក ហ៊ុន ម៉ាណែត	"	[Signature]
14	លោក ហ៊ុន ម៉ាណែត	ប្រធាន	[Signature]

## Participants of Consultations for DED of Kep Subproject

TA 9090-REG: Preparing the Second GMS Tourism Infrastructure  
for Inclusive Growth Project

### List of Participant in Public Consultation in Kep City, Cambodia

Time and date: 22/10/2018

Location: Sangkat Prey Tum

ល.រ No.	ឈ្មោះ Name	តំណាង Position & Agency	លេខទូរស័ព្ទ Phnom Number	ហត្ថលេខា Signature
1	ឈាត់ ច័ន្ទ	(ប្រធាន)		
2	ឈាត់ ឈន់	-		
3	(ឈាត់) ឈន់	-		
4	ឈាត់ ឈន់	-		
5	(ឈាត់) ឈន់	-		
6	ឈាត់ ឈន់	-		
7	ឈាត់ ឈន់	-		
8	(ឈាត់) ឈន់	-		
9	ឈាត់ ឈន់	-		
10	ឈាត់ ឈន់	-		
11	ឈាត់ (ឈាត់) ឈន់	-		
12	ឈាត់ ឈន់	-		
13	ឈាត់ ឈន់	-		
14	ឈាត់ ឈន់	-		



**TA 9090-REG: Preparing the Second GMS Tourism Infrastructure  
for Inclusive Growth Project**

**List of Participant in Public Consultation in Kep City, Cambodia**

Time and date: 22.10.2018

Location: Sangkat Prey Tum

ល.រ No.	ឈ្មោះ Name	តំណាង Position & Agency	លេខទូរស័ព្ទ Phnom Number	ហត្ថលេខា Signature
15	គុណ ធីតា	ក្រុម		
16	គុណ ធីតា			
17	បាត ឈៀង			
18	គុណ ធីតា			
19	គុណ ធីតា			
20	គុណ ធីតា	ក្រុម		
21	គុណ ធីតា	ក្រុម		
22	គុណ ធីតា	ក្រុម		
23	គុណ ធីតា	ក្រុម		
24	គុណ ធីតា			
25	គុណ ធីតា			
26	គុណ ធីតា	ក្រុម		
27	គុណ ធីតា			
28	គុណ ធីតា			

**TA 9090-REG: Preparing the Second GMS Tourism Infrastructure  
for Inclusive Growth Project**

**List of Participant in Public Consultation in Kep City, Cambodia**

**Time and date:** 24/10/2018

**Location:** Sangkat Du Krasa

ល.រ No.	ឈ្មោះ Name	តំណាង Position & Agency	លេខទូរស័ព្ទ Phnom Number	ហត្ថលេខា Signature
1	កាតា ឈីន	ប្រធានក្រុមការងារ	0964635471	uy
2	សាវីត្រី ឈីន	អគ្គនាយកដ្ឋានប្រជាពលរដ្ឋ/កសិកម្ម	010652590	Handwritten signature
3	វ៉ាន់ ហ៊ុយ	និមិត្តរូបក្រុមការងារ		Handwritten signature
4	ស៊ុន ហ៊ុយ	និមិត្តរូបក្រុមការងារ		
5	ស៊ុន ឈីន	— 11 —		
6	កែវ ហ៊ុយ	— 11 —		
7	ស៊ុន ឈីន	— 11 —		
8	ស៊ុន ឈីន	— 11 —		
9	ស៊ុន ឈីន	— 11 —		
10	ស៊ុន ឈីន	និមិត្តរូបក្រុមការងារ		
11	ស៊ុន ឈីន	និមិត្តរូបក្រុមការងារ	07-2906000	Handwritten signature
12	ស៊ុន ឈីន	— 11 —		
13	ស៊ុន ឈីន	— 11 —		
14	ស៊ុន ឈីន	— 11 —		

## APPENDIX B: OUTPUT OF IBAT SOFTWARE FOR SUBPROJECT SITES



### Proximity report generated by the Integrated Biodiversity Assessment Tool

Site name	Kep Landfill
Latitude/Longitude	10° 33' 51" North, 104° 19' 59" East
Date generated	15th January 2018
Generated by	asiandb
Company	ADB

### Protected Areas and Key Biodiversity Areas

The following sites are found within the selected buffer distances:

#### Features within 2 km

National-level protected areas		
IUCN Category I-II	Kep	67 ha


#### Features within 5 km

There are no additional features within 5 km.

#### Features within 20 km

Protected areas designated under regional or international conventions and agreements		
UNESCO Man and Biosphere	Kien Giang	11,686 ha
Priority Sites for Biodiversity		
Key Biodiversity Area	Kampong Trach VU, migratory birds/congregations	1,108 ha

## APPENDIX C: UXO CLEARANCE DOCUMENT

CERTIFICATE OF UXO DEPP CLEARANCE COMPLETION AT KEP LANDFILL IMPROVEMENT PROJECT	
NPMEC, EOD unit 213 would like to acknowledge that we have successfully completed UXO deep survey and clearance:	
- Project Title :	Construction of Kep Landfill Improvement Project
- Location :	Kep Province, Cambodia.
o Landfill and Access Road Reference:	
▪ Landfill Area	154,199 M <sup>2</sup>
▪ Access Road	84,600 M <sup>2</sup>
- Total Lines Cleared:	238,799 M <sup>2</sup>
- UXO Found:	06
I would also like to inform that our UXO deep clearance team had been executed professionally and our Mine/UXO Standard Operating Procedure (SOPs) is strictly followed.	
Phnom Penh, 18 June 2020	
Submitted	
	
MG MEY SOPHEA	