

# Initial Environmental Examination

---

Project Number: 53199-001

September 2021

## Cambodia: Livable Cities Investment Project Poipet

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

## **CURRENCY EQUIVALENTS**

(as of 2 September 2021)

Currency unit	–	riel (KR)
KR1.00	=	\$0.00024
\$1.00	=	KR4,086

## **ABBREVIATIONS**

ADB	–	Asian Development Bank
AP	–	Affected Person
ASP-EA	–	Activated Sludge Process with Extended Aeration
CCCSP	–	Cambodia Climate Change Strategic Plan
CCS	-	Comprehensive City Survey
CEMP	–	Construction Environmental Management Plan
CEMP	–	Contractor's Environmental Management Plan
CF	–	Community Forestry
CMAC	–	Cambodian Mine Action Centre
CMIP	–	Climate Model Intercomparison Project
CSIRO	–	Commonwealth Scientific and Industrial Research Organization
DCSC	=	Design and Construction Supervision Consultant
DED	–	Detailed Engineering Design
EA	–	Executing Agency
EHS	–	Environment, Health, And Safety
EIA	–	Environmental Impact Assessment
EIS	–	Environmental Impact Statement
EMP	–	Environmental Management Plan
EMoP	–	Environmental Monitoring Plan
ESO	–	Environment and Social Officer
ESSP	–	Environmental and Social Safeguards Policy
ESSF	–	Environmental and Social Safeguards Framework
FHH	–	Female Headed Household
FGD	–	Focal Group Discussion
FS	–	Feasibility Study
GAP	–	Gender Action Plan
GCM	–	Global Climate Model

GHG	–	Green House Gas
GMS	–	Greater Mekong Subregion project
GMS 1	–	Greater Mekong Subregion Southern Economic Corridor Towns Development Project
GMS 2	–	Second Greater Mekong Subregion Corridor Towns Development Project
GRM	–	Grievance Redress Mechanism
HH	–	Household
IA	–	Implementing Agency
IBAT	–	Integrated Biodiversity Assessment Tool
IEE	–	Initial Environmental Examination
IEIA	–	Initial Environmental Impact Assessment
IPCC	–	Intergovernmental Panel on Climate Change (IPCC3)
IUCN	–	International Union for Conservation of Nature
LCIP	–	Livable Cities Investment Project
LFG	–	Landfill Gas
MA	–	Municipal Administration
MEF	–	Ministry of Economy and Finance
MIH	–	Ministry of Industry and Handicrafts
MISTI	–	Ministry of Industry, Science, Technology and Innovation
MLMUPC	–	Ministry of Land Management Urban Planning and Construction
MP	–	Master Plan
MPWT	–	Ministry of Public Works and Transport
MOWRAM	–	Ministry of Water Resources and Meteorology
MOE	–	Ministry of Environment
MOI	–	Ministry of Interior
NFP	–	National Forest Programme
O&M	–	Operation and Maintenance
PA	–	Provincial Administration
PDLMUPC	–	Provincial Department of Land Management, Urban Planning and Construction
PDOE	–	Province Department of Environment
PDPWT	–	Province Department of Public Works and Transport
PIU	–	Project Implementing Unit

PIU-EO	–	PIU Environmental Officer
PIU-SO	–	PIU Social Officer
PMU	–	Project Management Unit
PMU-EOs	–	PMU Environmental Officer
PMU-SO	–	PMU Social Officer
PPCR	–	Pilot Program for Climate Resilience
PPE	–	Personal Protective Equipment
PS	–	Pumping Station
PWTESPO	–	Public Works & Transport, Environmental, Sanitation, and Public Order Office
RCP	–	Representative Concentration Pathway
REA	–	Rapid Environmental Assessment
RGC	–	Royal Government of Cambodia
RP	–	Resettlement Plan
SC	–	Steering Committee
SCF	–	Strategic Climate Fund
SEZ	–	Special Economic Zone
SOP	–	Standard Operating Procedure
SPS	–	Safeguard Policy Statement
SRES	–	Special Report on Emissions Scenarios
SWM	–	Solid Waste Management
TRTA	–	Transaction Technical Assistance
ToR	–	Terms of Reference
TRTA	–	Transaction Technical Assistance
TS 2	–	Second Urban Environmental Management in the Tonle Sap Basin
UDS	–	Urban Development Strategy
USD	–	United States Dollar
USU	–	Urban Service Unit
WEEE	–	Waste Electrical And Electronic Equipment
WHO	–	World Health Organization
WSP	–	Waste Stabilization Ponds
WW	–	Wastewater

WWPS	–	Wastewater Pumping Station
WWTP	–	Wastewater Treatment Plant
VAT	–	Value Added Tax

#### **NOTE**

In this report, "\$" refers to United States dollars.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the "terms of use" section on ADB's website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.



## CONTENTS

### EXECUTIVE SUMMARY

I.	INTRODUCTION	1
1.	Project Description	1
2.	Project Components and Proposed Infrastructure	1
3.	Rationale for an Environmental Assessment or Environmental Impact Assessment	17
II.	INSTITUTIONAL ARRANGEMENTS	19
4.	Agencies/Organizations Involved	19
5.	Organizational Procedures	20
6.	Composition and functions of the Steering Committee	22
7.	Implementation Plan and Schedule	22
8.	Implementation Process	24
III.	OBJECTIVES AND POLICY FRAMEWORK	26
9.	The objective of the Environmental Assessment	26
10.	Relevant Laws and Regulations	26
11.	ADB Safeguards Policy Statement	38
12.	Gap Analysis	40
IV.	DESCRIPTION OF THE ENVIRONMENT	41
1.	Location, Geography, and Topography	41
2.	Geology and Soils	42
3.	Climate, Hydrology, Water Resources, and Water Quality	44
4.	Ecology, Wilderness Values, and Protected Areas	57
5.	Human and Socio-Economic Resources	58
6.	Cultural Heritage and Physical Cultural Resources	63
7.	Noise	63
8.	Air Quality	65
9.	Water Supply	66
10.	Wastewater Management	67
11.	Stormwater Drainage	69
12.	Solid Waste Management	72
V.	ANTICIPATED ENVIRONMENTAL IMPACTS	75
1.	Project Areas of Influence and Sensitive Receptors	75

2.	Positive Impacts and Environmental Benefits	79
3.	Biodiversity Conservation and Sustainable Natural Resource Management	83
4.	Pollution Prevention and Abatement	87
5.	Health and Safety (Occupational Health and Safety; Community Health and Safety)	96
6.	Physical Cultural Resources	104
7.	Climate Change and Natural Hazards	104
8.	Indirect, Induced, and Cumulative Impacts	105
VI.	ANALYSIS OF ALTERNATIVES	106
1.	Wastewater	106
2.	Stormwater Drainage	110
3.	Solid Waste	112
VII.	CONSULTATION AND PARTICIPATION	118
1.	Consultations undertaken	118
2.	Results of consultations	119
3.	Roles of stakeholders in planning, design, and implementation	119
4.	Stakeholder consultation plan	120
5.	Next public consultations	120
VIII.	INFORMATION DISCLOSURE	121
IX.	GRIEVANCE REDRESS MECHANISM	122
X.	ENVIRONMENTAL MANAGEMENT PLAN	123
1.	Overview	123
2.	Objective and Scope	123
3.	Structure of the EMP	123
4.	Implementation Arrangements	124
5.	Documentation and Record-Keeping	129
6.	Management of Change	131
7.	Consultation and Participation	131
8.	Information Disclosure	132
9.	Grievance Redress Mechanism	132
10.	Environmental Management Plan	136
11.	Environmental Monitoring Plan	173
12.	Construction Environmental Monitoring	184
13.	Cost of EMP Implementation	185
XI.	CONCLUSION AND RECOMMENDATIONS	187



## APPENDICES

1.	Letter of MoE No. 1562, 23 November 2020, on approving location for the new landfill construction	188
2.	Environmental baseline survey report	191
3.	Integrated Biodiversity Assessment Tool (IBAT) Report	192
4.	Summary of public consultations	193
5.	Safeguards Monitoring Report Template	221
6.	GRM Complaint Form	222
7.	GRM Register	223

## LIST OF FIGURES

Figure 1: Location of main proposed infrastructures - wastewater	3
Figure 2: Process Flow Diagram – Activated Sludge Process with Extended Aeration (ASP-EA)	5
Figure 3: WWTP layout and location	6
Figure 4: Proposed urban drainage network - overview of box-culvert types	9
Figure 6: Proposed landfill and composting plant location (SWM)	12
Figure 7: General layout of the landfill	15
Figure 8: Relations between the different stakeholders for the project implementation	20
Figure 9: Tentative Project Implementation Schedule	24
Figure 10: Poipet City location	42
Figure 11: Geological map - Poipet city	43
Figure 12: Soil sampling location map	44
Figure 13: Wind rose for Poipet (source: meteoblue)	45
Figure 14: Detail of available road reserve for box culvert stormwater infrastructure in urban areas	51
Figure 15: Poipet hydrological context	52
Figure 16: Flood Prone Areas in Poipet City Identified from CCS Focus Groups and Field Investigations	53
Figure 17: Sampling location map of water quality examination	55
Figure 18: Current land use in Poipet City area	62
Figure 19: Location map of Noise and Air quality measurement	65
Figure 20: Excreta Flow Diagram	67
Figure 21: City Survey and Flood-Prone Areas Location	71
Figure 22: Collection Coverage in Poipet	72
Figure 23: Centralized collection points - Poipet	79
Figure 24: Flora at the WWTP site: endangered species - Poipet	84
Figure 25: Flora at the landfill site: endangered species - Poipet	85
Figure 26: Existing concrete plants in Poipet	88
Figure 27: CO2 flare stack emission - SWM in Poipet	94
Figure 28: Septage and sludge management – SWM and WWTP in Poipet	95
Figure 29: Wastewater list of scenarios	106
Figure 30: WWTP - site alternatives	108
Figure 31: Stormwater list of scenarios	110
Figure 32: Solid waste management - list of scenarios	112
Figure 33: Landfill sites locations	114
Figure 34: GRM - informal process	134
Figure 35: Grievance Redress Mechanism Chart	136

## LIST OF TABLES

Table 1: Investment horizon and Design Capacity	3
Table 2: Summary of investments in Poipet (wastewater)	4
Table 3: Wastewater and septage flow projection	4
Table 4: Summary table of investment in Poipet (stormwater)	10
Table 5: Drainage Lines Summary - Poipet	11
Table 6: Summary table of investment in Poipet (SWM)	12
Table 7: Solid Waste Management Sub-Components	12
Table 8: Key elements of the legal and policy framework on the environment that are applicable to the project	28
Table 9: Key directives in support of the Law on Environmental Protection and Natural Resources Management	28
Table 10: Other pertinent regulations, policy, or guidelines for the project	29
Table 11: Criteria for selection of the landfill site	32
Table 12: Parameters and standards for surface water quality	33
Table 13: Parameters and standards for groundwater quality	33
Table 14: Water Quality Standard in Public Water Areas for Public Health Protection	34
Table 15: Effluent Standard for Pollution Sources Discharging Wastewater to Public Areas or Sewer	36
Table 16: Ambient air quality standards for Cambodia and the WHO	37
Table 17: Cambodian National Standard for Ambient Noise	37
Table 18: Climate Change modeling discussed in this report.	46
Table 19: Range of Projected Mean Annual Temperature Change (°C) for the 5° x 2.5° cell containing Poipet Compared to the 2000-2020 model average under the SSP2 RCP4.5 and SSP5 RCP8.5 Scenarios from 13 Model Ensemble.	47
Table 20: Projected seasonal temperature change (°C) for Poipet for the period centered on 2055 under RCP 8.5 compared to the period 1975-2005.	47
Table 21: Range of Projected Mean Annual Precipitation Change (%) for the 5° x 2.5° cell containing Poipet Compared to the 2000-2020 average under different Scenarios from 10 Model Ensemble.	48
Table 22: Projected change in extreme rainfall parameters (mm) for Poipet for the period centered on 2055 under RCP 8.5 compared to the period 1975-2005.	49
Table 23: Results of water quality examination	56
Table 24: Results of noise measurement	64
Table 25: Air quality at the landfill site	66
Table 26: Sensitive receptors to proposed construction activities	75
Table 27: Employment generated by the project	81
Table 28: Construction Equipment Noise	96
Table 29: Site Assessment Summary	109
Table 30: Summary of landfill site assessments	114
Table 31: Technical options for the basal liner	115
Table 32: Technical options for the leachate treatment system	116
Table 33: Technical options for the landfill gas treatment system	116
Table 34: Consultations undertaken in Poipet	118
Table 35: Institutional responsibilities for EMP implementation	124
Table 36: Project Environment Training Program	128
Table 37: Estimated Costs for training of the Project Environment Management Plan	129
Table 38: Reporting Requirements	130
Table 39: Review Process	130
Table 40: Public Consultation and Participation Plan for Environment Safeguards	131
Table 41: Environmental Management Plan for Solid Waste Subproject	138

Table 42: Environmental Management Plan for Wastewater Subproject	152
Table 43: Environmental Management Plan for Stormwater Drainage Subproject	164
Table 44: Environmental Impact Monitoring for Solid Waste Subproject.	174
Table 45: Environmental Impact Monitoring for WW Subproject	178
Table 46: Environmental Impact Monitoring for Stormwater Subproject	182
Table 47: Estimated Costs for Implementation of the Project Environment Management Plan	185

## EXECUTIVE SUMMARY

### 1. Introduction

1. At the request of the Kingdom of Cambodia, the Asian Development Bank (ADB) is developing the Livable Cities Investment Project (LCIP) to improve the environment of several secondary cities in Cambodia, including Poipet, Bavet, and Kampot.

2. Project outputs include: (i) Output 1: policy and regulatory environment improved, (ii) Output 2: urban infrastructure improved, and (iii) Output 3: institutional effectiveness, and governance improved.

3. The scope of this Feasibility Stage Borrower Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) concerns subprojects under Output 2 only.

4. For the priority area in the short term (2025), the identified subprojects in Poipet under LCIP Output 2 are as follows:

- Improved wastewater management systems (pumping stations, network and treatment plant);
- Improved drainage systems to manage stormwater flows, and;
- Improved solid waste systems (including landfill, waste collection and recycling, and transportation vehicles, an upgrade of environmental protection measures and activities to promote waste reduction). The closure of the existing dumpsite is out of the project scope.

5. The IEE identifies and assesses potential impacts and risks arising from the implementation of the proposed project on the physical, biological, physical cultural and socioeconomic environment; and recommends measures to avoid, mitigate, and compensate for adverse impacts, while enhancing positive impacts. The EMP describes the project requirements and methods for environmental mitigation measures, monitoring, reporting, roles and responsibilities, budget, and the GRM. The EMP will be the key guiding document for environmental-related issues for project construction and operation.

6. The IEE and EMP will be updated at Detailed Engineering Design (DED) stage, and the updated DED stage EMP will form part of the bidding documents. The project also requires the completion domestic environmental assessments for national regulatory compliance; one Initial Environmental Impact Assessment, and one full Environmental Impact Assessment.

### 2. Description of the Environment

7. **Location, Geography and Topography.** Poipet City is a flourishing border city located in the Province of Banteay Meanchey in the far northwest of Cambodia, around 48 km away from the provincial capital. Poipet City is surrounded by Thailand's east border town Aranyaprathet on the northwest and west side; by Malai District on the southwestern side; and by Ou Chrov District in the northeast and eastern portions. The close surroundings of Poipet are dominated by agriculture, forest, and grassland and are defined by extensive lowlands, with a few higher areas to the north and east, ranging from 30 to 80 meters above sea level. The highest point is a hill formation north of the city, and the lowest elevations surround the stream south of the city.

8. **Geology and Soils.** In the region of Poipet, the geological map of Cambodia displays quaternary sedimentary rock basement and unconsolidated sediments. The prevailing soil type of Poipet is young alluvium soil made up of sediment deposits from rivers and streams, which normally result in fertile land. Poipet's soil is considered to have a high runoff potential.

9. **Climate and Climate Change.** The tropical monsoon climate of Cambodia has two distinct seasons: (i) the dry season, which lasts approximately from November to April; (ii) the wet season, lasting from May to October. The mean maximum temperature is 28°C, and the mean minimum temperature is 22°C. In lowland areas, annual rainfall ranges from 1,000 mm to 1,700 mm. Due to climate change, the number of days above 35°C is projected to increase from 25-30 days per year to over 50 days per year under Representative Concentration Pathway (RCP) 8.5. The projected change in rainfall from climate models is much more variable than it is for temperature; some models project a decrease and others an increase. Climate models mostly project a future decrease in tropical cyclone numbers and an increase in the intensities of the strongest storms.

10. **Hydrology, Water Resources, and Quality.** A dozen rivers and streams flow in and around Poipet. The Ou Chrov River, along the Cambodian and Thailand border, plays a major role for the city. It is used for irrigation and animal feeding, but the communities far from the city use water from ponds and wells because there is no water supply in their areas. Most of the stormwater and sewage in Poipet town and the Thailand border are drained into the Ou Chrov River, making the water undrinkable. Therefore, two plants are used to treat the water collected from two floating pumping stations settled on Ou Chrov River. The river is flooded during the rainy season, and some parts of the river have no water during the dry season. A derivation of the Ou Chrov River fills a water impoundment, the Ou Kaidon Reservoir, solicited mostly during the dry season. There is currently no data on the raw water, but concern has been raised about the upstream water catchment across the Thai border, which may be contaminated by some anthropogenic source.

11. **Ecology, Wilderness Values, and Protected Areas.** Integrated Biodiversity Assessment Tool (IBAT) data analysis confirms that neither protected areas nor key biodiversity areas are in the vicinity of the study area. Among the 132 species listed in this report, belonging to the International Union for Conservation of Nature (IUCN) Red List, 17 are identified as Critically Endangered and 34 as Endangered. A field survey in 2020 indicates that three trees and one tree of *Pterocarpus pedatus* (endangered) are in the vicinity of the Waste Water Treatment Plant (WWTP) and the landfill sites, respectively, and 2 fauna species (White-rumped Pygmy-falcon and Blossom-headed Parakeet) (near threatened) are potentially present in the studied area.

12. **Human and Socio-Economic Context.** At the time of the 2018 population census, 104,156 people lived in Poipet, making it the fourth most populous settlement in Cambodia. In 2018, 64.10% of the population aged from 18 to 60 were employed: 71% in the service sector, 16% in the agricultural sector, and 13% in the industry sector. In 2018, agricultural land use represented the biggest portion of the city at 80.63%, followed by urban use at 14.91%. In 2017, the Poipet border checkpoint recorded 613,094 tourists, which represents approximately 10.9% of the total international tourists entering Cambodia.

13. **Social and Transport Infrastructures.** To provide medical and health services to the local residents, the town has one referral hospital, four health centers, and one health post, complemented by 78 private clinics and pharmacies. In 2018, there were 38 state primary

schools, nine state secondary schools, and five high schools in Poipet. Poipet is accessible by rail and by road through the NR 5 and NR 59.

14. **Cultural Heritage and Physical Cultural Resources.** Few cultural monuments are found in the city, and cultural heritage is mostly represented by pagodas. Archeological sites are not recorded in the area.

15. **Noise.** In the outskirts of the city, the acoustic ambiance is relatively calm. The suburbs east of the city center is dominated by agricultural fields and forests, however, this area is also crossed by the railway and the national roads NR 5 and NR 59. The heart of the city provides a noisier background, with its urban-life activities, markets, as well as the night-life of casinos.

16. **Air Quality.** Poipet City is located in an area opened to the winds and dominated by agricultural fields and forests. Industries are not prevalent, and transport traffic is not sufficiently intense to cause a high level of pollution emissions. However, recurring and generalized waste burning is observed in Cambodia. This practice induces air pollution by releasing dust and fine particles, and it is also a source of odor nuisance.

17. **Water Supply.** The piped water supply is available to 51% of the population, but only 36% is connected to it, mainly for economic reasons (cost of water); only 1% use it as the main source of drinking water. 70% of the population has its own borehole, but only 9% use the water from it as the main source of drinking water, and the water has to be boiled or filtered. The accessibility of bottled drinking water is good in Poipet.

18. **Wastewater Management.** It is estimated that 91% of the excreta generated in Poipet is not safely managed. 90% of the population in Poipet has an onsite sanitation containment, which is emptied manually (the sludge is most of the time dumped onto paddy field or to a water body) or by pump trucks from the two emptying companies operating in Poipet. There is at present no wastewater treatment plant (WWTP) servicing the city, and one-third of the fecal sludge is sold to farmers and used as a fertilizer. The remainder is illegally dumped in unknown locations.

19. **Stormwater Drainage.** The existing gravity lines carry stormwater towards Ou Chrov River, the final receptor for stormwater. Except for the area covered by the Greater Mekong Subregion Southern Economic Corridor towns Development Project (GMS 1)<sup>1</sup> gravity lines (currently under construction), there is no existing overall strategy and roadmap. Recurrent floods are reported by inhabitants and local authorities, and bad odors are released from the drainage system.

20. **Solid Waste Management.** 28% of household wastes are covered by an existing waste collection service, meaning that 72% of household wastes are burnt or disposed of in open land. Garbage collection is mainly door to door, and solid waste is transported to a 4 ha dumpsite located 5 km from the city center. There are junk shops in Poipet collecting recyclables waste from informal collectors, waste pickers, and scavengers, which represents 16% of the total domestic solid waste flow.

---

<sup>1</sup> ADB. Greater Mekong Subregion Southern Economic Corridor Towns Development Project

### 3. Anticipated Environmental Impacts

21. The sensitive receptors within the project area of influence were identified to determine positive and negative impacts and associated measures. The following section presents the main impacts identified for the project.

#### 3.1. Positive Impacts and Environmental Benefits

22. **Wastewater Management.** By establishing a wastewater treatment system, groundwater pollution will be reduced, and the quality of the river will be improved. Collection and treatment of wastewater is also a matter of public health, as it will diminish the incidence of water-borne infections and diseases, associated with inadequate sanitation. Additionally, the quality of life will be improved with the reduction of odor nuisances, which can occur due to the practice of emptying the untreated contents of sanitation containments directly into the environment. Finally, operation, monitoring, and maintenance of the new pumping stations and WWTP will enable the creation of employment opportunities for the population.

23. **Stormwater Drainage.** Improving the drainage capacity of the city will reduce risks of flooding in urban areas; the system is designed to minimize street flooding during a 1 in 5-year rainfall event. Furthermore, bank erosion due to the absence of concrete material lining the currently used canals will be avoided by the projected piped network. Concerning socio-economic benefits, an increased capacity of the urban drainage system will relieve part of the population which experiences flooding during intense rainfall events and prevent economic loss due to damage to property. Functional and separated drainage and sewage systems will help reducing diseases from infection and mitigate health-related problems in the population. Finally, the improved drainage network will reduce flooding and consequent scattering of waste material in the streets, enhancing the touristic and commercial development of Poipet and attracting private sector investments.

24. **Solid Waste Management.** The new landfill will prevent contamination of local groundwater and related diseases with its leachate management. It will improve efficiency and long term sustainability of urban drainage due to reduced waste disposal in drains. The closure of the existing dumpsite (by others) will avoid groundwater pollution due to the infiltration of rainwater across the waste mass. With this landfill closure and the implementation of centralized collection points instead of door-to-door collection of plastic bags, the aesthetics of the surrounding area and the quality of life will be improved. The new solid waste management will minimize the population practice of waste burning and waste disposal into water bodies and other natural habitats, helping to reduce air, water, and soil pollution and improving living standards for the population. Pre-sorting activities will increase the recovery rate of solid waste materials, diverting from landfilling, and consequently saving agricultural land areas. Composting will reduce greenhouse gas emissions compared to landfilling, extend the landfill's life by diverting the incoming waste flows, and the produced compost will be reused in agriculture. Ultimately, the project will create around 194 jobs by 2040.

25. The waste management project components, including composting of organic waste; controlled wastewater treatment; GHG capture; recycling and waste minimization are greenhouse gas emission reduction strategies. In particular, emissions of the more potent greenhouse gases Methane (CH<sub>4</sub>) and Nitrous oxide (N<sub>2</sub>O) from anaerobic decomposition will be captured and converted to CO<sub>2</sub>, via a landfill gas (LFG) collection system and a gas flare unit to be installed during operation.



### 3.2. Biodiversity Conservation and Sustainable Natural Resource Management

26. **Hydrology and Water Availability.** The wastewater network will cross Ou Stueng Bot River around 2.2km before the WWTP inlet. The crossing of the river will be done by corbelling the main force pipe and attaching it to the existing crossing structure (small bridge). Moreover, awareness raising of the construction workers will be renewed regularly during this phase, in order to avoid water pollution from construction materials or machinery wash-down. Therefore, the impact on the water body is expected to be very limited.

27. Wastewater network pipes will be laid on the area adjacent to the perimeter of the Ou Kaidon Reservoir. Moreover, two pumping stations are planned to serve this part of the network: PS\_FM\_02 and PS\_FM\_03. To preserve the water quality, the reservoir will be protected with dedicated barriers during the construction phase.

28. **Ecological and Wilderness Values.** Around the perimeters of the WWTP and the landfill site, an endangered species of flora (*Pterocarpus pedatus*) was observed during the field survey. Concerning the WWTP, the three trees were identified in the same area at more than 500m distance from the site perimeter. Only one tree of *Pterocarpus pedatus* was observed in a dense vegetation area (1.5ha) adjacent to the south-west corner of the landfill site perimeter. This area will be preserved and protected with dedicated barriers during the construction phase.

29. Long-tailed macaque (*Macaca fascicularis*) and four bird species (*Rhyticeros undulates*, *Mulleripicus pulverulentus*, *Carpococcyx renauldi*, and *Leptoptilos javanicus*), which are listed as Vulnerable in the IUCN red list, were reported to be present at the project components sites as a result of the field survey. Moreover, Sarus crane (Vulnerable species according to the IUCN) populates the Ou Kaidon Reservoir. These species may be disturbed by construction activities and temporarily abandon the sites. They are expected to repopulate the areas during the operation phase, as the characteristics of the habitat will not be globally altered by the project.

30. Construction will cause short-term noise and visual disturbance, which may disrupt breeding or foraging by the resident or migratory fauna. There are no known rare or endangered wildlife species or critical habitats in the immediate environment of the project components. Mitigation measures include minimizing impacts on adjacent vegetation, for instance, with physical barriers, and carrying out unavoidable tree removal individually, after careful inspection, and with subsequent soil stabilization.

31. Human activity and equipment noise can generate disturbance, which may disrupt breeding or foraging by the resident or migratory fauna. There are no known rare or endangered wildlife species or critical habitats in the immediate environment of the project components. An impact on aquatic life may be generated in case water quality is altered by effluents discharge in receiving water bodies. The risks will be minimized by scheduling maintenance activities to avoid nesting or reproduction periods; and by implementing speed limits around the new infrastructure and restricting the circulation of project vehicles at night to avoid collision with fauna. Minimizing exposed tipping areas and prompt waste covering upon waste dumping in the normal operation of the landfill will minimize the attraction of pests/rodents/vermin, birds, and stray animals to the landfill. Based on the effective implementation of these measures, ecological-related impacts are considered to below.

### **3.3. Pollution Prevention and Abatement**

#### **3.3.1. Construction Phase**

32. **Geology and Soil.** Potential impacts include soil contamination. These risks will be managed through strict on-site measures.

33. **Water Quality and Wastewater Management.** Earthworks, excavation, and/or inappropriate storage and handling of fuel, accidental spills, domestic wastewater discharge from construction camps, and wash-down water for machinery and vehicles could contaminate soil or surface waterways. Water pollution will be mitigated by a specific timing and staging of the construction, by creating intercepting channels and drains, through safe management of dangerous substances and wastewater.

34. **Air Quality.** Air pollution sources include (i) dust from construction works; (ii) aggregate preparation and concrete-mixing; (iii) vehicle and machinery emissions (gaseous CO, SO<sub>x</sub>, and NO<sub>x</sub>). The exhaust emissions generated can cause respiratory issues for the residents living close to the construction site, especially for the vulnerable population, including the elderly and the very young. Mitigation measures to reduce impacts on air quality include preventing the generation of fugitive dust, especially near sensitive receptors; limiting speed and idling of vehicles; maintenance of vehicles; strict enforcement of sanitation practices; prohibiting the burning of wastes, and monitoring of air quality. Overall, considering the location and scope of project works, the risk of air pollution and disturbance to residents related to air quality is low.

35. **Solid Waste.** Solid waste will comprise domestic solid waste from workers and construction waste materials. Collection, transport, and disposal at the existing dumpsite will be ensured for non-hazardous waste. Hazardous waste will be stored in sealed drums and transported to the official landfill site in accordance with national regulations.

#### **3.3.2. Operational Phase**

36. **Geology and Soil.** Soil contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipelines or equipment of the wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system or by leachate streams from the landfill or the composting plant. Mitigation measures consist of the maintenance of equipment and processes, back-up material, and a basal geomembrane liner to avoid infiltration of leachate in the subsoil at the landfill site.

37. **Water Quality and Wastewater Management.** Improved sanitation and solid waste management will reduce the volume of sewage and solid waste entering local water bodies and particularly Ou Chrov River, Ou Stueng Bot River, and Ou Kaidon Reservoir. Due to design choices, it is expected that the water quality of the receiving bodies will not be significantly altered. Mitigation measures consist of the maintenance of equipment and processes, back-up material, and monitoring of the quality of the wastewater effluents. Concerning the landfill, surface water run-on and runoff will be mitigated through the provision of perimeter drains, and additional collector drains within the landfill area. The potential for waste mass inundation from precipitation will be mitigated through the provision of cover materials over waste mass surfaces, coupled with the drainage of these covered areas through the contouring of surfaces and installation of surface drains. A leachate management system will be set up to prevent contamination of local groundwater.

38. **Air Quality.** Air quality may be impacted by the generation of landfill gas and dust generated by the circulation of waste trucks. Mitigation measures to reduce impacts on air quality include preventing the generation of fugitive dust on access roads to the new infrastructures, especially near sensitive receptors, limiting engine idling; and maintenance of project vehicles.

39. **Solid Waste.** Wind-blown waste from the landfill may be dispersed into the surrounding environment. This impact can be reduced as follows: (i) minimizing exposed tipping areas, (ii) installing a 1.8m-high fence on landfill boundary, (iii) daily compaction of the new waste deposits, and (iv) prompt waste covering upon waste dumping in the normal operation of the landfill.

### **3.4. Health and Safety**

#### **3.4.1. Preconstruction Phase**

40. Environmental specialists will be assigned to ensure full and effective EMP implementation and health and safety compliance. Contractors will develop a construction site EMP (CEMP), based on the EMP, assign at least one person responsible for Environment, Health, and Safety (EHS) and establish grievance register and incident register and comply with labor law of Cambodia and core labor standards of the International Labor Organization (ILO).

41. Recruitment of construction workers will prioritize local residents to reduce the number of migrant workers. Construction workers will be exposed to pollution emissions, noise, vibration, construction-generated wastes and wastewater, hazardous substances, social conflicts with communities, transmittable diseases in the community, presence of unexploded ordnances (UXO), large moving and operating construction vehicles and equipment, and pits and excavations. Health and safety plans will provide mitigation measures and COVID-19 specific measures will also be implemented in contractors' health and safety plans.

#### **3.4.2. Construction Phase**

42. **Geology and Soil.** Construction sites may be concerned by unexploded ordnance (UXO), which can be uncovered by earthworks, and should have clearance prior to construction.

43. **Noise.** Noise generated by the construction equipment and vehicles will be temporary and localized. The construction machinery will be properly maintained, noise reduction devices will be applied near sensitive receptors, high-noise machinery will be prohibited at night, noise barriers will be set up, noise monitoring will be carried out, and regular interviews with residents will be conducted.

44. **Vibration.** Mechanical vibration may be sudden and discontinuous, which can cause stress among workers and communities. Vibration levels for machinery can be high and could affect buildings and infrastructure. To address these issues, high vibration activities will be prohibited at night, and communities will be consulted to avoid sensitive timing. Overall, considering the location and scope of project works, vibration impacts are not considered as a key risk.

45. **Community and Workers Health and Safety.** Use of heavy construction machinery, tools, and materials present physical hazards including noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, and

chemical hazards such as toxic fumes and vapors. Contractors will each prepare an environmental, health, and safety management plan, which will provide adequate measures to ensure proper sanitation, health, and safety, and avoid work hazards. COVID-19 specific measures will also be implemented in the contractors' health and safety plans.

46. **Construction inconveniences.** The project involves temporary and permanent land acquisition but no house demolition. However, network works may cause temporary disruptions to vehicle access, traffic flow and utility services, such as water supply. In order to limit inconveniences, a traffic management plan will be prepared and implemented in coordination with local authorities and communities; safe access to blocked properties will be ensured; network implementation will be undertaken on one side of the road at a time; and a close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines. Works must be implemented during night time in areas close to markets, and the construction contractor(s) will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population. Preliminary public information will be necessary before starting construction works.

### 3.4.3. Operational Phase

47. **Air Quality.** Air quality may be impacted by odor nuisance during waste dumping in the normal operation of the landfill and due to accidental dumping. The drains of the stormwater drainage system will be kept clear and in good working conditions by regular maintenance operations to avoid odor nuisances.

48. **Noise.** Noise and vibration sources related to the project during daily operation will be the WWTP, pumping stations, waste transportation, and pre-sorting equipment. The following mitigation measures will be implemented: using modern and well-maintained equipment; installing noisy equipment in closed buildings; applying noise reduction devices and methods for equipment close to sensitive receptors; forbidding truck traffic at night and conducting regular interviews with residents.

49. **Social Issues.** Frequent movement of waste trucks will cause a nuisance to villagers living along the access road to the landfill and to the collection points. This will be limited by planning for waste transportation in non-peak hours and the use of dedicated lanes by trucks. Landscape modification and visual impact associated with the new project facilities are very limited.

50. **Community and Workers Health and Safety.** The working conditions in the WWTP, landfill, pre-sorting, and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance. All workers will be trained with regular refresher courses. Posted speed limits along the access roads will be enforced, and the perimeter of the WWTP and of the landfill will be fenced off to prevent the public from entering the facilities. Access to facilities will be restricted to authorized employees.

### **3.5. Physical Cultural Resources**

#### **3.5.1. Construction Phase**

51. Any local cultural site will be protected from disturbances due to the construction activities, and their access will not be impeded. If the surroundings of the cultural sites are affected by construction works, they will be restored to their initial conditions. In the event that any artifacts are found, works in the site will cease immediately.

#### **3.5.2. Operational Phase**

52. Any local cultural site will be protected from disturbances due to the project operation, and their access will not be impeded. Noise disturbance may be generated by pumping stations and traffic around collection points depending on their distance from sensitive receptors. To minimize this impact, regular interviews will be conducted with the use of sensitive sites; if needed, noise reduction devices will be applied to equipment; and truck access to collection points adjacent to sensitive sites can be reduced to specific working hours.

### **3.6. Climate Change and Natural Hazards**

#### **3.6.1. Construction Phase**

53. **Geology and Soil.** Potential impacts include poorly planned excavation or disposal from borrow and spoil disposal sites. The deposit of excavated soil, as well as the weight and the traffic of construction equipment, can cause landslides into trenches. Mitigation measures comprise shoring or supporting the excavation and protecting the site from water inflows, which can be a source of instability of the excavated ground.

#### **3.6.2. Operational Phase**

54. **Geology and Soil.** Erosion may be caused by water flow in the earth's open channel as a part of the stormwater drainage network. This effect may be increased in case of severe meteorological events as a consequence of climate change. Concrete box-culverts chosen for the Poipet network will avoid this impact.

### **3.7. Indirect, Induced, and Cumulative Impacts**

55. **Indirect and Induced Impacts.** The project is expected to result in no significant indirect or induced impacts.

56. **Cumulative Impacts.** During the construction period, other infrastructure projects, such as road repair or road widening activities, may be implemented at the same time as the proposed subprojects. As such, potential localized impacts may be felt to a greater extent in the project influence areas (i.e., additional dust generation from road construction).

## **4. Consultation, Participation and Disclosure**

57. Consultations were undertaken during the preparation of the IEE. This included interviews with a range of expert stakeholders and affected people, and completion of a questionnaire form on social and environmental factors. The views of stakeholders are integrated into the EMP where appropriate. A Public Consultation and Participation Plan is included in the EMP to outline the plans for future stakeholder engagement.

58. Information Disclosure will be maintained during project design and implementation. All stakeholders will be provided with information on the subproject component including the Grievance Redress Mechanism. Local disclosure and disclosure on ADB's website is outlined in the EMP.

## **5. Grievance Redress Mechanism**

59. A project grievance redress mechanism (GRM) has been developed in compliance with ADB's SPS (2009) requirement to address environmental, health, safety, and social concerns associated with project construction and operation. Resettlement issues are dealt with through a separate mechanism.

60. The GRM is accessible to all members of the community, including women, youth, remote farmers and communities, and residents in poverty. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media. It includes clear timescales and steps for rectifying issues arising and will provide clear and open channels of communication for affected people.

## **6. Conclusion and Recommendations**

61. Assuming full and effective implementation of the EMP, potential adverse environmental impacts are expected to be minimized and/or mitigated to an acceptable level in accordance with the standards applied in this IEE.

## **I. INTRODUCTION**

### **1. Project Description**

1. At the request of the Kingdom of Cambodia, the Asian Development Bank (ADB) is developing the Livable Cities Investment Project (LCIP) to facilitate long-term sustainable and economic growth. The project is aligned with the Government's policies and national strategies, in particular, the Government's Rectangular Strategy – Phase IV and ADB Strategy 2030.

2. The project will concentrate on the three secondary cities of Bavet, Poipet, and Kampot, due to their economic potential and location at key trade and tourism zones. The project will focus on enhancing urban planning, building community resilience, and providing infrastructure. Project outputs include (i) output 1: policy and regulatory environment improved, (ii) output 2: urban infrastructure improved, and (iii) output 3: institutional effectiveness and governance improved.

3. As a result of recent population growth, these cities have identified that the limited infrastructure is restricting their development potential. Existing services are no longer operating optimally and incapable of servicing demands. The LCIP proposes to adopt a holistic methodology, comprising of an integrated urban development approach, to ensure interventions consider land use, long term city needs, asset management, and asset financing for sustainable operations.

4. To ensure climate resilient and sustainable development of participating cities, the project adopts a climate-centric city development approach. Appropriate structural and non-structural measures are incorporated to ensure climate change risks are appropriately mitigated to avoid the future cost associated with the climate change impact.

5. The areas of projected stormwater drainage outlets, landfill and WWTP may be subject to flooding in case of high flows, particularly with regards to climate change, overland flows during intense storms and discharge of stormwater. River capacities and flood plain are not well known in this region. However, project components design has taken into account the flooding hazard by bordering the landfill with perimeter barrier / topographic constraints (at least 2m-high) and increase the designed capacity of the stormwater drainage line to anticipate future increased rainfall and changes in the land use (soil impermeabilization related to urbanization).

### **2. Project Components and Proposed Infrastructure**

6. The scope of this IEE concerns Output 2 only. The project components under output 2 are:

- (i) Improved wastewater management systems (pumping stations, network and treatment plant);
- (ii) Improved drainage systems to manage stormwater flows, and;
- (iii) Improved solid waste systems (including landfill, waste collection & recycling, and transportation vehicles, an upgrade of environmental protection measures and activities to promote waste reduction). The closure of the existing dumpsite is out of the project scope.

## 2.1. Wastewater

7. Based on a comprehensive city survey conducted in June 2020, the assessment of the fecal and non-fecal waste disposal chain, both in rural and urban areas, suggests that 91% of fecal waste is not being managed safely.<sup>1</sup>

8. A master plan was prepared which assessed various technical scenarios; in discussions with the Ministry of Public Works and Transport (MPWT), provincial government and municipal administration, the scenario involving the construction of a centralized WWTP with activated sludge with extended aeration (ASP-EA) to serve the built-up areas of Poipet and its extensions in the medium (2030) and long term horizon (2040) was selected. Under LCIP, providing sewerage and connections to the existing population will be the priority but with the expected capacity required for the long term. To encourage households to connect to the sewerage system, the cost of connection will be subsidized by the project. It is proposed to start the implementation with:

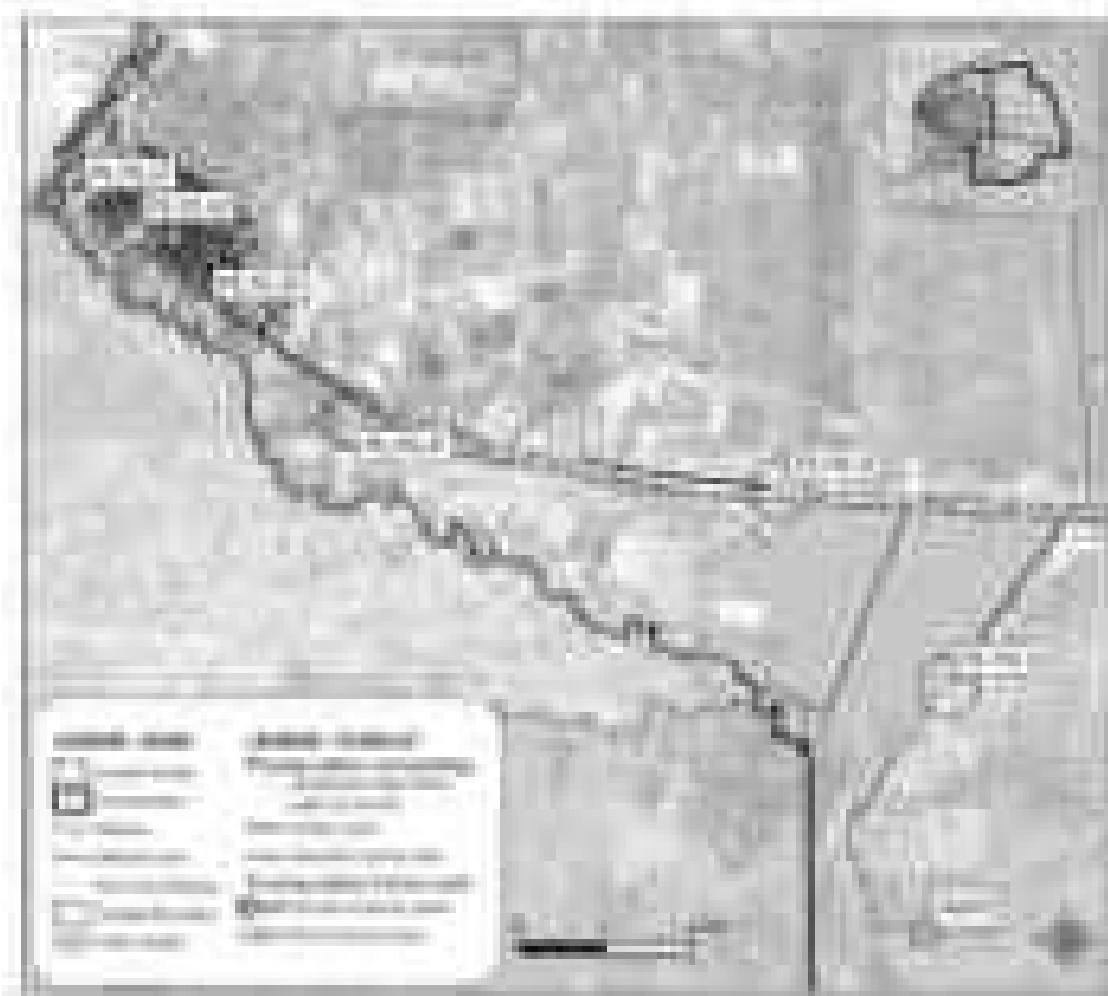
- (i) Construction of a wastewater treatment plant for the initially connected population;
- (ii) Construction of pumping stations to create a transfer chain to the WWTP; and
- (iii) Construction of sewer pipes primarily designed for the selected existing built-up areas with some capacity for extensions for future growth.

---

<sup>1</sup> Comprehensive city survey conducted by the transaction technical assistance consultants, through TA 9954-REG: Southeast Asia Urban Services Facility.



**Figure 1: Location of main proposed infrastructures - wastewater**



*Note: the WWTP is represented by the rectangular shape located south of PS\_FM\_03*  
Source: Egis, 2021

9. The project focuses on the sewerage system for the areas delineated by the zoning 2025 (short term area, see “Service areas” in color on the map above) but provides infrastructure designed for future needs. The tables below summarize the facilities designed and prioritized for the development of wastewater drainage networks:

**Table 1: Investment horizon and Design Capacity**

Item	LCIP – investment horizon	Design Capacity
Sewer Network	2025 – short term or priority area	2040
Pumping Stations & Force mains		Equipment 2030 Civil works 2040
WWTP		2030

Source: Egis, 2021

**Table 2: Summary of investments in Poipet (wastewater)**

Investment Area	Components
Pumping stations	6 PS
Networks	55.6km of gravity lines, 11km of force mains
Wastewater Treatment Plant	Activated sludge with extended aeration (ASP-EA).

Source: Egis, 2021

**2.1.1. Wastewater treatment plant**

10. The WWTP is designed for a medium-term (2030) maximum capacity of 9,576 m<sup>3</sup>/day. This is a suitable and sustainable design if the extensions described in the sector master plan strategy are implemented. These extensions will require additional investment. Therefore, the volume of wastewater and septage collected by the sewer system will be limited to the infrastructures proposed in the LCIP investment (designed as part of the current feasibility study) and the increase in population until 2040 in the collection service area.

**Table 3: Wastewater and septage flow projection**

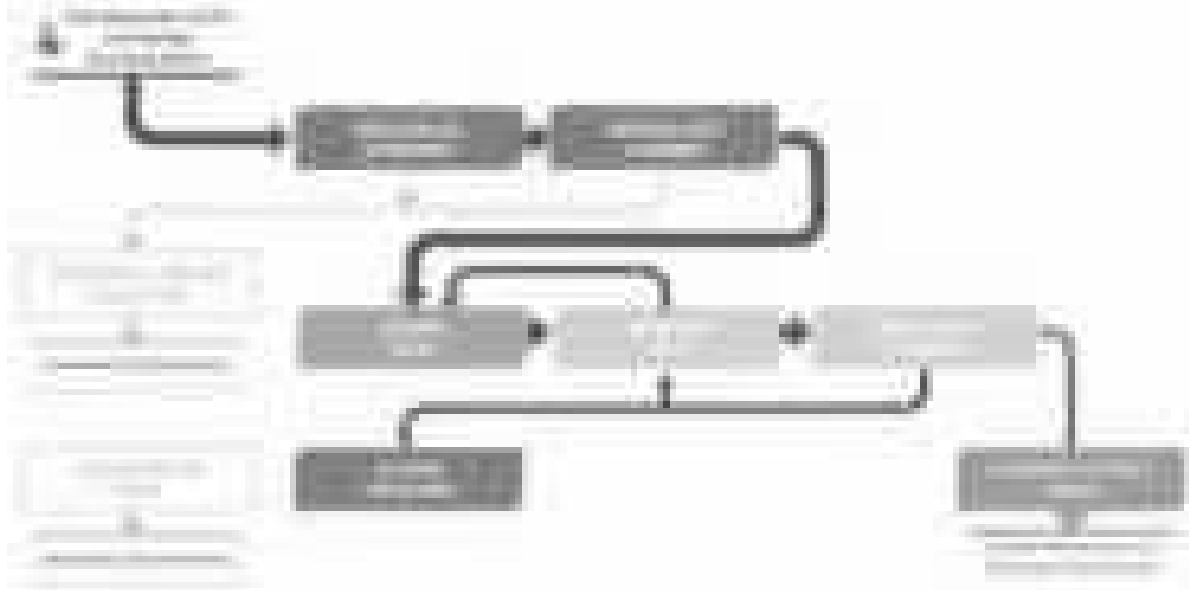
Ref.	Parameter	Unit	Short-term 2025	Mid-term 2030	Long-term 2040
A	Population - including temporary & tourist population, in service areas	Inhabitant.	53,271	75,105	130,445
B	SEZ population, in service areas	Inhabitant.	7,000	8,000	8,000
C	Daily wastewater production ratio considered for domestic workers	L/day/capita	153.6		
D	TOTAL population in service areas (D = A + B)	Inhabitant.	60,271	83,105	138,445
E	Connection rates	%	75%	75%	75%
F	<b>TOTAL population connected (F = D * E)</b>	<b>Inhabitant.</b>	<b>45,203</b>	<b>62,329</b>	<b>103,834</b>
G	<b>TOTAL wastewater volume collected (G = F * C)</b>	<b>m<sup>3</sup>/d</b>	<b>6,943</b>	<b>9,574</b>	<b>15,949</b>

Source: Egis, 2021.

11. The selected WWTP site is located near Stung Bot Village. The site is a rice field approximately 4.0km from NR 99 and is not completely accessible by road. The first 3.2km is an asphalt road; however, for the subsequent 800m to the site, there is no road. The closest point to connect to the electrical grid is along the National Road (3.3km from the site or 5km from No.5). Service water network availability close to site location for serving the domestic needs of WWTP should be assessed during the detailed design phase.

12. **Activated sludge with extended aeration (ASP-EA)** is selected for the Poipet WWTP treatment process in order to minimize the land footprint. A technical description of the process principle is given below:

**Figure 2: Process Flow Diagram – Activated Sludge Process with Extended Aeration (ASP-EA)**



Source: Egis, 2021.

13. The main stages part of the Activated Sludge Process with Extended Aeration are the following:

- (i) **Secondary treatment:** The biochemical reactions associated with the removal of organic matter takes place in this section of the treatment plant.
- (ii) **Anoxic tank.** The Anoxic Tank is mainly for the purpose of de-nitrification (nitrogen removal).
- (iii) **Aerobic tank.** Aerobic Tank where the organic pollutants present in the wastewater will be degraded by microorganisms (bacteria).
- (iv) **Secondary clarifier.** Subsequent to the aeration tank, the settling of bio-mass occurs in the Secondary Clarifier, and the treated effluent further flows downstream for further treatment.
- (v) **Sludge recirculation.** A part of settled bio-mass re-circulated back to the main biological treatment section in order to maintain biomass in the system.
- (vi) **Sludge extraction.** The other part of the sludge is withdrawn from the Secondary Clarifier and processed for further sludge treatment.

**Figure 3: WWTP layout and location**



Source: Egis, 2021

14. The WWTP process has been designed using proven technology both in western countries and in Cambodia. Hence, sizing parameters used for these project are COD, BOD, TSS, total nitrogen, and total phosphorus only. The Activated Sludge Process complies with the local regulation concerning wastewater water discharge quality.

15. **Septage management.** In urban areas, it is estimated that 75% of the population will have access to the sewer system. The remaining portion (remote households too far in rural areas for any connection) will have, therefore, on-site sanitation. The septage management can be described through this sanitation chain:

- (i) Septage collection. Based on the Comprehensive City Survey, it appears that most of the existing domestic septic tanks are unlined or inaccessible. A campaign for the rehabilitation/replacement of septic tanks not connected to the proposed centralized sewerage system is recommended, but no provision of new septic tanks is included in this project.
- (ii) Septage transportation: Mechanical desludging (vacuum truck).
- (iii) Septage treatment: co-treatment at the wastewater treatment plant.

16. **Septage Co-treatment.** A receiving septage station is implemented in the WWTP site, and the septage is added at the plant headworks, between the screening stage and the grit chamber. Septage collection service and treatment will be designed for:

- (i) Households in urban areas that are not connected to the sewer system (25% of the urban population);
- (ii) New households in rural areas that follow the construction permit; and
- (iii) Institutions and Commerce that are not connected to the sewer system.

17. An initial step for raw septage screen will be implemented to remove coarse material from it in order to avoid damages and efficiency loss during the next treatment stages. The waste retained by the screen is evacuated to a screw compactor in order to reduce its volume. Compacted wastes are stored in containers before final disposal to the projected landfill.

18. Raw septage is transferred after screening into a control tank, wherein the operator can observe the appearance of the load and lead further action in case of illegal waste.

19. As for the mixed storage tank, its capacity is sufficient to ensure a buffer volume of raw septage to feed with a constant flow rate of the WWTP. The control and storage tanks will be designed as follows:

- (i) The capacity of the control tank: 10m<sup>3</sup>;
- (ii) The capacity of the storage tank (2 days retention time): 40m<sup>3</sup>.

20. **Tertiary Treatment.** The effluent coming from the secondary clarifier will be filtrated on the disc filters unit before being released into the river.

21. **Discharge point.** The effluent from the WWTP will be discharged by gravity to a nearby stream flowing towards the Ou Chrov River through Ou Stueng Bot River. This will improve suspended solids and phosphorous removal. The design has also considered a Chlorine contact basin with baffle walled constructional feature for ensuring proper disinfection by adopting adequate contact time and mixing profile in the design. The effluent from the WWTP will be compliance with the Cambodian effluent standard for discharging into public water body.

22. **Sludge Treatment.** The excess sludge taken out from the secondary clarifier will be pumped to Sludge Thickener for further thickening before being discharged to Sludge Drying Beds for dewatering. The dried sludge, after a specified number of days from its application onto the beds, shall be disposed of off-site.

23. Sludge Drying Beds are proposed for the purpose of dewatering sludge and are designed with adequate solids loading to ensure the solids accumulated over a period of time are handled properly before being discharged. At this stage, the dried solids will be disposed-off site and will be taken to the projected composting plant for further treatment. A laboratory test will be realized systematically to confirm that the sludge is suitable for composting before each transfer. Otherwise, it will be landfilled with common wastes.

### 2.1.2. Sewer and pumping stations

24. The drone topography survey undertaken in January 2019 shows that the available slopes is not enough to convey the sewerage flow to the WWTP by gravity.

25. Due to the remoteness of the WWTP and to the flatness of the city, pumping stations are required to drain the wastewater to the treatment plant. The capacity of the pumping stations

have been designed to receive the wastewater flow at the horizon 2040 according to the expected future extension of the urban area.

26. Sewer alignments locations were adjusted to follow the existing and projected road alignments. This aims to limit land acquisition or resettlement issues.

27. Several connection points are anticipated in the design. The aim of these connection points is to foresee future connections of the additional areas (such as the expansion of the network on existing urban areas or connection of SEZs to the existing network) that will be developed at mid-term and long-term strategy.

28. **Force Mains and Pumping Stations.** The following technical options are selected for the project:

- (i) Maximal length for force mains: 3km.
- (iv) Pipe material: HDPE.

29. The location selected for the conveying chain offers the following advantages:

- (i) Optimize the use of gravity lines to drain the sewerage network out of the current built-up area;
- (ii) Enable the connection to the sewerage network for future urban growth, including special economic zones; and
- (iii) Limit the force mains length (and sulfide production risk) by alternating force mains and gravity mains along the conveying chain.

30. As a first approach, an area of 20m x 20m (area of 400m<sup>2</sup>) is considered for land acquisition needs. The sites are all empty of construction and located near existing roads to facilitate network connection and adjacent to artificial/natural drainage.

31. **Maintenance.** Considering that the network will be new, the breakage rate is expected to be low. Thus, no preventive maintenance is scheduled for concrete structures. However, equipment such as trucks and pumps will require preventive maintenance (on a regular basis), and reactive maintenance will be performed in case of failure.

### 2.1.1. Equipment

32. In total, 3 vacuum trucks are needed for septage collection (at horizon 2030). Based on the total number of trucks available in the city (1 from the private sector), it is suggested that only 1 additional vehicle may be purchased as part of the project. In addition to those vacuum trucks, it is considered that 1 additional vacuum truck is required for maintenance purposes on the sewer network. (1 vacuum truck can clean up to 3 km/day, 15% of the overall network length should be cleaned each year). In total 2 vacuum trucks are required.

33. Two pickup cars and one utility truck are also considered for the daily needs of the staff.

## 2.2. Stormwater

34. Poipet has more than 3.3km of open channel network within the Sangkat Poipet (this length corresponds to the length surveyed during field investigations). Concrete circular pipes are commonly disposed of in the city center, and earth open-channel are used to drain stormwater from the dense urban areas toward rural areas/rivers (mainly Ou Chrov river).

35. Except for the area covered by GMS 1, there is currently no existing comprehensive/integrated strategy for infrastructure development. The implementation of the new drainage sections only follows a patching logic following urban development.

36. Recurrent floods are reported by inhabitants and local authorities. Main stormwater channels are operating properly, but their capacity is not sufficient to ensure proper drainage of the city center.

37. The proposed drainage network follows the natural topography and discharges at low points of the road. As much as possible, the few existing cross-drains will be reused to limit the cost of road cutting and reinstatement. The figure below shows the types (simple or double) of box-culvert used for each section.

**Figure 4: Proposed urban drainage network - overview of box-culvert types**



Source: Egis, 2021

**Table 4: Summary table of investment in Poipet (stormwater)**

<b>Investment Area</b>	<b>Components</b>
Buried Box-culverts	7.1 km
Outfalls	3 (existing outfalls built under GMS 1 re-used/connected)

Source: Egis, 2021

38. Except for GMS1 box-culverts under construction, it is not proposed to reuse/rehabilitate existing lines. The existing secondary drainage network needs to be re-connected to the proposed drainage lines to get a consistent strategy for the whole drainage network. Secondary network connections will be studied during the detailed engineering design (DED) based on a detailed topographical survey.

39. **Urban Drainage has been designed Capacity for 1 in 5 Years Storm Runoff** following the guidelines of the MPWT.<sup>2</sup> The selected maximal rainfall is a 1-in-5 year return period rainfall. This intensity is based on RDF/IDF curve for Sisophon station, Banteay Meanchey province.

40. **In urban areas**, underground drainage is preferred to avoid the dumping of solid waste leading to drain obstruction, and to minimize width, to limit resettlement issues.

41. The lines proposed to be implemented will comprise the following elements:

- (i) New side-catch basins will be installed every 50 m to ensure a good surface runoff capture
- (ii) Manholes. To allow inspection of buried box-culverts, manholes will be disposed of every 100m.
- (iii) Concrete rectangular box-culvert will be laid in open-trench and buried. Typical cross-section dimension: 3m width box-culvert for 6m width road, 6m width double box-culvert for 8m width road.

42. **In rural areas**, no drainage network will be developed. Only the city center and related urban areas are targeted to be developed.

43. All the lines proposed to be implemented will be connected to the existing lines developed under GMS1 project. The existing secondary drainage network needs to be re-connected to the proposed drainage lines to get a consistent strategy for the whole drainage network. Secondary network connections will be studied during the DED based on a detailed topographical survey.

44. Regarding the limited land availability and allowable width on the road, it was proposed to multiply outfalls to avoid excessive drain widths. From this perspective, the proposed stormwater network divides the study area into 54 main catchments that flow through 9 outfalls drain into two watercourses: Ou Chrov and Ou Steoung Bot.

45. The priority areas were discussed during the meeting held on Friday 14th August 2020 at the Ministry of Public Works and Transport office where it was agreed to focus on drainage solutions for the city center and casino areas, i.e. 3 outfall (and 30 catchments) as shown in

<sup>2</sup> MPWT. 2003. Road Design Standard. Part 3. Drainage (CAM PW.03.103.99)



Figure 5, which presents a general layout for the proposed urban drainage network and an overview of the slopes for each designed line.

46. The preferred solution includes several alignments located upstream of the GMS 01 lines named GMS\_1, GMS 2, and GMS 3.

47. The table below summarizes the main characteristics of the proposed catchments and facilities:

**Table 5: Drainage Lines Summary - Poipet**

Subcatchment			Stormwater system		
Outfall name	Counted subcatchment	Total Area 2025 (ha)	Length 2025 (m)	Average slope (m/m)	Outfalls discharge peak flow (m <sup>3</sup> /s)
<b>GMS 01</b>	11	242.4	999	0.0016	8.8
<b>GMS 02</b>	8	305.7	3,691	0.0012	9.2
<b>GMS 03</b>	11	405.8	2,437	0.0017	9.8
<b>TOTAL</b>	<b>30</b>	<b>954</b>	<b>7,126</b>	<b>0.0045</b>	<b>27.8</b>

Source: Egis, 2021.

48. The outfalls of the proposed drainage lines are located near the southeast administrative boundary of the city (also representing the border between Cambodia and Thailand). They belong to the existing four lines built under GMS1 projects. No overflow of these lines is expected for storm events with a frequency lower than 1-in-5 year.

49. The operations and maintenance for drainage network will focus on: (i) Keeping the drainage systems free from any obstruction (inside and outside the box culvert and at outlets); (ii) Controlling illegal sewerage connection to the drainage system.

### 2.3. Solid Waste Management

50. Regarding the situation assessment of Poipet, it is estimated that 84% of the solid waste generated is unsafely managed. The household collection coverage is only approximately 28%. A large portion of the Municipal Solid Waste is also left uncollected and is dumped directly in the nearby natural environment and/or burnt. It is necessary to improve the collection for the whole city.

51. In terms of collection, door to door collection is preferred in the city center while the centralized collection is suggested in rural areas until these areas are sufficiently developed to allow door-to-door collection. Source segregation at markets, with a dedicated centralized collection point, would be an opportunity to increase the sorting of bio-waste. In terms of treatment, a sorting plant (capacity 66,709 tpy) and a composting plant (capacity 5,486 tpy) have been identified as the most appropriate technologies: (i) to reduce the amount of waste to be landfilled; (ii) to control part of the market for recyclables to increase revenue potential; and (iii) to contribute to climate change mitigation. Finally, a controlled landfill is proposed as the most appropriate disposal system for the city to avoid the harmful dumping and burning of waste. The design of the landfill has been based on 20-year design life, comprising of 12 cells. In the first phase, 6 cells will be constructed. Total design capacity is 1,265,568 m<sup>3</sup> but only capacity 632,784 m<sup>3</sup> will be delivered as part of LCIP (site: 20 ha – to be acquired). The

proposed landfill site location was visited and approved by MoE through the letter No. 1562, dated 23 November 2020, Appendix 1.

**Figure 5: Proposed landfill and composting plant location (SWM)**



Source: Egis, 2021

**Table 6: Summary table of investment in Poipet (SWM)**

Investment Area	Components
Collection	18 collection trucks by horizon 2030
Treatment	1 sorting-plant (capacity 66,709 tons per year (tpy)) and 1 composting plant (capacity 5,486 tpy)
Disposal	1 controlled landfill (capacity 632,784 m <sup>3</sup> )

Source: Egis, 2021

**Table 7: Solid Waste Management Sub-Components**

Sub-component	Options	Design Capacity
<b>Collection</b>		
Rural area collection	Centralized collection points	
Urban area collection	Door to door collection	
Market biowaste collection	Centralized collection points with segregation at source	
<b>Treatment</b>		
Sorting plant	Sheltered sorting line, managed as an	Designed for 2040

Sub-component	Options	Design Capacity
Composting plant	additional flow of the MRF	Designed for 2040
Landfill	Windrow composting process	Designed for 2030
	Leachate management: a combination of leachate recirculation and off-site treatment at WWTP	
	Landfill gas treatment: flare stack	

Source: Egis, 2021

52. **Waste Collection.** In urban areas, including the city center, the door-to-door collection will be provided. In the dense urban area, where every household are very close to one another, the door-to-door collection is a high service standard. Waste is collected at each property limit. It is admitted that all the SEZ are within urban areas so collected with the door-to-door system.

53. **Biowaste collection from markets:** Ra Thmei, Phsar Thmei, Phsar Trei, Mondul Boun, Samakoum, and Kandal market waste will be collected by non-compactor truck, and transported to the composting plant at landfill site. Market sellers will manage the segregation at the source and bring the biowaste to the collection point. It is assumed that 80% of the market biowaste could be recovered by implementing such a dedicated collection system. Biowaste will be collected in waste containers of 660 liters located at markets in a 15m<sup>2</sup> storage area. One truck of 5ton capacity is required to collect biowaste in each market.

54. **Hazardous household waste:** This waste category includes waste motor oils, car batteries, batteries, paint, solvents, etc. There are currently no available facilities for the recycling of the hazardous waste within an economically-viable distance of Poipet. To manage this waste, the following is proposed:

- (i) Store the hazardous waste at a storage platform to be created at the landfill until an economically viable quantity can be collected for shipment to treatment and elimination facilities in Phnom Penh or elsewhere.
- (ii) The hazardous waste can be stored in a dedicated container by waste type within lockable standard 20 or 40 foot shipping containers. Within the shipping containers, the hazardous waste will be stored in dedicated and suitable containers by waste type. Every 1-3 months the hazardous waste will be transported for disposal in a permitted industrial landfill in outskirts of Phnom Penh. Each SEZ will be responsible for hazardous waste generated by its commercial activities. Each SEZ will be in charge of properly storing and transporting this waste to the facility in Phnom Penh.

55. **In rural areas,** households are relatively scattered and/or with poor road access (most of the roads in rural areas are not asphalted). Therefore, centralized collection points are preferred to door-to-door to limit the collection cost. The centralized collection points are designed with 10 to 20 plastic containers of 660L capacity. The containers are housed in open shelters (20 m<sup>2</sup>), with access to the containers from the sides of the shelter. There are 8 proposed locations in the rural sangkats at the junction of major roads. These points would be located along the main roads (which are mostly asphalted).

56. Collection improvement will also include accompanying measures, including raising public awareness on managing their waste properly (at schools, etc.) thus raising the general willingness to pay for a better service.

57. **Sorting Plant.** The aim of the sorting plant is to sort the following fractions: valuable plastics, including PET bottles, plastic glasses, and plastic bags; cans and metals; and the fraction of green waste >80mm for composting. The sorting plant is located at the new landfill

site; the Department of solid waste management of MoE, clearly indicated that transfer/sorting station should be located in the new landfill.<sup>3</sup>

58. The sorting line process is as follows:

- (i) Reception area. Collection trucks discharge in this area. A wheel loader or a crane with a grab will grab the waste and feeds the sorting line.
- (ii) Sorting line. The sorting line will be built in a concrete-floored, open-plan hanger-type building (1,350 m<sup>2</sup>, 90x15m).

59. **Green waste recovered** from the sorting line is transferred to the nearby composting plant. The capacity of the composting facility comprises 57% of biowaste from markets and 43% of green waste from the sorting plant. The composting facility can also treat sewage sludge from the municipal WWTP (in this case, the moisture content of the sludge should be lower than 80%).

60. The composting roof will consist of a 12 m high and 15 m wide steel frame building. This design will allow for better control of moisture management and thus reduce leachate production.

61. In preparation for the Composting Process, green waste from parks and gardens are shredded and mixed up with the biowaste from the markets. The green waste provides carbon and confers a suitable structure to the mixture, creating porosity in the mixture that will improve the oxygen supply to the composting bacteria. The biowaste from the markets brings both nitrogen and water, enhancing bacterial growth. This mixing process is important in the success of the subsequent composting process.

62. Biowaste is placed in windrows on the composting platform, with a typical size of 50m x, 4m, and 3m spacing between the windrows (12 windrows and 5,040m<sup>2</sup> are required for the project). Each day of the two months process, the windrows are turned with a windrow turning the machine on a tractor. The tractor can also carry a water tank to add water into the windrow when the moisture content is too low. In the rainy season, windrows are covered from rainwater with a plastic cover system to reduce leachate production. After two months, the fresh compost is screened before being moved to the maturation area. The screen size is 20mm. The overflow material is mixed with the fresh waste to improve the structure and starting conditions of the composting process.

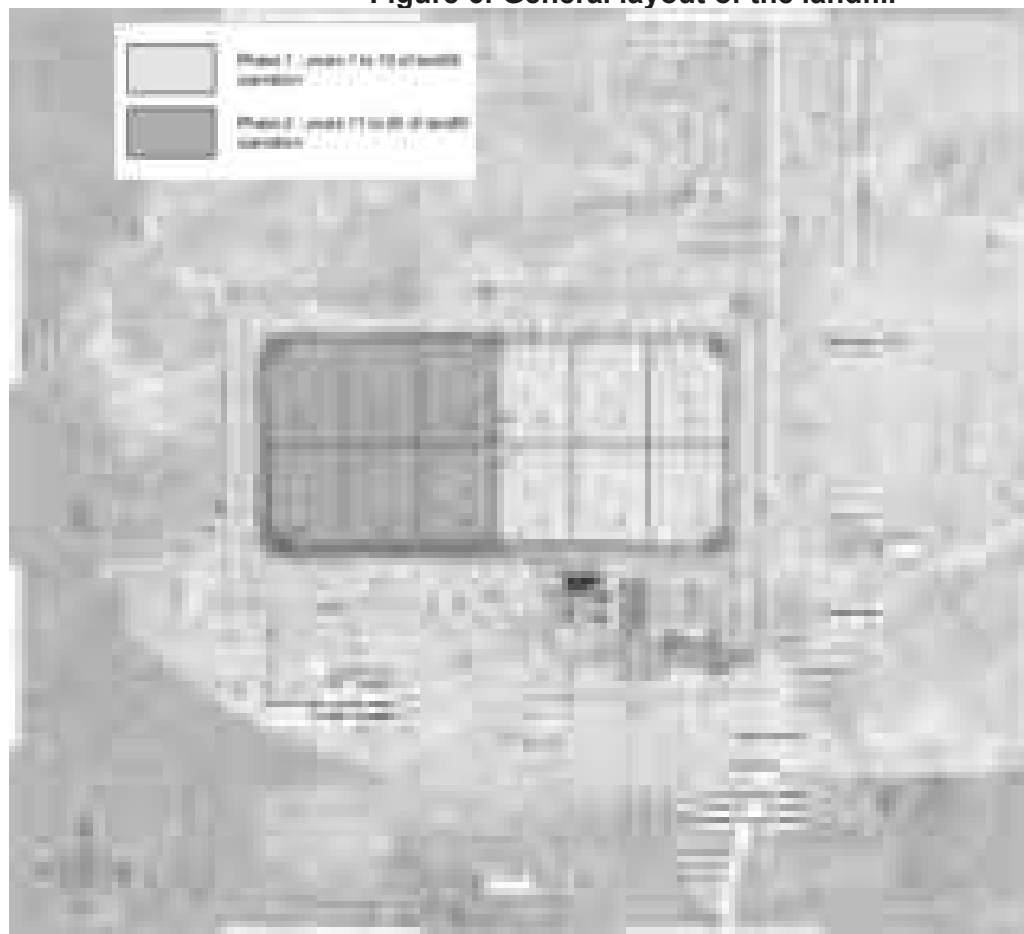
63. The compost is ready to use after a final maturation process. The maturation area is a sheltered bay for 1-month storage, divided into two smaller bays, i.e. surrounded by three concrete walls. The compost can be sold in bulk and in bags. The expected compost production by horizon is:

- (i) In 2025: 7 tons/year;
- (ii) In 2030: 1,646 tons/year;
- (iii) In 2040: 1,855 tons/year.

64. **The New Controlled Landfill** (land to be acquired) will be created in a location close to the proposed sorting plant. The access road for the controlled landfill will need to be paved over 3.5km.

---

<sup>3</sup> MoE letter No.1562, Nov.2020 on approving selection site for new landfill in Poipet, Appendix 1 of this report.

**Figure 6: General layout of the landfill**

Source: Egis, 2021.

65. In accordance with the “Integrated Solid Waste Management for Local Governments, A Practical Guide” (ADB, 2017), the purpose of the landfill facilities is to receive residual waste that cannot be recovered, reused, or recycled; in particular, the landfilling of easily biodegradable wastes should be avoided as these have the greatest potential for environmental impacts such as odors, vermin, disease, and impact to groundwater. Some waste types are explicitly excluded from the landfill: (i) All types of hazardous waste; (ii) Liquid wastes.

66. The void space that will be required in the landfill is estimated at 1,265,568 m<sup>3</sup>. The landfill cells will cover a total area of 16 ha and will be subdivided into 12 cells of approx. 13,000m<sup>2</sup> each, to be filled sequentially over the course of the 20-year design life. The maximum depth of waste within the cells will be 16.5m, rising to a maximum of 14 m above the existing ground level. Fencing on perimeters of the landfill site will be provided to restrict access to the site and to control windblown waste. The fence is 1.8 m high and is installed around the entire perimeter of the landfill for 2,200 meters.

67. The landfill cells will be created by excavating to an average depth of 5m below existing ground level: the excavated soils will be used for the perimeter bund, as daily cover, and for the final cover at the end of filling. The base of the landfill cells will be reworked, graded, and compacted to ensure a uniform and firm base for the landfill.

68. The landfilling of the waste will be done sequentially, cell-by-cell, and in a series of vertical lifts. The aim is to limit the extent of the working landfill face to reduce windblown waste and reduce the vertical infiltration of rainwater into the waste (producing leachate). The waste will be covered periodically with an intermediate or daily cover of soil taken from the on-site stockpile.

69. A final cover layer will be placed progressively over the waste mass during the course of the landfilling. Before the installation of the final cover layer, the surface of the waste mass may need to be remodeled to provide a uniform final site profile to ensure adequate surface run-off and allow for a long-term settlement of the waste. The final cover will comprise at least 0.5m of fine-graded soil, preferably silt or clay. The profile of the final cover system will have a slope of 4 to 6% to ensure adequate surface run-off and allow for long-term settlement. The final cover will be grassed to ensure the integration of the closed site with its surroundings.

70. The landfill will share common facilities with the composting and sorting plants, such as the site management offices, worker sanitary facilities, a garage for plant maintenance.

71. The landfill cells will have a low permeability liner with a permeability less than  $1 \times 10^{-9}$  m/s, comprising a geomembrane liner of 2mm thick high-density polyethylene (HDPE) fusion-welded geomembrane. The HDPE geomembrane will be protected by a non-woven geotextile fabric.

72. **Leachate Drainage & Treatment.** The basal liner (HDPE geomembrane) will be overlain by a leachate drainage layer consisting of 0.5m of soils of permeability greater than or equal to  $10^{-4}$  m/s (e.g., clean well-graded sands or gravels). The leachate will be drained by gravity towards the collection well at the low point and then, still by gravity, to the leachate storage lagoon, which has a capacity of 1,200m<sup>3</sup> capacity – 600m<sup>3</sup> for the run-off from the composting platform (20-hour duration for 10-year rainfall event) and 600m<sup>3</sup> for leachate.

73. It is proposed to use a combination of leachate recirculation and off-site treatment at WWTP. The majority of the leachate will be recirculated back into the landfill mass, with the excess being tankered off-site for treatment at the WWTP. The recirculation uses a pump in the leachate pond, with pressure lines leading from the leachate pond up to the landfill surface, where the leachate enters the waste mass via infiltration drains or wells.

1 **Landfill Gas (LFG) Extraction & Treatment.** The LFG is assured by vertical wells at a density of 2 – 3 wells per cell. The LFG extraction system (collection and treatment), are funded by the project and will be latter installed during the landfilling operations. It takes approx. 3-5 years before LFG will be generated. The LFG wells are vented by a blower, applying negative pressure to the waste mass and extracting the LFG, which is then combusted in a flare stack. Such a system can work full-time or intermittently, depending upon the rate of production of LFG, but does require an LFG that is sufficiently rich in methane. The estimation of LFG production indicates that an LFG-to-energy plant would not be a cost-effective solution for the site conditions.

74. Landfill gas is a natural byproduct of the decomposition of organic material in landfills. LFG is composed of roughly 50% methane (the primary component of natural gas), 50% carbon dioxide (CO<sub>2</sub>), and a small amount of non-methane organic compounds.

75. **Management of Stormwater Run-off.** The cells that are yet to be filled will be kept hydraulically separate from the operating cells to avoid mixing clean rainwater with leachate.

Any clean rainwater that accumulates in the unused cells can be pumped out by a portable pump towards the surface run-off ditches. The storm-water run-off from the on-site road and hard standing areas will be collected in the run-off ditches and then to the settlement lagoon before discharge to the watercourse.

76. The rainwater run-off on the hard-standing surfaced areas of the site will be collected by surface water ditches and then drained to a retention and settlement lagoon situated at the south of the site before discharge to the nearest watercourse. The stormwater retention lagoon has a storage capacity of 1,200m<sup>3</sup> capacity, designed for the hard standing areas of the site on the basis of 20-hour duration for a 10-year rainfall event. The storm-water settlement lagoon will also serve as a reserve of water for fire-fighting purposes.

77. **Groundwater Monitoring.** The landfill will be provided with three groundwater monitoring wells, one up-gradient and two down gradient of the site. The sampling of the groundwater wells will be done on a six-monthly basis.

### **3. Rationale for an Environmental Assessment or Environmental Impact Assessment**

#### **3.1. Cambodian background**

78. In 1996, the Law on Environmental Protection and Natural Resources Management (NS/RKM/1296/36) came into force. The law requires the government to prepare national and regional environmental plans and sub-decrees concerning a wide range of environmental issues, including environmental impact assessments (EIAs), pollution prevention and control, public participation, and access to information. The Law on Environmental Protection and Natural Resource Management (1996) is the enabling legislation which allows the MOE to pass sub-decrees and regulations to protect the environment. Several sub-decrees are already laws while there are sub-decrees which have been drafted and are expected to become law in the near future.

79. Environmental impact assessment in Cambodia is guided by the Royal Government of Cambodia Sub-decree No. 72 ANRK.BK on EIA, and the classification of EIA study level under the Prakas No.21, 2020 on Environmental Impact Assessment Classification for Development Projects. In compliance with the regulation in Cambodia, all individuals, private companies, joint venture companies, public companies, ministries and government agencies are obliged to conduct an environmental impact assessment for proposed projects or activities, which must be submitted for approval by the MOE.

80. The Annex of the decree No.72 provides a list of project types that proponents use to screen projects for requiring either an Environmental Impact Assessment (EIA) or initial EIA (IEIA). As project owner, the MPWT will have to prepare an IEIA for drainage and full EIA for WW system, and landfill in separately report, according to the Prakas No.21, 2020 on Environmental Impact Assessment Classification for Development Projects, item 143 (drainage), 172 (Mechanical WWTP and sewer system) and 188 (landfill) of this Prakas. However, due to consultation with EIA department of MoE indicated that drainage and sewerage system could be combined in one EIA report.<sup>4</sup>

---

<sup>4</sup> Meeting with Dep. of EIA of MoE, Mr. Doung Samkeat deputy director, dates September 2020.

81. Since the project will involve rehabilitation, extension, or creation of new public facilities, IEIA and EIA will be required (one EIA for Wastewater / stormwater and one IEIA for solid waste management).

82. IEIA and EIA are not necessary for the project preparation and loan signature but will be required prior to the implementation of the sub-project components.

### **3.2. ADB background**

83. Approved by ADB's Board of Directors in July 2009, the Safeguard Policy Statement (SPS) builds upon the three previous safeguard policies on the environment, involuntary resettlement, and indigenous peoples, and brings them into a consolidated policy framework that enhances effectiveness and relevance. The SPS applies to all ADB-supported projects reviewed by ADB's management after 20 January 2010.

84. ADB will not finance projects that do not comply with its safeguard policy statement, nor will it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law. In addition, ADB will not finance activities on the prohibited investment activities list.

85. The project screening and categorization at the earliest stage of project preparation have identified LCIP as "Environment" Category B. Therefore, an Initial Environmental Examination (IEE) is required. Further details on ADB's SPS is described in Section IV.



## II. INSTITUTIONAL ARRANGEMENTS

### 4. Agencies/Organizations Involved

86. The national agencies that oversee the environment and natural resources management are listed below.

- (i) Ministry of Environment (MoE);
- (ii) Ministry of Agriculture, Forestry and Fisheries (MAFF);
- (iii) Ministry of Water Resources and Meteorology (MOWRAM);
- (iv) Ministry of Mines and Energy (MIME);
- (v) Ministry of Industry Technology Science and Innovation (MISTI);
- (vi) Ministry of Land Management Urban Planning and Construction (MLMUPC);
- (vii) Ministry of Public Works and Transport (MPWT);
- (viii) National Climate Change Committee (NCCC).

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

88. The MoE is the primary agency mandated to implement Article 50 of the 1993 Constitution. The MoE is tasked to promote environmental protection and conservation of natural resources, thus, contributing to the improvement of environmental quality, public welfare, national culture, and the economy. This is embodied in the three pillars of development of the Royal Government of Cambodia. One of the three pillars is the sustainable use of natural resources and sound environmental management to reduce poverty and improve the livelihood of all Cambodians.

89. The EIA Department of the MoE oversees and regulates EIA and coordinates the implementation of projects in collaboration with project executive agencies and concerned ministries. MoE has the following responsibilities:

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

90. MOE also have very important role in SWM, according to the new sub-decree No.189 on Establishment of Enterprise for Managing of Transfer Station and Landfill of Solid Waste (EML) (dated Nov.2020).

91. The MAFF are responsible for the management and protection of coastal mangrove forests and wildlife and fisheries.

92. The MPWT developed an Environmental and Social Safeguards Policy (ESSP) for the Road Asset Management Project in 2008 to ensure that the rehabilitation of roads meets the social and environmental safeguard requirements of the MOE and donors such as the ADB and International Development Assistance. The ESSP is supported by an implementation framework (ESSF). The ESSF is applied to projects funded by all donors, which includes a screening process for the general environment, protected areas, resettlement, and ethnic minorities.

Specific technical, environmental guidelines have been prepared to ensure proper environmental management of activities within protected areas.

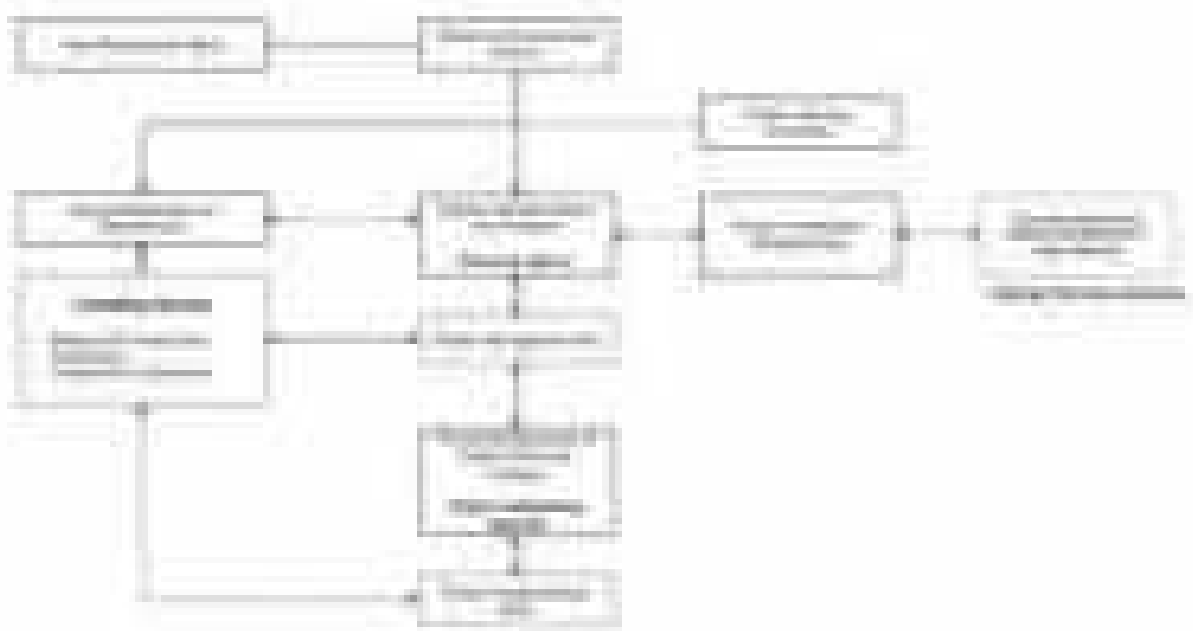
93. As the Executive Agency (EA) and Implementing Agency (IA) are both under the umbrella of MPWT, MPWT ensures EMP implementation across all the project stages (pre-construction, construction, and operation and maintenance) as stated in IEIA/EIA (under national law) which is to be written in Khmer and should be carried out during the DED phase of the project.

94. The local authorities including police force will be responsible for facilitation, controlling, and solving of any social conflicts that may happen in the project area. They will also assist the project executive agency to prevent illegal activities in the project area. So MPWT will work closely with them to ensure the project will be implemented smoothly.

## 5. Organizational Procedures

95. The proposed institutional arrangement during the project implementation are presented in the following **Figure 7**.

**Figure 7: Relations between the different stakeholders for the project implementation**



96. **Borrower.** As Borrower of the loan, the MEF has overall responsibility for the effective management and administration of public investment projects in Cambodia. It has a wide range of responsibilities which are described in its Standard Operating Procedure (SOP).<sup>5</sup>

97. **Executing Agency.** The MPWT has been designated by the MEF to be the EA for all Project sub-components. A PMU will be set up at the EA level. The PMU will be held

<sup>5</sup> MEF, December 2019. Standard Operating Procedure on Project Management for all Externally Financed Projects/ Programs in Cambodia.

accountable for the implementation and operation of the subproject on behalf of the EA and will work as a national subproject agency. The PMU will be led by a project director, who will be supported by deputy project directors, project managers, engineers/technical officers, safeguard specialists, procurement and financial specialists and administration support. It is recommended that at least one senior staff from the General Department of Sewerage and Wastewater Management (GDSWM) be part of the PMU to ensure an effective transition between the implementation phase and the future monitoring of the infrastructure.<sup>6</sup>

98. A PIA will be established to supervise and coordinate the implementation of the subproject investments. It will be responsible for coordinating with participating agencies and institutions to ensure broad participation in subproject related activities and to further enhance subproject ownership. A Project Implementation Unit (PIU) will be set up under the PIA, to coordinate the day-to-day implementation of the subproject. The PIU should include representatives of the municipal administration (MA), and the key departments such as the director/deputy director of the Provincial Department of Public Works and Transport (PDPWT), technical staff of the Provincial Department of Environment (PDOE), a technical staff of the Provincial Department of Land Management Urban Planning and Construction (PDLMUPC), and environment officer (PIU-EO) and social officer (PIU-SO). The MA, either through the participation of the Municipal Council members or technical staff of the Office of Public Works, Transport, Environment, Sanitation and Public Order Office (PWTESPO), should be closely associated with the PIU.

99. **Consulting support.** In addition, it is recommended that a Design and Construction Supervision Consultant (DCSC) be engaged, by the EA and the contract will include project management and capacity building services.

100. The DCSC will provide: (i) technical support, including the preparation of detailed engineering designs, technical specifications and bidding documents; (ii) construction supervision and contract administration; (iii) compliance with government and national policies and regulations, ADB's procurement policies and guidelines, Safeguards Policy statement, Gender and Development Policy, and Guidelines for Gender Mainstreaming Categories of ADB Projects; (iv) institutional capacity development; and (v) stakeholder engagement, awareness and communication activities.

101. The DCSC will also provide technical support to the PMU and PIAs concerning project management, financial, monitoring, evaluation procedures: (i) ensure that periodic project reviews are carried out; (ii) coordinate the reporting activities of the PMU, (iii) monitor and coordinate project-related procurement to ensure compliance with safeguard requirements; (iv) and support the PMU in implementation of the procedures required for land acquisition, including conducting and documenting consultations and the Grievance Redress Mechanism. The DCSC will also ensure that capacity within the PMU is built regarding ADB social safeguards requirements using both workshops and on-the-job training. The services of an NGO would be engaged to develop a behavior change analysis and support the development of a communication strategy on wastewater and solid waste management and to support the project in its social components.

---

<sup>6</sup> In December 2019, through sub-decree 220 ANKR BK, the Government established the General Directorate of Sewerage and Wastewater Management under the supervision of MPWT.

## 6. Composition and functions of the Steering Committee

102. As indicated in paragraph 62 of the MEF SOP, a Steering Committee is recommended when more than one line ministry or agency is involved in implementing the Project.

103. Although not mandatory, a project steering committee is suggested, given the scale of the project and the fact that it will involve a number of different line ministries, in particular, the MoE for the solid waste management component and potentially the Ministry of Industry, Science, Technology and Innovation (MISTI) if the water supply sector is involved during the implementation.

104. It is proposed for the LCIP Steering Committee to have the following responsibilities:

- (i) Provide guidance and policy direction to facilitate project implementation
- (ii) Facilitate interagency and inter-ministerial coordination
- (iii) Coordination of discussion among central level agencies

105. The members of the Steering Committee (PSC) should include (at least) the following representatives:

- |       |            |        |
|-------|------------|--------|
| (i)   | MPWT       | Chair  |
| (ii)  | MPWT/GDSWM | member |
| (iii) | MEF        | member |
| (iv)  | MoE        | member |
| (v)   | MoI        | member |
| (vi)  | MISTI      | member |
| (vii) | MLMUPC     | member |

106. To be official, the Project Steering Committee should be installed through a Prakas, and the members nominated through their positions – and not their names. Having the representatives mobilized based on their functions allows saving time, should the staff at the function changed.

107. The Steering committee will liaise with and be supported by other sub-committees, including:

- (i) The existing Inter-ministerial Sub-Committee on Cost Recovery and Tariff Setting, chaired by MEF;
- (ii) The existing Technical Sub-Working Group on Wastewater Management, Chaired by MPWT.

## 7. Implementation Plan and Schedule

108. The project is expected to be implemented over a 75-month period from August 2021 to December 2027 as shown in Figure 8.

109. This tentative implementation schedule is developed in conjunction with the Strategic Procurement Planning which assumes a DCSC will service the entire project. Within the DCSC, multiple design teams will therefore be required to carry out the study and supervision of the different components in parallel in order to achieve the project objectives.

110. The IEE report and its associated EMP will be updated at DED stage, and the updated DED stage EMP will be as part of the bidding documents. At this stage, both the updated IEE and EMP at DED stage will be re-disclosed, and updated stakeholder consultations will be

needed. If any variation orders take place under project implementation it shall be assessed by ADB if the environmental due diligence will need to be further updated and re-disclosed.

**Figure 8: Tentative Project Implementation Schedule**



DCS = design and construction supervision consultants; DED = detailed engineering design; GESIAP = gender equality and social inclusion action plan; Q = quarter.

Source: Egis

## **8. Implementation Process**

**111. Institutional Strengthening.** (a) The EA will assign one qualified environment officer (PMU-EO) and one social officer (PMU-SO) who will be the key focal point responsible for overall coordination, monitoring, and safeguard reporting for the project environmental and social safeguards. These officers will work closely with the PIU; and (b) the PIU will include one environment safeguard specialist (PIU-EO) and one social specialist (PIU-SO) (externally recruited experts), who will be responsible for coordination and daily implementation of the EMP and social safeguards. The specialists will work closely with the other PMU officers to ensure full and effective EMP implementation.

**112. Training in Environmental Management.** The PIU-EO, with the support of MEF and the Poipet government and the consulting teams (PMC and DCSC), will give training in implementation and supervision of environmental mitigation measures to contractors.

**113. Grievance Redress Mechanism (GRM).** The PIU/PMU will implement the project GRM at least two months before the start of construction to ensure that the project communities are well informed and have an opportunity to discuss any concerns. This is further to the public consultations already conducted during project preparation (Section VIII).

**114. Bidding Documents and Contract Documents.** The EMP will be included in the bidding documents and contracts for the procurement of civil works, goods, and services. All contractors and subcontractors will be required to comply with the EMP and other safeguard documents to be included in the tender documents.

115. **Contractor Obligations.** Contractors, in their bids, will respond to the environmental clauses in the bidding documents for EMP requirements. Prior to construction, each contractor will develop its own Construction EMP (CEMP), based on the EMP and specific for each site, and assign at least one person responsible for Environment, Health, and Safety (EHS). Each CEMP shall include the following: (a) surface water protection (especially, to avoid or minimize impacts to water bodies); (b) spill control and management; (c) site drainage and soil erosion protection; (d) health and safety taking into account COVID-19 national guidance and international guidance<sup>8</sup>; (e) temporary traffic management; (f) construction site access control. CEMP will be submitted to the PMU for review (with consultant team review support) and endorsement by MEF and the Poipet government, and its implementation will be reported monthly to the PIU. Each contractor will establish a grievance register and incident register and comply with the labor law of Cambodia and core labor standards of ILO.

116. **Consultations and Disclosures.** Consultations and disclosure activities will be maintained with affected people and other involved stakeholders to ensure continued communication, including, for example works schedule, details of activities including those that result in nuisances and disturbances, the status of claims, and other aspects.

---

<sup>8</sup> See e.g.: World Health Organization. 2020. Considerations for public health and social measures in the workplace in the context of COVID-19. Geneva. Available here: <https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19>; HM Government. 2020. Working safely during COVID-19 in construction and other outdoor work. Guidance for employers, employees and the self-employed. Available here: <https://assets.publishing.service.gov.uk/media/5eb961bfe90e070834b6675f/working-safely-during-covid-19-construction-outdoors-110520.pdf>. The Canadian Construction Association. 2020. COVID 19 Standard Protocols. Available here: <https://www.cca-acc.com/wp-content/uploads/2020/04/CCA-COVID-19-Standardized-Protocols-for-All-Canadian-Construction-Sites-04-16-20.pdf>

### III. OBJECTIVES AND POLICY FRAMEWORK

#### 9. The objective of the Environmental Assessment

117. The IEE and EMP have been prepared in accordance with the Safeguard Policy Statement (SPS, June 2009) of the Asian Development Bank (ADB) and the Law on Environmental Protection and Natural Resources Management, enacted by the National Assembly (1996) of Cambodia and Sub-decree No. 72 ANRK.BK on EIA, its implementing guidelines. These IEE and EMP: (i) identify and assess potential impacts and risks arising from the implementation of the proposed project on the physical, biological, physical cultural, and socioeconomic environment; and (ii) recommend measures to avoid, mitigate, and compensate for adverse impacts, and enhance positive impacts.

118. The IEE is based on-site reconnaissance, relevant reports and documents (inception reports, sector master plans, urban development scenarios, feasibility study, and environmental and social baseline survey reports prepared by the TRTA (Transaction Technical Assistance) of the three target cities), consultations with communities, and meetings and discussions with the government agencies.

#### 10. Relevant Laws and Regulations

##### 10.1. International Regulations, Conventions, and Treaties

119. Cambodia is a signatory to many international environmental treaties and conventions which provide a comprehensive legal framework. These include Association of Southeast Asian Nations (1999), Biodiversity Convention (1994), Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (1997), Ramsar Convention (1999) and Climate Change Convention (1995) (MOE 2006); Paris Agreement on Climate Change (2016) ; and Sendai Framework for Disaster Risk Reduction 2015-2030.

120. The Royal Government of Cambodia promulgated the Cambodia Climate Change Strategic Plan 2014–2023 (CCCSP) in response to the country's commitment to the United Nations Framework Convention on Climate Change. The CCCSP was prepared following the guidelines of the Council of Ministers and consultation stakeholders. The CCCSP is designed to address a wide range of climate change issues concerning adaptation, greenhouse gas (GHG) mitigation, and low-carbon development.<sup>9</sup> The MPWT's Climate Change Action Plan for Transport Sector 2014–2018 identified priority climate adaptation actions that include: (i) develop national road construction and maintenance design standards for national roads, taking into account climate change impact; (ii) repair and rehabilitate existing road infrastructure taking into account climate change impact and various other actions in relation to raising capacity and public awareness of climate change impacts, and (iii) capacity building and institutional strengthening for addressing climate change impacts.

121. The Royal Government of Cambodia is one of the pilot countries participating in the Pilot Program for Climate Resilience (PPCR) – one of the three sub-programs of the Strategic Climate Fund (SCF). The PPCR provides incentives for scaled-up action and transformational

---

<sup>9</sup> Cambodia Climate Change Strategic Plan 2014-2023. [www.bb.undp.org](http://www.bb.undp.org). 6 February 2017.



change in integrating consideration of climate risks and resilience in national development planning, consistent with poverty reduction and sustainable development goals. The priority sectors for PPCR in Cambodia include water resources, agriculture, and infrastructure. In June 2011, the PPCR sub-committee endorsed Cambodia's Strategic Program for Climate Resilience with a funding envelope of up to \$86 million (\$50 million in grants and up to \$36 million in concessional credit). Of this, an allocation of \$17 million (\$10 million loans and \$7 million grant) was endorsed for "Climate-proofing of Roads in Prey Veng, Svay Rieng, Kampong Chhnang, and Kampong Speu Provinces" as part of the ADB-funded PRIP. The PRIP includes piloting of approaches to strengthen civil works design and planning, as well as to reduce risks of damages resulting from climate change impacts through implementing ecosystem-based adaptation measures and emergency management responses.<sup>10</sup>

122. For all other applicable environmental standards and criteria such as ambient air quality, vibration, noise, contaminated soil, and workplace and community safety, the standards and protocols of the World Bank Group EHS (2007) will apply particularly for standards which impose stricter limits such as noise in the immediate vicinity of residential and commercial areas.

## **10.2. National Laws and Regulations**

123. The hierarchy of legislation in Cambodia is:

- (i) Royal Decree signed by the King;
- (ii) Sub-decree signed by the Prime Minister;
- (iii) Ministerial Decision signed by a Minister;
- (iv) Regulation issued by a Ministry.

124. The major legislation in Cambodia is the Royal Decree, which ratifies laws passed by parliament. These can be supplemented by "PRAKAS" or ministerial decisions. These laws allow sub-decrees and regulations to be passed, which can stipulate procedures and standards to be met in order to ensure compliance with the law. Many of these sub-decrees and standards have been drafted but have not yet been ratified by parliament.

125. In 1993, the Royal Government of Cambodia confirmed a new Constitution in which environmental considerations were included for the first time. Specifically, Article 59 requires the State to protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, fish and aquatic resources and it was within this constitutional context that the Ministry of Environment (MOE) was established.

126. 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 on the environment that are applicable to the project include the following:

---

<sup>10</sup> PRIP Climate change outputs include Climate Modeling Report, Flood Risk Management Interface Manual v10, Infrastructure Rehabilitation for Climate Resilience, Knowledge Management Report, Non mandatory guidelines for FPR v1,6, Reinforcing community flood resilience, Road Design Standard v6-hun-1 and Vulnerability Report v5. (<http://prp.mpwt.gov.kh/documentation>).

**Table 8: Key elements of the legal and policy framework on the environment that are applicable to the project**

Law/Circular	Date	Key elements
Law on Environmental Protection and Natural Resources Management	1996	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM-1296/36
Law on Natural Protected Areas	2008	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0208/007
Law on Fisheries Management and Administration	1989	-
Law on Forest	2002	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0802/016
Law on Land	2001	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0801/14
Law on Water Resource Management	2007	Enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0607/16

Source: Egis, 2021.

127. Key directives in support of the Law on Environmental Protection and Natural Resources Management are presented in Table 9.

**Table 9: Key directives in support of the Law on Environmental Protection and Natural Resources Management**

Law/Sub-decree	Date
Law on Protection of Natural Areas	2008
Sub-decree No. 72 on Environmental Impact Assessment Process	1999
Sub-decree on Water Pollution Control <ul style="list-style-type: none"> <li>Annex 2: Effluent standards for pollution sources discharging to public water area or sewer system</li> <li>Annex 4: Water quality standards for public water and biodiversity</li> <li>Annex 5: Water quality standards for public waters and health</li> </ul>	1999
Sub-decree on Air Pollution Control and Noise Disturbance <ul style="list-style-type: none"> <li>Annex 1: Ambient air quality standard</li> </ul> Annex 6: Maximum permitted noise level in a public and residential area (dB(A))	2000
Sub-decree on Solid Waste Management Annex: Type of hazardous waste	1999
Sub-decree on River Basin Management	2015
The sub-decree No.113 on delegates the management of waste to municipal and district administrations with a differentiation made between urban solid waste and garbage and set outs responsibilities for separation of	2015

Law/Sub-decree	Date
recyclable materials.	

Source: Egis, 2021.

128. The Forestry Law defines the framework for management, harvesting, use, development and conservation of the forests in the Kingdom of Cambodia. The objective of the law is to ensure the sustainable management of these forests for their social, economic and environmental benefits, including conservation of biological diversity and cultural heritage (Article 1). The law prescribes areas in the forestlands to be reforested. It also enjoins the citizens of Cambodia to plant trees and development of tree plantations, through the Arbor Day, for example.

129. The National Forest Programme (NFP) 2010-2029 aims to achieve sustainable forest management and alleviate poverty in Cambodia. Specifically, it identifies objectives and goals in developing and managing forests to improve livelihoods, environmental services and overall economic development. More importantly, it aims to ensure that the management and exploitation of forests generates benefits for government entities, local communities, the private sector and individuals. The NFP prioritizes six programmatic areas that will be emphasized over the next two decades in order to achieve several objectives: (i) forest demarcation; (ii) classification and registration; (iii) forest conservation and development of forest resource and biodiversity; (iv) forest law enforcement and governance programme; (v) capacity and research development; (vi) sustainable forest financing; and (vii) Community Forestry (CF).

130. The NFP aims to increase the current level of forest cover to 60% of the total land area as its strategic indicators. It also sets a target of 500,000 hectares of high value commercial plantation established and 10 million tree seedlings distributed per year and two million hectares of forest land allocated for Community Forestry (approximately 1,000 CF).

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

**Table 10: Other pertinent regulations, policy, or guidelines for the project**

Regulation	Date	Comment
Prime Ministerial Edict. entitled "Measures to Eliminate Anarchical Land Grabbing."	1999	Declares public land on the verge of roads and railways must not be occupied. For NR1, the road reserve is 30 m from the centerline, and for NR6, it is 25 m from the centerline
Directive on Managing Health Wastes in the Kingdom of Cambodia	2008	Ministry of Health
Preach Reach Kept on Creation of Fisheries Communities	2005	-
Anukret on the establishment of protected forests, natural resources conservations, wildlife protection areas, protected forest for biodiversity conservation	2002 and 2004	-

Source: Egis, 2021.

132. **Wildlife.** The Joint Prakas of MoE and Ministry of Agriculture, Forestry, and Fisheries on Prohibition of Hunting and Catching Wildlife (1996) specifically bans hunting of wild animals and

birds for food, including all species of mammals, reptiles, amphibians, insects, other invertebrates, and their eggs or offspring.<sup>11</sup>

133. The Law on Forestry Management prohibits the hunting of wildlife within protected areas. Aside from maintaining checkpoints and providing rangers, the MoE has an active community education program to promote environmental awareness, especially within the rural communities.

134. **Natural Areas.** Cambodia has a network of 23 natural protected areas managed through the MOE. These areas cover 2.2 million hectares or 18% of Cambodia's land area and include most of its important habitats. The Forest Administration has also designated protected forests (from canceled logging concessions), bringing the total area under protection to around 25%, which is more than twice the global average. Protected Areas are sites that are protected by Royal Decrees, laws, and regulations. Such mandatory stipulations are promulgated in the Khmer language. The Khmer version takes precedence over the translated version.

135. In 2008, Cambodia introduced the Protected Area Law (No. NS/RKM/0208/007), which defines (i) national parks, (ii) wildlife sanctuaries, (iii) protected landscapes, (iv) multiple-use areas, (v) Ramsar sites, (vi) biosphere reserves, (vii) natural heritage sites, and (viii) marine parks.

136. These have been referenced to the International Union for Conservation of Nature (IUCN) Categorization list:

- (i) National Parks (IUCN Category II) – Natural and scenic areas of significance for their scientific, educational, and recreational values.
- (ii) Wildlife Sanctuaries (IUCN Category IV) – Natural area where nationally significant species of flora or fauna, natural communities, or physical features require specific intervention for their perpetuation.
- (iii) Protected Landscapes (IUCN Category V) – Nationally significant natural and semi-natural landscapes that must be maintained to provide opportunities for recreation.
- (iv) Multiple-Use Areas (IUCN Category VIII) – Areas that provide for the sustainable use of water resources, timber, wildlife, fish, pasture, and recreation with the conservation of nature primarily oriented to support these economic activities.
- (v) Ramsar Sites – There are two sites in the IUCN Categories IV and VIII above and one site in the middle stretches of the Mekong River between Stung Treng and the border with Laos.
- (vi) Biosphere Reserve – The Tonle Sap Multiple-Use Area was nominated as Cambodia's first Biosphere Reserve in 1997. The Boeung Chmar portion of Tonle Sap Multiple-Use area (28,000 hectares) is designated as a Ramsar site.

1. Under Article 11 of the law, each protected area is divided into four management zoning systems as follows:

- (i) **Core Zone:** management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection

---

<sup>11</sup> <http://www.cambodiainvestment.gov.kh/> 6 February 2017

Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defense sectors.

- (ii) **Conservation Zone:** management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the core zone. Access to the zone is allowed only with the prior consent of the Nature Conservation and Protection Administration at the area, with the exception of national security and defense sectors. The small-scale community uses of non-timber forest products (NTFPs) to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone.
- (iii) **Sustainable Use Zone:** management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the Ministry of Environment
- (iv) **Community Zone:** management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar<sup>12</sup>) or farming. Issuing of land title or permission to use land in this zone shall have prior agreement from the Ministry of Environment in accordance with the Land Law. This management area does not cover the APSARA (Authority for the Protection and Management of Angkor and the Region of Siem Reap) authorities and other authorities designated and management area(s) to which the Royal Government has allocated the tasks.

137. **Historical Monuments and Cultural Heritage.** The Law on Protection of Cultural and National Heritage (1996) is the general law in Cambodia which covers all national monuments. This is supplemented by the "Decision on the Definition of Three Zones to Protect Temple and Surrounding Areas in all Provinces and Municipalities except Angkor Wat" (1996). These laws protect small temples or ancient structures.

138. **Solid Waste Management.** The Sub-decree on Solid Waste Management No.36 ANRK/BK (1999) regulates the collection, storage, disposal, dumping, recycling of solid domestic and industrial, commercial, hospital, and other assorted waste in order to prevent any ecological damage to the ecosystem and to avoid pollution of both soil and water. The sub-decree No.113 ANRK/BK (2015) delegates the management of waste to municipal and district administrations with a differentiation made between urban solid waste and garbage and set outs responsibilities for separation of recyclable materials.

139. **Technical Guideline on Urban Solid Waste Management, MoE 2016.** Criteria for selection of the landfill site are listed below.

---

<sup>12</sup> Swidden or Chamkar is also known as slash and burn or shifting cultivation.

**Table 11: Criteria for selection of the landfill site**

Criteria	Description
1.	1km from the national road, residential property, and public drainage
2.	3km from any school, health center, natural water source (lake, river, stream, sea/shoreline)
3.	5km from any place of tourism resort, worship (pagoda, religion temple) and natural conservation area
4.	8km from an airport
5.	10-50km from an urban area
6.	15km from any heritage site and historical resort
7.	Not in a flooded area and year-round access road
8.	At low economic value and unfertile soil for agricultural crop

Source: Egis, 2021.

140. **National Occupational Health and Safety Standards.** Occupational and Community Safety and Health (OHS) guidelines for the Government following the recent OHS Programme for Cambodia (2010-2013) that was developed by the International Labor Organization (ILO). The guidelines provide the framework for instituting OHS at the workplace and in the community.

### **10.3. National and International Environmental Standards**

141. Cambodia has national standards for a range of environmental parameters. Standards that were applied for the IEE are: (i) water quality standards (Sub-decree No.27 ANRK/BK, 1999, updated by the Prakas No.120, 11 April 2018, MoE); (ii) ambient air quality and Noise disturbance level standards (Anukret No.42 ANK/BK, 2000); and (iii) occupational health and safety standard (OHS Programme for Cambodia, 2010-2013). Comparison with the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines is given below.

142. **Water Quality.** The following tables summarize Cambodian water quality standards and international standards: Cambodian standards are more stringent than international ones when they exist, except for the TSS parameter.

**Table 12: Parameters and standards for surface water quality**

No	Parameter	Unit	National Standard for rivers <sup>13</sup>	National Standard for lakes and reservoirs <sup>13</sup>
1	pH	-	6.5 - 8.5	6.5 - 8.5
2	Total Dissolved Solid (TDS)	mg/L	< 1,000	< 1,000
3	Total Suspended Solid (TSS)	mg/L	25 - 100	1 - 15
4	Dissolved Oxygen (DO)	mg/L	2.0 - 7.5	2.0 - 7.5
5	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	1 - 10	< 30
6	Chemical Oxygen Demand (COD)	mg/L	< 50	1 - 8
7	Oil and grease		< 5	< 5
8	Detergent	mg/L	< 5	< 5
9	Sulphate (SO <sub>4</sub> )	mg/L	< 300	< 300
10	Total Nitrogen (TN)	mg/L	0.1 – 0.6	0.1 – 0.6
11	Total Phosphorus (TP)	mg/L	0.005 – 0.5	0.005 – 0.5
12	Lead (Pb)	mg/L	< 0.01	< 0.01
13	Arsenic (As)	mg/L	< 0.01	< 0.01
14	Cadmium (Cd)	mg/L	< 0.001	< 0.001
15	Iron (Fe)	mg/L	< 1	< 1
16	Mercury (Hg)	mg/L	< 0.0005	< 0.0005
17	Total Coliform	MPN/100mL	< 5,000	< 1,000

Source: Table 4 of the Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE

**Table 13: Parameters and standards for groundwater quality**

No	Parameter	Unit	National Standard <sup>14</sup>
1	pH	-	6.5 – 8.5
2	Turbidity	NTU	5
3	Electrical Conductivity (EC)	ms/cm	-
4	Total Dissolved Solid (TDS)	mg/L	800
5	Total Hardness (as CaCO <sub>3</sub> )	mg/L	300
6	Chloride (Cl)	mg/L	250
7	Fluoride (F)	mg/L	1.5
8	Nitrate (NO <sub>3</sub> )	mg/L	50
9	Sulphate (SO <sub>4</sub> )	mg/L	250
10	Iron (Fe)	mg/L	0.3
11	Arsenic (As)	mg/L	0.05
12	Mercury (Hg)	mg/L	0.001
13	Chromium (Cr)	mg/L	0.05
14	Manganese	mg/L	0.1
15	Aluminum (Al)	mg/L	0.2
16	Benzene (C <sub>6</sub> H <sub>6</sub> )	mg/L	0.01
17	Dichloromethane (CH <sub>2</sub> Cl <sub>2</sub> )	mg/L	-
18	Cadmium (Cd)	mg/L	0.003
19	Total Coliform	MPN/100mL	0

<sup>13</sup> Sub-Decree No. 27, updated by the Prakas No.120 on launching the use of ToR for preparing IEIA report for infrastructure development and tourism project, 11 April 2018, MoE.

<sup>14</sup> Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE.

No	Parameter	Unit	National Standard <sup>14</sup>
20	E.coli	MPN/100mL	0

Source: Table 6 of the Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE.

**Table 14: Water Quality Standard in Public Water Areas for Public Health Protection**

No	Parameter	Unit	National Standard <sup>15</sup>	WHO/EHS Standard
1	Carbon tetrachloride	µg/L	< 12	-
2	Hexachloro-benzene	µg/L	< 0.03	-
3	DDT	µg/L	< 10	-
4	Endrin	µg/L	< 0.01	0.6
5	Dieldrin	µg/L	< 0.01	-
6	Aldrin	µg/L	< 0.005	-
7	Isodrin	µg/L	< 0.005	-
8	Perchloroethylene	µg/L	< 10	-
9	Hexachlorobutadiene	µg/L	< 0.1	-
10	Chloroform	µg/L	< 12	-
11	1,2 Trichloroethylene	µg/L	< 10	-
12	Trichloroethylene	µg/L	< 10	-
13	Trichlorobenzene	µg/L	< 0.4	-
14	Hexachloroethylene	µg/L	< 0.05	-
15	Benzene	µg/L	< 10	10
16	Tetrachloroethylene	µg/L	< 10	-
	Barium	mg/L	-	1.3
	Boron	mg/L	-	2.4
	Copper	mg/L	-	2
	Sodium	mg/L	-	50
	Fluoride	mg/L	-	1.5
17	Cadmium	µg/L	< 1	3
18	Total mercury	µg/L	< 0.5	6
19	Organic mercury	µg/L	0	-
20	Lead	µg/L	< 10	10
21	Chromium, valent 6	µg/L	< 50	50
22	Arsenic	µg/L	< 10	10
23	Selenium	µg/L	< 10	40
24	Polychlorobiphenyl	µg/L	0	-
25	Cyanide	µg/L	< 0.005	-
26	Barium	mg/L	-	1.3
27	Boron	mg/L	-	2.4
28	Copper	mg/L	-	2
30	Sodium	mg/L	-	50
31	Fluoride	mg/L	-	1.5
32	pH	-	-	6.5 - 8.5

Source: The item 1 to 25 is extracted from annex 5 of sub-decree no.27, and the item 26-32 is international standards.

<sup>15</sup> Sub-Decree No. 27.



143. Table 15 provides the local standards for allowable limits for pollutants in effluent as indicated in Sub-Decree 27, Annex 2. For the project, the values listed in the column "Effluent standard for pollution sources discharging to water areas or public sewers" apply to this project.

**Table 15: Effluent Standard for Pollution Sources Discharging Wastewater to Public Areas or Sewer**

No	Parameter	Unit	Allowable limits for pollutant substance discharging to <sup>15</sup>		WHO/EHS Standard
			Protected water area	public water area and sewer	
1	Temperature	°C	< 45	< 45	-
2	pH		6 – 9	5 - 9	6-9
3	BOD5 ( 5 days at 200 C)	mg/L	< 30	< 80	30
4	COD	mg/L	< 50	< 100	125
5	Total Suspended Solids	mg/L	< 60	< 120	50
6	Total Dissolved Solids	mg/L	< 1000	< 2000	-
	Total Coliform Bacteria	MPN/100 mL	-	-	400
7	Grease and Oil	mg/L	< 5.0	< 15	10
8	Detergents	mg/L	< 5.0	< 15	-
9	Phenols	mg/L	< 0.1	< 1.2	-
10	Nitrate (NO <sub>3</sub> )	mg/L	< 10	< 20	-
	Total Nitrogen	mg/L	-	-	10
11	Chlorine ( free )	mg/L	< 1.0	< 2.0	-
12	Chloride ( ion )	mg/L	< 500	< 700	-
13	Sulphate ( as SO <sub>4</sub> )	mg/L	< 300	< 500	-
14	Sulphide ( as Sulphur )	mg/L	< 0.2	< 1.0	-
15	Phosphate ( PO <sub>4</sub> )	mg/L	< 3.0	< 6.0	-
	Total Phosphorus	mg/L	-	-	2
16	Cyanide ( CN )	mg/L	< 0.2	< 1.5	-
17	Barium ( Ba )	mg/L	< 4.0	< 7.0	-
18	Arsenic ( As )	mg/L	< 0.10	< 1.0	-
19	Tin ( Sn )	mg/L	< 2.0	< 8.0	-
20	Iron ( Fe )	mg/L	< 1.0	< 20	-
21	Boron ( B )	mg/L	< 1.0	< 5.0	-
22	Manganese ( Mn )	mg/L	< 1.0	< 5.0	-
23	Cadmium ( Cd )	mg/L	< 0.1	< 0.5	-
24	Chromium ( Cr )+3	mg/L	< 0.2	< 1.0	-
25	Chromium ( Cr )+6	mg/L	< 0.05	< 0.5	-
26	Copper ( Cu )	mg/L	< 0.2	< 1.0	-
27	Lead ( Pb )	mg/L	< 0.1	< 1.0	-
28	Mercury (Hg )	mg/L	< 0.002	< 0.05	-
29	Nickel ( Ni )	mg/L	< 0.2	< 1.0	-
30	Selenium ( Se )	mg/L	< 0.05	< 0.5	-
31	Silver ( Ag )	mg/L	< 0.1	< 0.5	-
32	Zinc ( Zn )	mg/L	< 1.0	< 3.0	-
33	Molybdenum ( Mo )	mg/L	< 0.1	< 1.0	-
34	Ammonia ( NH <sub>3</sub> )	mg/L	< 5.0	< 7.0	-
35	DO	mg/L	> 2.0	> 1.0	-
36	Polychlorinated Byphenyl	mg/L	< 0.003	< 0.003	-
37	Calcium	mg/L	< 150	< 200	-

No	Parameter	Unit	Allowable limits for pollutant substance discharging to <sup>15</sup>		WHO/EHS Standard
			Protected water area	public water area and sewer	
38	Magnesium	mg/L	< 150	< 200	-
39	Carbon tetrachloride	mg/L	< 3	< 3	-
40	Hexachloro benzene	mg/L	< 2	< 2	-
41	DTT	mg/L	< 1.3	< 1.3	-
42	Endrin	mg/L	< 0.01	< 0.01	-
43	Dieldrin	mg/L	< 0.01	< 0.01	-
44	Aldrin	mg/L	< 0.01	< 0.01	-
45	Isodrin	mg/L	< 0.01	< 0.01	-
46	Perchloro ethylene	mg/L	< 2.5	< 2.5	-
47	Hexachloro butadiene	mg/L	< 3	< 3	-
48	Chloroform	mg/L	< 1	< 1	-
49	1,2 Dichloro ethylene	mg/L	< 2.5	< 2.5	-
50	Trichloro ethylene	mg/L	< 1	< 1	-
51	Trichloro benzene	mg/L	< 2	< 2	-
52	Hexachloro cyclohexane	mg/L	< 2	< 2	-

Source: Column 2-4 is from Annex 2 of the sub-decree No.27, April 1999.

144. **Air Quality.** The ambient air quality standards for Cambodia (Anukret No42 ANK/BK, 2000) and the World Health Organization (WHO) (identical to EHS standards) are below.

**Table 16: Ambient air quality standards for Cambodia and the WHO**

Pollutant	Averaging period	National Standard (mg/m <sup>3</sup> )	EHS/WHO <sup>5</sup> (µg/m <sup>3</sup> )
Carbone Monoxide (CO)	1 hour	40	-
	8 hours	20	-
Nitrogen Dioxide (NO <sub>2</sub> )	1 hour	0,3	0,2
	24 hours	0,1	0,04
Sulphur Dioxide (SO <sub>2</sub> )	1 hour	0,5	-
	24 hours	0,3	20
Ozone (O <sub>3</sub> )	1 hour	0,2	-
	8 hour	-	160
Lead (Pb)	24 hours	0,005	-
Total suspended particulate (TSP)	24 hours	0,33	-
	Annual	0,10	-

Source: Annex 1 of the Sub-Decree on Air Pollution, 1999

145. **Noise.** Cambodian National Standard for Ambient Noise sets an allowable limit for noise in the daytime at 60 dB (45 dB(A) in quiet areas), and night at 45 dB (35 dB(A) in quiet areas), with the night being 10 pm-6 am according to the Anukret on the control of air pollution and disturbance. The comparison made with World Bank EHS standards shows that the EHS standards are less stringent than the national standard during the day.

**Table 17: Cambodian National Standard for Ambient Noise**

Standard	Maximum allowable noise limit, 1 hr LAeq in dBA
----------	---

	Day (6:00 – 18:00)	Mid (18:00 - 22:00)	Night (22:00 – 06:00)
WB/IFC Guideline			
Industrial/commercial	70	-	70
Residential/Institutional/Educational	55	-	45
Cambodian National Standard			
Quiet areas (hospital, libraries, school, kindergarten)	45	40	35
Residential areas (hotels, administrative offices, villas, flats)	60	50	45
Commercial and Service Areas and Area of multiple businesses	70	65	50
Small industrial factories mingling in a residential area	75	70	50

Source: Annex 6 of the Sub-Decree on Air Pollution, 1999

## 11. ADB Safeguards Policy Statement

146. **ADB's SPS (2009)** provides the joint basis for this IEE. All projects funded by ADB must comply with the SPS. The purpose of the SPS is to ensure that projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environmental, biology, health, or safety hazards. The SPS sets out the policy objectives, scope, and triggers, and principles for three key safeguard areas: (i) environmental safeguards; (ii) involuntary resettlement safeguards; and (iii) indigenous Peoples safeguards. The policies seek to avoid, minimize, or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process. The objectives of ADB's safeguards are to (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and, (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. The SPS is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010), and guidance is provided by the ADB Environmental Safeguards - A Good Practice Sourcebook (2012).

147. The SPS also promotes the use of international standards, including the World Bank Group's EHS Guidelines. EHS guidelines relevant to the project include environment protection, water conservation, hazardous materials, waste management, noise control, sanitation, and community and occupational health and safety. Where EHS standards are higher than national standards, efforts are made for ADB-funded projects to target the EHS standards. The standards applied to this project are based on a comparison of national and EHS thresholds: in cases where no EHS thresholds are available, or the Cambodian standards are identical to or higher than the EHS standards, the national standards are applied. In general, several Cambodian standards are equal to, or higher than, the EHS standards.

148. Compared with the Cambodian EIA requirements, the SPS emphasizes additional requirements, including (i) a project grievance redress mechanism; (ii) definition of the project area of influence; (iii) due diligence of associated facilities; (iv) climate change mitigation and adaptation; (v) impacts on livelihoods through environmental media; and (vi) biodiversity conservation.

149. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to (i) reflect the significance of the project's potential environmental impacts; (ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude, and sensitivity of the proposed project's potential impacts; and, (iii) determine consultation and disclosure requirements.

150. **SPS and protected areas.** The SPS requires that project activities will not be implemented in areas of critical habitat, which includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregation species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities.

151. SPS requires identification of measures to avoid, minimize, or mitigate potentially adverse impacts and risks on biodiversity and natural resource and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity. In areas where the natural habitat has apparently been altered, any further conversion or degradation of such habitat have to be minimized, and opportunities to enhance habitat and protect and conserve biodiversity as part of project operations have to be identified.

152. ADB assigns a proposed project to one of the following categories based on the potential environmental impacts:

- (i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale environmental impact assessment (EIA), including an environmental management plan (EMP), is required.
- (ii) **Category B.** Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An initial environmental examination (IEE), including an EMP, is required.
- (iii) **Category C.** Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required, although environmental implications need to be reviewed.

153. **This project is categorized by ADB as category B for the environment.** This IEE and EMP were prepared by the TA consultant on behalf of the MPWT, the executing agency.

154. **Climate Risk and Vulnerability Assessment.** The ADB also requires the identification of climate change risks to the proposed project early in the project cycle and to identify actions to screen projects for climate risks, assess these risks, and address them in the project design.

Technical guidelines have been developed by the ADB to aid in climate risk and vulnerability assessment.<sup>16</sup> Likewise, the Guidelines on Climate Proofing Investment in the Water Sector: Water Supply and Sanitation<sup>17</sup> was issued to present a step-by-step methodology to help project teams incorporate climate adaptation into the water supply and sanitation sector investment projects.

## **12. Gap Analysis**

155. Regarding the national regulation and international standards (such as WHO/EHS), numerous standards exist. Comparison with the World Bank Group's Environmental, Health and Safety (EHS) Guidelines has been carried out: where national and international thresholds differ, the most stringent value is preferred.

---

<sup>16</sup> <https://www.adb.org/sites/default/files/publication/148796/climate-risk-management-adb-projects.pdf>

<sup>17</sup> <https://www.adb.org/sites/default/files/institutional-document/32772/files/guidelines-climate-proofing-water.pdf>

## IV. DESCRIPTION OF THE ENVIRONMENT

### 1. Location, Geography, and Topography

156. Cambodia lies in the southwestern part of the Southeast Asian peninsula. International borders are shared with Thailand to the west, the Lao People's Democratic Republic to the north, and the Socialist Republic of Vietnam on the east and southeast. The country is bounded to the southwest by the Gulf of Thailand.

157. The topography of Cambodia is described as “bowl-shaped” and expands about 181,035km<sup>2</sup>. The central plains form 75% of the country and consist of the alluvial plains of the Mekong River and the Tonle Sap basin.

158. The central region of the country or the bottom of the bowl is represented by Tonle Sap Lake and the surrounding floodplain. The floodplain of Tonle Sap merges with the floodplain of the Mekong River to the southeast of Cambodia, which forms the Cambodian plain covering 25,069 km<sup>2</sup>. Knolls and low hills are scattered in the vast alluvial plains of the country. This means that the whole of northwest Cambodia acts as a catchment area ultimately draining into Tonle Sap.

159. Poipet City is a flourishing border city located in the Province of Banteay Meanchey in the far northwest of Cambodia, around 48 km away from the provincial capital. Poipet City is surrounded by Thailand's east border town Aranyaprathet on the northwest and west side; by Malai District on the southwestern side; and by Ou Chrov District in the northeast and eastern portions.

160. The approved land area of Poipet is 273.14km<sup>2</sup>, and the city consists of three quarters (*Sangkat*):

- (i) Sangkat Poipet (21.90km<sup>2</sup>), composed of 13 villages (*Phum*);
- (ii) Sangkat Phsar Kandal (75.81km<sup>2</sup>), composed of 10 villages;
- (iii) Sangkat Nimitt (175.43km<sup>2</sup>), composed of 15 villages.

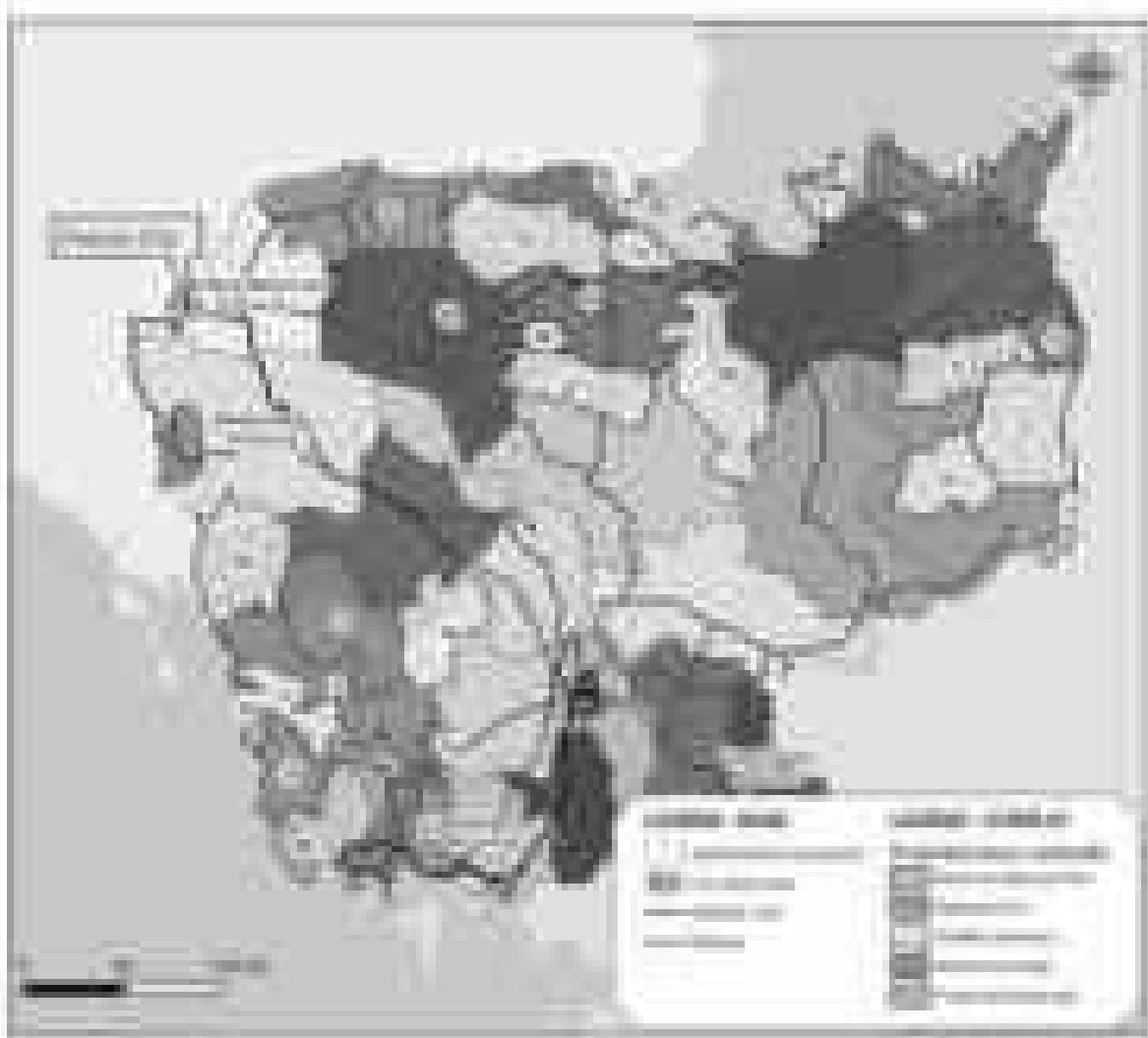
161. The close surroundings of Poipet are dominated by agriculture, forest, and grassland. Forest cover around Poipet is relatively sparse and characterized as deciduous dipterocarp forest, which can be distinguished by an open canopy combined with a grassy ground layer.<sup>18</sup>

162. The topography around Poipet is defined by extensive lowlands, with a few higher areas to the north and east, ranging from 30 to 80 meters above sea level. The highest point is a hill formation north of the city, and the lowest elevations surround the stream south of the city.

---

<sup>18</sup> Ministry of Public Works and Transport. Initial Environmental Examination - CAM: Greater Mekong Subregion Southern Economic Corridor Towns Development Project - Subprojects for Bavet, Battambang, and Poipet. August 2019.

**Figure 9: Poipet City location**



Source: Egis, 2021

## **2. Geology and Soils**

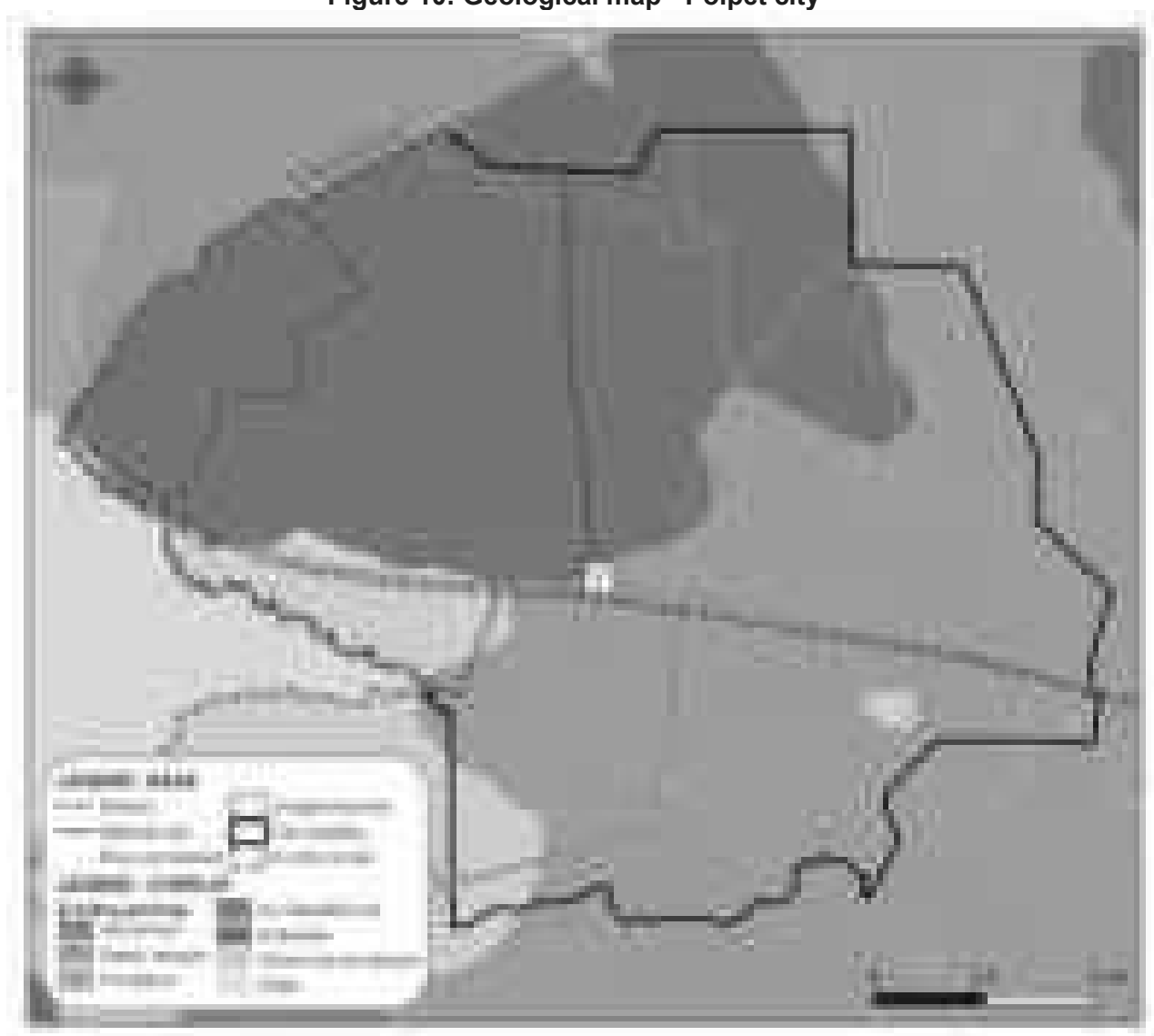
163. In the region of Poipet, the geological map of Cambodia displays quaternary sedimentary rock basement and unconsolidated sediments. There are three main types of substratum or layers around Poipet:

- (i) Pediments;
- (ii) Deltaic deposits;
- (iii) Terrace alluvial deposits.

164. A layer of alluvial fans is identified south of the city, and floodplains are encountered east and north of the city.



**Figure 10: Geological map - Poipet city**



Source: Egis, 2021

165. Soil sampling was realized during a field survey at the WWTP site (245681 E, 1503125 N) and landfill site (253507 E, 1513372 N). Based on laboratory results, soil can be classified as loam at the WWTP site and sandy loam at the landfill site.

**Figure 11: Soil sampling location map**



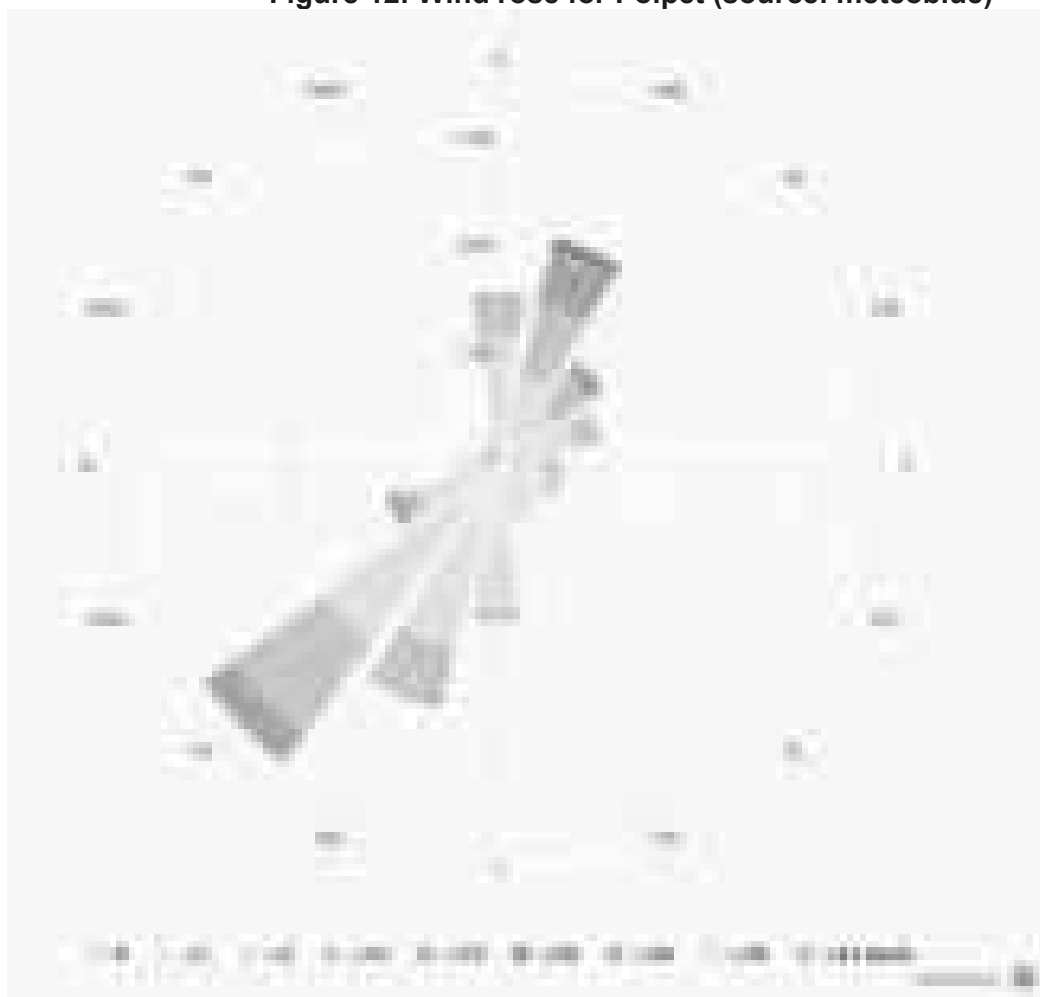
Source: Egis, 2021

### **3. Climate, Hydrology, Water Resources, and Water Quality**

#### **3.1. Climate**

166. The tropical monsoon climate of Cambodia has two distinct seasons: (i) the dry season, which lasts approximately from November to April and is associated with the northeast monsoon, providing drier and cooler air; (ii) the wet season, lasting from May to October and during which rainfall mostly comes from the southwest monsoon, drawn inland from the Indian Ocean and providing hotter air. The wet season accounts for 90% of annual precipitation. The two prevailing wind directions are from the southwest and from the north-northeast.

**Figure 12: Wind rose for Poipet (source: meteoblue)**



Source: Egis, 2021.

167. In lowland areas, annual rainfall ranges from 1,000 mm to 1,700 mm.<sup>19</sup> Daily cumulated rainfall height measurements and intensity-duration-frequency (IDF) curves were acquired from the Ministry Of Water Resources And Meteorology (MOWRAM) and show that every month from June to October, average rainfall height varies between 180 and 330 mm. For the rest of the year, the average monthly rainfall height stays below the 180 mm threshold.

168. The mean maximum temperature is 28°C, and the mean minimum temperature is 22°C. Maximum temperatures above 32°C are common before the start of the rainy season and may rise to more than 38°C. According to temperature data recorded at the meteorology station in Sisophon (2010-2012), which is approximately 45 km away, the average annual minimum temperature is 23.6°C, and the average annual maximum temperature is 32.3°C.

<sup>19</sup> GSSD 2015. Cambodia's Second National Communication Under the United Nations Framework Convention on Climate Change. General Secretariat, National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh.

### 3.2. Climate Change

169. Generally, climate modeling has been based on older generations of climate models released under the Climate Model Intercomparison Project (CMIP3) and using the IPCC3 Special Report on Emissions Scenarios (SRES) CO<sub>2</sub> scenarios. Climate change modeling reports that present data for Cambodia are summarized in Table 18. The Second National Communication released in 2015, did not provide any recent modeling results and relied on projections from earlier reports. The Climate Futures program of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) funded by Ausaid used 6 CMIP5 Global Climate Model (GCM) models and Representative Concentration Pathways (RCP) to create climate projections for Cambodia and Vietnam. The study produced downscaled projections from a Regional Climate Model with a resolution of 10 km, with six model runs based on inputs from each of the 6 GCMs. The CSIRO reports present maps of the average value of the projections from the six Regional Climate Model (RCM). Because of the higher resolution of the CSIRO RCM, where possible the results of the for RCP8.5 for the 20 year period centered on 2055 are used for projections presented below. Those projections are used for the design of the proposed infrastructure.

170. To provide more information on the range of individual GCM projections, results from the Royal Netherlands Meteorological Institute (KNMI) Climate Explorer Website are also presented. The Climate Explorer Website supported by the World Meteorological Organization, presents data from the latest CMIP6 models. The data consists of projections from a 13 ensemble of GCMs and is at the resolution of the original models with no downscaling (2.5° x 2.5° grid). Data was downloaded and compared to baseline of 2000 – 2020.

171. A discussion of the selection of projections to use for the design of project infrastructure is presented in section IV. 6 below.

**Table 18: Climate Change modeling discussed in this report.**

Report	Year Released	Model generation	No. Models	CO <sub>2</sub> future Scenario	Baseline
Second National Communication	2015	CMIP3	2	SRES A2	2002
Climate Futures Program, CSIRO (Ausaid)	2013	CMIP5	6	RPC8.5	1975-2005
KNMI. Climate Explorer (www.climexp.knmi.nl).	2021	CMIP6	13	SSP2 RCP4.5 SSP5 RCP8.5	2000-2020
SRES = CO <sub>2</sub> scenarios developed for the IPCC3 Special Report on Emissions Scenarios RCP = CO <sub>2</sub> Representative Concentration Pathways developed for IPCC5 SSP = Shared Socioeconomic Pathways developed for IPCC6 CMIP = Climate Model Intercomparison Project carried out for IPCC3, IPCC5 or IPCC6 CSIRO = Australian Commonwealth Scientific and Industrial Research Organisation KNMI = Royal Netherlands Meteorological Institute					

Source: Egis, 2021

#### 3.2.1. Temperature

172. Climate change models are very consistent in projecting an increase in temperature across Cambodia in the future. The projected temperature change for Poipet from CMIP6 GCMs

is shown in Table 19. The table shows the median and range of a 13 ensemble of GCM's projections of mean annual temperature anomalies relative to the mean climate of 2000-2020 under the two scenarios for three 20 year time periods. Average annual temperature for Poipet is projected to increase by 0.7 °C by 2030, by 1.5 °C by 2050 and by 3.8°C by the end of the century under RCP8.5. Projections for 2050 under RCP 4.5 are slightly less, with the difference much larger by the end of the century.

**Table 19: Range of Projected Mean Annual Temperature Change (°C) for the 5° x 2.5° cell containing Poipet Compared to the 2000-2020 model average under the SSP2 RCP4.5 and SSP5 RCP8.5 Scenarios from 13 Model Ensemble.**

Decade	2030			2050			2090		
Scenario	Min	Av	Max	Min	Av	Max	Min	Av	Max
SSP2 RCP4.5	0.2	0.6	0.9	0.7	1.2	1.8	0.9	2.0	3.4
SSP5 RCP8.5	0.2	0.7	1.0	0.6	1.5	2.5	2.2	3.8	6.3

Source. KNMI. Climate Explorer ([www.climexp.knmi.nl](http://www.climexp.knmi.nl)).

173. The projected change in seasonal temperature for Poipet from the CSIRO RCM downscaling for the period centered on 2055 compared to the period 1975-2005 under RCP8.5 is shown in Table 20. Temperature changes are projected to be relatively even across the year under RCP8.5.

**Table 20: Projected seasonal temperature change (°C) for Poipet for the period centered on 2055 under RCP 8.5 compared to the period 1975-2005.**

Parameter	Value
Mean Annual Temperature (°C)	2.1
April-May Temperature (°C)	1.8
June-September Temperature (°C)	2
October-November Temperature (°C)	2
December-March Temperature (°C)	2.1

Source. Katzfey, J., Jiao, X., Suppiah, R., Hoffmann, P., Nguyen, K. C. and Poun, S, Climate change projections for Monduliri and Koh Kong Provinces in Cambodia, 2013.

174. **Number of Hot Days.** Modeling carried out by the CSIRO presents projections of the number of days above 35°C which is a measure of potential heat stress conditions. The CSIRO modeling indicates that the number of days above 35°C is projected to increase from 25-30 days per year to over 50 days per year by 2050 under RCP8.5 and that the number of consecutive hot days will increase from <5 to over 25.<sup>20</sup>

### 3.2.2. Rainfall

175. The projected change in rainfall from climate models is much more variable than it is for temperature. The Second National Communication states that under the A2 scenario, annual

<sup>20</sup> Katzfey, J. et al, 2013. Climate change projections for Monduliri and Koh Kong Provinces in Cambodia.

rainfall for Cambodia in 2100 would increase between 3% and 35% from current rainfall (2015), depending on location, while under SRES B1 the increase would be smaller. The projected annual rainfall change for Poipet from an ensemble of 10 CMIP6 GCMs is shown in Table 21. The median projection for annual rainfall from the GCMs used in this study is for little change into the future. The projections for RCP4.5 are lower than for RCP8.5 with negative median projections from 2050 onwards under RCP4.5. With regards to the range of outputs, some models project a small decrease under most scenarios, while others project an increase.

**Table 21: Range of Projected Mean Annual Precipitation Change (%) for the 5° x 2.5° cell containing Poipet Compared to the 2000-2020 average under different Scenarios from 10 Model Ensemble.**

Year	Scenario	Min	25th	Av	75th	Max
2030	SSP2 RCP4.5	-3	-1	1	5	7
	SSP5 RCP8.5	1	2	2	5	8
2050	SSP2 RCP4.5	-3	-2	-1	1	6
	SSP5 RCP8.5	-3	0	3	5	9
2090	SSP2 RCP4.5	-4	-3	-1	2	10
	SSP5 RCP8.5	-7	1	2	5	6

Source. KNMI. Climate Explorer ([www.climexp.knmi.nl](http://www.climexp.knmi.nl)).

### 3.2.3. Extreme weather events and flooding

176. Typhoons making landfall on the coast of Vietnam often impact Cambodia as a tropical depression and can bring widespread heavy rainfall and subsequent flooding. There is a growing level of consistency between global climate models that on a global basis the frequency of tropical cyclones is likely to decrease by the end of the 21st century. A CSIRO report found that the majority of GCMs project that there will be a decrease in tropical cyclone formation off the coast of Vietnam. This is consistent with a previous study by Chand et al 2016.<sup>21</sup> There is also a general agreement between models that the trade off to the decrease in frequency is an increase in intensity of wind speeds of 1.3 m/s,<sup>22</sup> and an increase in rainfall rates of the order of 20% within 100 km of the cyclone center.<sup>23</sup> This indicates that extreme rainfall events that result from tropical depressions crossing Cambodia will decrease in frequency, but each event will bring more rain.

177. Table 22 shows the projected increase in extreme rainfall events from two sources, the KNMI website, and the CSIRO study. Both results are based on outputs from CMIP5 GCM data. The KNMI website presents GCM data in 2.5° x 2.5° pixels. Poipet is located on the boundary of two cells in the E/W direction, so the results were averaged for the 2 cells. The CSIRO study used CMIP5 models as an input to a 10 km x 10km pixel Regional Climate Model. Both studies found that 1 day extreme events are projected to increase in the future. The KNMI GCM data

<sup>21</sup> Chand, S.; Tory, K.; Ye, H. & Walsh, K. (2016), 'Projected increase in El Niño-driven tropical cyclone frequency in the Pacific', *Nature Climate Change* 7.

<sup>22</sup> Kang, N.-Y., and J.B. Elsner. 2015. Trade-off between intensity and frequency of global tropical cyclones. *Nature Climate Change*.

<sup>23</sup> Knutson, T.R., McBride, J.L., Chan, J., Emanuel, K., Holland, G., Landsea, C., Held, I., Kossin, J.P., Srivastava, A.K., and Sugi, M., (2010), Tropical cyclones and climate change: *Nature Geoscience*, v. 3, p. 157-163.

showed that climate models produced a wide range of projected changes. The mean projection of the change in mm from the ensemble used in the CSIRO study is similar to the KNMI data. The CSIRO median projection equates to 4%, while the KNMI median equates to 6%. For the 5 day extreme events, the CSIRO study projected an decrease in 5 day events of 10 mm. This is inconsistent with the projected changes in rainfall that will result from more intense tropical depression. However, because Poipet is on the western border of Cambodia, the models may reflect decreased decay of events as they pass across the country.

**Table 22: Projected change in extreme rainfall parameters (mm) for Poipet for the period centered on 2055 under RCP 8.5 compared to the period 1975-2005.**

Parameter	Value			
	BL	25th	Median	75th
Maximum 1-day rainfall (mm), KNMI, RCP4.5	90 mm	-30	5 (6%)	36
Maximum 1-day rainfall (mm), KNMI, RCP8.5	93* mm	-16	5 (5%)	59
Maximum 1-day rainfall (mm), CSIRO, RCP8.5	130 mm	-8	5 (4%)	69
Maximum 5-day rainfall (mm), CSIRO, RCP8.5	180 mm		-10	
<b>NOTES:</b> Both are based on CMIP5 models. The KNMI website presents GCM data in 2.5° x 2.5° pixels The CSIRO study used CMIP5 models as an input to a 10 km x 10km pixel Regional Climate Model. BL = Average of the model outputs for the baseline runs (1975-2005). * A different ensemble of models available				

Source. KNMI. Climate Explorer ([www.climexp.knmi.nl](http://www.climexp.knmi.nl)) and Katzfey, J. et al, Climate change projections for Monduliri and Koh Kong Provinces in Cambodia, 2013.

178. The MRC State of the Basin Report found no clear trend in the extent of flooding across the Mekong River Basin including Tonle Sap over the last ten years. However, the economic costs of flooding have shown an increase. The report also found no increasing or decreasing trend in the number of tropical storms over the same period<sup>24</sup>. The MRC basin-wide assessments of climate impact on flood behavior suggests that flooded areas might increase by between 4.6% and 27.3% by 2060 for floods of all return intervals.

### 3.2.4. Droughts and land degradation/salinity hazard susceptibility

179. The Mekong River Commission state of the Basin Report concluded that a droughts could potentially increase across the Basin in the future due to the projected increase in temperatures and changes in rainfall patterns.<sup>25</sup> The CSIRO modeling showed no change in the projected average duration of drought for the 20-year period centered on 2055 under RCP 8.5.<sup>26</sup> Additionally, their modeling projected a small decrease in the frequency of short 3 month long agricultural droughts which affect rice cultivation in Cambodia.

<sup>24</sup> The Mekong River Commission 2019. State of the Basin Report 2018. The Mekong River Commission, Vientiane Lao PDR.

<sup>25</sup> 25 The Mekong River Commission 2019. State of the Basin Report 2018. The Mekong River Commission, Vientiane Lao PDR.

<sup>26</sup> Katzfey, J.; Jiao, X.; Suppiah, R.; Hoffmann, P.; Nguyen, K. C. & Poun, S. (2013), 'Climate change projections for Monduliri and Koh Kong Provinces in Cambodia', Technical report, CSIRO, Australia.

### **3.2.5. Selection of Projections of Extreme Rainfall Event Increase for Design of Climate Proof Project Infrastructure**

180. In designing drainage for a city that is located on very flat terrain, one difficulty is allowing for enough fall to generate gravity flow and developing adequate drainage cross sectional area to cater to projected water volumes. A number of scenarios that considered the merits of designing the stormwater system for Poipet using a 1 in 2 year return frequency compared to a 1 in 5 year return period. The design storm intensity based on a 1 in 5 year return period is equivalent to a total rainfall of 108mm in one day. The one-day total rainfall for a 1 in 2 year event is 5% lower (79 mm). The comparison found a considerable difference in costs for infrastructure depending on which scenario was used. An additional consideration is that the new lines are connected to existing lines (GMS1) and so pipe sizing needs to be compatible with their capacities.

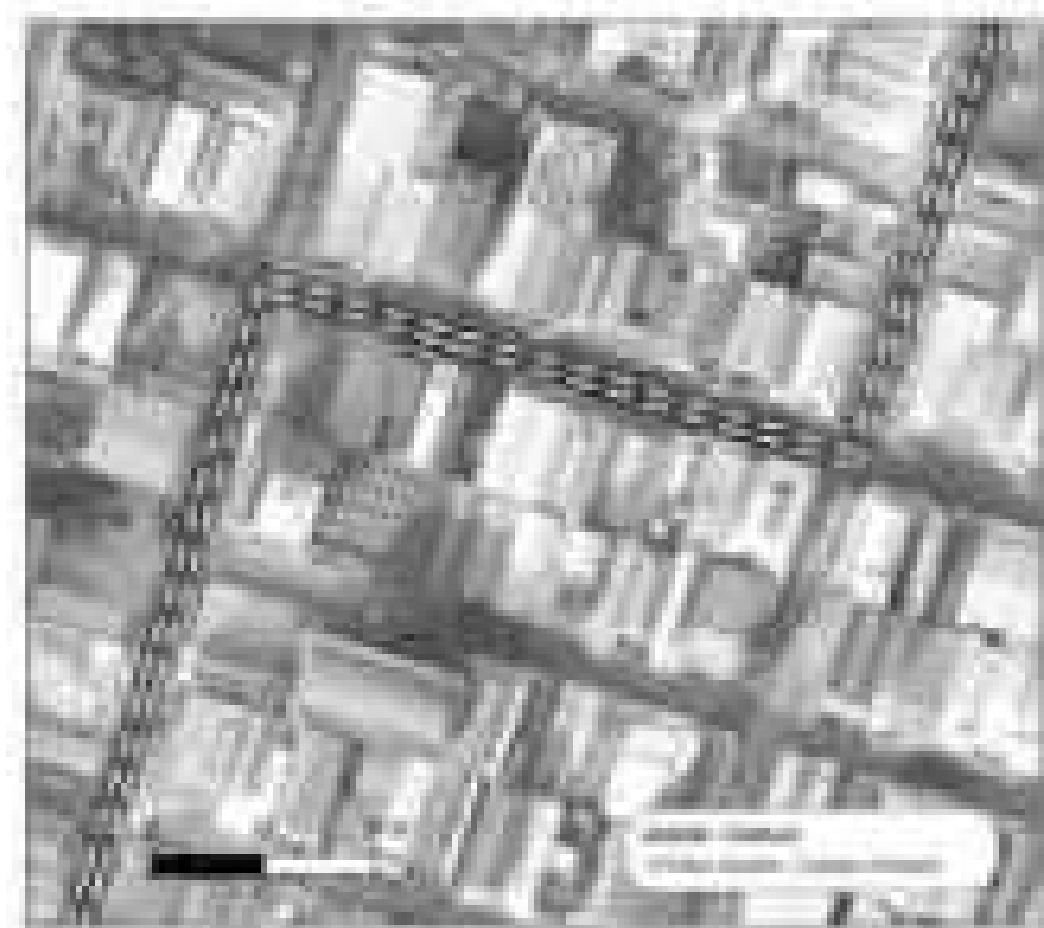
181. As there has been no clear trend in the number of storms or the size of extreme rainfall in recent decades across the Mekong River basin, it does not appear to be likely that there will be a large change in extreme event size in the next 10 to 20 years. Analysis of rainfall data from 1985-2019 indicates a (not statistically significant) increasing trend of 11.3 mm per decade the in maximum yearly rainfall. Projections for increases in typhoon intensity in the future are for an increase of 20% by the end of the century and this indicates that extreme rainfall events will increase in the future. The median projections from the modeling are for an increase of 4-5% between the baseline (2000 - 2020) and the modeled period (2045 - 2065) under the RCP8.5. Under RCP4.5, the median model projection is for a similar sized change.

182. Given the existing increasing trend and using the average projected change of the two data sources, it is recommended that each component of rainfall Intensity, Duration and Frequency (IDF) tables can be adjusted by the projected change as a percentage, i.e. 5% to determine projected rainfall conditions in 2040.

183. An additional impact of designing for a larger design storm intensity is that as the size of the cross sectional area increases, the amount of space required for the infrastructure also expands. Figure 13 shows critical open channel drainage infrastructure in Poipet with the corridor of impact. The available space provided by the road reserve and along the existing canal will be completely taken up by the recommended design (1 in 5 year event size 5% larger due to climate change). The design of the project has been carried out in an effort to reduce the displacement of landowners, under the proposed design, across Poipet there is no need for households to be relocated or have primary structures impacted, but 8 households will lose a proportion of their privately owned residential land. Using the median projected increase due to climate change means that it is still economically feasible to develop a climate change proof design based on a 1 in 5 year event.



**Figure 13: Detail of available road reserve for box culvert stormwater infrastructure in urban areas**



Source: Egis, 2021

### 3.3. Hydrology

184. Ou Chrov River is the main river. It is situated along the Cambodia and Thailand border; it is connected to Serei Sophorn River and flows into Tonle Sap Lake. The river is flooded during the rainy season by the floodwaters originating mostly from Thailand. Some parts of the river have no water during the dry season.

185. The main rivers and streams flowing in and around Poipet are illustrated in Figure 14, including the Ou Chrov River, the Ou Ansaong, and the Ou Stueng Bot:

- (i) Ou Chrov River;
- (ii) Ou Stueng Bot;
- (iii) Ou Neang Stream;
- (iv) Ou Pongro Stream;
- (v) Ou Ansaong Stream;
- (vi) Trapeang Ankrang Stream;
- (vii) Ou Chhik;
- (viii) Ou Pampan;
- (ix) Ou Samut;
- (x) Preaek Kamani;

- (xi) Ou Touch Stream;
- (xii) Ou Srae Tariv Stream.

**Figure 14: Poipet hydrological context**



Source: Egis, 2021

186. **Flood Prone Areas.** As part of the Comprehensive City Survey<sup>27</sup> (CCS) of specific vulnerable groups undertaken by the TRTA team, participants were asked to identify flood prone areas in the City. Additionally, any flooding evident during field visits by project staff were also noted. The current extent of the recorded flooding in and around Poipet is shown in Figure 15. The WWTP site has been identified as being at low risk of flooding, with a seasonal flood level of less than 0.5 meters. Both the existing landfill site and the identified alternative location have been assessed as not subject to flooding.

**Figure 15: Flood Prone Areas in Poipet City Identified from CCS Focus Groups and Field Investigations**



Source: Egis, 2021

### 3.4. Water Resources

187. Ou Chrov River is used for irrigation and animal feeding. The communities far from the city use water from ponds and wells because there is no water supply in their areas. Most of the stormwater and sewage in Poipet town and the Thailand border is drained into the Ou Chrov River, making the water undrinkable.

<sup>27</sup> Comprehensive City Survey, TRTA/Egis Dec.2019

188. Poipet is serviced entirely by surface water. Two floating pumping stations (42,500 m<sup>3</sup>/day) are settled on Ou Chrov River, close to the international border with Thailand. See the chapter “Water supply,” page 66, for additional information. A derivation of this river fills a water impoundment, Ou Kaidon Reservoir, solicited mostly during the dry season (volume unknown, a surface area estimated between 583 to 956 ha depending on the season).

### **3.5. Water Quality**

189. The quality of freshwater and coastal water in Cambodia is good compared to other regions of Southeast Asia. However, the increasing industrial development, intensive agriculture, and deforestation is reducing the quality of surface waters in different areas of the country due to untreated effluents, land erosion, and agricultural chemicals.<sup>28</sup>

190. Cambodia has national water quality standards (see chapter on National and International Environmental Standards).

191. There is currently no data on the raw water. There is concern that the upstream water catchment, across the Thai border, maybe contaminated by some anthropogenic source. Based on the treated water quality test results of October 2019, three among the six parameters tested were not compliant with exceedances on low pH, color, and residual chlorine. This raises operational concerns on the effectiveness of the water treatment plant.

192. A specific survey of surface and groundwater has been carried out in September 2020 in water bodies in the vicinity of studied areas (WWTP and landfill sites, see Figure 16, including two surface water samples and three groundwater samples. The groundwater sampling were taken from borehole well with 30-40m depth<sup>29</sup> at the landfill area and 30m depth at WWTP area. The results are presented in Table 27 below.

---

<sup>28</sup> Ministry of Tourism, Cambodia. Initial Environmental Examination. Kingdom of Cambodia: Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project - Kampot and Kep Provinces. March 2014.

<sup>29</sup> Responded by well owner to water quality survey team (KCC), September 2020

**Figure 16: Sampling location map of water quality examination**



Source: Egis, 2021

193. The results show that surface waters are affected by anthropogenic pollution sources (oil and grease). Iron concentration of the groundwater is slightly high compared to the national standards. The pollution source has not been identified at the WWTP area. Whereas, in the future landfill area, the existing dumpsite might be the main factor contributing to pollution of the groundwater. The total coliforms are higher than national standard of the public water area of Cambodia, and traces of E. Coli have been measured. The main source of total coliform and E. coli are fecals of humans and animals. This result might cause the environment surrounding water sources such as the existing dumpsite with high organic waste to contribute to water quality. The wetland forest and agricultural field might also contribute to the increasing bacteria in the water.

**Table 23: Results of water quality examination**

No	Parameter	Unit	National Standard for lakes and reservoirs	National Standard for groundwater	surface water quality		groundwater quality		
					LF_SW	WWTP_SW	LF_GW1	LF_GW2	WWTP_GW
1	pH	-	6.5 - 8.5	6.5 - 8.5	7.09	6.93	6.75	6.79	6.66
2	Electrical Conductivity (EC)	µS/cm	-	-	104.4	316.0	715	512	710
3	Dissolved Oxygen (DO)	mg/L	2 – 7.5	-	6.7	6.9	-	-	-
4	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	< 30	-	5.89	4.87	-	-	-
5	Chemical Oxygen Demand (COD)	mg/L	1 - 8	-	9.46	7.82	0	0	0
6	Carbonate (CO <sub>3</sub> )	mg/L	-	-	0	0	0	0	0
7	Bicarbonate (HCO <sub>3</sub> )	mg/L	-	-	41.15	87.92	407.19	278.21	382.95
8	Calcium (Ca)	mg/L	-	-	9.26	21.42	36.46	70.83	48.10
9	Magnesium (Mg)	mg/L	-	-	1.16	2.67	22.75	19.36	31.26
10	Sulphate (SO <sub>4</sub> )	mg/L	< 300	< 250	12.18	17.35	5.83	7.20	17.03
11	Chloride (Cl)	mg/L	-	< 250	6.79	38.80	1.35	1.34	1.33
12	Sodium (Na)	mg/L	-	-	9.20	28.72	7.89	6.75	8.13
13	Potassium (K)	mg/L	-	-	2.34	7.85	2.62	2.19	2.65
14	Nitrite (NO <sub>2</sub> )	mg/L	-	-	0	0	-	-	-
15	Total Nitrogen (TN)	mg/L	0.1 – 0.6	-	1.144	0.717	0.074	0.06	0.221
16	Total Phosphorus (TP)	mg/L	0.005 – 0.05	-	0.023	0.016	0.001	0.002	0.001
17	Iron (Fe <sup>2+</sup> )	mg/L	-	-	0.001	0.002	-	-	-
18	Iron (Fe <sup>3+</sup> )	mg/L	-	-	0.3	0.23	-	-	-
19	Oil & Grease	mg/L	< 5	-	7.4	6.1	-	-	-
20	Cadmium (Cd)	mg/L	< 0.001	< 0.003	0	0.0047	-	-	-
21	Arsenic (As)	mg/L	< 0.01	< 0.05	0	0.0011	0.0009	0.001	0.0018
22	Total Dissolved	mg/L	< 1,000	< 800	-	-	365.2	256.1	351.5

No	Parameter	Unit	National Standard for lakes and reservoirs	National Standard for groundwater	surface water quality		groundwater quality		
					LF_SW	WWTP_SW	LF_GW1	LF_GW2	WWTP_GW
	Solid (TDS)								
23	Nitrate (NO <sub>3</sub> )	mg/L	-	< 50	-	-	0.24	0.03	0.04
24	Ammonia (NH <sub>3</sub> )	mg/L	-	-	-	-	0.02	0.01	0.01
25	Iron (Fe)	mg/L	< 1	< 0.3	-	-	0.26	0.31	0.21
26	Mercury (Hg)	mg/L	< 0.0005	< 0.001	-	-	0.00011	0.00009	0.00016
27	Manganese (Mn)	mg/L	-	< 0.1	-	-	0.0037	0.004	0.0047
28	Chromium (Cr)	mg/L	-	< 0.05	-	-	0.0076	0.0075	0.0087
29	Total Coliform	MPN/100mL	< 1,000	0	-	-	0	0	0
30	E.coli	MPN/100mL	-	0	-	-	0	0	0

Source: Baseline environmental survey by TRTA-KCC, September 2020

#### 4. Ecology, Wilderness Values, and Protected Areas

194. There is one protected area in the Banteay Meanchey Province, located approximately a hundred kilometers away from Poipet: the protected forest of Ang Trapaing Thmor.

195. Results of the proximity report from the IBAT data analysis (see appendices) confirms that neither protected areas nor key biodiversity areas are in the vicinity of the study area. Among the 132 species listed in this report, belonging to the IUCN Red List, 17 are identified as Critically Endangered and 34 as Endangered. Although this data source is useful, precautions should be taken: among the species listed are marine species (Great Hammerhead, Bowmouth Guitarfish) that may not be present in the project study area.

196. The dominating landscape in the Poipet area is agricultural, accompanied by urban land use. Given extensive deforestation and expansion of agricultural activities, there is no forest vegetation in the projected WWTP and landfill locations.

197. A small number of bird species have been observed, including the white heron, dove, wood-sparrow, common moorhen, and sarus crane, at the Ou Kaidon Reservoir (around 4 km from the edges of the urban area). Some fish species (catfish, *hermibagrus*, *mystus rhegma*, *micronema cheveyi*) are present in the Ou Chrov River and in the rice fields during flooding. No rare or endangered species of aquatic flora or fauna are recorded.

198. **Flora.** Regarding local flora, a field survey in September 2020 identified:

- (i) At the WWTP site: 11 different species and 11 families. They are common species in the local status, except for *Pterocarpus pedatus*, which is listed in Endangered (En) species of IUCN red list 2020: three trees were identified in the same area more than 500m from the site perimeter.
- (ii) At the landfill site: 11 different species, and 9 families. They are common species in the local status, except for *Pterocarpus pedatus*, which is listed in Endangered (En)

species: one tree in the vicinity of the landfill site, and Least Concern (LC) species of the IUCN red list 2020, *Microcos tomentosa*, *Bombax ceiba*, *Azadirachta indica*, and *Streblus asper*.

199. **Mammals and Birds.** The presence following species was confirmed by the survey:

- (i) At the WWTP site: one mammal species listed as Vulnerable in the IUCN red list, the Long-tailed macaque *Macaca fascicularis*; four bird species that are also listed as Vulnerable, Wreathed Hornbill *Rhyticeros undulates*, Great Slaty Woodpecker *Mulleripicus pulverulentus*, Coral-billed Ground-cuckoo *Carpococcyx renauldi* and Lesser adjutant *Leptoptilos javanicus*; and four Near Threatened species that are the Red-collared Woodpecker *Picus rabieri*, White-rumped Pygmy-falcon *Polihierax insignis*, Blossom-headed Parakeet *Psittacula roseate* and Alexandrine Parakeet *Psittacula eupatria*;
- (ii) At the landfill site: two species, Coral-billed Ground-cuckoo *Carpococcyx renauldi* and Lesser adjutant *Leptoptilos javanicus*, that is listed as Vulnerable in the IUCN red list; and three species listed as Near Threatened in the IUCN red list, White-rumped Pygmy-falcon *Polihierax insignis*, Blossom-headed Parakeet *Psittacula roseate* and Alexandrine Parakeet *Psittacula eupatria*.

200. It is to be noted that during the field survey, the experts did not observe all of these species directly: a villager (a 56-year-old man resident near the projected WWTP site) reported the presence of some of them to the experts during an interview, and particularly of the Long-tailed macaque. According to the consultation with bird experts (Mr. Hong Chamnan, freelance biodiversity consultant and Mr. Bou Vorsak, previously from BirdLife International), additional surveys should be done during the domestic EIA process.

201. **Amphibians and Reptiles.** The inventory of herpetofauna revealed:

- (i) At the WWTP site: a total of 15 herpetofaunal species, none of which are listed as threatened species;
- (ii) At the landfill site: a total of 11 herpetofaunal species, none of which are listed as threatened species.

202. The reptile species can live in varied habitats to keep their population stable, and most amphibian species are common to shrubland, agricultural areas, and ponds around the village.

203. **Bats.** Both at the WWTP and landfill sites, few bats are present, possibly as a consequence of the use of pesticides for rice and vegetable crops.

## 5. Human and Socio-Economic Resources

### 5.1. Population

204. At the time of the population census of 2018, 104,156 people lived in Poipet, making it the fourth most populous settlement in Cambodia, just ahead of Sihanoukville and larger than its provincial capital Serei Saophoan. The closest houses to the LCIP project sites were identified and are listed in Table 26, page 75. No house is located nearby (within 300m) the landfill and the WWTP sites.



## 5.2. Poverty Impact and Social Dimensions

205. Between the 21<sup>st</sup> December 2019 and the 15<sup>th</sup> of January 2020, a Comprehensive City Survey, was carried out in Poipet. A total of 692 households were surveyed. This sample size guarantees a minimum of 95% confidence level with a 5% margin of error.

206. The households present the following socioeconomic status:

- (i) 73% of the household heads are males;
- (ii) 70% of the Survey respondents are women;
- (iii) 97% are married or widow/er;
- (iv) The households are on average, constituted of 5.2 persons;
- (v) The average income of the household is \$460;
- (vi) 15% of the respondents did not attend primary school. 13% continue in High School;
- (vii) 40% of the family are living in their house for less than ten years.

207. The informal/temporary housing/shelters are mainly located downtown. Low income and disadvantaged people may need special assistance to benefit equitably from new infrastructure.

## 5.3. Gender and Development

208. Women generally have a higher risk and health exposure as the primary contributors toward household and community sanitation tasks.

209. Women are the main users of water in the households who are also primarily responsible for solid waste, liquid waste, and wastewater management on the household level. Water shortages also significantly increase the time needed for cooking, cleaning, and caring for both children, the sick and disabled members. In addition, women who work in kindergarten, schools, and hospitals bear the responsibility to fetch water and clean the toilets. A lack or low quality of potable water and sanitation also increase the incidences of water-borne diseases and thus households' expenditures on medicine and doctors' fees.

## 5.4. City Economic Conditions

210. **Employment.** In 2018, 64.10% of the population, aged from 18 to 60, were employed. The employed population of those with the main occupation<sup>30</sup> increased by 20% from 2012 to 2018. An increasing trend from 2012 to 2015 was observed, but this was followed by a decline in 2016 before increasing again from 2017 to 2018. In 2018, 16% of the population was working in the agricultural sector, 71% in the service sector, and 13% in the industry sector.

211. **Agriculture.** Agriculture is a dynamic sector in Poipet, with agricultural land accounting for a total of 21.40 km<sup>2</sup> or 77.40% of the city's total land area.

212. **Services.** The opening of the cross-border trade in 1991<sup>31</sup> has enabled the growth in trade activities and a growing influx of worker migrants into the area. Service-oriented activities

<sup>30</sup> Principal work or means of earning a living as defined in the yearly City Socio-Economic Status report.

<sup>31</sup> Cross-border trade was formalized in 1993 with the opening of the Customs Office.

have, therefore, expanded. Major accommodation in the city consists of two hotels and three guesthouses along with five casinos.

213. **Tourism.** The cross-border activity has made Poipet grow larger than its provincial capital, Serei Saophoan, in terms of a number of visitors and population. In 2017, the Poipet border checkpoint recorded 613,094 tourists, which represents approximately 10.9% of the total international tourists entering Cambodia.<sup>32</sup> A planned second checkpoint (Stung Bot International Checkpoint) is targeted for completion by 2020. Between 2014 and 2019, the number of provincial tourists in the area increased, except during the period 2016-2017 where it dwindled by 138,071 (10.98%).

214. **Industry.** Given the competitive labor costs, the cheap and stable electricity supply from Thailand (\$0.16 per kilowatt), the proximity to Bangkok, and the favorable investment policy providing incentives, Poipet is seen as a future industrial city of the northwestern part of Cambodia. Currently, there are two major Special Economic Zones (SEZs), which are both located on the Psar Kandal village. The first is Sanco Cambo, established in 2014 and specialized in the production of hard-disks, car-seats, and cars. It counted 1,964 employees within its ranks in 2017. The second is Poipet O'Neang; it was established in 2006, had a workforce of 4,589 in 2017, and produces jewelry packages. About 216 employees work for small to medium industries outside the SEZs (located in Sangkat Nimit and Village Phsar Kandal). These areas are marked as proposed industrial areas and SEZs in the Poipet Land Use Plan and are currently at the planning stage.

215. **Markets.** The city counts four large markets/trading centers and nine small markets. The markets comprise 284 stalls and 130 shops.**Error! Bookmark not defined.**

## 5.5. Social Infrastructure

216. **Health.** The town has one referral hospital, four health centers, and one health post to provide medical and health services to the local residents, complemented by 78 private clinics and pharmacies. The key health strategy in the City 5-Year Development Plan pertains to access to clean water and sanitation, citing that not all families have access to clean water supply systems and sanitary toilets.

217. **Education.** In 2018, there were 38 state primary schools. Given 8,802 students and 146 teachers in the state primary schools, the ratio of students to teachers in state primary schools is 60:1. There were nine state secondary schools with 65 classrooms in Poipet. With 2,670 students and 81 teachers in the state secondary schools, the ratio of students to teachers is 33:1. In five high schools with 33 rooms, there were 63 teachers for 611 students, corresponding to a ratio of approximately 10:1. These student-teacher ratios are above the international average ratio of 1 teacher for 23 students, except for the high school level.<sup>33</sup> In line with the policies and plans of the Provincial Department of Education, Poipet City prioritizes education as the key to develop human resources and as a poverty reduction measure by constructing new schools and providing clean toilets in schools that lack this sanitary facility.

218. **Social Welfare and Vulnerable Persons.** In 2018, there were 612 vulnerable people and 294 people with disabilities aged over 18 years old, among whom 154 had no income.

<sup>32</sup> Government of Cambodia, 2017. Annual Tourism Statistics Report. Phnom Penh.

<sup>33</sup> <https://data.worldbank.org/indicator/>. Retrieved on 18/12/2019.

There were 101 elderly persons, 78 in Sangkat Poipet, 13 Sangkat Phsar Kandal, and 10 in Sangkat Nimitt. There were 18 homeless people, 16 were from Sangkat Poipet and 2 in Sangkat Phsar Kandal. The proportion of vulnerable persons is 5.88 per 1000 people in Poipet City. There were 482 persons with disabilities; 117 were in Sangkat Poipet, 179 in Sangkat Phsar Kandal, and 186 in Sangkat Nimitt.

219. **Public Open Space and Recreational Facilities.** Very limited and poorly landscaped green open spaces are found near the railway track in Sangkat Poipet, schools, and pagoda vicinities in the villages.

## 5.6. Governance

220. Articles 145 and 146 in the Constitution, promulgated in 1993 (as amended), stipulated the territorial divisions of the local administration in Cambodia. Article 145 stipulates that the Cambodian territory is divided into provinces and municipalities. Below that, provinces are divided into districts, and districts are divided into communes, whereas the municipalities are divided into khans, and the khans are divided into Sangkat.

221. Article 146 provides that provinces/municipalities, districts/khans, and communes/Sangkat shall be governed by the provisions of the 2008 organic law.

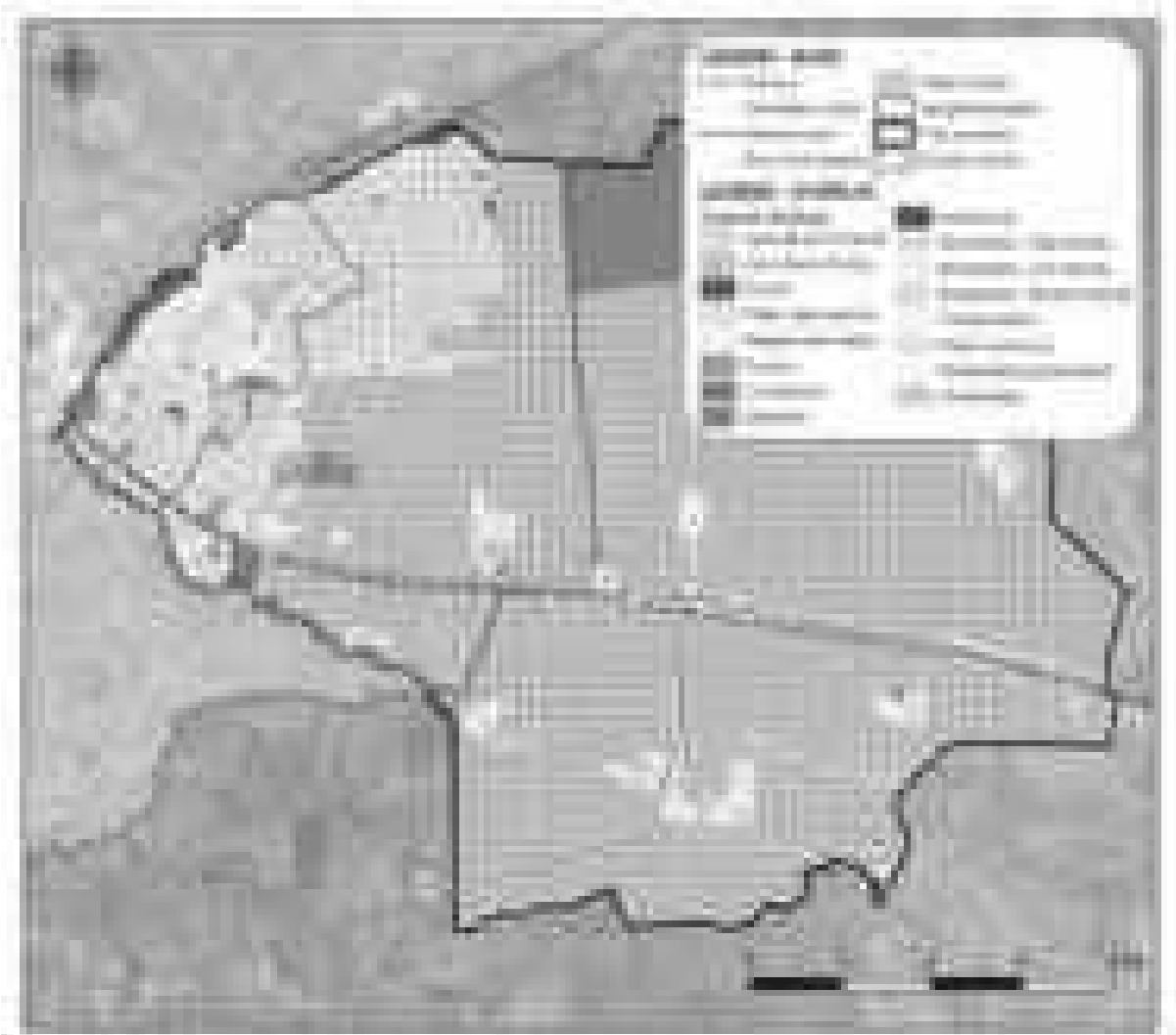
## 5.7. Land Use

222. In 2018, agricultural land use represented the biggest portion of the city at over 80%; followed by urban use at 15% (of which residential represents 8%, industrial 5%; commercial 1% and transport 3%), water 1%, natural forest 1.47% and open space 0.07%.

223. Informal and ad hoc settlements are found on the urban fringes. Based on the City 5-Year Development Plan, there were 21,956 households (6%) residing on public land with limited access to public utilities.

224. The land use around Poipet can be classified as built-up, farming, grassland, or forest areas.

**Figure 17: Current land use in Poipet City area**



Source: Egis, 2021

### **5.8. Transport Infrastructures**

225. **Providers.** The MPWT is the main responsible agency for the provision of roads and transport infrastructure.

226. **Access to Services.** Poipet is accessible by rail and by road through the National Road (NR) 5 and NR 59. As of December 2019, the majority of the city roads have a gravel surface, need upgrading, and have average daily traffic inferior to 500 vehicles per day. During rainy conditions, these roads are barely passable for even four-wheel vehicles and motorbikes.

227. **Service Quality and Consistency.** NR 5 is accessible to vehicular traffic with a varied time of congestion. During the project preparation (until November 2020), the railway system is

not operating due to rail maintenance activities.<sup>34</sup> In addition, recent floods and the COVID-19 pandemic have to lead to traffic interruption at the border. The date for a new start is not known yet. Congested public bus terminal and fragmented bus terminals of private bus operators are found along NR 5 and many other parts of the City.

228. **Institutional Arrangements.** National roads are under the MPWT, while roads within the city and the whole province are under the Provincial Department of Public Works and Transport (PDPWT). The Department of Railway under the MPWT-General Inspectorate is the agency responsible for the railway system in the country. The Royal Railway Co. Ltd. is a private company contracted to operate the railway system for both passenger and freight services.

229. **Financial Status.** The service is financed by the public sector through the national budget allocations (at the provincial or municipal level) or by financial and technical partners of Cambodia through specific projects.

230. **Bus Services.** All three bus services/terminals operating in Poipet are managed by the private sector; one is a small terminal providing passenger bus services, another terminal is for cargo and freight, and the third terminal operates international/cross border services for passengers and goods. On average, 800 passengers and tourist buses travel daily between Poipet, Siem Reap, and Phnom Penh.

231. **Dry Port.** A dry port and a loading facility are located along NR 5, leading to the city center. However, the facilities and area of less than 2 ha are inadequate to deal with the increasing volume of traffic and container trucks. In addition, disruption of traffic flows occurs along NR 5 when container trucks and heavy vehicles park on either side of the road; therefore, the municipal authority plans to transfer the site.

## 6. Cultural Heritage and Physical Cultural Resources

232. Few cultural monuments are found in the city, and cultural heritage is mostly represented by pagodas. Archeological sites are not recorded in this agrarian zone, and new potential site discovery is limited, as terrains are largely reworked by farmers.

233. During the field survey, no cultural heritage places were found in the 300 m buffer zone of the project areas.

## 7. Noise

234. In the outskirts of the city, the acoustic ambiance is relatively calm: the suburbs east of the city center is dominated by agricultural fields and forests. However, this area is also crossed by the railway and the national roads NR 5 and NR 59; therefore, calm can be disrupted along these infrastructures. The heart of the city provides a noisier background, with its urban-life activities, markets, as well as the night-life of casinos.

---

<sup>34</sup> The system operates from Phnom Penh up to Serei Saophoan and is scheduled to proceed up to Poipet in early 2020.

235. During the field survey, noise level measurement has been conducted at the WWTP site and four houses close to it, at the landfill site and four houses close to it, as well as at two pumping stations (see Figure 1). The results are presented in the Table 24 and they indicate that there is no concern about noise disturbance around the landfill area, the WWTP area and the pumping stations in their current configuration.

**Table 24: Results of noise measurement**

Location	Standard $L_{eq}$ (dB (A))	$LA_{eq}$ (dB (A))	$L_{max}$ (dB (A))
Noise_LF (landfill)	70	44.5*	61.4*
Noise_LF_H1	70	44.2	59.7
Noise_LF_H2	70	47.2	62.1
Noise_LF_H3	70	41.4	64.3
Noise_LF_H4	70	39.7	56.3
Noise_WWTP	70	44.0*	58.8*
Noise_WWTP_H1	70	44.1	57.0
Noise_WWTP_H2	70	46.0	63.3
Noise_WWTP_H3	70	41.4	59.3
Noise_WWTP_H4	70	42.1	59.3
Noise_mainpump	70	44.1	61.4
Noise_liftpump	70	45.5	64.7

\*Average over 8 hours

**Figure 18: Location map of Noise and Air quality measurement**



Source: Egis, 2021

## **8. Air Quality**

236. Poipet City is located in relatively flat area open to winds and dominated by agricultural fields and forests. Industries are not prevalent, and transport traffics is not sufficiently intense to cause a high level of pollution emissions. Thus air can be considered to be of good quality in the Poipet territory.

237. Recurring and generalized waste burning are observed in Cambodia. This practice induces air pollution by releasing dust and fine particles, and it is also a source of odor nuisance.

238. During the field survey, the air quality has been measured at the landfill site, Figure 29, and the results are described in the Table 25. The result of air quality measurement conducted at the landfill site indicates that all the parameters are below the standard of MoE. Hydrogen sulfite and ammonia were not detected.

**Table 25: Air quality at the landfill site**

No	Parameters	Unit	Result	Standard
1	Carbon Monoxide (CO)	mg/m <sup>3</sup>	0.97	<20 (8 hours)
2	Nitrogen Dioxide (NO <sub>2</sub> )	mg/m <sup>3</sup>	0.010	<0.1 (24 hours)
3	Sulfur Dioxide (SO <sub>2</sub> )	mg/m <sup>3</sup>	0.016	<0.3 (24 hours)
4	Total Suspended Particles (TSP)	mg/m <sup>3</sup>	0.058	0.33 (24 hours)
5	PM10	mg/m <sup>3</sup>	0.028	<0.05 (24 hours)
6	Hydrogen Sulfite (H <sub>2</sub> S)	mg/m <sup>3</sup>	ND	<0.001
7	Ammonia (NH <sub>3</sub> )	mg/m <sup>3</sup>	ND	<0.2

Source: Egis, 2021

## 9. Water Supply

239. **Providers.** Water supply in the city is operated by ANCO Water Supply Company Ltd., a private company with an authorization license from the Ministry of Industry and Handicraft (MIH) (2017-2037). ANCO is responsible for producing and providing clean and drinkable water to Poipet City.

240. **Water Resource.** Poipet is entirely reliant on surface water. Two floating pumping stations are settled beside a meander of the Ou Chrov River, downstream from Poipet City.

241. **Access to Services.** The piped water supply is available for 51% of the population, but only 36% is connected to it, mainly for economic reasons. Due to the cost of water, only 1% use it as the main source of drinking water<sup>35</sup>. Some of the people connected to the piped water supply prefer to use their own borehole and use the piped water supply only during electricity cuts<sup>36</sup>. The average consumption is from 6 to 10m<sup>3</sup>/mont.h<sup>35</sup>. The survey respondents complained about the price deemed too expensive (47%), the poor quality of the drinking water (52%), the poor service water pressure (18%), the lack of customer services (3%). 32% of the users are satisfied by the service provided. The connection fee to the ANCO water network is \$200 to \$300 depending on the area, and the cost of water consumption is \$0.5/m<sup>3</sup>.<sup>35</sup>

242. 70% of the population has its own borehole<sup>36</sup>, but only 9% use the water from it as the main source of drinking water<sup>35</sup>. When used to drink, the borehole water is always treated<sup>36</sup>. 93% of the population treat it daily, 6% weekly, and 1% monthly<sup>35</sup>. 67% of the population boils the water before drinking it, and 33% use a filter.

243. The accessibility of bottled drinking water is good in Poipet. Even in remote villages, 20L bottles can be found in small grocery shops. It costs around \$0.5 to fill the 20L container. In some villages, organizations (i.e., KAMA) are distributing water tanks once a week.

244. **Water Treatment Plant (WTP).** Two plants operate on the same site. The current operation rate shows a total of 30,500 m<sup>3</sup>/day. The treatment consists of a typical surface water process, with a final chlorine disinfection stage and letting to the underground tanks (2,500 m<sup>3</sup>).

245. **Distribution Network.** The distribution network was 315km long in 2019 (diameter between 50 and 400 mm), mainly in HDPE. The global coverage was 55% in 2019 (12,349 connections). Non-revenue water was 15.7% in September 2019. The global ratio is around 1,670 to 1,780L/day/connection, including casinos and SEZ factories' needs.

<sup>35</sup> Comprehensive City Survey (CCS), Egis 2019.

<sup>36</sup> Focus Groups Discussions.



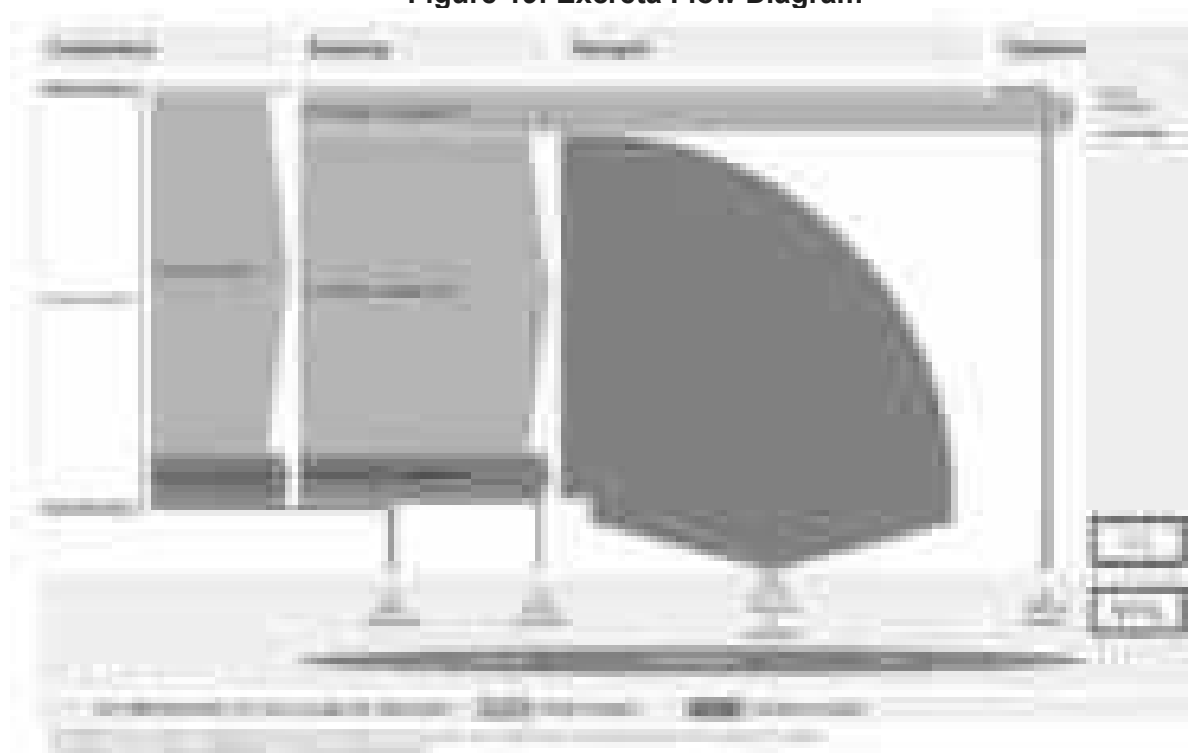
246. **Institutional Arrangements.** The MIH plays an important role in i) preparing policies, strategies, guidelines, and regulations related to the potable water sector; ii) developing technical standards or norms for potable water production and supply.

2 **Financial Status.** The water supply service is financed by a user-pay arrangement, and billings are issued and collected by ANCO from end-users. The tariff guidelines are in its contract and approved by the MIH ( $\approx 2,000$  Riel / m<sup>3</sup>).

## 10. Wastewater Management

3 It is estimated that 91% of the excreta generated in Poipet is not safely managed.

**Figure 19: Excreta Flow Diagram**



Source: Egis, 2021.

247. **Toilets.** Flush and pour-flush toilets are the most prevalent sanitation technology in Poipet.

248. Based on the comprehensive city survey, approximately 2% of the population are still practicing open defecation. This number rises to 10% in some villages (e.g., Kilou Lek). The people practicing open defecation have been identified into two categories. Some are temporary workers who cannot afford to pay for the use of public toilets, which are located in the market area and costs \$0.12 per use. The other category is composed of the villagers in remote villages. Due to the wide spaces (manly paddy field) and due to their low income, open defecation is also an encountered practice (i.e., 7% in Nimit Village).

249. The hotels and restaurants located along the NR 5 mostly have flush toilets.

250. Sharing of sanitation facilities is also an important consideration given the negative impacts on dignity, privacy, and personal safety, especially for women and girls.<sup>37</sup> It has been estimated that 6%<sup>35</sup> of the surveyed population share their facility with others who are not members of their household. For most of them, the principal reason is financial.<sup>36</sup>

251. **Containment.** 90% of the population in Poipet has an onsite sanitation containment. The most common type is a tank made of cylindrical concrete rings stacked on top of the other. The rings used are 0.5 m high and 1 m in diameter.

252. 56% of the containments don't have an outlet of overflow pipes. Approximately 9% of the containment overflow pipes are connected to drainage along the roads. 5% have their overflow pipe leading to the open ground around the tank.

253. The majority of the containments are considered semi-impermeable (two holes on the side of each cylinder and no sealed junctions between each cylinder) with an open bottom and a depth of 1.5-2 m on average. 30% of those containments are connected to one or two other identical tanks.<sup>36</sup>

254. Hostels in Poipet's center mainly use the same type of containment with higher volume.

255. Inadequate sanitation is closely associated with diarrheal diseases, which exacerbate malnutrition and remain a leading global cause of child deaths, as well as parasitic infections such as soil-transmitted helminths (worms) and a range of other neglected tropical diseases.<sup>37</sup>

256. NGOs are providing sanitation facilities in Poipet. Free of charge, the inhabitants obtain a pour flush toilet and the four rings to build the containment. One of them is Nirmal Bharat Abhiyan (NBA) that is working in Poipet since 1999.

257. **Emptying and Transport.** 30% of the population emptied its sanitation containment at least once. 26% of them hired a pump truck to empty and transport the fecal sludge, while 4% did it manually.<sup>35</sup> When emptied manually, the sludge is most of the time dumped onto a paddy field or to a water body. A properly designed tank takes on average three to five years to be filled up (WaterAid, 2018).

258. Two emptying companies are providing emptying services in Poipet City. The first one started 30 years ago and has a single vacuum truck of 5 m<sup>3</sup>. The high season for emptying is during the rainy season. At this period, they sometimes empty two to three tanks per day. The average emptying frequency is around five tanks per week.<sup>38</sup> The second company started its business in 2017. It covers all the area of Poipet (including household and industry), except for the Psar Kandal commune. They provide on average 10 emptying service per month, but this number increases during the rainy season. Currently, the company has five vacuum trucks, including two big trucks (15 m<sup>3</sup>) and medium trucks (5 m<sup>3</sup>)—the price for emptying around KHR30,000 (\$7.5) per cylinder.

---

<sup>37</sup> Joint Monitoring Programme (JMP) sanitation assessment in Cambodia, 2018.

<sup>38</sup> KII – Emptying Companies

259. **Treatment.** While access to a hygienic toilet facility is essential for reducing the transmission of pathogens, it is equally important to ensure safe treatment and disposal of the excreta produced.<sup>37</sup>

260. There is no WWTP operating in Poipet.

261. For both pit emptying companies, approximately one-third of the fecal sludge is sold to farmers and used as a fertilizer. One full truck can be sold for approximately \$10. Dumpsites are never used for disposal due to the fees applied. The remaining part is illegally dumped in unknown locations.

262. Approximately 9% of the population relies on its own boreholes for drinking water supply. Due to the low proportion of groundwater as the main source of drinking water (for less than 25% of the population), the risk of groundwater contamination can be estimated as a “low risk.”<sup>39</sup>

263. Therefore and in rural areas only, the fecal sludge not emptied from the containment systems could be considered as treated in-situ and thus safely managed.

264. **SEZ Sanitation Assessment.** CCI SEZ (Sanco Cambo SEZ) accounts for about 7,000 workers. The toilets in the SEZ are managed by each factory. All the toilets are flush toilets. Each factory has a large tank of 5 m<sup>3</sup> or more, in plastic and round shaped. Those tanks act as septic tanks, separating the fecal sludge from the supernatant. When full, the sludge is pumped out of the tank by private emptying companies. The wastewater from the septic tank is flowing to the public drainage network. The tank will be emptied and pumped when out of capacity, but the liquid waste goes into the public sewer. For hazardous chemicals, the company receives services from LENG BOPHA Co., located in Ou Bei Choan. The waste is then sent to Phnom Penh for further treatments.

265. Poipet O’Neang SEZ was inaugurated on 09 December 2019, with currently only one factory in operation. There are currently 120 workers in this factory. 21 flush toilets are at the disposition of the workers. There are four septic tanks in the factory, each one measuring 8 m<sup>3</sup>. When full, the sludge is pumped out of the tank by private emptying companies. This new SEZ has its own water treatment plant (under construction). The WWTP has a three waste stabilization ponds technology. The water quality of the effluent will be controlled by the MoE before being released into the urban drainage network. This SEZ is expected to discharge its treated effluent to the projected wastewater system in the long term horizon (2040).

## 11. Stormwater Drainage

266. **Natural Transport.** Poipet has more than 3.3km of open channel network within the Sangkat Poipet. Concrete circular pipes are commonly disposed of in the city center, and earth open-channel are used to drain stormwater from dense urban areas toward rural areas/river.

267. Some key canals are totally blocked, leading to an incapacity to drain the collected water from the secondary network. None of the canals are lined with concrete material. At some locations, this leads to important bank erosion. Due to the low flow in the canals, especially

---

<sup>39</sup> SFD Manual Volume 1 and 2, Version 2.0, July 2017.

during the dry season, plants and algae overgrow the banks. This leads to a reduction of the flow capacity.

268. The water quality in open channels is poor, especially during dry periods of the year when the wastewater becomes pure sewage. In rural areas, ditches are disposed along the main roads and are commonly dry during dry weather days. In an urban area, the “middle south channel” and “southeast channel” are continuously filled with wastewater.

269. The existing gravity lines carry stormwater towards Ou Chrov River, the final receptor for stormwater.

270. **Urban Drainage.** Recurrent floods are reported by inhabitants and local authorities. Main stormwater channels are operating properly, but their capacity is not sufficient to ensure proper drainage of the city center.

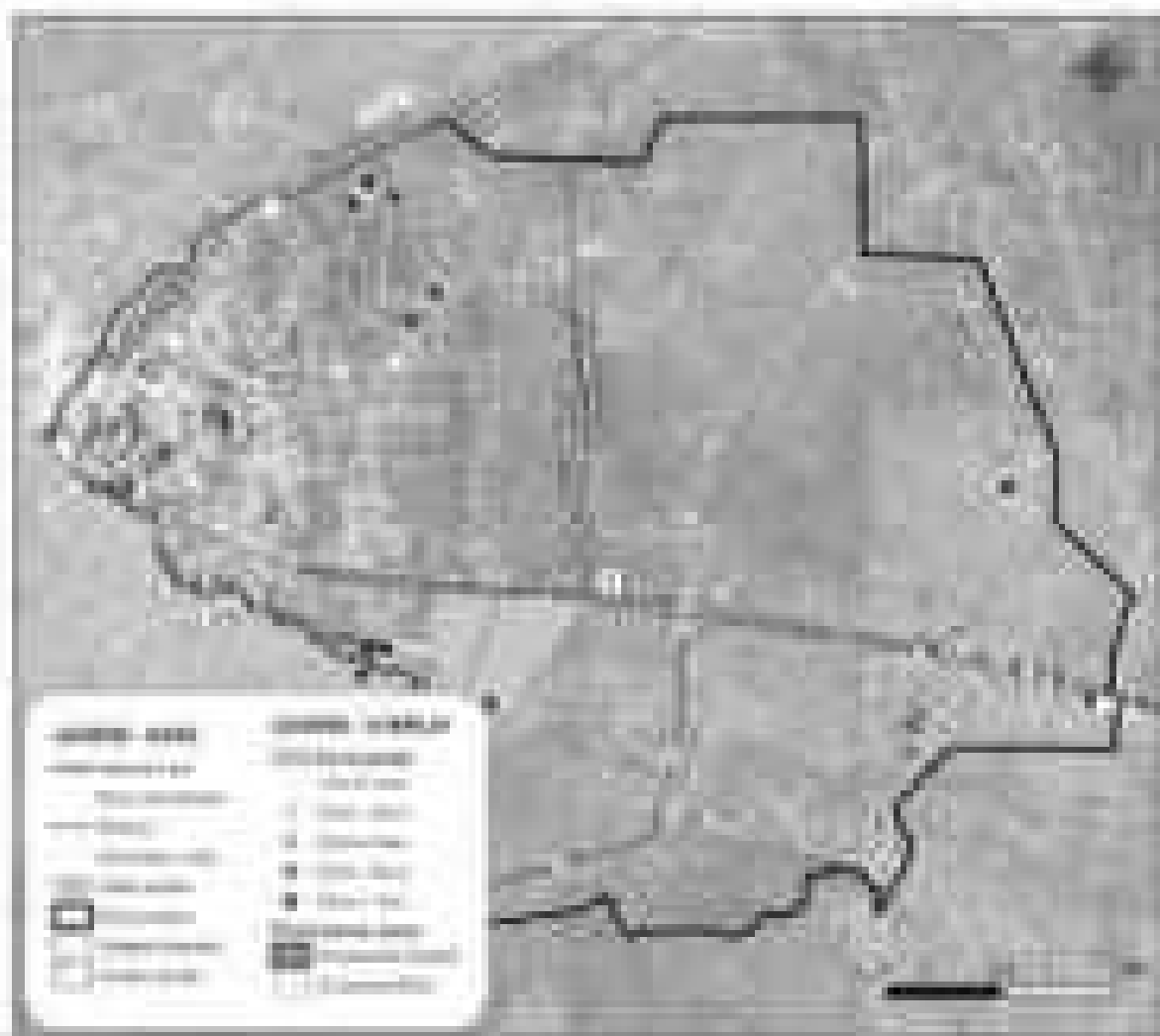
271. Except for the area covered by GMS 1 gravity lines (currently under construction), there is no existing overall strategy and roadmap. The implementation of the new drainage section does not seem to follow an overall strategy but a patching logic following the urban development.

272. The main common issues identified in the urban area are the following:

- (i) The existing sewers and stormwater pipelines have a high level of filling within the city extent.
- (ii) A lot of operating stormwater drainage lines are obstructed by solid waste. Particularly in Poipet, the lack of existing facilities for solid waste collection and treatment leads the households to release solid waste into the stormwater system.
- (iii) Because of stagnant wastewater, bad odors are released from the drainage system. To avoid odor nuisances, the local inhabitants obstruct the catch pits grids with plastic waste. This obstruction reduces drastically the capacity of the existing drainage system.
- (iv) A lot of streets are only serviced on one side by a road drainage network. For this reason, the inlets are insufficient to carry all the runoff coming from the impervious urban areas.
- (v) There is no existing global strategy for the development of stormwater/wastewater drainage networks. For this reason, inconsistencies could be noticed in the conception/design of the existing drainage networks (pipelines are connected to the existing system in the wrong direction, other pipelines are not connected to the existing primary drainage system).
- (vi) Along roads, household residents often developed their own stormwater drainage system. Those pipes are not always connected to each other due to the lack of vision and overall strategy.

273. The CCS has investigated flood levels, and a map of the areas commonly flooded could be established during the focus groups lead during the master plan study stage.

**Figure 20: City Survey and Flood-Prone Areas Location**



Source: Egis, 2021

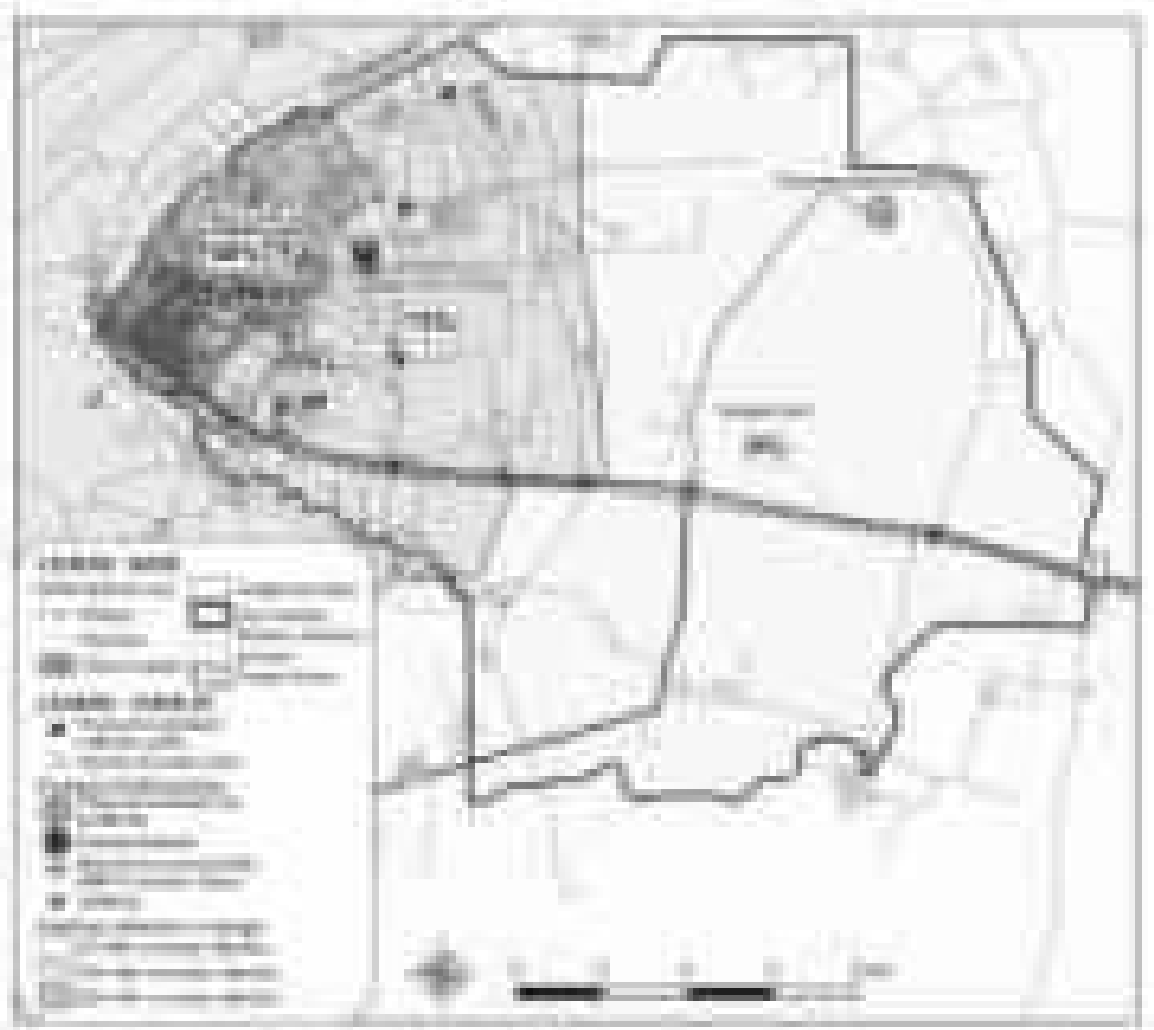
## 12. Solid Waste Management

274. A solid waste characterization survey was carried out in February 2020 at the dumpsite on fresh solid waste before the scavengers have removed the recyclables. It was observed that 55% of the municipal solid waste flow is composed of the organic fraction (biowaste), followed by 11% of plastic bags, 7% of baby diapers, 5% of garments and other textiles, and 5% of paper and light cardboard (by weight).

275. **Providers.** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The company has a 10-years license from January 2019 to December 2028 for the whole Poipet city administrative area. It is equipped with 13 compactors of 5 tons, two hydraulic dump trucks of 16 tons.

276. **Access to Services.** The collection coverage ratio is relatively efficient, considering the domestic waste arisings, reaching 71%. Casinos are well covered, whereas the main developed industrial zone (Oh Neang) is not covered. 28% of household wastes are covered, meaning that 72% of household wastes are burnt or disposed of in open land.

**Figure 21: Collection Coverage in Poipet**



Source: Egis 2020

277. The solid waste collection's frequency is every day, according to 70% of households having access to the service. Garbage collection is mainly door to door, and solid waste is transported to a 4 ha dumpsite located 5 km far from the city center. There are junk shops in Poipet collecting recyclables waste from informal collectors, waste pickers, and scavengers, which represents 16% of the total domestic solid waste flow. Current dumpsite has 37 families with 171 persons of informal waste pickers working there.

278. Households pay a monthly fee to the operator and have to buy their own waste containers. Most of the households dispose of waste in plastic bags along the street.

279. A new Material Recovery Facility (MRF) built by the GMS1 project exists. However, it is not yet in operation. A review of the institutional set up is required to commence the operations.

280. **Service Quality.** Solid waste is related to significant environmental issues, as the collection coverage is low and wastes are either burnt or dumped in the environment, resulting in blockages in the drainage system.

281. Moreover, the current dumpsite is not equipped to avoid underground water pollution.

282. **Service Consistency.** To date, two quarters are served: *Sangkat* Poipet and *Sangkat* Phsar Kandal. *Sangkat* Nimitt is not covered. In total, the service solid wastes from 3,350 households and clients, including five casinos, six markets, and five gated communities (boreys). According to local authorities, this represents approximately the collection and disposal of 150 tons/day.

283. **Institutional Arrangements.** CINTRI is a private operator that holds a waste management contract with the Poipet City Government. Agreements are signed directly with the provincial governor, but the MEF reviews and endorses the waste collection contract before signing. The Ministry of Environment (MoE) plays an important role in establishing guidelines on disposal, collection, transport, storage, recycling, minimizing, and dumping of household waste. Provinces and city authorities shall establish the waste management plan in their province and city/municipalities for the short, medium, and long-term.

284. **Financial Status.** The service is financed by a user-pay arrangement, and billings are issued and collected by CINTRI. The tariff guidelines are in its contract and approved by the government MoE.

285. Other Solid Waste flows can be described as follows:

#### **Non-Hazardous Domestic Solid Waste.**

286. Septage from septic tanks is discharged into the environment. Flushing of septic tanks is actually not a common practice in Poipet, so the volumes concerned are low.

287. No specific collection of bulky waste is organized. It seems that bulky wastes are reused, repaired locally as no bulky waste is found in the streets or in the environment. It can be assumed that the bulky waste flow is negligible.

#### **Hazardous Municipal Solid Waste.**

288. Household hazardous waste principally comprises used engine oils, accumulator batteries, car batteries, fluorescent lamps, small containers of miscellaneous products: paint, solvents, etc.

289. Concerning hazardous medical waste, the normal procedure is to burn this waste at the hospital in a rather uncontrolled or simple manner. If adequately carried out, it eliminates the health risks.

290. No data is available at the Province or City level concerning the generation of waste electrical and electronic equipment (WEEE). In principle, WEEE should be managed by retailers, who should provide collection points. However, repairing WEEE or metal recovery activities are common in Cambodia, so it can be assumed that the electronic waste flow is negligible.

291. No data is available concerning the generation of domestic hazardous municipal solid waste since no separate collection or disposal is carried out for this waste stream. In a situation where no hazardous waste management exists at all locally, it is difficult to estimate figures based on the available municipal solid waste composition data, and a dedicated survey would be required. More realistically, as an assumption based on experience from several studies and surveys in developing and developed countries, hazardous waste would represent around 1% of the municipal solid waste flow. Based on this assumption, around 500 tons per year of hazardous waste is generated within the municipal solid waste in Poipet.

### **Industrial Waste**

292. In the SEZ, the domestic and industrial wastes are segregated. The industrial waste is collected by local contractors and treated by private operators who have an agreement from the MoE. However, the absence of the application of local policies and procedures for the proper handling of hazardous waste is a source of risk for Poipet residents. For example, the industrial waste collection and disposal contractors are not properly checked with respect to their capability to handle and dispose of the industrial waste, and the municipality cannot be assured that the contractors follow environmentally sound disposal practices. Currently, there is no facility available in the region for receiving and treating industrial hazardous waste.

### **Agricultural Waste**

293. Presently Poipet does not have a designated area where it can dispose of industrial, agricultural, and other toxic waste, which may pose a danger to the environment.

### **Construction Waste Collection**

294. Construction waste is collected by informal operators. It is quite difficult to get information on this waste as there is no proper control. However, it seems that reuse is quite a common practice. As the region is a low land area, construction materials are used to fill and level up the land.



## V. ANTICIPATED ENVIRONMENTAL IMPACTS

295. The impact assessment for this project includes consideration of (i) delineation of the project area of influence and sensitive receptors; (ii) assessment of project benefits; (iii) factors required for pre-construction readiness for environmental safeguards; (iii) potential construction-phase impacts; (iv) potential operation-phase impacts; and (v) factors related to climate change and greenhouse gas emissions. The impact assessment also considered the specific context of each subproject, i.e., ecological values, water resources, and social, economic, cultural, and tourism values; relevant national laws and regulations; and ADB's SPS requirements in relation to projects within protected areas.

### 1. Project Areas of Influence and Sensitive Receptors

296. To define the geographic scope of the impact assessment, the “project areas of influence” and “sensitive receptors” were identified. The project areas of influence for project components were defined as the total areas which might be subject to direct/indirect adverse impacts. They were based on the locations of sensitive receptors, defined as settlements and/or environmental values that might be affected by the project component construction and/or operation phases. For this impact assessment, the project areas of influence and sensitive receptors were largely defined by the planned infrastructure.

297. The following variables and distances were applied to identify the sensitive receptors: (i) for impacts to soil and/or geology – area of impact usually localized and restricted to the immediate construction site, immediate surroundings, and potential borrow areas; (ii) for construction and/or operational noise – all residences, and/or other permanent or seasonal settlements located within 80m of the noise-generating source; (iii) for construction-related air quality impacts – all residences, agricultural fields, and/or other permanent or seasonal settlements within 100m of the emission source; (iv) for impacts to the water quality main rivers or watercourses, all construction works within at least 200m of the water bodies (based on the shortest distance between project components and water bodies); and/or (v) for impacts to ecological values, all vegetation communities, fauna habitats, and permanent or seasonal food and/or breeding resources within or adjacent to the project construction sites. The approximate distances encompassed by these variables, combined with the direct construction sites, were assumed to encompass the total project area of influence. Potential sensitive receptors within the project area of influence were identified through field surveys, topographic maps, and satellite imagery.

298. Based on these definitions, sensitive receptors within the project area of influence were identified as follows (Table 26).

**Table 26: Sensitive receptors to proposed construction activities**

Project components	Sensitive receptors	Distance
<b>Wastewater</b>		
WWTP	Agricultural land (paddy fields)	0m
	Irrigation canal network	< 100m
	Houses	> 300m
	Settlements	1km
	Natural Waterbody (Ou Stueng Bot)	> 1km
	Schools (closest: Raksmei Samaki Primary School)	> 1.5km

Project components	Sensitive receptors	Distance
	Religious sites (closest: Serei Mungkul Sothea Ream Pagoda)	> 4.2km
	Health facilities (closest: Kob Health Center)	> 15 km
Access road to the WWTP	Agricultural land (paddy fields)	< 10m
	Houses along the road	< 10m
	Ou Stueng Bot and Ou Kaidon Reservoir	< 10m
Pumping Station PS_FS_01 (in a residential and commercial area, close to an agricultural land across the border)	Houses	< 20m
	Natural Waterbody (Ou Chrov)	> 50m
	Poipet Mongkol market	150m
	Railway	> 200m
	Agricultural fields and irrigation canal network	> 300m
	Schools, hospitals, and heritage places	> 300m
Pumping Station PS_FS_02 (in a residential area)	Houses	< 50m
	Religious sites (closest: Palilai pagoda)	> 50m
	Small store at the Palilai gate	> 50m
	Railway	> 100m
	Schools and health facilities	> 300m
Pumping Station PS_FS_03 (in a residential and commercial area, close to an agricultural land across the border)	Houses	< 100m
	Waterbody (periurban ponds and Ou Chrov)	> 250m
	Railway	> 100m
	Schools, health facilities and religious sites	> 300m
	Agricultural fields and irrigation canal network	> 350m
Pumping Station PS_FM_01 (in a residential area)	Houses	< 50m
	Schools (closest: Bridge of Hope Christian Fellowship)	> 50m
	Railway	> 100m
	Health facilities and religious sites	> 300m
Pumping Station PS_FM_02 (in a rice field)	Agricultural fields	0m
	Warehouse	< 50m
	Houses	> 100m
	Railway	> 100m
	Irrigation canal network and waterbody (Ou Kaidon Reservoir)	> 300m
	Schools, health facilities, and religious sites	> 300m
Pumping Station PS_FM_03 (surrounded by rice fields)	Agricultural fields	0m
	Waterbody (Ou Kaidon Reservoir)	< 50m
	House with a stall along the road	< 100m
	Irrigation canal network	< 200m
	Houses, schools, health facilities and religious sites	> 300m
	Railway	> 1km
Effluent discharge	Discharge point to irrigation network	> 200m > 1km

Project components	Sensitive receptors	Distance
	Ou Chrov River (final receptor)	
Sewer network	Urban areas	< 10 m
	Ongoing urban development	< 10 m
	Agricultural land (considered as future urban areas)	< 10 m
<b>Stormwater drainage</b>		
Discharge point(s)	Natural Waterbody (Ou Chrov River)	0m
<b>Solid waste management</b>		
Pre-sorting plant	Waterbody (pond)	> 200m
	Houses	< 250m
	Agricultural fields	> 250m
	Schools, health facilities and religious sites	> 500m
Landfill and composting plant	Agricultural land (paddy fields)	0m
	Ou Ansaong stream and Ou Srae Tariv stream	1km
	Houses	> 1.5km
	Land development project in planning (private company) and small selling office	2.1km
	Schools (closest: Preav Primary School)	> 2.3km
	Settlement (existing community)	3km
	Religious sites (closest: Nimith Sothiram Pagoda)	> 7km
Access road to the landfill	Health facilities (closest: Kob Health Center)	> 10km
	Agricultural land (paddy fields)	< 10m
	Houses along the road	< 10m
	Trapeang Angkrang stream and Ou Ansaong stream	< 10m
	Agricultural canal along the road and Ou Pongro stream	> 100m
Centralized collection points	Ou Srae Tariv stream	> 500m
	Along the National Road NR 5 and an intersecting road	(See the following figure)

Source: Egis, 2021

299. The **WWTP** site is located approximately 13 km from the city and covers around 10ha of private land. It is surrounded by agricultural land (paddy fields). Two **access roads** are proposed: 5.2km in the northern direction to National Road NR 5 and 2.6km in the southern direction to National Road NR 59. The roads already exist, therefore no construction works will be required for it, except for minor upgrading.

300. The sites for the **6 pumping stations** are scattered across the city, from the city center to rural areas. Considering their relatively small size and low inconvenience with intermittent operating conditions, their impacts on the neighboring buildings will be limited in time and space.

301. The **effluent from the WWTP** will be discharged by gravity to an open-channel used for irrigation, which leads to Ou Stueng Bot river and then the Ou Chrov river (final receiving water body).

302. The **pre-sorting plant** will be located in the vicinity of the existing dumpsite, its impacts on the surroundings will be limited compared to the current nuisances originating from the dumpsite.

303. The **landfill and composting plant** site is located approximately 18km from the city center and covers around 25ha of agricultural land. It is surrounded by agricultural land (paddy fields). 3.5km of paved **access road** is required but will have limited impacts on the surroundings due to its location in an agricultural area.

304. In addition to these punctual components, the project also includes primary networks for the wastewater treatment and the stormwater drainage, as well as centralized collection points for solid waste management.

305. The **network for the wastewater treatment** will connect 5,709 households (28,545 inhabitants, subsidies of \$750 per household for connection are included in the capital expenditure for the project) to the WWTP through **six pumping stations** to be constructed in the priority area by 2025. The coverage of this network will be focused on the city center. Sensitive receptors will include houses connected to the wastewater collection network, the Ou Kaidon Reservoir, which will be bordered by the network lines, as well as the railway and the Ou Chrov River, which will both be crossed by the network lines. Sensitive receptors also comprise the nearby irrigation network with its outfall into the Ou Chrov river, as receptors of the treated effluent of the WWTP.

306. The **network for the stormwater drainage** planned for the priority area by 2025 will be set across the city center, upstream of existing GMS1 lines and outfalls, discharging stormwater into the Ou Chrov River. Therefore, sensitive receptors will include the buildings located along the new network lines and the Ou Chrov River as the final receptor of the stormwater.

307. The **centralized collection points** will mainly be located along the NR 5, and a few others will be situated along a road from its intersection with the NR 5 to the north of the city, passing through the periurban area and 800 m east of the existing landfill (see figure below). Considering their location, away from dense residential areas, and their equipment with sheltered waste containers, odor nuisances will be limited. Good maintenance of these collection points will prevent waste from being scattered across agricultural land and from reaching the Ou Kaidon Reservoir, which will be close to a few of the points along the NR 5.

**Figure 22: Centralized collection points - Poipet**



Source: Egis, 2021

308. Other receptors that will be considered are the houses located along the proposed **routes of the solid waste collection trucks**.

309. The proposed site for the **sorting plant** is adjacent to the current dumpsite and the existing MRF. No new access road is required; only minimal maintenance of the access road will be required annually, with a very limited impact on the surrounding receptors. Sensitive receptors will include buildings close to the sites. The existing MRF would maintain its original location and functions. Therefore, the new additional impacts from the sorting plant will be very limited.

## **2. Positive Impacts and Environmental Benefits**

### **2.1. Environmental Benefits**

310. **Wastewater.** By establishing a wastewater treatment system, groundwater pollution will be reduced, as a higher quantity of the excreta produced in Poipet will be safely managed.

311. The implementation of a wastewater treatment plant and connection to the primary network will prevent wastewater from being discharged directly into the river without any form of treatment, changing the natural characteristics and ecology of the water body. Thus, the quality of the river will be improved.

312. Sludge produced by the treatment process will be dewatered in Sludge Drying Beds before being transferred to the new composting plant (if moisture < 80%). Thus, sludge spreading is not planned, avoiding any risk of pathogens transfers to agricultural lands, food crops, etc.

313. On-site septage collection will be provided by trucking for residential areas too far to connect or rural areas. Septic waste will be collected by vacuum trucks and brought to the closest pumping station or to the inlet of the WWTP for co-treatment. Septage co-treatment at the WWTP is the most viable option among the treatment alternatives, in comparison with a dedicated treatment.

314. Access to the wastewater treatment network will also restrain the current practice of the population of burying sanitation containments once they are full.

315. **Stormwater Drainage.** Improving the drainage capacity of the city will reduce the risks of flooding in urban areas. The system is designed to minimize street flooding during a 1 in 5-year rainfall event.

316. Improvement of the drainage capacity will also reduce risks of conveying waste material scattered in the streets to the rivers and the sea, impacting positively on prevention of marine litter and plastic pollution.

317. None of the canals currently used for urban drainage is lined with concrete material. At some locations, this leads to important bank erosion. This effect will be avoided by the projected piped network.

318. **Solid Waste Management.** The new landfill will prevent contamination of local groundwater with its leachate management. The majority of the collected leachate is recirculated back into the landfill mass. The residual leachate is transported by tanker to the WWTP and follows the complete wastewater treatment process.

319. The new solid waste management approach will minimize the practice of waste burning and waste disposal into water bodies and other natural habitats. This will help reducing air, water, and soil pollution, with a big improvement in the biological and chemical quality of local water bodies.

320. Pre-sorting activities will increase the recovery rate of solid waste materials, diverting from landfilling, and consequently saving agricultural land areas.

321. Composting will reduce greenhouse gas emissions compared to landfilling and will extend the landfill life by diverting the incoming waste flows.

322. **Greenhouse Gas Emission.** The waste management project components, including composting of organic waste; controlled wastewater treatment; GHG capture; recycling and waste minimization are greenhouse gas emission reduction strategies. In particular, emissions of the more potent greenhouse gases Methane (CH<sub>4</sub>) and Nitrous oxide (N<sub>2</sub>O) from anaerobic

decomposition will be captured and converted to CO<sub>2</sub>, via a landfill gas (LFG) collection system and a gas flare unit (to be installed during operation). Additionally, emissions of CO<sub>2</sub> and pollutants from burning waste will also be reduced.

323. The Cambodian Government has a number of national strategies to reduce greenhouse gas emissions, and where possible, these will be incorporated into the project. The CCCSP has a strategic objective to promote low-carbon planning and technologies to support sustainable development. General mitigation strategies will be used as part of the overall project strategy where possible such as the use of biofuels, light vehicle technologies, electric vehicles. The project will contribute to mitigation by promoting the use of solar operation at the infrastructure site.

## 2.2. Socio-Economic Benefits

324. Women may benefit more from improved waste, water and sewer services as they generally have a higher risk to health from exposure to pathogens as the primary contributors towards household and community sanitation tasks. A specific Gender Equality and Social Inclusion Action Plan (GESIAP) has been developed to include this social issue in the project implementation.

325. Additionally, employment increases and education opportunities may be able to provide more gender equality.

326. During works, all sub-projects will generate employment and local employees will be preferred:

**Table 27: Employment generated by the project**

Sub-project name	Component	Quantity	Construction schedule	Number of staff and workers
<b>Waste Water</b>	Sewers	48km	30 months	90-150
	Pumping Stations	6 stations		
	Force Mains	11.7km		
	WWTP (CAS)	10ha		
<b>Storm Drainage</b>	Box culvert	7.1km	24 months	50-80
	Outfall	2 places		
<b>Solid Waste</b>	Controlled Landfill	20ha	18 months	40-50
	Access road	8km		

Source: Egis, 2021

327. **Wastewater.** By 2040, the project aims to an objective of 100% of excreta safely managed at the end of the sanitation chain, with 61% of the households connected to the sewer network (including population growth).

328. In rural areas, on-site septage collection will be provided by vacuum trucks. Septic waste will be brought by trucking to the WWTP for co-treatment. This will minimize waste disposals to ground in agricultural fields or along the roads.

329. Collection and treatment of wastewater is a matter of public health, as it will diminish the incidence of water-borne infections and diseases associated with inadequate sanitation.

330. The quality of life will also be improved with the reduction of odor nuisances, which can occur due to the practice of emptying the untreated contents of sanitation containments directly into the environment. The urban environment for residents and visitors will, therefore, be improved.

331. The operation, monitoring, and maintenance of the new pumping stations and WWTP will enable the creation of employment opportunities for the population.

332. **Stormwater Drainage.** The proportion of the population living in a drained area will extend through network development and will reach 86% by 2040. By 2040, the urban drainage network will serve 100% of commerce, 89% of the hotels and SEZs, and 89% of the institutions.

333. An increased capacity of the urban drainage system will relieve part of the population which experiences flooding during intense rainfall events and prevent economic loss due to damage to property.

334. Functional and separated drainage and sewage systems will help reducing diseases from infection and mitigate health-related problems in the population.

335. The improved drainage network will reduce flooding and consequent scattering of waste material in the streets, enhancing the touristic and commercial development of Poipet and attracting private sector investments.

336. Considering climate change, amplified rainfalls may increase the number of flooding and pipe surcharge events. By improving the capacity of the drainage system, the vulnerability of the population to these consequences of climate change will be reduced, as the excess of water would be more easily evacuated.

337. **Solid Waste Management.** The project will minimize waste disposal and waste burning in the surroundings of the urban area, improving living standards for the population in Poipet. The project will create around 194 jobs by 2040, mostly manual sorting operators in the sorting lines of the pre-sorting plant, addressed in particular to waste pickers and scavengers. This facility will provide better working conditions for these workers and maintain their revenues.

338. Composting is a relatively efficient solution for diversion from landfill. Even with a relatively small composting plant, the actual landfill diversion rate is quite high, thus extending the landfill capacity by more than a year. The produced compost will be reused in agriculture and more practical in using compost fertilizers in Cambodia, e.g. the composting products from SCARO and CAMPED could not response to the market demand.

339. The proposed area for the new sorting plant is located in the landfill in according to the suggesting from department of SWM of the MoE.

340. For rural areas, the project does not include the door-to-door waste collection in order to reduce the fees for the served population. It will include centralized “bring-to” collection points instead, where the waste will be delivered from each household. This may improve acceptability from the population and thus increase the number of households using this service. Consequently, waste burning practices in the local population could be minimized.



341. Groundwater is used for household water supply and private vegetable gardens watering. Leachate collection will prevent groundwater pollution. This will help to reduce health impacts in the local population due to the consumption of poor quality water.

### **3. Biodiversity Conservation and Sustainable Natural Resource Management**

342. The clearing of vegetation, scouring, stripping, earthworks and the leveling of work areas is limited strictly to as little as necessary.

#### **3.1. Construction Phase**

##### **(i) Hydrology and Water Availability**

343. The project does not involve any works that would affect lake and river hydrology. Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers. This will be pumped directly from the closest surface water body into a water truck and transported to the work sites. If pumping is implemented from Ou Stueng Bot River, Ou Chrov River, or from Ou Kaidon Reservoir, local authorities approval will be necessary.

344. *Measures.* Pumping will occur at irrigation channels, only at sites with existing road and jetty access. No works or machine wash-down will be conducted at the pumping site. Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed.

345. The wastewater network will cross Ou Stueng Bot River around 2.2km before the WWTP inlet. The crossing of the river will be done by corbelling the main force pipe and attaching it to the existing crossing structure (small bridge). This technical method is used as long as this section of the pipe will be operating under pressure. Therefore, the impact on the water body is expected to be not significant.

346. *Measures.* Awareness raising of the construction workers will be renewed regularly during this phase, to avoid water pollution from construction materials or machinery wash-down. Works upon the river bed will be allowed during the dry season only when the river bed is naturally dry.

347. Wastewater network pipes will be laid on the area adjacent to the perimeter of the Ou Kaidon Reservoir. Moreover, two pumping stations are planned to serve this part of the network: PS\_FM\_02 and PS\_FM\_03. The first one will be located north of the reservoir on National Road No.5 at a 200m distance from the riverbank. The second one will be located on the opposite side of the road running along the eastern bank of the basin. This pumping station will be at around 50m distance from the shore.

348. *Measures.* (i) To preserve the water quality, the reservoir will be protected with dedicated barriers during the construction phase; (ii) Specific training will be provided to construction workers, for them to be able to identify and prevent all risks of water pollution during this phase; (iii) An awareness raising of the construction workers will be renewed regularly during this phase, in order to avoid water pollution from construction materials or machinery wash-down.

##### **(ii) Ecological and Wilderness Values**

349. Construction will cause short-term noise and visual disturbance, which may disrupt the breeding or foraging of the resident or migratory fauna. The construction works will take place within the urban context of Poipet and on agricultural land.

350. Around the perimeters of the WWTP and the landfill site, an endangered species of flora (*Pterocarpus pedatus*) was observed during a field survey. The following figures show its locations. Concerning the WWTP, three trees were identified in the same area at more than 500m distance from the site perimeter. Only one tree of *Pterocarpus pedatus* was observed in a dense vegetation area (1.5ha) adjacent to the south-west corner (out of the site area) of the landfill site perimeter. This tree will be preserved and protected with dedicated barriers during the construction phase. Hence, these endangered species will not be impacted by project construction and operation. A awareness raising of the construction workers will be provided to avoid accidental damage to the vegetation.

**Figure 23: Flora at the WWTP site: endangered species - Poipet**



Source: Egis, 2021

**Figure 24: Flora at the landfill site: endangered species - Poipet**



Source: Egis, 2021

351. Long-tailed macaque (*Macaca fascicularis*) and four bird species (*Rhyticeros undulates*, *Mulleripicus pulverulentus*, *Carpococcyx renauldi* and *Leptoptilos javanicus*), which are listed as Vulnerable in the IUCN red list, were reported to be potentially present at the project components sites as a result of the field survey. These species may be disturbed by construction activities and temporarily abandon the sites. They are expected to repopulate the areas during the operation phase, as the characteristics of the habitat will not be globally altered by the WWTP and the landfill presence. Therefore, scaring systems will be implemented prior to the beginning of the construction phase to ensure that the project area will be free of local fauna to avoid any accidental collision with vehicles or machinery.

352. Based on available data, *Sarus crane* populates the Ou Kaidon Reservoir. This species is listed as Vulnerable in the IUCN red list. *Sarus crane* may be disturbed by the construction of the wastewater network and the pumping station around the reservoir. Thus, it could temporarily abandon the site. But, it is expected to repopulate the areas during the operation phase, as the characteristics of the habitat will not be altered by the project components. Moreover, the reservoir does not represent the preferred nesting habitat of the Sarus crane, which is normally wetland. However, to ensure that the project area will be free of local fauna in order to avoid any

accidental collision with vehicles or machinery, scaring systems will be implemented prior to the beginning of the construction phase. It is to be noted that a crane sanctuary exists within the Ang Trapaing Thmor protected forest (around 100km north-east from the reservoir).

353. *Measures.* These risks have been minimized as follows:

- a) Careful designs to minimize the need for safeguard measures and impact to adjacent vegetation;
- b) Setting up protective physical barriers around vegetation that do not have to be removed;
- c) Strict speed limits (maximum 40km/h) for work vehicles around construction sites to minimize the risk of collisions with fauna, livestock, or people;
- d) Scaring systems will be implemented prior to the beginning of the construction phase;
- e) Restriction on any construction activity and project vehicle activity between 6.00 pm and 5.00 am to minimize the risk of collisions with fauna at night (when some mammals are more active).

354. Based on the effective implementation of these measures, ecological-related construction risks are considered to be very low.

### 3.2. Operational Phase

#### (i) **Ecological and Wilderness Values**

355. Human activity and equipment noise can generate disturbance, which may disrupt breeding or foraging by a resident or migratory fauna.

356. An impact on aquatic life may be generated in case water quality is altered by effluents discharge (effluent leakage, pipe rupture) in receiving water bodies. However, the WWTP and landfill facilities are designed to reduce water pollution by using treatment systems adapted to the local context.

357. *Measures.* These risks have been minimized as follows:

- a) Careful designs to minimize impacts to adjacent vegetation and fauna;
- b) Adapt the maintenance activities as far as possible to nesting or reproduction periods, to avoid fauna disturbance (e.g. tree pruning operations). Landscaping of the landfill design will be minimalist (peripheral shrub hedge for example), in order to ensure limited maintenance and will not attract fauna e.g. birds to the site;
- c) Strict speed limits (maximum 40km/h) for work vehicles around the project sites to minimize the risk of collisions with fauna, livestock, or people;
- d) Restriction on project vehicle circulation between 6.00 pm and 5.00 am to minimize the risk of collisions with fauna at night (when some mammals are more active);
- e) Regular control and maintenance of equipment and installations;
- f) Ensure maintenance of network, education and communication for householders on what to dispose of in a sewer;
- g) Pests/rodents/vermin, birds, and stray animals are likely to be attracted by the landfill waste. This effect can be minimized with some operating procedures mentioned above, such as minimizing exposed tipping areas and prompt waste covering upon waste dumping in the normal operation of the landfill. Additionally, 2m-high fences will limit fauna access to the WWTP and the landfill areas;

- h) To mitigate impacts of O&M on ecological issues by dedicated measures, a detailed training programme for operators will be required in the DED stage, with the PMU approval for scope and budget.

358. Based on the effective implementation of these measures, ecological-related impacts are considered to be low and not significant.

#### 4. Pollution Prevention and Abatement

##### 4.1. Construction phase

###### (i) Geology and Soil

359. **Erosion.** Potential impacts include poorly planned excavation or disposal from borrow and spoil disposal sites, causing erosion induced by rain flows events, which the intensity could increase drastically due to the climate change.

360. Erosion may be caused by rainwater flows, and compounded by construction works and/or vibration from movement and operation of construction vehicles/equipment near slopes, particularly at unprotected banks of gullies and creeks and moderately sloping terrain. Erosion could also occur after the completion of construction, where site restoration is inadequate. Works may also raise dust, which may reduce photosynthesis processes of natural vegetation by deposits on plant leaves which could lead to lowered productivity and damage biodiversity on adjacent natural habitats.

361. *General measures.* These risks will be managed through strict on-site measures including stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; minimizing the duration that surfaces are exposed for; timing works for dry seasons when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants); and, management of site stockpiles and storage sites for fuels and machinery. Pending effective management of the EMP, these risks are considered manageable.

362. *Specific measures.* Earthworks will be carried out during dry periods as much as possible to avoid erosion and sediment transport. Before construction, contractors will include site-specific drainage and soil erosion control measures as part of their site-specific EMPs, which will include and be modeled on the following actions:

- a) Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next;
- b) Minimize open excavation areas;
- c) Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground;
- d) Stabilize all cut slopes, embankments, and other erosion-prone working areas;
- e) Stabilize all earthwork disturbance areas within 15 days after earthworks are completed;
- f) Provide temporary detention ponds or containment to control silt runoff;
- g) Strip and stockpile topsoil, and cover (by geotechnical cloth) or seed temporary soil stockpiles;
- h) Limit construction and material handling during periods of rains and high winds;
- i) Properly slope or re-vegetate disturbed surfaces, e.g., pipeline trenches and cut banks;
- j) Landscaping will only use native plant species;
- k) Worker camps, if required, will be located in the project sites, and storage areas will be located to minimize the land area required.

(ii) **Geology and Soil**

363. Raw materials for concrete infrastructures will be selected from existing quarries or concrete plants to avoid the excavation of borrow pits and quarries, which may be a threat to the environment when left uncared for frequent sliding, loss of ecosystem, groundwater pollution, and loss of arable land. No new natural material extraction site will be created for this project.

364. The concrete infrastructures, such as WWTP, platforms, etc., will require 2,200m<sup>3</sup> of concrete needed for the construction phase. Existing concrete plants in Poipet will supply the works. The compact concrete plant related equipment will need regular cleaning and maintenance. The wastewater produced by such cleaning has a very high pH level: their discharge into the environment could cause harmful effects to vegetation and groundwater. Dust emission and high pH wastewaters generate the main impact related to this kind of facility.

**Figure 25: Existing concrete plants in Poipet**



Source: Egis, 2021

365. **Measures.** (i) For the cleaning of the concrete equipment and vehicles during the whole construction phase, a temporary impermeable basin will be created in order to prevent these

wastewaters from impacting the surrounding environment (i.e., agricultural fields and local vegetation). Its dimensions will be 5m in length and 3m in width, with a minimum depth of 1m. (ii) Due to the presence of a household located about 200m south-west of the WWTP site, works activities will be forbidden during night time and public holidays to limit nuisance for the residents. Moreover, raw materials and products will be stored in dedicated areas, as far as possible from the site boundaries, and covered to avoid dust emission from piles onto the surrounding environment.

366. **Earthworks.** The access road to the landfill and to the WWTP already exists. No construction works will be required for it, except for minor upgrading or small completion of the existing roads.

367. Extracted volumes are estimated to 109,500m<sup>3</sup> (WWTP) and 243,000m<sup>3</sup> (bulk excavation of the landfill). The stormwater works will generate 97,000m<sup>3</sup> of soft materials and 16,900m<sup>3</sup> of hard rocks. Topsoil stripping consists of a 1m-thick layer removed and stockpiled around the WWTP (12,300m<sup>3</sup>) and landfill areas (24,000m<sup>3</sup>). All materials will be reused on sites: on the WWTP site, topsoils will be layered for landscaping; on the landfill site, soils (beside topsoil) will be used for covering cells at the end of their filling. All excess of extracted materials will be easily dispatched to the numerous works in the city, as there is a lack of backfill materials.

368. *Measures for spoils.* Spoils will be utilized for the road works. The additional borrow materials required for the road access upgrading (landfill) will be sourced from existing borrow sites identified in Poipet surroundings. These sites are approved by the local and national administration for the provision of spoil for construction works and are confirmed to have sufficient capacity for the project requirements.

369. Spoils requiring removal and disposal will go to a predetermined and approved location, such as the existing dumpsite of Poipet. These spoil disposal sites will be located far from water bodies so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.

370. **Soil Contamination.** Potential impacts include soil contamination. This may be caused by (i) improper transport, storage, handling, and/or disposal of solid wastes, septic wastes, hazardous wastes, and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and (ii) accidental spills or leaks of hazardous wastes and substances.

371. *General measures.* These risks will be managed through strict on-site measures including stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; minimizing the duration that surfaces are exposed for; timing works for dry seasons when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants); and, management of site stockpiles and storage sites for fuels and machinery. Pending effective management of the EMP, these risks are considered manageable.

372. *Specific measures.* To reduce the risk of soil contamination from construction machinery, contractors will do the following: (i) store petroleum products, hazardous materials, and wastes on impermeable surfaces in secured and covered areas, provided with bunds; (ii) remove all construction wastes from the work sites to approved waste disposal sites; (iii) establish emergency preparedness and response actions; (iv) provide spill cleanup measures and

equipment at each construction site; and (v) train contractors and crews in emergency spill response procedures.

### **Water Quality and Wastewater Management**

373. Earthworks, excavation, and/or inappropriate storage and handling of fuel, accidental spills, domestic wastewater discharge from construction camps (clean water/sanitation, offices, refectory), and wash-down water for machinery and vehicles could contaminate soil or surface waterways. Construction wastewater will come from washing aggregates, pouring and curing concrete, cleaning of construction machinery and vehicles, and human wastes. Surface water bodies that could be potentially affected by project works are Ou Stueng Bot River, Ou Chrov River, Ou Kaidon Reservoir, and Ou Ansaong stream. In some cases, pumping stations and collection points will be built very close to surface water bodies. Construction may also cause a temporary impact on these receptors when adjacent to the project sites, mainly due to dust and waste production. Local water quality could be temporarily altered.

374. *Measures.* The following measures will be implemented to minimize water pollution:

- a) Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction during other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites;
- b) Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and minimize open excavation areas;
- c) Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground;
- d) Contractors will define actions to control oil and other dangerous substances as part of their site Contractor-EMPs;
- e) All sites for washing of construction equipment will be equipped with water collection basins and sediment traps;
- f) Fuel storage, machinery maintenance workshop, and vehicle cleaning areas will be stationed at least 200m from water bodies;
- g) Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations;
- h) Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel;
- i) Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps (if camps are required) along with proper maintenance protocols.

### **Air Quality**

375. Air pollution sources include: (i) dust from earth excavation, backfilling, road breaking, loading, hauling, bare earth surfaces, uncovered construction areas, and vehicle movements on unpaved roads, especially on windy days; (ii) aggregate preparation and concrete-mixing; (iii) vehicle and machinery emissions (gaseous CO, SO<sub>x</sub> and NO<sub>x</sub>). No asphalt heating and mixing processes are expected during these works. Asphalt materials for road reinstatement will be provided ready to use by a local supplier.

376. *Measures.* Mitigation measures to reduce impacts on air quality are as follows:

- a) Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion;
- b) Storing petroleum or other harmful materials inappropriate places and covering to minimize fugitive dust and emission;



- c) Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation;
- d) Regulation by speed limits of access roads to the construction sites;
- e) Maintenance of project vehicles to minimize greenhouse gas emissions;
- f) Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes;
- g) For odor: disinfection/deodorization/sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and strict enforcement of sanitation practices; prompt disposal of organic and hazardous wastes; and timely community consultations to ensure awareness of the risk of odors prior to landfill works;
- h) Prohibit burning of wastes;
- i) Timely monitoring of air quality and inspections during construction.

377. Moreover, particular attention will be paid to limiting dust production when work is carried out near sensitive receptors, e.g., schools, hospitals, residential areas.

378. Overall, the risk of air pollution and disturbance to residents related to air quality is low, because of: (i) the relatively small scope of project works; (ii) the wide distance from WWTP and landfill sites to the nearest residences (around 200m).

### **Solid Waste**

379. Solid waste will comprise domestic solid waste from workers and construction waste materials.

380. *Measures.* Covered garbage bins will be installed at each site of works. The construction contractors will be responsible for transporting the containers and dispose of them at the existing dumpsite, as the existing waste collection services are not adequate to address the project needs. Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed of and that recyclable wastes are separated (as a minimum plastic bottles). Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official hazardous waste treatment facility in Phnom Penh, in accordance with national regulations, to comply with environmental good practices. Waste burning will be forbidden.

## **4.2. Operational Phase**

### **Geology and Soil**

381. **Soil Contamination.** Soil contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipelines or equipment of the wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system or by leachate streams from the landfill or the composting plant.

382. *Measures.* To reduce the risk of soil contamination, all equipment and processes will be maintained in good working order, with back-up material in critical areas. Engineering and management systems will be set up to prevent and handle emergency situations. The landfill site will include a basal geomembrane liner to avoid infiltration of leachate in the subsoil, and the composting plant will include an impermeable concrete platform bordered by a sealed ditch. Additionally, a budget is allocated for testing, training and maintain the composting machinery to ensure a good quality of the outputs.

### **Water Quality and Wastewater Management**

383. Improved sanitation and solid waste management will reduce the volume of sewage and solid waste entering local water bodies and particularly Ou Chrov River and Ou Stueng Bot River.

384. **WWTP** effluents will be treated before release (70-90% design removal rate for COD, BOD, and TSS; 50-70% for TN and TP). Thus, the water quality of the receiving bodies will not be significantly altered.

385. As per sub-decree No.27 (26<sup>th</sup> of April 1999), the project includes the installation of equipment for measurement of flow, concentration, and amount of pollutant contained in the WWTP effluent. In order to confirm the theoretical design removal rates expected for the project, results will be compared to national standards listed in this sub-decree (these standards are more restrictive than international standards). These data will be recorded and kept available for consultation.

386. For the **drainage system**, it is expected that the water quality of the receiving bodies will not be significantly altered since the current combined drainage system is already being discharged into the same water bodies.

387. Surface water or groundwater contamination from spills or uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment of the wastewater treatment system of the landfill and the WWTP, and stormwater drainage systems.

388. Accidental leakage from the wastewater treatment or stormwater drainage systems may impact groundwater quality, depending on local groundwater depth. This impact might be increased in case of flooding.

389. *Measures for water contamination due to the wastewater treatment and stormwater drainage systems.* To reduce the risk of surface water and groundwater contamination, all equipment and processes will be maintained in good working order, with back-up material in critical areas. Engineering and management systems will be set up to prevent and handle emergency situations. Operators will schedule drain clearing maintenance program in order to ensure design flow is maintained for sewer and drainage networks. As mentioned above, monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.

390. Potential impacts related to the **controlled landfill** operations include: (i) surface water run-on, (ii) site water runoff, (iii) waste mass inundation, and (iv) leachate emissions.

391. Leachate generated within the waste mass can migrate through the sidewalls and base and cause contamination of groundwater. Leachate migration is not controlled or monitored at the existing dumpsite, which is likely to have degraded the local groundwater quality to some extent.

392. During the landfill operational phase, damage to the impermeable layer could result in failure in the integrity of the leachate collection system, resulting in subsurface contamination.

393. *Measures for water contamination due to the solid waste management incident.* Surface water run-on and runoff will be mitigated through the provision of perimeter drains, and additional collector drains within the landfill area. The potential for waste mass inundation from precipitation will be mitigated through the provision of cover materials over waste mass

surfaces, coupled with the drainage of these covered areas through the contouring of surfaces and installation of surface drains. Completed waste mass surfaces can also be vegetated to reduce cover material erosion.

394. In the new landfill, leachate will not be disposed to a water body but will be recirculated into the landfill mass. Residual leachate will be treated at the WWTP. Leachate quality will be tested before disposal at WWTP to ensure that it will not affect the WWTP effluent quality.

395. The impacts of the solid waste management project on surface water and groundwater need to be monitored by installing monitoring wells at the up-gradient and down-gradient for the new landfill site.

396. The depth of water table and quality of groundwater below, and down slope of the new landfill site needs to be conducted along with a soil permeability analysis to be able to complete the design of landfill and required leachate management system to prevent contamination of local groundwater.

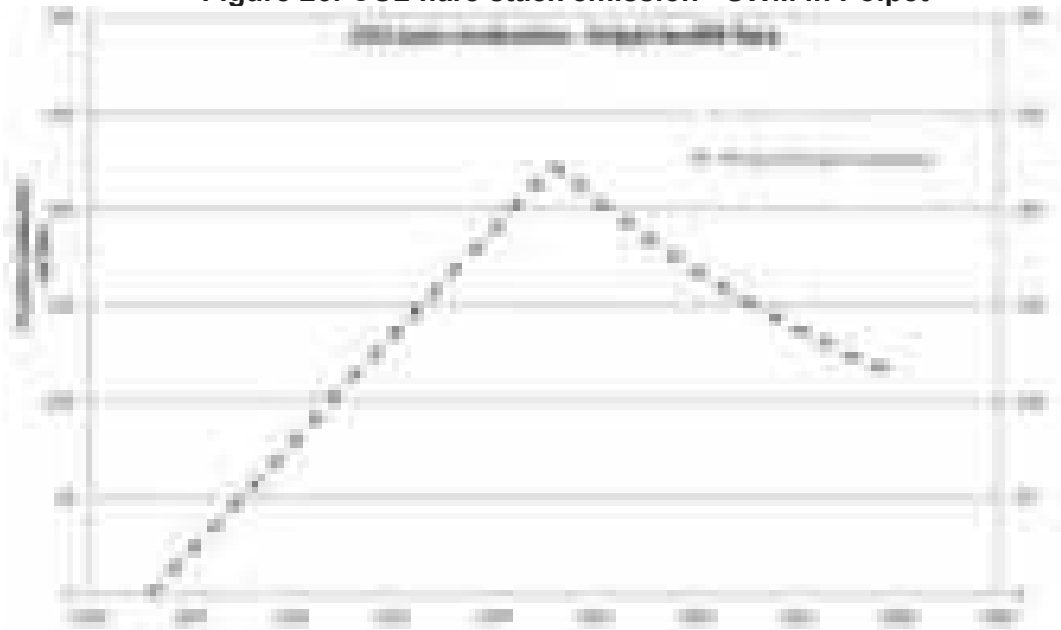
397. Potential damage to the impermeable layer of the landfill cells will be mitigated through: (i) O&M procedures and operator's training programme to ensure that the facilities operate as intended over the long term, (ii) continuous monitoring of groundwater quality to detect and mitigate any subsurface spill.

### **Air Quality**

398. During its operation, the controlled landfill will generate landfill gas, such as carbon dioxide, methane, and nitrous oxide. These gases are formed through the organic waste decomposition process, accelerated by the saturation of waste due to rainwater and surface waters infiltration into the waste mass. The project transition from the current dumpsite to controlled landfilling will, however, minimize this effect as a result of reduced water penetration due to the surface cover (capping) system.

399. As the landfill will receive only a relatively small waste volume (less than 100tons/day for the medium term and less than 200tons/day in the long term), the facility will only generate limited amounts of landfill gas (LFG). The LFG will be routed to a flare stack (design to be defined at the detailed design stage) which will be installed during operation but funded by the Project. The following figure shows the estimated CO<sub>2</sub> emission. The operator will implement its O&M requirements to ensure that the facilities operate as intended over a long time.

**Figure 26: CO2 flare stack emission - SWM in Poipet**



Source: Egis, 2021

400. Waste trucks circulation on unpaved roads around landfill site, pre-sorting and composting plants, and collections points is likely to generate dust both in urban and agricultural areas. This will not differ significantly from the existing situation. The collection points will be located along existing roads, mostly unpaved in rural areas, but waste trucks are not expected to deteriorate local air quality, as these roads are currently used for vehicle circulation.

401. Moreover, collection points are mainly located in rural residential areas where air quality is expected to be relatively good. Trucks emissions around those areas may impact local air quality.

402. *Measures for dust and truck emissions.* Mitigation measures to reduce impacts of dust and trucks emissions on air quality are as follows:

- a) Proper cover on trucks / compactor vehicles;
- b) Pavement of the landfill access road over 5km;
- c) Regulation by speed limits in the streets;
- d) Regulation by speed limits and speed bumps on access roads to project sites;
- e) Maintenance of project vehicles to minimize greenhouse gas emissions;
- f) Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes.

403. **Solid Waste.** Wind-blown waste from the landfill may be dispersed into the surrounding environment.

404. Accidental waste or leachate dumping on streets or into the natural environment can also occur during waste or septage transport or around collection points, causing a nuisance for the surrounding residential or commercial areas.

405. Some solid waste is transported by wastewater pipes to the WWTP.



## 5. Health and Safety (Occupational Health and Safety; Community Health and Safety)

### 5.1. Construction Phase

#### (i) Geology and Soil

410. **UXO.** Construction sites may be concerned by unexploded ordnance (UXO), which can be uncovered by earthworks.

411. *Measures.* Sites for earthworks that are suspected of having UXO should be declared free of UXO by the CMAC (Cambodian Mine Action Centre) or by the Government<sup>40</sup> prior to construction (confirmation in writing will be required). Should ordnance be detected, clearing work will be commissioned prior to undertaking earthworks. Basic training on UXO will be provided to contractor engineers/construction workers by demining organization such as CMAC. Training will focus on actions to take if UXO is identified during excavations / earth moving and how to report to CMAC.

#### (ii) Noise

412. Construction will involve excavators, bulldozers, scrapers, dredgers, concrete-mixer, trucks, and other heavy machinery. Noise emissions will not include rock-crushing, as any rock materials will be obtained and prepared at the borrow sites and transported to the sites. Noise will be temporary and localized. Construction materials, surplus spoil, and construction wastes will be transported to and from the construction sites during an average 8-hour work-day for the construction seasons of about 8-10 months per year (depending on annual weather condition) for about 2 years (storm drainage), 1.5 year (landfill) and 2.5 years (WWTP). Noise levels of representative construction equipment presented in the following table indicate that: (i) noise levels generated by a punctual source (construction equipment) decrease at a rate of approximately 6 decibels (dB(A)) per doubling of distance away from the source; (ii) the maximum noise level for receptors less than 5m could be 93-95dB(A); and (iii) within 150m from a noise source, noise level exceeds WHO guidelines of 55dB(A) and national standards of 60dB(A) (45dB(A) in quiet areas) during the day (no works are expected during the evening and the night).

**Table 28: Construction Equipment Noise**

Equipment	Noise emission level (dB(A)) at distances (m) from equipment										
	5	10	15*	20	40	60	80	100	150	200	300

<sup>40</sup> The government should provide certificate on free of UXO in case the area has been identified in the CMAC map as “no risk of mines.”

Equipment	Noise emission level (dB(A)) at distances (m) from equipment										
	5	10	15*	20	40	60	80	100	150	200	300
Bulldozer	86	80		74	68	64.5	62	60	56.5	54	50.5
Excavator	84	78		72	66	62.5	60	58	54.5	52	48.8
Loader	90	84		78	72	68.5	66	64	60.5	58	54.5
Land scraper	90	84		78	72	68.5	66	64	60.5	58	54.5
Mixing Equipment	87	81		75	69	65.5	63	61	57.5	55	51.5
Roller	87	81		75	69	65.5	63	61	57.5	55	51.5
Vibrator road roller	86	80		74	68	64.5	62	60	56.5	54	50.5
Backhoe			81								
Compactor			82								
Concrete mixer			85								
Crane (mobile)			83								
Generator			81								
Jack hammer			88								
Paver			89								
Pneumatic tool			85								
Pump			76								
Shovel			82								
Truck			88								

Source: ADB. 2011. Initial Environmental Examination of the Proposed Logistics development Project. Ulaanbaatar; and US EPA. 1971. Construction Equipment Noise Ranges. A blank field indicates no data available.

413. **Measures.** The following mitigation measures will be implemented to comply with EHS standards:

- Ensure communications to inform affected people in advance of noisy activities and the duration e.g. excavation/road breaking;
- Properly maintain construction vehicles and machinery to minimize noise;
- Apply noise reduction devices and methods for high noise equipment operating within 150m of the sensitive sites, i.e., schools, health centers, and religious sites;
- Prohibit operation of high-noise machinery and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am;
- Place temporary hoardings or noise barriers around noise sources during construction;
- Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation;
- Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust the work hours of noisy machinery.

(iii) **Vibration**

414. Vibration impacts will arise from the movement and/or operation of vehicles and equipment, earthworks, drilling, and excavation. Mechanical vibration may be sudden and

discontinuous, which can cause stress among workers and communities. Vibration levels for machinery can be high and could affect buildings and infrastructure.

415. *Measures.* To address these issues: (i) high vibration activities, such as compaction operations will be prohibited at night from 6.00pm to 8.00 am; (ii) Building owners and communities will be consulted prior to large earthworks to ensure they are informed and to avoid sensitive timing, e.g., exams at nearby schools or festivals, (iii) contractors will organize photograph surveys of state of buildings. Vibration impacts are not considered as a key risk due to the relatively limited scope of works and the distance (over 200m) of the nearest residents to main works areas (WWTP and landfill sites).

(iv) **Social Issues**

416. Networks construction may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded, and parking space in front of the residents' houses will be reduced. Additionally, access to public facilities such as schools and health centers/hospitals may be disturbed and submitted to safety risks.

417. The project includes some construction sites that are close to markets areas. These markets are busy areas from morning to early evening with people coming for shopping and social gathering. Moreover, day-time vendors block the road entirely for their commercial activity and permanent shops extent to the sidewalks for outdoor display of their goods.

418. *Measures.* These impacts will be minimized as follows:

- a) To limit inconveniences, construction vehicles should use different roads or dedicated lanes, and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time;
- b) Preparation and implementation of a traffic management plan and coordination with local authorities and communities;
- c) Works must be implemented during night time in areas close to markets, and construction contractor will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non-active periods. Additionally, a preliminary public information will be necessary before starting construction works;
- d) Information disclosure: villagers, residents, public facilities (schools, health centers/hospitals), and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of the expected disruption;
- e) Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways;
- f) Contractors will have to prepare as necessary an access plan which must be submitted to managers of public facilities in order to avoid any disruption of public service. Special attention will be paid to the surroundings of schools and health care buildings. This plan will be validated by the Municipality;
- g) Posting of billboards on the road/lane closure, traffic rerouting plan at strategic places, at least one week prior to works;
- h) Posting of traffic (flag) persons during entire working hours if necessary;
- i) Spreading out the schedule for materials delivery in non-peak hours as far as possible;
- j) Efficient management of truck arrival/departure;



- k) Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width, and length, and if necessary, with guide rail;
- l) Close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.

419. The wastewater networks cross the Poipet railway line at several locations. A trenchless technique will be used to build the crossing to avoid resettlement issues. The aerial crossing of the railway will be used only downstream of pumping station PS\_FM\_02 (rural area).

(v) **Network Disruption**

420. At the beginning of the design phase, it is recommended that a detailed ground topography study be conducted to identify all existing network. During construction phase, existing pipes and cables (piped water, fiber cables, power supply) could be temporarily impacted with potential disruption of the service. The duration of the service disruption will be reduced as much as possible and contractors will have to contact and make arrangements with all the utilities suppliers in order to minimize the impacts.

(vi) **Hiring of Workers**

421. Recruitment of construction workers will prioritize local residents to reduce the number of migrant workers. Thus, construction camps with overnight accommodation will not be necessary. In case of external workers needing accommodation, local guest houses will be selected. On site construction camps will only provide daytime facilities for workers needs during working hours (clean water/sanitation, offices, refectory).

(vii) **Community and Occupational Health and Safety**

422. **For the community:** The exhaust emissions generated can cause respiratory issues for the residents living close to the construction site, especially for the vulnerable population, including the elderly and the very young.

423. Traffic congestion and the risk of accidents may increase with construction traffic, causing temporary inconvenience to traffic, residents, commercial operations, and institutions.

424. *Measures.* For the communities where excavation in the street is required, the following measures will be implemented: (i) night lighting/reflectors around excavations, (ii) barrier/safety fencing installation along the construction site/trench, and (iii) access to properties will be maintained safely, particularly allowing older people safe access to their homes across any excavations.

425. **For construction workers:** Workers will be exposed to social conflicts with communities, transmittable diseases in the community, the presence of unexploded ordnance (UXO), large moving and operating construction vehicles and equipment, and pits and excavations.

426. The construction industry is also considered to be one of the most hazardous industries. Use of heavy construction machinery, tools, and materials present physical hazards including noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, and chemical hazards such as toxic fumes and vapors.

427. *Measures.* The proposed mitigation measures are the following:

- a) Measures implemented for air quality (described above) will also be efficient for prevention of community and worker health;

- b) Contractor compliance with environmental and occupational health and safety guidelines, and also with international guidance (ILO) on worker housing to address quality of for example, accommodation, sanitation, facilitation, fire equipment;
- c) CEMPs will include health and safety plans;
- d) Provision of Personal Protective Equipment (PPE) for workers;
- e) Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly);
- f) Adequate worksite lighting, water supply, sanitation facilities, and safe access;
- g) Establishment of a first-response team comprising trained staff, equipment, tools, supplies, and an adequate office/clinic. The first response team will be linked to ultimate responders;
- h) Appointment of a qualified Environmental, Health, and Safety Officer;
- i) Contractors will comply with local statutory requirements for the use of construction equipment.

428. Additionally, each project contractor will prepare an environmental, health and safety management plan, which will include the following:

- a) Construction site protection: clear signs will be placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues. Heavy machinery will not be used at night. All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate;
- b) Provide a clean and sufficient supply of freshwater for construction sites;
- c) Provide an adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state;
- d) Garbage receptacles at construction sites will be set up, which will be periodically cleared to prevent the outbreak of diseases;
- e) Provide personal protective equipment, e.g., safety boots, helmets, gloves, protective clothing, goggles, earplugs;
- f) Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Poipet will be established. Each construction site will have basic first aid kits;
- g) A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits;
- h) Occupational health and safety matters will be given a high degree of publicity to all work personnel, and posters will be displayed prominently at construction sites;
- i) All workers will be given basic training in sanitation, general health and safety matters, and work hazards. An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and the local communities;
- j) Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.

429. Moreover, at the end of the construction phase, the following measures (minimum requirements) will be implemented to ensure site clean up to an appropriate standard on completion of construction works:

- a) Surplus materials evacuation;
- b) Decommissioning of construction camp facilities and equipment;
- c) Waste removal;
- d) Contaminated soil removal/treatment;
- e) Leveling of soil.

430. **COVID-19 Specific measures.** To protect the health and safety of workers as well as communities potentially affected by ADB-financed and/or administered projects, contractors are required to conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental, health and safety (EHS) plans, which are part of their site-specific contractor EMP (CEMP). These EHS plans should be aligned with any government regulations and guidelines on COVID-19 prevention and control, or in the absence thereof, with international good practice guidelines as may be updated from time to time. The plans need to include sensitization measures to ensure proper briefings and education/capacity development materials, and proper signage for the workers. The contractors' EHS plans should be reviewed and cleared by the Engineer or supervision consultant in consultation with public health inspectors of the area, local medical officers, and other relevant health specialists.

431. The Engineer (or supervision consultant) shall be adequately staffed to undertake a professional review and make recommendations to the EA and monitor the contractors' EHS plans. The TOR of the Engineer (or supervision consultant) reflects the need to supervise and report on the contractors' EHS plans, including COVID-19 risk management. The contractors' CEMP, including the EHS plan, shall be cleared by the Engineer (or supervision consultant) prior to mobilization of construction workers.

432. For all works contracts, contract provision on EHS shall include the requirement to submit a specific COVID-19 risk management plan (as part of the EHS plan) showing what type of arrangements the contractor will take to address this risk.

433. Quarterly project progress reports and the semi-annual environment monitoring reports shall report on the findings of the project-level COVID-19 risk assessment and risk mitigation measures, shall confirm that such mitigation measures have been incorporated in all the contractors' H&S plans before works resumed/commenced at the site, and shall report on H&S plan implementation progress.

## 5.2. Operational Phase

### (i) Air Quality

434. Odor nuisance may be generated during waste dumping in the normal operation of the landfill, as well as accidental dumping during waste transport or temporary storage in the collection points. These effects can be mitigated through structural design and operating procedures.

435. Odor will be an issue / risk for communal collection points 1) if collections are missed or sporadic 2) during emptying of the container. The latter could also cause dust/litter depending on contractors' processes for emptying. These can be mitigated with regular collections, efficient (quick) transfer, cleaning the containers, cleaning spills, disinfection schedule, replacing of broken containers, etc.

436. *Measures for the landfill:* Odor at the landfill site will be primarily controlled through good housekeeping and operational procedures, which will include: (i) operator competence training, (ii) frequent cover, compaction, progressive capping to reduce odor, (iii) interviews with local community e.g. to get feedbacks that may state particular time of day when the odor is worse, etc.; (iv) implementation of additional measures based on such feedbacks.

437. The WWTP is likely to develop an impact on air quality in terms of odor, even if project options have been selected for minimizing this impact.

438. The discharge of septic sewage can be a significant source of odors at the discharge point, whether to an intermediate pumping station or to the inlet of WWTP. The odor threshold level of hydrogen sulfide measured in a laboratory is about 0.5 parts per billion (ppb). The level above which odor problems can occur is typically ten times this value.

439. *Measures for the wastewater system and network.* The following guidelines should be given proper attention in the design of the sewer network:

- a) Maintaining self-cleaning velocities;
- b) Minimizing turbulence wherever there is a hydraulic fall of sewer line;
- c) Ventilation of (gravity) sewers by proper venting arrangement;
- d) Design to ensure prevention of accumulation of grits/debris in the sewer;
- e) Routing maintenance shall consider using chemicals application in main pumping stations & sewer lines close to populated neighborhoods for controlling septicity.

440. Clogging of the stormwater drainage system may generate odor nuisances due to an accumulation of solid waste.

441. *Measures for the stormwater drainage.* The drains will be kept clear and in good working conditions by regular maintenance operations.

## (ii) Noise

442. Noise and vibration sources related to the project during daily operation will be WWTP, pumping stations, waste transportation, and pre-sorting equipment. All these sources but two pumping stations are located far (> 150m) from sensitive receptors such as schools, religious sites, health centers, etc.

443. In the buffer zone of the 6 projected pumping stations (300 meters), the field surveys did not identify significant sensitivity for socio-economic and environmental context, except for the presence of schools and religious sites in the surroundings of pumping stations PS\_FS\_01 and PS\_FS\_02. Anyway, motorized parts of all PS will be sound-insulated.

444. *Measures.* The following mitigation measures will be implemented:

- a) Modern and well-maintained equipment to minimize nuisance;
- b) Noisy equipment (pumping stations and WWTP motors, pre-sorting machinery), will be installed in the closed building;
- c) Apply noise reduction devices and methods for equipment operating within 150m of schools and religious sites (pumping stations PS\_FS\_01 and PS\_FS\_02);
- d) Truck traffic will be allowed during daylight hours as much as possible;
- e) Conduct regular interviews with sensitive areas residents/users to identify noise disturbance. Community feedback will be used to implement new mitigation measures if deemed necessary;

- f) A contact number will be displayed on the station entrances and the WWTP administration phone number will be public.

(iii) **Social Issues**

445. **Waste Transportation.** The collection and transport of solid wastes will become regular activities that will use existing roads and infrastructures. At horizon 2025, there will be an average of 22 trips per day to the landfill during the operational phase (from households and from collection points), which is considered as not significant compared to the existing traffic conditions. Frequent movement of waste trucks will cause a nuisance to villagers living along the access road to the landfill and to the collection points.

446. *Measures.* These impacts will be minimized as follows:

- a) Preparation and implementation of a waste trucks circulation management plan and coordination with local authorities and communities, including speed limits and warning signs along the access road;
- b) The truck circulation plan shall give priority to routing trucks away from dense traffic roads;
- c) Schedule planning for waste transportation in non-peak hours as much as possible.

447. **Landscape Modification and Visual Impact** associated with the new project facilities are very limited. Poipet is located in flat, low-lying land, and the project components are not located in prominent areas that could be easily noticed from a distance. The new landfill and composting plant will be set in an agricultural area without any close neighbors likely to be disturbed, and the potential future residential residence is located more than 500 m away from the proposed site. The WWTP is also set in an agricultural area, with only one remote house located around 200m away from the proposed site. The sorting plant is adjacent to the MRF and close to the existing dumpsite. Thus, other mitigation measures are not deemed necessary at this stage of the project.

448. *Measures.* Allocate time in the DED and during the supervision for an Architect/Landscaper (international/national pair) to enhance facility design.

(iv) **Community and Occupational Health and Safety**

449. Working conditions in the WWTP, landfill, pre-sorting, and composting plant could potentially deteriorate over time if no monitoring is carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.

450. Public safety may be impacted by the implementation of the projects. For instance, accidents may occur on the access roads, and exposure to the treatment pond operations of the WWTP could result in injuries or diseases.

451. *Measures for occupational H&S.* The working conditions in the WWTP, landfill, pre-sorting, and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance (if it does not exist, international guidance will be used). All workers will be trained with regular refresher courses. H&S will be embedded in operational manuals/procedures for each site; it concerns handling of waste and chemicals, waste sorting, safety risk situations of on-site workers, traffic risk situations for drivers, etc.

452. *Measures for community H&S.* Posted speed limits along the access roads will be enforced, and the perimeter of the WWTP and of the landfill will be fenced off to prevent the public from entering the facilities. Access to facilities will be restricted to authorized employees.

## **6. Physical Cultural Resources**

### **6.1. Pre-Construction Phase**

453. No impact is expected during this stage.

### **6.2. Construction Phase**

454. Any local cultural site will be protected from disturbances due to the construction activities, and their access will not be impeded. If the surroundings of cultural sites are affected by construction works, they will be restored to their initial conditions.

455. Chance-find procedures are included in the EMP. In the event that any artifacts are found, works in the site will cease immediately, the site cordoned off, and the Poipet government, EA, and Ministry of Culture notified.

### **6.3. Operational Phase**

456. Any local cultural sites will be kept away from any disturbance due to the operation of the project, and their access will not be impeded.

## **7. Climate Change and Natural Hazards**

### **7.1. Construction Phase**

457. Landslides. The deposit of excavated soil, as well as the weight and the traffic of construction equipment, can cause landslides into trenches. Additionally, water inflows of any kind could compromise the stability of the walls of trenches or the reliability of the excavation bottom.

458. *Measures.* Arrangements must be made to avoid any landslides and ensure the safety of personnel: by shoring or supporting the excavation by any means according to the nature of the soil (wood, sheet metal, mechanical shoring, etc.); and by protecting the site from water inflows. For this, common techniques such as excavation exhaustion or joint shoring could be used.

### **7.2. Operational Phase**

459. Erosion. Erosion may be caused by water flow in the earth's open channel as a part of the stormwater drainage network. This effect may be increased in case of severe meteorological events as a consequence of climate change. Concrete box-culverts chosen for Poipet networks will avoid this impact.

460. Measures for soil erosion control:

- a) Properly slope or re-vegetate surfaces;
- b) Stabilize all cut slopes and embankments: their design should consider climate change effects;
- c) Landscaping will only use native plant species.

461. For the landfill construction, topsoil stripping (to 50 cm depth) will be realized on the total landfill cell area (24,000 m<sup>3</sup>). For the short term horizon, bulk excavation expected volume is 243,000m<sup>3</sup>. This volume will be temporarily stocked on-site. It will then be reused for intermediate and final cells cover.

462. *Measures.* Topsoil will be separated and placed in dedicated stocks (max 2m height). It will be reused for the final cover of the landfill cells in order to preserve the agronomic quality of the site. Soils from the bulk excavation will be used to create a barrier on the site perimeter, aiming to minimize visual and dust impact on the surrounding environment.

## 8. Indirect, Induced, and Cumulative Impacts

463. *Indirect impacts* are adverse and/or beneficial environmental impacts that cannot be immediately traced to a project activity but can be causally linked. *Induced impacts* are adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project which may occur later or at a different location. *Cumulative impacts* are the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in the case of a stand-alone project.<sup>41</sup>

464. **Indirect and Induced Impacts.** The project is expected to result in no significant indirect or induced impacts.

465. **Cumulative Impacts.** During the construction period, other infrastructure projects, such as road repair or road widening activities, may be implemented at the same time as the proposed subprojects. As such, potential localized impacts may be felt to a greater extent in the project influence areas (i.e., additional dust generation from road construction). To minimize these impacts, the following measures can be implemented: (i) communications/consultation/collaboration with other major project construction teams; (ii) co-ordination between project owners.

---

<sup>41</sup> ADB. 2011. Sourcebook for Safeguard Requirement 1: Environment. ADB, Manila.

## VI. ANALYSIS OF ALTERNATIVES

466. An urban development scenarios (UDS) analysis was conducted in 2019 (culminating in a final report prepared in February 2020) to identify urban trends, the population projection for the next 20-years, and future infrastructure needs.<sup>42</sup>

467. Based on this assessment, sector master plans have been produced. For each component, several scenarios were proposed to address the identified gaps.

468. For the selected scenario,<sup>43</sup> the Comprehensive Technical Options (CTOP) was used to develop alternatives to address the short-term horizon (up to 2025).<sup>44</sup>

469. This section examines alternatives to the proposed project site, technology, design, and operation—including the no project alternative—in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

### 1. Wastewater

#### 1.1. Master Plan

470. Three scenarios were considered at the master plan phase: Scenario 0 – do nothing; Scenario 1 – fully centralized; and Scenario 2 – decentralized.

**Figure 28: Wastewater list of scenarios**



Source: Egis, 2021

<sup>42</sup> Workshop held in Phnom Penh on 12 December 2019 with the MEF, MPWT, the Provincial Government, and the Municipal Administration to present the city needs assessment and roadmap.

<sup>43</sup> Workshop at Phnom Penh on 22 April 2020 with the MPWT, the Provincial Government, and the Municipal Administration where the preferred scenario was agreed.

<sup>44</sup> Workshop held in Provincial Hall, Svay Rieng province, Cambodia on 29th Sep.2020 with the MPWT, the Provincial Government, and the Municipal Administration to confirm the technical options for the short-term horizon.



471. **Scenario 0.** The “Do nothing” scenario is a continuation of the current situation with the added growth of population, commercial, and industrial buildings in the built-up area. There is no public wastewater treatment plant or piped collection system.

472. SEZs are reported to provide partial treatment but probably insufficient in some cases (reported in the media): it is not clear whether dyes and other strong chemicals are used and how they are treated and disposed of.

473. As this scenario does not propose any treatment facility for fecal sludge, the “unsafely managed sanitation practices” proportion will rise to 91% in 2040, including 30% off-site sanitation provided by the SEZs (WW not treated/not sufficiently treated). The 9% of “safely managed sanitation practices” corresponds to households located in rural areas that are applying retention of wastewater and not emptying their retention tanks.

474. **Scenario1 – “Fully Centralized.”** The “Centralized” scenario proposes to service the whole built-up areas of Poipet (based on the projected land use 2030) with a centralized wastewater treatment plant. In this scheme, all wastewater is collected by gravity pipes and carried to the treatment plant. Trucking from rural areas will continue for the remaining on-site treatment systems. Connection points to the gravity network are foreseen for SEZs in order to allow the connection (only pre-treated influent is accepted) in areas serviced by the sewer network.

475. **Scenario 2 “Mainly centralized.”** In the “Mainly centralized” scenario, most built-up areas will be serviced by a piped collection network connected to one treatment plant, and on-site treatment systems will be promoted in rural areas, too far to connect. Connection points to the gravity network are still foreseen for SEZs in order to allow the connection (only pre-treated influent is accepted) in areas serviced by the sewer network.

476. This scenario includes the centralized collection and treatment only in the Poipet center. All other built-up areas and rural areas are expected to be served by decentralized systems.

477. **Scenario analysis.** The scenarios were evaluated and while both scenarios would provide 100% safe management of excreta, it was assessed that Scenario 2, where the system would provide a collection and treatment system, focusing mainly on the city centre, and other built up areas and rural areas served by on-site systems, was the preferred option due to lower capital and operational costs, with less pumping stations and force mains.

## 1.2. Site Alternatives

478. An initial assessment of WWTP sites in Poipet was carried out in November 2019 and presented during the UDS workshop in December 2019.

479. Four sites were selected based on discussions between the MPWT, the Municipal Administration (MA), and the TRTA consultants.

**Figure 29: WWTP - site alternatives**

Source: Egis, 2021

**Table 29: Site Assessment Summary**

<b>Criteria</b>	<b>Site 1 (GMS1)</b>	<b>Site 2</b>	<b>Site 3</b>	<b>Site 4</b>
<b>Area available</b>	14ha	20ha	21ha	4.3ha
	Government	Private	Private	Private
<b>Site description</b>	Ou Kaidon Reservoir, located by the side of the National Road no.5	Paddy/rice field (Classified as agricultural in land-use 2030)	Paddy/rice field (Classified as agricultural in land-use 2030)	Land located close to the city center, currently agricultural, residential under project land-use 2030
<b>Distance from city center</b>	9.7km	10.5km	15.0km	5.6km
<b>Distance from closest residential area</b>	300 m	2.1km	2km	800m
<b>Access road</b>	170m to National Road no. 5	5.2km to National Road No.5 2.6km to National Road No.59	2.5km to National Road No.59	350m to National Road no. 5
<b>Effluent discharge location</b>	Ou Kaidon Reservoir	Ou Chrov river or stream is belonging to the same river system.	Ou Chrov river or any stream belonging to the same river system.	Ou Chrov river (passing south of the site considered)
<b>Flooding</b>	Currently water body	Low lying area having annual flooding	Seasonal flooding (min. water height = 0.5m)	No specific flooding issues out of the ones known on the city center.
<b>HH / Activities within the 100m buffer zone</b>	A few industrial buildings	17-20 HH living from farming	The residential area currently under construction	

Source: Egis, 2021

480. **Site analysis.** Land acquisition problems and costs, as well as planned land use around and within the WWTP buffer zone, have led to discarding the site 4. Site 1 is located on a water resource. Because this location might cause water quality issues, this option has also not been considered. The remaining options, sites 2 and 3 are relatively equivalent in terms of constraints. However, site 2 is closer to the city center. For this reason, the cost of transfer is lower.

## 2. Stormwater Drainage

### 2.1. Master Plan

481. Four scenarios were assessed during the master plan stage, as indicated in the figure below.

**Figure 30: Stormwater list of scenarios**

Scenario	Scenario 0	Scenario 1	Scenario 2	Scenario 3
Assumptions	Continuation of present situation with added growth of population, commercial, and industrial buildings in the built-up area.	Construction of new buildings such as hotels, shopping malls, casinos, and parking areas will continue to cover the natural land with concrete, steel, and asphalt structures. Runoff rates will increase from these impermeable surfaces and cause more localized flooding on streets and around buildings in low-lying areas.	Natural slopes of the land and the small scale existing drainage will continue to cause flooding along roads and ditches in adjacent residential areas north and south of the national highway. In some cases, flooding will mix with sewage and create odors, increase risk and exposure to human contact and potential health hazards. The financial cost of flooding is not estimated.	
Storm Intensity	1 in 2-year storm intensity	1 in 2-year storm intensity	1 in 5-year storm intensity	1 in 5-year storm intensity
Design Rainfall	90mm (max. intensity: 124.5mm/h)	90mm (max. intensity: 124.5mm/h)	90mm (max. intensity: 124.5mm/h)	90mm (max. intensity: 124.5mm/h)
Return Period	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Standard	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Flow	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Velocity	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Slope	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Elevation	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Depth	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Width	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Length	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Area	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Volume	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Time	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year
Design Cost	1 in 2-year	1 in 2-year	1 in 5-year	1 in 5-year

Source: Egis, 2021

482. **Scenario 0.** This scenario is a continuation of the present situation with the added growth of population, commercial, and industrial buildings in the built-up area.

483. Construction of new buildings such as hotels, shopping malls, casinos, and parking areas will continue to cover the natural land with concrete, steel, and asphalt structures. Runoff rates will increase from these impermeable surfaces and cause more localized flooding on streets and around buildings in low-lying areas.

484. Natural slopes of the land and the small scale existing drainage will continue to cause flooding along roads and ditches in adjacent residential areas north and south of the national highway. In some cases, flooding will mix with sewage and create odors, increase risk and exposure to human contact and potential health hazards. The financial cost of flooding is not estimated.

485. **Scenario 1.** This scenario has been assessed based on rates for built-up areas based on a 1 in 2-year storm intensity. Less intense and more frequent storms were accommodated in the model. More intense and less frequent storms to be expected every few years will still cause occasional street flooding and damages to buildings and contents.

486. The system is designed for a cumulated rainfall height of 90mm (max. intensity: 124.5mm/h) equivalent to a 1-in-5 year return period.

487. **Scenario 2.** This scenario has been assessed based on rates for built-up areas for a 1 in 5-year storm intensity. Less frequent flooding during intense rainfall will occur as the infrastructure proposed will provide for a higher level of service (compared to a 1 in 2-year storms). However, this scenario will also require higher construction costs.

488. The system is designed for a cumulated rainfall height of 70mm (max intensity: 97mm/h).

489. **Scenario 3.** This scenario has been assessed based on runoff rates for built-up areas for a 1 in 10-year storm intensity. Less frequent flooding during intense rainfall will occur as the infrastructure proposed will provide for a higher level of service. Similar to the 1 in 5-year scenarios 2, this will incur a higher construction cost.

490. The system is designed for a cumulated rainfall height of 95mm (max. intensity: 207mm/h).

491. **Scenario analysis.** In terms of people, institutions, SEZ, etc. connected, the last three scenarios have the same impact but with a different level of service: 1 in 2 year return period and 1 in 5 years and 1 in 10 years.

492. The financial assessment found that the 1 in 2-year drainage design will be approximately 11% less expensive than the 1 in 5-year design. Operations costs are estimated to be identical.

493. Comparison of protection from 1 in 2 years return period urban drainage design and 1 in 5-year design for a 2.7 km<sup>2</sup> urban area in Italy showed that the additional annualized costs of 1.5 million Euros (15%) to provide 1 in 5-year storm protection over 1 in 2-year protection resulted in \$6 million less flood damage costs.<sup>45</sup> In many cities, the higher standard for urban drainage pipes and channels of 1-in-5 year design is now used, and it is considered an affordable balance between drainage infrastructure costs and reduced flood damage.

494. Therefore, and as recommended in the national Road Design Standard (MPWT, 2003), it was agreed to design the urban drainage of the city for a capacity for 1 in 5 years storm runoff.

## 2.2. Site Alternatives

495. Urban drainage is limited to existing concrete roads service.

496. Typical drainage lines are normally implemented on both sides of the road, where many buildings are present in existing areas and developing elsewhere. Some of these constructions are clearly encroaching on the road right of way, as a temporary facility (equipment stored at night time such as tables/chairs).

497. A basic topographical survey of the road center line has been completed in the coverage area. The proposed drainage network follows the natural topography and discharges at low points of the road. As far as possible, the few existing cross-drains will be reused to limit the cost of road cutting and reinstatement.

498. Discharge of the proposed urban drainage will be to the existing rivers, and special outfall structures, energy reduction, and dispersal are required to avoid erosion along the river from the concentration of discharge.

---

<sup>45</sup> Selection of the Optimal Design Rainfall Return Period of Urban Drainage Systems, A. Fortunato\*, E. Oliveria , M. R. Mazzolaa, 2014

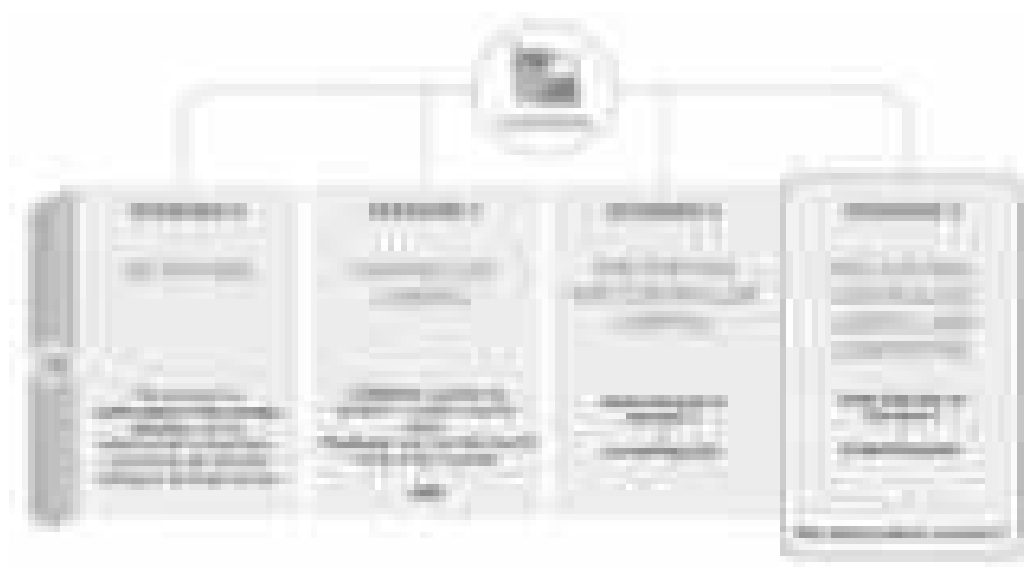
499. Choices on drainage network location aim at limiting nuisance to agricultural land use as well as to residential and commercial areas.

### 3. Solid Waste

#### 3.1. Master Plan

500. The following solid waste treatment scenarios were assessed as part of the master plan:

**Figure 31: Solid waste management - list of scenarios**



Source: Egis, 2021

501. **Scenario 0.** The impacts of the 'Do Nothing' Scenario include the decrease of recovery rate and collection rate with population and urban growth.

502. Moreover, the environmental impact of the existing dumpsite is the main issue, particularly in terms of groundwater pollution and greenhouse gas (GHG) emissions, as well as atmospheric pollution from waste burning. Furthermore, in terms of working conditions, the waste discharging process from trucks is not as safe as it is done manually by collection operators. Scavengers at the dumpsite will still work in poor conditions, and health risks and safety are the main issues (children are also part of the scavengers, estimated at 10% during the site visit).

503. **Scenario 1.** In terms of household waste collection coverage, this scenario proposes improvements in terms of 50% in 2025, 75% in 2030, and 85% in 2040 by developing:

- (i) **The door to door collection** in the dense urban area, where every household are very close one to another, the door to door collection is a high service standard. Waste is collected at each property limit. It is already functional nowadays. It is admitted that all the SEZ are within urban areas, so collected with the door to the door system.
- (ii) **The centralized collection points.** To limit the cost of collection, centralized collection points are preferred to a door-to-door collection due to the fact that households are relatively scattered and road access is poor (most of the roads in rural areas are not asphalted).

504. **Disposal/Treatment.** A controlled landfill to be built by 2025. The existing MRF would maintain its current purpose, packing the recyclables collected by the waste pickers.

505. **Scenario 2.** In this scenario, the collection, transport, treatment, and disposal are the same as in scenario 1. A pre-sorting plant, located near the new landfill site, is proposed and will allow managing of the dry recyclable.

506. **Scenario 3.** In addition to scenario 2, a composting plant is proposed in this scenario with the goal to reduce landfill. Compost is an opportunity to reduce greenhouse gas emissions compared to landfilling, as soils store the compost carbon. The biowastes considered for composting are the following:

- (i) Biowaste from markets, assuming an 80% source-sorted collection rate, based on successful experience in Battambang.
- (ii) Biowaste picked up manually at the pre-sorting plant, mainly green waste: it is assumed that 5% will be recovered from the biowaste flow. In the long term, the recovery rate could be improved.

507. **Scenario analysis.** Based on the impact assessment, Scenario 3 has been recommended for the following reasons:

- (i) It provides the highest diversion rate from landfill, 32% compared to 25% without composting, and 17% without composting and pre-sorting plant.
- (ii) Even if the composting plant costs are not recovered by the compost selling revenues due to low market maturity, long-term benefits should be considered, such as lower landfill footprint and economic benefits for farmers.
- (iii) In the long term, job creation would reach around 194 jobs. Most of the jobs would be accessible for poor and not qualified employees, such as actual waste pickers and scavengers.
- (iv) In scenarios 2 and 3, revenues from recyclables recovered at the pre-sorting plant are equivalent to or higher than total scenario OPEX. Therefore controlling part of the recyclables economy would improve the economic sustainability of solid waste management in Poipet. It would also trigger social and environmental benefits.

### 3.2. Site Alternatives

508. An initial assessment of landfill sites in Poipet was carried out in November 2019 and presented during the UDS workshop in December 2019. Its purpose was to identify the suitability of the sites proposed by the city authorities and by the Consultant in order to anticipate land acquisition issues and secure the project preparation and implementation process.

509. Four sites were selected based on discussions between the MPWT, the MA, and the consultants. Each was chosen based on the criteria of the “Technical Guidelines on Urban Solid Waste Management” (MoE, 2016), listed in Table 11: Criteria for selection of the landfill site. The figure below shows their locations, and the table below summarizes the site assessment.

**Figure 32: Landfill sites locations**

Source: Egis, 2021

**Table 30: Summary of landfill site assessments**

<b>CRITERIA</b>	<b>SITE 1</b>	<b>SITE 2</b>	<b>SITE 3 AND 4</b>
Area available	17ha	10 to 20ha	10 to 20ha
Owner	Government	Private	Private
Site description	A former quarry, close to the existing dumpsite and MRF facility	Agricultural land and rice fields	Agricultural land and rice fields
Distance from city center	Within the city boundaries	20km	20km
Distance from the closest residential area	More than 300m	1,000m	2,000m
Access road	1km paved access road required	3.5km paved access road required	6 km paved access road required



Environmental	Located in the urban expansion area, 40 m depth quarry, no special ecosystem	No flooding, no special ecosystem	Flooding occurrence, humid zone with a small stream
---------------	--	-----------------------------------	---

Source: Egis, 2021

510. **Site 2** was chosen as the preferred site by the stakeholders during the workshop held the 12 December 2020. This site itself is compliance with the criteria of the technical guideline on urban solid waste management of MoE, 2016 such as more than 10Km from the Poipet downtown, 4Km from the National Road, more than 5Km from the tourism site/religion site, more than 60Km from the national heritage, more than 100Km from the airport, year round access road, and no flooding. The selected location is mainly made of agricultural rice fields (paddy).

### 3.3. Technical Options – Landfill

511. Two solutions for final disposal of residual waste were proposed:

- (i) Controlled landfills;
- (ii) Sanitary landfills.

512. According to ADB guidelines, a controlled landfill is usually the most appropriate disposal system for most small to midsize municipalities. A sanitary landfill is generally too expensive and too complex for small to midsize municipalities to operate sustainably without ongoing external technical support or funding. Also, the additional operating costs for items like the leachate treatment plant are significant but yield little or no environmental gain at this scale, given their demonstrated unreliability. Furthermore, the required removal of all waste scavenging from the site could have significant social impacts and increase airspace consumption.

513. The selected solution for final disposal is a controlled landfill. Within this overall definition, consideration must be given to the different technical options for the landfill, focused on three principal elements:

- (i) The basal lining system
- (ii) The leachate treatment system
- (iii) The landfill gas treatment system

514. The following tables show the options for lining, leachate treatment, and landfill gas treatment. It is necessary for the landfill cells to have a low permeability basal liner, with a permeability less than  $1 \times 10^{-9}$  m/s, for which there are two options:

**Table 31: Technical options for the basal liner**

Criteria	HDPE geomembrane	Mineral clay liner
<b>Availability of materials</b>	Easily available on the market.	No source was identified.
<b>Ease of installation</b>	Requires trained installation contractor (of which there are many).	Requires appropriate plant (sheepsfoot roller) and expertise.
<b>Need for controls during construction</b>	An installation QA/QC scheme is necessary.	An installation QA/QC scheme is necessary.
<b>Degree of protection</b>	High.	Good.
<b>Permeability</b>	$<1 \times 10^{-12}$ m/s	$<1 \times 10^{-11}$ m/s
<b>Long-term durability</b>	Good.	Excellent.
<b>Cost</b>	High.	High.

Source: Egis, 2021

515. **Choice of baseliner option** In view of the above analysis, it is recommended that a basal geomembrane liner be used. This is principal because of the doubts about the availability of clay (in-situ or off-site) for a mineral liner: this point may be verified at the DED stage, based upon the findings of the site investigation.

516. The leachate will be drained by gravity towards the collection well at the low point and then, still by gravity, to a leachate storage lagoon. There are then three options for the treatment of the leachate, as follows:

**Table 32: Technical options for the leachate treatment system**

Criteria	Off-site treatment	On-site treatment	Recirculation
<b>Technical complexity</b>	High, depending upon the technology used.	None (on-site).	Low. The only operating plant is the pumping station.
<b>Investment cost</b>	High, depending upon the technology selected.	None.	Moderate. The recirculation system requires a small pump, distribution pipework, and infiltration drains or wells.
<b>Operating cost</b>	The operating costs per m <sup>3</sup> treated are high for a small leachate treatment plant, requiring manpower, reagents, and electricity.	Moderate. There are two costs - the transport cost by tanker and the cost charged by the WWTP for treating the leachate.	Low. The only costs are pump maintenance and electricity.
<b>Environmental impact</b>	Dependent upon the degree of treatment applied – for high-tech solutions, such as reverse osmosis, the discharge is very clean.	The transport of the leachate to the WWTP has an impact (GHG emissions, traffic circulation). Otherwise, the impact of the discharge is dependent upon the quality of treatment at the WWTP.	The recirculation of the leachate into the waste mass does promote the degradation of the waste and, thus, LFG emissions. It requires an effective operation of the site and good LFG measures.

517. **Choice of leachate treatment option.** It is proposed to use a combination of leachate recirculation and off-site treatment at WWTP. This solution is chosen because it avoids expensive and complex on-site treatment whilst, at the same time, providing a flexible means of managing the leachate as its quantity and quality vary over time. The use of leachate recirculation is a tried and tested technique, which, although it does need to be properly managed, does not require expensive reagents and technical expertise to implement. The majority of the leachate will be recirculated back into the landfill mass, with the excess being tankered off-site for treatment at the WWTP. The recirculation uses a pump in the leachate pond, with pressure lines leading from the leachate pond up to the landfill surface, where the leachate enters the waste mass via infiltration drains or wells.

518. There are three options for the treatment of the LFG:

**Table 33: Technical options for the landfill gas treatment system**

Criteria	Passive venting	Active venting with a flare stack	Active venting with electricity generation
<b>Technical complexity</b>	Simple.	Moderate.	High.

<b>Operational requirements</b>	Almost none.	Simple maintenance & monitoring.	Moderately difficult maintenance & monitoring.
<b>Reduction of greenhouse gas emissions</b>	None.	Good.	Good.
<b>Capital costs</b>	Low. Very low.	Moderate. Low.	High. Moderate to high but balanced by the value of electricity produced.
<b>Operating costs</b>			

Source: Egis, 2021

519. **Choice of LFG treatment system.** Based upon the above comparative analysis, the most suitable technical option is considered to be the flare stack. This is a relatively cost-effective solution, easy to maintain, which also meets the environmental requirements such as reduction of GHG emissions, limiting odors, etc., that a passive system would not provide. The use of LFG flare stacks is an extensively used technology in similar countries and it does not need a high degree of technical supervision or expertise. Furthermore, the estimation of LFG production indicates that an LFG-to-energy plant would not be a cost-effective solution for the site conditions.

## VII. CONSULTATION AND PARTICIPATION

### 1. Consultations undertaken

520. As a first step in preparing LCIP, a stakeholder analysis was completed to identify the key actors, their interests, and strategies to maximize their participation in the project. Information was gathered from (i) the different government organizations that will be involved in project implementation, (ii) civil society, (iii) public and private actors in the water and waste management sectors, and (iv) community members living in the project area.

521. In developing the project, a series of stakeholder consultations and workshops were carried out preparatory by the technical assistance team comprising international and national specialists with representatives at Sangkat, Municipality, Province, and Ministry levels, with community members and with private companies. In particular, detailed environmental consultations were undertaken as part of the social consultation in September 2020 (see Appendix 4).

522. As summarized in Table 34, consultations comprise interviews with stakeholders and completion of a questionnaire form. The consultations focused on: (i) current household livelihoods and living conditions (income, water and electricity supply, sanitation and waste disposal); (ii) community observations and concerns on current environmental and climate changes; (iii) social and gender issues (gender division of labor and decision-making, opportunities for poor and disabled persons); and (iv) existing needs and priority actions required for improvement of the livability of the city and for its sustainability.

**Table 34: Consultations undertaken in Poipet**

No	Name of the meeting	Date	Location	Total participant	Female (Person)
<b>A</b>	<b>The General Consultations</b>				
1	In an urban area	09/09/2020	Ou Chrov high school	49	30
2	In a rural area	10/09/2020	Psar Kandal pagoda	71	21
<b>B</b>	<b>Focus Group discussion (FGD)</b>				
3	FGD 1 ID poor	09/09/2020	Ou Chrov high school	10	6
4	FGD 2 FHHs	10/09/2020	Psar Kandal pagoda	11	11
5	FGD 3 Elder people	09/09/2020	Ou Chrov high school	12	9
6	FGD 4 Disable people	09/09/2020	Psar Kandal pagoda	15	
7	FGD 5 Youth (12-15 years old high school)	10/09/2020		13	5
8	FGD 6 Indigenous people	09/09/2020	Ou Chrov high school	10	6
9	FGD 7 Informal worker in solid waste management	10/09/2020	Psar Kandal pagoda	12	1
10	FGD 8 local authority	09/09/2020	City meeting hall	30	3
<b>C</b>	<b>Consult key CBOs/ NGOs</b>				
11	Imparting Smile Association Cambodia	09/09/2020	Imparting Smile Association Cambodia office	2	0
12	Don Bosco	09/09/2020	Don Bosco office	3	1

13	Damnok Toek	09/09/2020	Damnok Toek office	1	0
----	-------------	------------	--------------------	---	---

Source: Egis/KCC, 2020 - Social Survey

## 2. Results of consultations

4 Consultations provided input on the design of the project, it helped determine project priorities, socio-economic objectives, and confirm linkages with local development plans and aspirations. The information and recommendations gathered from the various stakeholder consultations has been incorporated into the design of the project to ensure that the investments align with local priorities and development plans, and that they will deliver equitable socio-economic benefits to the whole population, including women, the poor and vulnerable.

523. The results of the pre-implementation consultations are summarized in Appendix 4. There is broad community support for the project's approach to combine urban infrastructure development with capacity building to improve waste and water governance and management, improve urban sanitation and increase the city attractiveness.

524. In COVID-19 context, measures to minimize health risks during gathering meetings with community, including FGD, and HH survey, were applied in two ways:

- (i) In communities with no presence of COVID-19 detected, face to face meeting could be organized but with respect to the following rules:
  - a. Prevention methods should be applied, such as, wearing masks, washing hands, and respecting social distances of at least 1.5m between each participant,
  - b. the number of participants shall not exceed more than 50 persons
  - c. The meeting must take place in open spaces, without air conditioning
- (ii) In communities where the presence of COVID-19 has been detected, only the online method should be used for both FGD and the HH survey.

## 3. Roles of stakeholders in planning, design, and implementation

525. ADB is committed to putting meaningful consultation processes into practice. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender-inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision makings, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

526. ADB requires borrowers/clients to engage with communities, groups, or people affected by proposed projects and with civil society through information disclosure, consultation, and informed participation in a commensurate manner about the risks and impacts on affected communities. Enhancing stakeholder participation has also been shown to build understanding and support among diverse groups, which can improve project design and impacts.

527. Consistent with these efforts, the objectives of the consultation and participation plan and related stakeholder communication strategy are to: (i) fully disclose information on the proposed project, its components, and its activities with the beneficiary communities and stakeholders, (ii) obtain information about the opinions, needs and priorities of beneficiary communities and stakeholders; social input and feedbacks eg. on the quality and affordability of

services, (iii) encourage the participation of beneficiary communities and stakeholders in project activities such as the payment for connection or services, changes in waste management practices, change in the extend and quality of services delivered, participation to O&M, awareness-raising activities, capacity building, enforcement of local regulations and monitoring; (iv) obtain the cooperation of beneficiary communities and stakeholders for activities required to be undertaken as part of project planning and operation, (v) establish clear monitoring and effective grievance redress mechanism; and (vi) ensure transparency in all project activities.

#### **4. Stakeholder consultation plan**

528. The public consultation plan is described in the chapter Environmental Management Plan. In general, regular information exchange meetings with stakeholders are recommended throughout the implementation of the subprojects.

529. More specifically, stakeholders who may be affected by a subproject, or concerned about its environmental impacts, are entitled to lodge complaints regarding any aspect of the subproject, from its preparation to its implementation. In this regard, the grievance redress mechanism (see page 122) aims to resolve complaints promptly and locally, through a conciliation process, and, as a last resort, to provide clear and transparent procedures for appeal.

530. Household connections are vital to the operation of the proposed wastewater management strategy, and therefore to achieve environmentally beneficial outcomes. To encourage households to connect to the sewerage system, the cost of connection will be subsidized by the project.

#### **5. Next public consultations**

531. An additional public consultation campaign should be organized prior to DED phase in order to accommodate any project changes and schedule adjustments. Any future consultations will be required to follow national guidance from the Ministry of Health regarding COVID-19 protection for all participants.

## **VIII. INFORMATION DISCLOSURE**

532. All stakeholders will be provided with information on the subproject component, comprising: (i) description of project components; (ii) site locations; (iii) proposed construction measures; (iv) environmental impact assessment procedures; (v) avenues for public feedback; (vi) contact details of the executing and implementing agencies; and (vii) procedures and scope of the EIS. This IEE and corresponding EMP as well as the updated versions at detailed engineering design stage, and Semi-Annual Environmental Monitoring reports for the Project will be submitted to ADB and disclosed on their website when the documents are cleared.

533. The domestic disclosure will be conducted by the posting of information on government websites and on public notice boards in the city halls and by distributing information booklets.

534. Once more advanced preparations of the project designs are undertaken, the second round of information will be conducted to seek public feedback on the findings, including potential impacts, mitigation measures, and consultations with communities and businesses in and near project sites.

## **IX. GRIEVANCE REDRESS MECHANISM**

535. The grievance redress mechanism (GRM) is described in more detail in the EMP (chapter X.9. Grievance Redress Mechanism). A summary is provided below.

536. A GRM has been developed in compliance with ADB's SPS (2009) requirement to address environmental, health, safety, and social concerns associated with project construction and operation. The GRM is designed to achieve the following objectives: (i) provide channels of communication for local communities to raise concerns about the environment- and social-related grievances which might result from the project; (ii) prevent and mitigate adverse environmental and social impacts to communities caused by project construction and operation; (iii) improve mutual trust and respect and promote productive relationships between the project agencies and local communities; and (iv) build community acceptance of the project. The GRM is accessible to all members of the community, including women, youth, remote herders/farmers and communities, and poverty-stricken residents. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media.

537. Public grievances to be addressed by the GRM are most likely to involve disturbance from construction dust, noise, traffic, soil erosion, interruption of public services, inappropriate disposal of construction materials, and safety for the general public and construction workers. It could also concern odors (landfill, WWTP, collection points) and waste dispersions by the wind during the operational phase.

538. Currently in Cambodia, there is no legally established system to resolve environmental grievances and complaints. The Ministry of Public Works and Transport (MPWT), as the Executing Agency (EA) of the LCIP, establishes the GRM before the start of the construction phase and counts members from the Project Management Unit (PMU), the district authority, and the commune government within its ranks (here, commune councils). The PMU's Environment Officer (PMU-EO), as the focal point, will supervise the mechanism's implementation with technical support from the PMU's environmental safeguard consultants and will be responsible for updating the PMU. The Project Implementing Unit's environmental officer (PIU-EO) will be accountable for guaranteeing the implementation of the GRM at the subproject level, in collaboration with the PIU Social Officer (PIU-SO).

539. The PMU is assigned the role of ensuring the awareness of the public and stakeholders of their rights to access the GRM without administrative or legal charges. The existence of the GRM will be fully disseminated before construction works begin, through an effective public information campaign (public consultations, posters, distribution of information booklets), in an effort to inform the stakeholders concerning their rights and the procedures for filing grievances and understanding the GRM access points available to them.



## **X. ENVIRONMENTAL MANAGEMENT PLAN**

### **1. Overview**

540. The Environmental Management Plan (EMP) presents the mitigation and enhancement principles, practices, and technologies aimed at minimizing and/or eliminating the potential impacts of the project to its surrounding environment. The EMP is a dynamic document that may be updated any time during project implementation if it is found inadequate. Corrective actions or additional mitigation measures may be included.

### **2. Objective and Scope**

541. This EMP is for the Poipet subprojects of the Livable Cities Investment Project - LCIP (hereafter referred to as the project). The EMP is to be implemented in all phases of each subproject – design, pre-construction, construction, and operation. The EMP is to ensure project compliance with Cambodia’s environmental laws and the Safeguard Policy Statement (SPS, 2009) of the Asian Development Bank (ADB).

542. During the preparation of the Detailed Engineering Design (DED), the project implementation unit (PIU), acting on behalf of the executing and implementing agencies, will pass this EMP to the engineering design team for the incorporation of the mitigation measures into the detailed designs.

543. The EMP will be updated at DED stage to be aligned to the updated design and any MoE requirements and conditions in the domestic environmental assessment shall be incorporated into the respective IEEs and corresponding EMPs, ideally before bidding, and latest before works commence.

544. The updated DED stage EMP will be as part of the bidding documents. This updated bidding-ready version of the EMP (and updated IEE) shall be shared with ADB for clearance and disclosure on the ADB website.

545. To ensure that bidders will respond to the EMP’s provisions, the PIU will prepare and provide the following specification clauses for incorporation into the bidding documents:

- (i) a list of environmental management requirements to be budgeted by the bidders in their proposals;
- (ii) environmental clauses for contractual terms and conditions, and;
- (iii) the updated EMP, for compliance.

546. If any variation orders take place under project implementation it shall be assessed by ADB if the environmental due diligence will need to be further update and re-disclosed.

### **3. Structure of the EMP**

547. The EMP describes the roles and responsibilities of relevant institutions for EMP implementation; potential impacts and the measures to mitigate them; environmental monitoring and inspection; institutional strengthening and training; inspection, monitoring, reporting arrangements, and EMP’s implementation costs; grievance redress mechanism (GRM); and, future public consultation.

## 4. Implementation Arrangements

### 4.1. Roles and Responsibilities

548. The institutional management framework supervising EMP consists of:

- a) The MPWT, as the EA of all subprojects;
- b) A PMU, created within the EA, whose role is to supervise the implementation of all subprojects. A Social and Environmental Monitoring Unit (ESMU) already exists in the MPWT and activities of the officers should be coordinated with this unit during implementation. The PMU will be held accountable for the implementation and operation of the subproject on behalf of the EA and will work as a national subproject agency;
- c) The PDPWT, as the chairman of the PIA of all subprojects in each province;
- d) A PIU per targeted city, who will assist the PMU and coordinate the day-to-day implementation of the subprojects.

549. **PMU:** An environment officer (PMU-EO) and a social/resettlement officer (PMU-SO) will be assigned at the PMU.

550. **PIU:** An externally recruited environmental officer (PIU-EO) and a social/resettlement officer (PIU-SO) will be assigned at the PIU. The PIU will ensure adequate working relations with local actors engaged by the PMU e.g. contractors, suppliers and service providers.

551. **Design and Construction Supervision Consultant:** Advisory services will be provided to the PMU and PIU by the Design and Construction Supervision Consultant (DCSC). The DCSC will engage one suitably qualified national environmental safeguards consultant and one international environmental safeguards consultant.

552. Project management services will be provided under the DCSC contract, concerning project management, financial and procurement methods, monitoring and evaluation procedures, and operation and maintenance works. The EMP and IEE updates required for the Project will be implemented by the PMU with support of the DCSC Environmental Safeguards team.

**Table 35: Institutional responsibilities for EMP implementation**

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
<b>Executing Agency</b>	<p>MPWT is responsible for ensuring the implementation of the mitigation measures in the EMP and in ensuring compliance with loan covenants</p> <p>Collaborate with the MoE for the subprojects' compliance with the Government's environmental safeguard requirements on IEIA and EMP implementation</p> <p>Coordinate with implementing agencies, other stakeholders, and ADB the efficient project implementation activities, including the EMP</p> <p>Chairs the project steering committee</p> <p>Co-signs approval for withdrawal applications from project advance account (with Ministry of Finance)</p> <p>Accountability and responsibility for project planning, management, and</p>		

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
	<p>implementation</p> <p>Timely and effective execution of loan agreement</p>		
<b>Implementing Agency</b>	<p>The Provincial Department of MPWT oversees implementation in conformity with the Project's development objectives and scope;</p> <p>Assist the coordination among government agencies involved in subprojects' implementation, including PDOE;</p> <p>Ensure coordinated and efficient project implementation activities including EMP.</p>		
<b>PMU</b>	<p>Hold overall accountability of the subproject implementation and operation on behalf of the EA and work as national subproject agency</p> <p>Review any new proposals involving projects and/or safeguards</p> <p>Facilitate timely allocation and disbursement of required counterpart financing and/or internal government budget ceilings, to enable the project to achieve annual disbursement targets</p> <p>Ensure sufficient domestic financial and technical resources are allocated for the project EMP</p> <p>Review and formally approve (in writing) the submitted CEMPs</p> <p>Procure and manage DCSC (including PMC) for subproject implementation</p>		
	<p>Update IEE and EMP</p> <p>Coordinate with DCSC to ensure the incorporation of updated findings &amp; mitigation measures in the design &amp; bidding documents</p> <p>Ensure EMP is part of the bidding documents, EMP clauses are incorporated in bidding documents, contracts</p> <p>Ensure MoE approval of IEIA Report has been secured prior to awarding of civil works</p> <p>Conduct affect people consultation</p> <p>Establish and disseminate GRM</p>	<p>Formally approve CEMP</p> <p>Conduct inspections and spot checks to monitor the performance of the contractor in implementing the CEMP/EMP</p> <p>Prepare the Project's semi-annual EMR for submission to ADB</p> <p>EMP implementation site visits</p> <p>Implement the GRM for environmental Issues</p> <p>Conduct appropriate consultation and monitoring of effect of construction on effect people</p>	<p>Review relevant operator monitoring report</p> <p>Prepare the Project's semi-annual EMR for submission to ADB, until loan closure or as agreed</p> <p>Ensure all GRM complaints are closed out to affected person's satisfaction</p>

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
		Participate in training	
<b>PIU-EO</b>	<p>Represents the executing and implementing agencies for implementation – planning, coordination, guidance, procurement, supervision, monitoring, reporting</p> <p>Central office (at MPWT in Phnom Penh) and field offices in Poipet</p> <p>Supervise and manage EMP implementation</p> <p>Manage and monitor contractors and suppliers</p> <p>Coordinate with PMU on progress and monitoring</p>		
	<p>Submit bidding documents, bid evaluation reports and other documents to ADB for necessary approval</p> <p>Coordinate and collaborate with relevant provincial agencies, as necessary</p> <p>Support PMU-EO</p> <p>Conduct affected people consultation</p> <p>Establish health and safety baseline conditions in affected villages</p> <p>Establish GRM for environmental Issues</p> <p>Conduct trainings in collaboration with DCSC</p>	<p>Collate monthly EMR of contractor, and submit to the PMU</p> <p>Oversee the conduct of the environmental effects monitoring to be managed by the contractor and testing to be conducted by MoE Laboratory</p> <p>Implement the GRM for environmental issue</p> <p>Conduct consultation and monitoring of construction impacts on people</p> <p>Conduct training in collaboration with DCSC</p> <p>Verify EMP implementation and report on it</p>	<p>Support reporting requirements of PMU</p> <p>Ensure all GRM complaints are closed out to affect person's satisfaction</p>
<b>ADB</b>	<p>Clear and disclose updated IEE/EMP, review bidding documents, confirm readiness of subproject</p> <p>Undertake periodic loan review missions to check EMP compliance</p>	<p>Undertake loan review missions to check EMP compliance</p> <p>Clear and disclose semi-annual EMR</p>	
<b>Contractor</b>	<p>Prepare a CEMP that addresses as minimum the requirements of the</p>	<p>Implement mitigation measures &amp; conduct internal EMP</p>	

Institution	Prior to Construction including Detailed Engineering Design	During Construction	During Operation and Decommissioning
	<p>EMP</p> <p>Engage EHS specialist for construction site(s)</p>	<p>implementation monitoring</p> <p>Conduct environmental quality monitoring of the EMP. (If an independent licensed laboratory will not be engaged)</p> <p>Prepare Monthly and semi-annual EMRs</p>	
<b>Operator</b>	Ensure budget for O&M to ensure design standard of operation		<p>Implement mitigation measures &amp; conduct internal EMP implementation monitoring</p> <p>Prepare Monthly and Annual EMRs</p>
<b>MoE / PDOE</b>	Review, comment on approve EIA/IEIA Report.	Monitor compliance with approved EIA/IEIA & EMP	Monitor compliance with environmental standards
<b>Municipality</b>	<p>Facilitate obtaining the necessary inputs from and/or participation/ cooperation of, concerned communes and villages through collaboration with their Commune Councils</p> <p>Facilitate (&amp; participate in) GRM dissemination and implementation</p>	<p>Participate in monitoring of the performance of contractor with the CEMP implementation</p> <p>Facilitate &amp; participate in GRM dissemination and implementation</p>	
<b>Commune Councils</b>	Facilitate and participate in GRM dissemination and implementation	<p>Participate in monitoring of the performance of contractor in EMP implementation</p> <p>Facilitate and participate in GRM dissemination and implementation</p>	

ADB = Asian Development Bank, CEMP = Contractor Environmental Management Plan, RM = grievance redress mechanism, MPWT = Ministry of Public Works and Transport, PIU = project implementation unit, EIA: Environmental Impact Assessment; IEIA: Initial Environmental Impact Assessment.

Sources: Egis, 2021.

## 4.2. Training and Awareness

553. MPWT, local administrations and provincial government have some experience with ADB-funded projects, through the implementation of GMS-1 grant. However, none of these agencies have experience of a multiple subproject loan and associated safeguard management. To ensure effective implementation of the EMP, a capacity building program will be implemented on the EMP, including the mitigation measures, monitoring, and reporting.

554. Training will be conducted by PIU-EO, with facilitation and support from the DCSC. Trainees will include MPWT, the IAs, contractors, and local environment, water, and forestry officials. The training shall include, but not be limited to: (i) EMP implementation (ii) EMP monitoring and reporting (iii) establishment and implementation of the GRM (iv) waste management (v) occupational health and safety measures during work and emergency preparedness in case of incidents, (vi) Consultation during implementation. Also operational training is aimed at specific infrastructure operators.

**Table 36: Project Environment Training Program**

Training program	Scope of Training	Trainer	Trainee	Days	Persons
ADB Safeguards and SPS 2009	ADB requirements Project Cycle Role of Safeguards CEMP Development	PIU-EO/DCSC	PIU, MPWT/PMU	1	10
EMP Implementation, Monitoring and Reporting (Project Requirements including Consultation)	Roles, responsibilities, monitoring, inspection, reporting in EMP Environment monitoring program including Consultation Mitigation measures Public consultation and participation GRM implementation, coordination, reporting, working with the public Environment, health and safety during project construction and operation for workers and the community Prevention and control of transmissible diseases, COVID and HIV/AIDS	PIU-EO and PIU-SO and DCSC	PIU, MPWT/PMU local and provincial administration officers, Contractor	2	25
GRM Procedures	Establishing and implementing GRM GRM recording and process for resolution Affected People follow up	PIU-EO and PIU-SO and DCSC	PIU, MPWT/PMU local and provincial administration GRM Access Points	1	10
Occupational Health and Safety	EMP requirements Response and planning for incident management	PIU-EO and PIU-SO and DCSC	PMU, MPWT, Contractor	1	10
Solid waste management	Organizational arrangements and responsibilities SWM principles and hierarchy Waste streams, types and sources SWM facilities Management procedures (collection, recovery, recycling and disposal) and support documents Hazardous waste management Health and waste management	PIU-EO and DCSC	PIU, local and provincial administration officers, operator staff and informal waste collectors	3	25

Training program	Scope of Training	Trainer	Trainee	Days	Persons
Sanitation management	Wastewater (WW) collection management WWTP management (WW disposal registering procedure, interrelations with truck drivers, treatment process and maintenance, output sludge transportation towards landfill)	PIU-EO and DCSC	PIU, local and provincial administration officers, operators and WW truck drivers	2	20
Storm water management	Organizational arrangements and responsibilities Storm Water Management	PIU-EO and DCSC	PIU, local and provincial administration officers	2	15

LASI = local agency for specialized inspection

Source: Egis, 2021

### 4.3. Budget

**Table 37: Estimated Costs for training of the Project Environment Management Plan**

Parameter	Estimated Cost (\$)
<b>TRAINING</b>	
Training Delivery	16,800
Travel costs	2,000.00
Equipment (room rental, printing, ...)	3,000.00
<b>TOTAL</b>	<b>21,800.00</b>

Source: Egis, 2021

## 5. Documentation and Record-Keeping

### 5.1. Record Keeping

555. Contractors shall appoint a qualified Environmental Health and Safety (EHS) staff member to be responsible for environmental management and monitoring plans (EMMP) implementation and reporting.

556. The EMMP should be either in electronic or paper form and has to be controlled to ensure that current versions are approved before distributed, and obsolete versions are removed from the system. The changes to versions are identified, that the current versions are available at points of use, that they are legible, identifiable, and that obsolete one are so noted to avoid unintended use.

557. Records, which are produced to evaluate the EMMP compliance and performance, are expected to exist and be maintained; records should be identifiable, retrievable, safely stored, and legible, retained as appropriate, and traceable. The EMMP applies from the handover date to the end of the first year of the operational phase for each project, and will be reviewed and adapted as often as needed in between. But, as the construction phase will not start before 2022, the EMMP will have to progressively be implemented during the consolidation phase in order to establish and put into action all the necessary organization and documentation. It should be plainly effective at the going-live phase or the beginning of the construction works, whichever is the sooner.

## 5.2. Reporting

558. All reporting requirements are listed in the following table:

**Table 38: Reporting Requirements**

No.	Report	Frequency	Purpose	From	To
1	Monthly Construction Progress Report	Monthly	Ensure the effective implementation of the EMMPs Progress against performance indicators	Contractor	PMU / PIU / DCSC (+ Municipality and Commune Councils)
2	EMP Verification and consultation report	Monthly	Checking EMP measures and impacts on stakeholders	PIU /DCSC	PMU
3	Environmental Monitoring Reports (EMR)	Semi-annual	Monitoring all EMP measures and performance	PMU/PIUs	MPWT (EA) and ADB
4	Contractors' Environmental Management Plans (CEMP)	One time, Preparatory phase of the works	Addresses the EMP implementation and monitoring requirements	Contractor	PMU / DCSC
5	Operator EMRs	Determined by Permit / MoE	EMP implementation monitoring	Operator	MoE as required
6	Bidding documents, Bid Evaluation Reports	Bidding Phase	Support in bidding phase	PIU	ADB

Source: Egis, 2021

## 5.3. Review

559. In addition to reporting, a review process will include wider stakeholders as follows:

**Table 39: Review Process**

Institution	Prior to Construction including Detailed Engineering Design	During Construction
<b>MoE / PDOE</b>	Review, comment on approve IEIA Report	Review and Monitor compliance with approved IEIA & EMP & Environmental Standards
<b>Municipality</b>		Participate in monitoring of the performance of contractor with the CEMP implementation Review EMRs & results of environmental effects monitoring
<b>Commune Councils</b>	-	Review EMRs and results of environmental effects monitoring Participate in monitoring of the performance of contractor in EMP implementation

Source: Egis, 2021



## 6. Management of Change

560. Based on the established project environmental monitoring and reporting systems, the EA, IAs, and PIU shall assess whether further mitigation measures are required as corrective actions, and/or whether improvement in environmental management practices are required, and health and safety risks are controlled throughout the entire project cycle.

561. The effectiveness of mitigation measures and monitoring plans will be evaluated by a feedback reporting system. The PIU will play a critical role in the feedback and adjustment mechanism. If the PIU identifies a substantial deviation from the EMP, or if any changes are made to the scope of the subprojects that may cause significant adverse environmental impacts or increase the number of affected people, then the PIU shall immediately consult MPWT and ADB for feedback and/or approval to update the EMP. If necessary, further public consultations will be undertaken.

## 7. Consultation and Participation

562. Public consultations were conducted during project preparation and will continue throughout the project implementation. The public consultations will raise awareness of project activities, especially those which may impact the public, such as noise, air, and water quality, as well as access. A public consultation plan is in the following table. This includes public participation in evaluating environmental benefits and impacts. The PIU environment officer and social officer are responsible for facilitating the public consultations, with support from all project agencies.

**Table 40: Public Consultation and Participation Plan for Environment Safeguards**

Organizer	Approach	Times/Frequency	Subjects	Participants
<b>Construction</b>				
PIU	A questionnaire survey, site visits, and/or informal interviews	At least monthly during peak construction	Construction impacts; adjusting mitigation measures if necessary; feedback	Workers, residents in construction areas
	Public workshops	At least twice per year during peak construction	EMP implementation progress; construction impacts; adjusting mitigation measures if necessary; feedback	Residents, affected persons, social sectors
<b>Operation</b>				
PIU, operators of project facilities	Public consultation and site visits	At least once in the first year of operation	Effects of mitigation measures, impacts of operation, feedback	Residents, affected persons adjacent to project facilities
	Public workshop	As needed based on public consultation	Effects of mitigation measures, impacts of operation, feedback	Residents, affected persons, social sectors
	Public satisfaction survey	At least once after one year of operation	Comments and suggestions	Project beneficiaries

EMP = environment management plan, PIU = project implementing unit.

Source: Egis, 2021

## 8. Information Disclosure

563. Information disclosure and public consultation will continue throughout project implementation. Further information disclosure will be as follows:

- (i) Copies of the domestic environmental impact assessments in the Cambodian language, completed for all the subprojects in Poipet, are available on request at MPWT in Phnom Penh; the Province's office, and the Poipet Municipality offices.
- (ii) This IEE and corresponding EMP are disclosed on the ADB public website on behalf of the borrower and at detailed engineering design stage (DED) updated versions to reflect DED and any further changes and corresponding environmental due diligence will be disclosed.

564. The project environment monitoring reports will be prepared on a semi-annual basis and disclosed on the ADB public website.

565. Future public consultations will be facilitated by the PIU environment and social officers and will involve the Poipet municipal administration, provincial government, and work contractors. All agencies will work together with the PIU to provide timely communications and consultations with stakeholders. Prior to works, the PIU will lead disclosure and consultation with local communities, and other relevant stakeholders, on the scope and planned dates for works, potential issues (e.g., noise, dust, temporary traffic, and residential/economic activities access disturbance), and the planned mitigation measures. This will include, but not be limited to, public notices and meetings. Information on the GRM will be highlighted through these approaches. During construction, the PIU and Poipet municipal administration will conduct frequent consultations to identify any public concerns and respond to them promptly. These approaches will be continued for at least one year after the completion of works (i.e., up to a maximum of one year after completion of the overall project) by the Poipet municipal administration to identify any concerns with the completed works.

## 9. Grievance Redress Mechanism

### 9.1. The objective of the Grievance Redress Mechanism

566. A grievance redress mechanism (GRM), consistent with the requirements of the ADB Safeguard Policy Statement (2009), will be established to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM is accessible to all members of the community.

567. This project GRM is separate from the GRM system managed by the General Department of Resettlement (for resettlement issue only) and described in the Land Acquisition and Involuntary Resettlement - Standard Operating Procedures for Externally Financed Projects in Cambodia (RGC, 2018).

## 9.2. Proposed GRM System

568. In Cambodia, there is currently no existing legally established system to resolve environmental concerns and complaints. The MPWT, as the EA of the LCIP, establishes the GRM before commencement of site works and have members from the PMU, the district authority, and the commune councils. Grievances can be filed in writing or verbally with any entry point of the GRM. PMU-EO will oversee the implementation of the mechanism with technical support from the PMU engaged Project Management Consultants as needed and will be responsible for keeping the PMU informed. The PIU-EO, in collaboration with the PIU-SO will be responsible for ensuring GRM implementation at the subproject level and report on the observance/implementation of the GRM in the monthly progress reports and in the periodic Environmental Monitoring Report that will be submitted to the PMU. Examples of a GRM register and GRM complaint form can be found in appendix 6 and 7.

569. The GRM will accommodate both informally and formally lodged eligible, grievances. The GRM aims to solve any complaints/disputes prior to using the Cambodian judicial system, but shall not impede access to it. Access to the Cambodian judicial system and the GRM may be simultaneous. However, all cost associated to the project GRM are borne by the PMU.

## 9.3. Access to the Mechanism

570. Grievances raised on environmental impacts are critical to the health and safety of Affected Persons (AP). Hence, the proposed mechanism intends to be easily accessible, free of charge, and promptly responsive to APs' complaints.

571. A grievance redress and resolution mechanism have been established to resolve grievances and complaints in all subprojects of GMS-1, and it can also be replicated for LCIP. The PMU, through its PMU-EO or PIU-EO will ensure that the public and all stakeholders are aware of their rights to access and will have access to the GRM free of administrative and legal charges. The GRM is fully disclosed prior to construction during public consultations and through posters displayed in the commune office (posters to include names and contact details of the PIU).

572. **Informal process.** Informally, APs can lodge complaints directly to the contractor during construction. PMU to provide the contractor with GRM contact details, which the contractor will use to print 'GRM Contact Cards' for its staff to hand to complainants and will keep cards with all vehicles, machinery, and site managers/foremen.

**Figure 33: GRM - informal process**

Source: Egis, 2021

573. The contractor shall raise awareness of all workers on how to respond when an AP or member of the public has a complaint, i.e., direct the person to the most senior site manager present at the time and/or Contractor GRM focal point and prepare a 'GRM Contact Card.'

574. The contractor shall document and assess the complaint immediately, in consultation with the PIU-EO.. If assessment validates the complaint as within the scope of the GRM/eligible, the contractor shall act on the complaint within three days from receipt of the complaint. PIU shall obtain written confirmation of satisfaction from the AP after five working days from completion of resolution by the contractor.

575. If assessment invalidates the complaint (i.e., reveals the complaint as ineligible or not associated with the project's environmental performance), the contractor shall direct the AP to the Village chief and shall report the complaint to PIU within two working days from receipt of the complaint, stating reasons for ineligibility.

576. **Formal process.** If the complaint is eligible but is not acted on within three days from receipt of the complaint, or if AP is not satisfied with the resolution undertaken by the contractor, he/she can access the formal mechanism. The grievance redress process includes four steps before complaints may be elevated to the ADB as a last resort, as follows:

- (i) **The first step (Village/Sangkat level):** 5 working days - Complaints and grievances are reported verbally or submitted in writing to the Village chief or Sangkat chief or to the contractor. The receiving agent will provide immediate

written confirmation of the receipt of the complaint. If after 5 days the complainant does not hear from the contractor, Village or Sangkat chief or if the complainant is not satisfied with the decision taken in the first step, the complaint may be brought to the Municipal Office or Project Implementation Unit (PIU).

- (ii) **The second step (Municipal level):** 10 working days - The Municipal Office or the PIU have ten days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the Municipal Office or the PIU will bring the case to the Provincial Administration (PA) - Provincial Grievance Redress Committee (PGRC) or to the Project Management Unit (PMU), which will then inform the complainant.
- (iii) **The third step (Provincial level):** 10 working days - The PGRC or the PMU have ten days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the PGRC or the PMU will bring the case to the national level (line-ministries concerned by the issue), which will then inform the complainant.
- (iv) **Fourth steps (National level):** 20 working days - The representative of the concerned line Ministry or the Project Management Unit (PMU) meets with the aggrieved party to resolve the complaint/issue. Within 20 days of the submission of the grievance, the Committee or the PMU will make a written decision and submit a copy to the ADB. If the complaint cannot be solved at this stage, the MEF or EA or the PMU will bring the case to ADB.
- (v) **Fifth step (ADB):** ADB has developed an Accountability Mechanism<sup>[1]</sup> to address the grievances of people adversely affected by ADB-assisted projects and ensure compliance with ADB operational policies and procedures. The mechanism is described on the ADB website.

---

<sup>[1]</sup> <https://www.adb.org/who-we-are/accountability-mechanism/main>

**Figure 34: Grievance Redress Mechanism Chart**

PIU = Project Implementing Unit; PGRC = Provincial Grievance Redress Committee; PMU = Project Management Unit  
 Source: Egis, 2021

## 10. Environmental Management Plan

577. The following tables summarize the potential impacts of the subprojects during project preparation, design, construction and operation, and the mitigation measures. They include: (i) anticipated significant adverse environmental impacts and risks; (ii) mitigation measure with technical details, including the type of impact to which it relates, and the conditions under which it is required; (iii) links to any other mitigation plans required for the project; and (iv) roles and responsibilities for implementing the mitigation measures.

578. These EMP requirements will be incorporated into bidding documents, construction contracts and operational management manuals, during detailed design and contractors during construction, under the supervision of the PIU and DCSC. The effectiveness of the measures will be evaluated based on environmental inspections and monitoring to determine whether they should be continued, improved or adjusted.

**Table 41: Environmental Management Plan for Solid Waste Subproject**

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	The collection points and the landfill project components will take land from adjacent agricultural parcels	The property owners impacted by the construction will receive economic compensation and/or will be assisted in the resettlement.	PIU	PMU, IA, Municipality, Commune council
Ecology and biodiversity	Project areas located on a sub-natural zone (ancient agricultural area)	Clearing of vegetation, scouring, stripping, earthworks, and the leveling of work areas is limited to strictly as necessary.	Contractor	PIU
Water resources	Decrease of water quality, which is used by households and agricultural activities	Impermeable disposal cells, process waters are treated.	Designer	PMU, PIU, IA
Air quality	GHG emissions	Good composting practice reduces methane emissions; GHG emissions from solid waste disposal operations will be controlled and managed. The landfill gas will be collected and routed to a flare stack.	Designer	PMU, PIU, IA
Noise and vibration	Noise emissions which should cause neighboring disturbance	Project designs defined to mitigate noise emissions as far as possible.	Operator	PMU, PIU, IA
Materials and waste	Common practice of waste disposal into water bodies and other natural habitats	The high recovery rate of waste collection.	Operator	PMU, PIU, IA
Materials and waste	Use of materials and waste production	Design and daily processes have been defined to limit material needs and waste production.	Designer / Operator	PMU, PIU, IA
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety	Stop the informal waste-pickers activity of the existing dumpsite	Training and official employment of waste-pickers on the projected solid waste platform (pre-sorting plant, drivers, ...).	Operator	PIU, Municipality, Commune council



Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
<b>Socio-economic and community health and safety</b>	-	Compost will be reused in agriculture.	Operator	IA
<b>Construction</b>				
<b>Land and geology</b>	Excavation of borrow pits and quarries may be a threat to the environment when left in poor condition, loss of ecosystem services or arable land	No new natural material extraction site will be created for this project; Manufactured materials and products will also be prepared in Poipet and transported, given the relatively short distance; Spoils will be utilized for the road works.	Contractor	PIU, PMU
<b>Land and geology</b>	Spoils require removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
<b>Land and geology</b>	Soil contamination: (i) improper transport, storage, handling, and/or disposal of solid wastes, septic wastes, hazardous wastes, and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products; and (ii) accidental spills or leaks of hazardous wastes and substances	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting ; Minimize the duration that surfaces are exposed for; The timing works for dry seasons when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants); Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials, and wastes on impermeable surfaces in secured and covered areas; Remove all construction wastes from the work sites to approved waste disposal sites; Establish emergency preparedness and response actions; Provide spill clean-up	Contractor	PIU, PMU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		measures and equipment at each construction site; Train contractors and crews in emergency spill response procedures.		
<b>Ecology and biodiversity</b>	Potential disturbance of fauna and collision	Temporary fences around WWTP boundary; Restriction on any construction activity and project vehicle activity between 6:00 pm and 6:00 am to minimize the risk of collisions with fauna at night.	Contractor	PIU
<b>Water resources</b>	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access; No works or machine wash-down will be conducted at the pumping sit; Contractors ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed; For the cleaning of the concrete equipment and vehicles during the whole construction phase, a temporary impermeable basin will be created at the WWTP site in order to prevent wastewaters from impacting the surrounding environment.	Contractor	PIU, Municipality, Commune council
<b>Water resources</b>	Surface water bodies could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machinery and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October) and to limit runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and minimize open excavation areas; Construct intercepting channels and drains to prevent runoff entering	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		<p>construction sites and to divert runoff from sites to existing drainage or open ground.</p> <p>Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs;</p> <p>All sites for washing of construction equipment will be equipped with water collection basins and sediment traps;</p> <p>Fuel storage, machinery maintenance workshop, and vehicle cleaning areas will be stationed at least 100m from the natural water bodies and 20m from channels;</p> <p>Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations;</p> <p>Contractors' fuel suppliers will be properly licensed and will follow established protocol for transferring fuel;</p> <p>Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.</p>		
<b>Air quality</b>	Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions	<p>Spraying water on the exposed construction site where fugitive dust is being generated;</p> <p>Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion;</p> <p>Storing petroleum or other harmful materials inappropriate places and covering to minimize fugitive dust and emission;</p>	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		<p>Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation;</p> <p>Regulation by speed limits of access roads to the construction site.</p> <p>Maintenance of project vehicles to minimize greenhouse gas emissions;</p> <p>Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes;</p> <p>For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and strict enforcement of sanitation practices; prompt disposal of organic and hazardous wastes; and timely community consultations to ensure awareness of the risk of odors prior to landfill works;</p> <p>Prohibit burning of wastes;</p> <p>Timely monitoring of air quality and inspections during construction.</p>		
<b>Noise and vibration</b>	Construction noise disturbance, mainly in the urban areas	<p>Properly maintain construction vehicles and machinery to minimize noise;</p> <p>Apply noise reduction devices and methods for high noise equipment operating within 150m of the sensitive sites, i.e., schools, health centers, and religious sites;</p> <p>Prohibit operation of high-noise machinery and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am;</p> <p>Place temporary hoardings or noise barriers around noise sources during construction;</p> <p>Monitor noise at sensitive</p>	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.		
<b>Noise and vibration</b>	Construction works may cause neighboring vibration disturbance, mainly in the urban areas	High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am; Communities will be consulted prior to large earthworks to ensure they are informed and to avoid sensitive timing.	Contractor	PIU, Municipality, Commune council
<b>Materials and waste</b>	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible for transporting the containers and disposing them at the existing dumpsite; Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed of; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations; Waste burning will be forbidden.	Contractor	PIU
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-
<b>Socio-economic</b>	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
<b>and community health and safety</b>				Commune council
<b>Community health and safety</b>	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues; Heavy machinery will not be used at night. All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate;	Contractor	PIU Municipality, Commune council
<b>Community health and safety</b>	Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded and parking space in front of the residents' houses will be reduced.	Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Information disclosure: villagers, residents and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption; Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways; Posting of billboards on	Contractor	PIU Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works; Posting of traffic (flag) persons during entire working hours if necessary; Spreading out the schedule for materials delivery in non-peak hours as far as possible; Efficient management of truck arrival/departure; Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail; A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.		
<b>Community Health and safety</b>	Sites left in unsafe conditions	Surplus materials removed from site; Decommissioning of construction camp facilities and equipment; Waste removal; Contaminated soil removal/treatment; Leveling of soil and returning to prior condition as per contract requirements.	Contractor	PIU, Municipality, Commune council
<b>Occupational health and safety</b>	Risk to workers from construction site activities and working in/ around high traffic areas	Appointment of an Environmental, Health and Safety Officer; Contractor compliance with environmental and occupational health and safety guidelines; CEMPs will include health and safety plans; Provide a clean and sufficient supply of fresh water for construction sites; Provide adequate number of latrines at construction sites and ensure that they are	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		<p>cleaned and maintained in a hygienic state;</p> <p>Garbage receptacles at construction sites will be set up, and regularly emptied;</p> <p>Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs;</p> <p>Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Poipet will be established. Each site of works will have basic first aid kits;</p> <p>A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits;</p> <p>Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites;</p> <p>Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly);</p> <p>An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers</p>		



Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		and the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
<b>Occupational health and safety</b>	Construction workers will be exposed to the presence of unexploded ordnances (UXO)	Sites for earthworks that are suspected of having UXO should be surveyed by the CMAC prior to construction. Should ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.	Government of Cambodia	PMU, PIU Municipality, Commune council
<b>Occupational and community health and safety</b>	Workers, as well as communities, may potentially be affected by COVID-19	Conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental and occupational health and safety (H&S) plans, which are part of their site-specific contractor EMP (CEMP).	Contractor	PIU
<b>Operation</b>				
<b>Land and geology</b>	Soil contamination - from spills / accidents or uncontrolled discharge due to clogging of untreated water or leachate and stormwater	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations; The landfill site will include a low permeability baseliner to avoid infiltration of leachate in the subsoil, and the composting plant will include an impermeable concrete platform.	Operator	PDPWT/ PDOE  PMU, PIU  PMU, PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
<b>Land and geology</b>	Topsoil stripping will be temporarily stocked on the landfill site. It will then be reused for intermediate and final cells cover	Topsoil will be separated and placed in dedicated stocks (max 2 m height); It will be reused for the final cover of the landfill cells in order to preserve the agronomic quality of the site; Soils from the bulk excavation will be used to create a barrier on the site perimeter, aiming to minimize visual and dust impact on the surrounding environment.	Operator	PMU, PIU PDPWT/ PDOE
<b>Ecology and biodiversity</b>	Pests/rodents/vermin, birds, and stray animals are likely to be attracted by the landfill	Minimize exposed tipping areas and prompt waste covering upon waste dumping in the normal operation of the landfill.	Operator	PMU, PIU
<b>Water resources</b>	Surface water or groundwater contamination from surface water run-on, site water runoff, waste mass inundation, and leachate emissions.	Provision of perimeter drains and additional collector drains within the landfill area; Provision of cover materials over waste mass surfaces, coupled with the drainage of these covered areas through the contouring of surfaces and installation of surface drains; Vegetate the completed waste mass surfaces.	Operator	PMU, PIU
<b>Water resources</b>	Leachate generated within the waste mass can migrate through the sidewalls and base and cause contamination of groundwater.	Leachate will be recirculated into the landfill mass; Residual leachate will be treated at the WWTP.	Operator	PMU, PIU
<b>Water resources</b>	Damage to the impermeable layer could result to failure in the integrity of the leachate collection system, resulting in subsurface contamination.	O&M procedures to ensure that the facilities operate as intended over the long term; Continuous monitoring of groundwater quality to detect and mitigate any subsurface spill.	Operator	PMU, PIU
<b>Air quality</b>	The landfill will generate gas, such as carbon dioxide, methane, and nitrous	Landfill gas will be routed to a flare stack.	Operator	PMU, PIU, MoE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	oxide			
<b>Air quality</b>	Vehicle gas emissions and dust emissions	Pavement of the landfill access road over 5km. Regulation by speed limits in the streets; Regulation by speed limits and speed bumps on access roads to project sites; Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes; Maintenance of project vehicles to minimize greenhouse gas emissions.	Operator	PMU, PIU  PDPWT/ PDOE
<b>Air quality</b>	Odor nuisance may be generated during waste dumping in the normal operation of the landfill, as well as accidental dumping during waste transport or temporary storage in the collection points	Adapted operating procedures.	Operator	PDPWT/ PDOE
<b>Noise and vibration</b>	Noise emissions which should cause neighboring disturbance	Modern and well-maintained equipment, meeting international standards, to minimize nuisance; Apply noise reduction devices and methods for equipment operating within 150m of schools and religious sites in rural areas of Poipet municipality; Truck traffic will be allowed during daylight hours as far as possible; Conduct regular interviews with sensitive areas residents/users to identify noise disturbance; Community feedback will be used to implement new mitigation measures if deemed necessary.	Operator	PDPWT/ PDOE
<b>Materials and waste</b>	Wind-blown waste from the landfill may be dispersed into the surrounding	Minimize exposed tipping areas; Install and maintain a 1.80m-high fence on landfill	Operator	PMU, PIU  PDPWT/

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	environment.	boundary; Prompt waste covering upon waste dumping in normal operation; Daily compaction of the new waste deposits.		PDOE
<b>Materials and waste</b>	Accidental waste dumping on streets or into the natural environment during waste or around collection points, causing a nuisance for the surrounding residential or commercial areas.	Waste encapsulation in trucks while in transit; Wash vehicles on facility exit; For collection points: - Cleaning and maintenance of temporary storage areas; - Waste sorting skips with a retention system to avoid leachate dispersion.	Operator	PDPWT/ PDOE
<b>Materials and waste</b>	Pollution by WWTP sludge	Laboratory tests on sludge will be planned yearly: - on WWTP sludge after treatment on the Sludge Drying Beds, to verify their suitability for composting; - on Residual Leachate from the landfill, before being routed to the WWTP for treatment.	WWTP and landfill operators	PDPWT/ PDOE
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-
<b>Occupational health and safety</b>	Frequent movement of waste trucks will cause a nuisance to villagers living along the access road to the landfill and to the collection points.	Preparation and implementation of a waste trucks circulation management plan and coordination with local authorities and communities; The truck circulation plan shall give priority to routing trucks away from dense traffic roads; Schedule planning for waste transportation in non-peak hours as much as possible.	Operator	PMU, PIU PDPWT/ PDOE
<b>Occupational health and safety</b>	Working conditions in the landfill, pre-sorting and composting plant could potentially deteriorate over time if no monitoring is	The working conditions in the landfill, pre-sorting and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19	Operator	PDPWT

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.	national guidance (if it does not exist, international guidance will be used); All workers will be trained with regular refresher courses.		
<b>Occupational health and safety</b>	Public safety may be impacted by the implementation of the projects, for instance accidents, may occur on the access roads.	Posted speed limits along the access roads will be enforced, and the perimeter of the landfill will be fenced off; Access to facilities will be restricted to authorized employees.	Operator	PMU, PIU

Table 42: Environmental Management Plan for Wastewater Subproject

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	WWTP located on a private land	Establishment of buffer zones inside each site with vegetation along the fences; Avoidance of unnecessary earth movement and removal of vegetation; Management plans and protection/conservation strategies.	Operator	PMU, PIU, IA
	Wastewater collection network and pumping stations along channels as a part of project components will subtract surface area from adjacent agricultural parcels	The property owners impacted by the construction will receive economic compensation and/or will be assisted in the resettlement.	PIU	PMU, IA, Municipality, Commune council
Ecology and biodiversity	Vegetation destruction	Clearing of vegetation, scouring, stripping, earthworks, and the leveling of work areas is limited to strictly as necessary; Pre-inspection of each tree to be removed, to ensure that no nesting fauna are present; Individual removal of each tree (rather than bulldozing) to minimize impacts to surrounding trees; Soil stabilization after tree removal, to avoid local erosion that would contaminate surface water bodies.	Contractor	PIU
	Water resources	Removal of polluted waters into existing water bodies; a decrease of water quality, which is used by households and agricultural activities	Designer	PMU, PIU, IA
Air quality	Potential reduction of air quality and increase of odors	Design of a high-performance WWTP.	Designer	PMU, PIU, IA
Noise and vibration	Noise emissions which should cause neighboring disturbance	Project designs of the WWTP and PS defined to mitigate noise emissions as far as possible.	Designer	PMU, PIU, IA
Materials and waste	Use of materials and waste production	Design and daily processes have been defined to limit material needs and waste production.	Designer Operator	PMU, PIU, IA
Archeology and cultural	A shrine place and a sacred tree are	The long term project location will be adapted in order not to	Designer	PIU,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
heritage	close to the WWTP area (50m)	affect them. An effective barrier (fence) will be installed along the western WWTP boundary during the construction phase, and the shrine place access will be maintained in its current configuration and upgraded during construction and operation phases.		Municipality, Commune council
Community health and safety	Removal of raw water discharges	Design of a high-performance WWTP and its associated collection network.	Designer	PMU, PIU, IA
<b>Construction</b>				
Land and geology	Excavation of borrow pits and quarries may be a threat to the environment when left in poor condition, loss of ecosystem services or arable land	No new natural material extraction site will be created for this project; Manufactured materials and products will also be prepared in Poipet and transported, given the relatively short distance.	Contractor	PIU, PMU
Land and geology	Spoils require removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
Land and geology	Soil contamination: (i) improper transport, storage, handling, and/or disposal of solid wastes, septic wastes, hazardous wastes, and hazardous substances, such as petroleum products from equipment operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and (ii) accidental spills or leaks of hazardous wastes and substances	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; Minimize the duration that surfaces are exposed for; The timing works for dry seasons when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants); Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials, and wastes on impermeable surfaces in secured and covered areas; Remove all construction wastes from the work sites to approved waste disposal sites; Establish emergency preparedness and response actions; Provide spill cleanup measures and equipment at each construction site; Train contractors and crews in emergency spill response	Contractor	PIU, PMU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
<b>Ecology and biodiversity</b>	Potential disturbance of fauna and collision	procedures. Temporary fences around WWTP boundary; Restriction on any construction activity and project vehicle activity between 6:00 pm and 6:00 am to minimize the risk of collisions with fauna at night; Implement scaring systems to deter fauna prior to construction.	Contractor	PIU
	The potential destruction of an IUCN Red list tree ( <i>Pterocarpus pedatus</i> )	Preserve and protect this with dedicated barriers during the construction phase; Awareness raising of the construction workers.	Contractor PIU	PIU, PMU
<b>Water resources</b>	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access; No works or machine wash-down will be conducted at the pumping site; Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report; Pumping at Ou Chrov River, Ou Stueng Bot River, and Ou Kaidon Reservoir will require authorization from official authorities;	Contractor	PIU, Municipality, Commune council
<b>Water resources</b>	Surface water bodies (Ou Chrov River, Ou Stueng Bot River, and Ou Kaidon Reservoir) could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machinery and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction in other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and minimize open excavation areas; Construct intercepting channels and drains to prevent runoff entering construction sites and to divert runoff from sites to existing drainage or open ground; Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs;	Contractor	PIU



Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
Air quality		<p>All sites for washing of construction equipment will be equipped with water collection basins and sediment traps; Fuel storage, machinery maintenance workshop, and vehicle cleaning areas will be stationed at least 100m from the natural water bodies (Ou Chrov River, Ou Stuong Bot River) and Ou Kaidon Reservoir, and 20m from channels; Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations; Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel; Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.</p>		
	<p>Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions</p>	<p>Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion;</p> <p>Storing petroleum or other harmful materials inappropriate places and covering to minimize fugitive dust and emission;</p> <p>Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation;</p> <p>Regulation by speed limits in the streets;</p> <p>Regulation by speed limits of access roads to the construction sites;</p> <p>Maintenance of project vehicles to minimize greenhouse gas emissions;</p> <p>Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes;</p> <p>For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and strict enforcement of sanitation practices; prompt disposal of organic and hazardous wastes; and timely community consultations to ensure awareness of the risk of odors prior to landfill works;</p>	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
		<p>Prohibit burning of wastes; Timely monitoring of air quality and inspections during construction; Limit dust production when work is carried out near sensitive receptors, e.g., schools, hospitals, residential areas; Due to the presence of a household located about 200m south-west of the WWTP site, works activities will be forbidden during nighttime and public holidays to limit nuisance for the residents. Raw materials and products will be stored in dedicated areas, as far as possible from the site boundaries, and covered to avoid dust emission from piles onto the surrounding environment.</p>		
<b>Noise and vibration</b>	Construction works may cause noise disturbance, mainly in the urban areas	<p>Properly maintain construction vehicles and machinery to minimize noise; Apply noise reduction devices and methods for high noise equipment operating within 150m of the sensitive sites i.e., schools, health centers, and religious sites; Prohibit operation of high-noise machinery and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am (with a possible exception for market areas); Place temporary hoardings or noise barriers around noise sources during construction; Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation; Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance. Community feedback will be used to adjust work hours of noisy machinery.</p>	Contractor	PIU, Municipality, Commune council
	Construction works may cause noise disturbance, mainly in the urban areas	Due to the presence of a household located about 200m south-west of the WWTP site, works activities will be forbidden during nighttime and public holidays to limit	Contractor	PIU, Municipality, Commune

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
		nuisance for the residents (with a possible exception for market areas); High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am; Communities will be consulted prior to large earthworks to ensure they are informed and to avoid sensitive timing, e.g., exams at nearby schools or festivals.		council
<b>Materials and waste</b>	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible to transport the containers and dispose of them at the existing dumpsite; Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed of; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations; Waste burning will be forbidden.	Contractor	PIU
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-
<b>Socio-economic and community health and safety context</b>	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality, Commune council
<b>Socio-economic and community health and safety context</b>	Market areas: street vendors selling goods along the streets around the market will be temporarily affected during construction (economic losses).	Works must be implemented during night time in areas close to markets, and construction contractor will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non-active periods. Additionally, a preliminary public information will be necessary before starting construction works.	Contractor	PIU, Municipality, Commune council
<b>Occupational health and safety</b>	Railway crossings	A trenchless technique will be used to build the crossing to avoid resettlement issues. The aerial crossing of the railway	Contractor	PMU, PIU Municipality,

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
Occupational health and safety		will be used only at downstream of pumping station PS_FM_02 (rural area).		Commune council
	Construction workers will be exposed to the presence of unexploded ordnances (UXO)	Sites for earthworks that are suspected of having UXO should be surveyed by the Government prior to construction. Should ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.	Government of Cambodia	PMU, PIU Municipality, Commune council
Occupational health and safety	Risk to workers from construction site activities and working in/ around high traffic areas	Appointment of an Environmental, Health and Safety Officer; Contractor compliance with environmental and occupational health and safety guidelines; CEMPs will include health and safety plans; Provide a clean and sufficient supply of fresh water for construction sites; Provide adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state; Garbage receptacles at construction sites will be set up, and regularly emptied; Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs; Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Polpet will be established. Each site of works will have basic first aid kits; A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits; Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites;	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
		Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly); An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
Community health and safety	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues. Heavy machinery will not be used at night; All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.	Contractor	PIU Municipality, Commune council
	Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded, and parking space in front of the residents' houses will be reduced.	Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time; Preparation and implementation of a traffic management plan, and coordination with local authorities and communities; Information disclosure: villagers, residents and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of expected disruption;	Contractor	PIU Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways; Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works; Posting of traffic (flag) persons during entire working hours if necessary; Spreading out the schedule for materials delivery in non-peak hours as far as possible; Efficient management of truck arrival/departure; Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail; A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.		
<b>Community Health and safety</b>	Sites left in unsafe conditions	Surplus materials removed from site; Decommissioning of construction camp facilities and equipment; Waste removal; Contaminated soil removal/treatment; Leveling of soil and returning to prior condition as per contract requirements.	Contractor	PIU, Municipality, Commune council
<b>Occupational health and safety</b>	Workers, as well as communities, may potentially be affected by COVID-19	Conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental and occupational health and safety (EHS) plans, which are part of their site-specific contractor EMP (CEMP).	Contractor	PIU
<b>Operation</b>				
<b>Land and geology</b>	Soil contamination (from spills or uncontrolled discharge of untreated or treated water) can occur due to faulty pipelines or equipment of the	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations.	Operator	PDPWT/ PDOE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to the clogging of the drainage system.			PMU, PIU
<b>Ecology and biodiversity</b>	Human activity and equipment noise can generate disturbance which may disrupt breeding or foraging by the resident or migratory fauna, i.e., breeding waterbirds.	Project areas enclosed by 1.8m-high fences, avoiding any impacts to adjacent vegetation and fauna; Readapt the maintenance activities to nesting or reproduction periods to avoid fauna disturbance; Strict speed limits (maximum 50km/h) for work vehicles around the project sites to minimize the risk of collisions with fauna, livestock, or people; Restriction on project vehicle circulation between 6:00 pm and 6:00 am to minimize the risk of collisions with fauna at night (when some mammals are more active).	Operator	PMU, PIU  PDPWT/ PDOE
	Wastewater network will cross Ou Suteng Bot River, and pipes will be laid on the area adjacent to the perimeter of the Ou Kaidon reservoir: Removal of polluted waters into existing water bodies	Implement an efficient daily monitoring; On-site septage collection will be provided by trucking for residential areas too far to connect or rural areas.	Operator	PMU, PIU, MoE, PDPWT/ PDOE
<b>Water resources</b>	Surface water or groundwater contamination from spills or uncontrolled discharge of untreated or treated water due to faulty pipeline or equipment Accidental leakage from the wastewater treatment or stormwater drainage systems may impact surface water quality and also groundwater quality, depending on local groundwater depth.	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations; Monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.	Operator	PDPWT/ PDOE  PMU, PIU  PMU, PIU
<b>Air quality</b>	Vehicle gas emissions and dust	Regulation by speed limits in the streets;	Operator	PMU, PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
Air quality	emissions	Regulation by speed limits and speed bumps on access roads to project sites; Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/vehicle when not in use; limiting engine idling to a max. of 5 minutes.		PDPWT/ PDOE
	WWTP is likely to develop an impact on air quality in terms of odor	Maintain self-cleaning velocities into pipelines; Minimize turbulence wherever there is a hydraulic fall of sewer line; Ventilation of (gravity) sewers by proper venting arrangement; Design to ensure prevention of accumulation of grits/debris in the sewer; Route maintenance shall consider using chemicals application in main pumping stations & sewer lines close to populated neighborhoods for controlling septicity.	Operator	PDPWT/ PDOE
	Noise emissions which should cause neighboring disturbance	Modern and well-maintained equipment, meeting international standards, to minimize nuisance; Apply noise reduction devices and methods for equipment operating within 150 m of schools and religious sites in rural areas located in Poipet municipality; Truck traffic will be allowed during daylight hours as far as possible; Conduct regular interviews with sensitive areas residents/users to identify noise disturbance. Community feedback will be used to implement new mitigation measures if deemed necessary.	Operator	PDPWT/ PDOE
Materials and waste	Solid waste disposed of illegally	Solid waste is collected by trucks and transported to the landfill.	Operator	PDPWT/ PDOE
Materials and waste	Pollution by WWTP sludge	Laboratory tests on sludge will be planned yearly: - on WWTP sludge after treatment on the Sludge Drying Beds, to verify their suitability for composting; - on Residual Leachate from the landfill, before being	WWTP and landfill operators	PDPWT/ PDOE



Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
		routed to the WWTP for treatment.		
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-
<b>Community health and safety</b>	Risk of pathogens transfer to agricultural lands, food crops, etc.	No sludge spreading.	Operator	PDPWT/ PDOE
<b>Occupational health and safety</b>	Working conditions in the WWTP could potentially deteriorate over time if no monitoring is carried out to ensure the workers' health and safety conditions. Additionally, new projects have to include COVID-19 measures.	The working conditions in the WWTP, landfill, pre-sorting, and composting plants will be reviewed regularly to maintain adequate health and safety conditions for the workers, including COVID-19 national guidance (if it does not exist, international guidance will be used); All workers will be trained with regular refresher courses.	Operator	PDPWT
<b>Community health and safety</b>	Public safety may be impacted by the implementation of the projects. For instance, accidents may occur on the access roads, and exposure to the treatment pond operations of the WWTP could result in injuries or health diseases.	Posted speed limits along the access roads will be enforced, and the perimeter of the WWTP will be fenced off; Access to facilities will be restricted to authorized employees.	Operator	PMU, PIU

Table 43: Environmental Management Plan for Stormwater Drainage Subproject

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Design and Pre-construction				
Land and geology	Storm drainage network will subtract surface area from adjacent agricultural parcels	The property owners impacted by the construction will receive economic compensation and/or will be assisted in the resettlement.	PIU	PMU, IA, Municipality, Commune council
Land and geology	Bank erosion of canals for urban drainage	Projected piped network with concrete materials for an urban area.	Contractor	PIU
Ecology and biodiversity	No significant impact	-	-	-
Water resources	No significant impact	-	-	-
Air quality	No significant impact	-	-	-
Noise and vibration	No significant impact	-	-	-
Materials and waste	Use of materials and waste production	Design and daily processes have been defined to limit material needs and waste production.	Designer, Operator	PMU, PIU, IA
Archeology and cultural heritage	No significant impact	-	-	-
Socio-economic and community health and safety	Street flooding	Network of channels, culverts, and pipes, designed to minimize street flooding during a 1 in 5-year rainfall event.	Designer	PMU, PIU, IA
Construction				
Land and geology	Spoils require removal and disposal in a predetermined and approved location	Spoil disposal sites will be located far from water bodies so that spoils will not interfere with the flow of the surface water runoff to side drains and do not block the side drains themselves.	Contractor	PIU
Land and geology	Soil contamination: (i) improper transport, storage, handling, and/or disposal of solid wastes, septic wastes, hazardous wastes, and hazardous substances, such as petroleum products from equipment	Stabilization of exposed surfaces and spoil piles with ditches and/or sheeting; Minimize the duration that surfaces are exposed for; Timing works for dry seasons when rains are minimal, and the ground is firm (to minimize infiltration of any contaminants);	Contractor, PIU	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
	operation and maintenance, lubricants, paints, chemicals, curing compounds, asphalt products, among others; and  (ii) accidental spills or leaks of hazardous wastes and substances	Management of site stockpiles and storage sites for fuels and machinery; Store petroleum products, hazardous materials, and wastes on impermeable surfaces in secured and covered areas; Remove all construction wastes from the work sites to approved waste disposal sites; Establish emergency preparedness and response actions; Provide spill cleanup measures and equipment at each construction site; Train contractors and crews in emergency spill response procedures.		
<b>Ecology and biodiversity</b>	Vegetation destruction	If the removal of vegetation cannot be avoided and does not concern public lands, private owners of the concerned vegetation will be provided a compensation.	Contractor	PIU
<b>Ecology and biodiversity</b>	Potential disturbance of fauna and collision	Restriction on any construction activity and project vehicle activity between 6:00 pm and 6:00 am to minimize the risk of collisions with fauna at night.	Contractor	PIU
<b>Water resources</b>	Construction works will require water for the mixing of materials, wash-down of equipment, and drinking water for workers.	Pumping will occur at irrigation channels, only at sites with existing road and jetty access. No works or machine wash-down will be conducted at the pumping site. Contractors should ensure that the use of irrigation water or any water bodies complies with the EMP of the approved IEIA report and permit is obtained as needed.	Contractor	PIU, Municipality, Commune council
<b>Water resources</b>	Surface water bodies (Ou Chrov River and Ou Stueng Bot River) could be potentially affected by construction wastewater (from washing aggregates, pouring and curing concrete, cleaning of construction machinery and vehicles, and human wastes)	Timing of construction to avoid peak rainfall during the rainy season (from May to October). Construction in other months imparts much lower construction risk as the ground is hard, infiltration is limited, and there will be limited runoff from work sites; Plan and implement construction in staged sections, with one section completed and stabilized before beginning the next; and minimize open excavation areas; Construct intercepting channels and drains to prevent runoff	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
Air quality		entering construction sites and to divert runoff from sites to existing drainage or open ground; Contractors will develop actions for control of oil and other dangerous substances as part of their site Contractor-EMPs; All sites for washing of construction equipment will be equipped with water collection basins and sediment traps; Fuel storage, machinery maintenance workshop, and vehicle cleaning areas will be stationed at least 100m from the natural water bodies and 20m from channels; Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable surfaces and provided with bunds and cleanup installations; Contractors' fuel suppliers must be properly licensed and will follow established protocol for transferring fuel; Portable toilets and on-site wastewater pre-treatment systems will be installed at construction camps along with proper maintenance protocols.		
	Dust emissions, air pollution from aggregate preparation and concrete-mixing, air pollution from vehicle and machinery emissions	Spraying water on exposed construction sites where fugitive dust is being generated. Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion; Storing petroleum or other harmful materials in appropriate places and covering to minimize fugitive dust and emission; Covering materials during truck transportation, in particular, fine material, to avoid spillage or dust generation; Regulation by speed limits in the streets; Regulation by speed limits of access roads to the construction sites; Maintenance of project vehicles to minimize greenhouse gas emissions; Turning off equipment/ vehicle when not in use; limiting engine idling to a max. of 5 minutes; For odor: disinfection/ deodorization/ sanitizing affected latrines prior to clearing; provision of adequate sanitation facilities; and strict enforcement of sanitation practices;	Contractor	PIU

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
<b>Noise and vibration</b>		<p>prompt disposal of organic and hazardous wastes; and timely community consultations to ensure awareness of the risk of odors prior to works;</p> <p>Prohibit burning of wastes;</p> <p>Timely monitoring of air quality and inspections during construction;</p> <p>Particular attention will be paid to limiting dust production when work is carried out near sensitive receptors e.g., schools, hospitals, residential areas.</p>		
	Construction works may cause neighboring noise disturbance, mainly in the urban areas	<p>Properly maintain construction vehicles and machinery to minimize noise;</p> <p>Apply noise reduction devices and methods for high noise equipment operating within 150 m of the sensitive sites i.e., schools, health centers, and religious sites;</p> <p>Prohibit operation of high-noise machinery and movement of heavy vehicles along urban and village roads, between 6.00 pm and 8.00 am (with a possible exception for market areas);</p> <p>Place temporary hoardings or noise barriers around noise sources during construction;</p> <p>Monitor noise at sensitive areas at regular intervals. If noise standards are exceeded, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation;</p> <p>Conduct regular interviews with residents/villagers adjacent to construction sites to identify noise disturbance.</p> <p>Community feedback will be used to adjust work hours of noisy machinery.</p>	Contractor	PIU, Municipality, Commune council
<b>Noise and vibration</b>	Construction works may cause neighboring vibration disturbance, mainly in the urban areas	<p>High vibration activities, such as compaction operations, will be prohibited at night from 6.00 pm to 8.00 am (with a possible exception for market areas);</p> <p>Communities will be consulted prior to large earthworks to ensure they are informed and to avoid sensitive timing, e.g., exams at nearby schools or festivals.</p>	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
<b>Materials and waste</b>	Domestic solid waste from workers and construction waste materials	Covered garbage bins will be installed at each site of works; The contractors will be responsible for transporting the containers and disposing them at the existing dumpsite; Waste collection and disposal methods will follow strict procedures to ensure that only non-hazardous waste is disposed of; Hazardous wastes (discarded fuel, oil, spills) will be stored in sealed drums and transported to the official landfill site in accordance with national regulations; Waste burning will be forbidden.	Contractor	PIU
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-
<b>Socio-economic and community health and safety</b>	Job creation during works	Local people employment and women employment.	Contractor	PIU, Municipality, Commune council
<b>Socio-economic and community health and safety context</b>	Market areas: street vendors selling goods along the streets around the market will be temporarily affected during construction (economic losses).	Works must be implemented during night time in areas close to markets, and construction contractor will have to prepare noise reduction and mitigation plan and implement dedicated measures for noise disturbance reduction and safe conditions for workers and neighboring population during works as well as during non-active periods. Additionally, a preliminary public information will be necessary before starting construction works.	Contractor	PIU, Municipality, Commune council
<b>Community health and safety</b>	Deliberate or accidental access to construction site works	Construction site protection will include clear signs placed at construction sites in view of the public, informing people about the project's GRM, and warning people against potential dangers such as moving vehicles, hazardous materials, and excavations, and raising awareness on safety issues; Heavy machinery will not be used at night; All sites will be secured, disabling access by the public through appropriate fencing whenever appropriate.	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	Supervision
Community health and safety	Network works may cause temporary disruptions to vehicle access; traffic flow will be temporarily impeded and parking space in front of the residents' houses will be reduced.	<p>Construction vehicles should use different roads or dedicated lanes and the implementation of wastewater and drainage networks will be undertaken on one side of the road at a time;</p> <p>Preparation and implementation of a traffic management plan, and coordination with local authorities and communities;</p> <p>Information disclosure: villagers, residents and businesses will be informed in advance through media and information boards at construction sites of the construction activities, given the dates and duration of the expected disruption;</p> <p>Public consultations on work phasing and schedules, anticipated access blocking, provisions for temporary and safe access for blocked properties and temporary parking for blocked garages/driveways;</p> <p>Posting of billboards on road/lane closure, traffic rerouting plan at strategic places, at least 1 week prior to works;</p> <p>Posting of traffic (flag) persons during entire working hours if necessary;</p> <p>Spreading out the schedule for materials delivery in non-peak hours as far as possible;</p> <p>Efficient management of truck arrival/departure;</p> <p>Provision of safe access, if needed, to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rail;</p> <p>A close coordination with utility companies will prevent the disruption of utility services such as water and electricity supply due to damaged lines.</p>	Contractor	PIU Municipality, Commune council
Community Health and safety	Sites left in unsafe conditions	<p>Surplus materials removed from site;</p> <p>Decommissioning of construction camp facilities and equipment;</p> <p>Waste removal;</p> <p>Contaminated soil removal/treatment;</p> <p>Leveling of soil and returning to prior condition as per contract requirements.</p>	Contractor	PIU, Municipality, Commune council

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation
<b>Occupational health and safety</b>	Construction workers will be exposed to the presence of unexploded ordnances (UXO)	Sites for earthworks that are suspected of having UXO should be surveyed by the Government prior to construction; Should ordnance be detected, clearing work will be commissioned prior to undertaking earthworks.	PMU, PIU Municipality, Commune council
<b>Occupational health and safety</b>	Risk to workers from construction site activities and working in/ around high traffic areas	<p>Appointment of an Environmental, Health and Safety Officer; Contractor compliance with environmental and occupational health and safety guidelines;</p> <p>CEMPs will include health and safety plans;</p> <p>Provide a clean and sufficient supply of fresh water for construction sites;</p> <p>Provide adequate number of latrines at construction sites and ensure that they are cleaned and maintained in a hygienic state;</p> <p>Garbage receptacles at construction sites will be set up, and regularly emptied;</p> <p>Provide personal protection equipment e.g. safety boots, helmets, gloves, protective clothing, goggles, ear plugs;</p> <p>Emergency preparedness and response plan for accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events. These plans will be submitted to the local authorities for review and approval. Emergency phone link with the health center/hospital of Poipet will be established.</p> <p>Each site of works will have basic first aid kits;</p> <p>A records management system that will store and maintain easily retrievable records against loss or damage will be established. It will include documenting and reporting of occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits;</p> <p>Occupational health and safety matters will be given a high degree of publicity to all work personnel and posters will be displayed prominently at construction sites;</p> <p>Contractors will organize an initial Environmental, Health and Safety training for their workers, and short but regular reminder meetings will be organized (biweekly);</p>	Contractor  PIU, Municipality, Commune council



Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for Implementation	
			Implementation	Supervision
		An awareness program for HIV/AIDS and other communicable diseases will be implemented for workers and the local communities; Core labor standards will be implemented. Civil works contracts will stipulate priorities to: (i) employ local people for works; (ii) ensure equal opportunities for women and men; (iii) pay equal wages for work of equal value and pay women's wages directly to them; and (iv) not employ child or forced labor. Specific targets for employment have been included in the project gender action plan.		
<b>Occupational and community health and safety</b>	Workers, as well as communities, may potentially be affected by COVID-19	Conduct a COVID-19 risk assessment and to incorporate COVID-19 health risks as part of their environmental and occupational health and safety (H&S) plans, which are part of their site-specific contractor EMP (CEMP).	Contractor	PIU
<b>Operation</b>				
<b>Land and geology</b>	Soil contamination (from spills or uncontrolled discharge of untreated or treated water) can occur due to faulty pipelines or equipment of the wastewater treatment and stormwater drainage systems. The soil can also be contaminated by flooding due to clogging of the drainage system	All equipment and processes will be maintained in good working order, with back-up material in critical areas; Engineering and management systems will be set up to prevent and handle emergency situations.	Operator	PDPWT/ PDOE PMU, PIU
<b>Land and geology</b>	Erosion may be caused by water flow in open earth channels	Properly slope or re-vegetate surfaces; Stabilize all cut slopes and embankments: their design should consider climate change effects; Landscaping will only use native plant species.	Operator	PMU, PIU
<b>Ecology and biodiversity</b>	No significant impact	-	-	-
<b>Water resources</b>	Surface water or groundwater contamination from spills or	All equipment and processes will be maintained in good working order, with back-up material in critical areas;	Operator	PDPWT/ PDOE

Aspect	Potential Environmental Impact	Proposed Mitigation Measure	Responsible Party for	
			Implementation	Supervision
	uncontrolled discharge of untreated or treated water can occur due to faulty pipeline or equipment Accidental leakage from the wastewater treatment or stormwater drainage systems may impact surface water quality and also groundwater quality, depending on local groundwater depth. This impact might be increased in case of flooding.	Engineering and management systems will be set up to prevent and handle emergency situations Monitoring of the quality of the wastewater effluents will be set up to ensure they meet design criteria and can assimilate the treated effluent year-round.		
<b>Air quality</b>	Clogging of the stormwater drainage system may generate odor nuisances due to an accumulation of solid waste	Regular maintenance operations.	Operator	PDPWT/ PDOE
<b>Noise and vibration</b>	No significant impact	-	-	-
<b>Materials and waste</b>	No significant impact	-	-	-
<b>Archeology and cultural heritage</b>	No significant impact	-	-	-

## 11. Environmental Monitoring Plan

579. The Environmental Monitoring Plan (EMoP) presents environmental parameters that will allow the Proponent to ensure environmental compliance and sustainability of the project operations. The EMoP defines monitoring, verification, and performance requirements. Information obtained during the EMoP implementation can be used in examining the short- and long-term effects of the project's environmental aspects, from which future strategies on environmental enhancement measures can be formulated.

580. The following table presents the proposed EMoP that will be implemented by the Proponent. It shows concerns, parameters to be monitored, as well as the corresponding sampling and measurement plan (method, frequency, location), responsible party, and estimated budget.

Table 44: Environmental Impact Monitoring for Solid Waste Subproject.

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US\$)
<b>Design and Pre-construction Phase</b>							
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Baseline measurement survey	1 in front of the closest houses near the site 1 on-site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Before works' start	Implementation: Contractor Supervision: PIU, MoE	1,200
<b>Ambient noise levels</b>	The noise level during works (Leq, 1hour during the activities)	Baseline measurement survey	1 in front of the closest houses near the site 1 on-site	Anukret No.42 ANK/BK, 2000	Before works' start	Implementation: Contractor Supervision: PIU, MoE	450
<b>Water Quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform	Baseline measurement survey	1 Surface water near the project site water outlet 3 on-site piezometers/boreholes	Groundwater: WHO Guidelines for Drinking-water Quality Surface water: Sub-decree No.27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Baseline before works' start	Implementation: Contractor Supervision: PIU, MoE	540
<b>Water quality</b>	Surface water and groundwater protection	Visual inspections of water management on site	Worksite and access road	-	Before works' start	Implementation: Contractor Supervision: PIU, MoE	None
<b>Biodiversity</b>	Incidence of project-related injuries to wildlife e.g., collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Site boundaries and access road	-	Before works' start	Implementation: Contractor Supervision: PIU, MoE	None
<b>Community and worker health and safety</b>	unexploded ordnance (UXO) risks for workers	UXO survey/clearance	The site and access	-	Before works' start	Implementation: Consultant	80,000

		20ha	boundaries				Supervision: PIU, MoE	
<b>Socio-economic</b>	Current informal waste-pickers employment	Conversion training	Landfill site	-	Before the existing dumpsite decommissioning	Implementation: Contractor Supervision: PIU, MoE	2,000	
<b>Construction Phase</b>								
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Measurement survey	1 in front of the closest houses near the site 1 on-site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once biannual	Implementation: Contractor Supervision: PIU, MoE	3,510	
<b>Ambient noise levels</b>	The noise level during works (Leq, 1hour during the activities)	Measurement survey	1 in front of the closest houses near the site 1 on-site	Sub-decree No.42 ANK/BK, 2000	Once biannual	Implementation: Contractor Supervision: PIU, MoE	1,350	
<b>Groundwater quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform, E-Coli	Measurement survey	3 On-site piezometers/boreholes: upstream, downstream, and laterally from the landfill	WHO Guidelines for Drinking-water Quality	2/year of works (dry and wet seasons)	Implementation: Contractor Supervision: PIU, MoE	1,620	
<b>Surface water quality</b>	Siltation of nearby surface water (TSS)	Measurement survey	Surface water upstream and downstream near the project site outlet	Sub-decree No.27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Once quarterly	Implementation: Contractor Supervision: PIU, MoE	160	
<b>Community and worker health and safety</b>	Incidences of illness due to project Incidences of a work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Implementation: Contractor Supervision: PIU, MoE	1,200	

<b>Employment</b>	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office	-	Once/year	Implementation: Contractor Supervision: PIU, MoE	None
<b>Construction waste</b>	Presence/absence of illegal waste Environment safeguards at landfills	Visual inspection	Construction sites, waste disposal site	-	Once quarterly	Implementation: Contractor Supervision: PIU, MoE	None
<b>Biodiversity</b>	Incidence of project-related injuries to wildlife e.g., collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries and access road		Ongoing	Implementation: Contractor Supervision: PIU, MoE	None
<b>Operation Phase</b>							
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Measurement survey	1 in front of the closest houses near the site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once /year	Implementation: Operator Supervision: PIU, MoE	The operator will be in charge of these costs
<b>Ambient noise levels</b>	The noise level during activities (Leq, 1hour)	Measurement survey	1 in front of the closest houses near the site 1 on-site	Anukret No.42 ANK/BK, 2000	Once/year	Implementation: Operator Supervision: PIU, MoE	
<b>Groundwater quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform	Measurement survey	3 On-site piezometers/boreholes: upstream, downstream, and laterally from the landfill	WHO Guidelines for Drinking-water Quality	2/year (dry and wet seasons)	Implementation: Operator Supervision: PIU, MoE	
<b>Surface water quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform, E-Coli	Measurement survey	Surface water body upstream and downstream near landfill site outlet	Sub-decree No27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or	Once quarterly	Implementation: Operator Supervision: PIU, MoE	

						sewer)			
<b>Community and worker health and safety</b>	Incidences of illness due to project Incidences of a work-related accident, injurtes/deaths, illness	Logbook/ database registration of the operator	Landfill office	-		Once /year	Implementation: Operator		
							Supervision: PIU, MoE		
<b>Employment</b>	Number of locally employed personnel	Logbook/ database registration of the operator	Landfill office	-		Once /year	Implementation: Operator		
							Supervision: PIU, MoE		

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and the responsibility for supervision is the PIU.

Table 45: Environmental Impact Monitoring for WW Subproject

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US\$)
<b>Design and Pre-construction Phase</b>							
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Baseline measurement survey	1 WWTP on site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Before works' start	Implementation: Contractor Supervision: PIU, MoE	840
<b>Ambient noise levels</b>	The noise level during works (Leq, 1 hour during the activities)	Baseline measurement survey	1 on WWTP site 2 urban PS in front of the closest houses near the PS sites	Anukret No.42 ANK/BK, 2000	Before works' start	Implementation: Contractor Supervision: PIU, MoE	450
<b>Water Quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform, E-Coli	Baseline measurement survey	1 Surface water near the project site water outlet 1 on-site piezometer/borehole	Groundwater: WHO Guidelines for Drinking-water Quality Surface water: Sub-decree No.27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Baseline before works' start	Implementation: Contractor Supervision: PIU, MoE	500
<b>Water quality</b>	Surface water and groundwater protection	Visual inspections of water management on site	Worksite and access road	-	Before works' start	Implementation: Contractor Supervision: PIU, MoE	None
<b>Biodiversity</b>	Incidence of project-related injuries to wildlife, e.g., collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Site boundaries and access road	-	Before starting works	Implementation: Contractor Supervision: PIU, MoE	None



<b>Archeology and cultural heritage</b>	Shrine area protection	Visual inspections of temporary fences	Site boundaries	-	Before starting works	Implementation: Contractor	None
<b>Community and worker health and safety</b>	unexploded ordnance (UXO) risks for workers	UXO clearance	Site boundaries	-	Before starting works	Implementation: Consultant Supervision: PIU, MoE	80,000
<b>Construction Phase</b>							
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Measurement survey	1 on-site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Once biannual	Implementation: Contractor Supervision: PIU, MoE	3,360
<b>Ambient noise levels</b>	The noise level during works (Leq, 1 hour during the activities)	Measurement survey	1 on WWTP site 2 urban PS 2 in front of the closest houses near the PS sites	Anukret No.42 ANK/BK, 2000	Once biannual	Implementation: Contractor	1,800
<b>Groundwater quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform	Measurement survey	1 On-site piezometer/bo rehole	WHO Guidelines for Drinking-water Quality	2/year of works (dry and wet seasons)	Supervision: PIU, MoE	1,620
<b>Surface water quality</b>	Siltation of nearby surface water (TSS)	Measurement survey	Surface water upstream and downstream near the project site outlet	Sub-decree No.27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Once quarterly	Implementation: Contractor	160
<b>Community and worker health and safety</b>	Incidences of illness due to project Incidences of a work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Supervision: PIU, MoE	1,200

<b>Employment</b>	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office		Implementation: Contractor	
<b>Construction waste</b>	Presence/absence of illegal waste Environment safeguards at landfills	Visual inspection	Construction sites	-	Supervision: PIU, MoE	Once quarterly
<b>Biodiversity</b>	Incidence of project-related injuries to wildlife e.g., collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries		Implementation: Contractor	Ongoing
<b>Operation Phase</b>						
<b>Ambient air quality</b>	SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	Measurement survey	1 on site	Results are compared against the most restrictive standard between national (Sub-decree No.27 ANRK/BK, 1999) and international (WHO Guidelines) thresholds	Implementation: Operator Supervision: PIU, MoE	Once /year
<b>Ambient noise levels</b>	The noise level during activities (Leq, 1hour)	Measurement survey	1 on WWTP site 2 urban PS 2 in front of the closest houses near the PS sites	Anukret No.42 ANK/BK, 2000	Implementation: Operator Supervision: PIU, MoE	Once/year
<b>Groundwater quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform	Measurement survey	1 On-site piezometer/bo rehole	WHO Guidelines for Drinking-water Quality	Implementation: Operator Supervision: PIU, MoE	2/year (dry and wet seasons)
<b>Surface water quality</b>	pH, COD, BOD <sub>5</sub> , total P, total N, coliform	Measurement survey	Surface water upstream and downstream near the project site outlet	Sub-decree No.27 ANRK/BK, 1999 (Effluent standard for pollution sources discharging wastewater to public water areas or sewer)	Implementation: Operator Supervision: PIU, MoE	Once quarterly

The operator will be in charge of these costs

<b>Community and worker health and safety</b>	Incidences of illness due to project Incidences of a work-related accident, injuries/deaths, illness	Logbook/ database registration of the operator	WWTP office	-	Once /year	Implementation: Operator	
<b>Employment</b>	Number of locally employed personnel	Logbook/ database registration of the operator	WWTP office		Once /year	Supervision: PIU, MoE	

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and the responsibility for supervision is the PIU.

Table 46: Environmental Impact Monitoring for Stormwater Subproject

Concern	Parameter	Means of verification	Location	Standard	Frequency	Responsibility	Cost estimation (US\$)
Design and Pre-construction Phase							
Water quality	Surface water and groundwater protection	Visual inspections of water management on site	Worksite and access road	-	Before works' start	Contractor, PIU	None
Biodiversity	Incidence of project-related injuries to wildlife, e.g., collisions Hunting or fishing by project workers	Visual inspections of temporary fences	Works' boundaries	-	Before starting works	Contractor, PIU	None
Community and worker health and safety	unexploded ordnance (UXO) risks for workers	UXO clearance	Works' boundaries	-	Before starting works	Constructor, PIU	50,000
Construction Phase							
Community and worker health and safety	Incidences of illness due to project Incidences of a work-related accident, injuries/deaths, illness	Logbook/ database registration of the contractor	Contractor office	-	Once /month	Contractor, PIU, MoE	1,800
Employment	Number of locally employed personnel	Logbook/ database registration of the contractor	Contractor office			Contractor, PIU, MoE	
Construction waste	Presence/absence of illegal waste Environment safeguards at landfills	Visual inspection	Construction sites	-	Once quarterly	Contractor, PIU, MoE	
Biodiversity	Incidence of project-related injuries to wildlife, e.g., collisions Hunting or fishing by project workers	Visual inspections and interviews of workers	Works site boundaries		Ongoing	Contractor, PIU, MoE	
Operation Phase							
Community and worker health and safety	Incidences of illness due to project Incidences of a work-related accident, injuries/deaths, illness	Logbook/ database registration of the operator	Operator office	-	Once /year	Operator and PIU records	The operator will be in charge of

Employment	Number of locally employed personnel	Logbook/ database registration of the operator	Operator office		Once /year	Operator	these costs
------------	--------------------------------------	--	-----------------	--	------------	----------	-------------

Note: for all parameters, the responsibility for implementation will be a licensed laboratory (recruited by the contractor); and the responsibility for supervision is the PIU

## 12. Construction Environmental Monitoring

581. The construction environmental management plan (CEMP) shall be prepared by all contractors before the start of the construction works and shall be approved by PIU and the PMU. This requirement shall be included in the construction contracts.

582. The purpose of a CEMP is to outline how a construction project will avoid, minimize or mitigate effects on the environment and surrounding area.

583. The CEMP details the implementation of measures in accordance with environmental commitments outlined in; an Environmental Statement, an environmental policy or environmental plan, requirements of planning conditions, agreements or other legislative requirements. They are 'live' documents that are reviewed and updated at regular intervals throughout the project life cycle.

584. The purpose of the CEMP is to:

- (i) Highlight stakeholder requirements;
- (ii) Ensure that the development is compliant with current Cambodian environmental legislation and international standards (WHO, IFC, ...);
- (iii) Outline Environmental Management Systems e.g. ISO 14001;
- (iv) Detail the mitigation committed to within the Environmental Statement and how it will be implemented on site;
- (v) Ensure that any adverse effects are minimized during construction;
- (vi) Describe any site-specific method statements required.

585. The basic scope of the CEMP shall consider the following subject areas, as applicable to the individual projects: soil, water quality and drainage, noise and air quality disturbances, nature conservation (biodiversity), archaeology and cultural heritage, people and communities, waste management, energy consumption, transport and materials.

586. The CEMP shall be structured as follows:

- (i) Introduction – General purpose, scope, and structure of the document.
- (ii) Scope of work and project description – Information about the development.
- (iii) Environmental requirements and controls –
  - a. environmental impacts and risks;
  - b. Mitigation measures (minimum as set out in this EMP) and pollution control measures (air, noise, surface water, and groundwater quality);
  - c. Monitoring procedures for monitoring construction processes against requirements (minimum as set out in this EMP).
- (iv) Roles and responsibilities
- (v) Consents, commitments, and permissions
  - a. Appropriate environmental legislation, planning conditions, and any other consents or licensing;
- (vi) Management plans – Specific management plans such as ecology, noise, dust, waste, traffic disturbance, access disturbance;
- (vii) Emergency response plan;
- (viii) Communication – External and internal consultations.

587. CEMP should also include an Environmental and occupational health and safety plan, including COVID-19 measures, which should be defined according to national guidance from

Ministry of health with consideration of ADB COVID-19 guidance:  
<https://www.adb.org/publications/safety-well-being-workers-communities-covid-19>.

### 13. Cost of EMP Implementation

588. This section provides an estimate of the cost of EMP implementation. The cost comprises three categories: mitigation measures, monitoring, and travel costs (Table EMP-6). Costs are for the construction phase of two years and the first year of operation, i.e., a total of three years. The costs do not include: (i) detailed design revisions and adjustments; and (ii) salaries of government and PIU staff. Costs are based on the experience of the TRTA team from other projects in Cambodia and in other countries. The total estimated cost is \$236,100 (including surveys, travels, sampling analyses) for the construction phase (excluding the operator's charges). Additionally, the total UXO clearance is \$210,000. The EMP costs have been incorporated into the overall project budget.

589. The cost for the domestic environmental clearances is included in a separate project budget.

**Table 47: Estimated Costs for Implementation of the Project Environment Management Plan<sup>46</sup>**

	Solid waste management	Waste management water	Storm drainage water
Parameter	Estimated Cost (\$)	Estimated Cost (\$)	Estimated Cost (\$)
<b>A. PRE-CONSTRUCTION and CONSTRUCTION PHASE</b>			
<b>Ambient air quality</b> SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	1,200 baseline 3,500 works (1 on-site + 1 household)	840 baseline 3,360 works (1 on-site)	-
<b>Ambient noise levels</b>	450 baseline 1,350 works (1 on-site + 1 household)	450 baseline 1,800 works (1 WWTP site + 2 urban PS + 2 household)	-
<b>Groundwater quality</b> pH, COD, BOD5, total P, total N, coliform, E-Coli	1,200/piezometer (x3) 250 baseline 1,620 works	1,200/piezo (x1) 250 baseline 1,620 works	-
<b>Surface water quality</b> pH, COD, BOD5, total P, total N, coliform, E-Coli, TSS	250 baseline 160 works (TSS only)	250 baseline 160 works (TSS only)	-
<b>Community and worker health and safety</b> Incidences of work-related accident, injuries/deaths, illnesses	1,200	1,200	1,800
<b>UXO Clearance</b>	80,000	80,000	50,000

<sup>46</sup> Estimated costs for health and safety includes the costs of material compensation and health costs (medical consultation, medication, costs related to staff absence, ...)

<b>Sub-Total A</b>	<b>93,170.00</b>	<b>91,130.00</b>	<b>51,800</b>
<b>B. OPERATION PHASE (in charge of the operator)</b>			
<b>Ambient air quality</b> SO <sub>2</sub> , NO <sub>2</sub> , CO, TSP	1,200 / year	840 / year	
<b>Ambient noise levels</b>	450 / year	450 / year	
<b>Groundwater quality</b> pH, COD, BOD <sub>5</sub> , total P, total N, coliform, E-Coli	1,620 / year	1,620 / year	
<b>Surface water quality</b> (downstream and upstream from the outlet) pH, COD, BOD <sub>5</sub> , total P, total N, coliform, E-Coli	1,620 / year	1,620 / year	
<b>Worker health and safety</b> Incidences of a work-related accident, injuries/deaths, illnesses	Routine inspection	Routine inspection	
<b>Community health and safety</b> Incidence of accidents (e.g., vehicle damage, fire)	-	-	
<b>Sub-Total B</b>	<b>4,890.00</b>	<b>4,530.00</b>	
<b>TOTAL (A+B)</b>	<b>18,060.00</b>	<b>15,660.00</b>	
<b>Travel cost (surveys)</b>	200.00 (x1 – pre-construction) 200.00 (x6 - construction) +200.00 (x3 - =operation) <b>2,000</b>		

**Note:**

- Solid waste management – 18 months construction
- Waste water - 30 months construction
- Storm drainage - 24 months construction



## **XI. CONCLUSION AND RECOMMENDATIONS**

590. An IEE is deemed sufficient for the LCIP given its categorization as Category B for Environment and Category B for Involuntary Resettlement and Category C for Indigenous Peoples as per ADB SPS 2009.

591. During construction, anticipated project impacts on noise, dust, traffic, health, and safety will be localized, temporary, intermittent in nature and can be readily addressed through the implementation of the measures outlined in the EMP. Land clearing and grading will be limited to areas where necessary. A detailed tree inventory and survey will be undertaken as part of the tree cutting permit application in coordination with the concerned MoE office and the Municipality of Poipet.

592. During operation, the project is expected to have positive social impacts in terms of the generation of local benefits. It is expected to generate/contribute additional local employment and livelihood opportunities and local government revenues.

593. The Proponent is fully committed to its environmental and social responsibilities, including compliance with national environmental, health, and safety regulations and ADB SPS requirements.

594. Should there be changes in the project scope or location of the facilities that would result to significant impacts not included in this assessment, an updated or a new Borrower IEE will be prepared.

595. This is a feasibility study phase IEE; an updated Borrower IEE and standalone bidding ready EMP and domestic IEIA and EIA in Khmer will be prepared during the detailed design phase. The domestic EIA and IEIA will be submitted to the MoE, in accordance with national legislation.

## APPENDICES

### 1. Letter of MoE No. 1562, 23 November 2020, on approving location for the new landfill construction

Kingdom of Cambodia

Nation Religion King

Ministry of Environment

No 1562

To

**HE Senior Minister, Minister of Public Works, and Transport**

**Subject:** The Case approve the request for positioning (1) sub-project landfill in Poipet City (2). Sub-project collection-transfer and transportation of solid waste and (3) sub-project construction wastewater treatment plant in the Banteay Meanchey province for Livable Cities Investment Project of the Ministry of Public Works and Transport

**References:**

- Reach Kram No. NS / RKM / 1296 / 36 dated 24 December 1996 promulgating the law on environmental protection and natural resource management
- Decree No. 72, dated 18 months 1996 on the assessment process Environmental Impact
- Letter No. 3323, dated September 1, 2020 of the Ministry of Public Works and Transport
- Annotation Minister dated, 10 November 2020 on the Inspection Report dated October 26, 2020, Officials department's environmental impact assessment of the Ministry of Environment

The objective as stated in the above mentioned and I have the honor to inform the Senior Minister aware that the Ministry of Environment approved the selection location for

1. Sub-project new landfill for Poipet city which located in the village Thma Sen, Sangkat Nimit, Poipet city
2. Sub-project wastewater treatment plant for Poipet city which located in the Reaksmeay Samaki village, Sangkat Nimit, Poipet city of the Livable Cities Investment Project (LCIP) of the Ministry of Public Works and Transport (Owner) Under Asian Development Bank (ADB) loan agreement.

Anyway, the sub-project transfer station of solid waste, which is located Toul Pongro Village, Sangkat Psa Kandal, Poipet city, Banteay Meanchey Province. Ministry of Public Works and Transport should relocate and built the transfer station of solid waste near the new landfill to avoid causing odor problems affects people living near the project site, as well as Poipet City's development plan.

Meanwhile, the Ministry of transport and is working with consultants who have registered with the Ministry to prepare the environmental impact assessment and social (IESIA) report for the three sub-projects of urban development projects Livable Cities Investment Project before starting the project construction activities.

As described above, H.E. Senior Minister aware and manage with favor.

Please H.E. Senior Minister accept my salute.

Phnom Penh, November 23, 2020

For Minister of MPWT

Secretary of State

H.E. So Khorn Rithikun

Copy

- the Council of Ministers
- Ministry of Economy and Finance
- Ministry of Planning, Land management, Urban Planning and Construction
- Banteay Meanchey Provincial Administration
- Department of Environment of Banteay Meanchey
- Chronological documents



## ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏ

### ԿԱՌԱՐԱՐ

#### ԿԱՌԱՐԱՐՈՒՄԻ ՄԱՍԻՆ ԿԱՌԱՐԱՐՈՒՄԻ ԴԵՊԱՐՏՄԵՆՏԻ

**ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ՄԱՍԻՆ ԿԱՌԱՐԱՐՈՒՄԻ ԴԵՊԱՐՏՄԵՆՏԻ** ընդունել է հետևյալ կարգադրությունը:

**ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ** ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

**ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ** ընդունել է հետևյալ կարգադրությունը:

**ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ** ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԿՐԹԱՆՈՒԹՅԱՆ ԻՐԱՎԱԿԱՆ ԴԵՊԱՐՏՄԵՆՏԻ ընդունել է հետևյալ կարգադրությունը:

...  
...  
...  
...  
...

...  
...

...  
...

...  
...



...

...

...  
...  
...  
...  
...  
...

...  
...  
...

## **2. Environmental baseline survey report**

ASIAN DEVELOPMENT BANK



**TA-9554 – REG: SOUTHEAST ASIA URBAN SERVICES FACILITY**

CONTRACT NO: 143221-S53314

**CAM: LIVABLE CITIES INVESTMENT PROJECT**

## Baseline Environmental Survey for Poipet City



Prepared by



January 2021

## CONTENTS

List of Tables .....	v
List of Figures .....	vi
List of Abbreviation .....	ix
1 Introduction and Background .....	1
1.1 Background .....	1
1.2 Study Area.....	1
1.3 Survey Objective .....	1
1.4 Methodology .....	2
1.5 Survey Team Member .....	2
2 Environmental Legislation .....	3
3 Project Description .....	12
3.1 Wastewater .....	12
3.2 Stormwater drainage .....	13
3.3 Solid Waste Management Facilities .....	14
4 Baseline Survey Results .....	14
4.1 Overall environmental aspect .....	14
4.1.1 Geographical of Poipet city .....	14
4.1.2 Land use .....	15
4.1.3 Geology and Soil.....	16
4.1.4 Hydrology .....	18
4.1.5 Protection area.....	18
4.1.6 Climate Change .....	20
4.1.7 Existing Network Facilities.....	21
4.2 Characteristic of the project area .....	25
4.2.1 Landfill .....	25
4.2.1.1 Location of the landfill site.....	26
4.2.1.2 Community structure/type of building .....	27
4.2.1.3 Access Road .....	27
4.2.1.4 Land use/ Type of land .....	28
4.2.1.5 Hydrology/river system .....	28
4.2.1.6 Access to Service Facilities .....	30
4.2.1.7 Ecosystem/Protected area.....	32
4.2.2 The Wastewater Treatment Plant (WWTP) .....	33
4.2.2.1 Location.....	33
4.2.2.2 Community structure/type of building .....	34

4.2.2.3 Access Road .....	35
4.2.2.4 Land use/Type of land .....	36
4.2.2.5 Hydrology/river system .....	36
4.2.2.6 Access to Service Facilities .....	37
4.2.1.7 Ecosystem/Protected area .....	39
4.2.3 Storm Drainage Outfall .....	39
4.2.3.1 Outfall (GMS_01) .....	40
4.2.3.2 Outfall (GMS_02) .....	43
4.2.3.3 Outfall (GMS_03) .....	44
4.2.3.4 Outfall (GMS_04) .....	46
4.2.4 Pumping Station .....	48
4.2.4.1 Pumping Station (PS_MP_01) .....	48
4.2.4.2 Pumping Station (PS_MP_02) .....	50
4.2.4.3 Pumping Station (PS_MP_03) .....	52
4.2.4.4 Lift Pump (PS_LP_01) .....	53
4.2.4.5 Lift Pump (PS_LP_02) .....	55
4.2.4.6 Lift Pump (PS_LP_03) .....	57
4.3 Soil quality .....	59
4.3.1 Methodology .....	59
4.3.2 Finding .....	61
4.3.2.1 The Landfill .....	61
4.3.2.2 The WWTP .....	62
4.3.2.3 Discussion .....	63
4.4 Water quality .....	63
4.4.1 Methodology .....	63
4.4.1.1 The Surface water and groundwater .....	63
4.4.1.2 Bacteriological .....	66
4.4.2 Finding .....	67
4.4.2.1 Surface water and groundwater .....	67
4.4.2.2 Bacteriological .....	69
4.5 Flora and Fauna .....	70
4.5.1 Objective .....	70
4.5.2 Scope of the study .....	70
4.5.3 Methodology .....	71
4.5.3.1 Literature review .....	71
4.5.3.2 Field Survey .....	71
4.5.4 Finding .....	77



4.5.4.1 Flora .....	77
4.5.4.2 Fauna .....	82
4.5.5 Discussion.....	91
4.5.5.1 Flora .....	91
4.5.5.2 Fauna .....	92
4.6 Cultural Heritage.....	92
4.6.1 Methodology .....	92
4.6.2 Finding .....	92
4.7 Noise .....	94
4.7.1 Methodology .....	94
4.7.2 Finding .....	96
4.8 Air quality.....	98
4.8.1 Methodology .....	98
4.8.2 Finding .....	99
5 Conclusions .....	100
5.1 Environmental Regulation.....	100
5.2 Project Description .....	100
5.3 Baseline survey .....	100
5.3.1 Overall environmental aspect.....	100
5.3.2 Characteristic of the project area.....	100
5.3.3 Soil quality.....	101
5.3.4 Water quality .....	101
5.3.5 Flora.....	101
5.3.6 Fauna.....	102
5.3.7 Cultural Heritage .....	104
5.3.8 Noise.....	104
5.3.9 Air quality .....	104
6 References .....	105

## LIST OF TABLES

Table 1.4-1: List of team members.....	2
Table 4.1.2-1: Existing Land Use in Poipet.....	15
Table 4.1.5-1: List of protected areas in Cambodia .....	19
Table 4.3.1-1: The method for soil quality analysis in the laboratory .....	60
Table 4.3.2.1-1: The physical characteristic of soil .....	61
Table 4.3.2.1-2: Chemical characteristic of the soil .....	62
Table 4.3.2.2-1: The physical characteristic of the soil .....	62
Table 4.3.2.2-2: Chemical characteristic of the soil .....	63
Table 4.4.1.1-1: The location of the water sampling .....	64
Table 4.4.1.1-2: The methodology of water quality measurement .....	64
Table 4.4.1.2-1: Site description.....	66
Table 4.4.2.1-1: Result of surface water quality.....	68
Table 4.4.2.1-2: Result of groundwater quality .....	69
Table 4.4.2.2-1: The result of total coliform and E. coli at the landfill .....	69
Table 4.4.2.2-2: The result of total coliform and E. coli at the WWTP .....	70
Table 4.5.3.2.1-1: Field inventory plot locations .....	72
Table 4.5.3.2.1-2: Plot design and sub-plot specifications.....	72
Table 4.5.4.1.2-1: Species list and structural summary .....	78
Table 4.5.4.1.2-2: Species list and structural summary .....	79
Table 4.5.4.1.3-1: The vegetation estimation per hectare with standard errored (SE±) .....	80
Table 4.5.4.1.3-2: The vegetation estimation per hectare with standard errored (SE±) .....	81
Table 4.5.4.2.1-1: Species recorded on the line transects at the landfill site .....	82
Table 4.5.4.2.1-2: Species recorded on the line transects at the WWTP site .....	83
Table 4.5.4.2.1-3: Species list of wild animals obtain from interview result at the landfill site....	84
Table 4.5.4.2.1-3: Species list of wild animals obtain from interview result at the WWTP site ...	85
Table 4.5.4.2.2-1: Herpetofauna species known to exist at the survey of the landfill site .....	87
Table 4.6.2-1: Key discussion meeting with stakeholders at the community level .....	93
Table 4.7.1-1: The maximum standard of noise level allowable in the public and residential area (dB(A)) .....	94
Table 4.7.2-1: The results of the noise level measurement at the landfill site .....	96
Table 4.7.2-2: The results of the noise level measurement at the houses close to the landfill site97	
Table 4.7.2-3: The results of the noise level measurement at the WWTP site .....	97
Table 4.7.2-4: The results of the noise level measurement at the houses close to the WWTP site .....	98
Table 4.7.2-5: The results of the noise level measurement at the lift pumping station and main pumping station.....	98
Table 4.8-1: The method for air quality measurement .....	98
Table 4.8.2-1: The air quality result .....	99

## LIST OF FIGURES

Figure 3.1-1: Wastewater collection and treatment subproject in Poipet city .....	12
Figure 3.2-1: Stormwater drainage subproject in Poipet city.....	13
Figure 3.3-1: Solid waste management subproject in Poipet city.....	14
Figure 4.1.1-1: Map of Poipet city .....	15
Figure 4.1.2-1: Present Landuse Map of Poipet City .....	16
Figure 4.1.3-1: Geological Map of the project area.....	17
Figure 4.1.3-2: Soil type of the project area.....	17
Figure 4.1.4-1: Map of water bodies in the project area.....	18
Figure 4.1.5-1: Map of protected area in Cambodia .....	20
Figure 4.1.7-1: The road network in Poipet city .....	21
Figure 4.1.7-2: Ou Kaidon Reservoir for Water Supply.....	22
Figure 4.1.7-3: Operating pump station .....	23
Figure 4.1.7-4: The truck for solid waste transportation.....	24
Figure 4.2.1-1: Map of the landfill site with 300m buffer .....	26
Figure 4.2.1.1-1: Location map of the proposed landfill site .....	26
Figure 4.2.1.2-1: Land development project of the private company .....	27
Figure 4.2.1.3-1: Access Road to the proposed landfill site .....	28
Figure 4.2.1.4-1: Land use surrounding the proposed landfill site .....	28
Figure 4.2.1.5-1: Road drainage closest to the access road.....	29
Figure 4.2.1.6-2: Water supply in Soriya village .....	30
Figure 4.2.1.6-3: The closest schools to a landfill site .....	31
Figure 4.2.1.7-1: Map of project area concerned to the protected area .....	32
Figure 4.2.1.7-2: Rice field surrounding the landfill.....	32
Figure 4.2.1.7-3: Local people collect the bamboo .....	32
Figure 4.2.2-1: Map of the WWTP site with 300m buffer .....	33
Figure 4.2.2.1-1: Location map of the proposed WWTP site .....	34
Figure 4.2.2.2-1: The proposed site is dominant of paddy field .....	34
Figure 4.2.2.3-1: Sort cut access Road to the proposed WWTP site .....	35
Figure 4.2.2.3-2: Long way access road to the proposed WWTP site .....	36
Figure 4.2.2.5-1: Water bodies within the project area .....	37
Figure 4.2.2.5-2: The canal surrounding the rice field.....	37
Figure 4.2.2.6-1: Electrical pole along Road No.59 .....	38
Figure 4.2.1.6-2: Map of distance from schools to WWTP.....	39
Figure 4.2.3-1: Map of the proposed outfall for stormwater drainage.....	40
Figure 4.2.3.1-2: Present condition of the site .....	41

Figure 4.2.3.1-3: Present condition of the access road.....	42
Figure 4.2.3.1-4: The <i>Dipterocarpus alatus</i> (Cheu Teal) along the Cambodian-Thai border line.....	42
Figure 4.2.3.2-1: Location of Outfall (GMS_02) within 300m buffer .....	43
Figure 4.2.3.2-2: Present condition of Surrounding area .....	44
Figure 4.2.3.2-3: Present condition of the access road.....	44
Figure 4.2.3.3-1: Location of Outfall (GMS_03) within 300m buffer .....	45
Figure 4.2.3.3-2: Present condition of Surrounding area .....	45
Figure 4.2.3.3-3: Present condition of the access road.....	46
Figure 4.2.3.4-1: Location of Outfall (GMS_04) within 300m buffer .....	46
Figure 4.2.3.4-2: Present condition of Surrounding area .....	47
Figure 4.2.3.4-3: Present condition of the access road.....	47
Figure 4.2.4-1: Map of the proposed outlet for stormwater drainage .....	48
Figure 4.2.4.1-3: Present condition of the access road PS_MP_01 .....	50
Figure 4.2.4.2-2: Present condition of Surrounding area .....	51
Figure 4.2.4.2-3: Present condition of the access road (NR No.5).....	52
Figure 4.2.4.3-2: Reservoir and one house present in the 300m buffer zone of MP_03 .....	53
Figure 4.2.4.3-3: Present condition of the access road.....	53
Figure 4.2.4.4-2: The private area with a land filled up .....	54
Figure 4.2.4.4-3: Present condition of the access road.....	55
Figure 4.2.4.5-2: The proposed LP_02 site .....	56
Figure 4.2.4.5-3: Present condition of NR No.5 .....	56
Figure 4.2.4.6-4: Present condition of the access road.....	58
Figure 4.2.4.6-5: Electricity pole at LP_03.....	58
Figure 4.3.1-1: The location of the sampling point in the landfill site.....	59
Figure 4.3.1-2: The location of the sampling point in the WWTP site.....	60
Figure 4.3.1-3: Soil sampling at the landfill site, 253507 E, 1513372 N .....	61
Figure 4.3.1-4: Soil sampling at the WWTP site, 245681 E, 1503125 N .....	61
Figure 4.4.1-1 Water Quality Sampling in the landfill area .....	65
Figure 4.4.1.1-2 Water Quality Sampling at the WWTP Area .....	66
Figure 4.4.1.2-1: Water sampling activities for bacteriology indicators at the landfill site .....	67
Figure 4.4.1.2-2: Water sampling activities for bacteriology indicators at the WWTP site .....	67
Figure 4.5.2-1: Location map of the landfill and WWTP site .....	71
Figure 4.5.3.2.1-1: Plots and sub-plots inventory quadrilateral .....	71
Figure 4.5.3.2.1-3: Inventory plots with forest cover in WWTP site.....	73
Figure 4.5.3.2.1-4 (a, b, c, d): Illustrate the applications of measurement techniques under various conditions .....	73
Figure 4.5.3.2.2-1 A: Map of a line-transects survey of the proposed landfill .....	75

Figure 4.5.3.2.2-1 B: Map of a line-transects survey of proposed WWTP.....	75
Figure 4.5.4.1.2-1: Number of vegetation species blue color (dbh >5 cm) and yellow color (dbh<5cm) with standard error (dark grey) .....	78
Table 4.5.4.1.2-3: Number of vegetation species grey color( dbh >5 cm) and yellow color (dbh<5cm) with standard error (dark grey) .....	79
Figure 4.5.4.1.3-1: Forest coverage in the proposed landfill site .....	80
Figure 4.5.4.1.3-2: Forest coverage in the proposed WWTP site .....	81
Figure 4.5.4.2.1-1: Line transect surveys activity at the landfill site .....	82
Figure 4.5.4.2.1-2: Line transect surveys activity (left) and species captured by the camera (right) of the WWTP site. ....	83
Figure 4.5.4.2.1-3: Activity of interview local people about wildlife in the study area of the landfill site .....	85
Figure 4.5.4.2.1-4: Activity of interview local people about wildlife in the study area of the WWTP site .....	87
Figure 4.5.4.2.1-5: The seven recorded amphibians from the survey at the landfill site.....	88
Figure 4.5.4.2.1-7: The eight Amphibians species record from the survey at the WWTP site: ...	89
Figure 4.6.2-1: Activities of consultation with local Authority.....	93
Figure 4.7.1-1: The air quality and noise survey at the landfill site and three houses adjacent to the project site.....	95
Figure 4.7.1-2: The noise survey at the WWTP site and three houses adjacent to the project site	95
Figure 4.7.1-3: The noise survey at houses adjacent to the pumping stations.....	96
Figure 4.8-1 The air quality measurement at the proposed landfill site.....	99

## LIST OF ABBREVIATION

AASHTO	: American Association of State Highway and Transportation Officials
ADB	: The Asian Development Bank
DPWT	: Department of Public Works and Transport
EA	: Executing Agency
EIA	: Environmental Impact Assessment
EMP	: Environment Management Plan
FS	: Feasibility Study
GRC	: Royal Government of Cambodia
IEE	: Initial Environmental Examination
IEIA	: Initial Environmental Impact Assessment
KCC	: Key Consultants (CAMBODIA)
MAFF	: Ministry of Agriculture, Forestry, and Fisheries
MEF	: Ministry of Economy and Finance
MOE	: Ministry of Environment
MPWT	: Ministry of Public Works and Transport
PIC	: Project Implementation Consultant
PIU	: Project Implementation Unit
PMU	: Project Management Unit
SURF	: The Southeast Asia Urban Services Facility
USDA	: United States Department of Agriculture
WWTP	: Wastewater Treatment Plant

## **1 INTRODUCTION AND BACKGROUND**

### **1.1 Background**

At the request of the Kingdom of Cambodia, the Asian Development Bank is developing a project to improve secondary cities' environment in Cambodia. There are three targeted cities include Bavet, Kampot, and Poipet city.

The Southeast Asia Urban Services Facility (SURF), a transaction technical assistance facility led by EGIS EAU, will support the project preparation and conduct technical, financial, economic, institutional, sector policy, legal, regulatory, poverty, social, gender, and safeguard assessments. Egis Eau's service aims to assist government authorities in preparing the project in compliance with the ADB requirements.

The project stage is in the Feasibility Study (FS) for approximately 3 months (Sept.-Nov.2020). The social survey was awarded to Key Consultants (CAMBODIA) KCC to carry out by Egis Eau.

This report is focused only on the subprojects in Poipet city, which include (i) wastewater collection and treatment plant, (ii) storm drainage, and (iii) solid waste management.

### **1.2 Study Area**

The Poipet land is used to envision the city is becoming commercial and industrial for sustainable development. Poipet is a corridor city on the Cambodian border with Thailand country. Poipet has an area of 262 km<sup>2</sup>. It is far away, 470 km from the Phnom Penh capital when traveling via NR6 and approximately 390 km via NR5, where the potential road is connected to many cities in Cambodia indispensable economic corridor between Cambodia and Thailand. The Poipet city is divided into three communes: Sangkat Poipet, Sangkat Phsar Kandal, and Sangkat Nimith. It has a population of more than 140,000. Poipet was one of the last strongholds of the notorious Khmer Rouge from the 1980s until the early 1990s; the city saw much fighting between the Khmer Rouge and forces loyal to the government; after the Cambodian civil war ended in 1997 that the Poipet city experienced an economic renaissance of sorts. Poipet city is a main international border crossing with Thailand. Presently, Poipet is considering one of the fastest developing cities in the country, with the potential of becoming a center for manufacturing, tourism, and real estate development. There are three special economic zones (SEZs): Poipet O'Neang Special Economic Zone (POSEZ) hosts around five factories across 467 hectares, SANCO Poipet Special Economic Zone spans 83 hectares, and Poipet PP SEZ sits on 68 hectares.

### **1.3 Survey Objective**

The Survey also aims to describe the surrounding environment of each proposed project sites in Poipet city:

- WWTP and associated outlet and Pumping Stations (PS) along with the networks;
- Stormwater network and associated outlets; and
- Landfill, sorting plant, and composting area;

To describe the surrounding environment, additional data are required through monitoring or field observations and sampling on the following aspects:

- (i) Soil quality;
- (ii) Water quality;
- (iii) Ground Water Quality;
- (iv) Bacteriology;
- (v) Flora;
- (vi) Fauna;
- (vii) Cultural Heritage;
- (viii) Noise;
- (ix) Air quality.

The data, analysis, and reports from the Survey will assist and inform the Initial Environmental Examination (IEE) report for the Cambodia Livable Cities Investment Project. The IEE report comprises baseline data on the physical and biological environment's existing condition, the anticipated environmental impacts, and proposed mitigation measures.

#### 1.4 Methodology

The baseline survey will be used three main methodologies: (i) Collect legislation and regulation on environmental resources in Cambodia, and internationally/regionally if any, (ii) Extraction key information from previous report study concerning the project area, and (iii) Conduct filed observation and measurement the natural physical resources in according to the ToR.

- Collect legislation and regulation on environmental resources- National and regional/international legislation and regulation will be collected such as law, sub-decree, Prakas/declaration, etc.
- Extraction of key information/event on natural resources from any reported study concerned with the project target area, Poipet city.
- Field observation and measuring of the real condition of the environmental resources including physical (soil, air, water, hydrology, etc.), biological resources (forest, wildlife, and its habitat), and cultural resources (archeological site, artifact, religion site, etc.). The observation will also describe the public service facility's present condition, such as water supply and sanitation systems, electricity, public health facility, education facility, and transportation facility within 300m buffer area to the project site.

#### 1.5 Survey Team Member

There are 5 environmental survey team members and 7 fauna and flora survey team members, including the team leader, co-team leader, engineers, and field assistant, see Table 1.4-1.

Table 1.4-1: List of team members

No.	Description	Position	Responsible
<b>I. Environmental Survey Team</b>			
1	Miss. Chhun Sokhom	Team Leader	Coordinate with the local authority, Field investigation, and reporting
2	Mr. Ang Sovanna	Co- team leader	Field investigation and reporting
3	Mr. Eng Diamant	Member	Field investigation and compiling data
4	Mr. Kol Ponlok	Member	Field investigation and compiling data
5	Mr. Chan Thanin	Member	GIS mapping
<b>II. Fauna and Flora Survey Team</b>			
1	Mr. Toem Yean	Team Leader	Coordinate with the local authority, Field survey, and reporting on flora
2	Mr. Hun Seiha	Co-Team Leader	Coordinate with the local authority, Field



			survey, and reporting on amphibian and reptile
3	Mr. Ith Saveng	Member	Field survey and reporting on the bat
4	Mr. Pin Chanratana	Member	Field survey and report on bird and mammal
5	Mr. Noun Situn	Member	Field survey on flora and compile data
6	Mr. Yim Raksmei	Member	Field survey fauna and compile data
7	Mr. Phoen Bora	Member	Field survey fauna and compile data

## 2 ENVIRONMENTAL LEGISLATION

Some important laws, sub-decrees, and guideline that concerned the project location and the project nature are listed in the table below:

Level or legislation	Dated of launching to use	Key Concerned to the project
<b>Constitution</b>	Sept. 21, 1993.	<ul style="list-style-type: none"> <li>- State property notably comprises land, mineral resources, mountain, sea, underwater, continental shelf, coastline, airspace, islands, rivers, canals, streams, lakes, forests, natural resources, economic and cultural centers, bases for national defense, and other facilities determined as State property.</li> <li>- The state shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests, and forestry product, wildlife, fish, and aquatic resources.</li> </ul>
<b>Law</b>		
Law on Environmental Protection and Natural Resources Management	Dec. 24, 1996.	<ul style="list-style-type: none"> <li>- To protect and promote environmental quality and public health through prevention, reduction, and control of pollution.</li> <li>- To assess all proposed projects' environmental impacts prior to the issuance of a decision by the Royal Government.</li> <li>- To ensure the rational and sustainable conservation, development, management, and use of the Kingdom of Cambodia's natural resources.</li> <li>- To encourage and provide the public with the possibility to participate in protecting the environment and the management of natural resources.</li> <li>- To suppress any acts that cause harm to the environment.</li> <li>- Under this law, developers need to prepare an IEIA report or EIA report for their proposed or existing development projects</li> </ul>
Land Law	Jul. 20, 2001	<ul style="list-style-type: none"> <li>- All persons shall respect the property of the State and legally acquired private property. The management of the cadastral administration of immovable property belonging to the State and the competence to issue titles related to immovable property throughout the Kingdom of Cambodia is under the Ministry of Land Management Urban Planning authority Construction (MLMUPC).</li> <li>- Only natural persons or legal entities of Khmer nationality have the right to land ownership in the Kingdom of Cambodia.</li> <li>- For no less than five years before the promulgation of this law, any person who enjoyed peaceful, uncontested possession of immovable property that can lawfully be privately possessed has the right to request a definitive title of ownership.</li> </ul>

Law of Water Resources Management	May 22, 2007	<ul style="list-style-type: none"> <li>- Filling of the river, tributary, stream, natural lakes, canal, and reservoirs should subject to license or permitted letter.</li> <li>- The discharge, disposal, or deposit of polluting substances that are likely to deteriorate the quality of water or endanger human, animal, and plant health into the water, the soil, or the subsoil shall be subject to a license or permission form will be stated in Sub-decree.</li> </ul>
Law on Protected Areas	Jan. 4, 2008	<ul style="list-style-type: none"> <li>- This law defines the framework of management, conservation, and development of protected areas. This law aims to ensure the management, conservation of biodiversity, and sustainable use of natural resources in protected areas.</li> <li>- The establishment or modification of any protected area shall be based on research studies, criteria, management objectives, and access rights to resource use, land titles, and other relevant aspects.</li> <li>- Each protected area shall be divided into four (4) management zoning systems as the following: <ol style="list-style-type: none"> <li>1. <b>Core zone:</b> management area(s) of high conservation values containing threatened and critically endangered species and fragile ecosystems. Access to the zone is prohibited except for the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies to preserve and protect biological resources and the natural environment except for national security and defense sectors.</li> <li>2. <b>Conservation zone:</b> management area(s) of high conservation values containing natural resources, ecosystems, watershed areas, and natural landscape located adjacent to the core zone. Access to the zone is allowed only with the Nature Conservation and Protection Administration's prior consent at the area, except national security and defense sectors. The small-scale community uses of non-timber forest products (NTFPs) to support local ethnic minorities' livelihood may be allowed under strict control. They do not present serious adverse impacts on biodiversity within the zone.</li> <li>3. <b>Sustainable use zone:</b> management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself, thus contributing to the local community and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities following relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone following the Ministry of Environment's request.</li> <li>4. <b>Community zone:</b> management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy fields, and field gardens or swidden (Chamkar).</li> </ol> </li> </ul>
Expropriation Law	Dec. 29, 2009	<ul style="list-style-type: none"> <li>- The main purposes of the law are: (i) ensure in right withdrawal on private properties in fairly, and justice, (ii) ensure in prior compensation fairly, and justice (iii) serve to public and nation benefit, and (iv) develop public physical infrastructures.</li> <li>- The compensation rate should provide fixed asset owners in compliance with the real market rate or subsidy cost in the</li> </ul>

		dateline of the declaration on expropriation. Market rate and subsidy cost were arranged by committee or independent agency through a selection of expropriation committee
Law on Forest	Aug. 2002	<ul style="list-style-type: none"> <li>- This law aims to ensure the sustainable management of these forests for their social, economic, and environmental benefits, including conservation of biological diversity and cultural heritage.</li> <li>- This law shall be implemented to ensure public participation in any government decision that has the potential for heavy impact on concerned general citizens, livelihoods of local communities, and forest resources of the Kingdom of Cambodia.</li> <li>- Any individual who has committed a forestry offense harming the forest ecosystem shall be liable for payment to restore or repair the forest ecosystem to its original condition.</li> </ul>
<b>Sub-Decree</b>		
Sub-decree No.72 on the EIA Process	Aug. 11, 1999.	<ul style="list-style-type: none"> <li>- The EIA shall be done on every project and activity, private or public, and shall be reviewed by the MoE before being submitted to the RGC for decision.</li> <li>- The MoE shall: (i) evaluate and review the EIA report in collaboration with other Governmental Institutions and (ii) take appropriate administrative, conduct surveillance and monitor to ensure that the EMP during project construction, operation, and closure, which contained in an approved EIA report.</li> <li>- Prior to implementing the proposed project, the project owner must receive consent from the MoE in advance on IEIA or EIA report.</li> </ul>
Sub-Decree No. 27 on Water Pollution Control	Apr. 06, 1999	<ul style="list-style-type: none"> <li>- The purpose of this sub-decree is to regulate the water pollution control to prevent and reduce the water pollution of the public water areas so that the protection of human health and the conservation of biodiversity should be ensured.</li> <li>- This sub-decree applies to all pollution sources and all activities that cause pollution of the public water areas.</li> </ul>

Annex 2  
Effluent standard for pollution sources  
discharging wastewater to public water areas or sewer

Nº	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	°C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD <sub>5</sub> ( 5 days at 20 °C )	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 60	< 120
6	Total Dissolved Solids	mg/l	< 1000	< 2000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate (NO <sub>3</sub> )	mg/l	< 10	< 20
11	Chlorine ( free )	mg/l	< 1.0	< 2.0
12	Chloride ( ion )	mg/l	< 500	< 700
13	Sulphate ( as SO <sub>4</sub> )	mg/l	< 300	< 500
14	Sulphide ( as Sulphur )	mg/l	< 0.2	< 1.0
15	Phosphate ( PO <sub>4</sub> )	mg/l	< 3.0	< 6.0
16	Cyanide ( CN )	mg/l	< 0.2	< 1.5
17	Barium ( Ba )	mg/l	< 4.0	< 7.0
18	Arsenic ( As )	mg/l	< 0.10	< 1.0
19	Tin ( Sn )	mg/l	< 2.0	< 8.0
20	Iron ( Fe )	mg/l	< 1.0	< 20
21	Boron ( B )	mg/l	< 1.0	< 5.0
22	Manganese ( Mn )	mg/l	< 1.0	< 5.0
23	Cadmium ( Cd )	mg/l	< 0.1	< 0.5
24	Chromium ( Cr ) <sup>+3</sup>	mg/l	< 0.2	< 1.0
25	Chromium ( Cr ) <sup>+6</sup>	mg/l	< 0.05	< 0.5
26	Copper ( Cu )	mg/l	< 0.2	< 1.0
27	Lead ( Pb )	mg/l	< 0.1	< 1.0
28	Mercury (Hg )	mg/l	< 0.002	< 0.05
29	Nickel ( Ni )	mg/l	< 0.2	< 1.0
30	Selenium ( Se )	mg/l	< 0.05	< 0.5
31	Silver ( Ag )	mg/l	< 0.1	< 0.5
32	Zinc ( Zn )	mg/l	< 1.0	< 3.0
33	Molybdenum ( Mo )	mg/l	< 0.1	< 1.0
34	Ammonia ( NH <sub>3</sub> )	mg/l	< 5.0	< 7.0
35	DO	mg/l	>2.0	>1.0
36	Polychlorinated Byphenyl	mg/l	<0.003	<0.003
37	Calcium	mg/l	<150	<200
38	Magnesium	mg/l	<150	<200
39	Carbon tetrachloride	mg/l	<3	<3
40	Hexachloro benzene	mg/l	<2	<2
41	DTT	mg/l	<1.3	<1.3
42	Endrin	mg/l	<0.01	<0.01
43	Dieldrin	mg/l	<0.01	<0.01
44	Aldrin	mg/l	<0.01	<0.01
45	Isodrin	mg/l	<0.01	<0.01
46	Perchloro ethylene	mg/l	<2.5	<2.5
47	Hexachloro butadiene	mg/l	<3	<3
48	Chloroform	mg/l	<1	<1
49	1,2 Dichloro ethylene	mg/l	<2.5	<2.5
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexachloro cyclohexene	mg/l	<2	<2

**Annex 4**

**Water Quality Standard in public water areas  
for bio-diversity conservation**

No	Parameter	Unit	Standard Value
<b><u>1- River</u></b>			
1	pH	mg/l	6.5 – 8.5
2	BOD <sub>5</sub>	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 5000
<b><u>2- Lakes and Reservoirs</u></b>			
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05
<b><u>3- Coastal water</u></b>			
1	pH	mg/l	7.0 – 8.3
2	COD	mg/l	2 – 8
4	Dissolved Oxygen	mg/l	2 - 7.5
5	Coliform	MPN/100ml	< 1000
5	Oil content	mg/l	0
6	Total Nitrogen	mg/l	1– 1.0
7	Total Phosphorus	mg/l	0.02 – 0.09

**Annex 5**

**Water Quality Standard in public water areas for public health  
protection**

No	Parameter	Unit	Standard Value
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Dieldrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

Sub-Decree No.42 on Air Pollution and Noise Disturbance Control	Jul. 10, 2000	<ul style="list-style-type: none"><li>- The purpose of this sub-decree is to protect the quality of the environment quality and public health from air pollutants and noise disturbance through monitoring, curbing, and mitigating activities</li><li>- Ambient Air Quality Standards<table><tr><th>Parameter</th><th>1 Hour Average mg/m<sup>3</sup></th><th>8 Hours Average mg/m<sup>3</sup></th><th>24 Hours Average mg/m<sup>3</sup></th><th>1 Year Average mg/m<sup>3</sup></th></tr><tr><td>Carbon Monoxide (CO)</td><td>40</td><td>20</td><td>-</td><td>-</td></tr><tr><td>Nitrogen Dioxide (NO<sub>2</sub>)</td><td>0.3</td><td>-</td><td>0.1</td><td>-</td></tr><tr><td>Sulfur dioxide (SO<sub>2</sub>)</td><td>0.5</td><td>-</td><td>0.3</td><td>0.1</td></tr><tr><td>O Zone (O<sub>3</sub>)</td><td>0.2</td><td>-</td><td></td><td>-</td></tr><tr><td>Lead (Pb)</td><td>-</td><td>-</td><td>0.005</td><td>-</td></tr><tr><td>Total Suspended particulate (TSP)</td><td>-</td><td>-</td><td>0.33</td><td>0.1</td></tr></table></li><li>- Maximum Standard of Noise Level Allowable in the Public and Residential Areas (dB(A))<table><tr><th rowspan="2">Area</th><th colspan="3">Period of Time</th></tr><tr><th>From 6 am to 18 pm</th><th>From 18 pm to 22 pm</th><th>From 22 pm to 6 am</th></tr><tr><td>Quiet Areas Hospital Library School Kindergarten</td><td>45</td><td>40</td><td>35</td></tr><tr><td>Residential Areas Hotel Administrative office House</td><td>60</td><td>50</td><td>45</td></tr><tr><td>Commercial and service areas and area of multiple businesses</td><td>70</td><td>65</td><td>50</td></tr><tr><td>Small industrial factories mingling in residential area</td><td>75</td><td>70</td><td>50</td></tr></table></li></ul>	Parameter	1 Hour Average mg/m <sup>3</sup>	8 Hours Average mg/m <sup>3</sup>	24 Hours Average mg/m <sup>3</sup>	1 Year Average mg/m <sup>3</sup>	Carbon Monoxide (CO)	40	20	-	-	Nitrogen Dioxide (NO <sub>2</sub> )	0.3	-	0.1	-	Sulfur dioxide (SO <sub>2</sub> )	0.5	-	0.3	0.1	O Zone (O <sub>3</sub> )	0.2	-		-	Lead (Pb)	-	-	0.005	-	Total Suspended particulate (TSP)	-	-	0.33	0.1	Area	Period of Time			From 6 am to 18 pm	From 18 pm to 22 pm	From 22 pm to 6 am	Quiet Areas Hospital Library School Kindergarten	45	40	35	Residential Areas Hotel Administrative office House	60	50	45	Commercial and service areas and area of multiple businesses	70	65	50	Small industrial factories mingling in residential area	75	70	50
Parameter	1 Hour Average mg/m <sup>3</sup>	8 Hours Average mg/m <sup>3</sup>	24 Hours Average mg/m <sup>3</sup>	1 Year Average mg/m <sup>3</sup>																																																								
Carbon Monoxide (CO)	40	20	-	-																																																								
Nitrogen Dioxide (NO <sub>2</sub> )	0.3	-	0.1	-																																																								
Sulfur dioxide (SO <sub>2</sub> )	0.5	-	0.3	0.1																																																								
O Zone (O <sub>3</sub> )	0.2	-		-																																																								
Lead (Pb)	-	-	0.005	-																																																								
Total Suspended particulate (TSP)	-	-	0.33	0.1																																																								
Area	Period of Time																																																											
	From 6 am to 18 pm	From 18 pm to 22 pm	From 22 pm to 6 am																																																									
Quiet Areas Hospital Library School Kindergarten	45	40	35																																																									
Residential Areas Hotel Administrative office House	60	50	45																																																									
Commercial and service areas and area of multiple businesses	70	65	50																																																									
Small industrial factories mingling in residential area	75	70	50																																																									
Sub-Decree No.36 on Solid Waste Management	Apr. 27, 1999	<ul style="list-style-type: none"><li>- The purpose of this sub-decree is to regulate solid waste management in a proper technical manner and safe way to ensure the protection of human health and the conservation of biodiversity.</li><li>- This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage, and hazardous waste.</li><li>- The collection, transport, storage, recycling, minimizing, and dumping of waste in the provinces and cities are the responsibility of the authorities of provinces and cities.</li></ul>																																																										
Sub-decree No.113 on the	Aug. 27, 2015	<ul style="list-style-type: none"><li>- The goal of this sub-decree is to enhance the management of garbage and solid waste of downtowns with effectiveness,</li></ul>																																																										

Management of Urban Solid Waste		<p>transparency, and accountability, referring to ensure aesthetics, public health, and environmental protection.</p> <ul style="list-style-type: none"> <li>- Followings are objectives of this sub-decree are (i) Strengthen responsibilities of ministry, institution, skilled unit, sub-national administration, and other relevant stakeholders for the management of garbage and urban solid waste; (ii) Entrust function of the management of urban solid waste of municipal, city and district administrations and delegate function of the management of urban solid waste from municipal administration to khan administration; (iii) Determine necessary measures to improve efficiency and safety in the management of urban solid waste, and (iv) Promote public education and citizens 'participation in preparing and implementing measures relating to the management of urban solid waste.</li> </ul>
Sub-decree No.189 on Establishment of Enterprise for Managing Transfer Station and Landfill of Solid Waste	Nov. 16, 2020	<ul style="list-style-type: none"> <li>- Establishment of Enterprise for Managing of Transfer Station and Landfill of Solid Waste (EML) under the governance of MoE for technical aspect and MEF for the financial aspect.</li> <li>- EML is a public enterprise in the form of a state company that contacts trading enterprises and is fully autonomous in leading and management.</li> <li>- EML had priority resources from: <ul style="list-style-type: none"> <li>• Initial capital from the national budget for investment and operation service</li> <li>• Income from using landfill service fee</li> <li>• Income from the management of integrated infrastructures</li> <li>• Subsidize from the sub-national and national administration</li> <li>• Gift and endowment</li> <li>• Other income from legal sources</li> </ul> </li> </ul>
Sub-decree No.235 on Management of Drainage and Wastewater Treatment System	Dec. 25, 2017	<ul style="list-style-type: none"> <li>- Prepare, revise, and enhance the responsibility of Ministries, Institutions, Specialist Units, sub-national administrations, and concerned stakeholders on the improvement of drainage and wastewater treatment system;</li> <li>- Transfer of functions on operation and maintenance of drainage and wastewater treatment system to capital, municipal, district, and khan administrations;</li> <li>- Encourage the participation of development partners, private sectors to develop or to invest in the construction, operation, and maintenance of drainage and wastewater treatment system.</li> <li>- Provincial administration shall fulfill its role to support and promote on operation and maintenance of drainage and wastewater treatment system within its jurisdiction and duties as the following:</li> </ul>

- Cooperate to prepare a master plan for development and management of drainage and wastewater treatment system in towns, districts;
- Prepare the key standard specifications and procedures to guide the implementation of concerned laws and legal documents related to the management of drainage and wastewater treatment system;
- Facilitate the arrangement of drainage and wastewater treatment system services;
- Promote on concerning law and legal documents enforcement related to the management of drainage and wastewater treatment system and penalize on violations;
- Conduct and facilitate monitoring and evaluating regarding the management of drainage and wastewater treatment system;
- Mobilize funds from development partners, donors, and private sectors to develop a drainage system and wastewater treatment system in towns, districts.

- Usage Services of Sewerage and Wastewater Treatment System: (i) Municipal, District, Khan Administrations shall responsible for managing and providing the services of sewerage system within their jurisdiction area with efficiency, transparency, accountability, and environmental safeguard, (ii) Municipal, District, Khan Administrations can delegate the rights of service providing on sewerage system services to any specialized agencies or private companies, and (iii) The delegation of the rights of services providing on sewerage service to the private company must be strictly carried out in accordance with the procurement procedures.

- Measures on the management of wastewater, drainage, and wastewater treatment system.

Annex 1: Effluent Discharge Standard from Commercial Building, Borey, Satellite City, and Resort or Recreation Center to the Drainage/Sewerage System connected to Centralized WWTP

No.	Parameters	Units	Permissible Standard, Pollutant level that permitted to discharge into the public sewer
1	pH	-	5 - 9
2	TSS	mg/l	< 150
3	Oil and Grease	mg/l	< 20
4	BOD <sub>5</sub>	mg/l	< 80
5	COD	mg/l	< 120
6	Detergents- LAS	mg/l	< 15
7	Total Nitrogen (T-N)	mg/l	< 10
8	Total Phosphorus (T-P)	mg/l	< 1
9	Ammonia NH <sub>3</sub>	mg/l	< 8
10	Coliform	MPN/100ml	-



		<p>Annex 2: Effluent Discharge Standard from Commercial Building, Borey, Satellite City and Resort or Recreation Center Discharges Directly to the Public Waterbody or Drainage/Sewerage System</p> <table border="1"> <thead> <tr> <th>No.</th><th>Parameters</th><th>Units</th><th>Permissible Standard, Pollutant level allows for discharging into public water</th></tr> </thead> <tbody> <tr> <td>1</td><td>pH</td><td>-</td><td>6 - 8</td></tr> <tr> <td>2</td><td>TSS</td><td>mg/l</td><td>&lt; 80</td></tr> <tr> <td>3</td><td>Oil and Grease</td><td>mg/l</td><td>&lt; 5</td></tr> <tr> <td>4</td><td>BOD<sub>5</sub></td><td>mg/l</td><td>&lt; 30</td></tr> <tr> <td>5</td><td>COD</td><td>mg/l</td><td>&lt; 50</td></tr> <tr> <td>6</td><td>Detergents- LAS</td><td>mg/l</td><td>&lt; 7</td></tr> <tr> <td>7</td><td>Tot. Nitrogen (T-N)</td><td>mg/l</td><td>&lt; 6</td></tr> <tr> <td>8</td><td>Tot. Phosphorus (T-P)</td><td>mg/l</td><td>&lt; 0,5</td></tr> <tr> <td>9</td><td>Ammonia NH<sub>3</sub></td><td>mg/l</td><td>&lt; 5</td></tr> <tr> <td>10</td><td>Coliform</td><td>MPN/100ml</td><td>500 – 2,500</td></tr> </tbody> </table>		No.	Parameters	Units	Permissible Standard, Pollutant level allows for discharging into public water	1	pH	-	6 - 8	2	TSS	mg/l	< 80	3	Oil and Grease	mg/l	< 5	4	BOD <sub>5</sub>	mg/l	< 30	5	COD	mg/l	< 50	6	Detergents- LAS	mg/l	< 7	7	Tot. Nitrogen (T-N)	mg/l	< 6	8	Tot. Phosphorus (T-P)	mg/l	< 0,5	9	Ammonia NH <sub>3</sub>	mg/l	< 5	10	Coliform	MPN/100ml	500 – 2,500
No.	Parameters	Units	Permissible Standard, Pollutant level allows for discharging into public water																																												
1	pH	-	6 - 8																																												
2	TSS	mg/l	< 80																																												
3	Oil and Grease	mg/l	< 5																																												
4	BOD <sub>5</sub>	mg/l	< 30																																												
5	COD	mg/l	< 50																																												
6	Detergents- LAS	mg/l	< 7																																												
7	Tot. Nitrogen (T-N)	mg/l	< 6																																												
8	Tot. Phosphorus (T-P)	mg/l	< 0,5																																												
9	Ammonia NH <sub>3</sub>	mg/l	< 5																																												
10	Coliform	MPN/100ml	500 – 2,500																																												
<b>Guideline and design standard</b>																																															
Technical Guideline on Urban Solid Waste Management	2016	<ul style="list-style-type: none"> <li>- The technical guideline aims to provide the basic technical standards to sub-national administrations and all stakeholders concerning urban solid waste management to ensure effective protection of public health, the environment, and the conservation of biodiversity.</li> <li>- Managing solid waste in safety to the environment must be considered from the start of the waste generation process until the landfill's final storage. This management cycle starts with the waste generation stage, temporary storage, cleaning, collection and transportation, recycling, processing, and final storage at the landfill.</li> <li>- Criteria in the selection of landfill site: Some geographical features that require basic considerations for selecting a site for construction landfill are: <ul style="list-style-type: none"> <li>• Must be at least 10 km from urban area and not far than 50 km;</li> <li>• Must be at least 1 km from the national road, housing, public drainage;</li> <li>• Must be at least 3 km away from school, health center, natural water source (lake, river, beach, Praek, stung);</li> <li>• Must be at least 5 km from the tourist sites, religion site (pagodas, religion temple, ...), and natural resources conservation area;</li> <li>• Must be at least 15 km away from National Heritage sites and historical resort (natural and cultural);</li> <li>• Must be at least 8 km from the airport;</li> <li>• Do not be located in the flooded area and year-round</li> </ul> </li> </ul>																																													

		<p>access road to the site; and</p> <ul style="list-style-type: none"> <li>• Low economic value area and low fertile soil for crops (priority target). Depending on the current situation in Cambodia, the design of solid waste landfills can be classified into three different categories</li> </ul>
--	--	---

### 3 PROJECT DESCRIPTION

The project aims to improve the population's access to urban infrastructure through three components:

- (x) Improved wastewater management systems (pumping stations, network and treatment plants),
- (xi) Improved drainage systems to manage stormwater flows, and
- (xii) Improved Solid Waste Management systems (including landfill, waste collection & recycling, and vehicles).

The sub-project components for Poipet city are the following:

#### 3.1 Wastewater

- 50km of network
- 3 pumping stations (downtown)
- 3 pumping stations and 15km of force main
- 1 Wastewater Treatment Plant

Figure 3.1-1: Wastewater collection and treatment subproject in Poipet city





(Source: Egis Sept. 2020)

### 3.2 Stormwater drainage

- 10km of network
- 4 outlets (works in progress as part of the GMS1 project)

Figure 3.2-1: Stormwater drainage subproject in Poipet city

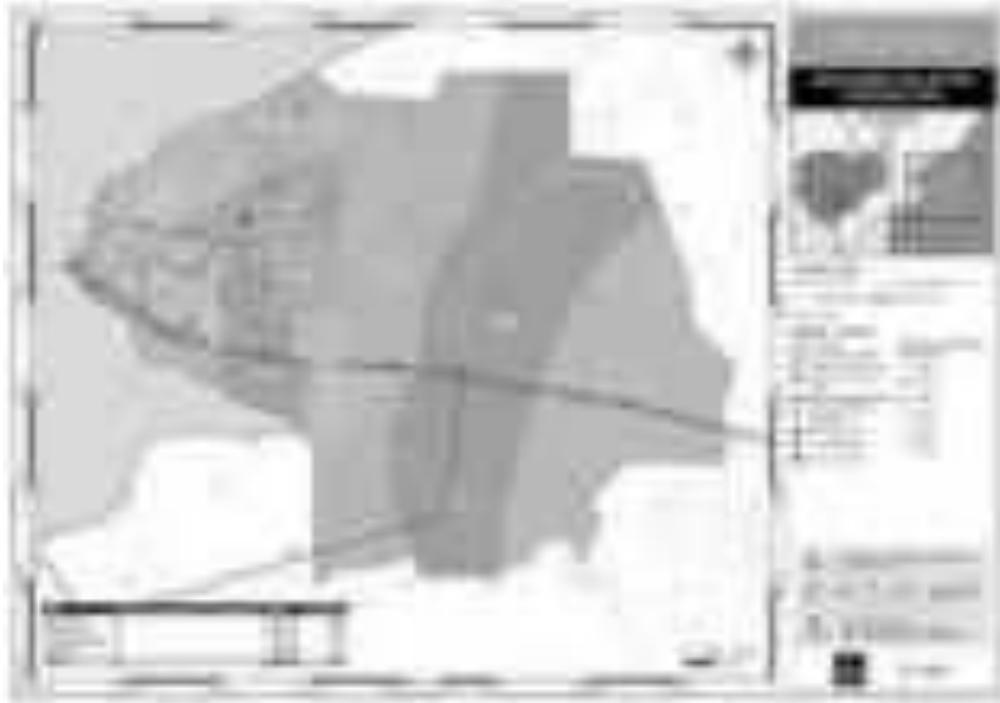


(Source: Egis Sept. 2020)

### 3.3 Solid Waste Management Facilities

- At the same location: 1 landfill + 1 composting plant
- 1 sorting plant (near the existing dumpsite)
- 8 centralized collection points

Figure 3.3-1: Solid waste management subproject in Poipet city



(Source: Egis Sept. 2020)

## 4 BASELINE SURVEY RESULTS

### 4.1 Overall environmental aspect

#### 4.1.1 Geographical of Poipet city

Poipet is a city in Banteay Meanchey Province in western Cambodia, on the border with Thailand. It's the mainland crossing and transport hub for travel between Siem Reap and Bangkok cities. It is far away, 470 km from the Phnom Penh capital when traveling via NR6 and approximately 390 km via NR5, where the potential road is connected to many cities in Cambodia indispensable economic corridor between Cambodia and Thailand. The Poipet city is divided into three communes/Sangkat: Sangkat Poipet, Sangkat Phsar Kandal, and Sangkat Nimith. Its border with Ou Chrov district at North, Northeast, East, and Southeast, Malai district at South and Southwest, and Thailand at Northwest and West.

Figure 4.1.1-1: Map of Poipet city



(Source: KCC Nov.2020)

#### 4.1.2 Land use

The municipality of Poipet has prepared its land use and zoning plan with the Ministry of Land Management, Urban Planning and Construction (MLMUPC) and other participating government agencies and institutions. The list delineates the land use categories into industrial, commercial, residential, social, open spaces, and administration zones.

Table 4.1.2-1 set out the existing land use as described in the FYDP. The largest proportion of land is dedicated to residential development is 49%. The second largest is dedicated to agriculture at 46%.

Table 4.1.2-1: Existing Land Use in Poipet

Land use by type	Area (ha)	%
Residential	13,340.66	49
Agricultural	12,604.76	46
Special economic zone	718	3
Lake and river	650	2
Total	27,313	100

Source: Poipet Five-Year Development Plan 2015-2019.

The Poipet town has its share of informal and ad hoc settlements on the urban fringes where informal settlers are located. Based on FYDP, 21,956 households (6%) resided on public land with limited access to public utilities.

The approved land area of Poipet City is 273.14 km<sup>2</sup> consisting of Sangkat Poipet (21.90 km<sup>2</sup>) and Sangkat Phsar Kandal (75.81 km<sup>2</sup>) and Sangkat Nimitt (175.43 km<sup>2</sup>).

Existing Land Use, 2018. Agriculture land use represents the biggest portion of the city at 80.63%; followed by urban use at 14.91% (of which residential represents 8%, industrial, 5%; commercial, 1% and transport, 3%), water, 1%, natural forest, 1.47% and open space 0.07%.

The land use around Poipet can be classified roughly as built-up, farming, grassland, or forest areas. The map below illustrates the distribution of the land use categories.

Figure 4.1.2-1: Present Landuse Map of Poipet City



(Source: LCIP sector Master Plan, Egis June 2020)

### 4.1.3 Geology and Soil

Pediments, Deltaic deposits characterize the geology of Poipet, and Terrance alluvial deposits Figure 4.1.3-1. Pediments are a broad, gently sloping expanse of rock debris extending outwards from the foot of a mountain slope, especially in a desert.

Deltaic deposits consist mainly of arenaceous argillaceous rocks with occasional intercalations of limestones, less frequently of coal and other rock of organic origin; conglomerates are often found in piedmont regions. Deposits of coal and iron and copper ores are found in deltaic Deposits. Terrance alluvial deposits<sup>1</sup> are unconsolidated gravels, sand, silt, and clay.

Based on the distribution of the soil type in Cambodia, Crocker, C.D. (1962), the general map of the Kingdom of Cambodia and the exploratory survey of the soils of Cambodia, and Save Cambodia's Wildlife "Agriculture." Atlas of Cambodia: maps on socio-economic development and environment. Seconded. Phnom Penh, 2014. The soil type of Poipet is Plimthite podzols, Alumisols, and Alluvial lithosols.

<sup>1</sup> Haley, B.R., Glick, E.E., Bush, W.V.; Clardy, B.F.; Stone, C.G.; Woodward, M.B., and Zachry, D.L., 1993, Geologic Map of Arkansas: U.S.Geological Survey Special Geologic Map, scale 1:500,000.

Figure 4.1.3-1: Geological Map of the project area



(Source: KCC Nov.2020)

Figure 4.1.3-2: Soil type of the project area



(Source: KCC Nov.2020)

#### 4.1.4 Hydrology

Cambodia's hydrologic setting is dominated by the Mekong River and Tonle Sap Lake system, which are connected by the Tonle Sap River. The Mekong River enters Cambodia from the north of Lao PDR and flows southeast to Vietnam.

Ou Chrov River is the main river in Poipet. It is situated along the Cambodian and Thailand border; it flows into Tonle Sap Lake. The river is flooded during the rainy season by the floodwaters originating mostly from Thailand. Some parts of the river have no water during the dry season. The water bodies in the project area include OuChrov River, the Ou Ansaong, Ou Stueng Bot, Ou Neang Stream, Ou Pongro Stream, Trapeang Ankrang Stream, Ou Chhik, Ou Pampan, Ou Samut, Preaek Kamani, Ou Touch Stream, Ou Srae Tariv Stream.

Figure 4.1.4-1: Map of water bodies in the project area



(Source: KCC Nov.2020)

#### 4.1.5 Protection area

Law on Natural Protected Areas, 2008, was enacted by National Assembly and promulgated by Preah Reach Kram/NS/RKM/0208/007. This law had been categorized the protected areas as following: (1) National Park, (2) Wildlife sanctuary, (3) Protected landscape, (4) Multiple use area, (5) Ramsar site, (6) Biosphere reserve, (7) Natural heritage site, and (8) Marine park. The list name of the national protected areas, as shown in Table 4.1.5-1 and Figure 4.1.5-1.



Table 4.1.5-1: List of protected areas in Cambodia

Kind of Protected Areas	Name of Protected Areas	Location of Protected Areas	Size (Hectare)
<b>1. National Park</b>	1. Preah Soramrith Kosomak "Kirirom."	Kampong Speu & Koh Kong	35
	2. Preah Monivong "Bokor."	Kamport, Kampong Speu, Koh Kong & Krong Preah Sihanouk	140
	3. Preah Sihanouk "Ream	"Krong Preah Sihanouk"	21
	4. Preah Chey Varaman-Norodom "Phnom Kulen"	Siem Reap	37.5
	5. Virakchey	Rottanak Kiri & Stung Treng	332.5
	6. Kep	Krong Kep	5
	7. Botum-Sakor	Koh Kong	171.25
<b>2. wildlife sanctuary</b>	1. Phnom Aural	Kampong Speu, Pursat, & Kampong Chhnang	253.75
	2. Phnom Samkos	Pursat, Battambang, & Koh Kong	333.75
	3. Lompart	Rottanak Kiri & Mondul Kiri	250
	4. Phnom Prich	Mondul Kiri	222.5
	5. Snuol	Kratie & Mondul Kiri	75
	6. Boeng Per	Kampong Thom, Preah Vihear, Siem Reap	242.5
	7. Peam Krosop	Koh Kong	23.75
	8. Roniem Daun Sam	Battambang & Banteay Meanchey	40.021
	9. Kulen-Prum Tep	Preah Vihear, Siem Reap, & Oddar Meanchey	402.5
	10. Phnom Narm Lear	Mondul Kiri	47.5
<b>3. Protected Landscape</b>	1. Angkor	Siem Reap	10.8
	2. Preah Vihear	Preah Vihear	5
	3. Banteay Chhmar	Bantey Meanchey & Oddar Meanchey	81.2
<b>4. Multiple Use Site</b>	1. Dong Peng	Koh Kong	27.7
	2. Samlaut	Pailin & Battambang	60
	3. Boeng Tonle Sap	Kampong Chhnang, Kampong Thom, Siem Reap, Battambang & Pursat	316. 250
<b>5. Tonle Sap Biosphere Reserve</b>	Core zone:		
	-Preak Torl	Battambang	
	-Boeng Tonle Chhmar	Kampong Thom	
	-Stung Sen	Kampong Thom	
<b>6. Ramsar Site</b>	1. Stung Treng	Stung Treng	14.6
	2. Boeng Tonle Chhmar	Kampong Thom	
	3. Koh Karpi	Koh Kong	
<b>7. Heritage Site</b>	1. Phnom Aural	Kampong Speu, Kampong Chhnang & Pursat	
	2. Phnom Samkos	Pursat, Battambang & Koh Kong	
<b>8. Marine Park</b>	1. Koh Ses	Krong Preah Sihanouk	
	2. Koh Thmei	Krong Preah Sihanouk	

Source: Annex of Law on Natural Protected Areas, 2008

Figure 4.1.5-1: Map of protected area in Cambodia



#### 4.1.6 Climate Change

The median and range for three 10-year time intervals of a 15-set of GCM estimates of mean temperature fluctuations compared to the mean climate of 1970-1999 under the A2 scenario. It is estimated that the average annual temperature will rise by 1 °C by 2030, 2.2 °C by 2050, and 3.6 °C by the end of the century.

Over the last few years, very little attempt has been made to update Cambodia's climate change forecasts; no recent modeling results were given by the second National Communication published in 2015.

Climate modeling is typically focused on older generations of climate models published under phase three of the Climate Model Intercomparison Project (CMIP3) and using the Special Report on Emissions Scenarios (SRES) of the Intergovernmental Panel on Climate Change (IPCC). The Third Assessment Report conducted after 2012 used the more recent CMIP5 models and Representative Concentrations Pathways (RCP) adopted for the fifth IPCC Assessment Report.

The annual rainfall at Banteay Meanchey during 1985-2019 was an average of 1,137mm/year. The highest annual rainfall recorded was 1,475 in 2011, and the lowest annual rainfall was 620 mm in 2014. Temperature is uniform all over the country. The maximum temperature is 28°C, and the mean minimum temperature is 22°C. Maximum temperatures above 32°C are common before starting the rainy season and can rise to more than 38°C.

The average annual minimum temperature is 23.6°C, and the average annual maximum temperature is 32.3°C, based on the temperature data recorded at the Sisophon Meteorological Station (2010-2012), which is approximately 45km away.

#### 4.1.7 Existing Network Facilities

- **Road Network**

Poipet is accessible on the National Road (NR) 5 and NR 59 by railway and by road. Most urban roads have a gravel surface as of December 2019, require upgrading, and the average daily traffic is less than 500 vehicles per day. Royal Railway Company. Ltd. is a private undertaking that operates the railways for passenger and freight services. The other roads are concrete, laterite roads, or earth roads, Figure 4.2.7-1. All three bus services and terminals operating in Poipet are operated by the private sector. On average, between Poipets, Siem Reap, and Phnom Penh, 800 passenger and tourist busses travel daily. A dry port and a loading facility are located along NR 5, leading to the city center. However, the rise in traffic volume and container trucks cannot be addressed with facilities and areas of less than 2 ha. Apart from that, traffic flow obstruction occurs along NR 5 when heavy vehicles and containers are parked on both sides of the lane. In the rainy sea, even four-wheel vehicles and motorcycles can hardly pass through such roads. Anyway, the latest floods and pandemics of COVID 19 could contribute to an interruption to border traffic.

Figure 4.1.7-1: The road network in Poipet city



National Road No 5



Concrete road



Gravel road



Laterite/earth road

- **Electricity Network**

Anco electricity Poipet Co.ltd (AEP) was established in 1999. The company has operated a 22kv transmission line facility from Thailand with a capacity of 11.7 MW. AEP now has 4,000 customers, including 8 casino customers, which consumes 70% of electricity purchases from Thailand. The electricity cost is \$0.18 per KW. The company has 4000 customers, including 8 casino customers, which consumes 70% of electricity purchased from Thailand.

- **Water Supply**

ANCO Water Supply Co Ltd is responsible for producing and supplying safe and drinkable water in Poipet city. The City depends on the water surface. In addition to the Ou Chrov river's meander, two floating pumping stations are in operation: the operating rate amounts to 30.500 m<sup>3</sup>/day. The treatment consists of a typical surface water process, with a final chlorine disinfection stage and letting the underground tanks (2,500 m<sup>3</sup>). 51% of the population have a piped water supply available, but only 36% are connected. Depending on the location, the water network to the ANCO water system is \$200 to \$300. The average consumption is between 6 and 10m<sup>3</sup>/month. Only 1% use drinking water as their primary source, with a cost of 0.5\$ per m<sup>3</sup>. 70% of the population has its borehole. Only 9% use the water as their primary drinking water source. The boiling water is still handled and used for drinking. In some villages, water tanks are distributed once a week by organizations (i.e., KAMA). The distribution network, which in 2019 was mainly in HDPE, was 315km long (diameter 50 to 400 mm). Non-revenue water penetration was 55% in 2019, 15.7% in September 2019. A user fee arrangement funds the water supply facility, and ANCO issued and received billing. In its contract, the tariff guidelines are approved by the MIH.

Figure 4.1.7-2: Ou Kaidon Reservoir for Water Supply



Figure 4.1.7-3: Operating pump station



- **Solid waste management**

The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The company has a 10-years license from January 2019 to December 2028 for the whole Poipet city administrative area. It is equipped with 13 compactors of 5 tons, two hydraulic dump trucks of 16 tons.

The collection coverage ratio is relatively efficient, considering the whole domestic waste flow, reaching 71%. Casinos are well covered, whereas the main developed industrial zone (Oh Neang) is not covered. However, only 28% of household waste is covered, meaning that 72% of household waste is burnt or disposed of in open land. Garbage collection is mainly door to door, and solid waste is transported to a 4 ha dumpsite located 5 km from the city center. There are junk shops in Poipet collecting recyclables waste from informal collectors, waste pickers, and scavengers, which represents.

A solid waste characterization survey was carried out in February 2020 at the dumpsite on fresh solid waste before the scavengers removed the recyclables. It was observed that 55% of the municipal solid waste flow is composed of the organic fraction (biowaste), followed by 11% of plastic bags, 7% of baby diapers, 5% of garments and other textiles, and 5% of paper and light cardboard. Two quarters are served: *Sangkat* Poipet and *Sangkat* Phsar Kandal. *Sangkat* Nimitt is not covered. In total, 3,350 households, five casinos, six markets, and five communities (boreys) have been served. According to local authorities, this represents approximately the collection and disposal of 150 tons/day.

No data is available concerning the generation of domestic hazardous municipal solid waste since no separate collection or disposal is carried out for this waste stream. In a situation where no hazardous waste management exists at all locally, it is difficult to estimate figures based on the available municipal solid waste composition data, and a dedicated survey would be required. More realistically, as an assumption based on experience from several studies and surveys in developing and developed countries, hazardous waste would represent around 1% of the municipal solid waste flow. Based on this assumption, around 500 tons per year of hazardous waste is generated within the municipal solid waste in Poipet.

The solid waste collection's frequency is every day, according to 70% of households having access to the service. Garbage collection is mainly door to door, and solid waste is transported to a 4 ha dumpsite located 5 km far from the city center. There are junk shops in Poipet collecting recyclables waste from informal collectors, waste pickers, and scavengers, which represent 16% of the total domestic solid waste flow.

- Households pay a monthly fee to the operator and have to buy their waste containers. Most of the households dispose of waste in plastic bags along the street.
- A new Material Recovery Facility (MRF) built by the GMS1 project exists. However, it is not yet in operation. A review of the institutional set up is required to commence the operations.

In the SEZ, the domestic and industrial wastes are segregated. The industrial waste is collected by local contractors and treated by private operators who have an agreement from the MoE. However, the absence of the application of local policies and procedures for the proper handling of hazardous waste is a source of risk for Poipet residents. For example, the industrial waste collection and disposal contractors are not properly checked concerning their capability to handle and dispose of the industrial waste, and the municipality cannot be assured that the contractors follow environmentally sound disposal practices.

Figure 4.1.7-4: The truck for solid waste transportation



(Source: KCC Sept.2020)

#### • **Education Facilities**

Poipet City prioritizes education as the key to develop human resources and as a poverty reduction measure. Base on Poipet Five-Year Development Plan, 2015-2019, the Social infrastructure provided in the town includes educational facilities provided by the public sector 36 kindergarten/pre-schools (state 19 and private 17), 39 primary schools with 344 classrooms, seven secondary schools, and four high schools with 87 classrooms. No school near the subproject site.

#### • **Health facilities**

The town has one referral hospital, four health centers, and one health post to provide medical and health services to the residents. The key health strategy in the City -5Year Development Plan pertains to access to clean water and sanitation.

In the town center, households generally have pour-flush, pit, or basic single vault latrines. In the case of hotels, casinos, and other larger buildings, there is a national standard for septic tank design requiring connection to the main drainage/sewerage system. Household waste and those from the commercial centers also discharge through collection and haulage to the town's northeastern part.

## 4.2 Characteristic of the project area

### 4.2.1 Landfill

The baseline survey for environmental resources (physical and biological) will focus on the proposed landfill site within a 300m buffer area, see Figure 4.2.1-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expand to the whole territory of Sangkat or the city itself. The characteristic in/adjunction of the proposed landfill site is described in the following points.

Observation is one of the founding principles of the scientific method, and it can be a very effective tool for studying human-environment interactions around the project area. Naturalistic observation is often used to generate new ideas because it allows the researcher to study the total situation; it often suggests avenues of inquiry, did not find before. This method is often conducted on a small scale and may lack a representative. This may result in the findings lacking the ability to be generalized to wider society; however, it can observe the flow of behavior in its setting studies have greater ecosystem validity.

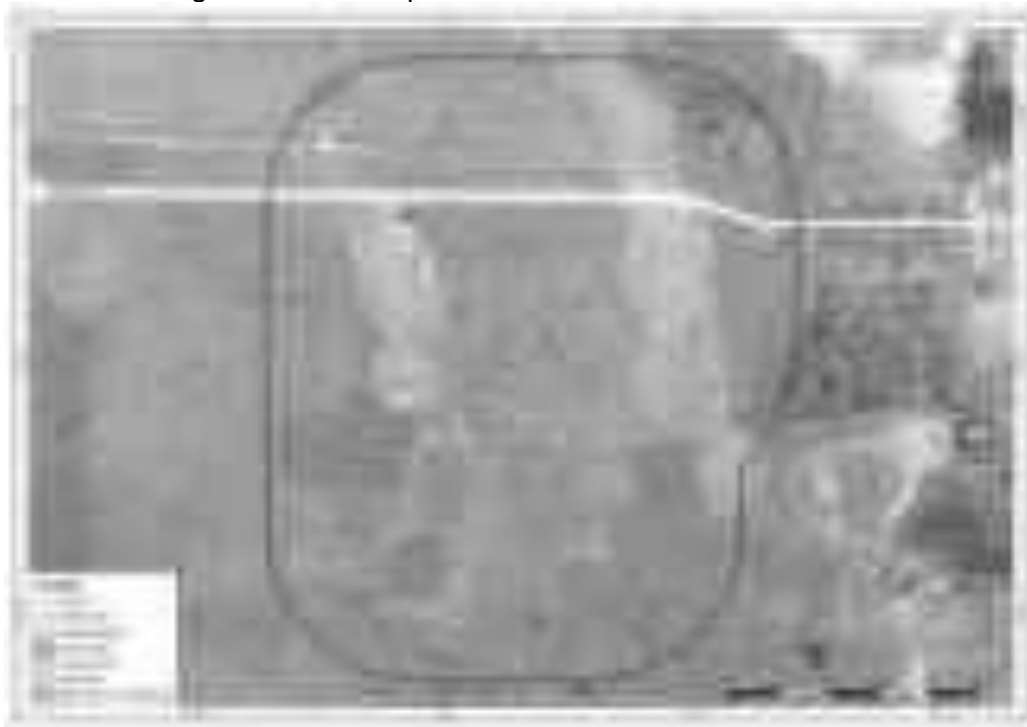
The site of observation of the subprojects in Poipet city is conducted within a buffer of 300 meters and supported by the local authority/people that live around the project site. It would explain the existing condition of the physical, biological environment, and the anticipated environmental impact of the project.

**Landfill** (land to be acquired) will be created in a location different from the existing dumpsite. The latter will be carefully closed, with the need to minimize the infiltration of rainwater across the waste mass. By the “Integrated Solid Waste Management for Local Governments, A Practical Guide” (ADB, 2017), the purpose of the landfill facilities is to receive residual waste that cannot be recovered, reused, or recycled; in particular, the landfilling of easily biodegradable wastes should be avoided as these have the greatest potential for environmental impacts such as odors, vermin, disease, and impact to groundwater. Some waste types are explicitly excluded from the landfill: (i) All types of hazardous waste; (ii) Liquid wastes.

It is proposed to use a combination of leachate recirculation and off-site treatment at WWTP. The majority of the leachate will be recirculated back into the landfill mass, with the excess being tinkered off-site for treatment at the WWTP. The recirculation uses a pump in the leachate pond, with pressure lines leading from the leachate pond up to the landfill surface, where the leachate enters the waste mass via infiltration drains or wells. The basal liner (HDPE geomembrane) will be overlain by a leachate drainage layer consisting of 0.5m of soils of permeability greater than or equal to  $10^{-4}$  m/s (e.g., clean well-graded sands or gravels). The leachate will be drained by gravity towards the collection well at the low point and then, still by gravity, to the leachate storage lagoon, which has a capacity of 1,200m<sup>3</sup> capacity – 600m<sup>3</sup> for the run-off from the composting platform (20-hour duration for 10-year rainfall event) and 600m<sup>3</sup> for leachate.

The existing MRF would maintain its current purpose, packing the recyclables collected by the waste pickers. It will create around 194 jobs in the long term, mostly manual sorting operators in the sorting lines of the pre-sorting plant, addressed in particular to waste pickers and scavengers. This facility will provide better working conditions for these workers and maintain their revenues.

Figure 4.2.1-1: Map of the landfill site with 300m buffer



(Source: KCC Nov.2020)

#### 4.2.1.1 Location of the landfill site

The proposed landfill site for Poipet city is located at Sorya village, Sangkat Nimitt, Poipet City, Banteay Meanchey Province (253558E, 1515614N). The location is about 20.5 km from the city center and covers around 20ha of agricultural land. (Figure 4.2.1.1-1).

Figure 4.2.1.1-1: Location map of the proposed landfill site



(Source: Egis Oct. 2020)



#### 4.2.1.2 Community structure/type of building

The proposed landfill area is approximately 20ha, located in Sorya village, Sangkat Nimit, Poipet city. This proposed site is surrounded by agricultural land (paddy fields). No houses are settled in the area of the buffer zone 300m, and no electricity and water supply within this distance. The electricity pole is available at 6.5km away from the proposed site, and the groundwater is the second water source (dry season) of the villagers near the area. In the rainy season, ponds, canals, lakes, and creeks are plenty of water, which is very useful for agricultural activities and the community's domestic water supply source. However, the proposed landfill site no flooding at all, according to a field visit in August 2020, and the local people reported.

There are no schools, hospitals, and heritage sites that have been found in the buffer zone 300m from the proposed landfill site. However, within the distance of 2.1km from the proposed site presented a land development project (private company) in planning and had a small selling office, Figure 4.2.1.2-1. The settlement area (existing community) is around 3km from the project site. The primary school Ouvanghang is about 4km from the proposed site.

Figure 4.2.1.2-1: Land development project of the private company



Land lot size: 5mx20m and 10mx20m

Selling office

#### 4.2.1.3 Access Road

The proposed landfill site is about 10.5 km from National Road No.5 (NR5). With this distance of 10.5km of the access road, there are three variants of road type by section: the first section, 1.2km is a concrete road with 7m width (a), the second section 7km, is an earth road with 10m width (b), and the third section of 2.3km is laterite road with 6-7m width (c). However, in the last section, the road condition seems poor due to very soft laterite and a new construction road and difficulty to pass (muddy and slide) in the rainy season (Figure 4.2.1.3-1). Furthermore, the final proposed site is about 500m from the laterite road of the last section, no access road yet, that

the project will be counted for completing the construction road. According to the feasibility study reported: a part of the access road to the proposed landfill site has been included in the project's cost.

Figure 4.2.1.3-1: Access Road to the proposed landfill site



(Source: KCC field survey Sept.2020)

#### 4.2.1.4 Land use/ Type of land

The proposed site comprises three land-use types: farmland, grassland/bush, and residential areas. Agriculture accounts for about 43% of Nimit's land use. Almost half of the area (53%) is forested, and the water body and only 3.7% are designated as a residential area. Land uses surround the proposed landfill, though, accounts for up to 80% of cultivation, of which 75% are rice paddy fields and 5% are farmland. The landfill is around 1 km away from the land development project Figure 4.2.1.4-1.

Figure 4.2.1.4-1: Land use surrounding the proposed landfill site



(Source: KCC Aug. 2020)

#### 4.2.1.5 Hydrology/river system

The Actual water body is about 1.39km from the proposed site. The river stream closest to the landfill site is the Ou Srae Triv stream and the Ou Ansaong stream, roughly 1km. Most agricultural canals are diverted into the natural streams, such as the Ou Srae Triv stream and

the Ou Ansaong stream; all agricultural canals have been dried up during the dry season. In addition to the stream mentioned above, the Ou Trapeang Angkrang stream and the Ou Pongror stream are situated at 1.5km and 1.36km to the southwest of the landfill site, Figure 4.2.1.5-2. Moreover, the existing Road drainage along the access road to the proposed landfill, Figure 4.2.1.5-1.

Figure 4.2.1.5-1: Road drainage closest to the access road



(Source: KCC Aug. 2020)

Figure 4.2.1.5-2: Water bodies adjacent to the project site



(Source: KCC Nov.2020)

#### 4.2.1.6 Access to Service Facilities

- **Access to the electricity network**

There are no houses in the buffer zone 300m away, and beyond the distance, there is no electricity. The electricity is available at the Soriya village 6.5km from the proposed landfill site by ANCO Electrical Power Group.

- **Access to water supply network**

As the location of the proposed landfill site for Poipet is about 20.5km from the city center and 10.5 km from NR No.5 where is far away from the capacity of the existing water supply system; Anco water supply. However, the groundwater source is available in the whole of Poipet city.

The main water supply source for the community near the landfill in Soriya village is groundwater. Based on the field survey in Aug. 2020, found that all households have at least a few concrete jars/basins to harvest rainwater during the rainy season.

Figure 4.2.1.6-1: Electricity power network 6.5km to the proposed landfill



(Source: KCC Aug. 2020)

Figure 4.2.1.6-2: Water supply in Soriya village



Borehole well

- **Solid waste management**

A private company, CINTRI provides the collection and disposal of domestic waste in Poipet city. It is a solid waste company holding a permit letter, released by the MOE from January 2019 to December 2028, to provide urban waste management service in Banteay Meanchey province. In Poipet city, the system is cover in Sangkat Poipet and Sangkat Phsar Kandal. However, the community near the landfill in Sorya village is not accessible to the system. The people use to burn or bury their domestic waste in their land lot.

- **Education facilities**

In Sangkat Nimit, Twelve primary schools were given 1370 students (682 students are female), two secondary schools have 150 students with 62 females and two high schools for 610 students with 322 females. Preav primary school, Snuol Tret Primary school, and Kaun Trei pr are located at 2.3km, 3.6km, and 3.5km, respectively, from the proposed landfill site, Figure 4.2.1.6-3.

There are no education facilities settled within the buffer zone 300 meters of the proposed landfill site, either the closest village Soriya.

Figure 4.2.1.6-3: The closest schools to a landfill site



(Source: KCC Nov.2020)

- **Health facilities**

According to the commune database, Kob Health Center is located in Sangkat Nimit with about 10km from the proposed landfill site. The Poipet referral hospital is located in Sangkat Poipet.

There are no health facilities settled within the buffer zone 300 meters of the proposed landfill site, either the closest village Soriya.

#### 4.2.1.7 Ecosystem/Protected area

Poipet is almost completely covered in lowlands, with a few upland regions to the north and east, outside the country's protected area. The proposed landfill would most likely combine grassland and rice fields. Shrub (small trees) and unvalued trees were found on small dikes of paddy fields. There are bamboo and small trees located on both sides of the river stream and a partial area at the right-side corner of the proposed landfill: no woodland and no fishing area on the proposed landfill site. People normally gather bamboo. The fishing activities have been done in the area, agriculture canal, and water bodies.

Figure 4.2.1.7-1: Map of project area concerned to the protected area



(Source: KCC Nov.2020)

Figure 4.2.1.7-2: Rice field surrounding the landfill



Figure 4.2.1.7-3: Local people collect the bamboo



(Source: KCC field survey in Aug.2020)

## 4.2.2 The Wastewater Treatment Plant (WWTP)

The baseline survey for environmental resources (physical and biological) will be the focus on the proposed WWTP site within a 300m buffer area, see Figure 4.2.2-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expand to the whole territory of Sangkat or the city itself. The characteristic in/ adjunction of the proposed landfill site is described in the following points.

Figure 4.2.2-1: Map of the WWTP site with 300m buffer



(source: KCC Nov.2020)

### 4.2.2.1 Location

The proposed WWTP site for Poipet city is located at Reaksmei Sereypheap village, Sangkat Nimitt, Poipet City, Banteay Meanchey Province. It is about 17km from the Poipet city center, where is a rural area and no settlement nearby, Figure 4.2.2.1-1.

Figure 4.2.2.1-1: Location map of the proposed WWTP site

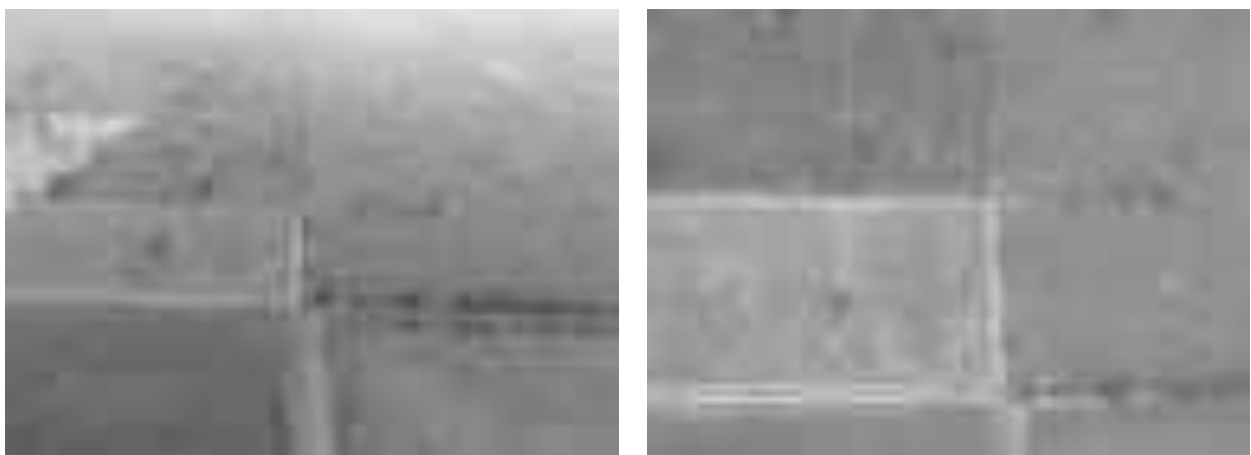


(source: KCC Nov.2020)

#### 4.2.2.2 Community structure/type of building

The proposed WWTP site is appointed with a total area of approximately 10ha. It is surrounding by agricultural land (paddy fields), Figure 4.2.2.2-1. The land belongs to the private within a price of 3-5\$ per 1m<sup>2</sup>. No households are living in the area of the buffer zone (300m). The settlements were found at 1km, and a pagoda settled about 800m the proposed site. There is no electricity and water supply. The electricity pole is available about 800m away. The pagodas, schools, hospitals, and heritage places were not found in the buffer zone (300m).

Figure 4.2.2.2-1: The proposed site is dominant of paddy field



(source: KCC Nov.2020)



#### 4.2.2.3 Access Road

There are four different types of access roads to the proposed WWTP site with a total length of 17km; the first section, 11km, is along with National Road No.5 (Asphalt road, very good condition). The second section 3km, is gravel road as the embankment of the Ou Khaidon reservoir, the third section 2km, is earth road and muddy in the wet season, and the fourth section is about 1km is Chinese road ( DBST road, good condition), Figure 4.2.2.3-1. However, to reach the site, need to pass the earth road about 300m, dike of a land lot boundary. For conveying wastewater to the treatment plant will be installed the feeding pipe along this access road.

There is an alternative access road to the proposed WWTP site with a total length of 23km from the city center. Along this road, way include NR#5 about 13km, NR#59 about 8.5km, Chinese road about 1.5km, and laterite road 300m (Figure 4.2.2.3-1). This access road is in very good condition (Asphalt and DBST road), except the last 300m (earth road).

Figure 4.2.2.3-1: Sort cut access Road to the proposed WWTP site



A: First Section: NR#5 inside Poipet city



B: Second section: as the embankment of Ou Khaidon reservoir (gravel road)



C: Forth section: Chinese road (DBST)



D: Last section connecting to WWTP site (earth road)

Figure 4.2.2.3-2: Long way access road to the proposed WWTP site



National Road No.5 (Asphalt Road)



National Road No.59 (Asphalt Road)



Chinese road (DBST)



Laterite Road 300m

#### 4.2.2.4 Land use/Type of land

The area surrounding the proposed WWTP is all land with agriculture, grassland, and shrub. In the paddy-field, rice is planted in the rainy season and does nothing in the dry season. The residential/land construction project in the buffer zone was not located surrounding the proposed WWTP.

#### 4.2.2.5 Hydrology/river system

The proposed WWTP site is appointed with a total area of approximately 10ha. It is surrounding by agricultural land (paddy fields), Figure 4.2.2.5-1.

The water bodies within 300m from the proposed WWTP site include agricultural canals in the western and southern of the WWTP site, and canals surrounding the rice field, Figure 4.2.2.5-2. It is used to maintain water for agricultural cultivating.

Figure 4.2.2.5-1: Water bodies within the project area



(Source: KCC Nov. 2020)

Figure 4.2.2.5-2: The canal surrounding the rice field



Agricultural Canals, source: source: KCC Nov.2020

#### **4.2.2.6 Access to Service Facilities**

- **Access to Electricity network**

As the WWTP site is located in the Reaksmeay Sereypheap village and the closest point to connect to the electrical grid is along the Road (1km from Road No.59 or 5km from No.5). Figure 4.2.2.6-1.

Figure 4.2.2.6-1: Electrical pole along Road No.59



(Source: KCC Aug. 2020)

- **Access to Water supply network**

As the location of the proposed WWTP is a rural area and no settlement nearby; However, the groundwater source is available in the whole of Poipet city.

The main water supply source for the community near the WWTP, in Reaksmey Sereypheap village, is groundwater. Based on the field survey in Aug. 2020 found that all households have at least a few concrete jars/basins to harvest rainwater during the rainy season for domestic use.

- **Solid waste management**

A private company, CINTRI provides the collection and disposal of domestic waste in Poipet city. It is a solid waste company holding a permit letter, released by the MOE from January 2019 to December 2028, to provide urban waste management service in Banteay Meanchey province. In Poipet city, the system is cover in Sangkat Poipet and Sangkat Phsar Kandal. However, the community near the WWTP, in Reaksmey Sereypheap village, is not access to the system.

Based on field observation in Aug. 2020 found that the people use to burn or bury their domestic waste in their land lot, and some plastic waste was spread in ope space in the community and the agricultural canal.

- **Education facilities**

In Sangkat Nimit, Twelve primary schools were given 1370 students (682 students are female), two secondary schools have 150 students with 62 females and two high schools for 610 students with 322 females. Reaksmey Sereypheap primary school, Reaksmey Samaki Primary school, and Kaun Trei primary school are located at 2.3km and 1.5km, respectively, from the proposed WWTP site, Figure 4.2.1.6-2.

There are no education facilities settled within the buffer zone 300 meters of the proposed WWTP site, either the closest Reaksmey Sereypheap village.

Figure 4.2.1.6-2: Map of distance from schools to WWTP



(Source: KCC Nov.2020)

- **Health facilities**

According to the commune database, Kob Health Center is located in Sangkat Nimit with about 15km from the proposed landfill site. The Poipet referral hospital is located in Sangkat Poipet.

There are no health facilities settled within the buffer zone 300 meters of the proposed WWTP site, either the closest village Reaksmei Serey Pheap.

#### **4.2.1.7 Ecosystem/Protected area**

There is no protected areas or forest in Poipet city as well as in the proposed WWTP area. The Poipet area's dominating landscape is an agricultural area (rice cultivation), mostly rice fields, an urban area settled along with the NR No.5. The ecosystem /adjacent to the site is a rice field.

#### **4.2.3 Storm Drainage Outfall**

The baseline survey for environmental resources (physical and biological) will focus on the proposed storm drainage outfall sites within a 300m buffer area (see Figure 4.2.3-1). While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expand to the whole territory of Sangkat or the city itself.

Five storm drainage outfalls (GMS\_01, GMS\_02, GMS\_03, and GMS\_04; Figure 4.2.3-1) have been proposed for solving significant floods in Poipet city. The storm drainage subproject mostly covered the built-up area and the potential development activities in Poipet town. The four outfalls (part of the GMS1 project) is in the southern part of the city will discharge to the Ou Chrov river.

Figure 4.2.3-1: Map of the proposed outfall for stormwater drainage



(source: KCC Nov.2020)

#### 4.2.3.1 Outfall (GMS\_01)

- **Location:** The exiting outlet (GMS\_01) with coordinate 235256 E, 1510964 N located in Kbal Koh Village, Sangkat Poipet, Poipet City; it is a part of the GMS1 project. It is about 500m from NR No.5. The drainage system is discharging into the Ou Chrov River.

Figure 4.2.3.1-1: The location of the Outfall (GMS\_01) within 300m buffer



(source: KCC Nov.2020)

- **Community Structure:** The area is surrounded by the residential area and commercial area adjacent to the border. It is about 700m from Palilai pagoda. The drainage system will discharge into the exiting river called Ou Chrov, where marks the borderline between Cambodia and Thailand. The available electric power supply and water supply by ANCO Electrical Power Group & ANCO Water Supply (Poipet). The Poipet Mongkol market is about 400m from the outlet point. The schools, hospitals, and heritage places were not found in the buffer zone (300m) (Figure 4.2.3.1-2).

Figure 4.2.3.1-2: Present condition of the site



Existing Outfall (GMS\_01)



Resettlement area adjacent to the outfall



Pipe of water supply



Electric power supply

**Access Road:** The access road of this outlet is about 550m from NR No 5. Section one is a concrete road with 250m, and the second section is an earth road with 300m, Figure 4.2.3.1-3.

Figure 4.2.3.1-3: Present condition of the access road



Concrete Road



Earth Road

- **Land use:** This outfall area is surrounding by a residential area, commercial area, and no land development activities, Figure 4.2.3.1-1.
- **Hydrology:** The existing open canal connected from the drainage system will discharge into the river called Ou Chrov. Ou Chrov River is the main river. It is situated along the Cambodia and Thailand border; it is connected to the Sereisophorn River and flows into Tonle Sap Lake. The river is flooded during the rainy season by the floodwaters originating mostly from Thailand. Some parts of the river have no water during the dry season.
- **Ecosystem/Projected area:** There is no protected areas or forest in Poipet city as well as in the GMS\_01 area, only *Dipterocarpus alatus* (Khmer name Cheu Teal) as a border. The ecosystem in/adjacent to the GMS\_01 is a small forest that is presented in the area along both sides of Ou Chrov (see Figure 4.2.3.1-4).

Figure 4.2.3.1-4: The *Dipterocarpus alatus* (Cheu Teal) along the Cambodian-Thai borderline



(source: KCC Agu.2020)



#### 4.2.3.2 Outfall (GMS\_02)

- **Location:** The exiting outlet (GMS\_02) is located in Ou Chrov Village, Sangkat Poipet, Poipet City (235844 E, 1510515N). It is about 450m from NR No.5. The storm drainage system is discharging into the Ou Chrov River. Surrounding this existing outlet is a residential area.

Figure 4.2.3.2-1: Location of Outfall (GMS\_02) within 300m buffer



(source: KCC Nov.2020)

- **Community Structure:** The area is surrounded by the illegal residential area adjacent to the border. The drainage system will discharge into the exiting river called Ou Chrov, where marks the borderline between Cambodia and Thailand. The electric power supply and water supply are available at the proposed site by ANCO Electrical Power Group & ANCO Water Supply (Poipet). The schools, hospitals, and heritage places are not found in the buffer zone of 300 meters.

Figure 4.2.3.2-2: Present condition of Surrounding area



Struture of the Outfall GMS\_02



Electric pole and settle area

- **Access Road:** The access road to the existing Outfall (GMS\_02) is about 500m from NR No 5 by concrete road with 6 meters width.

Figure 4.2.3.2-3: Present condition of the access road



(source: KCC Agu.2020)

- **Land use:** Same as a description at Outfall (GMS-01), see Figure 4.2.3.2-1.
- **Hydrology:** Description same as Outfall (GMS-01).
- **Ecosystem/Projected area:** Same condition as a description at outfall (GMS-01).

#### 4.2.3.3 Outfall (GMS\_03)

- **Location:** The exiting outlet (GMS\_03) is a part of the GMS1 project where is located in Kilou Lekh Boun Village, Sangkat Phsar Kandal, Poipet City with about 400m from NR No.5. It is located behind the Borey Thmey Post Border Patrol Police with coordinate 236676 E, 1509900N. The drainage system is discharging into Ou Chrov River, Figure 4.2.3.3-1.

Figure 4.2.3.3-1: Location of Outfall (GMS\_03) within 300m buffer



(source: KCC Nov.2020)

- **Community Structure:** The area is surrounded by the residential area adjacent to the Borey Thmey Post Border Patrol Police. The drainage system will discharge into the Ou Chrov River. One university is 100m away from the existing outfall. The electric power supply and water supply are available at the proposed site by ANCO Electrical Power Group & ANCO Water Supply (Poipet). The pagoda, hospitals, and heritage places were not found in the buffer zone of 300 meters.

Figure 4.2.3.3-2: Present condition of Surrounding area



Borey Thmey Post Border Patrol Police



Existing Outfall GMS\_03

- **Access road:** The access road to the existing outfall is about 400m from national road No 5 by concrete road with 6m width. The concrete road constructed adjacent to the proposed outfall is an alternative for the access road, Figure 4.2.3.3-3.

Figure 4.2.3.3-3: Present condition of the access road



(source: KCC Aug.2020)

- **Land use:** Description same as outfall (GMS-01), see Figure 4.2.3.3-1.
- **Hydrology:** Description same as outfall (GMS-01).
- **Ecosystem/Projected area:** Same condition as a description at outfall (GMS-01).

#### 4.2.3.4 Outfall (GMS\_04)

- **Location:** The exiting GMS\_04 is located (237208 E, 1509719N) in Kilou Lekh Boun Village, Sangkat Phsar Kandal, Poipet City, Banteay Meanchey province with 200m from the NR No.5. It was directly connected to the Ou Chrov River.

Figure 4.2.3.4-1: Location of Outfall (GMS\_04) within 300m buffer



(source: KCC Nov.2020)

- **Community Structure:** The area is surrounded by the residential area adjacent to the border. It is surrounding by a residential area and the new construction of the Villa. The drainage system will discharge into the Ou Chrov river. The electric power supply and water supply are available at the proposed site by ANCO Electrical Power Group & ANCO Water Supply (Poipet). The schools, hospitals, and heritage places are not found in the buffer zone of 300 meters.

Figure 4.2.3.4-2: Present condition of Surrounding area



Existing Outfall GMS\_04



The new construction of the Villa

- **Access Road:** the access road to the outfall GMS\_04 is about 200m from national road No.5 by earth road with 8m width.

Figure 4.2.3.4-3: Present condition of the access road



(source: KCC Aug.2020)

- **Land use:** This outfall area is surrounding by a residential area, commercial area, and land development activities, Figure 4.2.3.4-1.
- **Hydrology:** The existing open canal connected from the drainage system will discharge into the river called Ou Chrov. Ou Chrov River is the main river. It is situated along the Cambodia and Thailand border; it is connected to the Sereisophorn River and flows into Tonle Sap Lake. The river is flooded during the rainy season by the floodwaters originating mostly from Thailand. Some parts of the river have no water during the dry season. Moreover, one pond is about 200m away from the GMS\_04 with a size of 170m x 200m.
- **Ecosystem/Projected area:** Same condition as a description at outfall (GMS-01)

#### 4.2.4 Pumping Station

The baseline survey for environmental resources (physical and biological) will be a focus on the proposed pumping stations within a 300m buffer area, see Figure 4.2.4-1. While the baseline survey for social resources (village structure, land use, hydrology, and existing public facilities) and protected area) will expand to the whole territory of Sangkat or the city itself.

Three pumping stations and three lift pumps have been proposed in Poipet city. The proposed pumping station is to collect from sub-catchment/each part of the downtown and convey to the main pump station and finally, flow into the wastewater treatment plant where located in at Reaksmeay Sereypheap village.

Figure 4.2.4-1: Map of the proposed outlet for stormwater drainage



(source: KCC Nov.2020)

##### 4.2.4.1 Pumping Station (PS\_MP\_01)

- Location:** The proposed pumping station (PS\_MP\_01) is located in Kilo Lekh Buon village, Sangkat Psar Kandal, Poipet City, with coordinate 238386 E, 1508925N, Figure 4.2.4.1-1. It will collect all wastewaters from the residential and commercial areas and convey them to PS\_MP\_02. The size of PS\_MP\_01 is 68m x 68m. the proposed site for PS\_MP\_01 is surrounded by residential areas, but only a few houses were found in the next lot. There is one primary school 200m away from the site.

Figure 4.2.4.1-1: Location of Pumping Station (PS\_MP\_01) within 300m buffer



(Source, KCC Nov.2020)

- Community Structure:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. Sangkat Psar Kandal is an urban area, and the house was commonly built from brick and wood with tile or zinc roof. In the buffer zone of PS\_01, it is a settled area. Anyways, the close resident has only two houses. One small house with a wooden wall and zinc roof and one brick house with a zinc roof were found in the front and on the right of the PS, respectively. Moreover, one school is about 50m from the proposed pumping station. The hospital and heritage place did not found in the buffer zone of 300 meters.

Figure 4.2.4.1-2: Present condition of Surrounding area



One small house with a wooden wall



Brick house with a zinc roof



Entrance and school about 50m from Proposed PS\_MP\_01

- **Access road:** The access road to the proposed site is about 300m far from the National road No.5 by concrete road with 8m width and very good condition.

Figure 4.2.4.1-3: Present condition of the access road PS\_MP\_01



- **Land use:** This outfall area is surrounding by residential area and no land development activities, Figure 4.2.4.1-1.
- **Access to services facilities:**
  - **Electricity Network:** The electricity pole is available at the proposed PM site. The electrical power supply by ANCO Electrical Power Group.
  - **Water Supply:** The pipe water supply is available at the proposed MP\_01 site by ANCO Water Supply (Poipet).
  - **Solid Waste Management:** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The proposed site is in Sangkat Psar Kandal where is covered by CINTRI.

#### 4.2.4.2 Pumping Station (PS\_MP\_02)

- **Location:** The proposed PS\_MP\_02 is located in Andoung Thma Meas Village, Sangkat Psar Kandal, Poipet City, coordinating 243217 E, 1508121N, Figure 4.2.4.2-1. It is located along with the NR No.5. It will collect all wastewaters from the residential, commercial area and PS\_MP\_01 then convey them to PS\_MP\_03.



Figure 4.2.4.2-1: Location of Pumping Station (PS\_MP\_02) within 300m buffer



(Source, KCC Nov.2020)

- **Community structure/type of building:** That proposed site is surrounded by a rice field and has one warehouse (Yim Sambo), which is next to the PS\_MP\_02 area. The pagodas, schools, hospitals, and heritage places were not found in the buffer zone (300m) (Figure 4.2.4.2-2).

Figure 4.2.4.2-2: Present condition of Surrounding area



Warehouse (Yim Sambo)



Propose Main Pump 02

- **Access Road:** The proposed pumping station (PS\_MP\_02) is located along National Road No.5, a part of the right of way.

Figure 4.2.4.2-3: Present condition of the access road (NR No.5)



(Source, KCC Aug.2020)

- **Land use:** This outfall area is surrounding by agricultural land, commercial area, and land development activities, see Figure 4.2.4.2-1.
- **Access to services facilities:**
  - **Electricity Network:** Description same as PS\_MP\_01.
  - **Water Supply:** Description same as PS\_MP\_01.
  - **Solid Waste Management:** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The proposed site is in Sangkat Psar Kandal where is covered by CINTRI.

#### 4.2.4.3 Pumping Station (PS\_MP\_03)

- **Location:** The proposed pumping station\_03 (PS\_MP\_03) is located in Sokhsan village, Sangkat Nimitt, Poipet City, with coordinate 245130 E, 1505836 N. It will collect all wastewaters from residential, commercial area and PS\_MP\_02 then convey to the WWTP. That proposed site is surrounded by rice fields and the big reservoir called Ou Khaidon, which is the main water source of the ANCO water supply for Poipet city.

Figure 4.2.4.2-1: Location of Pumping Station (PS\_MP\_03) within 300m buffer



(Source, KCC Nov.2020)

- **Community structure:** As the pumping station\_03 is located far away from the village center, where only rice field and Ou Khaidon reservoir presented, so only one house presented within 300m buffer area as well as 1km from the outfall point. No water supply, even close to the reservoir. The pagoda, school, hospital, and heritage place were not found in the buffer zone of 300 meters, Figure 4.2.4.3-2.

Figure 4.2.4.3-2: Reservoir and one house present in the 300m buffer zone of MP\_03



Ou Khaidon reservoir



One house presented within 300m buffer area

- **Access road:** The access road to the proposed site is about 2.6 Km far from the National road No.5 by gravel road with 10m width, and this road is built on the embankment of the Ou Khaidon reservoir.

Figure 4.2.4.3-3: Present condition of the access road



(Source, KCC Nov.2020)

- **Land use:** Description same as PS\_MP\_01, see Figure 4.2.4.3-1.
- **Access to services facilities:**
  - **Electricity Network:** The electricity pole is available around 10 meters from the proposed PS site. The electrical power supply by ANCO Electrical Power Group.
  - **Water Supply:** There is no water supply system in this community.
  - **Solid Waste Management:** The solid waste not available in the proposed pumping station.

#### 4.2.4.4 Lift Pump (PS\_LP\_01)

- **Location:** The lift pump (PS\_LP\_01) is located in Kbal Koh Village, Sangkat Poipet, Poipet City with coordinate 235203.91 E, 1511118.31N, Figure 4.2.4.4-1. It is about 300m from NR No.5.

Figure 4.2.4.4-1: Location of Pumping Station (PS\_LP\_01) within 300m buffer



(Source: KCC Nov.2020)

- **Community Structure:** The area is surrounded by the residential area and commercial area adjacent to the border. The drainage system will discharge into the exiting river called Ou Chrov, where marks the borderline between Cambodia and Thailand. The available electric power supply and water supply by ANCO Electrical Power Group & ANCO Water Supply (Poipet). The Poipet Mongkol market is about 150m from the Lift pump. The schools, hospitals, and heritage places were not found in the buffer zone (300m) (Figure 4.2.4.4-2).

Figure 4.2.4.4-2: The private area with land filled up



(Source, KCC Aug.2020)

- **Access road:** The access road to the proposed site is about 300m far from National Road No.5. The first section is a concrete road with a 150m length, and the second section is an earth road with a 150m length, Figure 4.2.4.4-3.

Figure 4.2.4.4-3: Present condition of the access road



(Source, KCC Agu.2020)

- **Land use:** This lift pump area is a private area with land filled up and surrounded by a residential area, commercial area, and no land development activities, Figure 4.2.4.4-1.
- **Access to services facilities:**
  - **Electricity Network:** Description same as PS\_MP\_01.
  - **Water Supply:** Description same as PS\_MP\_01.
  - **Solid Waste Management:** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The proposed site is in Sangkat Psar Kandal where is covered by CINTRI.

#### 4.2.4.5 Lift Pump (PS\_LP\_02)

- **Location:** The proposed lift pump (PS\_LP\_02) is located in Palilai 2 Village, Sangkat Poipet, Poipet City, with coordinate 235908.90 E, 1511043.08N, Figure 4.2.4.5-1. It is located along with the NR No.5. It will collect all wastewaters from the residential, commercial area and PS\_LP\_01 then convey them to PS\_LP\_03.

Figure 4.2.4.5-1: Location of Pumping Station (PS\_LP\_02) within 300m buffer



(Source, KCC Nov.2020)

- **Community structure/type of building:** Commonly, the Cambodians prefer to settle their village along with the road network due to the ease of supporting their daily livelihood, concerning the water supply, electricity supply, agricultural activities, and transportation. It settled adjacent to the Palilai pagoda and a small store at the Palilai gate. The schools, hospitals, and heritage places were not found in the buffer zone (300m) (Figure 4.2.4.5-2).

Figure 4.2.4.5-2: The proposed LP\_02 site



(Source, KCC Aug.2020)

- **Access road:** The proposed (PS\_LP\_02) is located along National Road No.5, a part of the right of way.

Figure 4.2.4.5-3: Present condition of NR No.5



- **Land use:** Description same as PS\_MP\_01, see Figure 4.2.4.5-1.
- **Access to services facilities:**
  - **Electricity Network:** Description same as PS\_MP\_01.
  - **Water Supply:** Description same as PS\_MP\_01.
  - **Solid Waste Management:** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The proposed site is in Sangkat Poipet where is covered by CINTRI.

#### 4.2.4.6 Lift Pump (PS\_LP\_03)

- **Location:** The Pumping station (**PS\_LP\_03**) is located in Kilou Lekh Boun Village, Sangkat Phsar Kandal, Poipet City, about 200m from NR No.5 with coordinate 236719.10 E, 1510148.42N, Figure 4.2.4.6-1.

Figure 4.2.4.6-1: Location of Pumping Station (PS\_LP\_03) within 300m buffer



(Source, KCC Nov.2020)

- **Community structure/type of building:** It is located about 100m away from the railway and residential area. The pagoda, schools, hospitals, and heritage places were not found in the buffer zone (300m) (Figure 4.2.4.6-2 and Figure 4.2.4.6-3).

Figure 4.2.4.6-2: Railway close to the proposed site



Figure 4.2.4.6-3: The proposed site



- **Access road:** The access road to the proposed site is about 200m far from the National road No.5 by concrete road.

Figure 4.2.4.6-4: Present condition of the access road



(Source, KCC Aug.2020)

- **Land use:** This outfall area is surrounding by a residential area, commercial area, and no land development activities, see Figure 4.2.4.6-1.
- **Access to services facilities:**
  - **Electricity Network:** Description same as PS\_MP\_01.
  - **Water Supply:** Description same as PS\_MP\_01.
  - **Solid Waste Management:** The collection and disposal of domestic solid waste are provided by the private company CINTRI, which owns the assets. The proposed site is in Sangkat Phsar Kandal where is covered by CINTRI.

Figure 4.2.4.6-5: Electricity pole at LP\_03



(Source, KCC Aug.2020)



### 4.3 Soil quality

#### 4.3.1 Methodology

Soil sampling was taken to analyze for both chemical and physical. Two samples were taken, according to the ToR, one sample at proposed landfill sites (253507 E, 1513372 N) and the other one at proposed WWTP (245681 E, 1503125 N). The location map of soil sampling is shown in Figure 4.3.1-1 and Figure 4.3.1-2.

**Sampling method:** Remove surface debris (such as plant residues, mulch, or turf thatch) from the surface. The upper topsoil (0-20cm) is also not taken. The soil sample was taken 30cm to 40cm in depth and keeps it's in plastic bags to maintain the moisture. The activities of soil sampling in both sites are shown (Figure 3.1-3 and Figure 3.1-4).

**Measurement method:** The soil quality analysis following the measurement method applied in the laboratory. The sieve analysis was conducted to identify the soil particle. The analysis of chemical concentration in the soil has been used as the laboratory's technical method as the descript Table 3.1-1.

Figure 4.3.1-1: The location of the sampling point in the landfill site



(Source, KCC Nov.2020)

Figure 4.3.1-2: The location of the sampling point in the WWTP site



(Source, KCC Nov.2020)

Table 4.3.1-1: The method for soil quality analysis in the laboratory

No	Parameter	Unit	Reference Method
1	pH	-	Method 1:5 Soil Water
2	Arsenic (As)	mg/kg-dry	Method 3500-As D, (HNO <sub>3</sub> , HCl digestion)
3	Cadmium (Cd)	mg/kg-dry	Method 3500-Cd C, (HNO <sub>3</sub> ,HCl digestion)
4	Chromium (Cr-total)	mg/kg-dry	Method 3500-Cr C, (HNO <sub>3</sub> , HCl digestion)
5	Copper(Cu)	mg/kg-dry	Method 3500-Cu C, (HNO <sub>3</sub> ,HCl digestion)
6	Lead (Pb)	mg/kg-dry	Method 3500-Pb C, (HNO <sub>3</sub> ,HCl digestion)
7	Mercury (Hg)	mg/kg-dry	Method 3500-Hg B, (HNO <sub>3</sub> , HCl digestion)
8	Nickel(Ni)	mg/kg-dry	Method 3500-Ni C, (HNO <sub>3</sub> ,HCl digestion)
9	Zinc(Zn)	mg/kg-dry	Method 3500-Zn C, (HNO <sub>3</sub> ,HCl digestion)

Figure 4.3.1-3: Soil sampling at the landfill site, 253507 E, 1513372 N



Figure 4.3.1-4: Soil sampling at the WWTP site, 245681 E, 1503125 N



### 4.3.2 Finding

#### 4.3.2.1 The Landfill

The soil quality was taken samples and analyzed in August 2020, and following the ToR provided by the TA consultants. The soil quality at the landfill site was analyzed both physical (soil particle) and chemical (trace element) characteristics and the result is showed in Table 4.3.2.1-1 and Table 4.3.2.1-2. The detailed lab sheets are enclosed in Annex 2.

According to the mechanical sieve analysis (Pipette method), the soil particle at the landfill site contained clay 24.10%, fine silt 4.35%, coarse silt 6.63%, fine sand 37.01%, and coarse sand 25.91%. The Soil texture triangle showing the USDA (United States Department of Agriculture) classification system based on the grain size of clay, silt, and sand indicates that the soil at the landfill site is the sandy loam. However, clay was presented in a deeper layer >0.5m, according to the field visual, Figure 3.1-1.

Table 4.3.2.1-1: The physical characteristic of soil

No.	Soil particle (Size)	Unit	Results
1	Clay (<0.002mm)	%	24.10
2	Fine Silt (0.002-0.02mm)	%	4.35
3	Coarse Silt (0.02-0.05mm)	%	6.63
4	Fine Sand (0.05-0.2mm)	%	37.01
5	Coarse Sand (0.2-2.0mm)	%	25.91

The soil quality in the proposed landfill indicated that the pH characteristic is acid (pH=5.04). Natural soil pH depends on the rock from which the soil was formed (parent material) and the weathering processes that acted on it—for example, climate, vegetation, topography, and time. These processes tend to cause a lowering of pH (increase in acidity) over time.

The other chemical parameters of the soil at the landfill site showed that all the parameters below the standards, which means the soil quality in the proposed landfill is not polluted yet.

Table 4.3.2.1-2: Chemical characteristic of the soil

No	Parameters	Unit	Standards*	Results
1	pH	-	-	5.04
2	Arsenic (As)	mg/kg-dry	<15	ND
3	Cadmium (Cd)	mg/kg-dry	<0.8	0.08
4	Chromium (Cr-total)	mg/kg-dry	<100 (Cr+6)	ND
5	Copper (Cu)	mg/kg-dry	<125	22.42
6	Lead (Pb)	mg/kg-dry	<85	19.46
7	Mercury (Hg)	mg/kg-dry	<0.3	0.11
8	Nickel (Ni)	mg/kg-dry	<35	ND
9	Zinc (Zn)	mg/kg-dry	<140	39.40

**Note:** \* Prakas on launching of standards of the number of toxins or hazardous substances allowed to be disposed of, No. 387 Br.K.B.Sth of MoE, September, (Annex 2: Standards of the number of toxic chemicals or hazardous substances allowed in soils) 30, 2015).

#### 4.3.2.2 The WWTP

The soil quality at the WWTP site was analyzed both physical (soil particle) and chemical (trace element) characteristics and the results are shown in Table 4.3.2.2-1 and Table 4.3.2.2-2. The detailed lab sheets are enclosed in Annex 1.

According to the mechanical sieve analysis (Pipette method), the soil particle at the WWTP site contained clay 33.65%, fine silt 12.55%, coarse silt 6.85%, fine sand 30.08%, and coarse sand 14.48%. The Soil texture triangle showing the USDA classification system based on the grain size of clay, silt, and sand indicates that the soil at WWTP is the loam. However, clay was presented in a deeper layer >0.5m, according to the field visual, Figure 3.1-2.

Table 4.3.2.2-1: The physical characteristic of the soil

No.	Soil particle (Size)	Unit	Results
1	Clay (<0.002mm)	%	33.65
2	Fine Silt (0.002-0.02mm)	%	12.55
3	Coarse Silt (0.02-0.05mm)	%	6.85
4	Fine Sand (0.05-0.2mm)	%	30.08
5	Coarse Sand (0.2-2.0mm)	%	14.49

The soil quality in the proposed WWTP indicated that the pH characteristic is acid (pH=5.00). Arsenic (As) concentration in the soil is not present in the proposed WWTP; however, Cadmium (Cd) and Nickel (Ni) is 1.28 mg/kg and 45.92 mg/kg, which is a bit higher than the standards for toxic chemicals or hazardous substances that can be allowed to exist in the soil.

The soil pollutant source did not spot; however, the main sources of trace elements are soil parent materials (rocks), fertilizers, biosolids, irrigation water in its environment. Some are essential for plant growth and development. When present in soils at elevated levels, those same elements become toxic. Trace elements that have been taken up by plants, especially those grown on contaminated soils, could move up the food chain, some accumulating in the

fatty tissue of animals and humans. Based on the site investigation in the proposed WWTP is dominant in the rice field where chemical fertilizer and pesticide may be used to increase the rice product, so the high value of the Cd and Ni could come from agricultural activities in place.

Table 4.3.2.2-2: Chemical characteristic of the soil

No	Parameters	Unit	Standards*	Results
1	pH	-	-	5.00
2	Arsenic (As)	mg/kg-dry	<15	ND
3	Cadmium (Cd)	mg/kg-dry	<0.8	1.28
4	Chromium (Cr-total)	mg/kg-dry	<100 (Cr+6)	8.84
5	Copper (Cu)	mg/kg-dry	<125	69.88
6	Lead (Pb)	mg/kg-dry	<85	26.72
7	Mercury (Hg)	mg/kg-dry	<0.3	0.14
8	Nickel (Ni)	mg/kg-dry	<35	45.92
9	Zinc (Zn)	mg/kg-dry	<140	128.46

**Note:** \* Prakas on launching of standards of the number of toxins or hazardous substances allowed to be disposed of, No. 387 Br.K.B.Sth of MoE, September, (Annex 2: Standards of the number of toxic chemicals or hazardous substances allowed in soils) 30, 2015).

#### 4.3.2.3 Discussion

The soil particle analysis is sandy loam at the landfill site and loam at the WWTP site. The soil mixture contains more sand than other types of rock or minerals at the landfill site, and the small sand contains more than other minerals at the WWTP site. The soil particle analysis should conduct more points at the landfill and the WWTP site to understand the soil layer for analyzing the permeability conductivity to protect the groundwater pollution.

Soil quality monitoring at the proposed landfill and the WWTP indicated that the soil quality was not polluted yet. However, the WWTP site is a high-level concentration of the Cadmium (Cd) and Nickel (Ni) in the soil that might come from soil materials (rocks), fertilizers, biosolids, and irrigation water activities. Acid pH can significantly affect the soil's toxic element levels in the soil, especially the concentration, Cadmium (Cd) and Nickel (Ni). Treating an excess of Cadmium (Cd) and Nickel (Ni) in the soil can also be rather complicated; primarily, we need to focus on treating deficiencies in other elements. Firstly, soil pH should be monitored to ensure it doesn't drop too low. The soil pH very low at the landfill site, and the WWTP might include intensive fertilization with ammonium-based fertilizers or ammonium-forming fertilizers (urea) from agriculture activities.

### 4.4 Water quality

#### 4.4.1 Methodology

##### 4.4.1.1 The Surface water and groundwater

The water samples were taken from locations representing the water source includes stream, canal, and pond, which is closest to the project sites. The location of sampling points and the number of the sample are shown in Table 4.4.1.1-1, Figure 4.3.1-1, and Figure 4.3.1-2. Groundwater samples were taken from the tube/borehole well nearest to the project site. At least 10 minutes of pump out to get a good representative sample from the well were applied, and the storage and taking sample procedure is the same way as the surface water sampling.

Two different types of sample bottles (glass and polypropylene) have been used: 1000ml of polypropylene bottles for physical and chemical parameters, 500ml of polypropylene bottles for

biological parameters, and 200ml of glass bottles for biological parameters. For the physical and chemical parameters, the sample was filled with water, but for the biological parameters, the sample water kept some freeboard to allow some air for the microorganism alive. All samples were kept in an icebox to maintain temperature  $<5^{\circ}\text{C}$  after taking. The activities of water sampling are shown in Figure 4.4.1.1-1 and Figure 4.4.1.1-2.

The parameters and measurement methods for surface water and groundwater are listed in Table 4.4.1.1-2. Note that the methodology for water quality measurement is followed the MoE's lab standard.

Table 4.4.1.1-1: The location of the water sampling

Sample code	Water sources	Location Description	coordinate
<b>Landfill</b>			
LF_SW1	Surface water (Pond)	Distance within 260m away from the proposed landfill site	253785 E, 1513338 N
LF_GW1	Groundwater (tube well)	Distance within 2,1 km away from the proposed landfill site	252078 E, 1514823 N
LF_GW2	Groundwater (well)	distance within 3,5 km away from the proposed landfill site	250229 E, 1512448N
<b>WWTP</b>			
WWTP_SW1	Surface water (Pond)	Distance within 260m away from the proposed WWTP	246125 E, 1503216 N
WWTP_GW1	Groundwater (tube Well)	Distance within 1.64 km away from the proposed WWTP	247080 E, 1504087 N

Table 4.4.1.1-2: The methodology of water quality measurement

No	Parameters	Unit	Method
1	pH	-	4500-H+/SM
2	Electrical Conductivity (EC)	$\mu\text{S}/\text{cm}$	2510-Ec/SM
3	Dissolved Oxygen (DO)	mg/l	4500-O/SM
4	Biochemical Oxygen demand ( $\text{BOD}_5$ )	mg/l	5210-BOD/SM
5	Chemical Oxygen demand (COD)	mg/l	5220-COD/SM
6	Carbonate ( $\text{CO}_3$ )	mg/l	2320-A/SM
7	Bicarbonate ( $\text{HCO}_3$ )	mg/l	2320-A/SM
8	Calcium (Ca)	mg/l	3500-Ca-B/SM
9	Magnesium (Mg)	mg/l	3500-Mg-B/SM
10	Sulphate ( $\text{SO}_4$ )	mg/l	4500-SO4/SM
11	Chloride (Cl)	mg/l	4500-Cl/SM
12	Sodium (Na)	mg/l	3500-Na-B/SM
13	Potassium (K)	mg/l	3500-K-B/SM
14	Nitrite ( $\text{NO}_2$ )	mg/l	4500-NO2-3/SM
15	Total Nitrite (TN)	mg/l	4500-N/SM
16	Total Phosphorus (TP)	mg/l	4500-P/SM
17	Iron ( $\text{Fe}^{2+}$ )	mg/l	3500-Fe/SM
18	Iron ( $\text{Fe}^{3+}$ )	mg/l	3500-Fe/SM
19	Oil & Grease	mg/l	3500-Grease/SM
20	Cadmium (Cd)	mg/l	3500-Cd/SM
21	Arsenic (As)	mg/l	3500-As/SM
22	Total Coliform	MPN/100ml	3500-coliform/SM
23	E . Coli	MPN/100ml	3500-coli/SM

Source: MoE lab standard of measurement, Sept. 2020

Figure 4.4.1-1 Water Quality Sampling in the landfill area



Surface water sampling at the landfill site



Groundwater sampling closest to the landfill site

Figure 4.4.1.1-2 Water Quality Sampling at the WWTP Area



Surface water sampling closest to the WWTP site



Groundwater sampling closest to the WWTP site

#### 4.4.1.2 Bacteriological

The bacterial in the surface water is known as infectious disease-related to fecal contamination. Total coliforms and *Escherichia coli* (*E. coli*) have been recognized as a suitable microbial indicator of drinking-water quality, primarily because they are easy to detect and enumerate in water. The time between sample collection and analysis should, in general, not exceed 24 hours, and samples are immediately placed in a light-proof insulated and cool box containing melting ice or icepacks with water to ensure rapid cooling. Membrane-filtration (MF) method has been applied for counting the number of total *E. coli*, which quantifies the number of *E. coli* indicators in the lab. Two samples were taken from each proposed site for Landfill and WWTP, and the detailed location description is listed in Table 4.4.1.2-1 and showed in Fig. 4.4.1.2-1 and Fig. 4.4.1.2-2.

Table 4.4.1.2-1: Site description

Sample code	Water sources	Location Description	coordinate
<b>Landfill</b>			
LF_SW1	Surface water (Pond)	Distance within 260m away from the proposed landfill	253785 E, 1513338 N
LF_SW2	Surface water (Pond)	Distance within 120m away from the proposed landfill	253649 E, 1513353 N
<b>WWTP</b>			
WWTP_SW1	Surface water (Pond)	Distance within 460m away from the proposed WWTP	246125 E, 1503216 N
WWTP_SW2	Surface water (Dig lake)	Distance within 10m away from the proposed WWTP	245681 E, 1503134 N



Figure 4.4.1.2-1: Water sampling activities for bacteriology indicators at the landfill site



Figure 4.4.1.2-2: Water sampling activities for bacteriology indicators at the WWTP site



#### **4.4.2 Finding**

##### **4.4.2.1 Surface water and groundwater**

The water quality was taken samples and analyzed in August 2020, and following the ToR provided by the TA consultants. The result of water quality (WQ) analysis, both surface water, and groundwater area showed in Table 4.4.2.1-1 and Table 4.4.2.1-2. These WQ results are presented the baseline water quality in/adjacent to the project area. The detailed lab sheets are enclosed in Annex 3.

Table 4.4.2.1-1 indicated that the parameter oil and grease value of both samples (WWTP\_SW and LF-SW) is higher than the standard (<5mg/l), while the Total Nitrogen of the sample LF\_SW is also higher than the standard (0.1-0.6mg/l) too. The results of the other parameters are meeting the standards; it could be concluded that the physical and chemical water quality in and adjacent to the proposed WWTP and Landfill site is good.

According to the results in Table 4.2.1-1 below show that the Oil and Grease were higher than the standard. The oil and grease at the landfill site are 7.4 mg/l, while the standard is less than five mg/l. This result might be caused by a human activity because the water sampling was taken from a small pond adjacent to the bamboo forest, where very far from the settlement, the people can somehow gather the bamboo shoot. Motorcycle and tractor for agriculture might be the main cause of oil and grease in the water. The WWTP oil and grease at the WWTP site is 6.1 mg/l lower than the landfill site's water sampling. It is might from agriculture activities or urban flooding affected. This result indicated that water quality still has no polluted impacts yet.

According to the results in Table 4.2.1-2 below show that the that all parameters were lower than the standard. This result indicated that water quality still has no polluted impacts yet.

Table 4.4.2.1-1: Result of surface water quality

No	Parameters	Unit	Guideline*	LF_SW1	WWTP_SW1
1	pH	-	6.5-8.5	7.09	6.93
2	Electrical Conductivity (EC)	µS/cm	-	104.4	316.0
3	Dissolved Oxygen (DO)	mg/l	7.5-2	6.7	6.9
4	Biochemical Oxygen demand (BOD <sub>5</sub> )	mg/l	<30	5.89	4.87
5	Chemical Oxygen demand (COD)	mg/l	1-8	9.46	7.82
6	Carbonate (CO <sub>3</sub> )	mg/l	-	0.00	0.00
7	Bicarbonate (HCO <sub>3</sub> )	mg/l	-	41.15	87.92
8	Calcium (Ca)	mg/l	-	9.26	21.42
9	Magnesium (Mg)	mg/l	-	1.16	2.67
10	Sulphate (SO <sub>4</sub> )	mg/l	<300	12.18	17.35
11	Chloride (Cl)	mg/l	-	6.79	38.80
12	Sodium (Na)	mg/l	-	9.20	28.72
13	Potassium (K)	mg/l	-	2.34	7.85
14	Nitrite (NO <sub>2</sub> )	mg/l	-	0.00	0.00
15	Total Nitrite (TN)	mg/l	0.1-0.6	1.144	0.717
16	Total Phosphorus (TP)	mg/l	0.005-0.05	0.023	0.016
17	Iron (Fe <sup>2+</sup> )	mg/l	-	0.001	0.002
18	Iron (Fe <sup>3+</sup> )	mg/l	-	0.300	0.230
19	Oil & Grease	mg/l	<5	7.4	6.1
20	Cadmium (Cd)	mg/l	<0.01	0.00	0.0047
21	Arsenic (As)	mg/l	<0.001	0.00	0.0011

**Note:** \* The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

Table 4.4.2.1-2 indicated that the result of measurement on groundwater quality for all three samples has a pH value slightly lower than the standard of surface water, which means that the groundwater here is slightly acidic. While the iron (Fe) also value slightly higher than the standard (0.3mg/l).

Anyway, the results of the other parameters have met the standards for groundwater quality. So it could conclude that the groundwater quality in/adjacent to the proposed Landfill site is slightly polluted Fe.

Table 4.4.2.1-2: Result of groundwater quality

No	Parameters	Unit	Guideline*	LF_GW1	LF_GW2	WWTP_GW
1	pH	pH unit	6.5-8.5	6.75	6.79	6.66
2	Electrical Conductivity (EC)	µS/cm	-	715	512	710
3	Total Dissolved Solid (TDS)	mg/l	800	365.2	256.1	351.5
4	Chemical Oxygen demand (COD)	mg/l	-	0.0	0.0	0.00
5	Carbonate (CO <sub>3</sub> )	mg/l	-	0.0	0.0	0.00
6	Bicarbonate (HCO <sub>3</sub> )	mg/l	-	407.19	278.21	382.95
7	Calcium (Ca)	mg/l	-	36.46	70.83	48.10
8	Magnesium (Mg)	mg/l	-	22.75	19.36	31.26
9	Sulphate (SO <sub>4</sub> )	mg/l	250	5.83	7.20	17.03
10	Chloride (Cl)	mg/l	250	1.35	1.34	1.33
11	Sodium (Na)	mg/l	-	7.89	6.75	8.13
12	Potassium (K)	mg/l	-	2.62	2.19	2.65
13	Nitrite (NO <sub>3</sub> )	mg/l	50	0.24	0.03	0.04
14	Ammonia (NH <sub>3</sub> )	mg/l	-	0.02	0.01	0.01
15	Total Nitrite (TN)	mg/l	-	0.074	0.06	0.221
16	Total Phosphorus (TP)	mg/l	-	0.001	0.002	0.001
17	Iron (Fe)	mg/l	0.3	0.26	0.310	0.210
18	Mercury (Hg)	mg/l	0.001	0.00011	0.00009	0.00016
19	Manganese (Mn)	mg/l	0.1	0.0037	0.004	0.0047
20	Chromium (Cr)	mg/l	0.05	0.0076	0.0075	0.0087
21	Arsenic (As)	mg/l	0.05	0.0009	0.001	0.0018
22	Total Coliform	MPN/100 ml	-	0.0	0.0	0.0
23	E . Coli	MPN/100 ml	-	0.0	0.0	0.0

**Note:** \* The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (groundwater).

#### 4.4.2.2 Bacteriological

##### The Landfill

The total coliform and E. coli from the main water source near the landfill are 3,300 MPN/100ml and 61 MPN/100ml. The total coliform and E. coli from the tributary close to the landfill site are 3,900 MPN/100ml and 0 MPN/100ml. It is indicated that the total coliform and E. coli from each source is lower than the standard. It cannot be significantly harmful to human health because people did not use water directly from these water sources. The detailed lab sheets are enclosed in Annex 2c.

The high value of the total coliform might come from a polluted source and no pollution source in and adjacent to the sampling site, especially the existing dumpsite. It could be said that the watercourse in the area was polluted by animal manure. The bacteriology indicator results indicate that the total coliform is higher at the proposed landfill site compared to the proposed WWTP.

Table 4.4.2.2-1: The result of total coliform and E. coli at the landfill

No	Parameters	Unit	Guideline*	LF_SW1	LF_SW2
1	Tot. Coliform	MPN in 100ml	<1000	3,300	3,900
2	E. Coli	MPN in 100ml		61	0

**Note:** \* The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

## **The WWTP**

The results of the baseline survey in Sept.2020 indicated that the total coliform and E. coli from the main water source near the WWTP are 2,600 MPN/100ml and 40 MPN/100ml. The total coliform and E. coli from the tributary close to the landfill site are 2,700 MPN/100ml and 20 MPN/100ml. It is indicated that the total coliform and E. coli from each source is lower than the standard. It cannot be significantly harmful to human health because people did not use water directly from these water sources. The detailed lab sheets are enclosed in Annex 2c.

Table 4.4.2.2-2: The result of total coliform and E. coli at the WWTP

No	Parameters	Unit	Guideline	WWTP_SW1	WWTP_SW2
1	Tot. Coliform	MPN in 100ml	<1000	2,600	2,700
2	MPN in 100ml	MPN in 100ml		40	20

**Note:** \* The Prakas No.120 on launching the use of ToR for infrastructure development and tourism, 11 April 2018, MoE, for surface water quality standards (lake and reservoir).

## **4.5 Flora and Fauna**

### **4.5.1 Objective**

The objectives of the fauna and flora survey are to document baseline information, status, and distribution of biodiversity and access its conservation and economic values within the project site and its adjacent areas. Those data will be used for any proposes development projects. The information will help to minimize the negative impact of a development project on biodiversity.

The specific objective, as describes in the following:

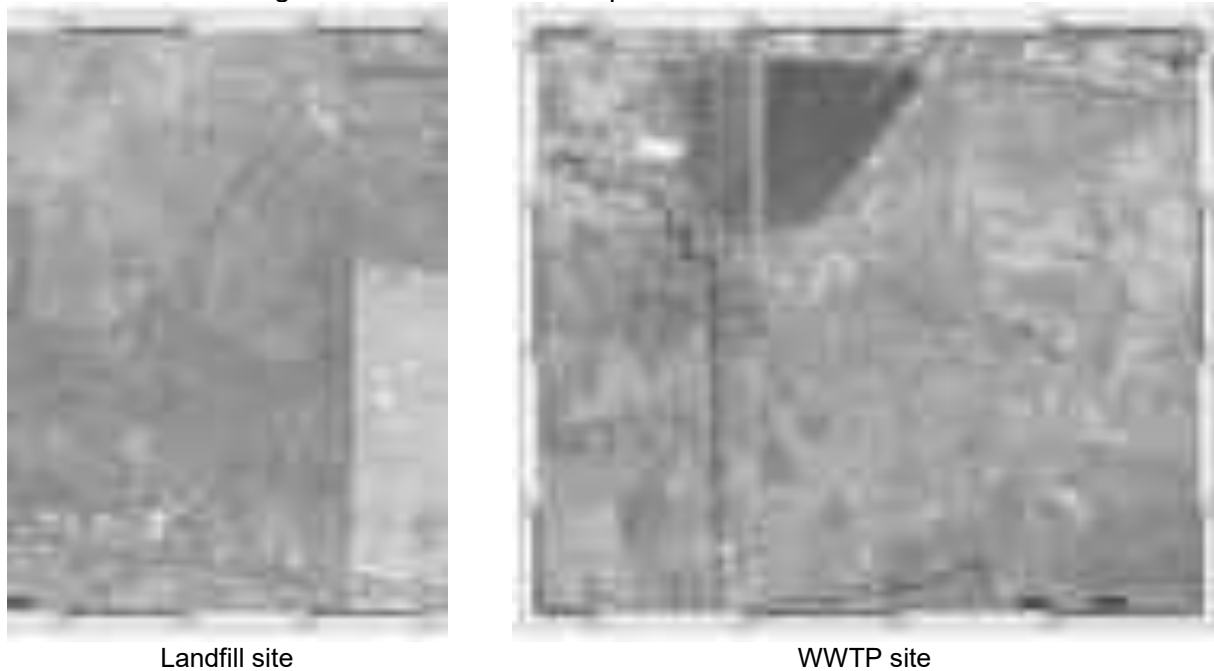
- To checklist and address tree species in the project area and adjunction.
- To document the endangered species list by IUCN red list and providing recommendations to policymakers for decision making on the negative impact of a development project.

### **4.5.2 Scope of the study**

The fauna and flora survey here are required to determine the species of trees/vegetation, reptiles, mammals, amphibians, birds, and bat present in the project area in the rainy season were covered in the survey period.

The results of the survey will report in term of present condition on the above resources and listing as local/English name, species name, family, and status in conservation value (common, rare, critical, vulnerable, endanger), and focus on the impact on the biodiversity that will be caused by the (1) Landfill site project in Sorya village, Sangkat Nimith, Poipet city, and (2) WWTP site in Rasmei Samaki village, Sangkat Nimith, Poipet City, Banteay Meanchey province, Figure 4.5.2-1.

Figure 4.5.2-1: Location map of the landfill and WWTP site



### 4.5.3 Methodology

There are two main methodologies to be applied for the study: literature review and field survey in the project area.

#### 4.5.3.1 Literature review

Previous study/research reports on flora and fauna concerning the proposed project sites will be reviewed and abstracted to use in the survey report according to the ToR for the survey.

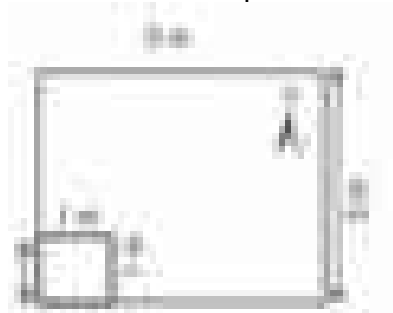
#### 4.5.3.2 Field Survey

##### 4.5.3.2.1 Flora

##### A. Plot design

We were undertaken basic inventories, using quadrat (5 m × 5 m) methodologies, of 2 plots to encounter rate, each botanical plot that is divided into 2 sub-plots within the project site ( Figure 4.5.3.2.1-2, Figure 4.5.3.2.1-3). Plots were marked using a compass and measuring tape, with each plot divided into 5 m x 5 m quadrats marked using tape. Within each quadrat, all trees with a diameter at breast height (dbh, c. 1.3 m) equal to or more than 5 cm were measured (dbh recorded) and identified to species. We have recorded vegetation understory within each plot.

Figure 4.5.3.2.1-1: Plots and sub-plots inventory quadrilateral



There are two field inventory plots for the Landfill site and two plots for the WWTP site with a geographical location in Table 4.5.3.2.1-1, Figure 4.5.3.2.1-2, Figure 4.5.3.2.1-3.

Table 4.5.3.2.1-1: Field inventory plot locations

Landfill site			WWTP site		
Plot No.	X	Y	Plot No.	X	Y
Plot1	253474	1513631	Plot1	245560	1503224
Plot2	253511	1513171	Plot2	245431	1503119

In accordance with National Forest Inventory (NFI) 2014 recommendations, rectangular plots were established for increases the accuracy of sampling intensity, especially for recording larger trees, and ensures the more efficient use of time (Vesa et al. 2014). Under this structure, we use square plots, which are divided into two levels of sub-plots in each plot, including (1) a sub-plot for measuring encountering trees and small tree (DBH>5cm.); (2) a sub-plot for encountering seedlings, climbers and shrubs (DBH <5 cm.) see Table 5.3.2-2.

Table 4.5.3.2.1-2: Plot design and sub-plot specifications.

Plot & Sub-plots	Dimensions	Area (m <sup>2</sup> )	Sizes of Trees to be Counted and/or Measured
Subplot 1: Trees, small tree	5 m × 5 m	25	DBH>5cm.
Subplot 2: Seedlings, vines /climbers	1 m × 1 m	1	DBH <5cm.

Source: Vesa et al. (2014).

Figure 4.5.3.2.1-2: Inventory plots for flora survey for Landfill



(Source, KCC Sept.2020)

The Wastewater Treatment Plant (WWTP) site (Figure 5.3-3) is covered 10 hectares, which is in Serey Pheap village, Sangkat Nimith, Poipet City, Banteay Meanchey province (Royal degree, 1993, (2003. The WWTP site was characterized by rice fields, plat plains, and grassland (ADB, 2012). The natural ecosystem type inherent to the surroundings of WWTP is characterized as

deciduous dipterocarp forest, which is tree vegetation typically with an open canopy combined with a grassy ground layer (ADB, 2019).

Figure 4.5.3.2.1-3: Inventory plots with forest cover in WWTP site

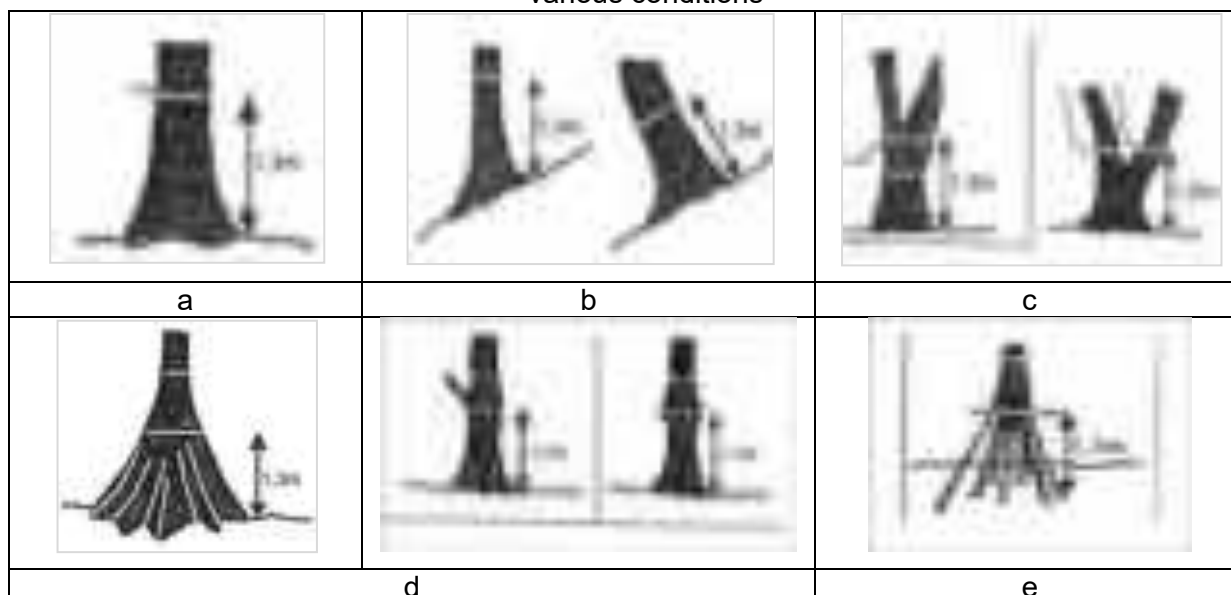


(Source, KCC Sept.2020)

## B. Measuring techniques

The local and scientific names of every tree species were recorded. If a species was unknown, a photograph was taken and shown to local plant 'experts' and/or villagers to enlist their assistance in naming the unknown species. The DBH of every tree with  $DBH \geq 5\text{cm}$  was measured with a measuring tape at the height of 1.3 m above the ground using a 1.3 m long stick. The DBH of every tree was measured twice to ensure accuracy.

Figure 4.5.3.2.1-4 (a, b, c, d): Illustrate the applications of measurement techniques under various conditions



Source: Cambodia Forestry Administration (2010)

If a fork of a tree originated at the height of 1.3 m or more above the ground, the tree was considered to be a single tree, and its DBH was measured below the fork (Figure 4.5.3-5 d)). If a fork originated below 1.3 m, each trunk was considered to be a single tree, and its DBH was measured at the height of 1.3 m above the ground (e). If a tree had an irregular shape at the height of 1.3 m above the ground because of bulges, wounds, hollowed-out trunks, or branches, its DBH was measured above the deformation (e) (FA, 2010; Vesa et al., 2014).

### **C. Equipment Tools**

- GPS (Garmin; GPSMap 64sc) for marking plot sites.
- Vertex laser is measuring tree height.
- Datasheet; for record species have been Date, time (start and end), Name team leader and members, Plot code (Plot ID), Location name, Plot size in meter, Scale factor, GPS coordinates of the plot, local name, Quality of the tree, diameter at breast height (DBH) in cm, Tree height (H1) in meter and total height.
- Map of Landfill and WWTP site.
- Measuring tapes for measuring the diameter of each tree of breath height (cycle).
- Measuring tapes for measuring each plot's size.
- Compass; for navigation of plot measuring (North)

### **D. Data analysis**

The principal/purpose of this study was to checklist vegetation species that present in landfills and WWTP sites. All vegetation species were entered into Excel and R programs (Pin et al., 2013; M. Rejou-Mechain et al., 2017). We also provided local status (Cambodia) and international status by International Union Conservation for Nature (IUCN red list).

#### **4.5.3.2.2 Fauna**

##### **4.5.3.2.2.1 Mammal and bird**

#### **A. Line transect surveys**

A total of 3 line transects ranging in Landfill and WWTP site with an average 250-300m (Figure 4.5.3.2.2-1 A and Figure 4.5.3.2.2-1 B) were randomly placed in the study area to record the number of large mammals (i.e., red muntjac, wild pig, etc.) and bird species within the study area following the method used to estimate large density ungulates and tropical forest bird community (Gray et al. 2012, Gale et al. 2009).

Two teams of three/four surveyors have walked the transects and conducted the point transect one time a day (start at 0600hr in the morning or 1600hr in the late afternoon) to record data of mammals and bird species. Handheld GPS devices, compass, and ranger finders were used to measure the UTM of sighting animals, the angle from surveyors to the animal, and to measure the distance to the animals, respectively.



Figure 4.5.3.2.2-1 A: Map of a line-transects survey of the proposed landfill



(Source, KCC Sept.2020)

Figure 4.5.3.2.2-1 B: Map of a line-transects survey of proposed WWTP



(Source, KCC Sept.2020)

## **B. Interviews with Local People**

In addition to the standard method we use to survey wildlife above, we will also collect information about wildlife within the study area and its adjacent areas from the opportunistic interview. We conducted a flash interview with local people such as the elderly regarding species that believe to be present in the area and collect documentation of historical records of wildlife species.

### **5.3.2.2.2 Amphibian and Reptile**

Due to the proposed landfill is rice fields were presented of water during the period of survey (September 2020), so some reptile and amphibians are active during the day and some action at night then the group of three researchers has been done during the daytime and at night after the rain.

The search was mostly along rice puddle field boundaries (small dike) with some vegetation and scattered trees, which are potential for finding reptiles and amphibians. Opportunistic searches for amphibians and reptiles were undertaken by slow-walking searching on the ground, grasses, vegetation, and visual/watch on the trees.

Most species that we found were caught, photographed, and released unharmed. Amphibians and reptiles were identified by using field guides to amphibians of Cambodia (Neang & Holden, 2008), the reptiles of Southeast Asia (Das, 2015).

### **5.3.2.2.3 Bat**

#### **A. Live Sampling**

The bat survey was depending on suitable places of potential to capture bats. The sampling was comprised of 6 mist nets. However, in a given area, there is relatively open space with shrub and farmland. The survey was conducted during the whole nighttime in the rainy season (September 5, 2020).

Different species of bats are evolved to adapt to different environmental factors, therefore equip with different senses and skills for researching food, escaping predators, mating, etc. Hence, using a mist net and harp traps is more effective in capturing different species of bats in an open area (Francis 1989, Berry et al. 2004). Mist nets were opened from 5:30—22:00pm.

All captured bats were measured, photographed, recorded echolocation calls, and identified into species in the field using a field guide and series of published papers (e.g., Francis 2008, Kruskop 2013).

#### **B. Interviews with Local People**

Interviews with local people were conducted to determine whether any significant bat colonies are roosting near the project site.

All measured data were analyzed and used to verify species identification. The conservation status of all recorded bat species during the research survey was determined using IUCN (2017) with additional publication from the region.

## 4.5.4 Finding

### 4.5.4.1 Flora

#### 4.5.4.1.1 Literature Review

##### Landfill site

Cambodian forests are dominated by species of Dipterocarpaceae, Leguminosae, Lythraceae, or Fagaceae, and in some places Pinaceae, Podocarpaceae, or bamboo. Lowland floras of Cambodia are typical of the Indochinese Floristic Province (and as such, contrasts with that of Chinese, Indo-Burmese, and Indo-Malayan Biogeographical Provinces), whilst the highland floras share a closer affinity with those of the Indo-Malayan region (Dy Phon 1982). The Land Field site is in the northwestern lowland vegetation species, potential forest gene conservation areas (Cheang et al., 2004), are including; Amblyoponinae, Cerapachyinae, Dolichoderinae, Ectatomminae, Formicinae, Myrmicinae, Ponerinae, Proceratiinae, Pseudomyrmecinae (Hosoishi et al., 2017).

However, characterized as deciduous dipterocarp forest, which is tree vegetation typically with an open canopy combined with a grassy ground layer. Given extensive deforestation and expansion of agricultural activities, there is no forest vegetation in the subproject areas. There have been local settlements, and some trees of economic value are including; banana, papaya, mango, and coconut (ADB., 2012).

##### WWTP site

Cambodian forests are dominated by species of Dipterocarpaceae, Leguminosae, Lythraceae, or Fagaceae, and in some places Pinaceae, Podocarpaceae, or bamboo. Lowland floras of Cambodia are typical of the Indochinese Floristic Province (and as such, contrasts with that of Chinese, Indo-Burmese, and Indo-Malayan Biogeographical Provinces), whilst the highland floras share a closer affinity with those of the Indo-Malayan region (Dy Phon 1982). The WWTP site is in the northwestern lowland vegetation species, potential forest gene conservation areas (Cheang et al., 2004), are including; Amblyoponinae, Cerapachyinae, Dolichoderinae, Ectatomminae, Formicinae, Myrmicinae, Ponerinae, Proceratiinae, Pseudomyrmecinae (Hosoishi et al., 2017). But ADB (2019) working group was a record of some in deciduous dipterocarp forest, which is tree vegetation typically with an open canopy combined with a grassy ground layer.

#### 4.5.4.1.2 Field Inventory

##### Landfill site

Our result suggested that among 2 plots and 4 subplots that selected for the tree/vegetation inventory in the project area (LF) site of approximately 20ha. The result was indicated 11 different species, and 9 families which mostly are common species in the local status, except for *Pterocarpus pedatus*, *Pierre* was listed in Endangered (En) species, and Least concern (LC) are including; *Microcos tomentosa*, *Bombax ceiba*, *Azadirachta indica*, *Streblus asper* of IUCN red list 2020.

Our result showed that a number of *Microcos tomentosa* is dominant species, which was a total number of 13 seedlings (Dbh<5cm), while *Azadirachta indica* was 5 stems (Dbh>5cm) and 5 seedlings (Dbh<5cm) and *Sindora cochinchinensis*, *Baill* was 8 seedlings (Dbh<5cm) (Table 5.4.1-1, Figure 5.4.1-1). Therefore, we also recorded *Wrightia arborea*, *Clausena excavata* var.

*villosa*, *Aganonerion polymorphum* Pierre, *Bombax ceiba*, *Spondias malayana*, *Pterocarpus pedatus*, Pierre, *Shorea roxburghii*, G.Don., *Streblus asper*.

In Table 4.5.4.1.2-1 Species list and structural summary based on inventorying all stems >5 cm dbh and dbh< 5 cm for understory count in all plots with IUCN Red-list, and Local grade (MAFF).

Table 4.5.4.1.2-1: Species list and structural summary

No	Scientific_name	Family	# of vegetation		Grade	IUCN 2020
			Dbh>5cm	Dbh<5 cm		
1	<i>Pterocarpus pedatus</i> , Pierre	Papilionaceae	1		Luxury	En
2	<i>Shorea roxburghii</i> , G.Don.	Dipterocarpaceae	1		1	
3	<i>Sindora cochinchinensis</i> , Baill.	Caesalpiniaceae		8	1	
4	<i>Microcos tomentosa</i>	Tiliaceae		13	nc	LC
5	<i>Wrightia arborea</i>	Apocynaceae		3	nc	
6	<i>Clausena excavata</i> var. <i>villosa</i>	Rutaceae		3	nc	
7	<i>Bombax ceiba</i> or <i>Bombax malabaricum</i>	Bombacaceae	1	1	Medical Plants	LC
8	<i>Spondias malayana</i> or <i>Spondias pinnata</i>	Anacardiaceae	1		Medical Plants	
9	<i>Azadirachta indica</i>	Meliaceae	5	5	Medical Plants	LC
10	<i>Streblus asper</i>	Moraceae		1	Medical Plants	LC
11	<i>Aganonerion polymorphum</i> Pierre	Apocynaceae		2	Climber	
Total			9	36		

**Note;** - IUCN: Endangered "En", Least concern "LC"

- Local grade: Luxury "Lux", First grade "1", Non grade "nc", Unknown species "NA", Climber, Shrub

Figure 4.5.4.1.2-1: Number of vegetation species blue color (dbh >5 cm) and yellow color (dbh<5cm) with standard error (dark grey)



## WWTP site

Our result suggested that among 2 plots and 4 subplots selected for the tree/vegetation inventory in the project area (WWTP) of approximately 12ha. The result was indicated 11 different species and 11 families who are most common in the local status, except for *Pterocarpus pedatus*, Pierre has listed in Endangered (En) species of IUCN red list 2020.

The result showed that the number of *Combrctum quadrangulare* is the dominant species, which was the total number of 15 stems (Dbh>5cm), and 10 seedlings (Dbh<5cm). Therefore, we also recorded *Peltophorum dasyrrhachis* Kurz, var, *Dalbergia nigrescens* Kurz, *Litsca glutinosa*, *Bridelia ovata* var. *curtisii*, *Amphineurion marginatum* (Roxb.) D.J.Middleton, *Passiflora foetida*, *Steptocaulon juvenas*, *Ellipeiopsis cherrevensis* (Pierre ex Finet & Gagnep.), *Chromolaena odorata* (Table 5.4.1-2, Figure 5.4.1-2). In Table 5.4.1-2 Species list and structural summary based on inventorying all stems >5 cm dbh and dbh< 5 cm for understory count in all plots with IUCN Red-list, and Local grade (MAFF).

Table 4.5.4.1.2-2: Species list and structural summary

No	Scientific_name	Family	# of tree species		Grade	IUCN
			Dbh>5cm	Dbh<5 cm		
1	<i>Pterocarpus pedatus</i> , Pierre	Papilionaceae	3		Luxury	En
2	<i>Peltophorum dasyrrhachis</i> Kurz, var	Caesalpiniaceae		1	1	
3	<i>Dalbergia nigrescens</i> Kurz	Fabaceae	1		nc	
4	<i>Combrctum quadrangulare</i>	Combretaceae	15	10	Medical Plants	
5	<i>Litsca glutinosa</i>	Lauraceae		1	Medical Plants	
6	<i>Bridelia ovata</i> var. <i>curtisii</i>	Euphorbiaceae		4	Climber	
7	<i>Amphineurion marginatum</i> (Roxb.) D.J.Middleton	Apocynaceae		1	Climber	
8	<i>Passiflora foetida</i>	Passifloraceae		3	Climber	
9	<i>Steptocaulon juvenas</i>	Asclepiadaceae		2	Climber	
10	<i>Ellipeiopsis cherrevensis</i> (Pierre ex Finet & Gagnep.)	Annonaceae		5	Climber	
11	<i>Chromolaena odorata</i>	Compositae		2	shrub	

Table 4.5.4.1.2-3: Number of vegetation species grey color( dbh &gt;5 cm) and yellow color (dbh&lt;5cm) with standard error (dark grey)



#### 4.5.4.1.3 The estimation of vegetations

##### Landfill site

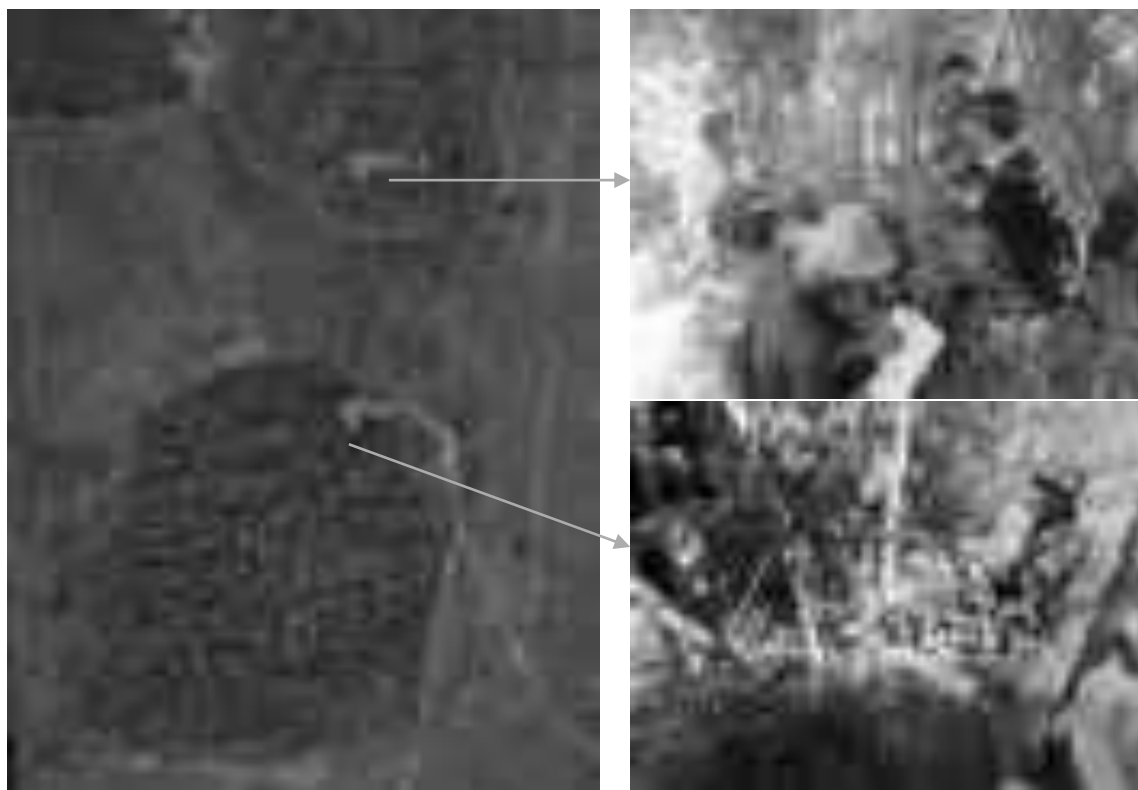
Based on the two plots survey, it can estimate the total number of the tree, diameter > 5cm, will be cut in the proposed landfill area of 20ha. From Table 4.5.4.1.3-1 is showed that the vegetation estimation with Dbh>5 cm in average number of 1,800 ( $\pm 200$ ) stems/ha with average volume of 78.29 ( $\pm 12.92$ ) m<sup>3</sup>/ha, within 1,600 stems/ha (plot\_1), and 2,000 stems/ha (plot\_2).

However, the proposed landfill site is forest/vegetation cover about 5% of the total area of only 1ha, Figure 4.5.4.1.3-1. Therefore, the total tree numbers will be cut in the whole proposed landfill area is 1,800 stems. According to the previous projects such as Sesan Hydropower, Nation Raod No 48, the MAFF forestry conservation team indicated that anyone who cut 1 tree needs to replant 1 tree, so the new development landfill here will require to compensate as replant trees with a total number of **1,800 trees**.

Table 4.5.4.1.3-1: The vegetation estimation per hectare with standard errored (SE $\pm$ )

Plots	Dbh>5cm in all plots		Dbh>5cm/ha	
	# Stems	Volume (m <sup>3</sup> )	# Stems/ha	Volume (m <sup>3</sup> /ha)
Plot_1	4	0.16	1,600	65.37
Plot_2	5	0.23	2,000	91.20
Total	9	0.391	3,600	156.57
Mean/Average			<b>1,800</b>	<b>78.29</b>
SE $\pm$			<b>200</b>	<b>12.92</b>

Figure 4.5.4.1.3-1: Forest coverage in the proposed landfill site



## WWTP site

Based on the three plots survey, it can estimate the total number of the tree, diameter > 5cm, will be cut in the WWTP site of 12ha. From Table 4.5.4.1.3-2 is showed that the vegetation estimation with Dbh>5 cm in average number of 3,800 ( $\pm 200$ ) stems/ha (*Melaleuca quinquenervia*<sup>2</sup> is dominant species) with average volume of 180.96 ( $\pm 0.87$ ) m<sup>3</sup>/ha, within 4,000 stems/ha (plot\_1), and 3,600 stems/ha (plot\_2).

However, the proposed WWTP site had forest/vegetation coverage of about 1% (at the dike and small mound) of the total area of only 0.12ha. Therefore, the total tree numbers that will be cut in the whole proposed WWTP area is only 456 stems. (Figure 4.5.4.1.3-2). According to the previous projects such as Sesan Hydropower, Nation Raod No.48 project, the MAFF forestry conservation team indicated that anyone who cut 1 tree needs to replant 1 tree, so the new development landfill here will require to compensate as replant trees with a total number of **456 trees**.

Table 4.5.4.1.3-2: The vegetation estimation per hectare with standard errored (SE $\pm$ )

Plots	Dbh>5cm in all plots		Dbh>5cm/ha	
	# Stems	Volume (m <sup>3</sup> )	# Stems/ha	Volume (m <sup>3</sup> /ha)
Plot_1	10	0.45	4,000	181.83
Plot_2	9	0.45	3,600	180.09
Total	19	0.90	7,600	361.92
Mean/Average			<b>3,800</b>	<b>180.96</b>
SE $\pm$			<b>200</b>	<b>0.87</b>

Figure 4.5.4.1.3-2: Forest coverage in the proposed WWTP site



<sup>2</sup> *Melaleuca quinquenervia* that classed in third grade by MAFF

#### 4.5.4.2 Fauna

##### 4.5.4.2.1 Mammal and Bird

#### A. Line transects survey

##### Landfill site

We surveyed 3 transects with a total of 740 m. We recorded three small mammals' species and 23 bird species (20 of them are listed as Least Concern, and two listed as Near Threatened in the IUCN Red listed species) (Table 4.5.4.2.1-1).

Table 4.5.4.2.1-1: Species recorded on the line transects at the landfill site

No.	Common name	Scientific Name	IUCN 2020
<b>Mammals</b>			
1	Berdmore's Squirrel	<i>Menetes berdmorei</i>	LC
2	Grey-bellied Squirrel	<i>Callosciurus caniceps</i>	LC
3	Northern Treeshrew	<i>Tupaia belangeri</i>	LC
<b>Birds</b>			
1	Common Flameback	<i>Dinopium javanense</i>	LC
2	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC
3	Scaly-breasted Munia	<i>Lonchura punctulata</i>	LC
4	Black-crested bulbul	<i>Pycnonotus flaviventris</i>	LC
5	Black Bulbul	<i>Hypsipetes leucocephalus</i>	LC
6	Crested Treeswift	<i>Hemiprocne coronata</i>	LC
7	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	LC
8	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC
9	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC
10	Crimson Sunbird	<i>Aethopyga siparaja</i>	LC
11	Black-naped Oriole	<i>Oriolus chinensis</i>	LC
12	White-rumped Shama	<i>Copsychus malabaricus</i>	LC
13	Oriental Dollarbird	<i>Eurystomus orientalis</i>	LC
14	Greater Racket-tailed drongo	<i>Dicrurus paradiseus</i>	
15	White-rumped Pygmy-falcon	<i>Polihierax insignis</i>	NT
16	Blossom-headed Parakeet	<i>Psittacula roseata</i>	NT
17	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	LC
18	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC
19	Red-collared Dove	<i>Streptopelia tranquebarica</i>	LC
20	Asian openbill	<i>Anastomus oscitans</i>	LC
21	Common myna	<i>Acridotheres tristis</i>	LC
22	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	LC
23	Lesser Whistling-duck	<i>Dendrocygna javanica</i>	LC

**Note:** Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Figure 4.5.4.2.1-1: Line transect surveys activity at the landfill site





## WWTP site

We surveyed 3 transects with a total of 740 m. We recorded three small mammals' species and 25 bird species (22 of them are listed as Least Concern, and two listed as Near Threatened in the IUCN Red listed species).

Table 4.5.4.2.1-2: Species recorded on the line transects at the WWTP site

No.	Common name	Scientific Name	IUCN status
<b>Mammals</b>			
1	Red muntjac	<i>Muntiacus vaginalis</i>	LC
2	Grey-bellied Squirrel	<i>Callosciurus caniceps</i>	LC
3	Northern Treeshrew	<i>Tupaia belangeri</i>	LC
<b>Birds</b>			
1	Common Flameback	<i>Dinopium javanense</i>	LC
2	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC
3	Scaly-breasted Munia	<i>Lonchura punctulata</i>	LC
4	Black-crested bulbul	<i>Pycnonotus flaviventris</i>	LC
5	Black Bulbul	<i>Hypsipetes leucocephalus</i>	LC
6	Crested Treeswift	<i>Hemiprocne coronata</i>	LC
7	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	LC
8	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC
9	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC
10	Crimson Sunbird	<i>Aethopyga siparaja</i>	LC
11	Black-naped Oriole	<i>Oriolus chinensis</i>	LC
12	White-rumped Shama	<i>Copsychus malabaricus</i>	LC
13	Oriental Dollarbird	<i>Eurystomus orientalis</i>	LC
14	Greater Racket-tailed drongo	<i>Dicrurus paradiseus</i>	
15	White-rumped Pygmy-falcon	<i>Polihierax insignis</i>	NT
16	Blossom-headed Parakeet	<i>Psittacula roseata</i>	NT
17	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	LC
18	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC
19	Red-collared Dove	<i>Streptopelia tranquebarica</i>	LC
20	Asian openbill	<i>Anastomus oscitans</i>	LC
21	Common myna	<i>Acridotheres tristis</i>	LC
22	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	LC
23	Spotted Owlet	<i>Athene brama</i>	LC
24	Common Barn-owl	<i>Tyto alba</i>	
25	Little Cormorant	<i>Microcarbo niger</i>	LC

**Note:** Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Figure 4.5.4.2.1-2: Line transect surveys activity (left) and species captured by the camera (right) of the WWTP site.



(Source, FF survey team Sept.2020)

## B. Interviews with Local People

### Landfill site

We interviewed one villager, a 39-year-old man resident near the study area. Results from interviews show that in the project area and the vicinity of the project, there are 62 species of wildlife, including nine mammals (eight are listed as Least Concern LC in the IUCN Red List), and 54 birds species (four species are Near Threaten NT, and six species are Vulnerable) (Table 4.5.4.2.1-3).

Table 4.5.4.2.1-3: Species list of wild animals obtain from interview result at the landfill site

No.	Common name	Scientific Name	IUCN 2020
<b>Mammals</b>			
1	Wild pig	<i>Sus scrofa</i>	LC
2	Red muntjac	<i>Muntiacus vaginalis</i>	LC
3	Small Asian Mongoose	<i>Herpestes javanicus</i>	LC
4	Crab-eating Mongoose	<i>Herpestes urva</i>	LC
5	Bermore's Squirrel	<i>Menetes bermorei</i>	LC
6	Grey-bellied Squirrel	<i>Callosciurus caniceps</i>	LC
7	Northern Treeshrew	<i>Tupaia belangeri</i>	LC
8	Burmese hare	<i>Lepus peguensis</i>	LC
<b>Birds</b>			
1	Yellow-footed Green Pigeon	<i>Treron curvirostra</i>	LC
2	Oriental Pied Hornbill	<i>Anthraceroceros albirostris</i>	LC
3	Wreathed Hornbill	<i>Rhyticeros undulatus</i>	VU
4	Common Flameback	<i>Dinopium javanense</i>	LC
5	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC
6	Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	VU
7	Red-collared Woodpecker	<i>Picus rabieri</i>	NT
8	Intermediate Egret	<i>Ardea intermedia</i>	LC
9	Cattal Egret	<i>Bubulcus ibis</i>	LC
10	Yellow Bittern	<i>Ixobrychus sinensis</i>	LC
11	Little Egret	<i>Egretta garzetta</i>	LC
12	Javan Pond Heron	<i>Ardeola speciosa</i>	LC
13	Black Drongo	<i>Dicrurus macrocercus</i>	LC
14	Common Myna	<i>Acridotheres tristis</i>	LC
15	White-vented Myna	<i>Acridotheres grandis</i>	LC
16	Common Hill Myna	<i>Gracula religiosa</i>	LC
17	Black-collared starling	<i>Gracupica nigricollis</i>	LC
18	Scaly-breasted Munia	<i>Lonchura punctulata</i>	LC
19	Oriental Magpie robin	<i>Copsychus saularis</i>	LC
20	Black-capped Kingfisher	<i>Halcyon pileata</i>	LC
21	Black-crested bulbul	<i>Pycnonotus flaviventris</i>	LC
22	Black Bulbul	<i>Hypsipetes leucocephalus</i>	LC
23	Crested Treeswift	<i>Hemiprocne coronata</i>	LC
24	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	LC
25	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC
26	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC
27	Crimson Sunbird	<i>Aethopyga siparaja</i>	LC
28	Black-naped Oriole	<i>Oriolus chinensis</i>	LC
29	Red-vented Barbet	<i>Psilopogon lagrandieri</i>	LC
30	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	LC
31	White-rumped Shama	<i>Copsychus malabaricus</i>	LC
32	Oriental Dollarbird	<i>Eurystomus orientalis</i>	LC
33	Greater Racket-tailed drongo	<i>Dicrurus paradiseus</i>	
34	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	LC
35	Chinese FRANCOLIN	<i>FRANCOLINUS pintadeanus</i>	LC
36	White-rumped Pygmy-falcon	<i>Polihierax insignis</i>	NT
37	Red Junglefowl	<i>Gallus gallus</i>	LC

38	Coral-billed Ground-cuckoo	<i>Carpococcyx renauldi</i>	VU
39	Red-billed Blue Magpie	<i>Urocissa erythroryncha</i>	LC
40	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC
41	Lesser adjutant	<i>Leptoptilos javanicus</i>	VU
42	Asian Openbill	<i>Anastomus oscitans</i>	LC
43	Racquet-tailed Treepie	<i>Crypsirina temia</i>	LC
44	Green Imperial pigeon	<i>Ducula aenea</i>	LC
45	Asian Barred Owlet	<i>Glaucidium cuculoides</i>	LC
46	Brown Wood-owl	<i>Strix leptogrammica</i>	LC
47	Spotted-bellied Eagle-owl	<i>Bubo nipalensis</i>	LC
48	Common Barn-owl	<i>Tyto alba</i>	LC
49	Blossom-headed Parakeet	<i>Psittacula roseata</i>	NT
50	Alexadrine Parakeet	<i>Psittacula eupatria</i>	NT
51	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	LC
52	Crested Serpent Eagle	<i>Spilornis cheela</i>	LC
53	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC
54	Red-collared Dove	<i>Streptopelia tranquebarica</i>	LC

**Note:** Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Figure 4.5.4.2.1-3: Activity of interview local people about wildlife in the study area of the landfill site



(Source, FF survey team Sept.2020)

### WWTP site

We interviewed 1 villager, a 56-year-old man resident near the study area. Results from interviews show that in the project area and the vicinity of the project, there are 61 species of wildlife, including seven mammals (six are listed as Least Concern LC and one listed as Vulnerable in the IUCN Red List), and 54 birds species (four species are Near Threaten NT, and six species are Vulnerable) (Table 4.5.4.2.1-3).

Table 4.5.4.2.1-3: Species list of wild animals obtain from interview result at the WWTP site

No.	Common name	Scientific Name	IUCN
<b>Mammals</b>			
1	Long-tailed Macaque	<i>Macaca fascicularis</i>	VU
2	Small Asian Mongoose	<i>Herpestes javanicus</i>	LC
3	Crab-eating Mongoose	<i>Herpestes urva</i>	LC
4	Berdmore's Squirrel	<i>Menetes berdmorei</i>	LC
5	Grey-bellied Squirrel	<i>Callosciurus caniceps</i>	LC
6	Northern Treeshrew	<i>Tupaia belangeri</i>	LC
7	Burmese hare	<i>Lepus peguensis</i>	LC
<b>Birds</b>			
1	Yellow-footed Green Pigeon	<i>Treron curvirostra</i>	LC
2	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	LC

3	Wreathed Hornbill	<i>Rhyticeros undulatus</i>	VU
4	Common Flameback	<i>Dinopium javanense</i>	LC
5	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC
6	Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	VU
7	Red-collared Woodpecker	<i>Picus rabieri</i>	NT
8	Intermediate Egret	<i>Ardea intermedia</i>	LC
9	Cattle Egret	<i>Bubulcus ibis</i>	LC
10	Yellow Bittern	<i>Ixobrychus sinensis</i>	LC
11	Little Egret	<i>Egretta garzetta</i>	LC
12	Javan Pond Heron	<i>Ardeola speciosa</i>	LC
13	Black Drongo	<i>Dicrurus macrocercus</i>	LC
14	Common Myna	<i>Acridotheres tristis</i>	LC
15	White-vented Myna	<i>Acridotheres grandis</i>	LC
16	Common Hill Myna	<i>Gracula religiosa</i>	LC
17	Black-collared starling	<i>Gracupica nigricollis</i>	LC
18	Scaly-breasted Munia	<i>Lonchura punctulata</i>	LC
19	Oriental Magpie robin	<i>Copsychus saularis</i>	LC
20	Black-capped Kingfisher	<i>Halcyon pileata</i>	LC
21	Black-crested bulbul	<i>Pycnonotus flaviventris</i>	LC
22	Black Bulbul	<i>Hypsipetes leucocephalus</i>	LC
23	Crested Treeswift	<i>Hemiprocne coronata</i>	LC
24	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	LC
25	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC
26	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC
27	Crimson Sunbird	<i>Aethopyga siparaja</i>	LC
28	Black-naped Oriole	<i>Oriolus chinensis</i>	LC
29	Red-vented Barbet	<i>Psilopogon lagrandieri</i>	LC
30	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	LC
31	White-rumped Shama	<i>Copsychus malabaricus</i>	LC
32	Oriental Dollarbird	<i>Eurystomus orientalis</i>	LC
33	Greater Racket-tailed drongo	<i>Dicrurus paradiseus</i>	
34	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	LC
35	Chinese Francolin	<i>Francolinus pintadeanus</i>	LC
36	White-rumped Pygmy-falcon	<i>Polihierax insignis</i>	NT
37	Red Junglefowl	<i>Gallus gallus</i>	LC
38	Coral-billed Ground-cuckoo	<i>Carpococcyx renauldi</i>	VU
39	Red-billed Blue Magpie	<i>Urocissa erythroryncha</i>	LC
40	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC
41	Lesser adjutant	<i>Leptoptilos javanicus</i>	VU
42	Asian Openbill	<i>Anastomus oscitans</i>	LC
43	Racquet-tailed Treepie	<i>Crypsirina temia</i>	LC
44	Green Imperial pigeon	<i>Ducula aenea</i>	LC
45	Asian Barred Owlet	<i>Glaucidium cuculoides</i>	LC
46	Brown Wood-owl	<i>Strix leptogrammica</i>	LC
47	Spotted-bellied Eagle-owl	<i>Bubo nipalensis</i>	LC
48	Common Barn-owl	<i>Tyto alba</i>	LC
49	Blossom-headed Parakeet	<i>Psittacula roseata</i>	NT
50	Alexandrine Parakeet	<i>Psittacula eupatria</i>	NT
51	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	LC
52	Crested Serpent Eagle	<i>Spilornis cheela</i>	LC
53	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC
54	Red-collared Dove	<i>Streptopelia tranquebarica</i>	LC

**Note:** Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

Figure 4.5.4.2.1-4: Activity of interview local people about wildlife in the study area of the WWTP site



(Source, FF survey team Sept.2020)

#### 4.5.4.2.2 Amphibian and Reptile

##### Landfill site

A total of 14 herpetofauna, comprising 7 amphibians (arranged by three families and six genera) and 4 reptiles (arranged by 3 families and 4 genera) were recorded from the survey area. In this result, there are 7 toad and frogs, 1 skink, 2 geckos, and 1 snake. This result shows a very low diversity of herpetofauna due to it is just a rice paddle field with some bamboo and trees.

Table 4.5.4.2.2-1: Herpetofauna species known to exist at the survey of the landfill site

Scientific names	English name	IUCN status
<b>Amphibians</b>		
<b>Bufonidae</b>		
<i>Duttaphrynus melanostictus</i>	Common Asian toad	LC
<b>Microhylidae</b>		
<i>Kaloula pulchra</i>	Common Asian bullfrog	LC
<i>Microhyla fissipes</i>	Ornate narrow mouth frog	LC
<i>Microhyla pulchra</i>	Beautiful narrow mouth frog	LC
<b>Dicroglossidae</b>		
<i>Fejervarya limnocharis</i>	Paddy frog	LC
<i>Hoplobatrachus rugulosus</i>	Rugulose bullfrog	LC
<i>Occidozyga lima</i>	Green floating frog	LC
<b>Subtotal=7 species</b>		
<b>Reptiles</b>		
<b>Gekkonidae</b>		
<i>Dixonius siamensis</i>	Siamese leaf-toed gecko	LC
<i>Hemiphyllodactylus sp.</i>		NE
<b>Scincidae</b>		
<i>Eutropis macularia</i>	Speckled forest skink	NE
<b>Snakes</b>		
<b>Colubridae</b>		
<i>Chrysopelea ornata</i>	Golden tree snake	LC
<b>Subtotal of 4 species</b>		
<b>Total of 11</b>		

**Note:** Endangered (EN); Vulnerable (VU); Data Deficient (DD); Near threatened (NT); Least concern (LC); Not evaluated (NE).

From the survey, there are 7 amphibian species which are commonly seen most part of the country and region. All of them are listed as Least Concern by IUCN (2020). There 4 reptile species, including snake, geckos, and skink. All of them are listed as Not evaluated and Least Concern.

Figure 4.5.4.2.1-5: The seven recorded amphibians from the survey at the landfill site.  
(A) *Duttaphrynus melanostictus*, (B) *Kaloula pulchra*, (C) *Microhyla pulchra*, (D) *Microhyla fissipes*, (E) *Fejervarya limnocharis*, (F) *Hoplobatrachus rugulosus*, (G) *Occidozyga lima*



A: *Duttaphrynus melanostictus*



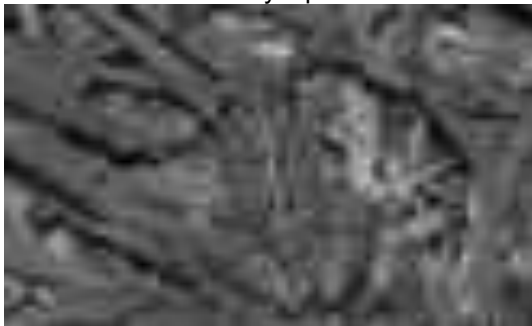
B: *Kaloula pulchra*



C: *Microhyla pulchra*



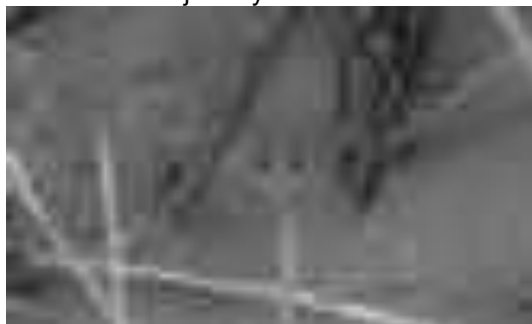
D: *Microhyla fissipes*



E: *Fejervarya limnocharis*



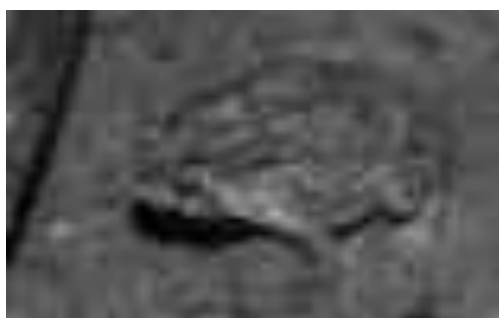
F: *Hoplobatrachus rugulosus*



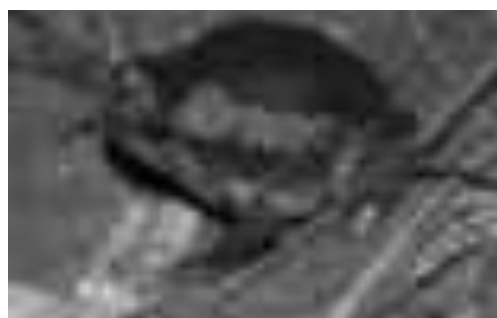
G: *Occidozyga lima*

(Source, FF survey team Sept.2020)

Figure 4.5.4.2.1-7: The eight Amphibians species record from the survey at the WWTP site:  
(A) *Duttaphrynus melanostictus*, (B) *Kaloula pulchra*, (C) *Microhyla pulchra*, (D) *Microhyla fissipes*, (E)  
*Fejervarya limnocharis*, (F) *Hoplobatrachus rugulosus*, (G) *Occidozyga lima*



A: *Duttaphrynus melanostictus*



B: *Kaloula pulchra*



C: *Microhyla pulchra*



D: *Microhyla fissipes*



E: *Fejervarya limnocharis*



F: *Hoplobatrachus rugulosus*



G: *Occidozyga lima*

(Source, FF survey team Sept.2020)

Figure 4.5.4.2.1-8: Recorded reptiles from the survey of the WWTP site:  
(A) *Calotes versicolor*, (B) *Dixonius siamensis*, (C) *Hemiphyllodactylus sp.*, (D) *Eutropis macularia*, (E) *Trimeresurus albolabris*, while other two species did not capture for a photograph



A: *Calotes versicolor*



B: *Dixonius siamensis*



C: *Hemiphyllodactylus sp.*



D: *Gekko gecko*



E: *Eutropis macularia*



F: *Trimeresurus albolabris*

(Source, FF survey team Sept.2020)

#### 4.5.4.2.3 Bat

During the rainy season survey, a total of 1,102 mist net-hours sampling were achieved at sampling locations. The sampling areas are located at a low altitude of less than 10m in a low land area surrounded by rice paddy fields and villages. Most habitats are shrub-covered by short vegetation near the stream. Trees are short, ranging from approximately 1-4 meters in height.

The weather is hot during the daytime, smoke from nearby burning, and there was some rain at the end of survey time.

##### A. Live Sampling

##### Landfill site

Over the sampling period, there was no bat captured even we saw a few bats flights high at the open area. The bats were flying high in an open area and could not know what group of the bat.



## WWTP site

Over the sampling period, there was no bat captured even we saw a few bats flights high at the open area. The bats that were flying in the open area probably *Cynopterus cf. sphinx* due to their flown direction to the village, which available ripe fruit trees.

## B. Interviews

### Landfill site

As there were not many local people available for interview within the study area, the interviews were undertaken with one company staff who look after the land. Anyways, he doesn't know any presence of bat roost around the site.

### WWTP site

As there were not many local people available for interviews within the study area, the interviews were undertaken with five people who live near there. Among them, no one knows any presence of bat roost around the site.

## C. Conservation Significance

*Cynopterus sphinx* is a fruit bat species which likely to fly around ripe fruit trees as the forage fruits.

## 4.5.5 Discussion

### 4.5.5.1 Flora

#### Landfill site

Land Field species have been 11 species and 9 families in plot inventories. Furthermore, our result showed that *Microcos tomentosa* is dominant species. Therefore, we also recorded of *Azadirachta indica*, *Sindora cochinchinensis*, *Wrightia arborea*, *Clausena excavata* var. *villosa*, *Aganonerion polymorphum* Pierre, *Bombax ceiba*, *Spondias malayana*, *Pterocarpus pedatus* Pierre (1 stem), *Shorea roxburgshii*, G.Don., *Streblus asper*.

However, Our result was supported of ADB (2012) working group that tree vegetation in paddy dikes typically with an open canopy combined with a grassy ground layer where is dominated by agriculture, forest, and grassland in LS site during the conducted survey.

#### WWTP site

WWTP species have been 11 species and 11 families in plot inventories. Furthermore, our result showed that *Combrctum quadrangulare* is the dominant species. Therefore, we also recorded *Peltophorum dasyrrhachis* Kurz, var, *Dalbergia nigrescens* Kurz, *Litsca glutinosa*, *Bridelia ovata* var. *curtisii*, *Amphineurion marginatum* (Roxb.) D.J.Middleton, *Passiflora foetida*, *Steptocaulon juvenas*, *Ellipeiopsis cherrevensis* (Pierre ex Finet & Gagnep.), *Chromolaena odorata*. Waste Water Treatment Plant is a former wildlife sanctuary where was created in 199, and re-bordered in 2003, and than cancelation by Royal degree in 2018 causes of land-encroachments. So, might be diversity of tree species, while there have been of *Combrctum quadrangulare*, *Pterocarpus pedatus* Pierre (3 stems), *Dalbergia nigrescens* Kurz, *Ellipeiopsis cherrevensis* (Pierre ex Finet & Gagnep.), *Peltophorum dasyrrhachis* Kurz, var in paddy dikes base on observation during the conducted survey.

#### **4.5.5.2 Fauna**

##### **Landfill site**

In the project location, rabbits, deer, and wild pig are present in the open areas, but no rare or endangered species are recorded from recent times. A small number of bird species are identified, including the white heron, dove, wood-sparrow, and house sparrow (ADB, 2012). However, the area supports many wildlife species, including globally threatened species. The result from our study showed that in the project area and the vicinity of the project, there is a significant number of wildlife species, including birds, mammals, and primates, present in the area. At least two large mammals species (i.e., Red muntjac and wild pig) are reported to be present in the area.

We hope that the report on wildlife studies from the project area has contributed to the decisions regarding the implementation of the project, which will minimize the impact of this Landfill. In this regard, we would like to propose to the owners of this project, the Landfill, as well as its stakeholders, to protect the wildlife present in the area to the extent possible that it contributes to wildlife conservation in Cambodia.

##### **WWTP site**

The project locates in the former Roneam Duan Sam Wildlife Sanctuary; the area supports many wildlife species, including globally threatened species. The result from our study showed that in the project area and the vicinity of the project, there is a significant number of waterbird species present in the area. At least two globally threatened bird species, including White-rumped Pygmy-falcon (NT) and Blossom-headed Parakeet (NT), were recorded during the survey period. Only small mammals are reported to be present in the study area.

We hope that the report on wildlife studies from the project area has contributed to the decisions regarding the implementation of the project, which will minimize the impact of this WWTP. In this regard, we would like to propose to the owners of this project, the WWTP, as well as its stakeholders, to protect the wildlife present in the area to the extent possible that it contributes to wildlife conservation in Cambodia.

### **4.6 Cultural Heritage**

#### **4.6.1 Methodology**

To observe cultural heritage places around the projects (WWTP, Landfill, Stormwater drainage outlet), we consulted with the chief village and locale people to understand heritage places (temple, pagoda, sanctuary) 300 meters from the project area. Observation is one of the founding principles of the scientific method, and it can be a very effective tool for studying human-environment interactions around the project area.

#### **4.6.2 Finding**

According to the observation, we found that there is no cultural heritage place in the buffer zone 300 m of the project areas, according to the site observation and interview with the local people. The consultation with local authority members in August, Figure 4.6.2-1. The key results of the discussion meeting with stakeholders show in Table 4.6.2-1. The attendance lists enclose in an Annex 6.

Figure 4.6.2-1: Activities of consultation with local Authority



Consultation and field survey at the proposed landfill site



Consultation with Snagkat Nimmit's chief



Consultation and field survey at the proposed WWTP site  
(Source, FF survey team Sept.2020)

Table 4.6.2-1: Key discussion meeting with stakeholders at the community level

N.o	Name	Position/From	Opinion
1	Mr. Houl Samoun	Chief of Sangk Nimitt	- He said no heritage in the proposed site (temples, pagodas, ancient pond, ancient gave area, the archeological site within 300 meters from the proposed landfill site, and the proposed WWTP site.
2	Mr. Samnang	Deputy chief of Sorya village	<ul style="list-style-type: none"> <li>- Land uses surround the proposed landfill, though, accounts for up to 80% of cultivation, of which 75% are rice paddy fields and 5% are farmland. The proposed landfill site is around 1 km away from the land development project.</li> <li>- There are no schools, hospitals, and heritage sites that have been found in the buffer zone 300m from the proposed landfill site.</li> <li>- The settlement area is around 3km from the proposed site.</li> <li>- The primary school Ouvanghang is about 4km from the proposed site.</li> </ul>
3	Mr. Chea Nung	Chief of Reaksmey Sereypheap	- The proposed WWTP site is surrounding by agricultural land (paddy fields). It is situated on private land at 3-5\$ per 1m2.

		village	<ul style="list-style-type: none"> <li>- No households are living in the area of the buffer zone (300m). The settlements are situated at 1km, and a pagoda settled about 800m from the proposed WWTP site.</li> <li>- The pagodas, schools, hospitals, and heritage places were not found in the buffer zone of 300m.</li> </ul>
--	--	---------	--

## 4.7 Noise

### 4.7.1 Methodology

The noise survey has been conducted at the site by an expert at MoE's lab. The measurement conducted at the site of 1.2 meters above the ground is far within 2 meters from the walls and trees. To avoid any noise sources (dogs, bus/taxi station) have not been conducted. The map location of the sampling points is shown in Figure 4.7.1-1 and Figure 4.7.1-2.

Noise is also the factor that impacts the environment, so studying the area's existing noise level is very important. Noise may affect the people's living in the area, and the standard of noise and vibration varies from one country to another country, and Cambodia also has its standard. The measurement of noise is in DeciBels (dB(A)). According to sub-decree No 42 on the Control of Air Pollution and Noise Disturbances (2000).

Table 4.7.1-1: The maximum standard of noise level allowable in the public and residential area (dB(A))

No.	Location	Period f Times		
		06:00-18:00	18:00-22:00	22:00-06:00
1	Quiet Areas <ul style="list-style-type: none"> <li>- Hospitals</li> <li>- Libraries</li> <li>- School</li> <li>- Kindergarten</li> </ul>	45	40	35
2	Residential Areas <ul style="list-style-type: none"> <li>- Hotels</li> <li>- Administrative office</li> <li>- Villa, flat</li> </ul>	60	50	45
3	Commercial and Service Areas and Area of multiple businesses	70	65	50
4	Small industrial factories mingling in the residential area	75	70	50

Figure 4.7.1-1: The air quality and noise survey at the landfill site and three houses adjacent to the project site



(Source, AQ survey team Sept.2020)

Figure 4.7.1-2: The noise survey at the WWTP site and three houses adjacent to the project site



(Source, AQ survey team Sept.2020)

Figure 4.7.1-3: The noise survey at houses adjacent to the pumping stations



(Source, AQ survey team Sept.2020)

#### 4.7.2 Finding

The noise level measurement has been conducted in many different places of the project site, such as the landfill site and 4 houses close to the landfill site, the WWTP site, and 4 houses close to the WWTP site, the lift pumping station, and the main pumping station.

The landfill site's noise level is a maximum of 65.3 dB(A) between 11 and 12 o'clock and a minimum of 30.8 dB(A) between 14 and 15 o'clock. The average noise level 8 hours from 7 o'clock to 15 o'clock is 44.5 dB(A), while 61.4 dB(A) and 30.8 dB(A) are the maximum and minimum of the measurement. The noise disturbance standard is 70 dB(A) issued by MoE for the commercial and service areas with multiple businesses. The landfill area is an agricultural area and adjacent to urban development. The noise disturbance might cause by transportation, human activities, or natural. There is no significant impact from noise disturbance in the landfill area yet.

Table 4.7.2-1: The results of the noise level measurement at the landfill site

Time	Survey period	Noise Level dB(A)				Coordinate
		LAeq	Standard (Leq)*	Lmax	Lmin	
Day	7:00 - 8:00	46.5	70	64.9	33.0	0253325 E, 1513610 N
	8:00 - 9:00	40.5		53.9	32.9	
	9:00 - 10:00	40.3		54.4	31.7	
	10:00 - 11:00	44.2		62.2	31.6	
	11:00 - 12:00	47.5		65.3	37.1	
	12:00 - 13:00	44.2		62.9	30.9	
	13:00 - 14:00	48.8		65.4	37.7	
	14:00 - 15:00	43.9		62.4	30.8	
Average of 8 hours		44.5		61.4	33.2	

Source: (\*) Sub decree 42 on Air pollution control and noise disturbance, MoE 2000

The average noise level in one hour of the four houses close to the landfill is 45 dB(A). The maximum is around 64.3 dB(A) between 9:00 to 10:00, while the standard of noise disturbance is 70 dB(A) issued by MoE for the commercial and service areas. The noise disturbance at the settlements might cause human activities. The 4 house's average measured noise level indicates that house no 2 is the highest (47.2 dB(A)) compared to others, but the maximum noise level that has been noted is at home no 3. This result might fluctuate depending on the

activities or natural factors like a windy or barking dog. There is no concern about the noise disturbance yet at the house close to the landfill site.

Table 4.7.2-2: The results of the noise level measurement at the houses close to the landfill site

Location	Survey period	Noise Level dB(A)				Coordinate
		LAeq	Standard (Leq)*	Lmax	Lmin	
Near house # 1	7:00 - 8:00	44.2	70	59.7	34.2	0251770 E, 1514535 N
Near house # 2	8:00 - 9:00	47.2	70	62.1	37.1	0250679 E, 1513149 N
Near house # 3	9:00 - 10:00	41.4	70	64.3	33.2	0249446 E, 1511629 N
Near house # 4	10:00 - 11:00	39.7	70	56.3	31.2	0248804 E, 1508833 N

Source: <sup>(\*)</sup> Sub decree 42 on Air pollution control and noise disturbance, MoE 2000

The WWTP site's noise level is a maximum of 63 dB(A) between 10 and 11 o'clock and a minimum of 21.2 dB(A) between 13 and 14 o'clock. The average noise level 8 hours from 10 o'clock to 18 o'clock is 44.0 dB(A), while 58.8 dB(A) and 29.7 dB(A) are the maximum and minimum of the measurement. The WWTP area is agricultural, far away from the settlement. The average maximum noise level has been noted 46 dB(A) below the standard is 70 dB(A) issued by MoE for the commercial and service areas with multiple businesses. The noise disturbance might cause by the vehicle on the way, human activities, or natural. The main point sources of noise disturbance did not spot in this area. The noise disturbance might cause by human actions or natural. There is no significant impact from noise disturbance in the WWTP area yet.

Table 4.7.2-3: The results of the noise level measurement at the WWTP site

Time	Survey period	Noise Level dB(A)				Coordinate
		LAeq	Standard (Leq)*	Lmax	Lmin	
Day	10:00 - 11:00	44.2	70	63.6	32.9	0245404 E, 1503135 N
	11:00 - 12:00	45.2		62.6	27.8	
	12:00 - 13:00	41.8		51.5	32.2	
	13:00 - 14:00	39.6		58.0	21.2	
	14:00 - 15:00	44.4		58.2	30.6	
	15:00 - 16:00	45.7		60.8	30.7	
	16:00 - 17:00	46.0		61.4	30.7	
	17:00 - 18:00	44.2		53.9	31.4	
Average of 8 hours		44.0		58.8	29.7	

Source: <sup>(\*)</sup> Sub decree 42 on Air pollution control and noise disturbance, MoE 2000

The average noise level in one hour of the four houses close to the WWTP is 43 dB(A). The maximum is around 63.3 dB(A) between 12:00 to 13:00, while the standard of noise disturbance is 70 dB(A) issued by MoE for the commercial and service areas. The noise disturbance at the settlements might cause human activities. The 4 house's average measured noise level indicates that house no 2 is highest (46 dB(A)) compared to others, and the maximum noise level has been noted is at home no 2 also. The result indicates that the noise level at house no 2 is high while the maximum and minimum are 63.3 dB(A) and 38.4 dB(A). This result might be depending on the human activities in house no 2. The noise sources at house no 2 are unclear; however, noise disturbance at house no 2 is also below the noise disturbance standard. The noise level of houses close to the WWTP might fluctuate depending on the activities or natural factors like a windy or barking dog. The time of noise measurement is also a contribution to noise levels, such as the high level on 12 to 13 o'clock in the busy time for animal feeding or

barking dog. There is no concern about the noise disturbance yet at the house close to the WWTP site.

Table 4.7.2-4: The results of the noise level measurement at the houses close to the WWTP site

Location	Survey period	Noise Level dB(A)				Coordinate
		LAeq	Standard (Leq)*	Lmax	Lmin	
Near house # 1	11:00 - 12:00	44.1	70	57.0	31.2	0244627 E, 1502602 N
Near house # 2	12:00 - 13:00	46.0	70	63.3	38.4	0245001 E, 1501708 N
Near house # 3	13:00 - 14:00	41.4	70	59.3	34.5	0245425 E, 1501841 N
Near house # 4	14:00 - 15:00	42.1	70	59.3	32.3	0246327 E, 1502100 N

Source: <sup>(\*)</sup> Sub decree 42 on Air pollution control and noise disturbance, MoE 2000

The average noise level in one hour of the lift pump station and the main pumping station has been measured. The average noise level at the lift pumping station is 44.1 d(B)A that a maximum of 61.4 dB(A) and a minimum of 34.2 dB(A). The average noise level at the main pumping station is 45.5 d(B)A that a maximum of 64.7 dB(A), and a minimum of 39.4 dB(A). The standard of noise disturbance is 70 dB(A) issued by MoE to define the commercial and service areas and multiple businesses' areas. There is no concern about the noise disturbance yet.

Table 4.7.2-5: The results of the noise level measurement at the lift pumping station and main pumping station

Location	Survey period	Noise Level dB(A)				Coordinate
		LAeq	Standard (Leq)*	Lmax	Lmin	
Lift pumping station	15:00 - 16:00	44.1	70	61.4	34.2	0243144 E, 1507993 N
Main pumping station	16:00 - 17:00	45.5	70	64.7	39.4	0245119 E, 1505903 N

Source: <sup>(\*)</sup> Sub decree 42 on Air pollution control and noise disturbance, MoE 2000

## 4.8 Air quality

### 4.8.1 Methodology

The release of various particles into the atmosphere comes from different activities, the chemical substance that releases a lot of pollution; it may impact the air quality. The proposed conducting the air quality is a baseline survey for supporting the initial environmental examination study. The air quality survey has been collected at the site by an expert at MoE's lab and analyzed the air quality indicators in the lab.

Table 4.8-1: The method for air quality measurement

No	Parameters	Unit	Standard	Method
1	Carbon Monoxide (CO)	mg/m <sup>3</sup>	<20 (8 hours)	Method Carbon Monoxide Passive Dosimeter
2	Nitrogen Dioxide (NO <sub>2</sub> )	mg/m <sup>3</sup>	<0.1 (24 hours)	Method Saltzman [ISO 6768:1998(E)]
3	Sulfur Dioxide (SO <sub>2</sub> )	mg/m <sup>3</sup>	<0.3 (24 hours)	Method Pararosaniline [ISO 6767:1990(E)]
4	Total Suspended Particles (TSP)	mg/m <sup>3</sup>	0.33 (24 hours)	Method Weight Concentration Measuring
5	PM <sub>10</sub>	mg/m <sup>3</sup>	<0.05 (24 hours)	Method Weight Concentration Measuring
6	Hydrogen Sulfide (H <sub>2</sub> S)	mg/m <sup>3</sup>	<0.001	Method Portable Gas Detector H <sub>2</sub> S
7	Ammonia (NH <sub>3</sub> )	mg/m <sup>3</sup>	<0.2	Method Portable Gas Detector H <sub>2</sub> S



Figure 4.8-1 The air quality measurement at the proposed landfill site



(Source, AQ survey team Sept.2020)

#### 4.8.2 Finding

The air quality was measured on 5th September 2020 to follow up on the impact of the project activities. According to the result below, the air qualities are below the standard, so no air pollution from the surrounding activities.

Table 4.8.2-1: The air quality result

No.	Parameter	Unit	Standard	Result
1	Carbon Monoxide(CO)	mg /m3	<20(8 Hour)	0.97
2	Nitrogen Dioxide (NO2)	mg /m3	<0.1(24 Hour)	0.010
3	Sulfur Dioxide (SO2)	mg /m3	<0.3(24 Hour)	0.016
4	Total Suspended Particles(TSP)	mg /m3	<0.33(24	0.058
5	PM10	mg /m3	<0.05(24	0.028
6	Hydrogen Sulfite (H2S)	mg /m3	<0.001*	ND
7	Ammonia (NH3)	mg /m3	<0.2*	ND

Source: <sup>(\*)</sup> Sub-decree 42 on Air pollution control and noise disturbance, MoE 2000

## **5 CONCLUSIONS**

### **5.1 Environmental Regulation**

There are some laws, sub-decrees, prakas, and guidelines relevant to environmental protection and monitoring to prevent the natural and social resources in good manner and sustainable development. The detailed objective and aim of these regulations are described in section 2 of this report.

### **5.2 Project Description**

The facilities development for improvement in Poipet city: (1) Pumping station and wastewater treatment plant for improving the wastewater management system, (2) the outlet of stormwater drainage, and (3) landfill site for solid waste management in the city do not cause any significant socio-environmental impacts and concerns to the area and the nearby. Some minor concerns can be sorted out as discussed in the section of results and findings. This is a small concern to social and environmental impact during the construction phase of stormwater drainage in the city. In contrast, it's many positive impacts on Poipet city. Therefore, this project should be implemented as it will have an essential benefit to Banteay Mean Chey province, a well-known province with potential for industrial development.

### **5.3 Baseline survey**

#### **5.3.1 Overall environmental aspect**

Poipet is a city in Banteay Meanchey Province in western Cambodia, on the border with Thailand. It's the mainland crossing and transport hub for travel between the cities of Siem Reap and Bangkok. The Poipet city is divided into three communes/ Sangkat: Sangkat Poipet, Sangkat Phsar Kandal, and Sangkat Nimith. It borders with Ou Chrov district at North, Northeast, East, and Southeast, Malai district at South and Southwest, and Thailand at Northwest and West.

The geology of Poipet is characterized by Pediments, Deltaic deposits, and Terrance alluvial deposits. Therefore, the average annual temperature is projected to increase by 1°C by 2030, 2.2°C by 2050, and 3.6°C by the end of the century. However, no protected area located nearby the city and no special ecosystem too, normally the area abundance of rice fields.

#### **5.3.2 Characteristic of the project area**

The proposed landfill site for Poipet city is located at Sorya village, Sangkat Nimitt, Poipet City, Banteay Meanchey Province, where is about 20.5 km from the city center, 10.5 km from the landfill site, and covers around 20ha of agricultural land, no school and health center, house within 300m from the landfill site. The access road condition seems poor quality due to very soft laterite and as a new construction road and difficulty to pass (muddy and slide) in the rainy season.

While the WWTP site is in Reaksmey Sereypheap village, Sangkat Nimitt, Poipet City, Banteay Meanchey Province, with 10ha covers. It is located about 17km from the Poipet city center, where is a rural area and no settlement nearby. No households are living in the area of the buffer zone (300m). The settlements were found at 1km, and a pagoda settled about 800m the proposed site.

### 5.3.3 Soil quality

The soil particle analysis is sandy loam at the landfill site and loamy at the WWTP site. But in visual, clay layers are presented in-depth more than 0.5m.

pH at both sites (landfill and WWTP) is acidic. The soil quality at the proposed landfill site and the WWTP site indicate that all parameters are under the standard value of MoE. The soil quality of both sites is not polluted yet. The soil quality at the proposed landfill is good; however, the soil quality at the landfill site meet to standard value seems polluted by agricultural fertilizer and pests.

The physical and chemical characteristics of the soil analysis should conduct more points and more depth at both the proposed landfill and the WWTP site to understand the soil layer for analyzing the permeability conductivity to protect the groundwater pollution.

### 5.3.4 Water quality

The surface water quality in the landfill site and the WWTP site did not pollute yet. The surface water quality is lower than the standard determined by the MoE of Cambodia.

The groundwater quality around the project sites did not reflect any concern yet; all parameters are under the standard value of MoE. The water quality should study more during implementation, and monitoring wells should be conducted to the measurement of groundwater pollution to protect the human health risk

The bacteriology indicates that the *E. coli* concentration is lower than the standard of the public water area of Cambodia. However, the Total Coliform concentration is about two times higher than the standard. The main source of total coliform and *E. coli* come from the fecal human and animal. In short, it is generally in the environmental system, and the bacteria can not survive long in the water without nutrients. The bacteria in the water do not be significantly harmful to human health.

### 5.3.5 Flora

#### Landfill site

**Vegetation:** Landfill site was found 11 different species, and 9 families who mostly are common species in the local status, except *Pterocarpus pedatus*, *Pierre* was listed in Endangered (En) species, and Least concern (LC) are including; *Microcos tomentosa*, *Bombax ceiba*, *Azadirachta indica*, *Streblus asper* of IUCN redlist 2020. The result was also recorded such as; *Azadirachta indica*, *Sindora cochinchinensis*, *Wrightia arborea*, *Clausena excavata* var. *villosa*, *Aganonerion polymorphum* *Pierre*, *Bombax ceiba*, *Spondias malayana*, *Pterocarpus pedatus*, *Pierre*, *Shorea roxburgshii*, *G.Don.*, *Streblus asper*.

*The total tree numbers will be cut in the whole proposed landfill area is approximately 1,800 stems, the vegetation estimation with Dbh>5 cm in an average number of 1,800 (±200) stems/ha with the average volume of 78.29 (±12.92) m<sup>3</sup>/ha, within 1,600 stems/ha (plot\_1), and 2,000 stems/ha (plot\_2). The new development landfill here will require to compensate as replant trees with a total number of 1,800 trees, according to the MAFF forestry conservation team comment in the previous project.*

## **WWTP site**

**-Vegetation:** Our result was found 11 different species and 11 families, which mostly are common species in the local status, except for *Pterocarpus pedatus*, Pierre was listed in Endangered species of IUCN red list 2020. The result was recorded mostly the common species are including; *Peltophorum dasyrrhachis* Kurz, var, *Dalbergia nigrescens* Kurz, *Litsca glutinosa*, *Bridelia ovata* var. *curtisii*, *Amphineurion marginatum* (Roxb.) D.J.Middleton, *Passiflora foetida*, *Steptocaulon juvenas*, *Ellipeiopsis cherrevensis* (Pierre ex Finet & Gagnep.), *Chromolaena odorata*.

Landfill and WWTP site was significant of *Pterocarpus pedatus* Pierre that identified by IUCN red list in endangered species. It is recommended to keep those endangered trees onsite during the construction phase. However, it could not keep it inside, then remove those trees and replant it in the other locations nearby.

The vegetation estimation with Dbh>5 cm in average number of 3,800 ( $\pm 200$ ) stems/ha (*Melaleuca quinquenervia*<sup>3</sup> is dominant species) with average volume of 180.96 ( $\pm 0.87$ ) m<sup>3</sup>/ha, within 4,000 stems/ha (plot\_1), and 3,600 stems/ha (plot\_2). However, the proposed WWTP site had forest/vegetation coverage of about 1%, so the total tree numbers will be cut in the whole proposed WWTP area is approximately 456 stems. According to the MAFF forestry conservation team indicated that anyone who cut 1 tree needs to replant 1 tree, so the proposed WWTP here will require to compensate as replant trees with a total number of 456 trees.

Trees should be replanted at least at the perimeter site of the proposed main pumping station, landfill, and WWTP to protect the odor, noise, and nature-based. Also, it is important to compensate as replant the trees for sustainable development. The replanted should be local trees that available in the market. However, the existing flora can be replanted; it is the priority to consider. The available land, such as in public gardens, along the road, green space as reserves by the city administration should replant the trees to compensate for the project development.

### **5.3.6 Fauna**

#### **Landfill site**

**Mammals and Birds.** In the project site, we recorded a number of wildlife species, including mammals and birds. The largest mammals reported to be present there are wild pig *Sus scrofa* and red muntjac *Muntiacus vaginalis* (both from interview data). From our line transect surveys and interviewing local people, we documented two species, including Coral-billed Ground-cuckoo *Carpococcyx renauldi*, and lesser adjutant *Leptoptilos javanicus* that are listed as Vulnerable in the IUCN red list. We also recorded three species listed as Near threatened in the IUCN red list; White-rumped Pygmy-falcon *Polihierax insignis*, Blossom-headed Parakeet *Psittacula roseate*, and Alexandrine Parakeet *Psittacula eupatria*.

**Amphibian and Reptile:** The total of 11 herpetofauna species is confirmed for the first time from the field comprehensive herpetological field survey of the survey site. This finding shows that the golden tree snake *Chrysopelea ornata* is likely to exist in shrub and in villages which is available of geckos and other prey for them. *Eutropis macularia* is like to live in a shrub, agricultural land, and also near human settlements. Other reptile species are not much different from above; they can live in varied habitats to keep their population stable.

<sup>3</sup> *Melaleuca quinquenervia* that classed in third grade by MAFF

Most amphibian species are common to shrubland, agricultural areas, and ponds around the village. Most of them including *Duttaphrynus melanostictus*, *Microhyla fissipes*, *Microhyla pulchra*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*. These species populations are in stable status except *Hoplobatrachus rugulosus* which is hunted by local people for food and selling. *Occidozyga lima* which is likely to live in paddy field and puddles but their status remains in good condition. *Kaloula pulchra* is a shy species that live underground and only emerges during heavy rain for foraging and breeding. This species is also hunted by people and led to a population decrease locally too. None of the species that occur in the area are listed as threatened species.

**Bat:** This location was too open, so capture bats are very low in rate. Low in bat diversity probably scarce of insect prey because farmers use pesticide for their rice crop.

### **WWTP site**

**-Mammals and Birds:** The result from our line-transect surveys and the interviewing local people show that there are numbers of wildlife species that occur in the project site and its adjacent area. During our surveys, we documented one mammal species, the Long-tailed macaque *Macaca fascicularis* listed as Vulnerable in the IUCN red. We documented four bird species that are listed as Vulnerable in the IUCN red list, including Wreathed Hornbill *Rhyticeros undulates*, Great Slaty Woodpecker *Mulleripicus pulverulentus*, Coral-billed Ground-cuckoo *Carpococcyx renauldi*, and Lesser adjutant *Leptoptilos javanicus*. Also, we recorded four Near Threatened (IUCN red list) species that includes Red-collared Woodpecker *Picus rabieri*, White-rumped Pygmy-falcon *Polihierax insignis*, Blossom-headed Parakeet *Psittacula roseate*, and Alexadrine Parakeet *Psittacula eupatria*.

**Amphibian and Reptile:** The total of 15 herpetofaunal species is confirmed for the first time from the field comprehensive herpetological field survey of the survey site. This finding shows that one species of snake *Trimeresurus albolabris* is a wide range of habitats and elevation including shrub, forest edge, and other habitat types (Devan-Song, 2014). Besides *T. albolabris*, sun beam snake *Xenopeltis unicolor* is likely to live hold, under lodge, grasses, open areas, and near human settlements. *Eutropis macularia* is like to live in a shrub, agricultural land, and also near human settlements. Other reptile species are not much different from above; they can live in varied habitats to keep their population is stable.

Most amphibian species are common to shrubland, agricultural areas, and ponds around the village. Most of them including *Duttaphrynus melanostictus*, *Microhyla fissipes*, *Microhyla pulchra*, *Fejervarya limnocharis*, *Hoplobatrachus rugulosus*. These species populations are in stable status except *Hoplobatrachus rugulosus*, which is hunted by local people for food and selling. *Occidozyga lima* which is likely to live in paddy field and puddles but their status remains in good condition. *Kaloula pulchra* is a shy species that live underground and only emerges during heavy rain for foraging and breeding. This species is also hunted by people and led to a population decrease locally too. Due to none of the species that occur in the area are listed as threatened species

**Bat:** This location was too open, so capture bats are very low in rate. Low in bat diversity probably scarce of insect prey because farmers use pesticide for their rice crop and vegetable.

### **5.3.7 Cultural Heritage**

There is no cultural heritage site in the proposed WWTP and Landfill location.

### **5.3.8 Noise**

The result of the noise disturbance measurement in all sites indicated is below the standard of MoE. The noise level measurement might be fluctuating depending on human activities. The baseline noise in a landfill site, WWTP site, pump stations, and some houses close to the landfill and WWTP does not cause disturbance to villagers due to most of the station is a rural area and have not industrial or transportation activities.

### **5.3.9 Air quality**

Same as noise measurement, due to most of the station are calm areas less of settlement and have not industrial or transportation activities, the air quality is not significantly concerned in all CLIP project sites in Poipet city, and the value of each parameter is under the MoE standard, so the air quality in this area was very good.

## 6 REFERENCES

- Sub-Decree No. 42 ANK.BK on The Control of Air Pollution and Noise Disturbance, 2000
- Sub-Decree No. 27 ANRK.BK on water pollution control, 1999
- Sub-Decree No. 72 ANRK.BK on Environmental Impact Assessment Process, 1999
- Sub-Degree No. 235 ANRK. BK on the Management of Drainage system and Wastewater Treatment System, 2017
- Sub-Degree No. 113 ANRK. BK on Management of Garbage and Solid Waste of Downtowns, 2015
- The Prakas No.120 PK.BST on launching the use of ToR for infrastructure development and tourism of MoE, 2018.
- ADB, 2019 Initial Environmental Examination Greater Mekong Subregion Southern Economic Corridor Towns Development Project: Bavet, Neak Loeung, Battambang, and Poipet Subprojects Updated Initial Environmental Examination CAM-43319-033, Cambodia.
- ADB, 2012 Initial Environmental Examination Greater Mekong Subregion Southern Economic Corridor Towns Development Project: Bavet, Neak Loeung, Battambang, and Poipet Subprojects Updated Initial Environmental Examination CAM-43319-033, Cambodia.
- Campbell, I. C., Poole, C., Giesen, W., & Valbo-Jorgensen, J. (2006). Species diversity and ecology of Tonle Sap Great Lake, Cambodia. *Aquatic Sciences*, 68(3), 355-373.
- Cheang, D., S. Burgess, A. Sloth, T. So, and S. Sok. 2004. Cambodia Tree Species Monographs, Forestry Administration/Cambodia Tree Seed Project/DANIDA.
- Dy Phon, P., 1982, Végétation du Cambodge: endemisme et affinités de sa flore avec les région voisines, C.R. Séances Soc. Biogéogr, 58 (3): 135-144.
- Hosoishi, S., Hashimoto, Y., Park, S. H., Yamane, S., & Ogata, K. (2017). A comparison of ground-dwelling and arboreal ant assemblages (Hymenoptera: Formicidae) in lowland forests of Cambodia. *Raffles Bulletin of Zoology*, 65.
- Gale, G. A., P. D. Round, A. J. Pierce, S. Nimnuan, A. Pattanavibool, and W. Y. Brockelman. 2009. A field test of distance sampling methods for a tropical forest bird community. *The Auk* 126:439-448.
- Gray, T. N., C. Phan, C. Pin, and S. Prum. 2012. Establishing a monitoring baseline for threatened large ungulates in eastern Cambodia. *Wildlife Biology* 18:406-413
- List, IUCN. (2020). URL: <http://www.iucnredlist.org/documents>.
- Marsh, D. M., & Trenham, P. C. (2001). Metapopulation dynamics and amphibian conservation. *Conservation biology*, 15(1), 40-49.
- Marsh, D. M., & Trenham, P. C. (2001). Metapopulation dynamics and amphibian conservation. *Conservation biology*, 15(1), 40-49.
- Martin, E., Delerue, C., Allan, G., & Lannoo, M. (1994). Theory of excitonic exchange splitting and optical Stokes shift in silicon nanocrystallites: Application to porous silicon. *Physical Review B*, 50(24), 18258.
- Rubbo, M. J., & Kiesecker, J. M. (2004). Leaf litter composition and community structure: translating regional species changes into local dynamics. *Ecology*, 85(9), 2519-2525.
- Sithirith, M. (2016). Territorialisation of natural resources and environmental management. *Routledge Handbook of the Environment in Southeast Asia*, 356.
- Tordoff, A. W., Bezuijen, M. R., Duckworth, J. W., Fellowes, J. R., Koenig, K., Pollard, E. H. B., & Royo, A. G. (2012). Ecosystem Profile: Indo-Burma Biodiversity Hotspot Indochina Region. Final Version October.

Vesa, L., Than, S., Vanna, S., Hyvonen, P., Korhonen, K.T., and Rijin.,M. (2014). Mannual for national forest inventory in Cambodia. With technical assistance from FAO-Finland Forestry Programme (Forestry Department, FAO), the Finnish Forest Research Institute (METLA), and Cambodia UN-REDD Programme.



## Annex 1: Soil Quality

### A. Soil Particle



Department of Health and Human Services  
Centers for Disease Control and Prevention

Surveillance Report  
for

*Measles*

Reported by *State of New York*

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

Age Group		Sex	1	2	3	4
Total	Male	0-4	100	100	100	100
		5-9	100	100	100	100
		10-14	100	100	100	100
		15-19	100	100	100	100
Total	Female	0-4	100	100	100	100
		5-9	100	100	100	100
		10-14	100	100	100	100
		15-19	100	100	100	100

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

Reported by *State of New York*

Reported on *10/1/80*

Reported to *10/1/80*

## B. Chemical parameters

[illegible]

Итого:					
Средняя оценка:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					
Подпись:					
Дата:					
Место:					



## Annex 2: Water Quality

### A. Surface water quality

Ministry of Water Resources and Irrigation  
Department of Planning and Policy Studies  
Water Quality Section

Sampling Station No. 101  
Sampling Location: ...  
Sampling Date: ...  
Sampling Time: ...  
Sampling Method: ...

Water Quality Parameters

Temperature (°C)

No.	Parameter	Unit	Result	Standard		Remarks
				Min	Max	
1	Temperature	°C	25.5	15	30	
2	Dissolved Oxygen	mg/L	8.5	5	12	
3	pH		7.5	6.5	8.5	
4	Total Dissolved Solids	mg/L	150	50	500	
5	Total Suspended Solids	mg/L	10	5	50	
6	Calcium	mg/L	120	20	200	
7	Magnesium	mg/L	30	10	50	
8	Hardness	mg/L	150	50	250	
9	Chloride	mg/L	10	5	25	
10	Sulfate	mg/L	5	2	10	
11	Nitrate	mg/L	10	5	25	
12	Nitrite	mg/L	0.5	0.1	1.0	
13	Ammonia	mg/L	0.5	0.1	1.0	
14	Phosphate	mg/L	0.5	0.1	1.0	
15	Iron	mg/L	0.5	0.1	1.0	
16	Copper	mg/L	0.05	0.01	0.1	
17	Zinc	mg/L	0.5	0.1	1.0	
18	Lead	mg/L	0.05	0.01	0.1	
19	Cadmium	mg/L	0.01	0.001	0.01	
20	Mercury	mg/L	0.001	0.0001	0.001	
21	Fluoride	mg/L	1.0	0.5	2.0	
22	Boron	mg/L	0.5	0.1	1.0	
23	Selenium	mg/L	0.05	0.01	0.1	
24	Antimony	mg/L	0.05	0.01	0.1	
25	As	mg/L	0.05	0.01	0.1	
26	Co	mg/L	0.05	0.01	0.1	
27	Cr	mg/L	0.05	0.01	0.1	
28	Mn	mg/L	0.05	0.01	0.1	
29	Ni	mg/L	0.05	0.01	0.1	
30	Pb	mg/L	0.05	0.01	0.1	
31	Cd	mg/L	0.01	0.001	0.01	
32	Hg	mg/L	0.001	0.0001	0.001	
33	Ag	mg/L	0.05	0.01	0.1	
34	Cu	mg/L	0.05	0.01	0.1	
35	Zn	mg/L	0.05	0.01	0.1	
36	Al	mg/L	0.05	0.01	0.1	
37	Fe	mg/L	0.05	0.01	0.1	
38	Mn	mg/L	0.05	0.01	0.1	
39	Pb	mg/L	0.05	0.01	0.1	
40	Cd	mg/L	0.01	0.001	0.01	
41	Hg	mg/L	0.001	0.0001	0.001	
42	As	mg/L	0.05	0.01	0.1	
43	Cr	mg/L	0.05	0.01	0.1	
44	Mn	mg/L	0.05	0.01	0.1	
45	Ni	mg/L	0.05	0.01	0.1	
46	Cu	mg/L	0.05	0.01	0.1	
47	Zn	mg/L	0.05	0.01	0.1	
48	Al	mg/L	0.05	0.01	0.1	
49	Fe	mg/L	0.05	0.01	0.1	
50	Mn	mg/L	0.05	0.01	0.1	

Water Quality Section

Report No. 101/2020

Date: 10/10/2020

Signature: ...

Stamp: ...

## B. Groundwater quality

**Station of Water Measurement and Monitoring**  
 Name of the station: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Date of measurement: \_\_\_\_\_

**Water Quality Data**  
 Date of measurement: \_\_\_\_\_  
 Name of the station: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Date of measurement: \_\_\_\_\_

**Station Name: \_\_\_\_\_**

**Station Number: \_\_\_\_\_**

**Station Location: \_\_\_\_\_**

**Station Date: \_\_\_\_\_**

No.	Item	Unit	Result	Standard	Remarks	Remarks	Remarks
1	pH		7.5	6.5 - 8.5			
2	Temperature	°C	25.0	10 - 30			
3	Dissolved Oxygen	mg/L	8.0	5 - 12			
4	Total Dissolved Solids	mg/L	150	50 - 250			
5	Total Suspended Solids	mg/L	10	5 - 20			
6	Calcium	mg/L	100	50 - 200			
7	Magnesium	mg/L	50	20 - 100			
8	Sulfate	mg/L	100	50 - 200			
9	Chloride	mg/L	100	50 - 200			
10	Nitrate	mg/L	10	5 - 20			
11	Ammonia	mg/L	1.0	0.5 - 2.0			
12	Phosphate	mg/L	0.5	0.2 - 1.0			
13	Iron	mg/L	0.5	0.2 - 1.0			
14	Copper	mg/L	0.1	0.05 - 0.2			
15	Zinc	mg/L	0.1	0.05 - 0.2			
16	Lead	mg/L	0.05	0.01 - 0.1			
17	Cadmium	mg/L	0.01	0.005 - 0.02			
18	Mercury	mg/L	0.001	0.0005 - 0.002			
19	Fluoride	mg/L	1.0	0.5 - 2.0			
20	Boron	mg/L	0.5	0.2 - 1.0			
21	Selenium	mg/L	0.1	0.05 - 0.2			
22	Antimony	mg/L	0.05	0.01 - 0.1			
23	Chromium	mg/L	0.1	0.05 - 0.2			
24	Manganese	mg/L	0.5	0.2 - 1.0			
25	Cobalt	mg/L	0.1	0.05 - 0.2			
26	Nickel	mg/L	0.1	0.05 - 0.2			
27	Copper	mg/L	0.1	0.05 - 0.2			
28	Zinc	mg/L	0.1	0.05 - 0.2			
29	Lead	mg/L	0.05	0.01 - 0.1			
30	Cadmium	mg/L	0.01	0.005 - 0.02			
31	Mercury	mg/L	0.001	0.0005 - 0.002			
32	Fluoride	mg/L	1.0	0.5 - 2.0			
33	Boron	mg/L	0.5	0.2 - 1.0			
34	Selenium	mg/L	0.1	0.05 - 0.2			
35	Antimony	mg/L	0.05	0.01 - 0.1			
36	Chromium	mg/L	0.1	0.05 - 0.2			
37	Manganese	mg/L	0.5	0.2 - 1.0			
38	Cobalt	mg/L	0.1	0.05 - 0.2			
39	Nickel	mg/L	0.1	0.05 - 0.2			
40	Copper	mg/L	0.1	0.05 - 0.2			
41	Zinc	mg/L	0.1	0.05 - 0.2			
42	Lead	mg/L	0.05	0.01 - 0.1			
43	Cadmium	mg/L	0.01	0.005 - 0.02			
44	Mercury	mg/L	0.001	0.0005 - 0.002			
45	Fluoride	mg/L	1.0	0.5 - 2.0			
46	Boron	mg/L	0.5	0.2 - 1.0			
47	Selenium	mg/L	0.1	0.05 - 0.2			
48	Antimony	mg/L	0.05	0.01 - 0.1			
49	Chromium	mg/L	0.1	0.05 - 0.2			
50	Manganese	mg/L	0.5	0.2 - 1.0			
51	Cobalt	mg/L	0.1	0.05 - 0.2			
52	Nickel	mg/L	0.1	0.05 - 0.2			
53	Copper	mg/L	0.1	0.05 - 0.2			
54	Zinc	mg/L	0.1	0.05 - 0.2			
55	Lead	mg/L	0.05	0.01 - 0.1			
56	Cadmium	mg/L	0.01	0.005 - 0.02			
57	Mercury	mg/L	0.001	0.0005 - 0.002			
58	Fluoride	mg/L	1.0	0.5 - 2.0			
59	Boron	mg/L	0.5	0.2 - 1.0			
60	Selenium	mg/L	0.1	0.05 - 0.2			
61	Antimony	mg/L	0.05	0.01 - 0.1			
62	Chromium	mg/L	0.1	0.05 - 0.2			
63	Manganese	mg/L	0.5	0.2 - 1.0			
64	Cobalt	mg/L	0.1	0.05 - 0.2			
65	Nickel	mg/L	0.1	0.05 - 0.2			
66	Copper	mg/L	0.1	0.05 - 0.2			
67	Zinc	mg/L	0.1	0.05 - 0.2			
68	Lead	mg/L	0.05	0.01 - 0.1			
69	Cadmium	mg/L	0.01	0.005 - 0.02			
70	Mercury	mg/L	0.001	0.0005 - 0.002			
71	Fluoride	mg/L	1.0	0.5 - 2.0			
72	Boron	mg/L	0.5	0.2 - 1.0			
73	Selenium	mg/L	0.1	0.05 - 0.2			
74	Antimony	mg/L	0.05	0.01 - 0.1			
75	Chromium	mg/L	0.1	0.05 - 0.2			
76	Manganese	mg/L	0.5	0.2 - 1.0			
77	Cobalt	mg/L	0.1	0.05 - 0.2			
78	Nickel	mg/L	0.1	0.05 - 0.2			
79	Copper	mg/L	0.1	0.05 - 0.2			
80	Zinc	mg/L	0.1	0.05 - 0.2			
81	Lead	mg/L	0.05	0.01 - 0.1			
82	Cadmium	mg/L	0.01	0.005 - 0.02			
83	Mercury	mg/L	0.001	0.0005 - 0.002			
84	Fluoride	mg/L	1.0	0.5 - 2.0			
85	Boron	mg/L	0.5	0.2 - 1.0			
86	Selenium	mg/L	0.1	0.05 - 0.2			
87	Antimony	mg/L	0.05	0.01 - 0.1			
88	Chromium	mg/L	0.1	0.05 - 0.2			
89	Manganese	mg/L	0.5	0.2 - 1.0			
90	Cobalt	mg/L	0.1	0.05 - 0.2			
91	Nickel	mg/L	0.1	0.05 - 0.2			
92	Copper	mg/L	0.1	0.05 - 0.2			
93	Zinc	mg/L	0.1	0.05 - 0.2			
94	Lead	mg/L	0.05	0.01 - 0.1			
95	Cadmium	mg/L	0.01	0.005 - 0.02			
96	Mercury	mg/L	0.001	0.0005 - 0.002			
97	Fluoride	mg/L	1.0	0.5 - 2.0			
98	Boron	mg/L	0.5	0.2 - 1.0			
99	Selenium	mg/L	0.1	0.05 - 0.2			
100	Antimony	mg/L	0.05	0.01 - 0.1			

**Remarks:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Station Name:** \_\_\_\_\_

**Station Number:** \_\_\_\_\_

**Station Location:** \_\_\_\_\_

**Station Date:** \_\_\_\_\_

## C. Bacteriology

<b>Section 1: Patient Information and History</b> Name: _____ Address: _____ Date of Birth: _____ Sex: _____ Referring Doctor: _____ Referring Hospital: _____ Referring Date: _____ Referring Doctor: _____					<b>Section 2: Laboratory Information</b> Laboratory Name: _____ Date: _____ Referring Doctor: _____ Referring Hospital: _____				
<b>Section 3: Test Results</b>									
No.	Test Name	Result	Reference Range	Units	Date	Time	Technician	Supervisor	Reviewer
1	Gram Stain	Gram Positive Cocci	Gram Negative Cocci						
2	Culture	Gram Positive Cocci	Gram Negative Cocci						

**Notes:**

- Gram Stain: Gram Positive Cocci
- Culture: Gram Positive Cocci
- Gram Stain: Gram Negative Cocci
- Culture: Gram Negative Cocci
- Gram Stain: Gram Positive Cocci
- Culture: Gram Positive Cocci
- Gram Stain: Gram Negative Cocci
- Culture: Gram Negative Cocci

Dr. \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Title: \_\_\_\_\_

## Annex 3: Flora and Fauna survey

### A. Flora survey

#### Species picture in Landfill site (LS)



*Sindora cochinchinensis*, Baill. (right), and species counteracting and measuring (left)



North navigation plot (left), and *Azadirachta indica* measuring (left) plot2

**Species picture in Waste Water Treatment Plant (WWTP).**

	
Vegetation measuring of <i>Combrctum quadrangulare</i> (right), and <i>Pterocarpus pedatus</i> , Pierre (left)	
	
Leaf of <i>Peltophorum dasyrrhachis</i> was cute by insects plot2.	and species identified (left) plot2



## B. Fauna Survey

Picture of bird species in the Landfill site



**Bird species recorded during the line transect surveys at the landfill site;** Lesser Whistling-duck (top left), Chestnut-headed Bee-eater (top right), Red-wattled Lapwing (bottom left), and Rufescent Prinia (bottom right).

## Annex 4: Noise







**Department of Health and Human Services**  
**Centers for Disease Control and Prevention**

**Supplemental Form**

**Form 100-101 (Rev. 10-1-80)**

**1. Name of the person or organization submitting this form:** \_\_\_\_\_

**2. Address of the person or organization submitting this form:** \_\_\_\_\_

**3. City, State, and Zip:** \_\_\_\_\_

**4. Title of the person or organization submitting this form:** \_\_\_\_\_

**5. Date of submission:** \_\_\_\_\_

No.	Name	Address	City, State, Zip	Telephone Number	Signature	Date
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

**6. Name of the person or organization submitting this form:** \_\_\_\_\_

**7. Address of the person or organization submitting this form:** \_\_\_\_\_

**8. City, State, and Zip:** \_\_\_\_\_

**9. Title of the person or organization submitting this form:** \_\_\_\_\_

**10. Date of submission:** \_\_\_\_\_



**গণপ্রজাতন্ত্রী বাংলাদেশ**  
**জাতীয় সংসদ**

**সংসদ প্রশাসনিক পরিদপ্তর**  
**সংসদ ভবন, ঢাকা**

**স্মারক**

স্মারক নং: **সংসদ/সংসদ প্রশাসনিক পরিদপ্তর/স্মারক/১১৩৩/১৯**  
 তারিখ: **১৯/০৬/১৯**

ক্র.সং.	বিষয়	সংসদ সদস্য	সংসদ প্রশাসনিক পরিদপ্তর	স্মারক
০১	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯
০২	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯
০৩	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯
০৪	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯	১৯/০৬/১৯

**সংসদ প্রশাসনিক পরিদপ্তর**  
**সংসদ ভবন, ঢাকা**

**স্মারক**

**১৯/০৬/১৯**

## Annex 5: Air quality

**Environmental Impact Assessment**

**Project Name:** [Project Name]

**Location:** [Location]

**Client:** [Client Name]

**Consultant:** [Consultant Name]

**Scale:** [Scale]

**Phase:** [Phase]

**Objective:** [Objective]

**Methodology:** [Methodology]

**Results:** [Results]

**Conclusion:** [Conclusion]

**Recommendations:** [Recommendations]

**Signature:** [Signature]

**Date:** [Date]

**Stamp:** [Stamp]

**Page:** [Page]

## Annex 6: The attendance list with local meeting

Attendance List						
Meeting Date: 2023-01-10						
Meeting Time: 14:00 - 15:30						
No.	Name	Address	Phone	Signature	Remarks	Signature
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

### **3. Integrated Biodiversity Assessment Tool (IBAT) Report**



# Proximity Report

## POIPET

**Country:** Cambodia

**Location:** [ 13.6, 102.6 ]

**Date of analysis:** 01 December 2020 (GMT)

**Size of site:** 222 km<sup>2</sup>

**Buffers applied:** 1 km

**Generated by:** Jean-Louis Malfere

**Organisation:** ADB

### Overlaps with:

Protected Areas	0
Key Biodiversity Areas	0
IUCN Red List	132



Displaying project location and buffers: 1 km

## About this report

This report presents the results of [5956-12644] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1 km.

This report is one part of a package generated by IBAT on 01 December 2020 (GMT) that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

## Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: [www.protectedplanet.net](http://www.protectedplanet.net) - December 2020.
- BirdLife International (on behalf of the KBA Partnership), 2020. Key Biodiversity Areas - October 2020.
- IUCN, 2020. IUCN Red List of Threatened Species - July 2020.

## Protected Areas

The following protected areas are found within 1 km of the area of interest.  
For further details please refer to the associated csv file in the report folder.

No protected areas within buffer distance

## Key Biodiversity Areas

The following key biodiversity areas are found within 1 km of the area of interest.  
For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

## IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Crocodylus siamensis	Siamese Crocodile	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Indotestudo elongata	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
Manis javanica	Sunda Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
Sphyrna lewini	Scalloped Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Sphyrna mokarran	Great Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Pristis zijsron	Green Sawfish	CHONDRICHTHYES	CR	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Rhina ancylostoma	Bowmouth Guitarfish	CHONDRICHTHYES	CR	Decreasing	Marine
Rhynchobatus australiae	Bottlenose Wedgefish	CHONDRICHTHYES	CR	Decreasing	Marine
Catlocarpio siamensis	Giant Carp	ACTINOPTERYGII	CR	Decreasing	Freshwater
Terniopsis ubonensis		MAGNOLIOPSIDA	CR	Unknown	Freshwater
Aythya baeri	Baer's Pochard	AVES	CR	Decreasing	Freshwater
Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
Eurochelidon sirintarae	White-eyed River Martin	AVES	CR	Decreasing	Terrestrial, Freshwater
Emberiza aureola	Yellow-breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater
Gyps tenuirostris	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
Panthera pardus ssp. delacouri	Indochinese Leopard	MAMMALIA	CR	Decreasing	Terrestrial
Bos javanicus	Banteng	MAMMALIA	EN	Decreasing	Terrestrial
Laubuka caeruleostigmata	Flying Minnow	ACTINOPTERYGII	EN	Decreasing	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Cuon alpinus</i>	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
<i>Cuora amboinensis</i>	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
<i>Elephas maximus</i>	Asian Elephant	MAMMALIA	EN	Decreasing	Terrestrial
<i>Hylobates pileatus</i>	Pileated Gibbon	MAMMALIA	EN	Decreasing	Terrestrial
<i>Lutra sumatrana</i>	Hairy-nosed Otter	MAMMALIA	EN	Decreasing	Terrestrial, Marine, Freshwater
<i>Panthera tigris</i>	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
<i>Rhincodon typus</i>	Whale Shark	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Dipterocarpus intricatus</i>		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
<i>Vatica philastraena</i>		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
<i>Nycticebus bengalensis</i>	Bengal Slow Loris	MAMMALIA	EN	Decreasing	Terrestrial
<i>Trachypithecus germaini</i>	Indochinese Silvered Langur	MAMMALIA	EN	Decreasing	Terrestrial
<i>Viverra zibetha</i>	Large-spotted Civet	MAMMALIA	EN	Decreasing	Terrestrial
<i>Stegostoma tigrinum</i>	Zebra Shark	CHONDRICHTHYES	EN	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Aetomylaeus maculatus</i>	Mottled Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Aetomylaeus vespertilio</i>	Ornate Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Mobula thurstoni</i>	Bentfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Alopias pelagicus</i>	Pelagic Thresher	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Holothuria scabra</i>	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
<i>Holothuria lessoni</i>	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
<i>Thelenota ananas</i>	Prickly Redfish	HOLOTHUROIDEA	EN	Decreasing	Marine
<i>Pangasianodon hypophthalmus</i>	Striped Catfish	ACTINOPTERYGII	EN	Decreasing	Freshwater
<i>Pachydrobia zilchi</i>		GASTROPODA	EN	Unknown	Freshwater
<i>Anulotaia forcarti</i>		GASTROPODA	EN	Unknown	Freshwater
<i>Terniopsis chanthaburiensis</i>		MAGNOLIOPSIDA	EN	Decreasing	Freshwater
<i>Pavo muticus</i>	Green Peafowl	AVES	EN	Decreasing	Terrestrial
<i>Asarcornis scutulata</i>	White-winged Duck	AVES	EN	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Sterna acuticauda</i>	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Mycteria cinerea</i>	Milky Stork	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
<i>Oriolus mellianus</i>	Silver Oriole	AVES	EN	Decreasing	Terrestrial
<i>Mobula mobular</i>	Spinetail Devil Ray	CHONDRICHTHYES	EN	Decreasing	Marine
<i>Calostoma insigne</i>		AGARICOMYCETES	EN	Decreasing	Terrestrial
<i>Scleropages formosus</i>		ACTINOPTERYGII	EN	Decreasing	Freshwater
<i>Bos gaurus</i>	Gaur	MAMMALIA	VU	Decreasing	Terrestrial
<i>Carcharhinus plumbeus</i>	Sandbar Shark	CHONDRICHTHYES	VU	Decreasing	Marine
<i>Caretta caretta</i>	Loggerhead Turtle	REPTILIA	VU	Decreasing	Terrestrial, Marine
<i>Dermochelys coriacea</i>	Leatherback	REPTILIA	VU	Decreasing	Terrestrial, Marine
<i>Dugong dugon</i>	Dugong	MAMMALIA	VU	Decreasing	Marine
<i>Helarctos malayanus</i>	Sun Bear	MAMMALIA	VU	Decreasing	Terrestrial
<i>Hippocampus histrix</i>	Thorny Seahorse	ACTINOPTERYGII	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Lepidochelys olivacea	Olive Ridley	REPTILIA	VU	Decreasing	Terrestrial, Marine
Lutrogale perspicillata	Smooth-coated Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Macaca fascicularis	Nicobar Crab-eating Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Neofelis nebulosa	Clouded Leopard	MAMMALIA	VU	Decreasing	Terrestrial
Panthera pardus	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
Ursus thibetanus	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial
Dipterocarpus alatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Shorea roxburghii	White Meranti	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Carcharhinus falciformis	Silky Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Urogymnus asperrimus	Porcupine Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Macaca leonina	Northern Pig-tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Hippocampus kelloggi	Great Seahorse	ACTINOPTERYGII	VU	Decreasing	Marine
Arctictis binturong	Binturong	MAMMALIA	VU	Decreasing	Terrestrial



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Rusa unicolor</i>	Sambar	MAMMALIA	VU	Decreasing	Terrestrial
<i>Nebrius ferrugineus</i>	Tawny Nurse Shark	CHONDRICHTHYES	VU	Decreasing	Marine
<i>Negaprion acutidens</i>	Sharptooth Lemon Shark	CHONDRICHTHYES	VU	Decreasing	Marine
<i>Hemipristis elongata</i>	Snaggletooth Shark	CHONDRICHTHYES	VU	Decreasing	Marine
<i>Aonyx cinereus</i>	Asian Small-clawed Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
<i>Epinephelus fuscoguttatus</i>	Brown-marbled Grouper	ACTINOPTERYGII	VU	Decreasing	Marine
<i>Rhinoptera javanica</i>	Javanese Cownose Ray	CHONDRICHTHYES	VU	Unknown	Marine
<i>Taeniurops meyeri</i>	Blotched Fantail Ray	CHONDRICHTHYES	VU	Decreasing	Marine
<i>Montipora angulata</i>		ANTHOZOA	VU	Decreasing	Marine
<i>Acropora vauhani</i>		ANTHOZOA	VU	Decreasing	Marine
<i>Pavona decussata</i>	Cactus Coral	ANTHOZOA	VU	Unknown	Marine
<i>Acropora aspera</i>		ANTHOZOA	VU	Decreasing	Marine
<i>Heliopora coerulea</i>	Blue Coral	ANTHOZOA	VU	Decreasing	Marine



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Alveopora allingi		ANTHOZOA	VU	Unknown	Marine
Galaxea astreata		ANTHOZOA	VU	Unknown	Marine
Turbinaria stellulata		ANTHOZOA	VU	Unknown	Marine
Acropora aculeus		ANTHOZOA	VU	Decreasing	Marine
Turbinaria peltata		ANTHOZOA	VU	Unknown	Marine
Pavona cactus		ANTHOZOA	VU	Unknown	Marine
Turbinaria mesenterina		ANTHOZOA	VU	Unknown	Marine
Turbinaria reniformis		ANTHOZOA	VU	Unknown	Marine
Odorrana indepressa		AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Urogymnus granulatus	Mangrove Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Pateobatis fai	Pink Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Himantura uarnak	Reticulate Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Pateobatis jenkinsii	Jenkins' Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Bayadera hyalina		INSECTA	VU	Unknown	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Protosticta khaosoidaoensis		INSECTA	VU	Unknown	Freshwater
Wallago attu		ACTINOPTERYGII	VU	Decreasing	Freshwater
Bagarius yarrelli		ACTINOPTERYGII	VU	Decreasing	Freshwater
Osphronemus exodon	Elephant Ear Gourami	ACTINOPTERYGII	VU	Decreasing	Freshwater
Epalzeorhynchodon	Red Fin Shark	ACTINOPTERYGII	VU	Decreasing	Freshwater
Naja siamensis	Black And White Spitting Cobra	REPTILIA	VU	Decreasing	Terrestrial
Ophiophagus hannah	King Cobra	REPTILIA	VU	Decreasing	Terrestrial
Stichopus herrmanni	Curryfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Actinopyga miliaris	Harry Blackfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Actinopyga mauritiana	Surf Redfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Actinopyga echinites	Deep Water Redfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Brotia subgloriosa		GASTROPODA	VU	Unknown	Freshwater
Hydrorissia munensis		GASTROPODA	VU	Unknown	Freshwater



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Limnonectes megastomias		AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Python bivittatus	Burmese Python	REPTILIA	VU	Decreasing	Terrestrial
Dalzellia ranongensis		MAGNOLIOPSIDA	VU	Unknown	Freshwater
Hanseniella heterophylla		MAGNOLIOPSIDA	VU	Unknown	Freshwater
Mobula alfredi	Reef Manta Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Mobula birostris	Giant Manta Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Holothuria fuscogilva		HOLOTHUROIDEA	VU	Decreasing	Marine
Mulleripicus pulverulentus	Great Slaty Woodpecker	AVES	VU	Decreasing	Terrestrial
Buceros bicornis	Great Hornbill	AVES	VU	Decreasing	Terrestrial
Rhyticeros undulatus	Wreathed Hornbill	AVES	VU	Decreasing	Terrestrial
Carpococcyx renauldi	Coral-billed Ground-cuckoo	AVES	VU	Decreasing	Terrestrial
Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila heliaca	Eastern Imperial Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Leptoptilos javanicus	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Ciconia episcopus	Asian Woollyneck	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Acrocephalus tangorum	White-browed Reed-warbler	AVES	VU	Decreasing	Terrestrial, Freshwater
Aetobatus ocellatus	Spotted Eagle Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Arctonyx collaris	Greater Hog Badger	MAMMALIA	VU	Decreasing	Terrestrial
Aetomylaeus nichofii	Banded Eagle Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Physignathus cocincinus	Chinese Water Dragon	REPTILIA	VU	Decreasing	Terrestrial, Freshwater
Capricornis sumatraensis	Mainland Serow	MAMMALIA	VU	Decreasing	Terrestrial

## Recommended citation

IBAT Proximity Report. Generated under licence 5956-12644 from the Integrated Biodiversity Assessment Tool on 01 December 2020 (GMT). [www.ibat-alliance.org](http://www.ibat-alliance.org)

## How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a “first-step”, providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

#### 4. Summary of public consultations

##### Summary of public consultations with different groups

##### Summary public consultation results

1. In developing the project, a series of stakeholder consultations and workshops were carried out preparatory by the technical assistance team comprising international and national specialists with representatives at Sangkat, Municipality, Province, and Ministry levels, with community members and with private companies. In particular, detailed environmental consultations were undertaken as part of the social consultation in September 2020.
2. Following COVID-19 procedures of the National Government and the RGC, the Ministry of Health of Cambodia, and WHO guidelines, the public consultations for LCIP have been carried out with a limited number of participants, no more than 50 persons per section. Mask wearing, use of hand sanitizer, and personal distancing were the measures applied.
3. 13 public consultations and Focus Group discussions (FGD) were undertaken in Poipet city at different Sangkat locations and dates, as described in tables below:

**Table 1: Summary of the dates and locations of the public consultation in Poipet city**

No.	Name of the different group of meeting	Date	Location	Total participant (persons)	Female (persons)
1	The dwellers in urban area	09/09/2020	Ou Chrov high school	49	30
2	The dwellers in rural area	10/09/2020	Psar Kandal pagoda	71	21
3	ID Poor group	09/09/2020	Ou Chrov high school	10	6
4	FHHs group	10/09/2020	Psar Kandal pagoda	11	11
5	Elders group	09/09/2020	Ou Chrov high school	12	9
6	Disable people group	09/09/2020	Psar Kandal pagoda	15	
7	Youth (12-15 years old at high school) group	10/09/2020	Psar Kandal pagoda	13	5
8	Indigenous People group	09/09/2020	Ou Chrov high school	10	6
9	Informal worker in solid waste management	10/09/2020	Psar Kandal pagoda	12	1
10	Local authorities (chief of Sangkat/village)	09/09/2020	City meeting hall	30	3
11	Imparting Smile Association Cambodia (ISAC)	09/09/2020	ISAC office	2	0
12	Don Bosco (NGO)	09/09/2020	Don Bosco office	3	1

13	Damnok Toek (NGO)	09/09/2020	Damnok Toek office	1	0
14	Biodiversity/birds freelance consultants	07/4/2021	By Phone call	2	0
<b>Total:</b>				<b>241</b>	<b>93</b>

**Table 2: Summary results of the public consultation in Poipet city**

No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
1	The dwellers in Poipet city both urban and rural area	All of them understand the project, which will provide many benefits to the whole people in Poipet City and contribute to the provincial as well as national economic development through various activities, especially tourism.	<ul style="list-style-type: none"> <li>- The project implementation agency should consider the traffic issues during construction of drainage and sewerage systems, and time schedule and mitigation measure should be provided properly.</li> <li>- The project's contractor should properly apply both quality and safety.</li> <li>- Sufficient dissemination on project information and their benefits to the local people and authorities before starting construction.</li> <li>- During the dry construction day, should spray the water at the project site/access road at least twice a day.</li> <li>- Improving the solid waste management in this city much more requirement.</li> </ul>
2	ID Poor group	All participants in the different PCs welcome and 100% support the project.	<ul style="list-style-type: none"> <li>- Solid waste collect system should be improved both cleaning and frequency</li> <li>- Recruitment of the local workforces as much as possible is requested to the project implementing agency.</li> <li>- Sufficiently provided project information to the local people to aware about project type and project construction schedule.</li> <li>- Requested to LCIP to consider on connection cost and service fee should be not expensive.</li> <li>- The active NGO/CBO in the Poipet city is Damnok Toek. and</li> <li>- The good media for sanitation campaigning is TVs.</li> </ul>
3	FHHs group		<ul style="list-style-type: none"> <li>- Requested to the project contractor should provide a temporary detour road, traffic sign, and safety barrier in some requirement locations during project construction phase, especially for drainage and sewerage system construction.</li> <li>- Working hours should be followed the law of</li> </ul>



No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
			<p>Cambodia, especially the law of the ministry of labor and vocational training.</p> <ul style="list-style-type: none"> <li>- The recruitment female workers to work in the LCIP is requested.</li> <li>- Improvement collection solid waste system is requested to current company service as well as to the LCIP.</li> <li>- During the construction phase, the project implementing agency should maintenance all access road to be a good quality for the residents use.</li> </ul>
4	Elders group		<ul style="list-style-type: none"> <li>- Sufficiently disseminate the project information to local authority, as well as community/villagers.</li> <li>- During the dry construction day, should spray the water on the project access road/construction site at least 2 times per day to avoid dusty.</li> <li>- The contact address or telephone/email of the project construction company should be provided to local authority/community leader.</li> <li>- Should compensate the impacted resident/property before starting the project.</li> <li>- Training on hygiene/sanitation and water-borne disease should be provided.</li> <li>- Awareness campaigning on separation of solid waste, reuse, and recycle should be provided to all residents.</li> <li>- The effective media in campaigning is local NGOs and TVs</li> </ul>
5	Disable people group		<ul style="list-style-type: none"> <li>- Solid waste company service should improve the collect system including frequency days much more regularly.</li> <li>- Provision vocational training for AHs/APs, especially for disable people for support their livelihood.</li> <li>- The compensation to AHs/APs should be done before starting construction</li> <li>- The effective media in campaigning is local NGOs and TVs</li> </ul>
6	Youth (12-15 years old at high school) group		<ul style="list-style-type: none"> <li>- Should encourage people not to burn garbage. It causes human health problems.</li> <li>- The project owner should provide any workshops or campaigns about the advantage of solid waste and wastewater system</li> </ul>

No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
			<p>management.</p> <ul style="list-style-type: none"> <li>- Should disseminate the benefits of the LCIP project to the people for encouraging them to involve in supporting O&amp;M cost.</li> <li>- Training in solid waste and wastewater management should provide to local authority as well as operation agency.</li> <li>- Radios and the TVs are good media for campaigning of the sanitation program.</li> </ul>
7	Indigenous People group		<ul style="list-style-type: none"> <li>- Training on solid waste sorting/reduction/recycle is needed.</li> <li>- Awareness campaigning on the benefit of the wastewater management system is suggested.</li> <li>- Improvement on the solid waste service in their community is much more required.</li> <li>- The project construction schedule should be sufficiently provided to the AHs/APs before the construction phase.</li> <li>- The most active organization in their community is the CWGCC organization, so they can share different kind information to the local people here.</li> <li>- Radios and TVs are the good media in providing sanitation awareness campaigning.</li> </ul>
8	Informal workers in solid waste management		<ul style="list-style-type: none"> <li>- Safety and hygienic as well as 3Rs training are requested to the LCIP project to include in the project design and budget.</li> <li>- Vocational training is necessary to change their livelihoods better.</li> <li>- Priority recruitment them to works in project construction phase is requested.</li> <li>- Suggest to project implementing agency to provide sufficient PPE during their working time.</li> </ul>
9	Local authorities (Municipality/ Sangkat/village)		<ul style="list-style-type: none"> <li>- The improvement of wastewater network is needed.</li> <li>- The improvement of access road shall be included in the LCIP project.</li> <li>- The collaboration between the local authority, stakeholders, and the technical team and the project to facilitate the project outcome was suggested.</li> <li>- The selection of an appropriate technology and implementation schedule were</li> </ul>

No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
			<p>suggested.</p> <ul style="list-style-type: none"> <li>- The improvement of the solid waste collection system is much more required.</li> <li>- The training needs, such as sorting waste at home, 3Rs, health affected, and wastewater management, should include in this project design and investment budget.</li> </ul>
10	Imparting Smile Association Cambodia (NGO)	Welcome the project, and the activities of our organization mainly concerned educated the children at least high school and given them opportunities for university-level study	In associating our experience of education and vocational training skill, so our organization could support/join the project activities in that tasks.
11	DON BOSCO (NGO)	Welcome the project, and the activities of Don Bosco are provided basic education and appropriate technical training to orphaned and marginalized youth that are poor and have no sources of support	As our experiences could provide campaign and training on the impact of the environmental surroundings and the importance of the proposed project.
12	DAMNOK TOEK	Welcome the project, and our organization "Damnok Toek" is focused on Non-Formal Education and Reintegration, Vulnerable children, Safe Migration and Anti-trafficking and Access to Employment and Sustainability; and Physical and Intellectual	Our organization can provide an Environmental and health sanitation campaign and a Human rights Campaign during project construction.

No.	Name of the different group of meeting	Perception to the project	Suggestions and Recommendations
		Disabilities.	

Individual consultation with key persons such as biodiversity specialist and BirdLife staff were also carried out for getting contribution idea on prevention and mitigation measure to valuable species in term of conservation aspect. The summary results are stated below:

The biodiversity consultant and BirdLife staff, Mr. Hong Chamnang and Mr. Bou Vorsak, both are suggested more bird study should be done during DED stage, even the WWTP site and the landfill site are not located in the protected area or special ecosystem to make sure the proposed project implementation will be not affected to the nearly threat bird species as reported from the local people.

## 4.2 Attendant lists

## 4.2.1 Attendant list of General consultation in urban area

ប្រជាជនក្រុង

ឈ្មោះ: បញ្ជីបង្គោល  
 General Meeting Urban  
 At O'Chhrov High School  
 កាលបរិច្ឆេទ: ថ្ងៃទី ០១ ខែ ០១ ឆ្នាំ ២០២០ វេលាម៉ោង ៥ PM

ល.រ	នាម គោត្តនាម	ភេទ	តួនាទី	អង្គភាព	លេខទូរស័ព្ទ	ហត្ថលេខា ស្នាមមេដៃ
១	ឈុន ឈុន	ប	ប្រធានបង្គោល	បង្គោល	០៩២៩៣០៣៨២	
២	កែវ កែវ	ប	អគ្គនាយក	អគ្គនាយក		
៣	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៤	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៥	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៦	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៧	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៨	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
៩	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១០	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១១	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១២	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៣	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៤	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៥	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៦	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៧	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៨	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
១៩	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	
២០	នីត ឈុន	ប	អគ្គនាយក	អគ្គនាយក	០៩៤៦៥០៣៨២៤	

បញ្ជីបង្គោល  
 ឈ្មោះ: General Meeting Urban  
 At O' Chrov High School  
 កាលបរិច្ឆេទ: ថ្ងៃទី ០១ ខែ ០១ ឆ្នាំ ២០២០ វេលាម៉ោង ៥ PM

ល.រ	នាម គោត្តនាម	ភេទ	តួនាទី	អង្គភាព	លេខទូរស័ព្ទ	ហត្ថលេខា រឺ ស្នាមមេដៃ
១	គុក ឌីន	ប	ប្រធានបង្គោល	ក្រ/ក្រ		
២	គុក គុក	ប	អ	គុក គុក		
៣	គុក គុក	ប	អ	គុក គុក		
៤	គុក គុក	ប	អ	អ		
៥	គុក គុក	ប	អ	អ		
៦	គុក គុក	ប	អ	អ		
៧	គុក គុក	ប	អ	អ		
៨	គុក គុក	ប	អ	គុក គុក		
៩	គុក គុក	ប	អ	គុក គុក		
១០	គុក គុក	ប	អ	អ		
១១	គុក គុក	ប	អ	អ		
១២	គុក គុក	ប	អ	អ		
១៣	គុក គុក	ប	អ	អ		
១៤	គុក គុក	ប	អ	អ		
១៥	គុក គុក	ប	អ	គុក គុក		
១៦	គុក គុក	ប	អ	អ		
១៧	គុក គុក	ប	អ	គុក គុក		
១៨	គុក គុក	ប	អ	អ		
១៩	គុក គុក	ប	អ	អ		
២០	គុក គុក	ប	អ	គុក គុក		

ប្រធានបង្គោល



**THE ATTENDANCE LIST OF THE MEETING**

Name of Meeting: General Meeting  
 Date: 2011-01-12  
 Location: 11000 111th Ave  
 Time/Period: 7:00 PM - 8:00 PM

No.	Name	Address	Phone	Signature	Amount Received	Remarks
1	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
2	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
3	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
4	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
5	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
6	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
7	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
8	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
9	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
10	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
11	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
12	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
13	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
14	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
15	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
16	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
17	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
18	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
19	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
20	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	

**THE ATTENDANCE LIST OF THE MEETING**


Name of Meeting: General Meeting  
 Date: 2011-01-12  
 Location: 11000 111th Ave  
 Time/Period: 7:00 PM - 8:00 PM

No.	Name	Address	Phone	Signature	Amount Received	Remarks
1	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	
2	John A. Smith	11111 111th Ave	111-1111	[Signature]	100.00	



**THE ATTENDANCE LIST OF THE MEETING**

Name of Meeting: General P.D. Meeting  
 Date: 11/18/2011  
 Location: 1111 N. Central Expressway  
 Time: 7:00 AM - 8:00 AM

  
 \_\_\_\_\_

No.	Name	Address	City	State	Zip	Phone
1	John Doe	123 Main St	Anytown	CA	90210	555-1234
2	Jane Smith	456 Elm St	Anytown	CA	90210	555-5678
3	Bob Johnson	789 Oak St	Anytown	CA	90210	555-9012
4	Alice Brown	101 Pine St	Anytown	CA	90210	555-3456
5	Charlie White	202 Maple St	Anytown	CA	90210	555-7890
6	Diana Green	303 Cedar St	Anytown	CA	90210	555-2345
7	Frank Black	404 Birch St	Anytown	CA	90210	555-6789
8	Grace Hall	505 Spruce St	Anytown	CA	90210	555-0123
9	Henry King	606 Willow St	Anytown	CA	90210	555-4567
10	Ivy Lee	707 Ash St	Anytown	CA	90210	555-8901
11	Jack Miller	808 Hickory St	Anytown	CA	90210	555-2345
12	Karen Davis	909 Walnut St	Anytown	CA	90210	555-6789
13	Leo Wilson	1010 Cherry St	Anytown	CA	90210	555-0123
14	Mary Taylor	1111 Peach St	Anytown	CA	90210	555-4567
15	Nathan Moore	1212 Plum St	Anytown	CA	90210	555-8901
16	Olivia Baker	1313 Apple St	Anytown	CA	90210	555-2345
17	Peter Clark	1414 Orange St	Anytown	CA	90210	555-6789
18	Quinn Adams	1515 Grape St	Anytown	CA	90210	555-0123
19	Rachel Nelson	1616 Lemon St	Anytown	CA	90210	555-4567
20	Samuel Hill	1717 Lime St	Anytown	CA	90210	555-8901
21	Tina Scott	1818 Coffee St	Anytown	CA	90210	555-2345
22	Victor King	1919 Tea St	Anytown	CA	90210	555-6789
23	Wendy Lee	2020 Herb St	Anytown	CA	90210	555-0123
24	Xavier White	2121 Spice St	Anytown	CA	90210	555-4567
25	Yvonne Black	2222 Sugar St	Anytown	CA	90210	555-8901
26	Zoe Green	2323 Salt St	Anytown	CA	90210	555-2345
27	Adam Brown	2424 Vine St	Anytown	CA	90210	555-6789
28	Bella Hall	2525 Olive St	Anytown	CA	90210	555-0123
29	Carl King	2626 Corn St	Anytown	CA	90210	555-4567
30	Dora Lee	2727 Bean St	Anytown	CA	90210	555-8901
31	Ethan Miller	2828 Lentil St	Anytown	CA	90210	555-2345
32	Fiona Davis	2929 Pea St	Anytown	CA	90210	555-6789
33	Gavin Wilson	3030 Chickpea St	Anytown	CA	90210	555-0123
34	Hannah Taylor	3131 Lentil St	Anytown	CA	90210	555-4567
35	Ian Moore	3232 Broad Bean St	Anytown	CA	90210	555-8901
36	Jessica Baker	3333 Kidney Bean St	Anytown	CA	90210	555-2345
37	Kyle Clark	3434 Navy Bean St	Anytown	CA	90210	555-6789
38	Laura Adams	3535 Black Bean St	Anytown	CA	90210	555-0123
39	Michael Nelson	3636 Pinto Bean St	Anytown	CA	90210	555-4567
40	Nicole Hill	3737 Lima Bean St	Anytown	CA	90210	555-8901
41	Oscar Scott	3838 Mung Bean St	Anytown	CA	90210	555-2345
42	Pamela King	3939 Soy Bean St	Anytown	CA	90210	555-6789
43	Quinn Lee	4040 Adzuki Bean St	Anytown	CA	90210	555-0123
44	Rachel White	4141 Black Bean St	Anytown	CA	90210	555-4567
45	Samuel Black	4242 Kidney Bean St	Anytown	CA	90210	555-8901
46	Tina Green	4343 Navy Bean St	Anytown	CA	90210	555-2345
47	Victor Brown	4444 Black Bean St	Anytown	CA	90210	555-6789
48	Wendy Hall	4545 Pinto Bean St	Anytown	CA	90210	555-0123
49	Xavier King	4646 Lima Bean St	Anytown	CA	90210	555-4567
50	Yvonne Lee	4747 Mung Bean St	Anytown	CA	90210	555-8901
51	Zoe White	4848 Soy Bean St	Anytown	CA	90210	555-2345
52	Adam Black	4949 Adzuki Bean St	Anytown	CA	90210	555-6789
53	Bella Green	5050 Black Bean St	Anytown	CA	90210	555-0123
54	Carl Brown	5151 Kidney Bean St	Anytown	CA	90210	555-4567
55	Dora Hall	5252 Navy Bean St	Anytown	CA	90210	555-8901
56	Ethan King	5353 Black Bean St	Anytown	CA	90210	555-2345
57	Fiona Lee	5454 Pinto Bean St	Anytown	CA	90210	555-6789
58	Gavin White	5555 Lima Bean St	Anytown	CA	90210	555-0123
59	Hannah Black	5656 Mung Bean St	Anytown	CA	90210	555-4567
60	Ian Green	5757 Soy Bean St	Anytown	CA	90210	555-8901
61	Jessica Brown	5858 Adzuki Bean St	Anytown	CA	90210	555-2345
62	Kyle Hall	5959 Black Bean St	Anytown	CA	90210	555-6789
63	Laura King	6060 Kidney Bean St	Anytown	CA	90210	555-0123
64	Michael Lee	6161 Navy Bean St	Anytown	CA	90210	555-4567
65	Nicole White	6262 Black Bean St	Anytown	CA	90210	555-8901
66	Oscar Black	6363 Pinto Bean St	Anytown	CA	90210	555-2345
67	Pamela Green	6464 Lima Bean St	Anytown	CA	90210	555-6789
68	Quinn Brown	6565 Mung Bean St	Anytown	CA	90210	555-0123
69	Rachel Hall	6666 Soy Bean St	Anytown	CA	90210	555-4567
70	Samuel King	6767 Adzuki Bean St	Anytown	CA	90210	555-8901
71	Tina Lee	6868 Black Bean St	Anytown	CA	90210	555-2345
72	Victor White	6969 Kidney Bean St	Anytown	CA	90210	555-6789
73	Wendy Black	7070 Navy Bean St	Anytown	CA	90210	555-0123
74	Xavier Green	7171 Black Bean St	Anytown	CA	90210	555-4567
75	Yvonne Brown	7272 Pinto Bean St	Anytown	CA	90210	555-8901
76	Zoe Hall	7373 Lima Bean St	Anytown	CA	90210	555-2345
77	Adam King	7474 Mung Bean St	Anytown	CA	90210	555-6789
78	Bella Lee	7575 Soy Bean St	Anytown	CA	90210	555-0123
79	Carl White	7676 Adzuki Bean St	Anytown	CA	90210	555-4567
80	Dora Black	7777 Black Bean St	Anytown	CA	90210	555-8901
81	Ethan Green	7878 Kidney Bean St	Anytown	CA	90210	555-2345
82	Fiona Brown	7979 Navy Bean St	Anytown	CA	90210	555-6789
83	Gavin Hall	8080 Black Bean St	Anytown	CA	90210	555-0123
84	Hannah King	8181 Pinto Bean St	Anytown	CA	90210	555-4567
85	Ian Lee	8282 Lima Bean St	Anytown	CA	90210	555-8901
86	Jessica White	8383 Mung Bean St	Anytown	CA	90210	555-2345
87	Kyle Black	8484 Soy Bean St	Anytown	CA	90210	555-6789
88	Laura Green	8585 Adzuki Bean St	Anytown	CA	90210	555-0123
89	Michael Brown	8686 Black Bean St	Anytown	CA	90210	555-4567
90	Nicole Hall	8787 Kidney Bean St	Anytown	CA	90210	555-8901
91	Oscar King	8888 Navy Bean St	Anytown	CA	90210	555-2345
92	Pamela Lee	8989 Black Bean St	Anytown	CA	90210	555-6789
93	Quinn White	9090 Pinto Bean St	Anytown	CA	90210	555-0123
94	Rachel Black	9191 Lima Bean St	Anytown	CA	90210	555-4567
95	Samuel Green	9292 Mung Bean St	Anytown	CA	90210	555-8901
96	Tina Brown	9393 Soy Bean St	Anytown	CA	90210	555-2345
97	Victor Hall	9494 Adzuki Bean St	Anytown	CA	90210	555-6789
98	Wendy King	9595 Black Bean St	Anytown	CA	90210	555-0123
99	Xavier Lee	9696 Kidney Bean St	Anytown	CA	90210	555-4567
100	Yvonne White	9797 Navy Bean St	Anytown	CA	90210	555-8901

**THE ATTENDANCE LIST OF THE MEETING**

Name of Meeting: General Meeting  
 Date: 10/10/2011  
 Location: Hotel Victoria  
 Time: 10:00 AM

No.	Name	Address	Phone	Signature	Signature	Signature
1	Mr. A. A. A.					
2	Mr. B. B. B.					
3	Mr. C. C. C.					
4	Mr. D. D. D.					
5	Mr. E. E. E.					
6	Mr. F. F. F.					
7	Mr. G. G. G.					
8	Mr. H. H. H.					
9	Mr. I. I. I.					
10	Mr. J. J. J.					

**THE ATTENDANCE LIST OF THE MEETING**

Name of Meeting: General Meeting  
 Date: 10/10/2011  
 Location: Hotel Victoria  
 Time: 10:00 AM

No.	Name	Address	Phone	Signature	Signature	Signature
1	Mr. A. A. A.					
2	Mr. B. B. B.					
3	Mr. C. C. C.					
4	Mr. D. D. D.					
5	Mr. E. E. E.					
6	Mr. F. F. F.					
7	Mr. G. G. G.					
8	Mr. H. H. H.					
9	Mr. I. I. I.					
10	Mr. J. J. J.					
11	Mr. K. K. K.					
12	Mr. L. L. L.					
13	Mr. M. M. M.					
14	Mr. N. N. N.					
15	Mr. O. O. O.					

THE ATTENDING LIST OF THE DEPT. OF

Name of County: San Diego 10/10/1918  
 Date: 10/10/1918  
 Name: San Diego  
 Title: San Diego

No.	First Name	Last Name	First Name	Last Name	First Name	Last Name
1	John	Smith	John	Smith	John	Smith
2	John	Smith	John	Smith	John	Smith
3	John	Smith	John	Smith	John	Smith
4	John	Smith	John	Smith	John	Smith
5	John	Smith	John	Smith	John	Smith
6	John	Smith	John	Smith	John	Smith
7	John	Smith	John	Smith	John	Smith
8	John	Smith	John	Smith	John	Smith
9	John	Smith	John	Smith	John	Smith
10	John	Smith	John	Smith	John	Smith

THE ATTENDING LIST OF THE DEPT. OF

Name of County: San Diego 10/10/1918  
 Date: 10/10/1918  
 Name: San Diego  
 Title: San Diego

No.	First Name	Last Name	First Name	Last Name	First Name	Last Name
1	John	Smith	John	Smith	John	Smith
2	John	Smith	John	Smith	John	Smith
3	John	Smith	John	Smith	John	Smith
4	John	Smith	John	Smith	John	Smith
5	John	Smith	John	Smith	John	Smith
6	John	Smith	John	Smith	John	Smith
7	John	Smith	John	Smith	John	Smith
8	John	Smith	John	Smith	John	Smith
9	John	Smith	John	Smith	John	Smith
10	John	Smith	John	Smith	John	Smith

#### 4.2.3 Attendant list of FGD 1 ID Poor

**THE ATTENDANCE LIST OF THE MEETING**

Name of meeting: FGD 1 ID Poor  
 Date: 20.05.2018  
 Location: Uluwatu, Bali  
 FGD Facilitator: Blom, G. / Hendri

No	Name	Sex	Age	Occupation	Initial Name	Signature
1	Mr. I. I. I.	M	45	Farmer		
2	Mr. I. I. I.	M	45	Farmer		
3	Mr. I. I. I.	M	45	Farmer		
4	Mr. I. I. I.	M	45	Farmer		
5	Mr. I. I. I.	M	45	Farmer		
6	Mr. I. I. I.	M	45	Farmer		
7	Mr. I. I. I.	M	45	Farmer		
8	Mr. I. I. I.	M	45	Farmer		
9	Mr. I. I. I.	M	45	Farmer		
10	Mr. I. I. I.	M	45	Farmer		

## 4.2.4 Attendant list of FGD 2 FHHs

**Attendant list of FGD 2 FHHs**

Date: \_\_\_\_\_  
 Time: \_\_\_\_\_  
 Location: \_\_\_\_\_

No.	Name	Age	Gender	Occupation	Religion	Signature
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

Name: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Date: \_\_\_\_\_

#### 4.2.5 Attendant list of FGD 3 Elders People

THE ATTENDANCE LIST OF THE MEETING						
Name of meeting: <u>Focus Group Discussion with Elders People</u> Date: <u>08/04/2020</u> Time: <u>11:00 AM</u> Location: <u>At the village hall</u>						
No.	Name	Age	Gender	Signature	Date of Birth	Phone Number
1.	Mr. T.	65	Male	[Signature]	1954-11-10	012
2.	Mr. A.	65	Male	[Signature]	1954-11-10	012
3.	Mr. A.	65	Male	[Signature]	1954-11-10	012
4.	Mr. A.	65	Male	[Signature]	1954-11-10	012
5.	Mr. A.	65	Male	[Signature]	1954-11-10	012
6.	Mr. A.	65	Male	[Signature]	1954-11-10	012
7.	Mr. A.	65	Male	[Signature]	1954-11-10	012
8.	Mr. A.	65	Male	[Signature]	1954-11-10	012
9.	Mr. A.	65	Male	[Signature]	1954-11-10	012
10.	Mr. A.	65	Male	[Signature]	1954-11-10	012
11.	Mr. A.	65	Male	[Signature]	1954-11-10	012
12.	Mr. A.	65	Male	[Signature]	1954-11-10	012
13.	Mr. A.	65	Male	[Signature]	1954-11-10	012
14.	Mr. A.	65	Male	[Signature]	1954-11-10	012
15.	Mr. A.	65	Male	[Signature]	1954-11-10	012

## 4.2.6 Attendant list of FGD 4 Disabled People

The accompanying list of the attendees

Name of meeting: FGD 4 Disabled People

Date: 18/05/2010

Location: St. Michael's Church

Facilitator: Dr. [Signature]

No.	Name	Gender	Age	Occupation	Current Residence	Signature
1	[Name]	M	45	Retired	[Address]	[Signature]
2	[Name]	F	55	Homemaker	[Address]	[Signature]
3	[Name]	M	60	Retired	[Address]	[Signature]
4	[Name]	F	50	Homemaker	[Address]	[Signature]
5	[Name]	M	40	Retired	[Address]	[Signature]
6	[Name]	F	55	Homemaker	[Address]	[Signature]
7	[Name]	M	65	Retired	[Address]	[Signature]
8	[Name]	F	50	Homemaker	[Address]	[Signature]
9	[Name]	M	45	Retired	[Address]	[Signature]
10	[Name]	F	55	Homemaker	[Address]	[Signature]
11	[Name]	M	60	Retired	[Address]	[Signature]
12	[Name]	F	50	Homemaker	[Address]	[Signature]
13	[Name]	M	40	Retired	[Address]	[Signature]
14	[Name]	F	55	Homemaker	[Address]	[Signature]
15	[Name]	M	65	Retired	[Address]	[Signature]
16	[Name]	F	50	Homemaker	[Address]	[Signature]
17	[Name]	M	45	Retired	[Address]	[Signature]
18	[Name]	F	55	Homemaker	[Address]	[Signature]
19	[Name]	M	60	Retired	[Address]	[Signature]
20	[Name]	F	50	Homemaker	[Address]	[Signature]
21	[Name]	M	40	Retired	[Address]	[Signature]
22	[Name]	F	55	Homemaker	[Address]	[Signature]
23	[Name]	M	65	Retired	[Address]	[Signature]
24	[Name]	F	50	Homemaker	[Address]	[Signature]
25	[Name]	M	45	Retired	[Address]	[Signature]
26	[Name]	F	55	Homemaker	[Address]	[Signature]
27	[Name]	M	60	Retired	[Address]	[Signature]
28	[Name]	F	50	Homemaker	[Address]	[Signature]
29	[Name]	M	40	Retired	[Address]	[Signature]
30	[Name]	F	55	Homemaker	[Address]	[Signature]
31	[Name]	M	65	Retired	[Address]	[Signature]
32	[Name]	F	50	Homemaker	[Address]	[Signature]
33	[Name]	M	45	Retired	[Address]	[Signature]
34	[Name]	F	55	Homemaker	[Address]	[Signature]
35	[Name]	M	60	Retired	[Address]	[Signature]
36	[Name]	F	50	Homemaker	[Address]	[Signature]
37	[Name]	M	40	Retired	[Address]	[Signature]
38	[Name]	F	55	Homemaker	[Address]	[Signature]
39	[Name]	M	65	Retired	[Address]	[Signature]
40	[Name]	F	50	Homemaker	[Address]	[Signature]
41	[Name]	M	45	Retired	[Address]	[Signature]
42	[Name]	F	55	Homemaker	[Address]	[Signature]
43	[Name]	M	60	Retired	[Address]	[Signature]
44	[Name]	F	50	Homemaker	[Address]	[Signature]
45	[Name]	M	40	Retired	[Address]	[Signature]
46	[Name]	F	55	Homemaker	[Address]	[Signature]
47	[Name]	M	65	Retired	[Address]	[Signature]
48	[Name]	F	50	Homemaker	[Address]	[Signature]
49	[Name]	M	45	Retired	[Address]	[Signature]
50	[Name]	F	55	Homemaker	[Address]	[Signature]
51	[Name]	M	60	Retired	[Address]	[Signature]
52	[Name]	F	50	Homemaker	[Address]	[Signature]
53	[Name]	M	40	Retired	[Address]	[Signature]
54	[Name]	F	55	Homemaker	[Address]	[Signature]
55	[Name]	M	65	Retired	[Address]	[Signature]
56	[Name]	F	50	Homemaker	[Address]	[Signature]
57	[Name]	M	45	Retired	[Address]	[Signature]
58	[Name]	F	55	Homemaker	[Address]	[Signature]
59	[Name]	M	60	Retired	[Address]	[Signature]
60	[Name]	F	50	Homemaker	[Address]	[Signature]
61	[Name]	M	40	Retired	[Address]	[Signature]
62	[Name]	F	55	Homemaker	[Address]	[Signature]
63	[Name]	M	65	Retired	[Address]	[Signature]
64	[Name]	F	50	Homemaker	[Address]	[Signature]
65	[Name]	M	45	Retired	[Address]	[Signature]
66	[Name]	F	55	Homemaker	[Address]	[Signature]
67	[Name]	M	60	Retired	[Address]	[Signature]
68	[Name]	F	50	Homemaker	[Address]	[Signature]
69	[Name]	M	40	Retired	[Address]	[Signature]
70	[Name]	F	55	Homemaker	[Address]	[Signature]
71	[Name]	M	65	Retired	[Address]	[Signature]
72	[Name]	F	50	Homemaker	[Address]	[Signature]
73	[Name]	M	45	Retired	[Address]	[Signature]
74	[Name]	F	55	Homemaker	[Address]	[Signature]
75	[Name]	M	60	Retired	[Address]	[Signature]
76	[Name]	F	50	Homemaker	[Address]	[Signature]
77	[Name]	M	40	Retired	[Address]	[Signature]
78	[Name]	F	55	Homemaker	[Address]	[Signature]
79	[Name]	M	65	Retired	[Address]	[Signature]
80	[Name]	F	50	Homemaker	[Address]	[Signature]
81	[Name]	M	45	Retired	[Address]	[Signature]
82	[Name]	F	55	Homemaker	[Address]	[Signature]
83	[Name]	M	60	Retired	[Address]	[Signature]
84	[Name]	F	50	Homemaker	[Address]	[Signature]
85	[Name]	M	40	Retired	[Address]	[Signature]
86	[Name]	F	55	Homemaker	[Address]	[Signature]
87	[Name]	M	65	Retired	[Address]	[Signature]
88	[Name]	F	50	Homemaker	[Address]	[Signature]
89	[Name]	M	45	Retired	[Address]	[Signature]
90	[Name]	F	55	Homemaker	[Address]	[Signature]
91	[Name]	M	60	Retired	[Address]	[Signature]
92	[Name]	F	50	Homemaker	[Address]	[Signature]
93	[Name]	M	40	Retired	[Address]	[Signature]
94	[Name]	F	55	Homemaker	[Address]	[Signature]
95	[Name]	M	65	Retired	[Address]	[Signature]
96	[Name]	F	50	Homemaker	[Address]	[Signature]
97	[Name]	M	45	Retired	[Address]	[Signature]
98	[Name]	F	55	Homemaker	[Address]	[Signature]
99	[Name]	M	60	Retired	[Address]	[Signature]
100	[Name]	F	50	Homemaker	[Address]	[Signature]

Source: [Name] (Interviewed on [Date])

#### 4.2.7 Attendant list of FGD 5 Youth (12-15 years old at High School)

**The ATTENDANT LIST OF THE FGD(Youth)**

Date: \_\_\_\_\_  
 Time: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Facilitator: \_\_\_\_\_

No.	Full Name	Age	Gender	Occupation	Phone Number	Address
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

(Signature of Facilitator)

(Signature of Participant)





**ATTENDANCE LIST OF THE MEETING**

**Name of the meeting:** *Local Authorities*

**Date:** *12/11/2019*

**Time:** *10:00 AM*

**Facilitator:** *Mr. [Name]*

**Recorder:** *Mr. [Name]*

No.	Name	Address	Phone	Signature	Remarks
1	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
2	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
3	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
4	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
5	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
6	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
7	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
8	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
9	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
10	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
11	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
12	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
13	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
14	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
15	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
16	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
17	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
18	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
19	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
20	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
21	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
22	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
23	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
24	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
25	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
26	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
27	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
28	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
29	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
30	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
31	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
32	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
33	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
34	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
35	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
36	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
37	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
38	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
39	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
40	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
41	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
42	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
43	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
44	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
45	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
46	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
47	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
48	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
49	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>
50	<i>Mr. [Name]</i>	<i>[Address]</i>	<i>[Phone]</i>	<i>[Signature]</i>	<i>[Remarks]</i>

**Signature of the Facilitator:** *[Signature]*

**Date:** *12/11/2019*

#### 4.2.10 Attendant list of FGD 8 Local Authorities

THE OFFICIAL LIST OF THE WRITERS						
Local Authors' Union						
— 1914-1915 —						
City of New York						
1914-1915						
No.	Name	Address	Profession	Age	Birth	Death
1	John G. Thompson	1234 5th Ave.	Writer	45	1869	1914
2	William D. Howells	1234 5th Ave.	Writer	45	1869	1914
3	Henry James	1234 5th Ave.	Writer	45	1869	1914
4	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
5	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
6	Jack London	1234 5th Ave.	Writer	45	1869	1914
7	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
8	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
9	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
10	Henry James	1234 5th Ave.	Writer	45	1869	1914
11	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
12	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
13	Jack London	1234 5th Ave.	Writer	45	1869	1914
14	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
15	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
16	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
17	Henry James	1234 5th Ave.	Writer	45	1869	1914
18	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
19	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
20	Jack London	1234 5th Ave.	Writer	45	1869	1914
21	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
22	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
23	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
24	Henry James	1234 5th Ave.	Writer	45	1869	1914
25	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
26	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
27	Jack London	1234 5th Ave.	Writer	45	1869	1914
28	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
29	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
30	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
31	Henry James	1234 5th Ave.	Writer	45	1869	1914
32	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
33	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
34	Jack London	1234 5th Ave.	Writer	45	1869	1914
35	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
36	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
37	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
38	Henry James	1234 5th Ave.	Writer	45	1869	1914
39	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
40	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
41	Jack London	1234 5th Ave.	Writer	45	1869	1914
42	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
43	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
44	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
45	Henry James	1234 5th Ave.	Writer	45	1869	1914
46	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
47	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
48	Jack London	1234 5th Ave.	Writer	45	1869	1914
49	Frank Norris	1234 5th Ave.	Writer	45	1869	1914
50	Walter Dill Scott	1234 5th Ave.	Writer	45	1869	1914
51	William Dean Howells	1234 5th Ave.	Writer	45	1869	1914
52	Henry James	1234 5th Ave.	Writer	45	1869	1914
53	Edith Wharton	1234 5th Ave.	Writer	45	1869	1914
54	Upton Sinclair	1234 5th Ave.	Writer	45	1869	1914
55	Jack London	1234 5th Ave.	Writer	45	1869	1914
56	Frank Norris	1234 5th Ave.	Writer	45	1869	1914

#### 4.2.11 Attendant list of NGOs/CBO

Total Participants : 2 (Male= 2 Female= 0.....)

[illegible]



# END OF MONTHLY LIST OF THE MEMBERS

Name (printing) \_\_\_\_\_  
 Sex \_\_\_\_\_  
 Age \_\_\_\_\_  
 Date of Birth \_\_\_\_\_

No.	First Name	Last Name	Address	Occupation	Religious Beliefs	Remarks
1	John	Doe	123 Main St.	Teacher	Methodist	Active
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

THIS LIST IS FOR THE MONTH OF \_\_\_\_\_, 19\_\_\_\_.

### 4.3 Activities of Public consultants

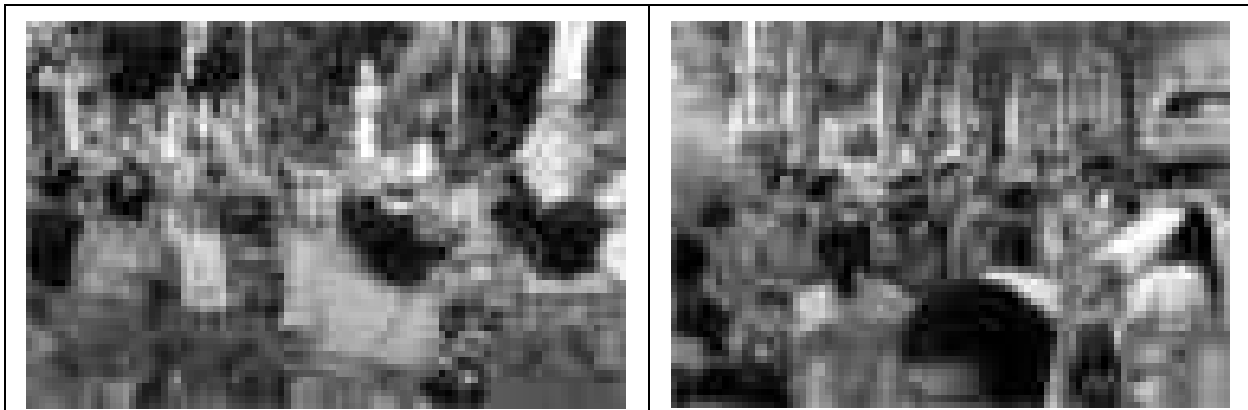
#### 4.3.1 Activity of the general meeting

			
			
The General consultation in Urban Area			
			
The General consultation in Rural Area			

#### 4.3.2 Activity of the FGD 1 ID Poor



#### 4.3.3 Activity of the FGD for Female Household



#### 4.3.4 Activity of the FGD with Elders people





#### 4.3.5 Activity of the FDG with Disable people



#### 4.3.6 Activity of the FDG with Youth



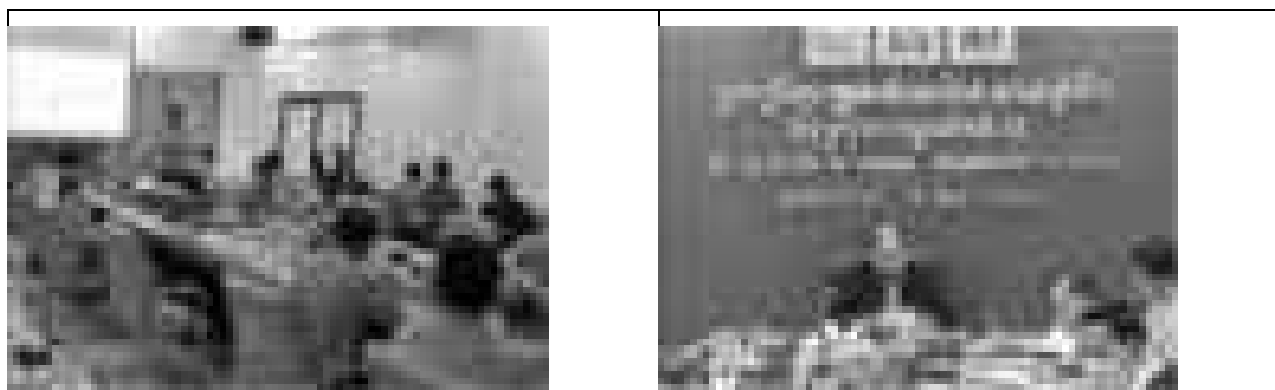
#### 4.3.7 Activity of the FGD with indigenous people



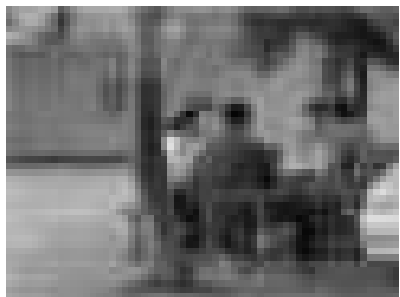

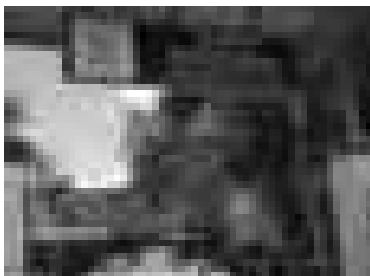
#### 4.3.8 The activities of the FGD with informal workers in solid waste management



#### 4.3.9 The activities of local authority meeting



#### 4.3.10 The activities of the meeting with NGOs-CBO

		
Imparting Smile Association Cambodia	Don Bosco	Damnok Toek

## 5. Safeguards Monitoring Report Template

### Semi-Annual Environmental Monitoring Report

---

**COUNTRY [complete]**

**Ministry of [complete]**

---

**[Project Number/Name]**

**Reporting Period:** *[date covered by this report]*

**Date:** *[date of issue of this report]*

**SEMR Report Number:** *[1, 2 or 3 ... – depending on how many SEMRs issued before]*

## Contents

1	ENVIRONMENTAL SAFEGUARDS SUMMARY .....	1
1.1	Summary of Project Progress .....	1
1.2	Summary of EMP Implementation.....	2
1.3	Summary of EMP Monitoring .....	2
1.4	Summary of Complaints, Issues and Corrective Action .....	2
2	SAFEGUARDS STAFF, TRAINING AND DOCUMENTATION.....	3
2.1	Implementation Arrangements .....	3
2.2	Training & Capacity Building .....	4
2.3	ADB Approvals .....	5
2.4	National Approvals.....	5
2.5	Construction Environmental Management Plan (CEMP) Approvals .....	6
3	EMP IMPLEMENTATION .....	7
3.1	Environmental Performance.....	7
3.2	Health and Safety Performance .....	10
4	EMP MONITORING.....	12
4.1	Environmental Quality Monitoring .....	12
4.2	Construction Phase Affected People Consultation .....	13
5	COMPLAINTS, ISSUES, CORRECTIVE ACTION .....	14
5.1	Information Disclosure .....	14
5.2	Grievance Redress Mechanism .....	15
5.3	Corrective Action .....	16
6	CONCLUSION & RECOMMENDATION .....	17

## Tables

Table 1	Project Progress Summary.....	1
Table 2.	Status of Environmental Safeguard Roles .....	3
Table 3.	Environmental Safeguards Training Provided and Planned.....	4
Table 4.	Status of Environmental Safeguard Documents .....	5
Table 5.	Status of National Approvals for Environmental Documents.....	5
Table 6.	Status of CEMP Approvals .....	6
Table 7.	Status of EMP Compliance [subproject] .....	7
Table 8.	EMP– Actions Needed for Compliance [subproject] .....	8
Table 9.	EMP Compliance Outstanding Issues from Previous Report(s) [subproject].....	9
Table 10.	Status of Health and Safety Compliance - ALL subprojects.....	10

Table 10. Status of Health and Safety Actions Needed for Compliance - ALL subprojects..	11
Table 11. EMP Compliance Outstanding Issues from Previous Report(s) – ALL subprojects	12
Table 12. EMP Environmental Quality Monitoring Requirements .....	12
Table 13. EMP Environmental Quality Monitoring implemented .....	13
Table 14. Construction Phase Affected People Consultation.....	14
Table 15. Information Disclosure.....	14
Table 16. Project Complaints or Issues .....	15
Table 17. Project Complaints or Issues – Not resolved from previous reports.....	16
Table 18. Corrective Action Issued.....	16

## **Annexes**

Annex 1 Environmental Quality Monitoring Results.....	18
Annex 2 Photo Record – Visits, Monitoring, Consultation.....	19

## Notes on this template:

[**Advice:** text in red] - this gives the PMU help on what information to add into the sections of the report. **Delete** the red text when the report is complete.

[text in yellow] - delete this text and add the relevant answer. **Delete** the text in yellow when the answers are completed.

## 1 ENVIRONMENTAL SAFEGUARDS SUMMARY

[Advice: Complete this summary under each heading. This summary can be copied directly into the main report to support with the Main Report preparation]

1. The [1st,2nd, 3rd etc] Semi-annual Environment Monitoring Report (SEMR) covers the period of [start month – end month and year] for [Project Name]. The SEMR has been prepared to fulfil the safeguard policy requirement of ADB.
2. The SEMR is prepared by [name of organisation and function e.g External Monitoring Consultant or Support Consultant] and checked by [PMU or Ministry].

### 1.1 Summary of Project Progress

[Advice: Complete the summary table below. Section 2 gives more detail Project Progress]

3. The following table gives a brief summary of the project progress for contract award, construction and key activities in this reporting period:

**Table 1 Project Progress Summary**

Safeguards Category	Environment	B	
Reporting Period:	[Months/ Year]	Date Last Report Issued:	[Month/ Year]
<b>Contracts Awarded to Date:</b>	[Advice: For each Civil Works Contract to be awarded, give progress to date] CW1 [contractor name, award date, subproject] CW2 [contractor name, award date, subproject]		
<b>Construction Progress to Date:</b>	[Advice: For each Civil Works Contract to be awarded, at END of Reporting Period] As of [Month/Year of this reporting period] the physical construction progress is as follows:  CW1 [x %] construction completed CW2 [x %] construction completed		
<b>Key Sub-project Activities in this Reporting Period:</b>	[Advice: For each Civil Works (CW) Contract, write the key activities that have taken place on construction sites during the 6 months covered in this report]  Construction Activities CW1 [e.g. ground clearance and preparation, excavation of site] CW2 [e.g. ground clearance and preparation, excavation of site]  [Advice: Include any consents or permissions in this section such as UXO clearance, EIA Approval, Waste disposal permission – include any issued during the 6 months covered in this report]  Permits or Consents Issued: Permit / Consent for [activity] issued by [Authority] on [date]		

## 1.2 Summary of EMP Implementation

[**Advice:** This section gives a high level summary of how the progress on implementing the EMP and the mitigation measures is progressing, in this reporting period. Consider any main issues – the detail will be in the EMP Implementation section of the main report]

4. EMP implementation is summarised in the following points, for this reporting period:

- [mitigation measures in use]
- [overall progress and performance of contractors]
- [other issues affecting project environmental performance?]

## 1.3 Summary of EMP Monitoring

[**Advice:** This section gives a high level summary of how the EMP has been monitored in this reporting period. This includes site visits by PIU, PMU, Construction Supervision Contractor, Independent Monitoring Organisation. The EMP will say who should be monitoring and when. Detail will be in the EMP Monitoring section of the main report]

5. EMP monitoring is summarised in the following points, for this reporting period:

- Number of Monitoring Visits to Construction Site and wider area:
  - [Number of] visits by PMU/PIU
  - [Number of] visits by [others e.g. Independent Monitoring Organisation, MoE, CSC]
- Number of Environmental Samples Tested:
  - [Number of] water quality samples tested
  - [Number of] air quality samples tested
  - [Number of] water quality samples tested

## 1.4 Summary of Complaints, Issues and Corrective Action

[**Advice:** This section informs the Project and ADB of any potential problems that have been addressed or need to be addressed. It can include formal complaints through project Grievance Redress Mechanism. This is main issues only – the detail will be in the Corrective Actions/GRM part of the main report]

6. Any complaints, issues and corrective action that has been identified or implement is summarised in the following points, for this reporting period:

- Issues Raised: [issues on construction sites e.g. dust, noise, traffic]
- Grievances Raised with GRM: [Number of] grievances
- Corrective Action issued by project to Contractor:
  - [problem that needed corrective action]
  - [problem that needed corrective action]



## 2 SAFEGUARDS STAFF, TRAINING AND DOCUMENTATION

### 2.1 Implementation Arrangements

**[Advice:** This section confirms if all roles have staff allocated, or if there are more people to recruit. It confirms if there are resources available for the project for Environmental Safeguards. If resources are not available e.g. cannot find the skills, or people have no time, say so here]

7. The EMP defines the Environmental Safeguards roles and responsibilities. The roles are required to be filled in order to meet the EMP requirements. The following table gives the status of the key roles for EMP implementation:

**Table 2. Status of Environmental Safeguard Roles**

Safeguards Role	Status & Comment			
[see EMP for list of roles required e.g. Project Consultant Environmental Specialist]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[e.g. PMU- Environmental Control Officer (ECO)]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[e.g. PIU Environmental And Social Safeguards Staff ]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[e.g. PIU GRM Focal Point ]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[e.g. CSC]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		

[e.g. Environmental Monitoring Consultant (EMC)]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[e.g. Contractor Environment Health & safety Staff]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		
[others? E.g Contractor GRM Person]	<b>Date Started:</b>	[date]	Full Time/ Part Time	[FT/PT]
	<b>Comment</b>	[Person Identified? Problems identifying person? No time available?]		

8. The project concludes that the environmental safeguards roles are [conclusion – enough people? Enough budget for staff? Other conclusion or comment?]

## 2.2 Training & Capacity Building

[see EMP for list of training required]

9. The following table gives the environmental safeguards training courses that have been completed during this reporting period and the planned training courses for the next six months:

**Table 3. Environmental Safeguards Training Provided and Planned**

Training Course Title	Training Date	Participants	Training Provider
[E.g CEMP /EMP preparation]	[date – completed or future]	[e.g. No. of PIU/PMU, Contractors]	[e.g. Support consultants, MoE, Independent trainer]

### 2.3 ADB Clearances

**[Advice:** This section updates ADB with the current progress on the EMP and IEE for the project. Ensure the up to date documents are available and it is clear which is the latest version of each document]

10. The following table gives information on the status of the safeguards documents.

**Table 4. Status of Environmental Safeguard Documents**

Safeguards Documents	Update Issued (Latest Version)	Submitted to MoE	Submitted to ADB
[e.g. IEE]	[date]	[date or Not Applicable]	[date]
[e.g. EMP subproject 1]	[date]	[date or Not Applicable]	[date]
[e.g. EMP Subproject 2]	[date]	[date or Not Applicable]	[date]
[e.g. EMP Subproject 3]	[date]	[date or Not Applicable]	[date]

### 2.4 National Approvals

**[Advice:** This section updates ADB with the current progress on any national approvals and/or certifications needed such as final Environmental Impact Assessment (EIA), IEIA, ECC, Environmental Protections Contract, etc. (varies from country to country) or EMP approvals from the relevant Ministry. If there is no change between this reporting period and the last, the table in the previous report can be used here]

11. The following table gives an update on the necessary national approvals required for the project to proceed.

**Table 5. Status of National Approvals for Environmental Documents**

Documents	Submitted to MoE	Approved By	Status – if not	Comment
-----------	------------------	-------------	-----------------	---------

[PROJECT NAME]

		MoE:	approved	
[e.g. EIA]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	[add any further comment/ suggestion here]
[e.g. EMP subproject 1]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	
[e.g. EMP Subproject 2]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	
[e.g. EMP Subproject 3]	[date or Not Applicable]	[date]	[e.g on going, expected July 2020]	

## 2.5 Construction Environmental Management Plan (CEMP) Approvals

**[Advice:** This section updates ADB on whether the contractor's have submitted the CEMP for each civil works package, and if the quality of the CEMP is suitable. *ADB would also need assurance that the CEMPs have updated health and safety plans in line with national legislation and any WHO best practices to ensure the necessary COVID-19 mitigation and safety measures are in place to ensure workers health and safety.*]

12. The following table confirms the status of the Construction Environmental Management Plan (CEMP) for each CW package:

**Table 6. Status of CEMP Approvals**

Civil Works Package/ Subproject	CEMP Given to PMU	Approved By PMU:	Comment:
[e.g. CW01 Wastewater]	[date]	[Yes & Date or No]	[E.g. quality of CEMP? Good quality? Easy to monitor, generally complies with ADB?]
[e.g. CW02 Landfill]	[date]	[Yes & Date or No]	

[e.g. CW03 Drainage]	[date]	[Yes & Date or No]	
----------------------	--------	--------------------	--

### 3 EMP IMPLEMENTATION

#### 3.1 Environmental Performance

**[Advice:** This is the most important table showing if the Safeguard requirements are being followed. This section is summarised for Section 1: Summary. The summary will be included in the main 6 monthly report for the entire project. Use all the monthly reports from PIU, PMU, GRM, Contractor, construction supervision consultant etc to complete this table. ]

13. The following table gives the environmental impact mitigation measures in the Borrower (Project) EMP and the corresponding CEMP and how the project is progressing with implementing the mitigation measures, for each subproject.

14. The evidence for the compliance is through a combination of:

- Site visits to observe site practices;
- Consultation with affected people;
- Regular environmental reporting from [CSC, Contractor, others, according to EMP requirements].

**[Advice:** This table needs to be repeated for each sub-project. Each subproject can EMP has different Mitigation Measures & progress to report on. **Health & safety** Mitigation measures are reported separately]

**Table 7. Status of EMP Compliance [subproject]**

	<b>EMP Requirement (Mitigation Measure)</b>	<b>Compliance &amp; Description (Yes, No, Partial)</b>	<b>Comment or Further Explanation if Needed</b>	<b>Reasons for Not Full Compliance</b>
1	Example 1. Worker Camp Sanitation	<b>Yes</b>	Camp includes septic tank which is installed	-
2	Example 2. Noise and Dust	<b>Partial</b>	Contractor given corrective action issued <b>21-</b>	-Water is not sprayed 2x daily;

[PROJECT NAME]

	Management		<b>07-19:</b> -Spray 3x daily -Start work 7am	-Working outside allowed hours, starting at 6:30am
1	[mitigation measure]	[Yes/No/Partial]	[comment on evidence of compliance if needed – any additional information]	[give reason/evidence for non-compliance]
2				
3				
4				
5				
6	[continue]			

15. For all 'Partial' or 'No' compliance issues in the table above, the actions needed to solve the compliance issues are in the table below:

[**Advice:** For any Partial or Not Compliance issues in the table above, the table below shows ADB what actions will be taken to ensure compliance]

**Table 8. EMP– Actions Needed for Compliance [subproject]**

	EMP Requirement	Further Action to Take	Date for Action	Who will Implement Action

	EMP Requirement	Further Action to Take	Date for Action	Who will Implement Action
02	Noise and dust management	Contractor should not start work before 7am  Contractor should spray water minimum 3x daily	End of Sep. 2020	Contractor
	[requirement from table above for non-compliant issues]	[action needed to make issue compliant]	[deadline for action]	[who implements action]

16. The following table gives information on environmental performance issues from previous Environmental Monitoring Reports. This table confirms that the action was completed or that the action is outstanding.

[Advice: This table shows the result/outcome of Actions needed to be taken in the previous report (this means follow up Table 8, above, of previous EMR)]

**Table 9. EMP Compliance Outstanding Issues from Previous Report(s) [subproject]**

EMP Requirement	Further Action to Take	Responsibility and Timing	Resolution	Required Action
Example 1. Water pollution from sediment	<b>Change construction drainage</b>	Contractor – by 2 April 2020	<b>Completed</b> – Action was taken and confirmed by PIU visit 4 <sup>th</sup> April 2020	None

[PROJECT NAME]

[complete for each issue]				
---------------------------	--	--	--	--

### 3.2 Health and Safety Performance

**[Advice:** This reports on any health and safety requirements for the project that the contractor needs to fulfil. This can be combined for all subprojects with similar H&S requirements. *Due to the COVID-19 reporting on specific measures that are in place in line with national legislation and requirements for the pandemic need to be included. ADB would also need assurance that the CEMPs have updated health and safety plans in line with national legislation and any WHO best practices to ensure the necessary COVID-19 mitigation and safety measures are in place.]*

17. The following table gives the Health and Safety impact mitigation measures in the Borrower EMP and how the project is progressing with implementing the mitigation measures, for all subprojects.

**Table 10. Status of Health and Safety Compliance - ALL subprojects**

	<b>Health and Safety Requirement</b>	<b>Compliance &amp; Description (Yes, No, Partial)</b>	<b>Comment or Further Explanation if Needed</b>	<b>Reasons for Not Full Compliance</b>
1	Example 1. Workers Need to wear protective clothing	<b>Partial</b>	<b>Subproject: Landfill</b> Workers are not all wearing hard hats and high visibility Workers seen without safety boots	- Re-issue safety clothing to those without -Training on staff to remind them to wear it 18 <sup>th</sup> August 2020
2	Example 2. First Aid kit needed on site	<b>Yes</b>	<b>Subproject: All</b> First Aid Kit available in site offices	None
	[complete for each issue]			



18. For all 'Partial' or 'No' compliance issues in the table above, the actions needed to solve the compliance issues are in the table below:

[Advice: For any Partial or Not Compliance issues in the table above, the table below shows ADB what actions will be taken to ensure compliance]

**Table 11. Status of Health and Safety Actions Needed for Compliance - ALL subprojects**

	<b>Health and Safety Requirement</b>	<b>Further Action to Take</b>	<b>Date for Action</b>	<b>Who will Implement Action</b>
1	Example 1. Workers Need to wear protective clothing	All workers to be given and wear safety clothing	25 <sup>th</sup> August 2020	Contractor
	[complete for each issue]			

19. The following table follows up on Health and Safety performance issues from previous Environmental Monitoring Reports for this subproject. This table confirms that the action was completed or that the action is outstanding.

[Advice: This table shows the result/outcome of Actions needed to be taken in the previous report (this means follow up Table 11, above, of previous EMR)]

[PROJECT NAME]

**Table 12. EMP Compliance Outstanding Issues from Previous Report(s) – ALL subprojects**

Issue	Required Action	Responsibility and Timing	Resolution	Required Action
Example 1. Water pollution from sediment	<b>Change construction drainage</b>	Contractor – by 2 September 2020	Completed – Action was taken and confirmed by PIU visit 4 <sup>th</sup> April 2020	None

## 4 EMP MONITORING

[Advice: This section should show the progress made against the monitoring that is required in the EMP for each subproject. This is a combination of environmental quality monitoring (e.g. taking samples or water, noise measurements) and monitoring the EMP performance by consulting affected people.]

### 4.1 Environmental Quality Monitoring

20. Environmental quality monitoring requirements are defined in the Monitoring Plan section of the EMP. The following table gives a summary of the environmental quality monitoring requirements for each subproject

**Table 13. EMP Environmental Quality Monitoring Requirements**

Subproject	Environmental Issue Monitored	Location	Parameters	Responsible Organisation	Frequency
[use EMP to complete this table e.g Subproject 1 ]	[noise ]	[primary school ]	[DbA ]	[Contractor ]	[every 3 months ]
[Subproject 1 ]	[water ]	[stream ]	[chemicals/temp ]	[Contractor ]	[every 3 months ]
[Subproject 2 ]	[noise ]	[hospital ]	[DbA ]	[Contractor ]	[every 3 months ]

--	--	--	--	--	--

21. The following table gives information on the environmental quality monitoring implemented, during this reporting period. Detailed results compared to relevant national / international standards are in Annex 1.

**Table 14. EMP Environmental Quality Monitoring implemented**

Subproject	Environmental Issue Monitored	Location	Monitoring Date
[Subproject 1 ]	[Noise ]		
[Subproject 1 ]	[Surface Water Quality ]		
[Subproject 1 ]	[Groundwater Quality ]		

22. **Summary of Results – Noise.** [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

23. **Summary of Results – Surface Water quality.** [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

24. **Summary of Results – Groundwater quality.** [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

25. **Summary of Results – Air quality.** [one paragraph summary on the results – eg. do they meet national standards, international standards? Does it show a good quality or poor quality environment?].

## 4.2 Construction Phase Affected People Consultation

[Advice: Complete the table below with the consultations undertaken during construction site monitoring. This is usually undertaken by project staff e.g. PIU or PMU]

[PROJECT NAME]

26. During the construction phase, the following table gives information on the consultations that were undertaken in order to understand the impact of the project on Affected People and how effective the EMP Mitigation measures are for residents, businesses and other affected people around the construction sites.

**Table 15. Construction Phase Affected People Consultation**

Subproject	Consultation Date	Person Consulted / Location	Outcome / Issues	Corrective Action Needed	Action Implemented by (person/date)
[Subproject 1 ]	[date ]	[e.g. group of 5 residents, outside commune office ]	[Issues raised or General comment from person on project]	[Describe how this issue will be solved ]	[e.g Contractor, by June 14 2020]

## 5 COMPLAINTS, ISSUES, CORRECTIVE ACTION

### 5.1 Information Disclosure

[**Advice:** In this section, provide information on any public meetings, dissemination of information that has taken place to give information to the public. Some of this will take place in the 'before construction' phase, when the project is being prepared. For the FIRST SEMR, include information on pre-construction disclosure activities such as GRM dissemination.]

27. The following table gives information on any information disclosure activities undertaken;:

**Table 16. Information Disclosure**

Topic / Reason for Information	Disclosure Date	Method of Disclosure	Outcome / Results
[e.g. new project schedule, update on GRM, change to construction plans]	[date ]	[e.g. information board, meeting, leaflet ]	[Issues raised or outcome of meeting]

--	--	--	--

## 5.2 Grievance Redress Mechanism

**[Advice:** In this section include any complaints made through the GRM INCLUDING those made during any consultation with Affected People – such as issued raised in Table 15 . Include any complaints made that have already been resolved e.g. resolved during time of consultation]

28. The following table gives information on complaints about the project the Project Team is aware of, during this reporting period. The table includes:

- Complaints made thorough GRM entry points
- Issues raised in consultation;
- Issues raised any other way that the project team is aware of.

29. For issues that have already been solved, this is confirmed in the final column of the table. Where possible the project tries to solve all issues as quickly as possible through informal discussions between the affected people and the contractor.

**Table 17. Project Complaints or Issues**

Details of Complaint / Issue Raised	Detail of Person (Date, Name, Contact Details)	Action Needed & Date	Comment / Resolved?
[e.g. noise/dust, poor access to house, affected water supply]	[date , Name of Person, Phone number/village location]	[e.g. contractor to reinstate water supply by 19 <sup>th</sup> June 2020 ]	[Issue solved. Action has been taken and Affected Person is satisfied. PIU followed up.]

[PROJECT NAME]

30. The following table gives information on all issues raised in previous SEMRs which are not yet resolved:

**Table 18. Project Complaints or Issues – Not resolved from previous reports**

Details of Complaint	Detail of Person (Date, Name, Contact Details)	Action Needed & Date	Reason this is still not resolved
[e.g. noise/dust, poor access to house, affected water supply]	[date , Name of Person, Phone number/village location]	[e.g. contractor to reinstate water supply by 19 <sup>th</sup> June 2020]	[explain why the problem continues.]

### 5.3 Corrective Action

[**Advice:** In this section, provide information on any formal corrective action that had to be issued to change practices on the construction site] being

31. The following table gives information on any formal corrective action that has been issued to the contractor in order to improve environmental performance:

**Table 19. Corrective Action Issued**

Reason for Corrective Action	Date Issued	Outcome	Comment / Follow Up
[e.g. water supply damaged to village]	[date ]	[e.g. Contractor formally requested to repair water supply and compensate people. This was undertaken. ]	[PIU will monitor the water supply monthly]

## 6 CONCLUSION & RECOMMENDATION

**[Advice:** Summarise if the EMP is being followed and if the Environmental Safeguards are adequate. Make recommendations on what will happen to improve the project environmental performance in the next reporting period]

32. Conclusion: [on general environmental progress]

33. Recommendations: [ on next steps and actions to take to make improvements in environmental performance of the project]

## **Annex 1 Environmental Quality Monitoring Results**

[Insert Table of results and relevant national/international standard]



## **Annex 2 Photo Record – Visits, Monitoring, Consultation**

**Photographs of Site Visits**

**Photographs of Environmental Quality Monitoring**

**Photographs of Consultation**

## 6. GRM Complaint Form

The \_\_\_\_\_ Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing \*(CONFIDENTIAL)\* above your name.

Thank you.

<b>Date</b>		<b>Place where grievance is filed:</b>			
<b>Contact Information/Personal Details</b>					
<b>Name</b>		<b>Gender</b>	* Male * Female	<b>Age</b>	
<b>Home Address</b>					
<b>Place</b>					
<b>Phone No.</b>					
<b>E-mail</b>					
<b>Complaint/Suggestion/Comment/Question details (who, what, where, and how) of your grievance below:</b>					
<b>How do you want us to reach you for feedback or update on your comment/grievance?</b>					
<u>If included as attachment/note/letter, please stick here:</u>					

Grievance ID:

