Initial Environmental Examination

April 2021

Cambodia: Second Urban Environmental Management in the Tonle Sap Basin Project

Stueng Saen: Solid Waste Management, Kampong Thom Province

Prepared by Ministry of Public Works and Transport for the Asian Development Bank. This is an updated version of the draft originally posted in May 2018 available on https://www.adb.org/projects/documents/cam-50102-002-iee.

CURRENCY EQUIVALENTS

(as of February 2020)

Currency unit	–	riel (KR)
KR 1.00	=	$ 0.000250
$1.00	=	KR 4,000

ABBREVIATIONS

ADB	–	Asian Development Bank
AH	–	Affected Household
BOD	–	Biochemical Oxygen Demand
CDIA	–	Cities Development Initiative for Asia
CEMP	–	Construction Environmental Management Plan
C-EHS	–	Contractor Environmental Health and Safety Officer
CMAC	–	Cambodia Main Action Center
COD	–	Chemical Oxygen Demand
COI	–	Corridor of Impact
CRVA	–	Climate Risk Vulnerability Assessment
DDPP	–	Detailed Design and Project Preparation
DMS	–	Detailed Measurement Survey
EA	–	Executing Agency
EAG	–	Environmental Assessment Guidelines
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
FGD	–	Focus Group Discussion
FS	–	Feasibility Study
GHG	–	Greenhouse Gas
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IBA	–	Important Bird Area
IEE	–	Initial Environmental Examination
IESIA	–	Initial Environmental and Social Impact Assessment
IRC	–	Inter- Ministerial Resettlement Committee
IRP	–	Income Restoration Plan
I/NES	–	International and National Environmental Specialists
KBA	–	Key Biodiversity Area
MAFF	–	Ministry of Agriculture, Forest, and Fishery
MoE	–	Ministry of Environment
MOWRAM	–	Ministry of Water Resources and Meteorology
MPWT	–	Ministry of Public Works and Transport
PDoE	–	Provincial Department of Environment
PDAFF	–	Provincial Department of Agriculture, Forest, and Fishery
PDPWT	–	Provincial Department of Public Works and Transport
PMC	–	Project Management Consultants
PMC-I/NES	–	PIM-International and National Environment Specialists
PIB	–	Public Information Brochure
PIU	–	Project Implementation Unit
PIU-SFP	–	PIU Safeguards Focal Point
PMC	–	Project Management Consultants
PMU	–	Project Management Unit
PMU-ESO	–	PMU Environmental Safeguards Officer
PPE	–	Personal Protective Equipment
PPTA	–	Project Preparation Technical Assistance
PSC	–	Project Steering Committee
RCP	–	Representative Concentration Pathway
RF	–	Resettlement Framework

RGC	–	Royal Government of Cambodia
SEC	–	Social Economic Survey
SHC	–	Sewer Household Connection
SOP	–	Standard Operation Procedures
SPS	–	Safeguards Policy Statement
TS-1	–	Tonle Sap Urban Environmental Improvement Project
TSBR	–	Tonle Sap Biosphere Reserve
TSS	–	Total Suspended Solid
UXO	–	Unexploded Ordnance
WG	–	Working Group
WHO	–	World Health Organization
WSP	–	Waste Stabilization Ponds
WWTP	–	Sewage Treatment Plant

WEIGHTS AND MEASURES

dBA	–	A-weighted Decibel
km	–	Kilometre
km2	–	Square kilometre
LAeq	–	Equivalent Continuous Level 'A weighting' - 'A'-weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies
m	–	Meter
^{oC}	–	Degree Celsius
PM10	–	Particulate Matter 10 micrometres or less
PM2.5	–	Particulate Matter 2.5 micrometres or less
µg/m3	–	Microgram per cubic meter

GLOSSARY

District	–	Sub-divisions of the 24 provinces in Cambodia
Commune	–	Sub-divisions of districts, referred to as Sangkats in urban areas

NOTE

(i) In this report, "$" refers to United States dollars.

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1. EXECUTIVE SUMMARY

1.1. The Project

1. The Second Urban Environmental Management in the Tonle Sap Basin Project (TS2 Project) will support the Government of Cambodia in improving urban services and enhancing climate resilience in the Tonle Sap Basin. The project is part of ADB's programmatic approach in the Tonle Sap Basin, and will build on an ongoing project, under which similar interventions are financed in two of the basin's towns.

2. The TS2 Project focuses on improvement of solid waste management through the development of controlled landfills, and improvement of wastewater treatment, through the development of urban wastewater infrastructures and storm water drainage. A summary of the project interventions and their locations is shown in Table 1.

Table 1: Summary of Project Interventions

Subproject City	Wastewater Treatment Plant and Network	Stormwater Drainage	Engineered Landfill
Serei Saophoan	✓	✓	✓
Battambang	✓	×	✓
Stueng Saen	✓	✓	✓

3. Stueng Saen has one existing dump site, which has been operating for about 21 years. The site is being operated as an uncontrolled dump with limited environmental controls and is resulting in significant socio-environmental impacts. The site is about a hectare in size with waste deposited to a depth of up to four metres. The waste has not been profiled, compacted nor regularly covered with soil and is simply left exposed and then burnt. Consequently, this site will need to be rehabilitated.

4. The objective of this subproject is to replace the current dumpsite used for waste disposal with a controlled engineered landfill.

5. The Project Preparation Technical Assistance (PPTA) (SCE, 2019) considered a range of landfill standards and determined that the appropriate type would be controlled landfills with the following general characteristics:

- Site with regard to hydrogeology.
- Planned cell development.
- Grading, drainage in site preparation.
- Improved leachate and surface water management.
- Regular (not usually daily) cover.
- Waste compaction.
- Fencing.
- Basic record-keeping.
- Controlled waste picking.
- Gas management.
- Monitoring of groundwater.

6. With a design period of 20 years, the project components/facilities were planned up to the year 2040, with operations expected to commence in 2022. The conceptual designs prepared during the feasibility study stage formed the basis for the detailed designs which have been prepared in conjunction with this IEE thus ensuring consistency between the environmental requirements and engineering designs. Investment works to be implemented for Stueng Saen under Tonle Sap 2 project comprises the following:

- Upgrading of access road to the landfill site: 2,150 metres of dirt road to be upgraded to a 6 m wide concrete road above flood levels.
- Construction of one controlled landfill cell out of a total of three cells.

- Construction of one hazardous waste landfill cell.
- Construction of a non-mechanical type materials recovery facility (MRF).
- Construction of drainage, leachate collection, treatment, and recirculation system.
- Construction of weighbridge and office building; staff dining and rest room; workshop, electrical and mechanical room, and supply building.
- Construction of 1,403 metres of concrete internal roads, bunds, and drainage system.
- Construction of wire mesh fencing, and entrance wall, gate and security guardhouse.
- Construction of car/ vehicle washing facility.
- Construction of a facility for temporary storage of hazardous waste.
- Provision of operations & maintenance (O&M) equipment.

7. The wider ADB project "Second Urban Environmental Management in the Tonle Sap Basin Project" involves the closure of the existing dumpsite in Stueng Saen. The closure of the dumpsite is planned to occur immediately following the opening of the new landfill. This dumpsite is an Existing Facility of the wider project which means that an Environmental Compliance Audit (ECA) shall be carried out for that facility pursuant to the ADB Safeguards Policy Statement (SPS) (2009) (ref: section 4.6. Associated & Existing Facilities). The ECA is not part of this subproject but will be prepared separately for the dumpsite closure and remediation under a separate subproject. The current sub-project (construction of new engineered landfill) does not have any existing or associated facilities.

8. The method of closure and remediation of the dumpsite will be determined based on the ECA. Basically, there are three conceptual methods for closure and remediation[1]:

(i) In-place closure by capping the waste
(ii) Closure by upgrading into a controlled engineered landfill, and
(iii) Closure by removing the waste from the dump and disposing it at the new landfill.

The key objectives of closing and remediating the existing dumpsite include:

(i) Minimise the risk that leachate from the dump may infiltrate groundwater resources that are or may in the future be used as a source of drinking water
(ii) Minimise the risk of contamination of nearby waterways
(iii) Minimise the risk to public health from spread of infections
(iv) Eliminate the generation of harmful air emissions from open burning of waste
(v) Control migration of landfill gasses
(vi) Eliminate generation and odour and windblown waste
(vii) Create an area that can be safely used for predetermined purposes
(viii) Improving the livelihoods and living conditions of informal recyclers.

9. The implementation of the landfill project in Stueng Saen will significantly contribute to improving the quality of life for the residents of Stueng Saen. The proposed landfill site is located in Trapaeng Russey Village, Snor Commune, Kampong Svay District, Kampong Thom province. The proposed site location is:

- About 12 km from Stueng Saen town (by road) and about 12 km from Stueng Saen River.
- About 2.5 km from National Road 6 and about 4 km from National Road 62
- About 2-3 km from Trapaeng Russey Village where houses, school, and pagoda are present.

10. The subproject is classified as category B for environment as confirmed during the project preparation. This lEE has been prepared after the completion of detailed engineering

[1] A Roadmap for closing Waste Dumpsites, The World's most Polluted Places, ISWA, 2016, https://www.iswa.org/fileadmin/galleries/About%20ISWA/ISWA_Roadmap_Report.pdf

design (DED) in accordance with ADB Safeguards Policy Statement (SPS) 2009. This IEE has led to the preparation of a separate Environmental Management Plan (EMP). The IEE and EMP will be updated as needed during the construction and operation of this subproject.

1.2. Key Findings

11. The environmental baseline study has established that the most sensitive receptors in the project area are local communities and nearby households due to potential effects of construction noise and nuisance odour during landfill operations, and the local groundwater and surface water resources. The landfill site is dominated by cashew trees (farmed), and natural sparse secondary shrub cover including rattan and bamboo. No protected areas or habitats and species of conservation value were identified in the project area of influence.

12. Impacts during construction will be localized and short-term and limited to the common impacts associated with any construction project and associated earthworks. Potential impacts include generation of noise, dust, pollutants and greenhouse gas emissions, impeded traffic flow and waste generation.

13. The most significant environmental risks associated with the subproject are during the operation phase. Landfill sites can cause environmental pollution if they are not managed and maintained effectively. Such pollution can include long term risks to groundwater and soils from poor leachate management and windblown litter if waste is not regularly covered. In addition, traffic will increase on the roads that lead to the landfill, leading to risks for the health and safety of communities.

14. If effectively managed, the subproject facilities will bring about significant environmental improvements to the local project areas and urban core. Field visits show that the current environment is being contaminated with litter and the growing pressures on the urban areas means that this would likely continue. The development of well- engineered waste management facilities will mean that the pollution to the environment should be reduced and therefore the risks to human health and water quality, will be less. In addition, the municipalities will have improved disaster and climate change resilient infrastructure.

15. In Stueng Saen, the new landfill site will be adequate for the next 20 years and will solve the emerging problem of near-full capacity of the existing dumpsite. This in turn will contribute to the aesthetics and hygiene of the urban environment and improve the quality of life or “liveability” of the city and its surrounding areas.

16. The community consultations undertaken during the IEE preparation at PPTA and DED stages show widespread support for the subproject as the residents recognize the need to improve waste management.

1.3. Environmental Management Plan

17. The EMP is developed in accordance with the “mitigation hierarchy” and aims to avoid impacts where possible and mitigate those impacts which cannot be eliminated to an acceptable and minimum level. The EMP includes detailed requirements for:

- Mitigation and monitoring measures
- Institutional arrangements and project responsibilities
- EMP budget for implementation
- Capacity building and training requirements
- Public consultation and information disclosure
- GRM including clearly defined timescale and responsibilities.

18. The project includes a Capacity Building Program to address technical and institutional issues and ensure the sustainable provision of quality services.

19. The Project Management Consultant (PMC) will be responsible for ensuring adequate training during project implementation and will include training as follows:

- EMP adjustment and implementation - Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting
- Grievance Redress Mechanism – roles and responsibilities
- Environmental protection - Pollution control on construction sites (air, noise, wastewater, solid waste)
- Environmental monitoring - Monitoring methods, data collection and processing, reporting systems.

20. The key mitigation measures during construction will include:

- Good construction practices will be adopted to ensure minimal disturbance to affected persons from construction related nuisance, such as noise, dust and pollutant emissions.
- Access to properties and agricultural land will be maintained and encroachment avoided to allow people to continue their activities unimpeded.
- The contractor will submit site specific Construction Environmental Management Plans (CEMPs) for the key activities which will also require the contractor to develop appropriate maps to ensure all stakeholders are clear on where activities will take place.
- A community and occupational health and safety plan is required as part of the CEMP, emphasizing the need to address risks in particular to site operatives including risk of COVID-19.
- The CEMP shall also include a traffic management and access control plan to ensure traffic safety, prevent unauthorized access to the site and prevent domestic animals from entering the site.

21. Mitigation and monitoring measures are also required for the operation phase. The importance of training in landfill operations and management is emphasized to ensure that the investments are sustainable, and that landfill operations are effectively carried out. Recognizing that operator performance is critical to environmental performance, a detailed long-term operator training plan and associated budget is provided in the capacity development component of this project.

1.4. Conclusion

22. This IEE was undertaken to determine the environmental issues and concerns associated with Stueng Saen Solid Waste Management Subproject. The assessment confirms that the project is classified as Category B for environment. The assessment has not identified any significant adverse impacts that cannot be readily mitigated if implemented effectively, and the EMP contains the necessary measures to mitigate impacts on the natural environment and affected people to an acceptable level. The key parties for mitigation measures implementation are the construction contractors and the landfill operators. They will be supported by qualified national and international environmental consultants within the Project Management Consultant team. The implementation of the EMP will be closely monitored and reported on by the relevant stakeholders in the project.

23. The most significant impacts from the project will arise from operation of the landfill. As a result, the project includes a comprehensive training and capacity building component which is essential for ensuring that the investment is both financially and environmentally sustainable and achieves anticipated outcomes.

24. Overall, the expected project outcome is improved urban environmental services and in particular improved waste management in Stueng Saen, Kampong Thom Province. The project is anticipated to bring environmental benefits to the population of the project city and adjacent areas. It will serve to improve solid waste management in the town, reduce pollution impacts and provide long term urban environmental improvements, health benefits and promote sustainable city development.

25. The next step of Environmental Safeguards implementation is the preparation of the Construction Environmental Management Plan (CEMP) by the Contractor. The CEMP will be

based on the EMP and will contain detailed measures to be implemented by the Contractor. The CEMP will be the backbone of the Environmental Management System of the contractor and will be supported by associated sub-plans which will deal with specific topics, such as health and safety, waste management, soil and borrow sites management, traffic management, etc.

26. When operations start, the operator shall an Environmental Management Plan specific to the operations.

27. A Grievance Redress Mechanism has been established as outlined in this IEE and the EMP. It will ensure that all unplanned impacts which cause grievances for affected people are managed and a satisfactory outcome brought about swiftly.

2. INTRODUCTION

2.1. Introduction

28. The Royal Government of Cambodia has obtained a loan and grant from the Asian Development Bank (ADB) towards the cost of the Second Integrated Urban Environmental Management in the Tonle Sap Basin Project (TS2 Project).

29. The TS2 project will improve urban environmental services in Serei Saophoan, Banteay Meanchey Province, Battambang Town, Battambang Province and, Stueng Saen town, Kampong Thom Province. Three of Cambodia's provincial cities located around the Tonle Sap lake (Figure 1).

Figure 1: Location of TS2 Project Urban Centres

Source: Detailed Engineering Design Report, SCE 2019.

30. The TS2 Project focuses on improvement of solid waste management through the development of controlled landfills, and improvement of wastewater treatment, through the development of urban wastewater infrastructures and storm water drainage. A summary of the project interventions and their locations is shown in Table 1.

Table 2: Summary of Project Interventions

Subproject City	Wastewater Treatment Plant and Network	Stormwater Drainage	Engineered Landfill
Serei Saophoan	✓	✓	✓
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Stueng Saen	✓	✓	✓

2.2. Project Background and Location

31. Stueng Saen has one existing dump site, which has been operating for about 21 years. The site is being operated as an uncontrolled dump, with limited environmental controls, and is resulting in significant socio-environmental impacts. The site is about a hectare in size with waste deposited to a depth of up to four metres. The waste has not been profiled,

compacted nor regularly covered with soil and is simply left exposed and then burnt. Consequently, this site will need to be rehabilitated.

32. The objective of this subproject is to replace the current dumpsite used for waste disposal with a controlled engineered landfill. The proposed landfill site is located in Trapaeng Russey Village, Snor Commune, Kampong Svay District, Kampong Thom province. The site is about 8 km due north of Stueng Saen town.

33. The Project Preparation Technical Assistance (PPTA) (SCE, 2019) considered a range of landfill standards and determined that the appropriate type would be controlled landfills with the following general characteristics:

- Site with regard to hydrogeology.
- Planned cell development.
- Grading, drainage in site preparation.
- Improved leachate and surface water management.
- Regular (not usually daily) cover.
- Waste compaction.
- Fencing.
- Basic record-keeping.
- Controlled waste picking.
- Gas management.
- Monitoring of groundwater.

34. With a design period of 20 years, the project components/facilities were planned up to the year 2040, with operations expected to commence in 2022. The concept designs prepared during the feasibility study stage were updated and elaborated upon as the basis for the detailed designs. Investment works to be implemented for Stueng Saen under Tonle Sap 2 project comprises the following:

- Upgrading of access road to the landfill site: 2,150 metres of dirt road to be upgraded to a 6 m wide concrete road above flood levels.
- Construction of one controlled landfill cells out of a total of three cells.
- Construction of one hazardous waste landfill cell.
- Construction of a non-mechanical type material recovery facility (MRF).
- Construction of drainage, leachate collection, treatment, and recirculation system.
- Construction of weighbridge and office building; staff dining and rest room; workshop, electrical and mechanical room, and supply building.
- Construction of 1,403 metres of concrete internal roads, bunds, and drainage system.
- Construction of wire mesh fencing, and entrance wall, gate and security guardhouse.
- Construction of car/ vehicle washing facility.
- Construction of a facility for temporary storage of hazardous waste.
- Provision of operations & maintenance (O&M) equipment.

35. The solid waste management subproject entails the construction of a new controlled engineered landfill. As further detailed in Section 4.6, the closure and remediation of the existing dumpsite will be undertaken as a separate sub-project. The current sub-project (construction of new engineered landfill) does not have any existing or associated facilities.

36. The implementation of the solid waste management project in Stueng Saen will significantly contribute to improving the quality of life for the residents of Stueng Saen.

2.3. Objectives of IEE

37. The first Initial Environmental Examination (IEE) was prepared during the PPTA and approved by ADB in May 2018. The first IEE was prepared for all the subprojects within TS2 Project as a single document.

38. This IEE has been prepared for the Steung Saen Solid waste management and it has been updated after the completion of the detailed engineering design (DED). The Environmental Management Plan (EMP) for this subproject has also been updated and is available as a separate document dated March 2021.

39. The purposes of the IEE study for the subproject are as follows:

- To understand the existing of natural and social environments in the project area, through studying on physical environment, biological environment, and social environment.
- To inform the project development activities to local agencies, affected people, and concerning parties to receive relevant information, key feedbacks, issues, and comments concerning to environmental and social safeguards or impacts and proposed solutions or responses.
- To assess the impacts on the environmental-social resources in and around project site by the proposed project activities for providing the mitigation measures or correcting actions.
- To assess and predict the impact on environmental and social resources in construction, operation, and closure of the project.
- To extract valuable comments and experiences from ministries, related institutions, local authority, community, and stakeholders to improve the project activities with environmental sound technologi8Ees.
- To develop EMP for conducting the implementation and monitoring on the project activities in whole project stage.
- To ensure the project will contribute to sustainable economic development of Cambodia.

2.4. ADB and National Environmental Due Diligence

40. The project classification of environment category B has been confirmed during project preparation. This IEE covering the Stueng Saen Solid Waste Management Subproject has been prepared based on the detailed designs and information available at the Project Management Consultant (PMC) level. This IEE is complemented by a separate Environmental Management Plan (EMP). The IEE and EMP have been undertaken in accordance with ADB SPS 2009, ADB Environmental Assessment Guidelines (EAG) 2003, and Royal Government of Cambodia (RGC) environmental requirements: Laws, sub-decrees, guidelines, and standards and will be updated to the extent any subsequent revisions to the detailed design would have any significant environmental implications.

41. The requirements for Ministry of Environment (MoE) approvals under Cambodian law are set out in detail in Section 3.2 and as required by Sub-Decree No. 72 ANRK. BK. of 11 August 1999 an approved company registered with the Ministry of Environment (MoE) has prepared and submitted an Initial Environmental and Social Impact Assessment (IESIA) to MoE for review and approval. It is expected that MoE will issue the approval in Q2 2021.

2.5. Structure of This Report

42. This IEE report follows the format prescribed in ADB SPS 2009 and ADB EAG 2003. It includes:

- The policy, legal and administrative framework;
- A description of the project and subprojects;
- The environmental baseline for the project locations;
- Alternatives analysis for all subproject interventions; and
- Information on disclosure and consultation of this IEE.

43. The Environmental Management Plan (EMP) for the Solid Waste Management Subproject is a standalone document that determines the environmental mitigation measures

and sets out the environmental monitoring programmes for all phases of project implementation. The EMP is structured in the following main sections:

- Brief subproject descriptions
- Institutional arrangements and responsibilities for EMP implementation;
- Summary of environmental impacts on key receptors;
- Mitigation measures for implementation at all phases of construction and operation;
- Monitoring requirements;
- Consultation requirements during construction;
- Grievance Redress Mechanism; and
- Estimated costs of environmental safeguard measures.

Based on the EMP, the Contractor is required to develop a Construction Environmental Management Plan (CEMP), which shall include specific protection and monitoring measures taking sensitive receptors into account.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Environmental Assessment Requirements

3.1.1. Environmental Assessment Requirements of ADB

44. Safeguard requirements for all projects funded by ADB are defined in SPS 2009 which establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound; are designed to operate in compliance with applicable regulatory requirements; and are not likely to cause significant environmental, health, or safety hazards. SPS 2009 is underpinned by the ADB Operations Manual, Bank Policy (OM Section F1/BP, October 2013). The policy also promotes adoption of international good practice as reflected the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. This IEE is intended to meet SPS 2009 requirements.

45. SPS 2009 environmental assessment requirements specify that:

- At an early stage of project preparation, the borrower/client will identify potential direct, indirect, cumulative, and induced environmental impacts on and risks to physical, biological, socioeconomic, and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected people and concerned nongovernment organizations. If potentially adverse environmental impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle.
- The assessment process will be based on current information, including an accurate project description, and appropriate environmental and social baseline data;
- Impacts and risks will be analysed in the context of the project's area of influence;
- Environmental impacts and risks will be analysed for all relevant stages of the project cycle, including preconstruction, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration; and
- The assessment will identify potential transboundary effects as well as global impacts;

46. Other requirements of SPS 2009 include:

- Analysis of alternatives. There is a requirement to examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no project alternative. SPS 2009 states that this is only for projects which have ''significant adverse environmental impacts that are irreversible, diverse, or unprecedented'' i.e., category A projects. This does not apply to this category B IEE but is included for completion.
- Environmental management plan. The borrower/client will prepare an EMP that addresses the potential impacts and risks identified by the environmental assessment.
- Consultation and participation. The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.
- Information disclosure. Environmental information on the project, including the IEE and other safeguards information will be disclosed in accordance with ADB's Public Communications Policy (2011) and SPS (2009). This includes: (i) The EMP will be translated into Khmer language and be made available at each provincial department of public works and transport (PDPWT); (ii) The IEE will be disclosed on ADB's project website (www.adb.org);
- Grievance redress mechanism. The borrower/client will establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's environmental performance.
- Monitoring. The borrower/client will monitor and measure the progress of implementation of the EMP.

47. As stated in the "Guidelines for Climate Proofing Investments in the Water Sector: Water Supply and Sanitation, Climate Impacts", ADB (2016) there may be impacts from

climate change on solid waste disposal. More frequent and/or intense extreme weather events can lead to (i) increased risk of direct flood damage to landfill infrastructure and (ii) increased risk of untreated leachate overflows.

48. These climate change risks are assessed in the project Climate Change Assessment and are reflected where appropriate in the project designs.

3.1.2. Environmental Assessments Requirements of Cambodia

49. Environmental assessment in Cambodia is governed by the following law and guideline document:

- Sub-decree on EIA Process No. 72 (1999). The sub-decree determines the types and sizes of project or activities that are required to prepare an IESIA or ESIA report (amended in 2020), and the sub-decree sets out the responsibilities and procedures for preparing, reviewing and approving IESIA and ESIA reports.
- Declaration on Guideline for Conducting IESIA and ESIA Reports No. 376 (2009). This declaration specifies the basic contents of IESIA/ESIA Reports, which should include: (i) introduction; (ii) legal framework; (iii) project description; (iv) description of the existing environment; (v) public participation; (vi) assessment of, and mitigation measures for, significant environmental impacts; (vii) environmental management plan; (viii) cost-benefit analysis; and (ix) conclusion and recommendations.

50. The MoE through its EIA Department regulates and monitors the ESIA Process. The MoE is responsible for: (i) review and approval of IESIA/ESIA reports in collaboration with other relevant ministries and (ii) monitoring the EMP implementation of Project Proponents/Owners throughout the different project phases. MoE operates at the municipal and provincial levels through its Provincial Department of Environment (PDoE).

51. The project owner (public or private) is required to submit the necessary project document (IESIA/ESIA report) to MoE for review and approval. After submission of IESIA/ESIA report, it should take a maximum of 30 working days for the Ministry to make a decision.

52. A meeting[2] held between MoE, Ministry of Public Works and Transport (MPWT) and TS-2 Project consultants on 06 December 2017 confirmed that the following requirements apply to the subprojects under the TS-2 Project:

- EIA department agrees that this project needs to prepare IESIA report which can be informed by the IEE report and will incorporate the additional baseline environmental survey (air and water quality) results.
- The IESIA report for landfills shall be prepared as separate standalone reports.
- The EIA department agrees with and supports the Project and will facilitate issuance of approval letters from MoE to MPWT after receiving IESIA report and request letter from MPWT.

3.2. National Environmental Policies and Legislations

3.2.1. Legal Framework for Environmental Management

53. In 1993 the new Constitution of Cambodia included environmental considerations for the first time. Specifically, Article 59 states: ‘’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, rock and sand,

[2] Participants from MPWT and MoE: 1. H.E Vong Pisith (PD), 2. Mr. Danh Serey (Head of EIA department), meeting held and MoE, Phonm Penh**.** Participants from consulting teams: 3. Mr. Taing Sophanara (Deputy Team Leader of 2nd GMS-CTDP2), 4 Mr. Srei Socheat (Deputy Team Leader Tonle Sap 1 Project), 5. Mr. Morm Deth, (Deputy Team Leader Tonle Sap 2 Project).

gems, forests and forestry products, wildlife, fish and aquatic resources''. This led to the establishment of the Ministry of Environment.

54. The hierarchy of legislation in Cambodia is:

- Royal Decree signed by the King;
- Sub-decree signed by the Prime Minister;
- Ministerial Decision signed by a Minister; and
- Regulation issued by a Ministry.

55. A Royal Decree 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.

3.2.2. Policies and Legal Instruments

56. Cambodia's main legal framework for addressing environmental protection, management of natural resources and public consultation is the Law on Environmental Protection and Natural Resource Management ('the Environment Law'), which was adopted in 1996.

57. The Environment Law has the following objectives:

- Protect and upgrade environmental quality and reduce pollution;
- Assess the impacts of proposed projects before approval;
- Ensure rational and sustainable use of the Kingdom's resources;
- Encourage public participation in environmental protection and natural resource management; and
- Reduce activities which impact negatively on the environment.

58. Specific regulations and standards for waste disposal and environmental quality are contained in three sub-decrees:

- Sub-decree on Solid Waste Management (1999);
- Sub-decree on Water Pollution Control (1999); and
- Sub-decree on Air Pollution Control and Noise Disturbance (2000)

A summary of these and other legislative and policy instruments relevant to the project is presented in Table 3. The Table includes national landfill location guidelines.

Table 3: Relevant Laws, Regulations and Guidelines

Law/Regulation/Guideline	Year	Summary
Royal Decree on the Protection of Natural Areas	1993	Classified 23 protected areas in Cambodia into four categories: (i) natural parks; (ii) wildlife sanctuaries; (iii) protected landscapes; and (iv) multiple-use areas. Designated the Tonle Sap (316,250 ha) as a multiple-use area or area necessary for the stability of the water, forestry, wildlife and fishery resources, for tourism, and for conservation of long-term existing natural resources with a view to assure sustainable economic development.
Law on the Protection of Cultural Heritage (NS/RKM/0196/26)	1996	Regulates the protection of national cultural heritage and cultural property in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Its Article 37 stipulates that in case of chance find of a cultural property during construction, work should be stopped and the person who found the property should immediately make a declaration to the local police, who shall, in turn, transmit the property to the Provincial Governor without delay.

Law/Regulation/Guideline	Year	Summary
Labour Law (1997) Decree No. CS/RKM/0397/01	1997	This law governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: Chapter VIII Health and Safety of Worker. The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace. Article 230: Workplaces must guarantee the safety of workers. However, the only specific occupational health and safety Prakas relates to the garment industry and brick manufacture. Chapter IX Work-Related Accidents Article 248: All occupational illness, as defined by law, shall be considered a work-related accident. The law sets out how accidents should be managed in terms of compensation.
Sub-decree No. 36 ANK/BK on Solid Waste Management	1999	Article 1: Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity through using appropriate technical approaches. Article 2: This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste. Article 4: The Ministry of Environment shall establish guidelines on disposal, collection, transport, storage, recycling, minimizing, and dumping of household waste in provinces and cities in order to ensure the safe management of household waste. The authorities of the provinces and cities shall establish the waste management plan in their province and city for short, medium and long-term.
Sub-decree No. 27 ANRK/BK on Water Pollution Control	1999	Regulates activities that cause pollution in public water areas in order to sustain good water quality so that the protection of human health and the conservation of biodiversity are ensured. Annex 2 contains effluent standards. Annex 4 contains ambient water quality standards for biodiversity conservation, and annex 5 includes ambient water quality standards for public health.
Sub-decree No. 42 ANK/BK on Control of Air Pollution and Noise Disturbance	2000	Regulates air and noise pollution from mobile and fixed sources through monitoring, curb and mitigation activities to protect the environmental quality and public health. It contains the following relevant standards: (i)) ambient air quality standard (Annex 1); and (ii) maximum allowable noise level in public and residential areas (Annex 6). Article 3 A. “Source of pollution” is defined and separates mobile sources (including transport) and fixed sources such as factories and construction sites. Article 3 B. “Pollutant” is defined as smoke, dust, ash particle substance, gas, vapour, fog, odour, radio-active substance.
Law on Land (NS/RKM/0801/14)	2001	Provides that: (i) unless it is in the public interest, no person may be deprived of ownership of his immovable property; and (ii) ownership deprivation shall be carried out according to legal forms and procedures and after an advanced payment of fair and just compensation. (Article 5)
Royal Decree on the Establishment and Management of Tonle Sap Biosphere Reserve (Royal Decree No. NS/RKT/0401/070)	2001	Establishes the Tonle Sap Biosphere Reserve (TSBR) in accordance with the statutory framework of the World Network of Biosphere Reserves. Divides the TSBR into 3 zones: (i) core areas; (ii) buffer zone and (iii) flexible transition zone.

Law/Regulation/Guideline	Year	Summary
		Core area: set aside for long term protection, human activity is limited to monitoring and research. Buffer zone: is area surrounding the core areas helping to protect the environment. It may accommodate education and training activities. Transition area: may contain a variety of agricultural activities and human settlements. Here all stakeholders have to cooperate to achieve sustainable development.
Environmental Guidelines on Solid Waste Management	2006	Contains a Landfill Ordinance that regulates landfill requirements to: (i) reduce as far as possible the adverse effects of waste disposal on the environment; (ii) preserve groundwater, surface water & air quality & to reduce emissions of greenhouse gases (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; and (iv) provide information and technical recommendation on the construction, operation, closure and aftercare management of landfills to ensure public health and safety and environmental protection.
Law on Water Resources Management (NS/RKM/0607/016)	2007	Requires license/permit/written authorization for the: (i) abstraction & use of water resources other than for domestic purposes, watering for animal husbandry, fishing & irrigation of domestic gardens and orchards; (ii) extraction of sand, soil & gravel from the beds & banks of water courses, lakes, canals & reservoirs; (iii) filling of river, tributary, stream, natural lakes, canal & reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and to endanger human, animal and plant health. (Articles 12 & 22) Its Article 24 stipulates that Ministry of Water Resources and Meteorology (MOWRAM), in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Royal Decree No. NS/RKM/0208/007 on Protected Areas	2008	Defines the framework of management, conservation & development of protected areas to ensure the conservation of biodiversity, & sustainable use of natural resources in protected areas. The Law gives the Royal Government of Cambodia the authority to establish or modify Protected Areas (Article 9 and 10). A Protected Area shall be established by sub-decree. Article 11 divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone & community zone. Article 36 strictly prohibits all types of public infrastructure in the Core Zone & Conservation Zone; & allows development of public infrastructures in the Sustainable Use Zone & Community Zone with approval from the Royal Government at MoE's request. Article 41 provides for the protection of each protected area against destructive/harmful practices, such as destroying water quality in all forms, poisoning, using of chemical substances, disposing of solid and liquid wastes into water or on land. Article 44 requires all proposals & investments within or adjacent to protected area boundary an Environmental and Social Impact Assessment. The law defines Protected Area as **"***An area of the State's public properties in land or water territories, including coasts and sea, located in the area established by a Royal Decree or a new area established in the jurisdiction of the Ministry of*

Law/Regulation/Guideline	Year	Summary
		Environment. These areas are of physical and biological importance which requires management by law with the purpose of protecting and maintaining biological, natural and cultural resources, and shall be sustainably managed in every generation for environmental, social and economic benefits". Each protected area shall be divided into four (4) management zoning systems: **1. 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 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 for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defence sectors. **2. 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 prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defence sectors. Small-scale community uses of Non-Timber Forest Products 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. **3. 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. **4. 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).
Expropriation Law	2010	Defines the principles, mechanisms, and procedures of expropriation, and defining fair and just compensation for any construction, rehabilitation, and public physical infrastructure expansion project for the public and national interests and development of Cambodia.
Sub-Decree on Demarcation of 647,406 Hectare Flooded Forest Domain in Six Provinces adjacent to Tonle Sap Lake (Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom) (Sub-decree No. 197 ANKr/BK)	2011	Stipulates a zoning system for the area between the national highways and the Tonle Sap Lake system and the nature of agriculture activities that are permitted and banned in each zone. Note that the new landfill site is located north of the national highway and thus outside these zones.

<table>
<tr><th>Law/Regulation/Guideline</th><th>Year</th><th>Summary</th></tr>
<tr><td>Prakas on the Launch of Standards of the Quantity of Toxins or Hazardous Substances Allowed to be Disposed</td><td>2015</td><td>This Parkas includes the standards of the quantity of toxic chemicals or hazardous substances contained in hazardous waste which is allowed to be disposed in sanitary landfills and standards of the quantity of toxic chemicals or hazardous substances allowed in soils. Any disposal of chemical waste or hazardous substances as stipulated in the Parkas out of sites determined by the ministry and competent institutions shall be absolutely prohibited and deemed as the infringement of law.</td></tr>
<tr><td>Guidance on Selection of Landfill Sites (2016)</td><td>2016</td><td>The Guidance sets out the requirements for site selection in terms of:
<table>
<tr><th></th><th>MoE Landfill site Requirements (2016)</th></tr>
<tr><td rowspan="6">Distance to Receptors</td><td>1 km from any residential property</td></tr>
<tr><td>3 km from any school/health centre/natural resources/ water source</td></tr>
<tr><td>5 km from any place of worship and resort</td></tr>
<tr><td>8 km from an airport</td></tr>
<tr><td>10 km from town centre</td></tr>
<tr><td>15 km from any heritage site</td></tr>
<tr><td rowspan="2">Hydrology</td><td>Not in a flooded area</td></tr>
<tr><td>Depth to Groundwater – More than 3 m</td></tr>
<tr><td rowspan="6">Cell Design</td><td>Gas collection (flaring)</td></tr>
<tr><td>Leachate collection system</td></tr>
<tr><td>Leachate treatment (lagoon)</td></tr>
<tr><td>Clay liner ≥ 1 m (first liner)</td></tr>
<tr><td>HDPE liner (second liner)</td></tr>
<tr><td>Permeable liner (third liner)</td></tr>
<tr><td>Drainage system</td><td>Depth 1 m, width 0,6 m</td></tr>
</table></td></tr>
<tr><td>Technical Guideline on Garbage and Urban Solid Waste Management</td><td>2016</td><td>The technical guideline provides standards for all activities related to disposal, storage, collection, transportation, recycling, dumping of municipal and hazardous waste as well as management of final dumpsite (closing Landfill) and continued management. The technical guidelines list the requirements to be implemented within 90 days for landfill closing (e.g. monitoring, gas management).</td></tr>
<tr><td>Prakas on Environmental Impact Assessment Classification for Development Projects No. 21 PRK.BST</td><td>2020</td><td>The Prakas determines the types and sizes of projects that are required to prepare environmental impact assessments. Projects having minor environmental impacts are required to prepare an Environmental Protection Agreement together with an Environmental Management Plan. Projects having medium impacts shall prepare an Initial Environmental Impact Assessment report, and projects with significant impacts are required to prepare a full EIA.
All sizes of rubbish disposal sites are required to undertake an IESIA and all sizes of industrial waste disposal sites are required to undertake an ESIA</td></tr>
</table>

59. Landfill Site Guidance. A meeting was held at MoE[3] Phnom Penh on 31-10-17 in order to discuss the application of the guidance for ADB projects. MoE advised the project team to follow the guidance where possible, but recognized it was not always possible given

[3] Participants: HE Heng Nareth, Director General, General Directorate of Environmental Protection, MOE; HE Vong Pisith, Deputy Director General, MPWT; Mr Dy Kiden, Director, Department of Solid Waste Management, MOE; Ms Genevieve O'Farrell, Environmental Specialist, ADB; Ms Rachel Wildblood, Environmental Specialist, TS-1; Mr Teemu Jantunen, Resettlement and Social Development Specialist.

the very stringent requirements. MoE emphasized that groundwater protection was the main concern however the requirements could be applied pragmatically with MoE review of the landfill design before it is finalised.

60. A comparison of national and international landfill siting guidance is shown in Table 4 below. The table shows that the minimum distance to houses in any of the international guidance is 250 m (ADB and World Bank/IFC) however ADB guidance also refers to daily cover indicating that 250 m is appropriate for a site which has daily cover. The highest depth to groundwater in any of the international guidance is 1.5 m (World Bank/IFC). The Cambodian guidance is most stringent for distance to housing and depth to groundwater.

Table 4: Comparison of Landfill Selection Criteria

Source of Guidance	Residential Receptors	Water Receptors
International Solid Waste Association (ISWA) - Guidelines for Design and Operation of Municipal Solid Waste Landfills in Tropical Climates (2013).	Not located in the immediate proximity of occupied dwellings Minimum 500 m	No distance given
ADB – Integrated SWM for Local Governments., A Practical Guide (2017)	No residential development within 250 m	The site must be located in an area where the landfill's operation will not detrimentally affect environmentally sensitive resources such as aquifer/ groundwater
World Bank / IFC EHS Guidelines: Sanitary Landfill (2007)	Typically, further than 250 m (for gas only, no mention of dust /odour)	A landfill should not be located within 300 m up-gradient of a perennial stream Groundwater's seasonally high table level (i.e., 10 year high) should be at least 1.5 m below
Cambodian Landfill Site Selection Guidance	1 km from residences	Out of flooded area Depth to ground water over 3 m

61. The key national environmental quality standards applied to the subproject are listed in Table 5 together with relevant international guidelines. The numeric values of the national standards are presented in Annex 1. The effluent standards applicable to the subproject are those stipulated in Sub-decree No. 27 ANRK/BK 1999 on Water Pollution Control: Annex 2, effluent standards for discharge of wastewater to public water areas and sewer.

Annex 1 also includes a comparison of USEPA effluent limitations with the Cambodian effluent standards applicable to the subproject.

Table 5: Key National and International Environmental Standards and Guidelines

Environmental Issue	National Standards	International Guidelines
Ambient air quality	Annex 1, Ambient Air Quality Standard, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Air Quality Guidelines, global update 2005
Noise	Annex 6, Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Guidelines for Community Noise, 1999
Groundwater quality	Drinking water Quality Standards, 2004	WHO Guidelines for Drinking-water Quality, Fourth Edition, 2011
Surface water quality	Sub-decree No. 27 ANRK/BK 1999 on Water Pollution Control: Annex 4, Water Quality Standards for Public Waters for	US EPA National Recommended Water Quality Criteria

Environmental Issue	National Standards	International Guidelines
	the Purpose of Biodiversity Conservation, and Annex 5, Water Quality Standards for Public Waters and Health	Mekong River Commission (MRC)_ Technical Guidelines for the Protection of Aquatic Life MRC Technical Guidelines for the Protection of Human Health
Effluent quality (including leachate)	Sub-decree No. 27 ANRK/BK 1999 on Water Pollution Control: Annex 2, Effluent standards for discharge of wastewater to public water area and sewer	IFC EHS General Guidelines, April 2007 IFC EHS Guidelines for Water and Sanitation, December 2007 IFC EHS Guidelines for Waste Management Facilities, December 2007 USEPA Effluent Limitations

62. In terms of SPS 2009 requirements, during the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in this document. These Environment, Health and Safety Guidelines are considered throughout the Environmental Management Plans for the subproject.

63. The design complies with IFC EHS requirements. Landfill gas collection has been installed, as per the Cambodian Municipality Solid Waste Management Guidelines. This is a passive system, using vertical gas vents. No flaring or recovery of gas is initially planned for. However, the overall landfill cell and gas collection approach has been designed so that can be converted to an active system, which includes an induced exhaust system and flaring.

3.3. International Agreements

64. Cambodia is party to the following international environmental agreements relevant to the Project: (i) UNESCO World Heritage Convention, 1991; (ii) Convention on Biodiversity, 1995; (iii) UN Framework Convention on Climate Change, 1995; (iv) Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997; (v) Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1999; (vi) Basel Convention on the Control of Transboundary Movements of the Hazardous Wastes and Their Disposal, 2001; (vii) Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer, 2001, and all Amendments, 2007; (viii) Climate Change Kyoto Protocol, 2002; and (ix) International Tropical Timber Agreement, 2006.

Cambodia joined the UNESCO Network of Biosphere Reserves in 1997. It is committed to the Millennium Development Goals, the seventh goal of which is to "ensure environmental sustainability". It is among the 168 Governments that adopted the Hyogo Framework for Action 2005-2015, a 10-year global footprint for disaster risk reduction efforts, in January 2005. At the regional level, it ratified the following ASEAN Agreements: (i) on Transboundary Haze Pollution in 2006; and (ii) on Disaster Management and Emergency Response, which entered into force in 2009. At the sub-regional level, Cambodia, along with Lao PDR, Thailand and Viet Nam, signed the "Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin" (or the Mekong Agreement in April 1995).

Cambodia also supports the global efforts against climate change by being a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 1996. Cambodia has adopted and ratified the Paris Agreement, and in 2020 the Government submitted an

updated Intended Nationally Determined Contribution, which puts forward mitigation targets and adaptation actions towards a cleaner and greener economy to improve the lives of the citizens, in particular the vulnerable. The 2030 mitigation targets include a 18% reduction in greenhouse gas emissions from the waste sector from a share of 2.1% of the total greenhouse gas emissions in 2016 to 0.9% in 2030. This is planned to be achieved through source segregation and composting of the organic fraction in the municipal solid, increased recycling and increased extraction of landfill gases.

4. DESCRIPTION OF THE PROJECT

4.1. Rationale

65. Cambodia's population was estimated at 15.2 million in 2016, spread across 24 provinces, 26 cities and numerous district cities. While Cambodia remains almost 80% rural, urbanization is accelerating and is expected to reach 30% of the national total by 2030. In recent years, Cambodia's robust 7% economic growth has been driven by garments, construction and tourism. With an increasingly urban economy, urban services contribute to environmentally sustainable and inclusive growth through laying basic infrastructure for businesses and households, creating jobs, safeguarding the surrounding environment and ecosystem, and reducing exposure to flooding and other extreme events. They also contribute to the health, welfare and protection of Cambodia's people. Strong urban-rural linkages mean that developments in Cambodia's growing provincial cities, including Battambang (Battambang Province), Serei Saophoan (Banteay Meanchey Province) and Stueng Saen (Kampong Thom Province), have significant spill over effects to rural areas, where poverty is more acute.

66. **Tonle Sap Lake.** The Tonle Sap Basin is home to about a third of Cambodia's population, and nearly half of the population depends on the lake's resources, particularly its fishs, for their livelihoods. Rural-urban migration is occurring at unprecedented rates. Cambodia's urban population growth rate of about 4%, one of the highest in Southeast Asia, translates into significant growth in the basin's cities. The 3 towns of the project areas are largely rural towns surrounding the Tonle Sap Basin with population: (i) Serei Saophoan Town is 87 885, Battambang Town is 150 312, and Stueng Saen town is 34,890. These towns are key for economic growth and their development is linked to the surrounding Tonle Sap Lake environment. The basin's urban areas are also sensitive to climate change, as they are located next to rivers and most experience flooding during the wet season.

67. **Access to services.** At present, solid waste services in urban areas (excluding Phnom Penh) is inadequate. More than 75% of households in Cambodia's urban areas (excluding Phnom Penh) do not have access to solid waste services. The main reasons for these service delivery gaps are (i) inadequate coverage and delivery of urban environmental infrastructure and services; (ii) inadequate management of public investments, and (iii) poor urban planning that doesn't consider environmental management and climate change events.

68. **Institutional arrangements.** The MPWT is responsible for asset creation for urban sanitation, with the Provincial Department of Public Works and Transport (PDPWT) responsible for operations and maintenance. Solid waste management is the responsibility of the city, although in practice the respective roles of the city and the Ministry of Environment are not always clear. Due to limited technical capacities at the provincial and municipal level, MPWT continues to be involved with the construction of large-scale infrastructure including controlled landfills.

69. **The Project.** General observations indicate that the expansion in infrastructure and service provision has not been matched by equitable distribution, with disproportionate access in the capital region and certain municipalities. In order to contribute to the provision of a quality urban environment to this fast-growing urban population, including in secondary urban centres, the Second Urban Environmental Management in the Tonle Sap Basin Project will support the government of Cambodia in improving urban services and enhancing climate and disaster risk resilience in participating towns in the Tonle Sap Basin as well as in Stueng Saen town.

4.2. Project Impact, Outcome and Outputs

70. The expected project impact is sustainable, inclusive, equitable and resilient growth achieved. The outcome will be improved urban environmental services in participating cities, specifically for Stueng Saen the outputs are:

- **Output 1: Improved urban services.** The project will finance the controlled landfill of 452.771 m^3 for Stueng Saen town, Kampong Thom Province. The proposed service area is shown in Figure 4.
- **Output 2: Improved institutional effectiveness.** The project will strengthen institutional effectiveness by: (i) improving staff capacity in critical areas (including improved urban service delivery, O&M of urban facilities, public private partnerships (PPPs) and other institutional arrangements); (ii) supporting the establishment of urban service units; and (iii) providing dedicated consultant support for project management. As a long-term contribution to the sector, the project will promote gender inclusivity and finance scholarships in civil engineering.
- **Output 3: Improved policy and planning environment.** The project will develop urban development strategies and master plans for the cities/towns. It will develop a road map for financial sustainability for solid waste (including a proposed road map and arrangement for tariffs, and mechanism for ensuring household connections). It will build community awareness on the benefits of proper sanitation and safe disposal of solid waste.

4.3. Existing Situation of Solid Waste Management in Stueng Saen

4.3.1. Waste Collection

71. Based on the 2019 census, Stueng Saen has a population of 34,890. The total population covered by solid waste services is estimated to 32,000, although it is estimated that only 80% of waste is currently collected by GAEA. Waste collection frequency is twice a week, with a monthly charge of US $1-1.5 per household. The baseline solid waste collection is estimated at 19 tons per day. There is no weighbridge facility in the town to verify the amount of waste collected per day.

72. The collection fleet comprises only open body tipping trucks without any refuse compaction vehicles. The 4 m^3 tipping trucks make three loads a day with two vehicles making a maximum of 24 m^3/ per day.

73. GAEA has two containers (hook lift bins) with bin sizes (1.5 m x 3 m x 1.6 m or 7 m^3) for collecting commercial waste. The bins are collected three times per day, every day, especially for market waste. This equates to 42 m3/d or say 7 tons/d if 100% full. Typically, these bins are only 70% full on average making 5 tons/d.

74. There is no major industry within the city to produce large quantities of special or hazardous waste. There are a range of cottage-based food processing operations and handicraft industries in the city, which only generate general waste. The town has 1 hospital, 8 clinics, and 4 public health centres. The local hospital has a new incinerator, and it is believed that they manage their own medical waste.

4.3.2. Current Disposal Site

75. The existing dump site is located on state-owned land. The site is being operated as an uncontrolled dump and is resulting in significant socio-environmental impacts, both locally and downstream, and needs to be closed and remediated.

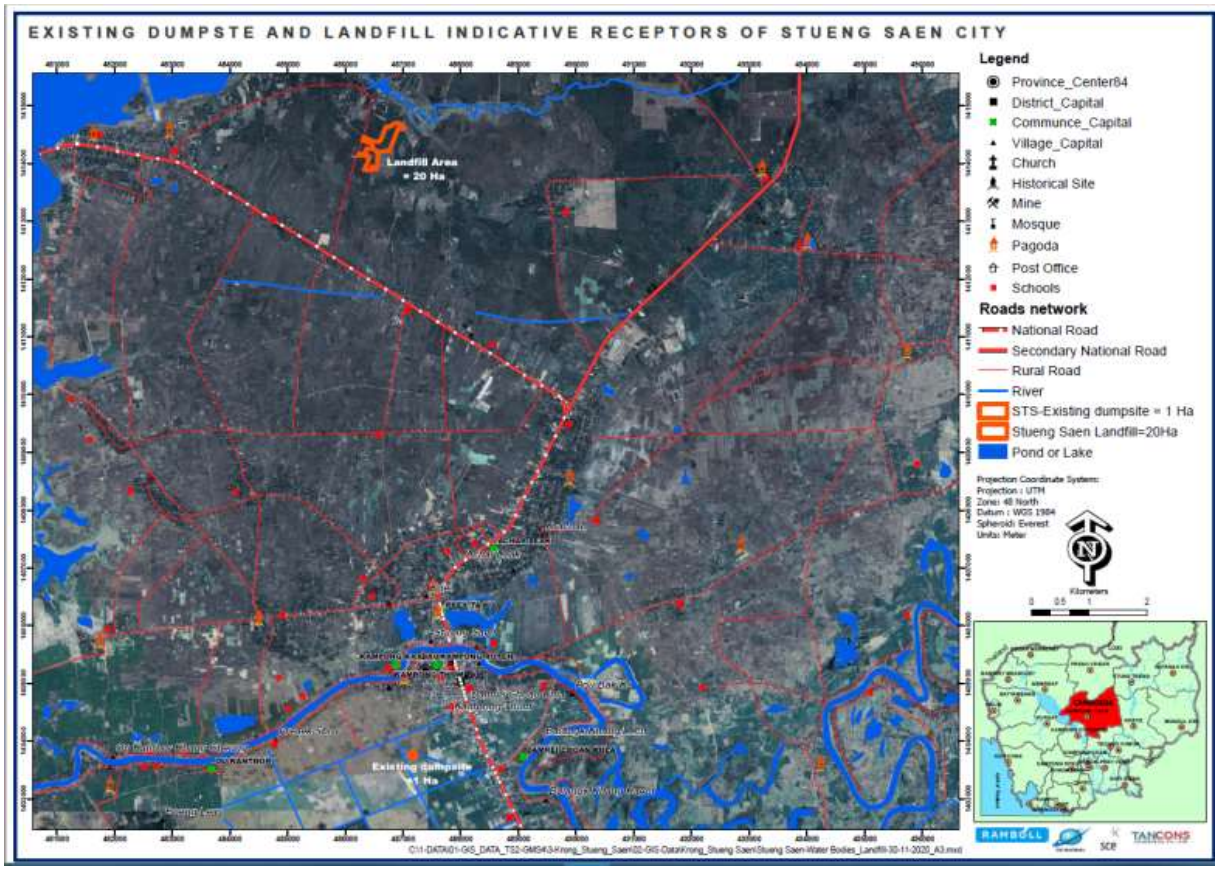
76. The waste has not been profiled, compacted nor sufficiently covered with soil and is simply left exposed and then burnt. Whilst burning of waste does reduce the potential odour and vermin issues, burning of waste at low temperatures can cause even more serious problems particularly if the waste contains plastic materials, and releases gases containing dioxins and furans which are serious health hazards. It is also very poor aesthetically and presents a traffic safety issue due to reduced visibility.

77. The site has been in operation for over 21 years. Within the main dumping area, there is approximately 1 to 1.5 m of waste rising above natural surface level, and with waste deposited to a depth of up to four meters. Consequently, this site will need to be rehabilitated.

Figure 2: Existing Landfill Site, Stueng Saen

The existing dumpsite is impacting on the environment primarily through the discharge of leachate and the contamination of land with decomposing waste. Windblown litter can be seen on and around the site. In addition, the dumpsite shows evidence of waste fires which cause localized air pollution and impacts on human health, particularly for informal recyclers and residents near the sites (Figure 2 and Figure 22).

Figure 3: Existing Dumpsite and New Landfill Site in Steung Saen



4.4. Project Location

78. The project is designed to cover the main urban areas of Stueng Saen. The service area for solid waste collection covers the six sangkats of Prey Ta Hu, Achar Leak, Kampong Roteh, Kampong Kraban, Kampong Thom, and Dameri Chom Khla. The service area is shown in Figure 4.

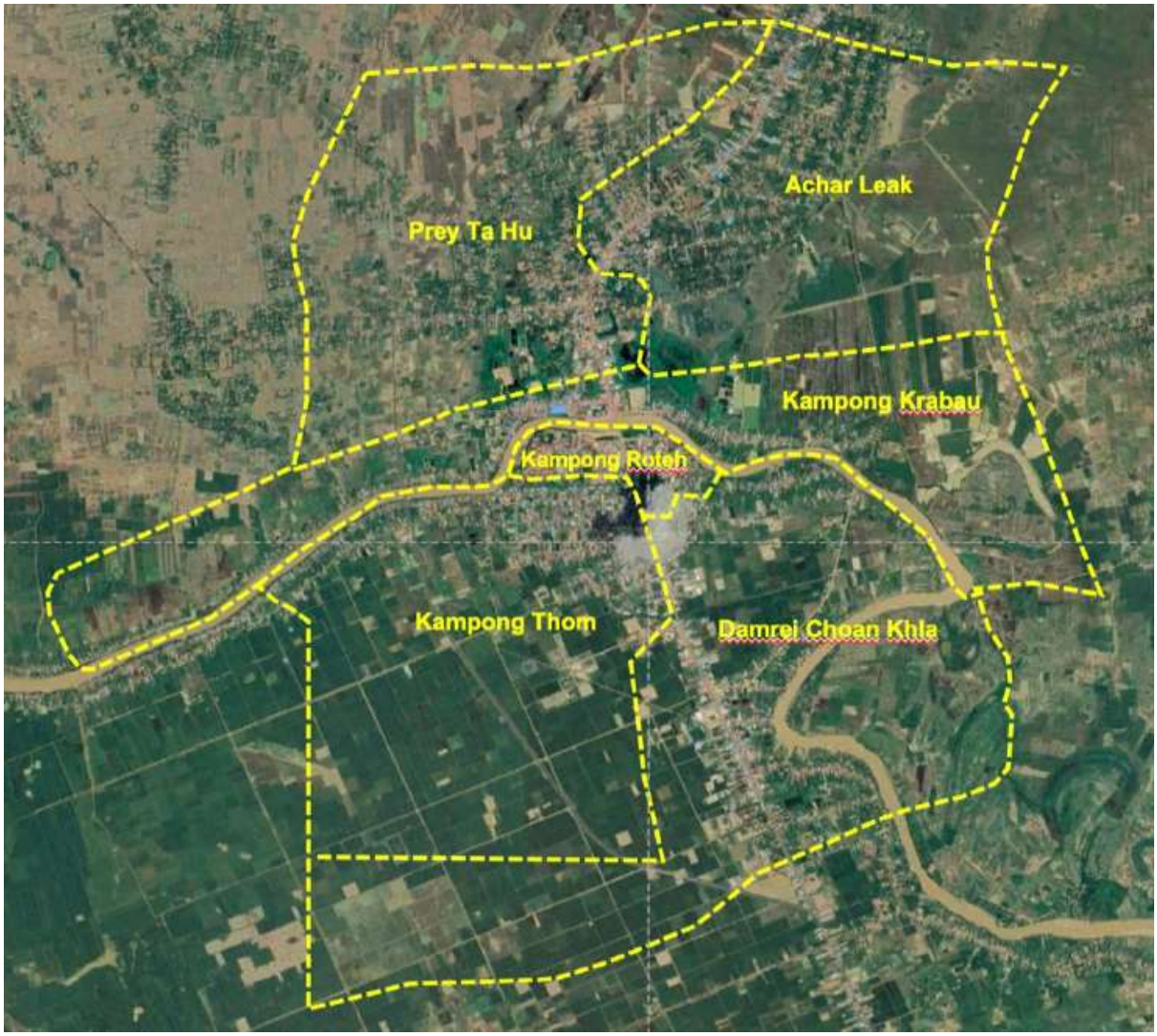
79. The proposed landfill site is 12.5 km from the town centre. The landfill has an area of 19.7 ha (Figure 3). The site has a fairly flat topography with elevations generally between 15.5 and 16 m.

80. This landfill site is:

- About 12 km (by road) from Stueng Saen town and about 12 km from Stueng Saen River.
- About 2.5 km from National Road 6 and about 4 km from National Road 62
- About 2-3 km from Trapaeng Russey Village where houses, school, and pagoda are present.
- The site boundary is 300 m from the nearest waterbody, Or Anlong Thlok Stream and the nearest waste cell is 500 m from the stream.

81. The site is located on privately owned land currently used as plantation. The site is divided in 10 separate land parcels, but with only one landowner, and it will be purchased through a willing buyer - willing seller agreement. The plantation does not have any workers, as trees have not matured yet. Compensation for the trees to the landowner is included in willing buyer - willing seller agreement. The landfill site has no involuntary resettlement impacts. The site has no protected area status, no public natural resources and no communal facilities, and no services are present.

Figure 4: Stueng Saen service area



4.5. Solid Waste Management Subproject

82. Detailed The scope of the Detailed Engineering Design (DED) covers the following components:

- Upgrading of access road to the landfill site: 2,150 metres of dirt road to be upgraded to a 6 m wide concrete road above flood levels.
- Construction of one controlled landfill cells out of a total of three cells.
- Construction of one hazardous waste landfill cell.
- Construction of a non-mechanical type material recovery facility (MRF).
- Construction of drainage, leachate collection, treatment, and recirculation system.
- Construction of weighbridge and office building; staff dining and rest room; workshop, electrical and mechanical room, and supply building.
- Construction of 1,403 metres of concrete internal roads, bunds, and drainage system.
- Construction of wire mesh fencing, and entrance wall, gate and security guardhouse.
- Construction of car/ vehicle washing facility.
- Construction of a facility for temporary storage of hazardous waste.
- Provision of operations & maintenance (O&M) equipment.

4.5.1. Design considerations

83. **Design population and required landfill capacities.** The consultant's team has updated the population projection for Stueng Saen and updated the capacity of the landfill

required for the next twenty years. Table 6 shows the capacity of the landfill required up to 2040.

Table 6: Proposed Capacity of Landfill for Stueng Saen

	2022	2030	2040
Population of Service Area	33,959	39,400	45,700
Waste Generation Rate	0.75 kg/ capita/ day	1 kg/ capita/ day	1.35 kg/ capita/ day
Collection Rate[4]	81%	85%	90%
Diversion Rate	12%	20%	30%
Tonnes Diverted/ Day	3	8	20
Tonnes Diverted/ Year	1,125	2,893	7,191
Tonnes Waste/ Day to Landfill	21	30	46
Tonnes Waste/ Year to Landfill	7,628	11,017	16,778
Cumulative Tons of Waste	7,628	83,404	219,769
Initial space utilised in Landfill (after compaction)	**8,974 m^3**	**98,123 m^3**	**258,551 m^3**
Final space utilised in Landfill (after settlement)	**8,032 m^3**	**83,895 m^3**	**208,134 m^3**

84. **Design Aim:** The proposed landfill is designed to provide for the safe disposal of waste by providing effective control measures to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, as well as the resulting risks to human health arising from landfilling of waste. The design approach has taken into account Cambodian, ADB, and international guidelines, in order to provide the most cost-effective solutions that take into account Cambodia's climate, local conditions, and operational capacity.

85. **Landfill Life:** This disposal facilities have been planned for an initial 10-year period from 2021 to 2030, with further provisions for a full 20-year period up to 2040. Though there is sufficient space in the identified future landfill cells for waste up to 2050. Waste volumes may change during this period and it is recommended that lifespan predictions are updated on a regular basis.

86. **Expected Waste Input:** The current and projected amount of waste to be collected and disposed of in the landfill cells have been estimated. It is estimated that 30 tons per day will be disposed of in the landfill cells in 2030, and it will reach 46 tons per day in 2040. Based on these amounts, calculations were undertaken to determine the size of the landfill cells and the predicted lifespan of the facility (Table 6).

87. **Geology:** The underlying geology is comprised of silty sand, sandy clay, and lean clay, which will provide a good natural impermeable layer. The foundation for the landfill should have the adequate bearing capacity. Based on the geotechnical survey, we have assumed 18 tonnes per square metre.

88. **Hydrogeology:** The proximity of the groundwater to the surface affects the extent of excavation needed to generate the airspace for the landfill cells. The majority of international guidelines recommend that the base of a landfill cell should be a minimum 1.5 m above the water table. However, the Cambodian Municipality Solid Waste Management Guidelines state that the base of the cell should be minimum 3 m above the water table. During the geotechnical survey, it was found that the ground water table in the landfill cell area varies between 3.92 m to 4.16 m. The design and excavation depths ensure that the base of the waste cells will be

[4] This is the collection rate for the municipal area. The collection rate for the adjacent sangkats is predicted to only increase to 65%.

at least 3 m above the groundwater table – thus complying with the Cambodian guidelines and also ensuring that there will not be any problems with uplift.

89. **Hydrology:** Surface water draining towards the landfill area could potentially increase leachate and bring about local flooding during major rain events. The design has incorporated peripheral drainage systems which will divert water away from the landfill cells.

90. **Availability of Cover Materials:** Landfill cover will be sourced from adjoining areas of the landfill. Clay for the natural liners in the landfill cells and the leachate ponds will be sourced within the site, utilising natural lean clay. Gravels will need to be imported, along with sand and topsoil. The total levels of cut and fill, along with required imported material are as follows (required volumes of imported material are outlined in the Bill of Quantities):

- Cut: 46,635 m^3
- Fill: 47,878 m^3
- Import: 1,238 m^3

91. **Type of landfill:** Due to the water table, there will be limitations on the ability to undertake any deep excavations. Consequently, this will be an area landfill, with waste deposited predominantly above ground. The maximum height of waste in any landfill cell will be 20 m, with a 1:2.5 slope, which through settlement is likely to achieve a final slope of 1:3.

92. **Approach to landfilling:** The overriding consideration for landfill operations will be to minimise the operational face and exposure of wastes to rain, therefore, minimising the production of leachate. The approach to laying waste involves dividing landfill cells into phases, with waste built up in a pyramid profile, utilising intermediate cover on side slopes, in order to reduce rainfall infiltration and maximise surface water runoff.

93. **Liner, Leachate collection and prevention of seepage:** A liner and a leachate collection system will be installed. The liner will provide a barrier to prevent leachate infiltration into underlying groundwater. The drainage layer will reduce the contact time between waste and leachate, so reducing the transport of contaminants from the solid to the liquid phase; prevent liquids laterally moving out of the landfill cell; and to increase the efficiency of the liners by reduction of the hydraulic head of leachate above the liner. The design and materials for the landfill have been selected to ensure that the system can cope with the “worst case” scenario in terms of leachate production, which will vary over time. A basal barrier in the form of a single composite liner will be utilised for the standard landfill cells, comprised of a 1 m natural clay layer (using lean clay excavated in-situ, with some additional material imported), overlain with a 1.5 mm artificial HDPE geomembrane. For the hazardous landfill cell, the clay will be 1 m thick and the geomembrane 2 mm thick.

94. Above these layers will be a leachate drainage layer, which is designed to cope with intense periods of rainfall. This will be comprised of 250 mm perforated HDPE pipes, contained within a 400 mm layer of gravel. These pipes will be spaced at 30 m intervals. A geotextile protective membrane, with a minimum mass per unit area of 400 grams per square metre, will provide protection to the HDPE membrane from any angular material in the drainage layer, as well as protection from the sun’s UV rays.

95. **Leachate Strategy:** The leachate collection and treatment system is designed as a zero-discharge system. Leachate quantities will be minimised through landfill design and operations, including intercepting incoming surface water from upstream catchment areas through drains; reducing ability for water to infiltrate wastes via heavy compaction of wastes; building waste in phases as opposed to spreading across the whole cell; utilising intermediate cover to promote surface water run-off; and completing the main phases prior to the onset of the wet season.

96. Clean surface water, which does not require treatment, will be separated from polluted seepage, ensuring that volumes in leachate treatment facilities are minimised. As such, landfill cells will have two transport pipes for liquids, one for leachate and one for stormwater. Each part of the landfill cell will be interchangeable (using a valve system)

drainage systems, so that only those parts of the cell that have active waste are connected to the leachate transport pipes.

97. **Leachate treatment:** The approach for treatment involves easy to maintain, low-tech, low cost, biological treatment in a series of lagoons. The leachate first enters an anaerobic lagoon, from there it flows by gravity to an aerobic lagoon, and then to a maturation lagoon in the form of a constructed wetland. There will also be a final treated water lagoon, which will provide a storage for liquid until it is used in recirculation.

98. The lagoons will be constructed using a single composite liner, 1 m of clay, a 2 mm HDPE geomembrane. A final 300 mm layer of compacted clay will be placed over the HDPE geomembrane to provide protection to the HDPE layer from UV rays from the sun, thereby extending the life of this liner. Water will pass through each lagoon via gravity, via 600 mm HDPE overflow pipes.

99. Following initial treatment, some leachate will be returned to the landfill through a recirculation system, which distributes leachate via drip irrigation or a sprinkler system onto the active waste piles and potentially onto vegetated final caps of completed landfill cells or other parts of the site.

100. **Landfill Gas:** The aim of the proposed landfill gas management system is to minimize the risk of landfill fires and permit the effective control of gas emissions. This will be achieved through a passive vent system, which uses the positive pressure in the landfill body to transport the gas out of the landfill under semi-controlled conditions. The vertical gas wells will comprise of 200 mm HDPE perforated/ slotted pipes in 800 mm of coarse aggregate fill. The system will allow for subsequent retrofitting if gas flaring and active approaches to gas management are required at a later stage.

101. The landfill gas pipes will only be added when the waste pile reaches a height of 5 metres. Consequently, only materials are required upfront, and the construction will be undertaken by operational staff.

102. **Density of Deposited Waste:** Landfill waste density of 850 kg/m^3 has been used for estimation of the capacity of the landfill. World Bank[5] guidelines recommend a final solid waste density of 800-1,000 kg/m^3 for developing countries.

103. **Settlement:** Following initial deposition, over subsequent days, weeks, months and years, settlement will occur in the wastes at a landfill. These processes include immediate settlement through compression and expulsion of air; primary settlement through consolidation; and secondary settlement over the long term through mechanical creep (including ravelling) and biodegradation. Due to the high amount of biodegradable material in Cambodia's waste streams (in excess of 60%) it is suggested that there may be a high level of settlement, and that final compaction rates of 1.1 tonnes/ cubic meter may be achieved. As such, it is recommended that the waste cells are 'overfilled' by 20%.

104. **Cover:** It is not proposed to use daily cover at the site. Daily cover is predominantly used to control nuisances, such as odours and pests. Due to the remote nature of the site and the operational limitations, daily cover is neither required nor feasible.

105. As the phases are built up, intermediate cover is to be utilised on the completed side slopes of the waste pile. The aim of this approach is to minimise rainwater infiltration and maximise surface water run-off. The phases will be built up during the dry season and must be completed prior to the commencement of the wet season.

106. **Final Capping:** Final capping is applied once the landfill cell is completed, requiring the addition of a number of layers above the waste, which are adequately compacted and graded. The primary purpose of the capping is to minimise infiltration of water into the waste and, therefore, the production of leachate. It achieves this by developing an impermeable

[5] World Bank (2004), "Sanitary Landfill Design and Siting Criteria", Washington DC, USA.

barrier and also by promoting surface water drainage and maximising run-off. The capping is also important in controlling gas migration.

107. From bottom to top, these layers include a 300 mm gas collection layer, 600 mm barrier layer, 300 mm intermediate/ drainage layer, and 150 mm topsoil. The intermediate layer detailed above is comprised of the 300 mm gas collection layer and 200 mm of the clay barrier layer. Only the material for intermediate capping is required under the 2030 planning horizon, as landfill cell number 1 is estimated to require final capping in 2031. The remainder of the material will be procured in the 2030 to 2040 planning horizon.

108. **Odour and Dust Control:** Odours will be minimised through the use of intermediate cover. Dust can be supressed through the recirculation of leachate on active parts of the landfill. Mitigation approaches will be developed by planting trees around selected boundaries of the site. These windbreaks will create an obstacle for moving air masses, forcing odour plumes into the lower atmosphere where polluted air can be dispersed and diluted. These shelter belts will also encourage the deposition and settling of windblown dust on the ground.

4.5.2. Landfill Site Description

109. The proposed landfill site is 12.5 km from the town centre. The landfill has an area of 19.7 ha. The site has a fairly flat topography with elevations generally between 15.5 and 16 m asl.

110. There is a river to the north of the site, which leads to the Prey Pros Lake, which is an important site for fishing and tourism. The Cambodian Municipality Solid Waste Management Guidelines state that a landfill should not be located within 200 m up-gradient of a perennial stream (Figure 5). In order to provide greater environmental safeguards, the nearest cell will be placed 500 m from the stream. There are no permanent natural waterbodies within the site. There is one small, constructed pond, which will be utilised for collection of stormwater from the landfill cells.

Figure 5: Buffer from Watercourse

111. The site has no protected area status. A large proportion of the site is currently forested, particularly in the northern section. However, this part of the site will not be utilised for landfill operations, as it provides the buffer zone for the river to the north. These trees include cashew trees (farmed), plus natural sparse secondary shrub cover including rattan, bamboo, *Combretum Quadrangutare,* and *Bauhinia Acuminata* (white orchid-tree). Wherever

possible trees will be left in-situ, so long as they do not interfere with construction and subsequent site operations.

112. The main land use activity in neighbouring properties is agriculture, comprised of cane, cashews, mango farms.

113. Internal access roads throughout the site will be constructed, providing access to the tipping faces and for operational machinery. The roads will be constructed on a 1 m high bund, using reinforced concrete with a width of up to 6 m and concrete thickness of 230 mm.

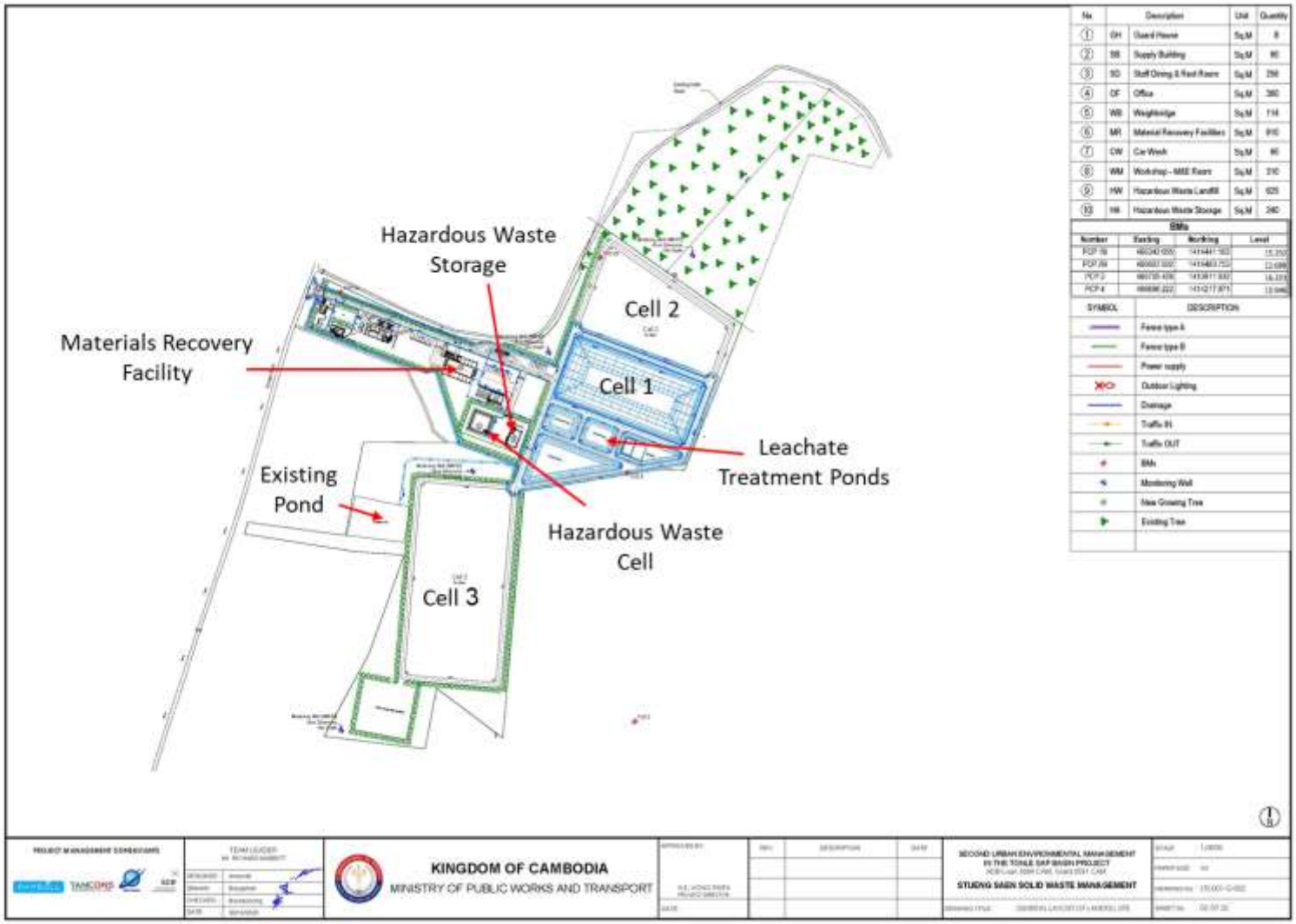
114. Apart from the front boundary brick wall of the landfill facility (length 67 m), the entire site will be surrounded by a wire-mesh fence. This fence will restrict access and also help intercept any windblown wastes from being blown into adjacent land. A wire-mesh fence is also provided around the hazardous waste facility. The total length of required wire-mesh is 2,978 m.

115. The site currently has no access to the public water supply system. A deep tube well needs to be installed at the landfill site.

116. The landfill site is expected to receive 21 tons of solid waste per day in 2022, 30 tons in 2030, and 46 tons in 2040. It is estimated that over the next 20 years, the landfill will receive and manage 219,769 tonnes of municipal solid waste in an environmentally sound manner.

117. The general layout of the landfill is shown in Figure 6. The landfill site has a total area of 19.7 ha, out of which 6.7 ha have been designated for use as landfill cells (1.7 ha for current cell and 5 ha for future cells), just under 1.3 ha for leachate treatment facilities, and 2.4 ha for buildings and facilities. The remaining 9.3 ha land is comprised of embankments, roads, areas for surface water discharge, areas for the stockpiling of cover material, and the forested area to the north that provides a buffer zone from the watercourse to the north. An area of 0.5 hectares has also been set aside for the potential establishment of a composting facility at a later date, under a separate contract.

Figure 6: Steung Saen Proposed Landfill Layout

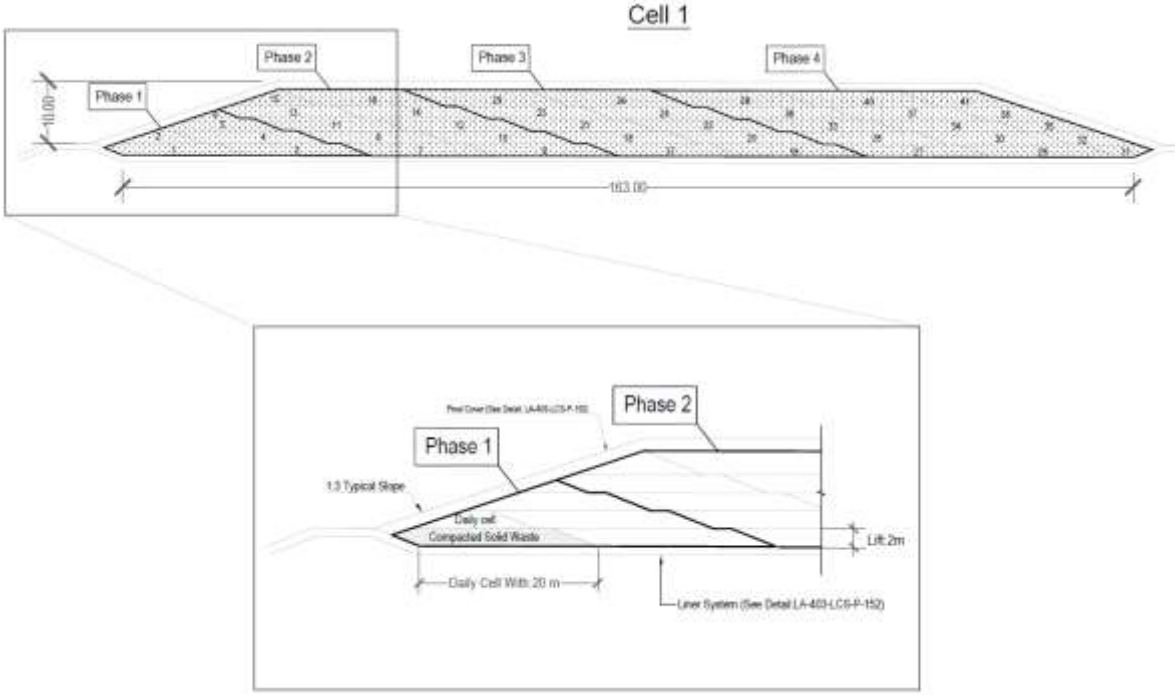


4.5.3. Cell Volumes and Phasing

118. Many landfills in Asia are developed by depositing waste in flat plateaus, which maximises rainfall infiltration and therefore leachate generation. The design took a more contemporary approach, taking into account Cambodia's climate and the wet and dry seasons. This have the key objective of minimising the amount of waste that is exposed to rain, in order to minimise the amount of leachate that is generated.

119. As outlined in Figure 7, each cell is to be divided into a number of phases, which will be built up in alternating wet and dry seasons. The waste pile will be built up in a pyramid style profile, with side slopes of the waste pile profiled to 1:2.5 initially, with a final settlement to 1:3. This staged approach will prolong the period before waste is spread across the entire cell and minimise the area of waste that is exposed to rain, as well as encouraging surface water runoff. The recommended maximum height of the final waste piles in all cells is 25 m, in order to maintain safe working practices and reduce the aesthetic impacts of the site. However, in order to account for slope the actual final heights are likely to be lower and in the vicinity of 20 m.

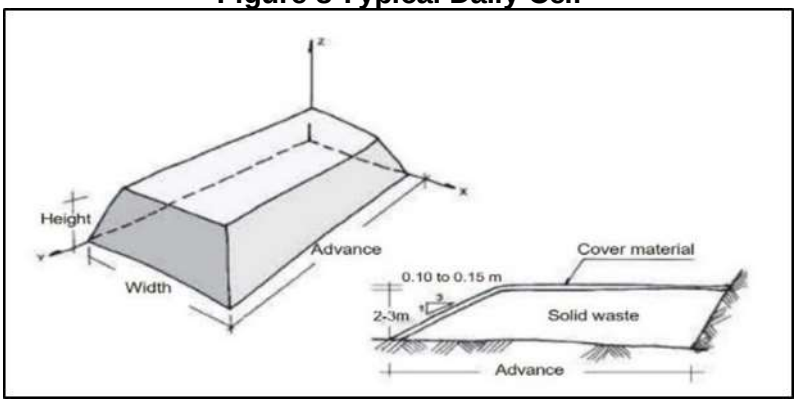
Figure 7 Landfill Cell Phasing



120. The approach to laying waste involves deposition by collection trucks at the working face, with 4 to 6 m width required per vehicle. Initially, this approach will involve depositing waste from the side embankments to achieve an uncompacted operational layer, which will provide protection to the leachate collection layer. The surrounding open surface drain will require temporary infilling at the working face, in order to allow vehicle access.

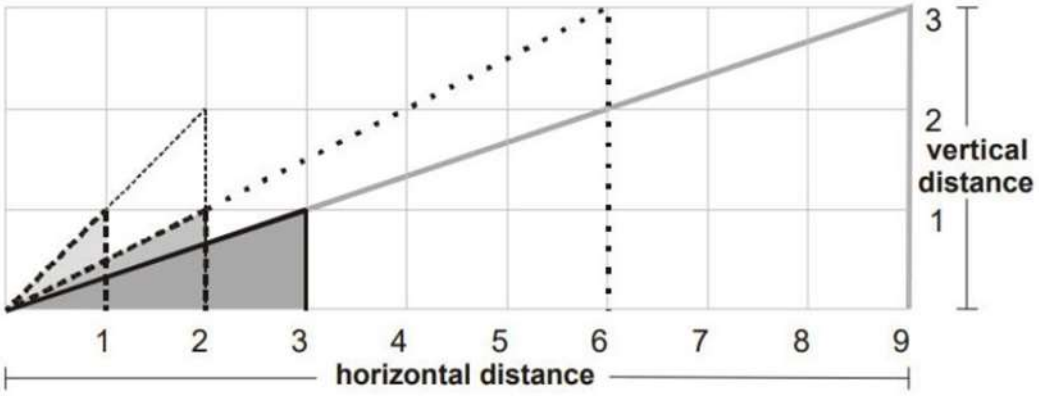
121. The bulldozer will subsequently spread the waste in thin layers of between 300 mm and 500 mm, depending on the quantity and nature of incoming wastes, which will be compacted by approximately 6 passes. Individual daily lifts may be between 2 to 3 m in height, as shown Figure 8, depending on the daily volume of refuse deposited. The maximum height of 3 m will allow for safe working practices.

Figure 8 Typical Daily Cell



122. The material is to be spread and compacted in horizontal layers or sloping layers with a gradient of 3:1 or 2:1 (advance: height), which provides a better degree of compacting, better surface drainage, less consumption of soil, and better retention and stability of the landfill, as shown in Figure 9. At the start of the landfill construction, containment must always be provided for the fill, by supporting each cell on the natural slope of the land or on the walls of the trench and, as the operation advances, on the previously completed cell.

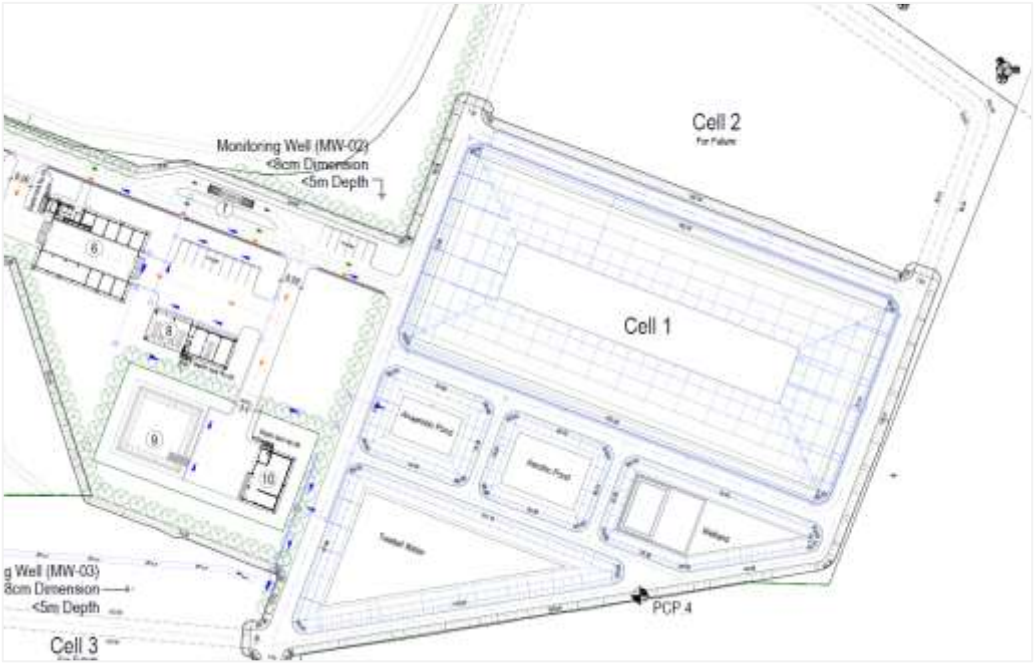
Figure 9: Ways of Representing the Gradient of a Site



123. As the phases are built up, intermediate cover (which will be the bottom layer of the final capping, including 300 mm of the gas collection layer and 200 mm of the clay barrier layer) is to be utilised on the side slopes of the waste pile. The aim of this approach is to minimise rainwater infiltration and maximise surface water run-off. The phases will be built up during the dry season and must be completed prior to the commencement of the wet season. During the wet season, it is recommended that removable geosynthetic tarpaulins are utilised whenever possible to reduce the infiltration of rain into the exposed wastes.

124. As shown in Figure 10, three cells are designed, with only cell 1 initially constructed, as well as a small cell for hazardous waste.

Figure 10 Landfill Cells



125. The landfill cells have been designed to accommodate waste from 2021/22 until 2040, with an estimated 219,769 tonnes of waste expected during this period. Cell 1 will be able to accommodate all waste during the first planning phase to 2030. The three cells will actually be able to accommodate a total of 498,048 tonnes of settled waste (based on a final settlement of 1.1 tonnes/ cubic metre), so there is flexibility for the landfill to accommodate another 278,279 tons above what is predicted for 2040. As such, the three cells will be able to accommodate waste to approximately 2050. Table 7 shows each of the landfill cell capacities, assuming that the first full year that the site receives waste will be 2022.

Table 7: Landfill Cell Capacity

Cell Number	Predicted years covered	Total Base Area (m^2)	Total Space (m^3)
Cell 1	2022-2032	14,165	97,886
Cell 2	2033-2040	15,537	110,977
Cell 3	2041-2050	31,956	243,908
Total		**61,658**	**452,771**

4.5.4. Groundwater Levels and Liner

126. During the geotechnical survey, the groundwater table in the landfill cell area varies was found at depths between 3.92 m to 4.16 m. International guidelines typical recommend that groundwater seasonal high-level should be at least 1.5 m below the proposed base of any cell excavation (e.g., ADB's 2017 guide for integrated solid waste management). However, the Cambodian Municipality Solid Waste Management Guidelines take a more conservative approach, specifying that this unsaturated zone must be a minimum of 3 m. The excavations at Stueng Saen comply with the 3 m depth to groundwater table requirements.

127. The sides of the landfill cell will be comprised of earth bunds, minimum 1 m in height, with an inner clay core that is connected to the underlying clay liner in order to prevent any lateral movement of leachate out of the landfill cell.

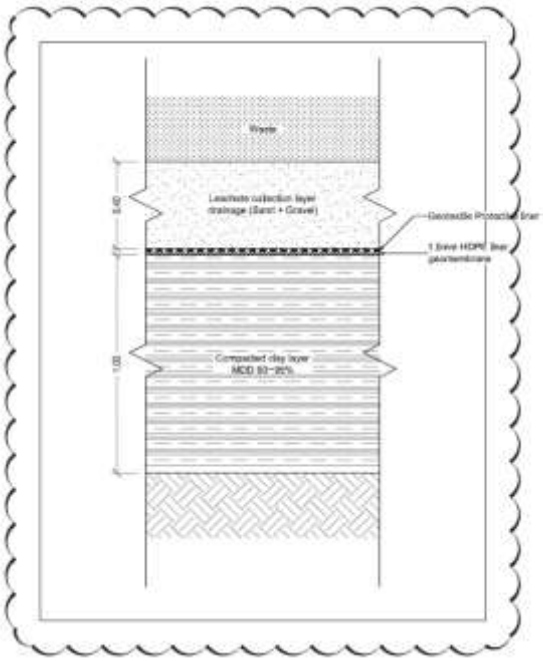
128. To protect leachate infiltration into underlying groundwater a single composite liner will be utilised, which will block/ minimize the flow of liquid and gas. The liner will involve the following natural and synthetic components (Figure 11):

- 1 m clay liner.
- 1.5 mm HDPE geomembrane.
- Protective geotextile (400 g/m^2).

129. *Clay Liner:* A 1 m thick liner utilising natural clay or other low permeability soils, with a hydraulic conductivity of between 1x10^{-7} m/sec and 1x10^{-9} m/sec (higher limit set in Cambodian guidelines; lower limit desirable). These layers are to be compacted in uniform layers no greater than 250 mm, achieving standard compaction rates of 90% to 95%, placed using a moisture content of at least 3% above optimum.

130. *Geomembrane:* A synthetic flexible membrane manufactured from High Density Polyethylene (HDPE), which will provide good chemical and biological resistance. The geomembrane will have a thickness of 1.5 mm. On installation of the geomembrane, wrinkling must be carefully avoided as is one of the reasons for failure. Seams are to be heat welded to provide a continuous cover. Seaming must be carried out along the direction of the leachate flux and in parallel to the line of the maximum slope along the side.

Figure 11 Landfill Liner



131. The geomembrane will cover the inner slopes of the side bund, with the latter feature providing an anchor trench to prevent slippage and creasing of the membrane. This anchor trench should be 1 m back from the top of the bund, in order to prevent down dragging of the geomembrane during and after waste placement.

132. The geomembrane must be installed in direct contact with the clay layer without any kind of interposed material. It is essential that there is no air or extraneous material between the two liners that hinders close contact, as this may compromise the ability for these two layers to work harmoniously in preventing any leachate seepage.

133. *Geotextile Protective Layer:* In order to provide mechanical protection to the HDPE geomembrane from punctures and tears, a protective geotextile layer will be utilised below the leachate drainage layer, and on the side slopes of the landfill cell. This layer is to be comprised of a needle-punched non-woven geotextile, with a minimum mass per unit area of 400 g/m^2. The geotextile will be overlapped above the geomembrane, with no bonding. This geotextile

will also provide protection to exposed parts of the landfill cell, prior to waste deposition, thereby protecting damage to the HDPE geomembrane from the sun's UV rays.

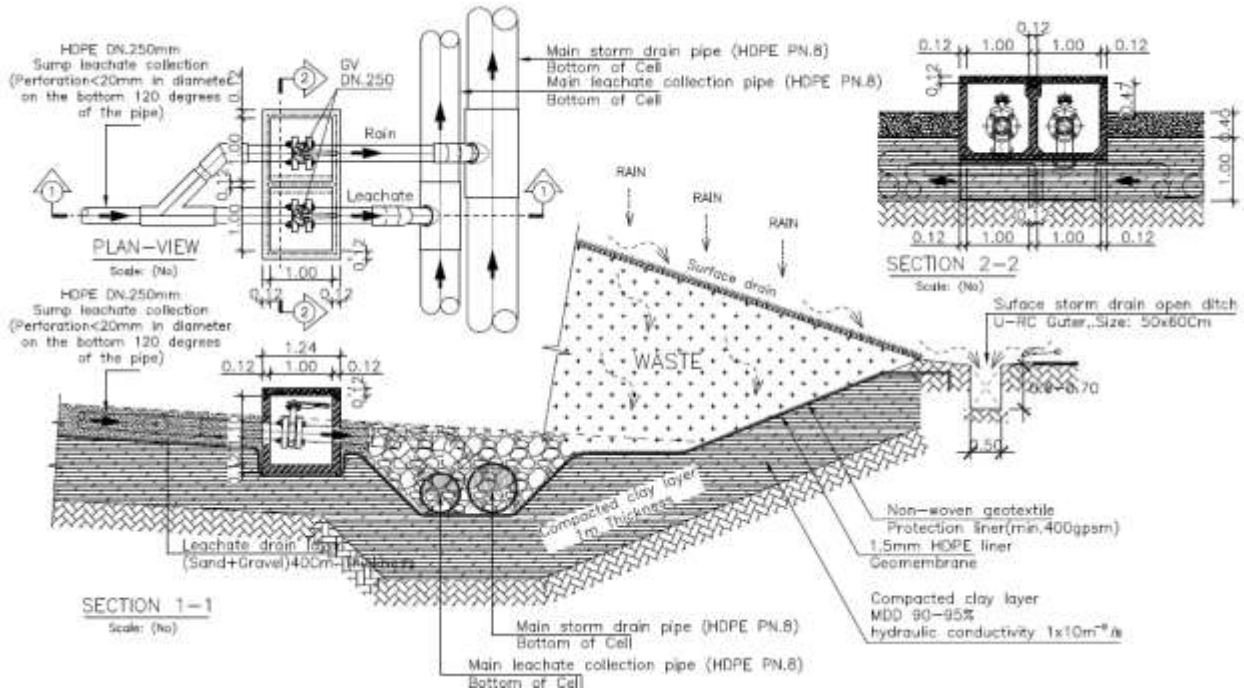
134. This cushioning layer will provide protection during construction and operations, by offering resistance to penetration from any angular material (e.g. gravels) in the drainage layer or any sharp material from the waste, which may result in puncture damage to the HDPE geomembrane. Prolonged exposure to ultraviolet (UV) rays from the sun and elevated temperature can reduce the strength of the HDPE geomembrane. The use of a geotextile on the landfill cell's bottom and side slopes will offer protection to the geomembrane from the direct heat and rays of sunlight, prior to the deposition of waste.

135. The use of a filter layer above the drainage layer is not recommended. In some landfills a 300-500 mm layer of soil or compost, overlain with a geotextile filter layer, is used to prevent fine particles from washing out of the waste into the drainage layer. However, these filter layers can become clogged, preventing the migration of leachate to the collection system. Instead of a protective layer, it is recommended that the first two metres of waste are deposited without compaction and that all bulky and hard waste is removed from this initial waste layer. This operational layer ('fluff' layer) will provide protection to the drainage layer, HDPE pipes, and the geomembrane. Waste compaction should be started on the top of the next waste layer.

4.5.5. Leachate Collection

136. Drainage will be provided at the base of the landfill, promoting the collection and removal of fluids blocked by the liner, thus avoiding perched water tables in the waste mass. To avoid accumulation of liquids in the waste layers, the leachate has to be transferred directly and as fast as possible to the drainage collection system. Consequently, this system has been designed with pipes that have adequate diameters to allow rapid water diffusion.

137. The leachate collection system is detailed below in



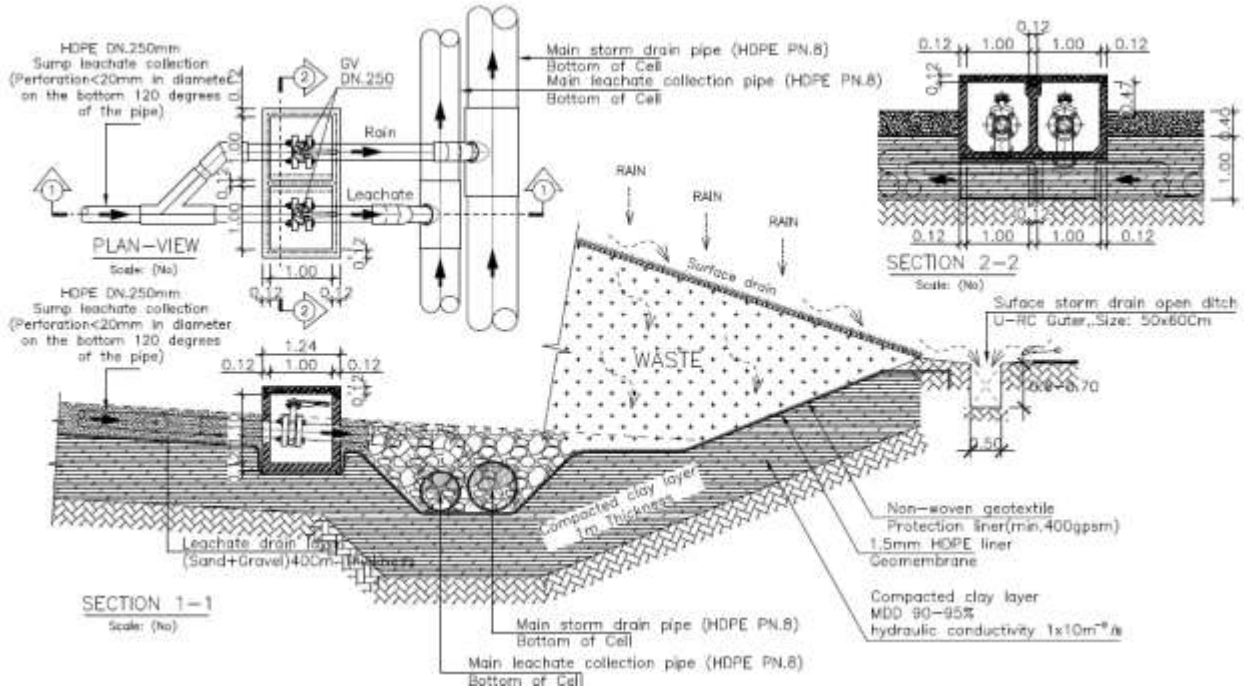
below, and is comprised of the following key features:

- 400 mm drainage layer of gravel/ sand.
- 250 mm perforated collection pipes set in channels.

138. The leachate collection pipes will drain into a leachate transport system (main leachate collection pipes), which will allow for leachate to be transported to the leachate treatment lagoons. Due to the slopping nature of the site, leachate will be transported via gravity and pumps will not be required. These main leachate collection pipes will be

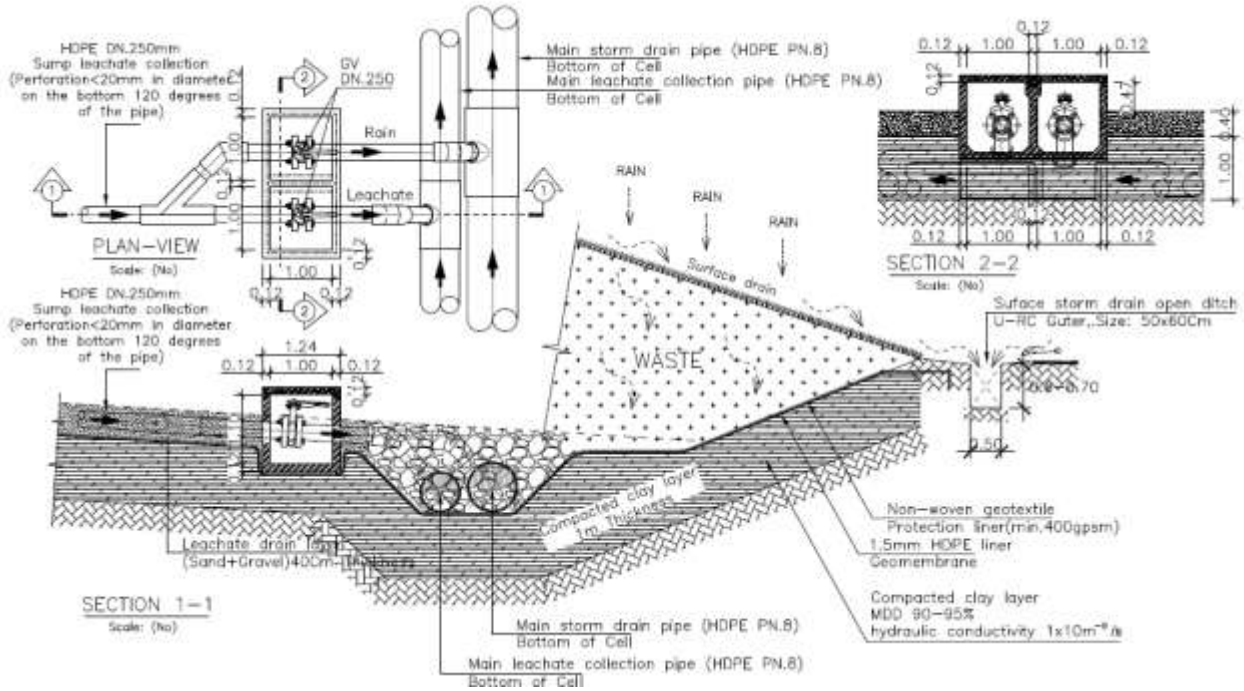
manufactured from HDPE (SDR 17). For the initial construction of cell 1, these pipes will have a diameter of 600 mm. The diameter of these pipes takes into account flow, gravity, and the need to minimise the likelihood of clogging in the lower sections of the pipes.

139. The overall system as shown in Figure 12



is designed so that clean rainwater and leachate follows the correct pathway. Only leachate from active phases goes to treatment facility. Drainage in inactive phases diverted to storm water and subsequently switched to drain into the collection system when they become active parts of the cell.

Figure 12 Design of Leachate Collection System



4.5.6. Leachate Treatment

140. The main constituents of leachate requiring treatment are the ammoniacal content, soluble salts, and the organic constituent of the leachates. Although, the exact composition of

leachate will depend on the waste composition, temperature, and moisture content. The stage of decomposition of the wastes will be a critical factor in determining the quality of leachate. There are typically two phases in anaerobic condition. The first acid phase is usually characterised by leachate with a low pH due to a high concentration of organic acids and inorganic ions, resulting in a high Biochemical Oxygen Demand (BOD) and high BOD/ COD (Chemical Oxygen Demand) ratios. The stable methanogenic phase resulting an increase of pH to between 6 and 8, with low BOD volumes and low ratios of BOD/COD. Ammonia continues to stay at a relatively high level.

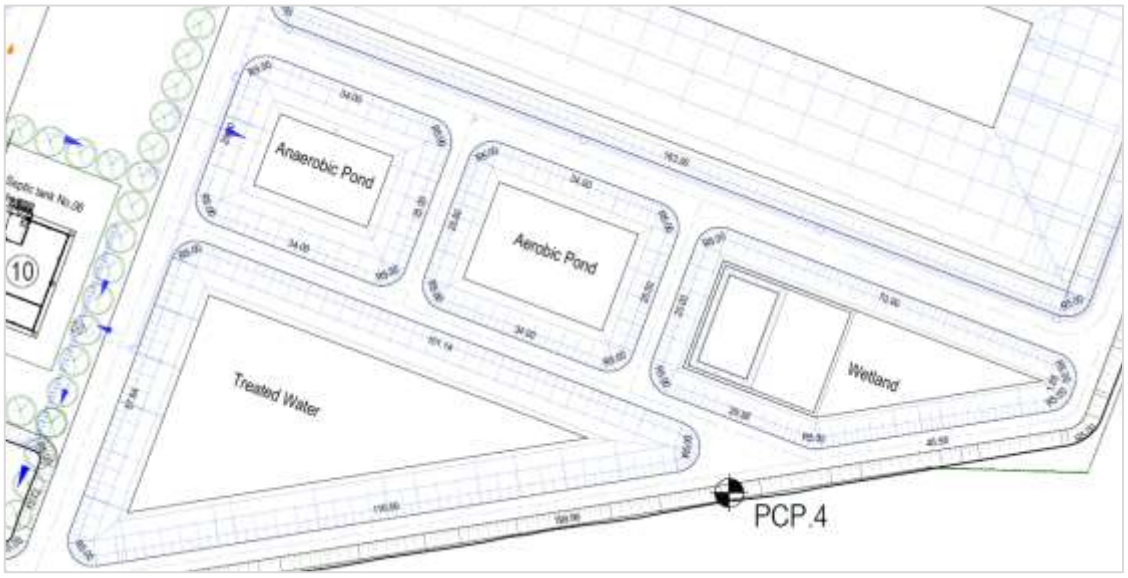
141. Due to the climate in Stueng Saen, there will be a difference between leachate generation in the wet and dry season. In the wet season high volumes of a low concentrated leachate would be expected, compared to the dry season when volumes will be lower, but concentrations of contaminants higher. Landfills will continue to produce leachate after they are closed and capped, although at a lesser rate, so treatment must continue for many years. One of the challenges of effective treatment is finding a system that will work for a wide range of leachate compositions and flow rates, because these characteristics vary with time at any landfill site.

142. There are various physical, chemical and biological options for the treatment of leachate. In developing countries in Asia, biological processes are generally used, as these are the easiest to maintain and most cost-effective ways of treating leachate. The biological treatment processes at this landfill will involve passing leachate through three stabilization lagoons, before reaching a final storage lagoon for treated water:

- Anaerobic lagoon (absence of air).
- Aerobic lagoon (presence of air).
- Maturation lagoon (constructed wetland) for final stabilization.
- Final storage lagoon for treated leachate

143. The leachate treatment ponds will be located close to cell 1 and leachate will be transported via gravity, requiring no pumps to move liquid from the bottom of the cell. The layout of the individual ponds is shown in Figure 13.

Figure 13: Layout of the Leachate Treatment Ponds



144. *Anaerobic Lagoon:* The first lagoon will remove strong biological degradable materials (generally >2,000 milligrams per litre), using anaerobic processes. This lagoon will be 3 m deep. The ideal retention time for leachate in this lagoon will be approximately 20 days.

145. *Aerobic Lagoon:* The second lagoon's purpose is to remove biological degradable materials, some ammonia, plus achieve low BOD. This is achieved through an aeration

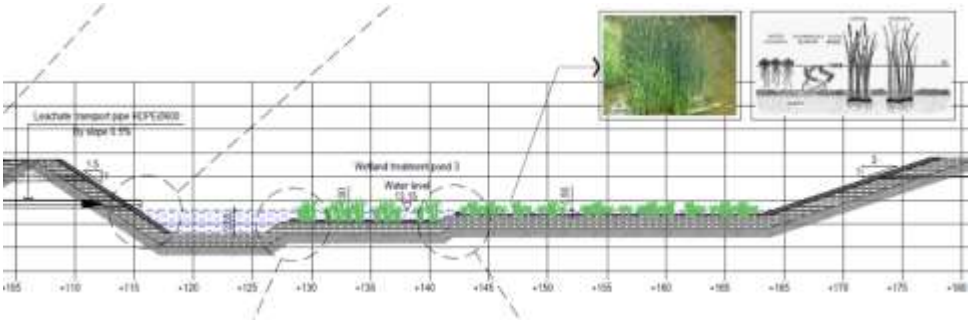
process to diffuse and mix the water. In order to minimise operational costs and resources electric aerators will not be utilised. Instead, this will be a shallow pool, with a depth of 1 m, which relies on disturbance of the upper surfaces by the wind to mix up the layers of water. The retention time in this pond will be 5 days.

146. *Maturation Lagoon:* This will involve a constructed wetland, which have been shown to provide cost effective, low energy, easy operation, and highly efficient processes for the treatment of a range of leachates. The year-round warm temperatures and abundant rainfall in tropical countries provide ideal conditions, favouring vegetation growth and biogeochemical processes that promote good constructed wetland performance. This lagoon will be designed to mimic a natural wetland system, utilizing vegetation, substrate, and associated microorganisms. Wetlands provide natural filtration, removing contaminants through a range of physical, chemical and biological mechanisms including sedimentation, microbial degradation, plant uptake, and absorption. In addition to removing organic matter, inorganic mater, pathogens and other contaminants, the wetland will have the ability to substantially reduce leachate volume due to vegetation evapotranspiration and evaporation.

147. The lagoon will be constructed as a free water surface wetland to give a variety of depths and conditions, from vegetated zones to open water (Figure 14). This approach will involve a series of shelves of different heights for the establishment of plants: a shelf with 1 m depth and one with 0.5 m depth. The deepest parts of this lagoon will be 2 m. As such, the lagoon will provide both aerobic and anaerobic microsites. Shallow areas will allow for additional aeration and evaporation of leachate. Previous studies have shown that between 5 to 14 days detention time is adequate in most constructed wetland systems.

148. The wetland will have a range of emergent, submergent and floating wetland plants, including species such as Typha (cattail), *Phragmites* (reed), or *Scirpus* (bulrush). Many macrophytes have the ability to transfer oxygen to their root systems and rhizomes, which stimulates the growth of bacteria that can break down organic substances. Other constituents of the leachate can be absorbed and immobilised by the plants themselves, as well as the soil. Substrate media will comprise of gravel, sand and loamy soil, and will be deep enough to allow rooting of the emergent plants (50 – 150 mm). Smooth round rocks will be placed at the end of each shelf to ensure that substrate is not washed down to lower levels.

Figure 14: Constructed Wetland



149. *Treated Water Lagoon:* This lagoon of 2 m metres depth will provide a holding area for treated water, although it will not be possible to guarantee that this water is of a suitable quality for discharge to receiving waters (noting that there is actually no intention of discharging leachate from the landfill). It is from this lagoon that liquid can be removed for recirculation. The approach will be that leachate will be kept in the constructed wetland for as long as possible. Following rain, if flow levels are high, then water will be passed from the wetland into this final lagoon.

150. *Construction of Lagoons:* The three types of lagoons will require liners to ensure that leachate does not infiltrate groundwater. This will involve a similar approach to the landfill cells, with a 1 m clay liner, overlain with a 2 mm HDPE geomembrane (using a slightly thicker geomembrane than the landfill cells for additional protection). A final 300 mm layer of compacted clay will be placed over the HDPE geomembrane to provide protection to the

HDPE layer from UV rays from the sun (when water levels are low this layer is likely to be exposed), thereby extending the life of this liner.

151. The lagoons are arranged in a way where leachate is driven by gravity through each lagoon, reducing in height from the anaerobic lagoon to the final treated water lagoon. Control between each lagoon will be provided via a 600 mm overflow HDPE pipe. Two submersible pumps will be positioned in the final treated water lagoon. The first pump will be utilised for the leachate recirculation system, as detailed below. The second pump will be used to control water levels during extremely high rainfall, with water being pumped out into the natural drainage ditch, which will run into the existing pond on the site (see Figure 6).

152. Summary information on each treatment lagoon is outlined in Table 8.

Table 8 Leachate Treatment System Details

Lagoon	Square Metres	Metres Cubed	Depth Range	Retention Time
Anaerobic	1,518	2,250	3 m	20 Days
Aerobic	1,518	850	1 m	5 Days
Wetland	2,226	1,350	0.5 – 2 m	5 to 14 Days
Treated	4,387	5,858	2 m	Unlimited
Total		**10,308**		

153. *Recirculation System:* The practice of returning leachate back into the waste is undertaken for a variety of reasons, including managing flow rates in treatment lagoons and achieving and seasonal balancing, accelerating uniform settlement of wastes, stabilisation of organic waste, and flushing of contaminants. This leachate can also be utilised on completed landfill cells that have been capped.

154. The recirculation system involves a submersible pump, which will be used to pump water from the treated water lagoon to cell 1. The leachate will be transported via a buried pipe system to cell 1, which has a series of valves and connectors to allow leachate to be distributed at various points of the cell. The final distribution mechanism will consist of a 100 m long flexible HDPE pipe, with perforations across the final 30 m to achieve a broad distribution and fairly uniform wetting (the end of the pipe is to be sealed). This system will allow leachate to be distributed using drip irrigation (trickle). Sprinkler systems will also be provided, so that site operators have two mechanisms for distributing leachate.

155. This surface approach will also ensure that there is a high level of evaporation. Recirculation is to be only practised during dry periods (this can be in the wet season during periods when there is no rain) and will require staff to move pipes throughout the day in order to avoid ponding of leachate. Vehicle traffic is not to be allowed in areas where surface application of leachate has recently occurred.

4.5.7. Leachate and Pond Volumes

156. Calculations for volumes of leachate have been undertaken for each phase across cell 1, as shown in Table 9. Calculations have been made based on average rainfalls, as well as separate calculations based on the maximum rain for each month. These calculations take into account the level of exposed waste, level of intermediate cover being used, and adsorptive capacity of waste.

Table 9 Estimated Leachate Volumes

Year	Active Phase	Season	Average Rainfall Leachate produced M^3				Maximum Rainfall Leachate produced M^3			
			Season	Month	Week	Day	Season	Month	Week	Day
1	1	Dry	0	0	0	0	-1	0	0	0
1	1	Wet	353	59	15	2	511	85	21	3
2	1	Dry	6	1	0	0	18	3	1	0

Year	Active Phase	Season	Average Rainfall Leachate produced M^3				Maximum Rainfall Leachate produced M^3			
			Season	Month	Week	Day	Season	Month	Week	Day
2	1	Wet	472	79	20	3	676	113	28	4
3	1	Dry	24	4	1	0	39	6	2	0
3	1	Wet	597	99	25	3	848	141	35	5
4	1	Dry	42	7	2	0	60	10	2	0
4	1	Wet	728	121	30	4	1,029	171	43	6
5	2	Dry	61	10	3	0	82	14	3	0
5	2	Wet	864	144	36	5	1,217	203	51	7
6	2	Dry	81	13	3	0	106	18	4	1
6	2	Wet	1,008	168	42	6	1,416	236	59	8
7	2	Dry	102	17	4	1	130	22	5	1
7	3	Wet	1,136	189	47	6	1,594	266	66	9
8	3	Dry	119	20	5	1	151	25	6	1
8	3	Wet	1,288	215	54	7	1,803	301	75	10
9	3	Dry	141	24	6	1	177	29	7	1
9	4	Wet	1,340	223	56	7	1,876	313	78	10
10	4	Dry	144	24	6	1	180	30	7	1
10	4	Wet	1,468	245	61	8	2,054	342	86	11

157. The composition and volume of leachate will vary during the lifetime of the landfill. In the first few years, leachate volumes will be low. In addition to the input of leachate into cell 1, all of the ponds will be exposed to the elements and will receive inputs directly from rainfall. Inputs from the rain will exceed leachate volumes, which will help dilute concentrations. There are predicted to be high rates of evaporation from these ponds.

4.5.8. Surface Water Drainage

158. Drains will be constructed throughout the site in the form of reinforced concrete-lined open ditches and reinforced-concrete covered drains. These drains will divert storm water away from roads, landfill cells, buildings and facilities. The storm water will be discharged into a ditch, which will be constructed as a simple natural channel, which will transport water to the existing pond that is on the site.

159. In some landfill sites storm water is allowed to enter leachate collection systems, which results in the production of a large volume of highly diluted leachate that is difficult to manage. In this project, uncontaminated stormwater will be kept completely separate from the leachate interception and collection system to minimize the volume of contaminated water requiring management at the leachate treatment facilities. As such, the water collected in leachate collection pipes in areas (phases) within active landfill cells where waste is not yet deposited will not be permitted to enter the leachate transport pipes. Each landfill cell will have a separate storm water transport pipe, as well as a leachate transport pipe. The end of each leachate collection pipe will have a valve contained in a manhole, which will allow operators to switch between the two systems. Storm water will subsequently enter the internal drainage system, bypassing the leachate treatment system.

4.5.9. Groundwater Monitoring

160. Four groundwater monitoring wells will be constructed, which will enable monitoring of groundwater quality and determining groundwater flow direction. One well will be located upstream and three wells will be located down gradient of the landfill site. The monitoring wells are to be located on the sides of the landfill (no closer than 10 to 20 m from waste perimeter). The monitoring data will enable early detection and assessment of groundwater contamination.

4.5.10. Landfill Gas Control

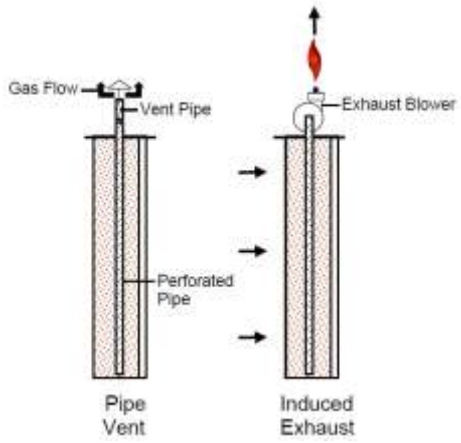
161. Landfill gas results from the biodegradation of wastes, with the main constituents being methane and carbon dioxide. Generation rates vary throughout the landfill's lifespan. Methane is highly flammable and is also a powerful greenhouse gas. The accumulation of a mixture of methane and air in a confined space within certain concentration limits can result in an explosion if ignited. The aim of the proposed landfill gas management system is to minimize the risk of landfill fires and permit the effective control of gas emissions. The system has also been designed in a way that will allow for the system to be converted into an active system with gas flaring at a later date. This active system would involve suction and burning of gas in order to safely dispose of flammable constituents, control odour nuisance, and reduce the implications from releasing greenhouse gases into the atmosphere.

162. The approach to landfill gas management will be to utilise passive vents, using vertical wells, which use existing variations in landfill pressure and gas concentrations to vent landfill gas into the atmosphere. The end of the pipe at the surface will need to have a u-bend to prevent infiltration of rain into the landfill cell.

163. The gas collection layer in the final capping will also provide additional pathways. It is essential that there is a good clay seal around the gas pipe at the surface when final capping is put in place across the landfill cell (this will go from the surface to the barrier layer of the final cap). This will ensure that gas is emitted via the pipe. The landfill cells have been designed so that there is no lateral movement of gas out of the sides/ bottom of the landfill. This approach will ensure that there a vacuum can be created, which is critical if an active approach to landfill gas is required at a later stage.

164. As shown in Figure 15, the passive gas collection system can be converted to an active system, which includes an induced exhaust system and flaring. This would require the addition of a well head, to allow for vacuum adjustment, the inclusion of monitoring ports, and the installation of lateral pipes to transport landfill gas to the flare system. The type of flare system would need to be considered based on the levels of gas produced, health and safety, and the operational capacity.

Figure 15 Potential Future Transition from Passive to Active System



165. The vent pipes are to be placed vertically in the landfill cell when the waste reaches a height of five metres, which means that the pipes will be present in approximately 75% of the waste height. Additional lengths of pipe are to be added in accordance with progress of the landfilling to avoid being covered by the waste. This approach takes into account that in the early stages of filling a cell it is likely that the combination of waste quantity and age means that there are relatively low amounts of gas volumes being produced.

4.5.11. Landfill Cap

166. Once a landfill cell is full of waste it is essential to ensure that the cell is fully capped as soon as operations ceases. The primary purpose of the capping is to minimise infiltration of water into the waste and, therefore, the production of leachate. It achieves this by developing an impermeable barrier and also by promoting surface water drainage and maximising run-off. The capping also is important in controlling gas migration. It is recommended that the following layers are utilised in capping from top to bottom:

- Topsoil (150 mm).
- Intermediate layer (150-300 mm).
- Barrier layer (600 mm).
- Gas collection layer (150 – 300 mm).

167. The final capping of landfill cell 1 will be completed post 2030. As such, only material associated with the intermediate cover needs to be initially provided. This involves the 300 mm gas collection layer and 200 mm of the barrier layer. Post 2030 this layer will be added to, involving compacting and grading the additional clay (400 mm), intermediate layer, and topsoil.

168. The intermediate cover will be stored in the area where cell 2 will be located. Operational staff will be responsible for maintaining these stored piles of material and spreading intermediate cover on completed parts of the active landfill.

4.5.12. Hazardous Waste

169. The joint disposal of untreated hazardous waste with municipal solid waste is not considered an appropriate management practice. As such, a separate hazardous waste landfill cell is included in the design. The waste acceptance policy for hazardous wastes will be detailed in the Operation and Maintenance manual (O&M manual). It is envisaged that the majority of this waste will be securely stored in either HDPE plastic or steel drums, with exact requirements specified in the O&M manual and purchases made as part of general equipment purchases (typically this will involve plastic drums for corrosive wastes and steel drums for non-corrosive, oil-based and flammable liquids). These must conform to the United Nations standard for packaging materials. On completion of each layer of waste, these will be covered with 300 mm of intermediate cover material. On completion of the cell, final capping will be utilised, as per the standard waste cell.

170. The conceptual design of the hazardous landfill cell is displayed in Figure 16 and the location is indicated in Figure 17. The cell will be broadly constructed in a similar way to the standard landfill cells, with the following additional requirements in order to achieve a higher level of protection to groundwater from the infiltration of leachate:

- Leachate collection layer: A 500 mm layer of gravel with a minimum hydraulic conductivity of $1x10^{-3}$ m/sec. One HDPE leachate collection pipe (250 mm diameter).
- Geomembrane: a 2 mm HDPE geomembrane.
- Clay liner: 1 m clay liner with hydraulic conductivity of $1x10^{-9}$ m/sec.
- Side walls to have the same level of protection as the base (clay and geomembrane).

171. The side walls will have a slope of 1:2, with a 3 m wide section that has a 1:4 ramp into the cell. This will allow site operators safe access into the site, so that they can manually (e.g., using trolleys) transport barrels from the hazardous storage facility into the landfill cell. The system is not designed to permit vehicular access into the cell. The hazardous landfill will have a volume of 1,211 m^3 and will be able to reach a final height of waste of 3 metres. This will be able to accommodate three layers of 220 litre drums. One gas collection well will be provided and constructed upfront (not by operational staff as per the standard landfill cell).

172. An emergency cut-off valve will be installed in the leachate collection pipe, located within a manhole cover to the side of the hazardous landfill cell. This valve can be utilised in case of accidental deposition or spillage of extremely hazardous material into the cell, in order to prevent flow of highly contaminated leachate into the leachate treatment facility.

Figure 16 Hazardous Waste Landfill Cell

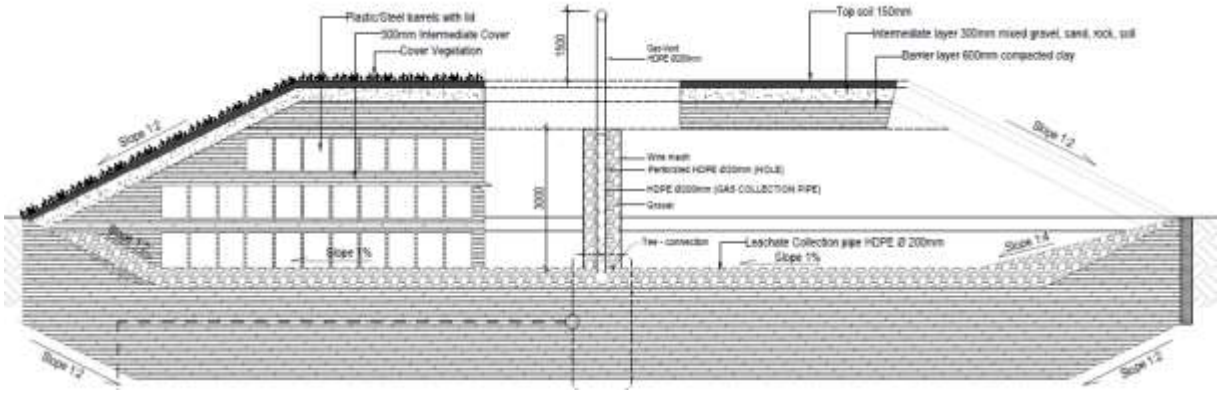
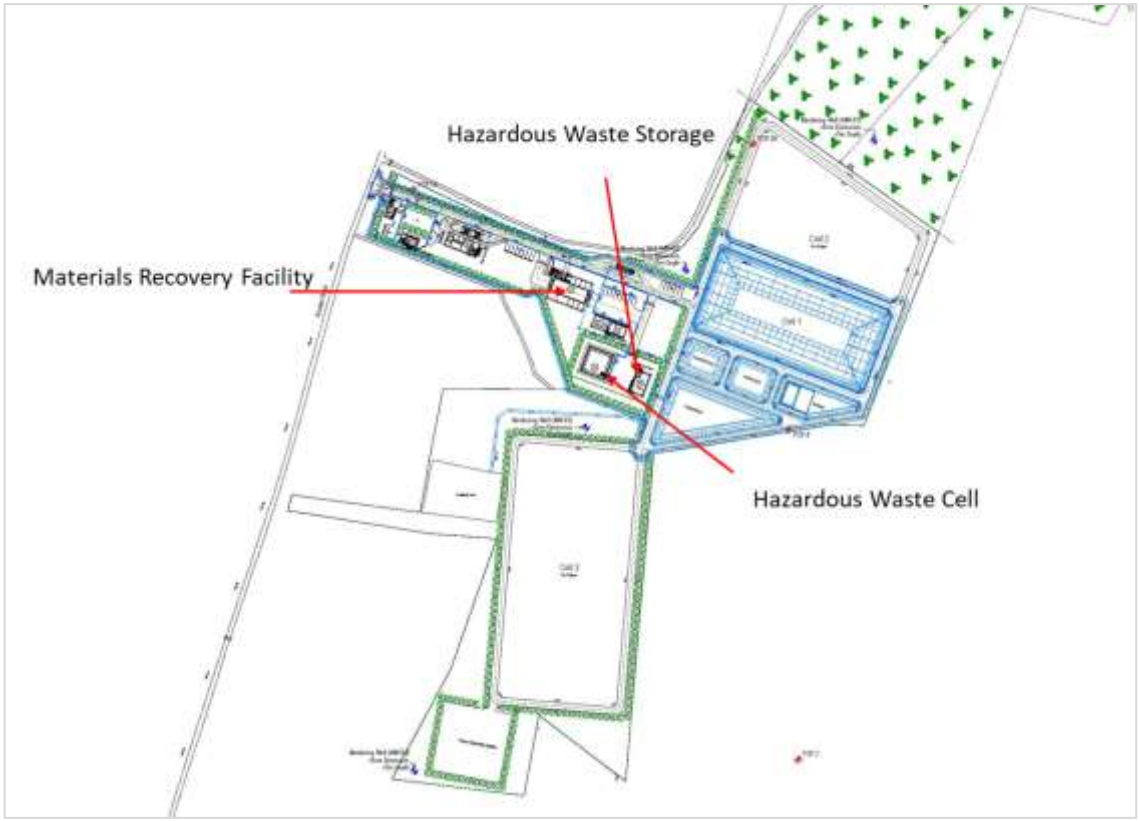


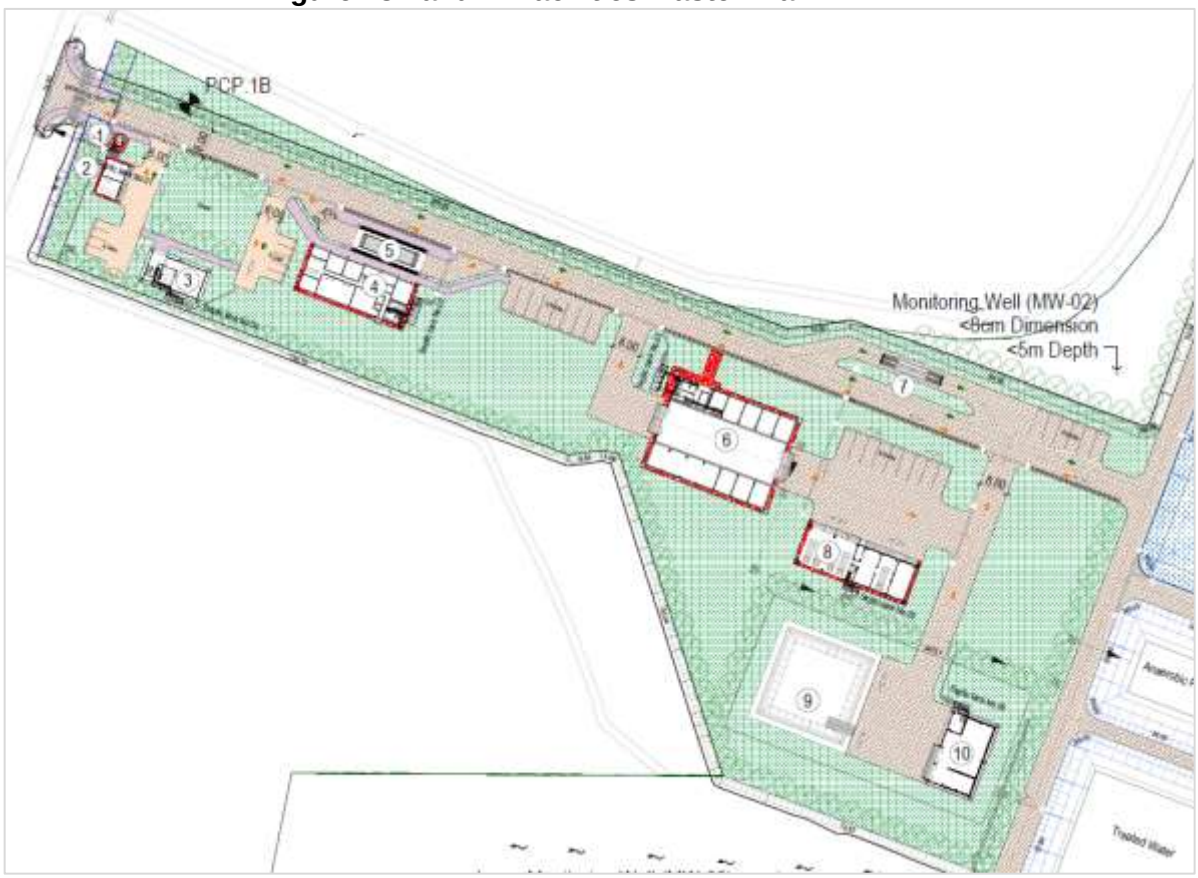
Figure 17: Location of the Hazardous Waste Cell and Hazardous Storage Facility



4.5.13. Landfill Facility Civil Works

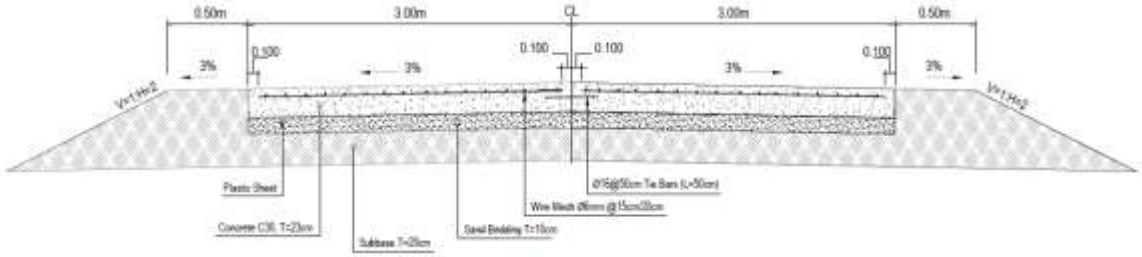
173. The layout of the facilities, detailed in Figure 18 below, takes into consideration safe working practices. The layout and road system are designed to ensure that vehicle movements are efficient, and crossing is minimised. The different components of the landfill consist of the following facilities:

Figure 18 Landfill Facilities Master Plan



174. ***Access Road:*** A 2.1 km (2,150 m) dirt road to the site will be upgraded using a concrete construction, which is 6 m wide by 23 cm thick and has a load bearing capacity of 25 tons (Figure 19).

Figure 19 Access Road Profile



175. ***Guardhouse:*** A room for security staff is provided at the very entrance to the site. This is a basic building, with space for two guards to sit, with a separate room with a toilet/ washroom provided. This building has a floor space of 8.05 m^2.

176. ***Weighing Bridge & Office Building:*** This facility will provide the main point of access into the site and will be where the waste will be weighed and checked to ensure that it meets waste acceptance criteria (which will be specified in the O&M manual).

177. The office block is comprised of a number of individual office rooms, meeting room, small storage room, a small kitchenette, and toilets (Figure 20).

178. The accurate recording of wastes is essential for effective management of the site. As such, a digital scale will be utilised, which is linked to computer software that provides data on all trucks and waste volumes. The weighbridge will have a maximum design loading of 60 tons and is comprised of a raised platform.

179. Waste collection trucks will be weighed on entry to the site. It is envisaged that a system of Tare, whereby for the vehicles regularly visiting site the site has verified records on the unladen vehicle weight. Under such systems the need to weigh each vehicle again on the way out of the site, after tipping, may be waived. The weighbridge is located at the righthand side of the road. The weighbridge facility is located at a sufficient distance from the public road to provide space for queuing in order to avoid tail backs on to the public road. The weighbridge office is located on the offside of the weighbridge and positioned so that the operator can easily see vehicles approaching, leaving and using the weighbridge. The office is positioned so that the weighbridge operator can speak to the vehicle driver. A small kitchen, tea-room, and toilets are provided in the office building. The total area of the office building is 360 m^2 and weighbridge is 114 m^2.

Figure 20: Office Building Layout

180. ***Staff Dining and Rest Room:*** A two storied building has been designed to provide dining and lodging facilities for the staff, officials, and security guards. Total of 256 m^2 floor area is allocated for these facilities.

181. ***Workshop, Electrical, and Mechanical Room:*** A workshop is provided to maintain all the vehicles within the facility. An electrical room is provided to maintain all electrical components of the facility. The mechanical room is provided for maintaining all mechanical parts, such as fans, exhaust fans, pumps, and motors. Altogether, 310 m^2 of floor area have been provided for these three facilities.

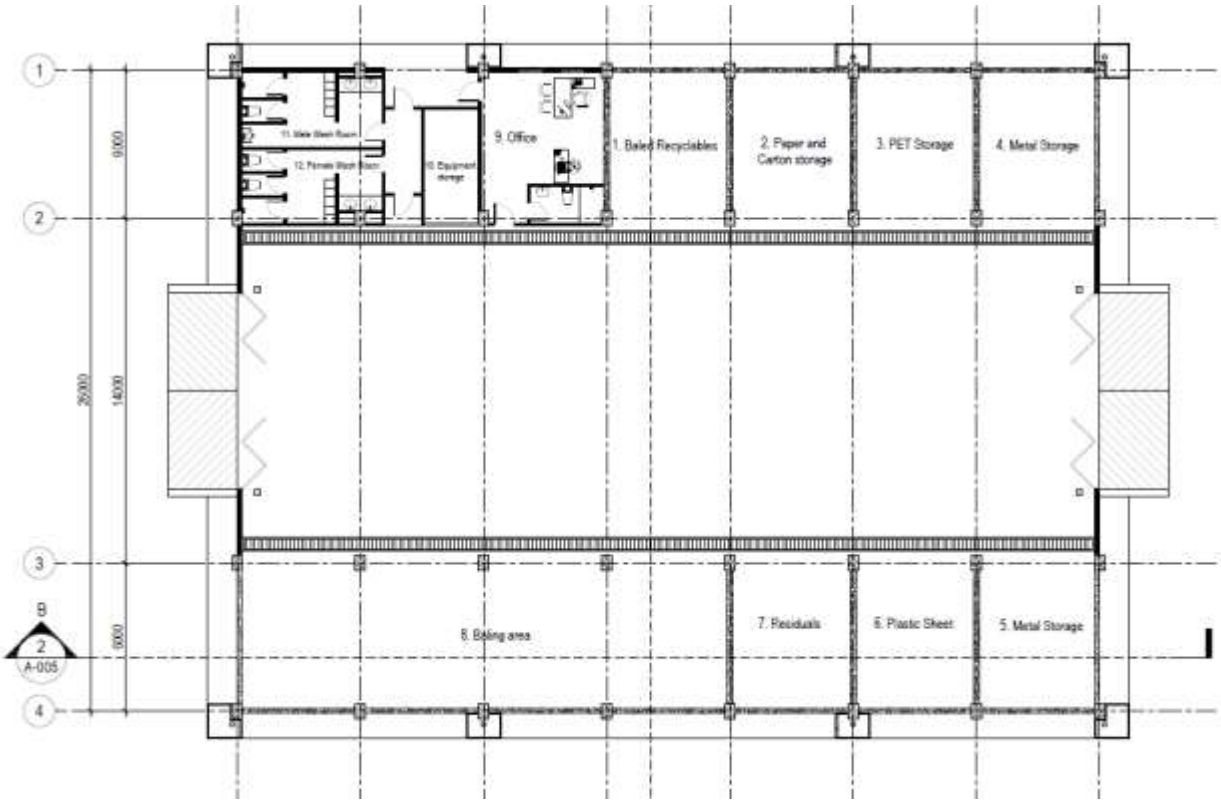
182. ***Supply Room:*** This small building will have two rooms a) Plumping technical room for the groundwater pump and supply; b) Electrical technical room for the generator and main distribution boards (MDB) for electricity supply. The total floor area of this building is 60 m^2.

183. ***Material Recovery Facility (MRF):*** This is a non-mechanical type material recovery facility, which will provide a covered building for the manual sorting of recyclable wastes. Seven bays have been provided to allow for the separation and storage of materials that are likely to have marketable value (e.g. recoverable plastic, glass, paper, aluminium, and ferrous metals). It is estimated that over the planning horizon there will be significant increases in the volume of waste that is diverted from landfill, as a result of new policies in relation to recyclable material, development of processing technologies, and improvement in regional markets for post-consumer materials. As such, it is predicted that by 2040 diversion rates of approximately 30% will be reached, amounting to an estimated 20 tons per day.

184. Space has been allocated for a baling area, where baling, shredding, and compacting of materials can take place. Ventilation and lighting are provided in the design, in order to keep the area well lighted for a safe working environment.

185. Full facilities are provided for staff, including an office room, equipment storage, and separate toilets and changing rooms for male and female workers. The MRF has 1,800 m^2 of floor area (Figure 21).

Figure 21: MRF layout



186. ***Hazardous Waste Storage Facility:*** This facility will be used for safe receipt repackaging, labelling and temporary storage of hazardous waste prior to disposal in the hazardous waste cell or sale to interested recyclers. For safety reasons, the hazardous waste storage facility and the hazardous waste cell are located in an area of the site that is slightly away from other buildings, and the facilities are contained within a dedicated secure fence and gate.

187. The hazardous waste storage facility will be able to store hazardous waste with potential value such as electronic waste which can then be disassembled and stored, until interested parties (recyclers) purchase or collect it for the purpose of recycling or treatment.

188. The building is to be well covered and ventilated, with a sealed floor to control any spills. A small office is also provided. Floor space: 240 m^2.

189. **Vehicle Washing Facility:** A vehicle washing ramp facility has been provided to clean and maintain the vehicles engaged with waste collection. This vehicle washing ramp is located on the righthand side of the road, so that vehicles can easily access this facility as they are leaving the site. Vehicles can subsequently drive forward out of the facility, thereby eliminating the need for reversing and reducing the potential for accidents. This covered facility is 60 m^2. Wastewater generated from the washing facility will be collected by PVC sewer pipes and will be conveyed to the septic tank for treatment

190. ***Internal Roads and Parking:*** Internal site roads and parking bays will be constructed using a concrete construction, which is 23 cm deep and has a load bearing capacity of 25 tons. The width of these roads varies, and the total length of these roads is 1,403 m in the initial construction (not including roads required for landfill cells 2 and 3).

191. ***Fence and Wall:*** A wire-mesh fence will be constructed around the site boundaries (including future cells), to avoid unauthorised people entering the landfill and to prevent illegal dumping. Wire mesh is being utilised as it will also help capture wind-blown litter, intercepting

it before it leaves the site. A 65 m long brick masonry wall will be constructed around the buildings.

192. ***Vegetation Screens:*** A line of trees will be provided to screen the operational buildings. Vegetation screens will also be provided to screen landfill cells 1 and 2 from the public road, which runs along the north/ north eastern side of the site. These screens will help minimise dust and odours along the public road.

193. ***On-Site Drainage:*** Drainage is provided in the form of reinforced concrete-lined open ditches, reinforced-concrete covered drains, and a natural ditch that drains into the existing on-site pond. These drains will divert storm water away from roads, landfill cells, buildings and facilities.

194. ***Electricity:*** A transformer of 160 KVA is required along with a 66 KVA back-up generator. Total connected load is calculated at 140 KW.

195. ***Water Supply:*** Water supply will come from a deep tube well on the site. An overhead HDPE tank will be installed for water storage. Water will then be supplied by gravity/booster pump to the buildings.

196. ***Sanitation Facility:*** Wastewater from the toilets and showers will be collected by PVC sewer pipes and will be conveyed to a septic tank for treatment.

4.5.14. Landfill Electrical Water Supply and Sanitation System Design

197. The electrical power requirements for the landfill were designed based on the estimated load required for lighting of different buildings, as per specifications, and the low voltage of 220v that is used in Cambodia. The power source will be taken from the 22 kV distribution line, which runs alongside the public road on the western side of the site. A transformer of 160 KVA is required along with a 66 kVA back-up generator. Total connected load is calculated at 140 kW.

198. Borewell water (deep tube well) will be the source of water considered for this project. Water consumption for a different type of buildings within the landfill is estimated at 45 litres per person per day.

199. Water from a deep tube-well will be initially stored into a central underground water reservoir having a capacity of 20 m^3. From the underground reservoir water will be lifted by pump through pipe to an overhead tank.

200. It has been observed that no sewer network is available near or around the proposed site. therefore, septic tanks and soak wells are provided for disposal of black and grey water.

201. The location for construction of septic tank shall be carefully selected so that it will not cause any pollution to the environment and it will have easy access for vehicles/equipment for sludge removal.

4.6. Associated & Existing Facilities

202. **Associated Facilities**. SPS 2009 defines associated facilities as “facilities that are not funded as part of a project but whose viability and existence depend exclusively on the project, or whose goods or services are essential for successful operation of the project.

203. **Existing Facilities.** The wider ADB project “Second Urban Environmental Management in the Tonle Sap Basin Project” involves the closure of the existing dumpsite in Stueng Saen which according to ADB SPS, 2009 is considered an “existing facility”, and in compliance with ADB requirements an Environmental Compliance Audit will be undertaken as a basis for the subsequent closure and remediation of the dumpsite. The ECA is not part of this subproject but will be prepared separately for the dumpsite closure and remediation under a separate subproject. The current sub-project (construction of new engineered landfill) does not have any existing or associated facilities.

204. The Environmental Compliance Audit (ECA) for the closure and remediation of Stueng Saen dumpsite will be initiated as soon as practical with the aim of enabling

implementation of the preferred closure and remediation solution immediately upon opening of the new landfill. A preliminary Terms of Reference for the ECA is attached in Annex 3. The audit report will be disclosed on ADB's website and be available for review in PDPWT's office (summary in Khmer) in accordance with SPS (2009).

4.6.1. Dumpsite Closure

205. The Existing Dumpsite (see Figure 22) is located south of Stueng Saen town on a publicly owned land. The dumpsite has an area of 1 ha and waste has been disposed to a depth of up to 4 m. The site has been in operation for 21 years. Waste has been and is currently dumped without any compaction and only occasional sporadic application of cover material. Informal recyclers are collecting recyclable materials and open burning of waste is occurring at the site.

Figure 22: Location of the Existing Dumpsite

206. The plan is to close the dumpsite as soon as the new landfill is ready to receive waste. The key objectives of closing and remediating the existing dumpsite include to:

- minimise the risk that leachate from the waste dump may infiltrate groundwater resources that are or may in the future be used as a source of drinking water;
- minimise the risk of contamination of nearby waterways;
- minimise the risk to public health from spread of infections;
- eliminate the generation of harmful air emissions from open burning of waste;
- control migration of landfill gasses;
- eliminate generation and odour and windblown waste;
- create an area that can be safely used for predetermined purposes;
- improve the livelihoods and living conditions of informal recyclers.

207. The closure and remediation of the dump site will be determined based on the ECA. The ECA will be executed in two phases, where phase 1 is a preliminary assessment of the risks, possible solutions and the need for immediate mitigation measures at the dump site to minimise on-going pollution and risks to human health as much as practical until the long-term

solution can be implemented. Phase 2 of the ECA concerns more detailed site investigations and analyses as a basis for making a decision on the long-term solution and to provide information for the preparation of the detailed remediation design. At the end of each phase, the results will be presented to the Project Steering Committee and ADB for their decision on the next steps.

208. The possible long-term solutions to closure and remediation of the dumpsite basically include the following three methods[6]:

(i) **In-place closure by capping the waste**. This method includes a low permeability cap and a topsoil layer (typically comprised of 4 layers: (1) gas drainage, (2) low permeable clay layer, (3) soil drainage layer and (4) a topsoil layer). The final grading of the closed dump should be designed to ensure slope stability and proper drainage that prevents ponding of water and which is not causing erosion. Leachate seepage on side slopes should be collected and then pumped onto a truck for disposal and treatment at the new landfill. Installation of landfill gas vents would also be considered. The site would likely be suitable for sport activities, park or recreation, agriculture (cropland, plantation, grazing land), but not for buildings or installations or infrastructure that require good foundation.

Long-term aftercare and monitoring would be required, and this would likely include groundwater monitoring (monitoring wells would have to be established), monitoring of seepage /leachate, landfill gas monitoring. Aftercare would consist of regular cleaning and repairs as required to the leachate collection and disposal systems, reinstatement of eroded batters, replacement of soils that are eroded, replanting any vegetation that dies back, filling any depressions that occur on site due to differential settlement, reparation of access roads to allow access at all times, and repairs to the perimeter and internal fences as needed.

(ii) **Closure by upgrading into a controlled engineered landfill**. If there is sufficient available space at the dumpsite, a controlled waste cell could be constructed at the site. The waste would be excavated and disposed in the cell with proper compaction of the waste in thin layers thereby potentially reducing the area or the footprint and thus also the generation of leachate. Ideally, the waste would be encapsulated in a cell with liner, leachate collection system, landfill gas venting and a cap as in the 'in-place closure' alternative, however, the level and scope of mitigation measures would depend on the results of the ECA. Leachate could be treated (possibly also recirculated) onsite or trucked to the new landfill for treatment. Segregating recyclable materials from the excavated waste could be part of the remediation. The future land use would be restricted similar to the 'in-place closure' alternative, but it may be possible to free-up some land that would free of waste and that would not have any land use restrictions. Monitoring and aftercare would likely be similar to the 'in-place closure' alternative.

(iii) **Closure by removing the waste from the dump and disposing it at the new landfill**. This alternative could be combined with sorting the waste for recyclable materials and separation of hazardous waste. In principle, deposition of the waste at the new landfill would inevitably reduce the design-life of the new landfill, however, as explained in Para 0, considering waste settlement, the cells have an extra capacity of some 240,000 m^3. The excavated void should be backfilled with suitable locally available materials. This would in principle ensure that there would not be any land use restrictions and no need for monitoring and aftercare. However, if the groundwater underneath the waste dump has already been contaminated, there may be a need for additional mitigation measure and/or monitoring activities.

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[6] A Roadmap for closing Waste Dumpsites, The World's most Polluted Places, ISWA, 2016, https://www.iswa.org/fileadmin/galleries/About%20ISWA/ISWA_Roadmap_Report.pdf

209. As mentioned above, Phase 1 of the ECA is designed to deliver an action plan and EMP for immediate mitigation measures at the dumpsite. Likely measures include the following:

- Extinguishing fires
- Regular covering of waste
- Extermination of pests (rats)
- Temporary leachate management such as diversion of leachate to a temporary pit
- Training of informal recyclers and providing them with PPEs
- Designation of work areas for waste dumping with minimal risk of polluting waterways.
- Fencing of the dumpsite.

An EMP covering the temporary mitigation measures at the dumpsite will be prepared as part of the ECA, Phase 1. The mitigation and monitoring measures for the closure and remediation of the dumpsite depend on the chosen solution which will be determined in Phase 2 of the ECA. A separate EMP for the closure and remediation of the dumpsite will be prepared based on the ECA in conjunction with the detailed remediation design.

5. DESCRIPTION OF THE ENVIRONMENT

5.1. Project Area of Influence

210. According to SPS 2009, the area of influence encompasses:

(i) **The primary project site(s) and related facilities** that the borrower/client develops or controls. The primary project sites for this project include direct construction sites, pipelines, canals, access roads, borrow pits, disposal areas, and construction camps.

(ii) **Associated facilities** that are not funded as part of the project whose viability and existence depends exclusively on the project. No associated facilities are anticipated for this project.

(iii) **Effects from cumulative impacts** meaning environmental or social impacts which result from the incremental impacts of the project when added to other past, existing or reasonably foreseeable future actions regardless of who undertakes such other actions. The Project is not anticipated to result in any cumulative impacts.

(iv) **Effects from unplanned but predictable developments** that would not have occurred but for the project and that may occur later or at a different location. The assessment has not identified any reasonably foreseeable developments that would not have happened but for the project.

211. The area of influence i.e. the area, which is affected by the project, also depends on the environmental impacts being considered. Local impacts with a narrow area of influence are those impacts arising from noise, dust and other nuisances. A larger area of influence results from impacts which contribute to global issues such as the embodied carbon associated with the manufacture, supply and use of concrete products, and the carbon emissions associated with material transport. SPS 2009 requires the assessment to identify potential transboundary effects, such as air pollution, and global impacts, such as emission of greenhouse gases.

212. For the proposed landfill project, the direct area of influence encompasses the project sites which includes the footprint of the landfill and access road, workers camp, borrow sites, and the future service area.

213. As there are no effluents expected as part of the project, the indirect area of influence based on potential nuisances is taken to be 250 m around direct project footprint, based on noise levels, as follows:

- WHO Community Noise Limits: One Hour LAeq 55 dBA (Outside; residential receptor, daytime limit)
- Construction Noise: Backhoe excavator 80 dBA at 15 m and concrete mixer 79 dBA at 15 m. Source: Construction Noise Handbook (www.fhwa.dot.gov), US Department of Transport.
- Noise attenuation factor: a conservative 6 dBA each time the distance from the point source is doubled. Source: US Occupational Safety and Health Administration (www.osha.gov/dts/osta/otm/new_noise/). Note that in soft vegetated environments such as in agricultural fields, the noise attenuation will be significantly increased meaning the area of influence could be narrowed. However, this would not be the case where vegetation is removed.
- Calculation: At 250 m the noise at a receptor is approximately 55 dBA (WHO limit).

5.2. Baseline Receptor Summary

214. The following chapters of the IEE provide the environmental baseline (description of the environment) for the project sites. A site-specific summary table for key receptors is provided in Table 10 and in Figure 23 and Figure 24.

215. These receptors are explored in more detail in the following sections describing the environmental baseline conditions.

Figure 23: Stueng Saen Landfill indicative receptors

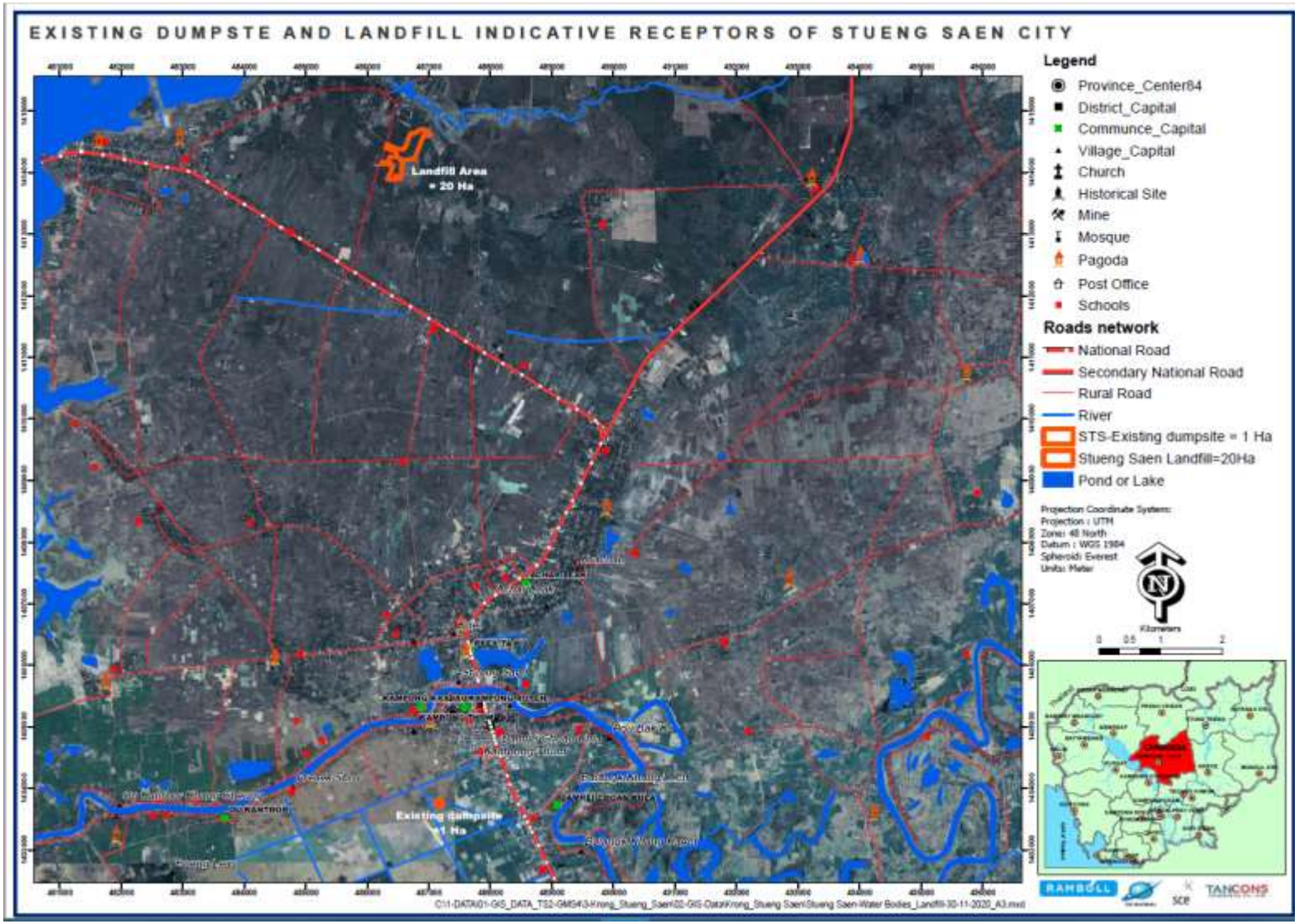
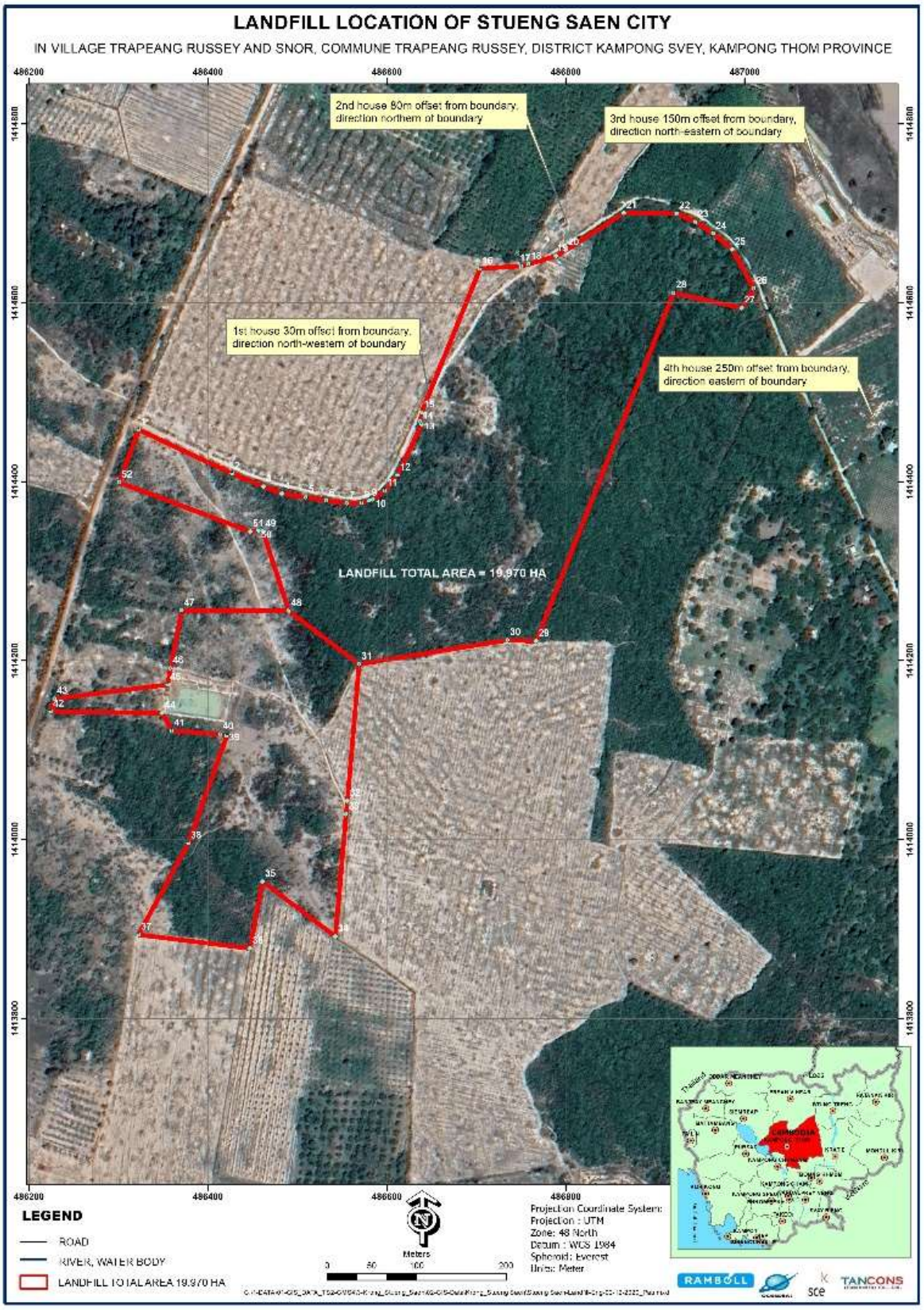


Table 10: Summary of Environmentally Sensitive Receptors for Stueng Saen landfill

GPS	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
12°47'29.82"N, 104°52'34.28"E	- River <500 m north of site leading to Prey Pros lake 5 km west of site - Upland area - not flooded, surface runoff only. River to the north dries up during the dry season	- 4 houses < 500 m from the landfill site - Nearest housing area: 1.5 km southwest - about 4 km from NR No.62 - about 2.5 km from NR No.6 - Distance to City: 8 km Pagoda: 2.5 km south Grave: adjacent to the access road	- Cashew trees (farmed), plus natural sparse secondary shrub cover including rattan, bamboo, *Combretum Quadrangutare, Bauhinia Acuminata* (white orchid-tree)	- Nearest UNESCO World Heritage Site: 17 km - Nearest protected area: 30 km - Nearest KBA: 5.2 km

Figure 24: Houses < 500 m From the Landfill Site



5.3. Geography and Topography

216. Kampong Thom Province is within the Tonle Sap Basin. The area is dominated by the Tonle Sap lake and this has affected the soil characteristics.

217. Figure 25 and Figure 26 show the geology of the subproject area which is characterized by a predominance of alluvial soils. The Stueng Saen area is associated with prolonged water saturation from groundwater and impeded drainage.

The landfill site has a fairly flat topography with elevations generally between 15.5 m asl. and 16 m asl. A topographical survey has been conducted for the DED (

218. Figure 27).

Figure 25: Soil type in Tonle Sap core zone

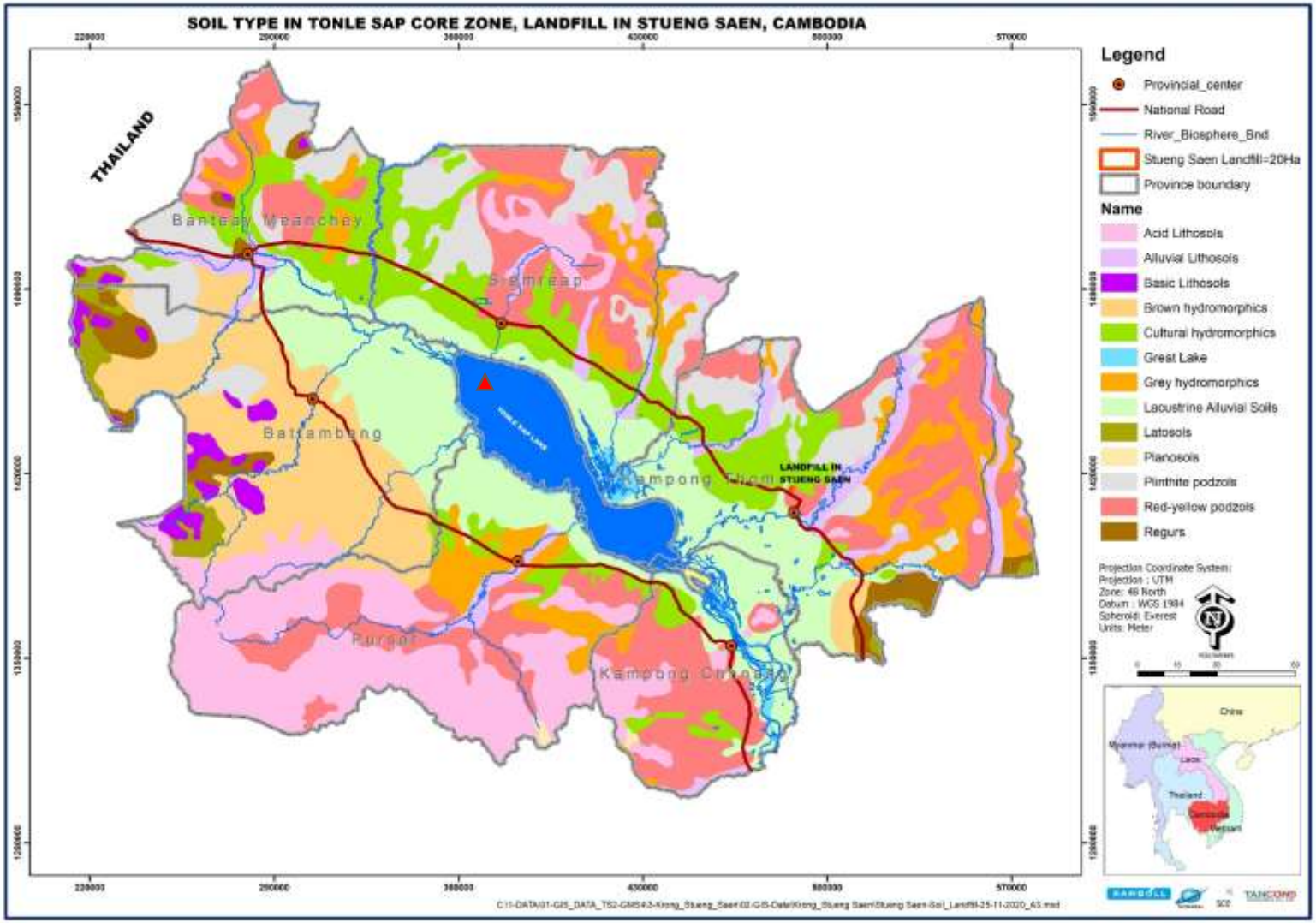


Figure 26: Geology type in Tonle Sap

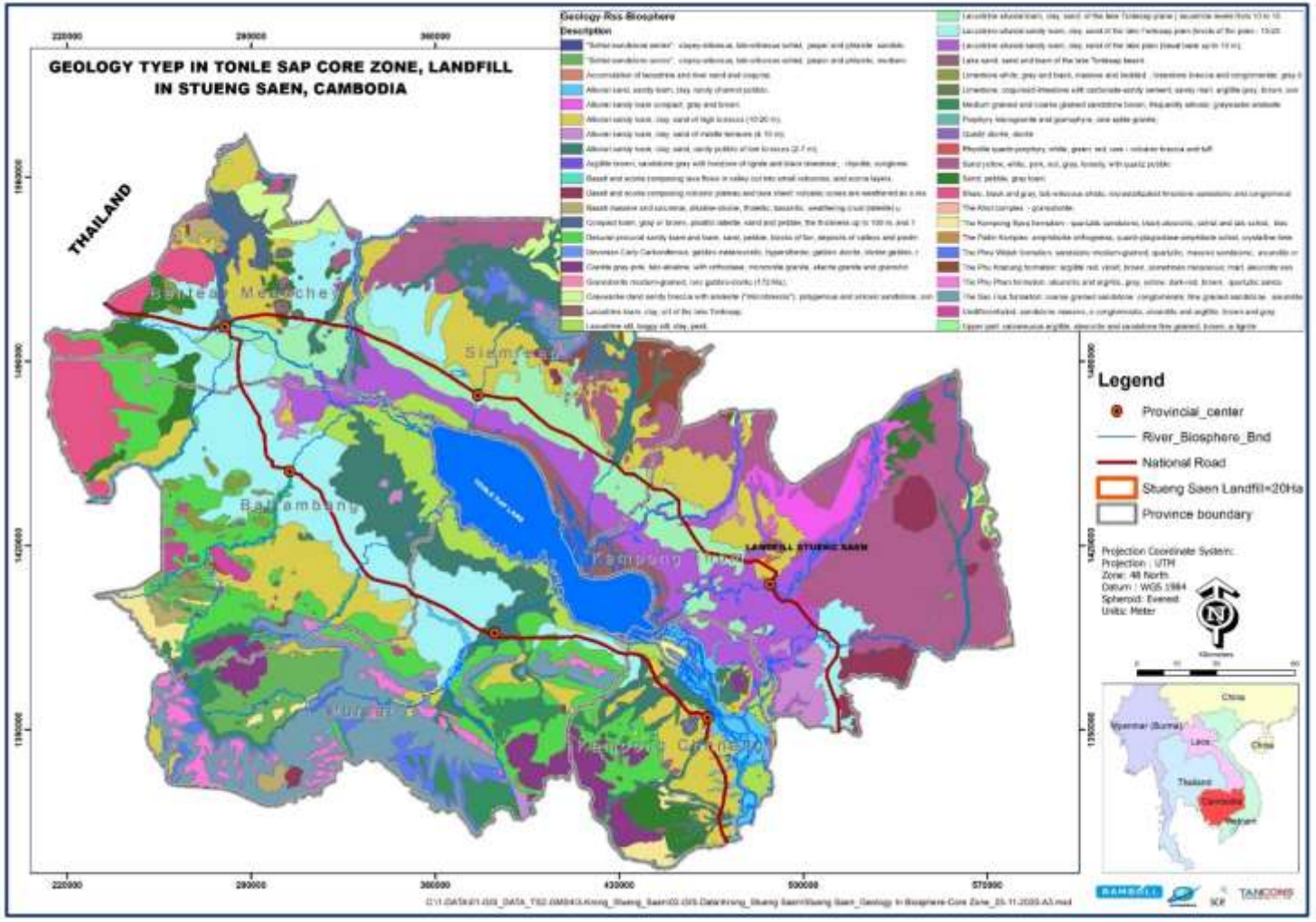
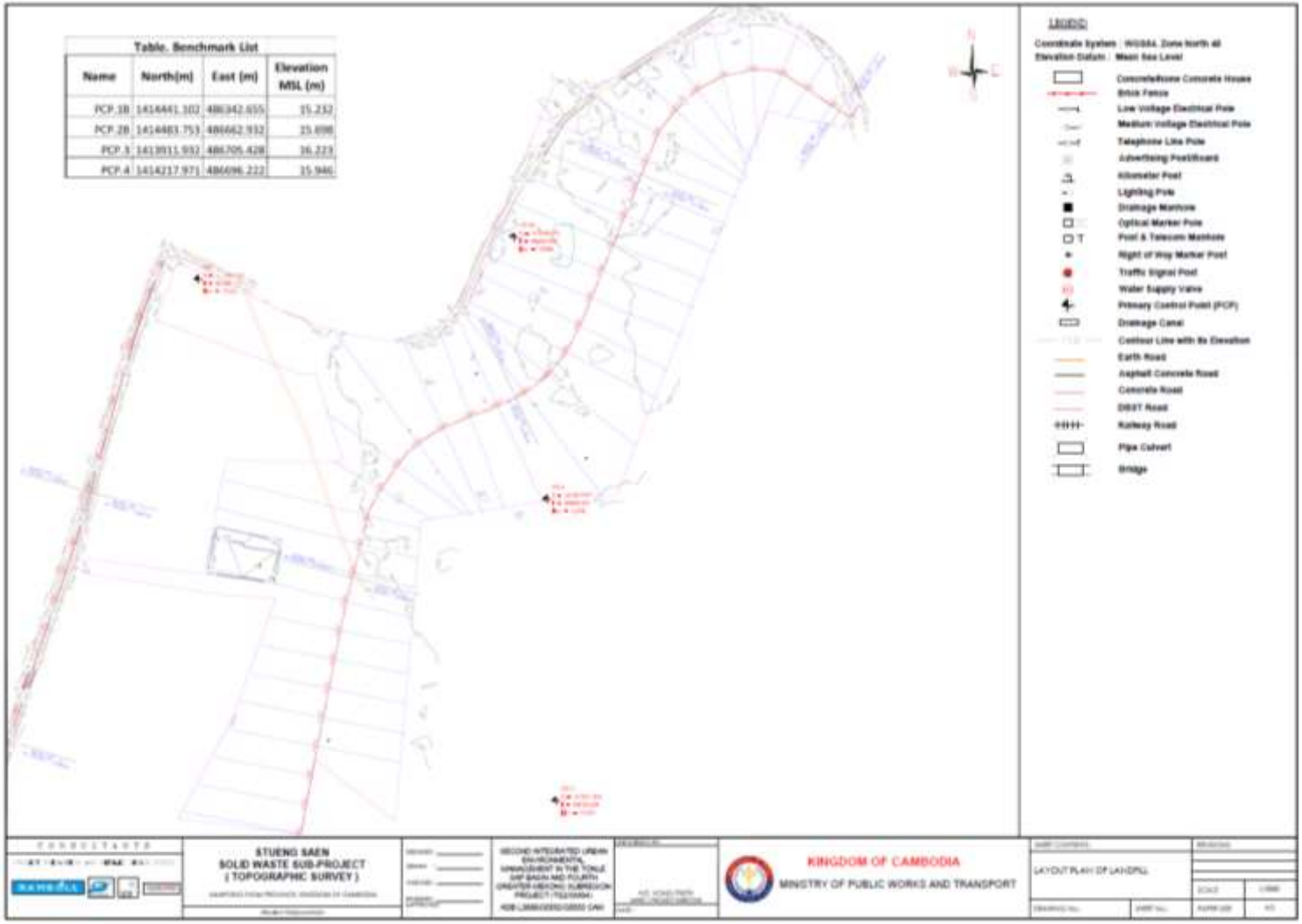


Figure 27: Stueng Saen Landfill Site, Topographical Survey



5.4. Meteorology and Climate Change

219. Stueng Saen's tropical climate is divided into two seasons, wet and dry, with regular annual monsoon events. The rainy season starts late May, lasting until late October. The dry season begins in November, lasting until the end of April. Stueng Saen is within the flood plain of Tonle Sap. The average annual rainfall for the 2008 to 2017 period was 1238 mm. The maximum monthly precipitation is shown in Table 11 and is based upon data from 2008 to 2017. Data is obtained from the Department of Meteorology in Phnom Penh and the Office of Meteorology in Stueng Saen.

Table 11 Stueng Saen Average and Maximum Rainfall Data (years 2008-2017)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total mm
	1	2	3	4	5	6	7	8	9	10	11	12	
Average	8.25	18.41	27.21	65.32	127.27	150.88	190.4	151	242.98	198.43	36	22	1238.15
Max (2011)	**0**	**0**	**36**	**113.2**	**69.7**	**245.4**	**271.8**	**208.6**	**465.4**	**194**	**41.4**	**12**	**1657.5**

220. The average minimum temperature is 25.3°C. The highest temperatures are in April, with an average maximum temperature of 30.5 °C. The average monthly temperatures are in Table 12.

Table 12 Stueng Saen Average Monthly Temperature

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	2	3	4	5	6	7	8	9	10	11	12
Avg. Temperature (°C)	25.5	27.1	29.2	30	29.3	28.6	28	27.9	27.4	27	26.2	25.3
Min. Temperature (°C)	**19.8**	**21.6**	**24.1**	**25.1**	**24.9**	**24.6**	**24.3**	**24.3**	**24**	**23.4**	**21.9**	**20.1**
Max. Temperature (°C)	**31.2**	**32.7**	**34.4**	**35**	**33.7**	**32.6**	**31.7**	**31.5**	**30.9**	**30.6**	**30.6**	**30.5**

Source: https://en.climate-data.org/asia/cambodia/kampong-thom/kampong-thom-3143/

221. **Precipitation.** Figure 28 summarizes rainfall data for Steung Saen between 2015 to 2018.

222. **Wind.** There is not available date of wind speed and wind direction in Stueng Saen town, Kampong Thom province.

223. Incorporation of a Program for Climate Resilience (PPCR) is an integral part of the TS2 Development Project. The PPCR will promote the mainstreaming of climate resilience in the project. Excerpts from the Strategic Program for Climate Resilience (SPCR), prepared for the PCCR, Royal Government of Cambodia, Asian Development Bank, 2011:

224. According to the latest technical assessment, Cambodia's temperature has been rising steadily over the past 50 years. The average temperature has increased since 1960 by 0.8°C, and the frequency of unusually hot days and nights has increased. A further 0.3 to 0.6°C increase is expected by 2025, and some studies suggest temperatures may increase from 0.7°C to 2.7°C by the 2060s. All climate change models agree that average rainfall in Cambodia will increase, but the magnitude of change is uncertain. Estimates of the increase vary from as little as 3% to as much as 35% by the year 2100. Mean annual rainfall is predicted to increase, with the most significant increase in the wet season. In contrast, water flows in the dry season are predicted to decrease.

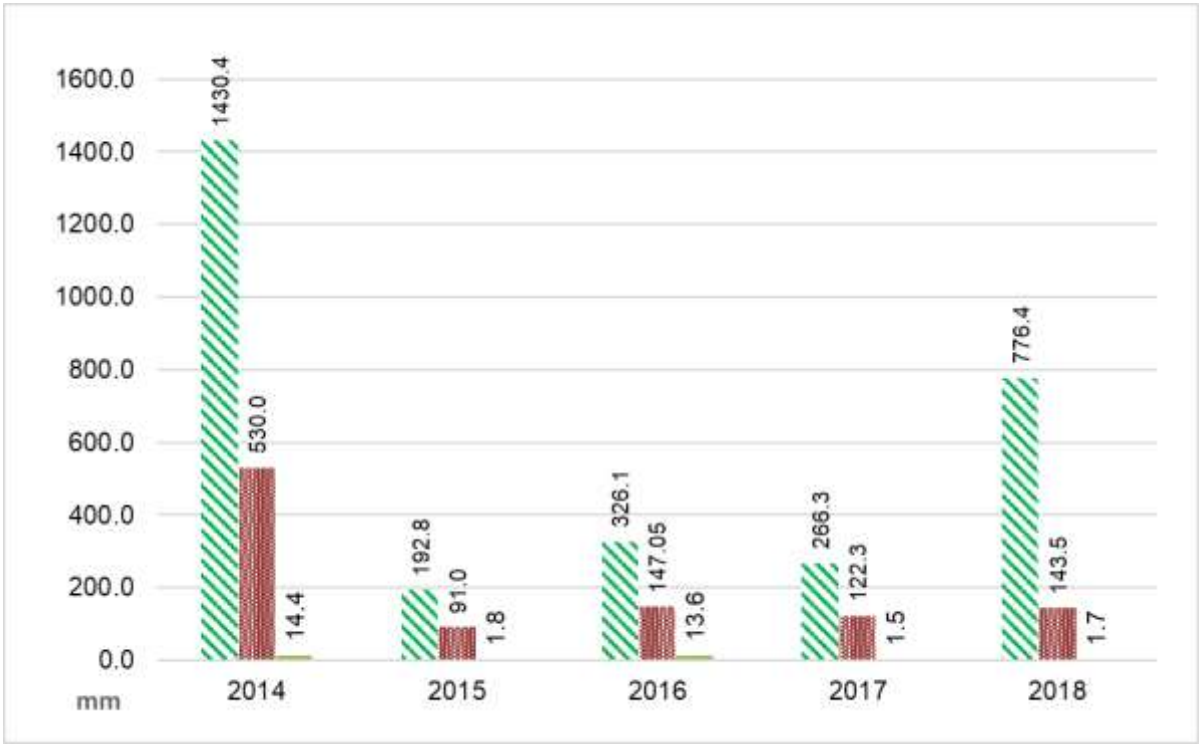
225. The urban area of Stueng Saen is undergoing a process of urbanization, which is expected to accelerate with the increasing trade and traffic flows in the Tonle Sap basin. The inability of the carrying capacity of the present storm drainage systems coupled with future climatic events such as increased precipitation during the rainy season and possible occurrence of cloudbursts due to increased urban heat islands in these cities would cause sudden heavy rainfall which if not foreseen in the design and construction of urban infrastructures would lead to severe flooding in just a short time causing physical and

economic losses. In addition, the absence of allowances for climate resilience measures for flooding in other urban infrastructures such as flood control and wastewater treatment would also cause these facilities to discontinue their operation and/or function and would hamper the services they are supposed to render to the local inhabitants.

226. The climate resilience measures of the proposed infrastructure investments under the Projects are intended to address the above possible future events. This subproject supports climate resilience in Stueng Saen by introducing the following measures:

- Landfill gas collection systems have been designed to allow for future retrofitting active systems and flaring of gas, including methane, a powerful greenhouse gas.
- The finished ground level of all the construction is considered to be above the flood level.
- Plinth level of all construction is kept above flood level.
- Embankments and interceptor surface water drainage has been utilised around the landfill, providing protection against storm events.
- All sidewalls and roofs are designed to withstand high wind velocity and storms up to 260 km/hr.
- Concrete roads are introduced to avoid vehicle penetration in the ground.
- Leachate collection and treatment lagoons can take high volumes of wastewater in case of extreme events.
- The highest rainfall amount in the last 10 years has been considered towards the design of leachate collection and the rainwater discharge system.
- Cells have a single composite liner to avoid percolation of leachate into the ground water.
- To save landfill area, a percentage of waste diversion is envisaged (30% of waste by 2030).
- Staff and workers' restroom with bathing and toilet facilities are provided to provide comfort to the workers during extreme weather. Staff to have adequate PPE.

Figure 28: Rainfall Data (mm) for Steung Saen 2015 – 2018



Source: Meteorological Department, MOWRAM, 2018

227. **Change in Rainfall.** The main change in rainfall will occur in the three wettest months of the year, August to September. In low lying areas flooding is generally caused by the rainfall in the wettest months of the year and lasts for several weeks. In such a case, changes in monthly rainfall are of more importance than rain falling over a shorter time period. Projections suggest that there will be little, if any, increase by 2030 but could increase by over 20% by 2070. The CRVA concludes that under Representative Concentration Pathway (RCP) 6.0 with regards to changes in future precipitation:

- Annual rainfall may remain unchanged, but rainfall will increase more in the wettest months by being of stronger duration. This will lead to longer dry periods. There may be "mini-droughts" during the wet season.
- Precipitation will increase most in the south-west and decrease in the north-east.
- Both the maximum 5-day and 1-day storms are expected to increase. The projected increases are 10% for 2030, 20% for 2050 and 30% or more for 2070.
- The relative increase in rainfall is heavier for short durations.
- An increase of 20% on existing IDF curves will allow for a global temperature increase of 2oC. This factor is conservative and is recommended as a design factor.

5.5. Surface Water

228. Surface Water Quality was tested at Or Anlong Thlok Stream, this stream is near the landfill site (downstream) in Trapaeng Russey commune, Kampong Svay district. Water was analyzed by MoE laboratory and results are shown in Table 13. The location of surface water quality sample is X: 487181 and Y: 1414744 as shown in Figure 29.

Table 13: The existing surface water quality in the landfill subproject area

No	Parameters	Unit	Results	Standards
1	pH	-	4.84	6.5-8.5
2	Dissolve Oxygen (DO)	mg/l	6.40	7.5-2.0
3	Total dissolved Solid (TDS)	mg/l	20.00	<1000
4	Total Suspended Solid (TSS)	mg/l	70.00	25-100
5	Biochemical Oxygen Demand (BOD)	mg/l	2.40	1.0-10
6	Chemical Oxygen Demand (COD)	mg/l	7.63	<5.0
7	Oil and Grease	mg/l	4.67	<5.0
8	Detergent	mg/l	0.02	<5.0
9	Sulphate (SO_4)	mg/l	15.00	<300
10	Total Nitrogen (TN)	mg/l	2.62	0.1-0.6
11	Total Phosphorus (TP)	mg/l	0.15	0.005-0.05
12	Arsenic (As)	mg/l	ND	<0.01
13	Lead (Pb)	mg/l	0.01	<0.01
14	Cadmium (Cd)	mg/l	0.0003	<0.001
15	Iron (Fe)	mg/l	11. 36	<1.0
16	Mercury (Hg)	mg/l	0.0002	<0.0005
17	Total Coliform	-	$1.1x10^3$	<5000

Source: MoE Laboratory and IESIA report, SBK November 2020

Figure 29: Water Sampling Point

5.6. Groundwater

229. The groundwater sample was taken from the well water in Trapaeng Russey commune. The location of surface water quality sample is X: 486805 and Y: 1414690. The results of the testing are shown in

230. Table 14.

Table 14: Existing Ground Water Quality in landfill subproject area

No	Parameters	Unit	Results	Standards
1	pH	-	4.78	6.5-8.5
2	Electrode Conductivity (EC)	µS/cm	16.90	500-1500
3	Total dissolved Solid (TDS)	mg/l	7.00	<800
4	Turbidity	NTU	0.00	<5.0
5	Total hardness (as $CaCO_2$)	mg/l	8.00	<300
6	Chloride (Cr)	mg/l	9.70	<250
7	Fluoride (F)	mg/l	0.12	<1.5
8	Nitrate (NO_2)	mg/l	1.00	<50
9	Sulphate (SO_2)	mg/l	2.00	<250
10	Aluminium (Al)	mg/l	4.64	<0.2
11	Arsenic (As)	mg/l	ND	<0.05
12	Cadmium (Cd)	mg/l	0.0002	<0.003
13	Chromium (Cr)	mg/l	0.36	<0.05
14	Iron (Fe)	mg/l	2.55	<0.3
15	Manganese (Mn)	mg/l	0.07	<0.1
16	Mercury (Hg)	mg/l	ND	<0.001
17	E-Coli	MPN/1000ml	-	0
18	Total Coliform	MPN/1000ml	94	0

Source: MoE Laboratory and IESIA report, SBK November 2020

5.7. Air Quality and Noise

231. The existing air quality data was conducted by MoE and SBK Consultant. The testing location is in Stueng Saen Commune, Stueng Saen town (X: 486301 and Y: 1414386). The air quality data is shonw in Table 15.

Table 15: Existing Air Quality in subproject area

No	Parameters	Unit		Air quality result	Standards
1	CO	mg/m^3		1.75	20 (8 hours)
2	NO_2	mg/m^3		0.014	0.1 (24 hours)
3	SO_2	mg/m^3		0.012	0.3 (24 hours)
4	Ozone (Q3)	mg/m^3		0.012	0.2 (24 hours)
5	TSP	mg/m^3		0.058	0.33 (24 hours)
6	PM 10	mg/m^3		0.029	0.05 (24 hours)
7	PM 2.5	mg/m^3		0.014	0.025 (24 hours)
8	Lead (Pb)	mg/m^3		ND	0.005 (24 hours)

Source: MoE Laboratory and IESIA report, SBK November 2020

5.8. Noise

232. The noise level sampling was conducted in Stueng Saen Commune, Stueng Saen town (X: 486301 and Y: 1414386). Results are shown in Table 16.

Table 16: The Existing Noise Level

Survey Period		Noise Level dB(A)				Remarks
		LAeq	Standard (Leq)	LAmax	LAmin	
Day	6:00 - 7:00	49.2	70	64.7	38.6	
	7:00 - 8:00	48.7		62.0	40.3	
	8:00 - 9:00	49.5		62.1	37.7	
	9:00 - 10:00	50.7		63.1	39.1	
	10:00 - 11:00	51.4		63.5	40.0	
	11:00 - 12:00	48.3		67.5	34.9	
	12:00 - 13:00	44.9		66.4	39.3	
	13:00 - 14:00	42.7		64.9	28.3	
	14:00 - 15:00	50.0		66.1	37.7	
	15:00 - 16:00	48.8		67.7	37.8	
	16:00 - 17:00	49.1		67.3	37.8	
	17:00 - 18:00	52.9		65.1	38.5	
Evening	18:00 - 19:00	48.3	65	59.9	35.6	
	19:00 - 20:00	43.3		58.2	34.2	
	20:00 - 21:00	42.9		58.4	35.2	
	21:00 - 22:00	41.0		57.3	33.6	
Night	22:00 - 23:00	41.5		45.6	33.3	
	23:00 - 00:00	40.4		46.7	31.8	
	00:00 - 1:00	40.8		47.2	43.2	
	1:00 - 2:00	45.3		46.3	43.2	

Survey Period		Noise Level dB(A)				Remarks
		LAeq	Standard (Leq)	LAmax	LAmin	
	2:00 - 3:00	41.7	50	47.4	35.9	
	3:00 - 4:00	44.3		47.3	35.1	
	4:00 - 5:00	42.5		50.4	34.4	
	5:00 - 6:00	42.6		49.6	35.5	
24 hours Average		**45.9**		**58.1**	**34.7**	

Source: MoE Laboratory and IESIA report, SBK November 2020

5.9. Natural Disasters

233. Storms and typhoons are not usually considered a major problem in Cambodia as the country is protected by surrounding mountain ranges. Storms do occasionally affect the country, with most storm-related damage being caused by localized floods associated with heavy rain. Tropical storms can also affect the level of Mekong River flooding experienced in a given year. Greatest damage occurs when these storms arrive during September and October when the seasonal discharge of the Mekong River is already high, and a second significant peak to the annual flood is generated. Also, wind damages property, agriculture and ecological systems.

234. Table 17 presents Natural Disasters occurring between 2012-2014 in provinces of TS2 Project and shows that the largest impact on the population around the Tonle Sap, in the project area, is flooding. Also, of note is the increase in drought affected households in 2013 and 2014 for the cities of Serei Saophoan and Stueng Saen. In addition, the socio-economic survey undertaken for this project (see Feasibility Study Volume 4) confirmed that 69% of respondents had experienced a flood where they are now living; the main sources of flooding were cited as drainage system (49%), river (27%) and canal (11%).

Table 17: Natural Disasters 2012-2014

City/Town	Type	2012 Families Affected	2013 Families Affected	2014 Families Affected
Battambang	Flood	21	244	50
	Drought	0	7	74
	Storm	3	5	7
Serei Saophoan	Flood	2,977	1,433	80
	Drought	0	1,323	3,113
	Storm	3	8	0
Stueng Saen	Flood	1,720	453	125
	Drought	0	250	1936
	Storm	547	3	9

Source: Municipality of each city (2015) in IEE for TA-8556 REG: CDIA

235. **Flood.** Based on Climate Change assessment, the site is described as not flood prone.

5.10. Physical Cultural Resources

The site has no protected area status. The main land use activity in the neighbouring properties is agriculture, comprised of cane, cashews and mango farms. There is no sight of cultural significance within the site (Figure 23).

5.11. Protected Areas and Key Biodiversity Areas

Based on an IBAT proximity analysis, 8 protected areas / key biodiversity areas have been identified within a distance of 50 km from landfill[7]. The full IBAT report and analysis is attached in Annex 7 and summarized in Table 18. The location of the areas is displayed in Sources:

BirdLife International (2021) Important Bird Areas factsheets downloaded from http://www.birdlife.org on 22/03/2021.
Key Biodiversity Areas Partnership (2020) Key Biodiversity Areas factsheets. Factsheets downloaded from http://www.keybiodiversityareas.org/ on 22/03/2021.
https://whc.unesco.org/en/list/1532
https://www.ramsar.org/wetland/cambodia

[7] Some areas overlap and only the most relevant have been included in the analysis

236. Figure 30.

Table 18: Summary of Protected Areas and Key Biodiversity Areas within 50 km of the landfill

Area / Site	Description	Distance to the Landfill
(1) Stung Sen Core Area UNESCO Biosphere Reserve, Core area of Tonle Sap Biosphere Reserve, and IBA Lower Stueng Saen KH019	The Site is an important spawning ground for several fish species such as Jullien's golden carp (*Probarbus jullieni*) and small-scale mud carp (*Cirrhinus microlepis*), a migratory pathway and feeding ground for waterbirds, and an important habitat for mammals. It is regionally important for supporting a number of globally threatened species such as the critically endangered Mekong giant carp (*Catlocarpio siamensis*); the endangered yellow-headed temple turtle (*Heosemys annandalii*) and Indochinese silvered langur (*Trachypithecus germaini*); and the vulnerable lesser adjutant (*Leptoptilos javanicus*) and smooth-coated otter (*Lutrogale perspicillata*).	39 km southwest of the landfill
(2) Stung / Chi Kreng / Kampong Svay KBA, IBA No KH016 Area: 52,317 ha	The IBA comprises one of the largest remnant tracts of contiguous semi-natural grassland within the Tonle Sap inundation zone. It supports breeding Bengal Floricans *Houbaropsis bengalensis*. Other bird species include a number of large waterbirds dispersing from the Tonle Sap breeding colonies, including Painted Stork *Mycteria leucocephala* and Lesser Adjutant *Leptoptilos javanicus*.	13.7 km southwest of the landfill
(3) Stung Prasat Balang KBA, IBA No KH017 Area: 105,647 ha	The IBA is one of the only currently known non-breeding areas for Bengal Florican *Houbaropsis bengalensis* in Cambodia. In addition, the wetland habitats at the IBA are used as a feeding area by a number of large waterbird species. Regionally significant species such as Woolly-necked Stork and Asian Openbill.	5.2 km northwest of the landfill
(4) Boeng Paer Wildlife sanctuary	The Boeng Paer wildlife sanctuary is protected at national level. It hosts wild cattle and deer, large water birds and elephants, as well as important archaeological sites	30 km northeast of the landfill
(5) Temple Zone of Sambor Prei Kuk Archaeological Site of Ancient Ishanapura UNESCO World Heritage Site	The property comprises more than a hundred temples, ten of which are octagonal, unique specimens of their genre in South-East Asia. Decorated sandstone elements in the site are characteristic of the pre-Angkor decorative idiom, known as the Sambor Prei Kuk Style. Some of these elements, including lintels, pediments and colonnades, are true masterpieces. The art and architecture developed here became models for other parts of the region and lay the ground for the unique Khmer style of the Angkor period.	17 km northeast of the landfill
(6) Northern Santuk KBA, IBA	The IBA is one of the only areas in Cambodia currently known to support non-breeding Bengal Floricans (*Houbaropsis bengalensis*). The seasonal wetlands at the IBA support a number of other globally threatened and near-threatened bird species, including Painted Stork (*Mycteria leucocephala*), Lesser Adjutant (*Leptoptilos javanicus*) and Greater Adjutant (*Leptoptilos dubius*)	16.6 km southeast of the landfill
(7) Stung Sen / Santuk / Baray KBA, IBA No KH021 Area: 109,081 ha	The IBA comprises and one of the largest remnant tracts of seasonally inundated grassland within the Tonle Sap floodplain. The IBA is a very important breeding site for Bengal Florican *Houbaropsis bengalensis*. A number of non-breeding waterbirds visit the site, including adjutants *Leptoptilos spp*., Painted Stork *Mycteria leucocephala* and Asian Openbill *Anastomus oscitans*. Non-bird biodiversity includes Long-tailed Macaque (*Macaca fascicularis*), and Silvered Langur (*Semnopithecus cristatus*)	16.7 km south of the landfill

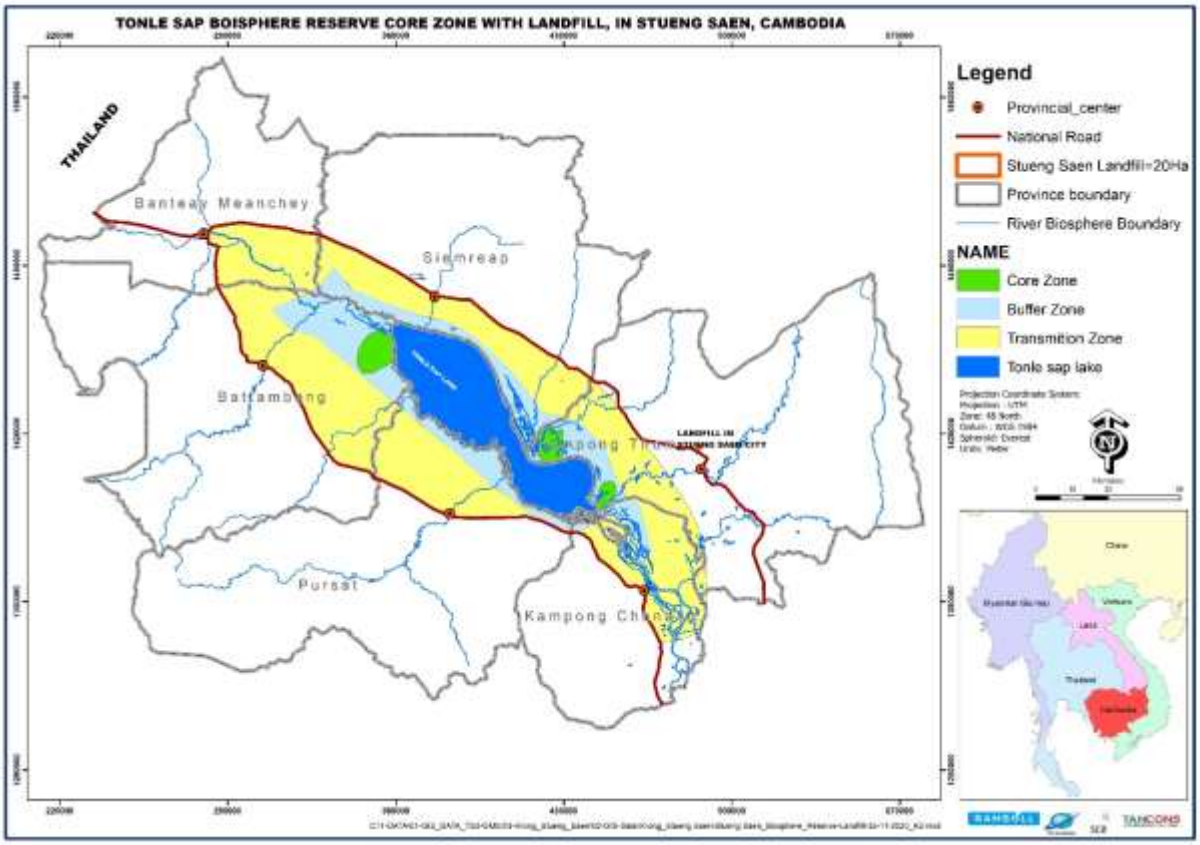
Area / Site	Description	Distance to the Landfill
(8) Veal Srongae KBA, IBA No KH020 Area: 5,467 ha	The IBA is an area of seasonally inundated grassland located within the inundation zone of Tonle Sap Lake. The IBA supports a breeding population of Bengal Florican *Houbaropsis bengalensis* and the IBA is visited by a number of non-breeding large waterbirds, including Painted Stork *Mycteria leucocephala*, Asian Openbill *Anastomus oscitans*, Lesser Adjutant *Leptoptilos javanicus* and Greater Adjutant *L. dubius*. Non-bird biodiversity includes Long-tailed Macaque (*Macaca fascicularis*) and Silvered Langur (*Semnopithecus cristatus*).	29 km southwest of the landfill

Sources:
BirdLife International (2021) Important Bird Areas factsheets downloaded from http://www.birdlife.org on 22/03/2021.
Key Biodiversity Areas Partnership (2020) Key Biodiversity Areas factsheets. Factsheets downloaded from http://www.keybiodiversityareas.org/ on 22/03/2021.
https://whc.unesco.org/en/list/1532
https://www.ramsar.org/wetland/cambodia

Figure 30: Protected Areas and Key Biodiversity Areas

237. The entire Tonle Sap Biosphere Reserve is shown in Figure 31. The biosphere covers an area of 316,250 ha and includes three core zones (one of which is the Stung Sen Core Area), a multiple use buffer zone and a transition zone. The Tonle Sap Authority was established by the RGC in 2009. It is mandated to coordinate the management, conservation and development of the Tonle Sap Lake region and the Tonle Sap Biosphere Reserve. The landfill site is outside the transition zone.

Figure 31: Tonle Sap Biosphere Reserve



5.12. Ecological Resources

238. **Flora**. Biodiversity screening of the project sites was carried out using the Integrated Biodiversity Assessment Tool (IBAT). The project area does not contain any protected areas

or habitats of particular biodiversity value. Based on field visits, without detailed floristic surveys, the site is located in an already disturbed environment dominated by agricultural land use with scattered shrubs or trees. There are however limited specific areas where trees are present within the project area. The common species including rattan (*Calamus* sp), acacia (*Acacia Auriculiformis*) bamboo (*Bambusa Arundinacea*), snowy orchid (*Bauhinia Acuminata*), Sanke (*Combretum Quadrangutare*) and some cassava plantation fields have been identified on the proposed landfill site.

239. On the proposed site, plantation include Thong and cashew trees growing, as all big trees have been cut much earlier. Estimated 87% is Thlong trees, and 13% is cashew trees, but site also has cassava, sour fruit (krasaing), June Phum (Mkak), Ampel Teuk and Tamarind. Nearby plantations include cashew nuts farms. A summary of the flora resources is included in Annex 8.

240. **Fish Species.** There was no specific fish survey conducted for this IEE. Cambodia is rich in fish biodiversity with at least 500 fish species recorded in the Cambodia's Mekong River and nearly 300 fish species in Tonle Sap Lake. During the preparation of the initial CDIA IEE for this project, interviews were held with local people regarding their understanding of fish species in the project area. The results were similar for all project towns. As an example, some species were named, with the most common being (including Khmer name) Trey Riel, *Henicorhynchus* sp (carp); Trey Andaing Toun, *Clarias macrocephalus* (catfish); Trey Phtuok/Raws, *Channa striata* (snakehead); Trey Kranh, and *Anabas testudineus* (climbing perch). It is noted that these species listed are not threatened, critical or endangered. A list of fish species is included in Annex 8.

241. **Bird Species.** As indicated in Table 18, there are several Important Bird Areas within a distance of 50 km from the landfill site. These areas will not be impacted by the project. However close to the site there is a stream with a dam that creates a small reservoir, and swampy area (that nearly dries up during dry season) and a lake downstream located about 5 km West of the landfill site. As with fish species, the initial CDIA IEE preparation team undertook consultation with people resident in all the subproject areas in 2016 to identify actual bird species which are observed by local people. Between 22 to 29 species were observed in their localities with majority being observed in Stueng Saen. Table 19 lists the species noted for only Stueng Saen, Kampong Thom province. The favoured habitat is well vegetated wetlands, including swamps and lake edges. These types of habitats are found within 5 km of the proposed site.

Table 19: Locally observed bird species, Stueng Saen Residents

No	Khmer Name	English Name	Scientific Name	IUCN Status
1	Brocheav	Not known		
2	Chab krouch	Yellow-vented Bulbul	*Pycnonotus blanfordi*	LC
3	Chreng	Not known		
4	Ka-ek	Large-billed Crow	*Corvus macrorhynchos*	LC
5	Khlom	Not known	Not known	
6	Khvek	Not known	Not known	
7	Kleng Srak	Barn Owl	*Tyto alba*	LC
8	Kok	Great White Egret	*Egretta alba*	LC
9	Kreal	Not known	Not known	
10	Kro Sapropes	Grey Heron	*Ardea cinerea*	LC
11	Kroling Kroloung	Black-collared Starling	*Sturnus nigricollis*	LC
12	Kruoch Art	Barred Buttonquail	*Turnix suscitator*	LC
13	Lo Lok	Red Collared Dove	*Streptopelia chinensis*	No Data
14	Mann Teuk	White-breasted Water hen	*Amaurormis phoenocures*	No Data

No	Khmer Name	English Name	Scientific Name	IUCN Status
15	Meam touchprey	Asian Barred Owlet	*Glaucidium cucloides*	No Data
16	Popich Thmar	Blue Rock Thrush	*Monticola solitarius*	LC
17	Popoul Teuk	Masked Finfoot	*Heliopais Personata*	Endangered
18	Preap	Not known	Not known	
19	Pro Vek	Lesser Whisling Duck	*Dendrocygna Javanica*	LC
20	Raneal	Not known	Not known	
21	Sa Rikakeo	Common Myna	*Acridotheres Tristis*	LC
22	Sek Kheav	Not known	Not known	
23	Stang	Black-shouldered Kite	*Elanus coeruleus*	No Data
24	Tea Prey	Garganey	*Anas querquedula*	LC
25	Tituy	Not known	Not known	
26	Toum	Purple Swamphen	*Porphyrio porphyrio*	LC
27	Tro Cheakkam	Barn Swallow	*Hirundo rustica*	LC
28	Trodok	Not known	Not known	
29	Tung Propes	Spot-billed Pelican	*Pelecanus philippensis*	NT

Key: LC = Least Concern, NT = Near Threatened, No Data = taxon has not yet been assessed for the IUCN Red List. Source: Adapted from CDIA, IEE, 2016 survey.

5.13. Land use and Socio-Economic Conditions

242. Land use. The proposed site is located in a rural area, with low density of population. More specifically, the proposed site is located 2.5 km away from the National road no. 6, where houses and businesses are located. The main land use activity in neighbouring properties is agriculture, comprised of cane, cashews and mango farms.

243. **Land Use.** The land use in the commune subproject as registered in Commune Data Book 2018 (SBK, January 2020) is shown in Table 20. The biggest use is for rice field.

Table 20: Land Use in subproject area

N.	Commune	Village Area (ha)	Resident (ha)	Rice field (ha)	Farm (ha)	Others (ha)
1	Damrei Chhoan Khla	1 499.32	173.32	1 021	No	305
2	Kampong Thom	872.471	640.891	--	No	231 580
3	Kampong Roteas	954	360	5922 509.81	No	2
4	Ou Konthor	3 508.5	82.06		No	915,63

244. A survey conducted by the social team identified 4 households that are located close to the site: (i) 30 m, (ii) 80 m, (iii) 150 m and (iv) 350 m distance from the landfill. The owners of these houses have been consulted by PMC, the registered firm that conducted the IESIA and by MoE (Annex 4).

245. Other households are located on the proposed access road to the future site and some at the dyke road which creates a reservoir, northwest of the site. The site is within an agricultural area, mainly linked to agroforestry (see species mentioned above). The proposed site belongs to only one owner. There are no built structures on the site.

246. Socio-economic data were obtained from Commune/sangkat discussions with the PMC team at PPTA stage. Table 21 presents a summary of the socio-economic situation in the project area and shows the number of affected communes on which these data are based.

Table 21: Socio-Economic Data

Project City/Town	No. Commune	Total Population	No. Female	Khmer Islam Pop.	Vietnamese Pop.	Poor Level 1 HH*	Poor Level 2 HH*	% Poor (1+2)

			Headed HH					
Stueng Saen	8	57216	2471	121	46	882	1342	17%
* Ministry of Interior classification HH= Household								

Source: IEE Report, TS2, 2018

247. **Poverty rates.** Based on the information provided from the Communes during the CDIA study, the percentage of level one and two poor households is 17% in Stueng Saen town.

248. **Socio-Economic Survey**. A survey of 1478 respondent was undertaken during the preparation stage of the TS2 project. A full analysis of the results from the survey is provided in the Feasibility Study. The analysis of this survey is not repeated here, however, a few key points relevant to environmental safeguards are summarized here, combined for the 03 provinces concerned by the PPTA studies:

- Electricity / Infrastructure. 97% of households are connected to the electricity grid.
- Waste Collection. 55% of respondents are aware of a waste collection service in their area, while the rest has no service offered. Of those who have a service available, 36% use it. Ninety-two of respondents have waste materials which they do not throw away. Of this, 99% of respondents sell recyclables to door-to-door collectors.

249. **Water Users.** The Socio-Economic survey identified that 57% of households are connected to a piped water supply, of which 63% are connected to the public water supply and the remainder to a private connection. The responses showed that in the dry season, for those who are not connected to a piped water supply, some use water from ponds and lakes and canals as a water source. A small number of community residents use the canal network as a water source. It is not known what subsequent treatment the resident may then undertake on the water, such as boiling, chemical or UV treatment.

5.14. Population

There are 08 Communes in the Stueng Saen town. The population in subproject area of Stueng Sean Town by village and commune shows in Table 22.

Table 22: The population in Stueng Saen town

No.	Commune Name	Village Name	Total Family	Male	Female	Total
1	Trapaeng Russey	Phum Trapaeng Russey	175	380	415	795
2		Phum Snor	307	589	683	1227
3		Phum Rormaeng Ngob	172	398	411	809
4		Phum Prasadh	138	294	333	627
5		Phum Lvai	163	367	379	746
Total			**955**	**2028**	**2176**	**4204**

Source: Commune Data 2020

Occupation: The results of interviews with 95 households in subproject area show that the main occupation of the family head is farming closely followed by merchant. The data are summarized in Table 23.

Table 23: Main head family occupation in commune

No.	Occupation	Village Name					Total	(%)
		Trapaeng Russey	Snor	Rormaeng Ngob	Prasat	Lvai		
1	Farmer	4	9	4	2	5	24	29,37
2	Merchant	6	6	8	2	0	22	24,18
3	Construction Workers	0	5	1	3	5	22	44
4	Factory Workers	2	2	0	2	1	7	7,69
5	Laborer	1	4	1	1	0	7	7,69
6	Government	2	1	01	0	1	5	5,49
7	Company Worker	0	1	0	0	2	3	3,30
8	Delivery Service	0	1	1	0	1	3	3,30
9	Animal husbandry	0	0	0	1	1	2	2,20
10	Forest Products	1	0	0	0	0	1	1,0
Total		**17**	**29**	**13**	**16**	**16**	**91**	**100**

Source: IESIA report. SBK November 2020.

Table 24: The supplementary / other occupation in families by commune

No.	Occupation of Member family	Village Name				Lvai	Total	(%)
		Trapaeng Russey	Snor	Prasat	Rormaeng Ngob			
1	Farmer	9	8	3	12	6	38	28,15
2	Laborer	2	5	1	2	8	18	13,33
3	Merchant	3	4	–	2	3	12	8,89
4	Factory Workers	1	6	2	0	1	10	7,41
5	Company Worker	0	3	2	3	1	9	6,67
6	Construction Workers	0	5	3	1	0	9	6,67
7	Animal husbandry	1	2	1	2	2	8	5,93
8	Forest Products	2	1	0	0	4	7	5,19
9	Government	0	1	0	1	2	4	2,96
10	Tailor	1	0	0	0	0	1	0,74
11	Motorcycle Repair	0	0	0	1	0	1	0,74
12	Chef	1	0	0	0	0	0	0,74
Total		**37**	**35**	**12**	**24**	**27**	**135**	**100**

Source: IESIA report. SBK November 2020.

250. **Migration:** The migration is relative to poverty condition. Some young people migrate to Phnom Penh and some go to outside country for finding jobs (as human power labors) Table 25.

Table 25: The migration condition in subproject area.

No.	Commune Name	Village Name	Inside Country			Out of Country			Total	
			Male	Female	Total	Male	Female	Total	Female	Total
1	Trapaeng Russey	Trapaeng Russey	1	20	21	4	9	13	26	34
2		Snor	68	41	109	13	11	24	12	133
3		Rormaeng Ngob	15	9	24	6	3	9	52	33
4		Prasat	25	25	50	3	1	4	29	54
5		Lvai	16	21	37	–	2	2	23	39
Total			**125**	**116**	**241**	**26**	**26**	**52**	**142**	**293**

Source: Commune data 2020

251. **Education.** Base of interviewing with local people (91 households) of 05 villages in Trapaeng Russey commune. The number of student or people go to schools is shown in Table 26

Table 26: Level of education

No.	Education Level	Village Name					Total	(%)
		Trapaeng Russey	Snor	Rormaeng Ngob	Prasat	Lvai		
1	Primary Level	11	17	8	8	8	52	57,14
2	No attended school	3	5	2	2	7	19	20,87
3	Secondary Level	1	2	5	3	1	15	16,48
4	Highschool Level	1	2	-	1	-	4	4,40
5	Read and Write Level (old people)	1	0	0	0	0	1	1,10
Total		**17**	**29**	**16**	**13**	**16**	**91**	**100**

Source: IESIA report. SBK November 2020

252. **Health and Sanitation.** The results of interviews with local people (95 households) in the subproject area are summarized in Table 28.

Table 27: The type of diseases

No.	Type of Disease	Number of Cases	Percentage
1	Fever	89	20,40
2	Headache	81	18,60
3	Cold	73	16,70
4	Cough	69	15,80
5	Arthritis	41	9,40
6	Diarrhea	35	8,00
7	Stomachache	15	3,40
8	Respiratory diseases	3	0,70
9	Dengue fever	3	0,70
10	Heart disease	3	0,70

No.	Type of Disease	Number of Cases	Percentage
11	Eye disease	2	0,50
12	Typhoid fever	2	0,50
13	High blood pressure	1	0,20
14	Diabetes	1	0,20
15	Nervous system diseases	1	0,20
Total		**436**	**100**

Source: Consultation with 91 households. IESIA Report SBK November 2020

6. ANTICIPATED IMPACTS AND MITIGATION MEASURES

6.1. Project Environmental Benefits

253. The project is anticipated to have significant localized environmental benefits. Field visits showed that the existing dumpsite is being polluted with untreated leachate and that there is a general lack of proper waste management practices, including lack of waste collection, indiscriminate dumping, and open burning. The growing urbanization of the project area means that this situation is only going to get worse unless adequate landfill infrastructure and operations are put in place.

254. The development of well-designed waste management facilities, with components dedicated to preventing leachate migration to soil, groundwater and surface water, separation of hazardous waste, collection of landfill gas, etc. and the proper maintenance and operation of those facilities will ensure that the risk of impacts on human health or the environment will be prevented or minimised

255. Materials Recovery Facility (MRF). The MRF to be constructed at the new landfill will provide safe and healthy working conditions with proper sanitary facilities for the waste pickers while improving the efficiency of waste recycling and increasing the amount of waste being recycled.

6.2. Environmental Impact Assessment Screening

256. The following discussion on environmental impacts screens the potential impacts according to the following factors and recommends mitigating activities on this basis:

(i) "**Receptor**": the resource (human/natural environment/economic/social) which is potentially going to receive and have to cope with potential impacts.

(ii) "**Sensitivity or Value**": ability to cope with an impact and/or its importance to Cambodia or value to different stakeholders. It is generally accepted that human health is always a high sensitivity receptor. In terms of environmental/natural resources, the sensitivity varies according to the receptor e.g. scrubland with no significant biodiversity values is considered less sensitive than a water body which supports ecosystems and livelihoods through fishing.

(iii) "**Magnitude**": the size, scale or intensity and spatial extent of the potential impact. Impacts may be short term and considered low magnitude (e.g. noise or temporary reduction of income during a short construction project) or high magnitude and long term (e.g. the pollution of water quality, air, and public health).

257. Where an impact may occur, if there is no receptor to potentially receive the impact, then mitigating actions or measures will not be required. This follows the source-pathway-receptor model, whereby in order for there to be an impact, the pollutant or issue (sources) needs to be present, the pathway to a receptor is needed (such as fissures in rocks, or water for human consumption) and a receptor must be present to receive the impacts, such as humans, flora or fauna.

258. Table 28 summarize anticipated impacts during construction and operation of landfill. Those impacts are further described and developed in the below sections.

Table 28: Screening of Impacts for Stueng Saen Landfill

Impact	Source	Receptors
Construction		
Degradation of Air Quality	▪ Exhaust fumes from construction machinery and equipment, movement of haulage trucks ▪ Asphalt pouring ▪ Fugitive dust from borrow pits and all excavation works ▪ Fugitive dust from loading, unloading and haulage of construction materials ▪ Fugitive dust from concrete batching plants.	▪ Ambient Air ▪ Populations near project sites ▪ Workers
Noise nuisance	▪ Noise from construction machinery and haulage trucks ▪ Noise from Generators ▪ Movement of material / dumping of material (including waste from dumpsite)	▪ Populations near project sites ▪ Workers ▪ Waste pickers at the dumpsite
Impacts on water quality	▪ Discharge of contaminated stormwater (suspended material, spills) ▪ Accidental Spills ▪ Waste / litter	▪ No surface water body identified nearby ▪ Ground water ▪ Nearby agricultural fields
Erosion or degradation of soil and land / Flooding	▪ Earthworks ▪ Accidental spills/ poor management of waste	▪ Surface water bodies ▪ Communities
Destruction of fauna and flora	▪ Clearing of construction sites (landfill, borrow pit)	▪ Trees, bushes and shrubs
Impacts on health and safety	▪ Traffic increase in residential areas from trucks movement ▪ Air emissions and effluents ▪ Co-activity ▪ Use of construction equipment/tools ▪ COVID-19	▪ Communities ▪ Workers
Operation		
Degradation of Air quality	▪ Biogas Generation ▪ Smoke from waste fires ▪ Emissions from waste trucks and cover material trucks	▪ Ambient air ▪ Nearby communities
Impacts on water quality	▪ Non-compliant discharged leachates ▪ Contaminated stormwater ▪ Spills and windblown litter	▪ No surface water body identified near the site ▪ Groundwater ▪ Nearby agricultural fields ▪ Fauna and Flora
Odors and Dust	▪ Landfill operations / open cells ▪ Dust from movement of vehicles	▪ Workers ▪ Communities
Impacts on Health and Safety	▪ Movement of waste trucks and trucks for cover material ▪ Accidental events such as fires and explosions ▪ Use of equipment/maintenance of landfill ▪ Presence of litter and pests around landfill ▪ Non-compliant effluents ▪ COVID 19	▪ Workers ▪ Communities

6.3. Environmental Impacts and Mitigation Measures linked to pre-construction activities

259. Potential negative impacts associated with the pre-construction phase of the subproject concern mainly land acquisition.

260. The details of any required land acquisition and resettlement are addressed in the Resettlement Plan (RP) and Inventory of Losses (IoL) that have been prepared separately. The RP includes a grievance redress mechanism and compensation and resettlement budget covering the direct compensation costs, implementation costs, and contingencies.

261. The mitigation measures related to project planning and design issues:

(i) Ensure IESIA approvals are in place for the landfill construction and that they include baseline environmental surveys as required by MoE. The PMU should also ensure all other relevant permits are obtained prior to start of any works (including vegetation clearing).

(ii) Institutional set up and strengthening. (a) appointment of a Safeguards Focal Point within each PIU (PIU-SFP); (b) appointment of Environmental Safeguards Officer in the PMU (PMU-ESO); and (b) contracting of international and national Project Management Consultant for Environmental Safeguards (PMC-I/NES) will be carried out. Prior to the start of construction, an environmental capacity building and training program will be delivered by the consultant. The training will focus on ADB's and Cambodia's relevant environmental, health and safety laws, regulations and policies; implementation of the EMP, environmental monitoring, requirements for information disclosure, public consultation and the project GRM. Training will be provided to the PIU, and contractors.

(iii) Disclosure and Consultation: Information disclosure and consultation activities will be continued with affected people and other interested stakeholders, including but not limited to the project implementation schedule, key construction activities (in particular those that result in disturbance or nuisance) GRM and status of compensation (if relevant).

- The project implementation schedule,
- Key construction activities (in particular those that result in disturbance or nuisance).
- GRM and status of compensation (if relevant).
- Impacts/ Nuisance on the Environment and the communities reported by community members.
- Concerns and expectations from the project

(iv) Grievance Redress Mechanism (GRM). In accordance with the GRM (see Environmental Management Plan), the PIU-SFPs will be responsible for day-to-day monitoring of the GRM and the PMU-ESO will assume overall responsibility for coordinating and reporting on GRM. The PIUs/PMU will issue public notices to inform the public within the project area of influence of the GRM contact information (GRM website address, PIU/PMU address and telephone number, PIU/PMU contact point email address) and local entry points (e.g. contractors and country-system via Grievance Redress Committee.

(v) EMP in bidding document. The subproject specific EMP will be incorporated in the bid documents and construction contracts to provide basis for Contractors to develop package specific CEMP.

(vi) The Contractor Environmental Management Plan (CEMP) will be prepared and updated by Contractor in alignment with the approved IEE and EMP and submitted to the PMU for approval before starting construction. It will contain associated subplans as appendices:

- Materials, Spoil and Borrow Site Management Subplan
- Solid and Liquid Waste Management Subplan
- Community and Occupational Health and Safety and Emergency Response Subplan
- Traffic Management Subplan
- Construction Workers Camp Management Sub-Plan
- COVID-19 health and safety subplan in accordance with national COVID-19 instructions and regulations.

(vii) Unexploded ordinance. The contractor will coordinate with the Cambodia Mine Action Centre to undertake UXO clearance in the project area of influence prior to civil works, as deemed necessary. UXO clearance will include surveys and explosive detection, removal, transport and destruction in accordance with the national regulations. During this process warning signs will be erected to warn households and communities. The UXO clearance certificate will be provided to ADB prior to construction.

(viii) Associated facilities. Confirm location of the borrow pit and temporary spoil storage and final disposal sites, securing permits from relevant DOE.

(ix) Borrow sites. The proposed designs require backfill materials to keep the waste cells 3 m above the groundwater table. The borrow sites to be exploited for the construction activities need to be identified within the CEMP, and site-specific spoil and borrow site management plans need to be prepared for each borrow site identified for construction.

(x) Prior to start of operations, the Operator will also conduct the same exercise as regular cover will be required at the site to limit nuisances. The Borrow sites will need to be identified and approved, the amount of cover material required on a yearly basis, and the source of material, shall be clearly stated in the future operation plan and spoil and borrow site management plan.

(xi) Groundwater study. A site-specific hydrogeological study is required prior to start of works in order to identify groundwater characteristics (depth, flow direction, productivity, usage, variations), and identify the most appropriate location for monitoring wells. The groundwater study must include the identification of all groundwater wells and boreholes used by nearby villagers (farmers and industries) within a 3 km radius.

(xii) A method statement for the construction of groundwater monitoring wells and water supply wells shall be prepared during the pre-construction period and included in the CEMP. The statement will be prepared by Contractor and approved by PMC-NES.

(xiii) Monitoring boreholes should also be put in place prior to start of excavation of landfill cells (minimum 1 borehole upstream and 2 boreholes downstream), and a baseline assessment of groundwater quality should be conducted prior to start of work. Samples must be taken from each borehole, and from nearby boreholes at the nearest receptors, to conduct laboratory analyses against drinking water guidelines.

(xiv) A registration of high trees and other vegetation at the project sites (landfill site, access road, construction camp site, and borrow sites) prior to start of works and the results integrated into the CEMP. This is to ensure that:

- existing vegetation is preserved where no construction activity is planned,
- all trees over 3 m high are registered prior to construction works and reported to DWPT for protection or removal,
- relevant permits from DWPT and local authorities for removal or cutting of trees can be obtained.
- make provisions for plantation of new trees for each one removed (agree number with communities in affected area).

6.3.1. Location criteria

262. The location of the landfill and proximity to sensitive receptors (see also Section 5.2 and Table 10) compared with the landfill siting guidelines is presented in Table 29.

Table 29: Location of the Landfill compared with location guidelines

Landfill Siting Guidelines (2016)		Proposed Landfill Location
Minimum distances to Receptors	1 km from any residential property	- 4 isolated houses < 500 m from the landfill - housing area 1.5 km southwest of the landfill
	3 km from any school/health centre/natural resources/ water source	- 2.5 km to nearest school - about 4 km from National road No.62 - about 2.5 km from National road No.6 - 500 m to nearest water body
	5 km from any place of worship and resort	- 2.5 km to nearest pagoda
	8 km from an airport	- there is no airport in Stueng Saen
	10 km from town centre	- 10 km to the city
	15 km from any heritage site	- 17 km from the UNESCO World Heritage site Sambor Prei Kuk - 39 km to the UNESCO Biosphere Reserve, Core area of Tonle Sap Biosphere Reserve
Hydrology	Not in a flooded area	- the landfill is not located in a flood prone area (see Para 235)
	Depth to groundwater > 3 m	- the design and excavation depths of the waste cells ensure that the depth to groundwater is more than 3 m (see Para 126)

263. As indicated in Table 29, some of the minimum distance guidelines are not fully met (school, pagoda, water body), however, following the review of the first draft IESIA report, the MoE approved the site selection in October 2020. In terms of proximity to water bodies, it should be taken into account that the design and operation of the landfill incorporate precautionary measures ensuring practically zero discharge of leachate.

264. The proximity to Protected Area and Key Biodiversity Area is discussed in Section 5.11 and in Annex 7. Eight areas have been identified as located within a distance of 50 km from the landfill. Six out of these 8 sites are more than 15 km from the landfill site, and the two remaining sites are 5-12 km from the landfill. There is therefore no direct disturbance of biodiversity in these areas. The construction and operation of the landfill will not cause nor contribute to any increase in illegal wildlife hunting, harvesting of biological resources or encroachment in these areas. The landfill is practically a zero-discharge facility and any occasional loud noise or other air emission from the landfill would, due to the distance be completely attenuated.

6.4. Environmental Impact and Mitigation Measures during Construction

6.4.1. Air Quality

265. Moderate to significant temporary air quality impacts can be expected during the construction stage of the project. The receptors for lower air quality are local residents close to the site particularly downwind of the construction activities, houses close to the dirt and gravel access road from the national road, and waste pickers working on the existing dumpsite.

266. Air quality impacts during construction are likely to result from the following sources:

(i) Emissions from construction machinery and equipment, movement of haulage trucks will lead to minor increases in levels of nitrogen oxides (NOx) and sulfur oxides (SOx).

(i) Asphalt for road pavement reinstatement will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH);

(ii) Fugitive dust from borrow pits and all excavations;

(iii) Fugitive dust from loading, unloading and haulage of construction materials;

(iv) Fugitive dust and bioaerosols from movement of waste within existing dumpsites and to new sites; and

1. The mitigation measures to protect sensitive receptors from air quality issues are:

(i) Select Borrow sites located as close as possible to the proposed landfill site to reduce distances.

(ii) Asphalt and concrete batching facilities will be located at least 500 m (0.5 km) downwind from the nearest dwellings in order to reduce the impact of fumes on humans and to be fitted with necessary equipment such as bag house filters to reduce fugitive dust emissions.

(iii) Water will be regularly sprayed on construction sites, material handling areas, and borrow pits where fugitive dust is generated.

(iv) Trucks carrying dry construction materials such as earth or waste will be covered with tarpaulins or other suitable cover.

(v) Construction vehicles and machinery will be maintained to a high standard to minimize emissions for comply to National emission standards. All mobile equipment should be fitted with catalytic converters.

(vi) Vehicle speed will be reduced to 30 km/h in each inhabited area.

(vii) Unauthorized burning of construction and demolition waste material and refuse is prohibited.

(viii) Air quality will be monitored at landfill site and at receptor level and actions should be taken in case of complaints or non-compliance.

6.4.2. Flora and Fauna

267. The site has no protected area status. A large proportion of the site is currently covered in forested, particularly in the northern section. However, this part of the site will not be utilised for landfill operations, as it provides the buffer zone for the river to the north. These trees include cashew trees (farmed), plus natural sparse secondary shrub cover including rattan, bamboo, *Combretum Quadrangutare,* and *Bauhinia Acuminata* (white orchid-tree). Wherever possible trees will be left in-situ, so long as they do not interfere with construction and subsequent site operations.

268. The main land use activity in neighbouring properties is agriculture, comprised of cane, cashews, mango farms.

269. Additional impacts on fauna and flora may arise from use of material from borrow pits and quarry, especially if new areas of land have to be cleared to obtain material.

270. In line with ADB guidelines, there shall be no net loss of biodiversity associated with this project and all potential impacts on terrestrial flora and fauna will be mitigated through the following measures:

(ix) Existing vegetation must be preserved where no construction activity is planned.

(x) Trees over 3 m high on the construction site or within the access road clearance area shall be protected from construction activities if they are not required to be removed.

(xi) Cutting of tree over 3 m high shall be informed to DPWT and the relevant local authority, and a permit for cutting shall be obtained. In addition, replantation shall be sought upon completion of the work. Where a tree must be removed, or an area of grassland disturbed, replant trees and re-vegetate the area after construction in accordance with applicable government guidelines

(xii) Where possible, material from existing licensed borrow and quarry sites will be used. If new sites are needed, they will be subject to due diligence and approval by ADB and the relevant PDOE to ensure that sensitive habitats are avoided and that an appropriate restoration plan using native species is agreed following re-contouring.

(xiii) Construction workers shall be prohibited from capturing any wildlife in the project areas.

(xiv) Impacts on agricultural fields, crops and trees, will be addressed in the Resettlement Action Plan.

6.4.3. Surface water

271. Construction will take place in an upland area (relatively flat terrain) and farming area. Anlong Thlok river stream is located about 0.5 km north of the nearest waste cell and 0.3 km from the landfill site boundary. During rainy season runoff from construction site with suspended solids and potentially other contaminants may flow into the stream and other water bodies in low lying areas and cause short term impact to water quality.

272. Modification of drainage patterns linked to new facilities and topography at the landfill site, but also on access road and at the borrow site, may lead to ponding and flooding in areas.

273. Potential impacts on surface water will be mitigated through the following measures:

(i) Portable toilets and small wastewater treatment units will be provided on construction sites and construction camps for the workers and canteens. If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers. All sanitary facilities will be located at least 200 m from surface water bodies.

(ii) Temporary ditches should be installed around the construction site to manage and control the runoff and prevent direct discharge to surrounding farmland or rivers body.

(iii) Sedimentation ponds will be installed on the construction sites to treat sediment-laden runoff process water (e.g. concrete batching) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide will be used to facilitate sedimentation.

(iv) Runoff accumulating at the bottom of the cells during construction will be pumped out and discharged appropriately

(v) The discharge point for stormwater runoff, pumped out water, and other effluents must be identified prior to construction works. Capacity of receiving water body or irrigated land needs to be assessed, as well as risk of contamination from pumped out water or stormwater runoff.

(vi) Construction machinery will be repaired and washed at dedicated repairing shops. No onsite machine repair and washing shall be allowed.

(vii) The hazardous waste (oil waste) shall be properly collected and stored in closed container under shelter for reuse/recycling or disposal, to ensure they will not contaminate soil, groundwater or surface water.

(viii) Material stockpiles will be protected against wind by being covered and runoff waters which might transport them to surface waters. They shall be located further than 50 m from water bodies.

(ix) Storage of bulk fuel should be on covered impermeable and bunded concrete pads (as required under bullet (x) away from the public and worker camp, and 300 m from surface waters. Fuel storage areas and tanks must be clearly marked, protected, and lighted. Contractors should be required to have an emergency plan to handle fuel and oil spillage.

(x) All construction fluids such as oils, and fuels should be stored and handled on a bunded impermeable surface; a bund will be provided around any above ground fuel storage tanks with a capacity of 110% of the largest single tank.

(xi) Implement all soil erosion protection measures needed to prevent erosion.

(xii) A vegetation buffer shall be maintained between the construction sites and the nearest water bodies.

(xiii) Final design includes adequate drainage management system like cross drains on all facilities and access roads to ensure project does not cause ponding or further flooding elsewhere.

(xiv) Conduct monitoring of surface water quality around the project site for key parameters including turbidity, Hydrocarbon content and physical parameters.

6.4.4. Groundwater

274. Groundwater impacts are primarily linked to the operation phase. However, the risk for groundwater, even at construction stage cannot be neglected as excavation activities need to be conducted, and construction activities can be a source of contamination (sanitary water, use of chemicals), and may also affect groundwater flow locally.

275. The PMC team has conducted geotechnical survey at the proposed landfill site and found that the groundwater table is between 3.92 m to 4.16 m below the existing ground level.

276. Potential impacts on groundwater will be mitigated through the following measures

(i) Construction vehicles and machinery will be maintained to a high standard to prevent leak of oil, lubricant into the ground.

(ii) Implement mitigation measures for waste management as indicated in Solid Waste Management section.

(iii) Groundwater monitoring wells must be put in place prior to start of works and monitoring must be conducted on water upstream and downstream of future cells. Baseline water quality and depth needs to be controlled before the start of works. Method statement for the construction of groundwater monitoring wells and water supply wells are required during pre-construction period. The statement will be prepared by Contractor.

(iv) An inventory of all water wells used by populations around the site should be conducted, and monitoring should also be conducted on these wells against drinking water guidelines

6.4.5. Soil and Land

277. Soil erosion is not anticipated at the landfill itself given the nature of the landfill project, however exploitation of borrow sites will potentially cause local impacts to the land through clearing of vegetation and modification drainage patterns.

278. Potential impacts on soil and land resources will be mitigated through the following measures:

(i) A map of all borrow sites will be developed and maintained with copies held by the Contractor and PIU.

(ii) Site specific spoil and borrow site management plan will be developed and approved by the relevant Municipal authorities or departments.

(iii) Safety measures will be implemented including the prevention of access by members of the public and livestock.

(iv) Measures to rehabilitate the borrow sites shall be implemented including contouring of the slopes within each site and replanting sites with native species;

(v) Topsoil present on construction sites will be removed and stockpiled in a labeled area for rehabilitation of the site post-construction or rehabilitation of borrow sites;

(vi) There shall be no disposal of spoil material on agriculturally productive land or within 50 m of a water course.

(vii) Construction working areas will be clearly demarcated and encroachment onto adjacent areas prevented.

(viii) After exploitation of a borrow site is completed, the site will be rehabilitated, which means at a minimum that slopes should be stabilized, and erosion prevented through re-vegetation and other measures as necessary.

6.4.6. Solid waste management.

279. Construction activities will generate waste (cleared vegetation, waste rock, debris, oily wastes, domestic waste from construction camps, etc.). If not managed properly these may cause impacts on the environment (soil, water) and populations.

280. Potential impacts from waste will be mitigated through the following measures.

(i) Preparation of a Waste Management Plan as part of the EMP and the CEMP before construction which applies the waste hierarchy to ensure efficient use and management of resources with a priority to prevent waste at source as much as possible.

(ii) Clear arrangements for storage and transportation of all hazardous and non-hazardous waste to an authorised and approved disposal point (approved by PDoE or Local authority).

(iii) Recyclables to be separated at source and given/sold to recycler (plastic, metal, card, paper as a minimum).

(iv) No waste will be stored within 20 m of a water course and all solid waste to be stored in containers with lids.

(v) Prohibit burning of waste at all times;

(vi) Provide all vehicles/drivers with plastic bags for waste collection and prevent any unauthorized waste disposal with particular attention paid to prevention of waste entering water ways including irrigation canals.

6.4.7. Noise

281. Noise nuisances will be temporary and localized in particular at construction sites (road access and landfill site) as construction machinery and vehicles generate noise as they operate. Other noise sources include loading and unloading of equipment and materials and the construction of boreholes for landfill groundwater monitoring. Significant noise impacts will be experienced by construction site operators. Construction machinery may produce noise levels up to 90 dB(A). For the project, no receptors other than construction workers will be this close to the machinery for extended periods of time. Noise disturbance will also result from the increase of traffic on roads from Stueng Sean town to the landfill.

282. Potential impacts from noise will be mitigated through the following measures:

(i) Maintain all exhaust systems: systems should remain at all time in good working order - undertake regular equipment maintenance;

(ii) Restrict construction activities between 8am-6pm;

(iii) Provide advance warning to the community on timing of noisy activities. Public notification of construction operations will incorporate noise considerations; information procedure of handling complaints through the GRM will be disseminated.

(iv) Ensure noise monitoring is undertaken near sensitive receptors, particularly dwellings when construction machinery is operational; and complied with noise standards of bub-decree N.42 on air pollution control and noise disturbance MoE, 2000.

(v) All construction workers will use appropriate Personal Protective Equipment (PPE) including ear defenders when operating or working near machinery;

(vi) Use of mobile noise barriers in densely populated areas where excavations are taking place.

(vii) As part of traffic management plan, speed limits should be set for trucks and other work machinery when passing through residential areas. Vehicle speed will be reduced to 30 km/hour in each inhabited area. Engines should be turned off when not in use.

(viii) Regularly monitor noise levels at construction site boundaries and in villages crossed by construction vehicles (like Poar Svay). If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.

6.4.8. Community and Occupational Health and Safety

283. Construction sites and access roads will present health and safety risks not only to construction workers, but also to people living around the sites. These risks can be linked amongst other things to:

- Temporary traffic diversion on access roads.
- Continual generation of noise and dust on hauling routes, and general hindrance to local access and services are common impacts associated with construction works within or nearby local settlements.
- The project may also contribute to increasing the risk and occurrence of road accidents because of the presence of heavy machinery on the roads.
- Community risks come from unauthorized access to construction sites and construction traffic.
- Other Occupational risks will come from a range of activities including the use of heavy machinery, earth moving, and use of chemicals.
- The potential presence of UXO also poses a threat to workers and communities, that is why UXO clearance must be conducted on all works site prior to any works (ref: section 6.3).

284. In addition to these usual construction risks, due to COVID-19 pandemic, workers and staff at constructing site can be infected by the virus, then some prevention and mitigation measures need to be applied.

285. Potential impacts on community and occupational health and safety will be mitigated through the following measures as defined in a Community and Occupational Health and Safety and Emergency Response Sub-Plan, that will have to be developed by the contractor and included in the CEMP based on measures presented in detail in the EMP:

286. Sufficient signage giving health and safety warnings and information disclosure at the entrance of all sites.

(i) The contractor shall appoint a qualified engineer as the Environment, Health and Safety (HSE) Officer.

(ii) Access to construction sites will be prevented through appropriate fencing, protective barriers, and buffer zones.

(iii) Excavation sites will also be specifically fenced, and no person shall enter an excavation area without supervision/control.

(iv) Sufficient signage giving health and safety warnings and information will be displayed at all sites.

(v) Worker education and awareness seminars for construction hazards will be given on a regular basis. A construction site safety program will be developed and distributed to all workers.

(vi) The Contractor HSE supervisor shall conduct daily toolbox meetings (safety briefings).

(vii) An accident record book will be maintained where all major or minor accidents and incidents are recorded with actions taken.

(viii) The contractor shall ensure that all workers are equipped with and use Personal Protective Equipment.

(ix) Adequate first aid equipment will be made available on site.

(x) Provision will be made for safety precautions when using 220 to 240V Electric Power tools if the workers are likely to be working within wet or flooded environments.

(xi) Warning signs will be set up if mud is likely on public roads. Mud will be removed at the end of each day. Other spillages on public roads will be removed immediately.

(xii) Contractor will set out an Emergency Response Plan.

(xiii) The contractor will also develop a traffic management plan covering movement of vehicles within the construction sites, and outside the construction sites. Traffic management must include regular monitoring of traffic safety both within construction site and on public road. Traffic monitoring should entail, description of access roads, speed limits, controls and monitoring on drivers, training of drivers on Health and Safety, emergency numbers for road accidents, grievance mechanism.

287. Potential impacts to workers in construction due to COVID-19 will be mitigated through the following measures[8]:

(i) Plan and execute work in compliance with country-specific COVID-19 risk management regulations and directives including directions of the General Department of Labour, MoLVT.

(ii) Conduct workplace risk assessment to identify low, medium or high exposure risk to COVID-19. Prepare an action plan for prevention and mitigation of the spreading of COVID-19.

(iii) Conduct Risk communication, training, and education. Training of workers in infection prevention and control practices

(iv) Adopt engineering, organizational and administrative measures, plan work so employees can keep distance from each other and minimise contact.

(v) Provide clear and visible guidelines on how to prevent infection at the construction site and initiatives taken.

(vi) Dissemination about COVID-19 prevention and mitigation measures to staff and workers through orientation or distributing leaflet/poster at information/safety board at each construction and camp site;

288. More specifically, measures implemented shall entail:

[8] For more details, refer to WHO Guidelines for geeting the workplace ready for COVID19: https://www.who.int/docs/default-source/coronaviruse/getting-workplace-ready-for-covid-19.pdf?ua=1 And ILO's Guide: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_740212.pdf

(i) Daily checking temperature of staff and workers prior starting the works;

(ii) Staff and workers have to wear masks all the time and properly;

(iii) Do not share personal items or supplies such as phones, pens, notebooks, tools, etc.;

(iv) Avoid common physical greetings, such as handshakes;

(v) Maintain a minimum physical distance of one metre from others if possible;

(vi) Wash hands often with soap and water for at least 20 seconds after using the washroom, before handling food, after blowing nose, coughing, or sneezing, and before smoking. If hands are not visibly soiled, and soap and water are unavailable, alcohol-based hand sanitizer can be used;

(vii) All offices and jobsites implement additional cleaning measures of common areas. All door handles, railings, ladders, switches, controls, eating surfaces, shared tools and equipment, taps, toilets, and personal workstation areas are wiped down at least twice a day with a disinfectant, such as disinfectant wipes. Individuals are responsible for cleaning and disinfecting their workstations;

(viii) Commonly touched surfaces on vehicles and equipment are thoroughly cleaned and disinfected at the end of shifts and between users;

(ix) Coughing or sneezing into a tissue or the bend of your arm, not your hand; And dispose of any tissues you have used as soon as possible in a lined waste basket and wash your hands afterwards;

(x) Individuals who have been potentially exposed to the virus, or who are exhibiting flu-like symptoms such as fever, tiredness, coughing, or congestion are instructed to: Not come to work; Contact their supervisor and/or human resources department; Stay at home and self-isolate; and Contact local health authorities for further direction.

(xi) Such individuals are required to follow the directions of the local health authority and may not return to work until given approval by the proper health authorities;

(xii) Individuals who begin to display flu-like symptoms on site are instructed to avoid touching anything, take extra care to contain coughs and sneezes, and return home immediately to undergo self-isolation as directed by the local health authority;

(xiii) All areas on site potentially infected by a confirmed or probable case are barricaded to keep individuals two meters away until the area is properly cleaned and disinfected.

289. COVID-19 contaminations should be reported as part of the HSE monitoring report submitted to PMU/ADB.

6.4.9. Worker/Labourer Impacts

290. Construction sites worker camps can impact on the environment if not adequately managed or located. This will include impacts from latrines, waste and social impacts if an external (national or international) labour force is used.

291. Potential impacts on the community and environment from work camps and external labor supplies will be mitigated through the following measures:

(i) Construction camp outside the village requires the contractor to develop campsite management plan which includes map showing camp lay out. Provide adequate accommodation and sanitation for male and female workers. Campsite restoration plan after completion of work shall be developed.

(ii) The construction campsite should be located far from water sources with fencing and safety zone campsite.

(iii) If a construction camp is not required, the contractor will set out a management plan which includes: Provision of adequate waste disposal facilities, welfare facilities, and sanitation for both male and female workers.

(iv) Priority should be given to use of local labour and contractor should retain evidence of how local labour recruitment efforts were undertaken.

6.4.10. Socio-Economic Impacts

292. The community within and nearby construction areas will be disrupted by the noise and dust and by potentially impaired access to their properties, farming and businesses.

293. Potential socio-economic impacts from construction will be mitigated through the following measures:

(i) Warning given to residents 4 weeks in advance of any works in thei area.

(ii) Develop traffic management plan and implement around the construction site. Avoid blockage the road and traffic sign shall be installed to indicate reduced driving speeds, changes to detour or traffic direction.

(iii) Restoration of any road surface damage.

(iv) Consideration and management of potential localised flood impacts due to construction work.

(v) Set up and follow up of grievance mechanism as prepared prior to works.

6.4.11. Cultural Impacts

294. The IEE studies have not identified any tangible or intangible cultural resources on or associated with the proposed landfill site and the access road. . The CEMP to be developed by the contractor shall verify that proposed borrow pits or spoil disposal sites will not impact any cultural resources.

295. Potential impacts from construction will be mitigated through the following measures:

(vi) The contractor will ensure awareness of all cultural resources in the area including individual family graves along access roads, cemeteries or other relevant sites.

(vii) The contractor will fence off any such resources to ensure that they are clearly marked and will not be affected by the construction.

(viii) The contractor will take and store pre-condition photographs of any such resources and make this available to MWPT should any dispute occur.

6.5. Environmental Impact and Mitigation Measures during Operation

296. The largest risks posed to the environment by the subproject are likely to occur during the operation phase. This is particularly the case for the operation of the landfill site. These types of facilities can cause environmental pollution if they are not designed, managed and maintained effectively. Contamination of the groundwater resources is among the most recognized impact of landfills. In cases of leakages, the contaminated leachate will percolate into the ground and may find its way into existing groundwater resources. Such pollution can include long term risks and impacts on community's health and safety.

297. The O&M budget for these facilities is outside the scope of this IEE, however the key mitigation measures for operational risk management relate to the capacity development of the operating staff and national and municipal governments who provide the budget for O&M.

298. As a result, the EMP for the subproject include capacity building and awareness raising on the management of environmental risks during operations.

299. Waste pickers at the existing dumpsite will also be impacted by the construction of the new landfill, especially as this one is distant from the existing site. The budget for site development has allowed for provision of sanitation facilities, potable water supply, PPE, training and support on health and registration of waste pickers to prevent unauthorized access. This is further defined in the resettlement plan for the project.

300. Details of potential impacts during operation are as follows:

6.5.1. Air Quality.

301. Air quality will be affected by the movement of vehicles, emergency operation of backup generator, windblown litter, and by the generation of biogas from waste decomposition. These landfill gasses are naturally released into the atmosphere. Whenever unabated, these gasses might affect the general environment including the welfare of its employees and nearby communities. Landfill gasses contain certain pollutants responsible for climate change (methane, CO2) but also carries a bad smell which may cause a nuisance and even lead to temporary discomfort but are not likely to cause permanent health effects.

302. SPS 2009 states that:

- The borrower/client will promote the reduction of project-related anthropogenic greenhouse gas (GHG) emissions in a manner appropriate to the nature and scale of project operations and impacts.
- During the development or operation of projects that are expected to or currently produce significant quantities of GHGs, the borrower/client will quantify direct emissions from the facilities.
- The borrower/client will evaluate technically and financially feasible and cost-effective options to reduce or offset project related GHG emissions.

303. The significance threshold for these requirements is set out in SPS 2009 as ''generally 100,000 tons of carbon dioxide equivalent per year for the aggregate emissions associated with electricity purchased for own consumption''. In this case, the most significant GHG emissions would be the annual emissions for all landfill sites; electricity use is not a major component of any of the project interventions. An estimation of GHG emissions for this subproject is provided in Table 30. The following calculations have been made using the USEPA's LandGEM model, which assumes 50%-50% split between carbon dioxide and methane

Table 30: Greenhouse Gas Emissions from Stueng Saen landfill

	Total landfill gas		Methane		Carbon dioxide		Non methane organic compounds	
	(Tonnes/ year)	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*
2022	0	0	0	0	0	0	0	0
2023	158	126,809	42	63,405	116	63,405	0	76
2024	317	253,615	85	126,808	232	126,808	1	152
2025	475	380,756	127	190,378	348	190,378	1	228
2026	635	508,146	170	254,073	465	254,073	1	305
2027	795	636,640	212	318,320	583	318,320	1	382
2028	956	765,887	255	382,944	701	382,944	2	460
2029	1,120	896,961	299	448,481	821	448,481	2	538
2030	1,285	1,029,282	343	514,641	942	514,641	2	618
2031	1,451	1,162,218	388	581,109	1,064	581,109	2	697
2032	1,621	1,297,830	433	648,915	1,188	648,915	3	779
2033	1,789	1,432,339	478	716,170	1,311	716,170	3	859
2034	1,953	1,564,248	522	782,124	1,432	782,124	3	939
2035	2,119	1,696,804	566	848,402	1,553	848,402	4	1,018
2036	2,281	1,826,877	609	913,438	1,672	913,438	4	1,096
2037	2,449	1,961,226	654	980,613	1,795	980,613	4	1,177
2038	2,626	2,102,868	701	1,051,434	1,925	1,051,434	5	1,262
2039	2,809	2,249,443	750	1,124,721	2,059	1,124,721	5	1,350
2040	3,003	2,404,272	802	1,202,136	2,201	1,202,136	5	1,443
2041	3,204	2,565,922	856	1,282,961	2,348	1,282,961	6	1,540
2042	3,048	2,440,781	814	1,220,390	2,234	1,220,390	5	1,464

	Total landfill gas		Methane		Carbon dioxide		Non methane organic compounds	
	(Tonnes/ year)	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*	*(Tonnes/ year)*	*(m^3/year)*
2043	2,899	2,321,742	774	1,160,871	2,125	1,160,871	5	1,393
2044	2,758	2,208,510	737	1,104,255	2,021	1,104,255	5	1,325
2045	2,624	2,100,799	701	1,050,400	1,923	1,050,400	5	1,260
2046	2,496	1,998,342	667	999,171	1,829	999,171	4	1,199
2047	2,374	1,900,882	634	950,441	1,740	950,441	4	1,141
2048	2,258	1,808,175	603	904,087	1,655	904,087	4	1,085
2049	2,148	1,719,989	574	859,995	1,574	859,995	4	1,032
2050	2,043	1,636,104	546	818,052	1,497	818,052	4	982
2051	1,944	1,556,311	519	778,155	1,424	778,155	3	934
2052	1,849	1,480,408	494	740,204	1,355	740,204	3	888
2053	1,759	1,408,208	470	704,104	1,289	704,104	3	845
2054	1,673	1,339,529	447	669,764	1,226	669,764	3	804
2055	1,591	1,274,199	425	637,100	1,166	637,100	3	765
2056	1,514	1,212,056	404	606,028	1,109	606,028	3	727
2057	1,440	1,152,943	385	576,472	1,055	576,472	2	692
2058	1,370	1,096,713	366	548,357	1,004	548,357	2	658
2059	1,303	1,043,226	348	521,613	955	521,613	2	626
2060	1,239	992,347	331	496,174	908	496,174	2	595
2061	1,179	943,950	315	471,975	864	471,975	2	566
2062	1,121	897,913	300	448,957	822	448,957	2	539
2063	1,067	854,121	285	427,061	782	427,061	2	512
2064	1,015	812,465	271	406,233	744	406,233	2	487
2065	965	772,841	258	386,420	707	386,420	2	464
2066	918	735,149	245	367,575	673	367,575	2	441
2067	873	699,295	233	349,648	640	349,648	2	420
2068	831	665,190	222	332,595	609	332,595	1	399
2069	790	632,749	211	316,374	579	316,374	1	380
2070	752	601,889	201	300,945	551	300,945	1	361
2071	715	572,535	191	286,267	524	286,267	1	344

304. GHG emissions are challenging to quantify given the phased nature of waste degradation i.e. phases of aerobic and anaerobic degradation and methangenosis. Direct field measurements of landfill CH4 emissions at small scale can vary over seven orders of magnitude (0.0001– >1000 g CH4 /m2/d) depending on variables including waste composition, cover materials, soil moisture and temperature.

305. The current status of GHG emissions from dumpsites in the project cities is uncontrolled and includes a combination of aerobic and anaerobic degradation as well as combustion, through the fires common at existing dumpsite. The new landfill project will allow for the venting of GHG emissions from landfill through the installation of gas collection pipes for passive venting as the development of the landfill phases progresses.

306. Given the relatively low quantities of waste produced and the cost and complexity of gas utilization and flaring systems, with an estimated cost of around $1.8 million USD in total, it is considered that venting is an option which is appropriate to the nature and scale of project operations and impacts. (PPTA TS2, 2018)

307. The proposed landfill will have a gas management system and a venting system. The aim of the proposed landfill gas management system is to minimize the risk of landfill fires and permit the effective control of gas emissions. This will be achieved through a passive vent system, which uses the positive pressure in the landfill body to transport the gas out of the

landfill under semi-controlled conditions. The vertical gas wells will comprise of 200 mm HDPE perforated/ slotted pipes in 800 mm of coarse aggregate fill. The system will allow for subsequent retrofitting, if gas flaring and active approaches to gas management are required at a later stage. Landfill gas control is described in section 4.5.10.

308. Mitigation measures will include:

(i) Controlled biogas generation and reduction of windblown litter through regular cover of waste and injection of leachate into waste heap to stimulate biogas generation.

(ii) Monitoring of Air Quality at source (vent) and at distant receptors level downwind to ensure the discharged gases do not affect nearby air quality.

(iii) Retrofitting of treatment systems and potentially flaring or gas recovery system, when economically viable.

(iv) Nets to collect windblown litter downwind of operated cells.

(v) Optimisation of waste collection routes, and study of construction of transfer stations to reduce transport distances

(vi) Monitoring of emissions from trucks to control that they respect Cambodian guidelines for vehicles

(vii) Regular maintenance should be conducted on machinery and vehicles.

(viii) Waste shall be covered during transport from existing dumpsites to new landfill site.

6.5.2. Flora and Fauna

309. As mentioned for construction, impacts on terrestrial flora and fauna will be limited. However, landfill sites tend to attract pests (birds and rats) and insects and operations can cause noise which might deter other fauna from the site. Ingestion of waste can lead to infection of fauna (like avian influenza and other bird diseases) that can then be carried off-site.

310. Potential impacts on fauna will be mitigated through the following measures:

(i) Prepare a Pest Management Plan complying with ADB Control presence of pest and take measures as necessary

(ii) Provide worker immunization and health monitoring (e.g. for Hepatitis B and tetanus).

(iii) Maintain good housekeeping in waste processing and storage areas.

(iv) Promptly compact and cover wastes in operated cells, especially for waste with the potential to attract vermin and flies, such as food wastes.

(v) Grade the area properly to prevent ponding (to minimize insect breeding areas)

(vi) Use integrated pest-control approaches to control vermin levels, treating infested areas.

(vii) Fully enclose the waste management site with fencing so that no livestock or wildlife is able to come in contact with the waste and thus prevent spread of livestock and zoonotic disease.

6.5.3. Surface Water

311. Discharge of effluent including potentially contaminated water run off or leachate which does not meet required standards may cause pollution to surface water, soil, groundwater or agricultural fields. Effluents can be:

- Sanitary wastewater from sanitary facilities for the workers at the landfill.
- Stormwater runoff, which can be contaminated with sediments, hydrocarbons from machinery, spills from vehicles or from the operation of generator.

- Leachate collected at the bottom of the cells and recirculated which may overflow during the wet season.
- Accidental release (spills, leaks) of hazardous substances entering stormwater canals/ditches or infiltrating into groundwater

2. The design of the landfill prevents the discharge of effluents offsite, and treatment facilities are included which will enable to reduce the risks of pollution.

3. Mitigation measures will include:

(i) Ensure separation of hazardous waste to be disposed at the hazardous waste cell. Ensure proper containment of the hazardous waste facility and cell.

(ii) Drains will be constructed throughout the site in the form of reinforced concrete-lined open ditches and reinforced-concrete covered drains. These drains will divert storm water away from roads, landfill cells, buildings and facilities. The storm water will be discharged into a ditch, which will be constructed as a simple natural channel, which will transport water to the existing pond that is on the site, which will act as a stormwater storage facility.

(ix) Leachate management consists of a three-pronged environmentally sustainable and low (least) cost approach taking into account constraints in terms of financial resources designed to ensure zero discharge of treated leachate under most rain events:

1) minimise leachate production by (i) intercepting surface water run-on to the site and internal runoff, (ii) intermediate cover and waste compaction to reduce infiltration into the waste, (iii) building waste in pyramidal phases as opposed to being spread across the whole cell; and (iv) completing the main phases prior to the onset of the wet season.

2) ensure that only waste leachate is sent to the leachate treatment facility by separating rainwater from the inactive parts of a cell and discharging it as clean stormwater. Each section of a cell will be equipped with an interchangeable pipe system, initially set to stormwater, and subsequently turned via a valve to the leachate transport system when waste is deposited in that particular area.

3) Operation of a low tech, easy to maintain, biological leachate treatment facility. Leachate is moved via gravity through a series of ponds: an anaerobic lagoon, aerobic lagoon, and a maturation lagoon in the form of a constructed wetland. There will also be a final lagoon for treated water, which will provide a storage for the water and which will be connected to a leachate recirculation system returning the liquid to the waste in order to manage flow rates and accelerate uniform settlement of wastes.

(iii) The leachate management system is designed to ensure zero discharge; however, the treatment system when properly operated and maintained is likely to ensure that any rare discharge of treated leachate during periods with unusual heavy rain will comply with applicable effluent standards including suitability for irrigation. The discharge will be further diluted when mixed with the stormwater runoff from the local catchment. The runoff will enter local ditches or canals connected to the stream north of the site. In practical terms, considering the low leachate flow rates mixed with the stormwater runoff from the local catchment and subsequently with the water in the stream, any rare discharge of treated leachate will be highly diluted (to be below the applicable effluent standards stipulated in Sub-decree No. 27 ANRK/BK on Water Pollution Control for Public water area and sewer) and is unlikely to pose any significant risk to human health or the environment.

(iv) Always comply with required operating standards to ensure effective treatment of leachates.

(v) Allocate adequate budget for O&M of the landfill and surface water management.

(vi) Recirculation of leachate to the landfill.

(vii) Monitoring of discharged effluents and reporting on quality of receiving water bodies around the landfill site if there is any found.

6.5.4. Groundwater

312. Groundwater contamination may arise from ineffective containment of leachates within the landfill cell or failure of the liner. This may occur throughout the lifespan of the landfill and may be also due to deposition of waste outside the landfill cells, damage to the landfill liner for example if a clay liner is allowed to dry and crack, and poor maintenance of any leachate management system.

313. Potential mitigation measures will include:

(i) Landfill design complies with best practices to prevent contamination of groundwater, including: Compacted clay layer at the bottom and on the side of the cells, HDPE liner bottom and side, drainage of leachates and pumping out of the cells, etc (ref: section 4.5).

(ii) Limit ingress of rainwater through use of drainage channels around the operating cells.

(iii) Ensure separation of hazardous waste to be treated at the hazardous waste facility. Ensure proper containment of hazardous waste facility.

(iv) Always comply with required operating standards to limit water infiltration and therefore the generation of leachate including compaction of waste, management of run off and use of (frequent) cover materials;

(v) Provision of adequate budget for O&M including monitoring three groundwater wells (locations to be identified during geotechnical investigation) and addressing liner integrity failure (if identified through groundwater monitoring).

(vi) Monitoring will be required during operation and after closure of landfill. Monitoring wells should be installed prior to start of construction. One upstream and three downstream of landfill cells at minima. Baseline conditions to be determined prior to start of works. Additional monitoring to be conducted on nearby wells and sources if there are any identified within a 3 km radius.

6.5.5. Waste Management

314. Operations at the landfill and in particular the collection and disposal of waste is the source of all the impacts mentioned above.

(i) An operational phase EMP shall be prepared by the operator of the landfill, and the EMP will need to be regularly updated during the course of the operational phase.

(ii) Conduct monitoring of waste disposed of at the landfill, including origin, quantity, type of waste, collector.

(iii) Hazardous waste shall be separated and managed according to their type and in line with local regulations and internationally accepted guidelines.

6.5.6. Odour, Dust and Pests (landfill) and Fire Protection

315. Landfill sites will generate nuisance impacts without adequate attention to good practice. This includes dust and odour from movement of degrading wastes, dust from vehicle movements, windblown litter on access roads and pests such as rats and flies attracted by organic wastes. Fires can also declare because of waste degradation. These should be absolutely prevented.

316. Potential mitigation measures will include:

(i) Compaction of the waste daily and cover of waste regularly.

(ii) Nets downwind of operated cell to capture potential windblown litter.

(iii) Weekly litter collections and removal of any wastes which are not deposited in cells, including waste at the boundary and access roads to the site.

(iv) Washing wheels of vehicles before they leave site if they are muddy from accessing the landfill cells to prevent dust increasing on public roads.

(v) Quarterly meetings with residents and / or their representatives to identify odour or nuisance issues.

(vi) Providing and maintenance of a vegetation buffer with tree plantings and green places around and in the landfill site as a screen around the site to reduce noise, dust and odours. The design includes the planting of trees around selected boundaries of the landfill site.

(vii) All transport of waste to be done with covered trucks.

(viii) Provision of adequate budget for O&M.

(ix) There is no plan to flare recovered landfill gas. Gas generated at landfill will be ventilated to atmosphere. The design considers appropriate landfill gas ventilation system (ref section 4.5.10).

(x) A strict control of fire risk will be implemented at the landfill site including prevention of burning and smoking.

(xi) A fire response team shall be designated and trained to intervene in case of fire at the landfill.

(xii) A fire water tank will be available at the landfill.

6.5.7. Nuisance for neighbouring residents

317. Mitigation measures for households living within 500 m of the landfill site boundary will be offered. 4 households have been identified in the social studies and the following mitigation measures will be offered:

(i) Installation of opening glass windows in all windows within the house.

(ii) Provision of enough viable tree or shrub saplings (native species, to be determined through consultation) to provide a vegetation screen around the front or back, and sides of the property; the resident is responsible for aftercare. The design includes the planting of trees around selected boundaries of the landfill site.

318. GRM will be operational at the site. Physical measures to be put in place will include:

(i) The operator will install a sign board with relevant contact details and operating hours at the entrance to the landfill site. It will state contact details for raising complaints.

(ii) The contractor will record all public complaints and deal with them within a timeframe agreed with MPWT.

6.5.8. Community and Occupational Health and Safety.

319. Landfill site, sorting area (MRF) and access roads will present health and safety risks not only to operators, but also to people living around the site.

320. Community risks come mainly from:

- Unauthorized access to landfill site,
- Traffic risks linked to the increase of movement of waste collection trucks and movement of vehicles including trucks transporting cover material.
- Unplanned overflow of untreated leachate to nearby water bodies or agricultural land which may cause sanitary issues for communities working in the field or for cattle.

321. Occupational risks come from a range of activities including:

- The manipulation of waste at the cells or at the MRF,

- Contact with hazardous waste
- The movement and operation of heavy machinery, earth moving,
- Risk of explosion and fires linked to degradation of waste.

322. In addition to health and safety measures linked to the operations, specific mitigation measures should be implemented to manage the risk from COVID-19 (see construction phase impacts).

323. Potential impacts on community and occupational health and safety will be mitigated through the following measures

(i) The Operator should appoint an Environment, Health and Safety Officer who is a qualified engineer.

(ii) Access to site will be prevented through appropriate fencing, protective barriers, and buffer zones for all non-authorized personnel. All entrances should be recorded. Video cameras should also be put in place around the perimeter of the site.

(iii) Sufficient signage giving health and safety warnings and information disclosure at the entrance of all sites.

(iv) Worker education and awareness seminars for landfill-related hazards will be given. A site safety program will be developed by the operator and workers shall be trained regularly.

(v) The site operator HSE supervisor should conduct daily toolbox meetings (safety briefings)

(vi) An accident record book will be maintained where all major or minor accidents and incidents are recorded with actions taken.

(vii) Ensure that all workers and waste pickers are equipped with and use Personal Protective Equipment.

(viii) Adequate first aid equipment will be made available on site for landfill operators and waste pickers.

(ix) Fire-fighting equipment and a trained fire-fighting team shall be present on site.

(x) The operator will set out an Emergency Response Plan.

(xi) The operator will develop a Traffic Management Plan for movement of vehicles within the landfill site, and to and from the landfill site. Traffic management must include regular monitoring of traffic safety both within construction site and on public road. Traffic monitoring should entail, description of access roads, speed limits, controls and monitoring on drivers, training of drivers on Health and Safety, emergency numbers for road accidents, grievance mechanism.

(xii) Monitoring should be conducted on spilled effluents (see surface and groundwater) to control sanitary innocuity.

324. Potential impacts to workers in operation due to COVID-19 will be mitigated through the following measures[9]:

(i) Plan and execute work in compliance with country-specific COVID-19 risk management regulations and directives including directions of the General Department of Labour, MoLVT.

[9] For more details, refer to WHO Guidelines for getting the workplace ready for COVID19: https://www.who.int/docs/default-source/coronaviruse/getting-workplace-ready-for-covid-19.pdf?ua=1 And ILO's Guide: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_740212.pdf

(ii) Conduct workplace risk assessment to identify low, medium or high exposure risk to COVID-19. Prepare an action plan for prevention and mitigation of the spreading of COVID-19.

(iii) Conduct Risk communication, training, and education. Training of workers in infection prevention and control practices

(iv) Adopt engineering, organizational and administrative measures, plan work so employees can keep distance from each other and minimise contact.

(v) Provide clear and visible guidelines on how to prevent infection at the work site and initiatives taken.

(vi) Dissemination about COVID-19 prevention and mitigation measures to staff and workers through orientation or distributing leaflet/poster at information/safety board at each construction and camp site;

325. More specifically, measures implemented shall entail:

(i) Daily checking temperature of staff and workers prior starting the works.

(ii) Staff and workers have to wear masks all the time and properly.

(iii) Do not share personal items or supplies such as phones, pens, notebooks, tools, etc.

(iv) Avoid common physical greetings, such as handshakes.

(v) Maintain a minimum physical distance of one metre from others if possible.

(vi) Wash hands often with soap and water for at least 20 seconds after using the washroom, before handling food, after blowing nose, coughing, or sneezing, and before smoking. If hands are not visibly soiled, and soap and water are unavailable, alcohol-based hand sanitizer can be used.

(vii) All offices and jobsites implement additional cleaning measures of common areas. All door handles, railings, ladders, switches, controls, eating surfaces, shared tools and equipment, taps, toilets, and personal workstation areas are wiped down at least twice a day with a disinfectant, such as disinfectant wipes. Individuals are responsible for cleaning and disinfecting their workstations.

(viii) Commonly touched surfaces on vehicles and equipment are thoroughly cleaned and disinfected at the end of shifts and between users.

(ix) Coughing or sneezing into a tissue or the bend of your arm, not your hand; And dispose of any tissues you have used as soon as possible in a lined waste basket and wash your hands afterwards.

(x) Individuals who have been potentially exposed to the virus, or who are exhibiting flu-like symptoms such as fever, tiredness, coughing, or congestion are instructed to: Not come to work; Contact their supervisor and/or human resources department; Stay at home and self-isolate; and Contact local health authorities for further direction.

(xi) Such individuals are required to follow the directions of the local health authority and may not return to work until given approval by the proper health authorities.

(xii) Individuals who begin to display flu-like symptoms on site are instructed to avoid touching anything, take extra care to contain coughs and sneezes, and return home immediately to undergo self-isolation as directed by the local health authority.

6.5.9. Landscape Alteration and erosion.

326. Landfills cells after filling are rounded mounds that can raise as high as a dozen meters above ground level. The final covers should be designed to limit storm water infiltration but also to limit the risk of erosion. Considering the site is relatively remote from the main road, and that it is in a hilly area, visual impact should be limited.

327. Prevention measures will include:

(i) Preventing infiltration by adding a cover at the top of the cell, including a soil cover and a geosynthetic liner.

(ii) The elevated design of the landfill and the diversion channels should be maintained. Appropriate ripraps / retaining walls should be established and regularly checked.

(iii) Re-Vegetation of the cover shall be facilitated by a cover of topsoil and seeding with local appropriate species.

(iv) Monitoring should be conducted even after closure of the cells:

- Monitor movement of heap and settlement
- Groundwater
- Revegetation/Erosion

7. ANALYSIS OF ALTERNATIVES

7.1. Solid Waste Management Design and Technology Alternatives

328. Alternative technological solutions for waste management were considered in detail in the Feasibility Study Report -Volume 2, Engineering Designs. A summary is provided in this section.

329. Four options ranging from uncontrolled open dumping to a fully engineered sanitary landfill were considered for the project. A brief summary of the key arguments for each option are as follows:

- **Option 1 open dumping**. This is essentially the 'do nothing' option as it is what is happening at present at all the current disposal facilities and cannot be supported in the future.
- **Option 2, a controlled dump**. This still does not have waste compaction and soil covering, leading to significant continuous environmental impacts. This option also could not be supported.
- **Option 3, a controlled landfill**. This includes groundwater protection, landfill gas collection which means that it has most of the environmental and operational benefits of Option 4 but without the technical complexities of leachate treatment plants for example, and social impacts of banning all waste pickers from site. The controlled landfill option can be upgraded with scale-appropriate additional interventions for leachate and gas management, but not burdened with the additional constraints of the full sanitary landfill option which are undesirable and unnecessary for such relatively small operations.
- **Option 4, an engineered sanitary landfill**. This compulsorily includes the following requirements in addition to those of a controlled landfill (the third level of complexity)
  - A leachate treatment plant;
  - Mechanized material recovery facilities;
  - Mandated removal of all waste pickers from the site; and
  - Full Gas control and use.

330. Given that there is little difference in cost or operational difficulty between a controlled dump and a controlled landfill, but the controlled landfill has significantly more environmental benefits, a controlled landfill is the most appropriate disposal system for the project interventions. This could be upgraded over time to a higher standard if later mandated. It is important that the basic infrastructure (such as liners and leachate collection and recirculation systems) are put in place initially to protect the surrounding environment (including groundwater), as these systems cannot be retrofitted later.

331. Option 4 is considered too expensive for the relatively small cities and far too complex to operate sustainably without ongoing external technical support at least for some years. Also, the additional operating costs for items like the leachate treatment plant are significant but yield little environmental gains at this scale. Furthermore, the required removal of all waste scavenging activities from the site would likely have significant social impacts at this time.

332. Therefore option 3 was considered the most adapted for Stung Saen Solid Waste Management Subproject.

7.2. Landfill location

333. Two locations were considered for Stueng Saen. Each option has been compared in Table 31. Based on these assessments, it was considered that option two is the preferred site.

334. The site is flood free and is sufficiently remote from housing and other sensitive receptors such as local watercourses and Wat O Rudeng Pagoda. The soil is a highly leached silt with some clay content and is suitable for landfill development and cover material.

Table 31: Stueng Saen Landfill Comparison

Option	Capital Costs USD (million)	Comments and Issues
Option 1 – Srayov Village	$2.74M	• Large cost associated with providing a raised access road and encircling bund as site floods to a depth of 1 metre • Stormwater Pump not being operated within the encircling dike so site floods and wet waste forming excess leachate. • Leachate pump may not be operated as generator may not be started when required • Sufficiently remote from main road and housing and other sensitive aspects such as watercourses
Option 2 – Snor and Trapaeng Russey Village, Trapaeng Russey Commune, Kampong Svay District	$2.2M	• Stormwater pump out less critical as not a fully enclosed bunded site and will partially self-drain • Assumes leachate system will be better operated as on mains power, not a generator. • Sufficiently remote from main road and housing and other sensitive aspects such as watercourses

Source: PPTA Team, 2018

7.3. The "no project" alternative

335. The No-project alternative means that the project does not happen, and that the situation continues as it is now: operations in the existing dumpsite, located close to an urbanized area, with no prevention of pollution in place.

336. This means continued and increased pollution of the soil and groundwater and atmospheric emissions of PM2.5 particles, black carbon and dioxins, as dumped quantities and open burning will likely increase in the coming years.

337. Also, considering the current urban growth trend, it is likely that the residential areas will come closer to the existing site causing health and safety threats to the residents.

338. If the project is not implemented, urban environmental quality will remain poor and potentially even decrease. It also limits the chances of socio-economic development of the area.

8. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

8.1. Public Consultations during Project Preparation

339. During Project Preparation, meetings were held with stakeholders to obtain views and opinions on the project which also assisted the project team with the choice of the site and the development of the subproject outline designs. The consultations were held for the two subprojects in Stueng Saen: (1) WWTP and drainage; and (2) solid waste management (this subproject).

340. During the preparation of the first IEE and EMPs for TS2 project, consultation took place within each subproject area. An outline of the consultation meetings held is provided in Table 32**.** In general, the consultations found the subproject to be welcomed for the positive benefits it will bring. However, concerns were raised regarding impacts arising first from construction and more during operation stage. In Stueng Sean the issues of land availability, surface water quality, dust, odour, and public safety were raised at a number of meetings.

Table 32: CDIA Phase Consultations Held for Landfill subproject

Location	Dates	Stakeholders or Group Meetings	
Stueng Saen town	From 16/12/16 To 17/01/2017	PDPWT PDoE PDWRAM PDLMUP Waste collection Company Local Authority Group Women Group Vulnerable Group	Sangkat Srayov Sangkat Trapeang Russey
PDoE PDPWT PDWRAM PDLMUP PDoP	Provincial Department of Environment Provincial Department of Public work and Transportation Provincial Department of Water Resources and Minerals Provincial Department of Land Management and Urban Planning Provincial Department of Planning		

341. **Preparation of this IEE.** Further consultations were undertaken in two formats during the IEE preparation (May 2018): (i) a household socio-economic survey which was undertaken at TS2 project level by a trained team of researchers, and which included a number of questions to inform this IEE; and (ii) consultation focus groups, undertaken by collaboration of the environmental and social team members and aimed to inform the project team on concerns people may have and how they may wish to see their concerns mitigated.

342. Household socio-economic surveys were undertaken in January 2018 and included the questions relevant to environmental safeguards. The respondent's views are summarized in Table 33. Where appropriate, corresponding mitigation measures are in the EMP.

Table 33: Socio-Economic Survey Questions

Household Question	Response	EMP Response
Concerns over construction impacts (Dust, Noise, Water Quality, Other suggestions) – Rank two responses	Combining the two scores, 75% of responses included dust as a concern, 41% included noise, 15% included water quality and no other suggestions for concerns were given.	Mitigation measures for noise and dust Control of construction near water bodies
Connection to piped water supply	57% of households are connected to a piped water supply, of which 63% are connected to the public water supply and the remainder to a private connection	-
What is your main water sources during dry season? – Rank two responses	The majority of responses confirm piped water as the main water supply (833 responses) with the primary alternatives being bottled water (147 responses) own	Measures to prevent water pollution in all surface water bodies during operations in particular

Household Question	Response	EMP Response
	well (104 responses). No respondents use water from public or private ponds/lakes or a public well.	where the risk to receptors is higher
What is your main water sources during wet season? (if have piped water) – Rank two responses	The majority of responses confirm piped water as the main water supply (815 responses) with the primary alternatives being bottled water (80 responses) own well (46 responses) and the river (32 responses).	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
If you are not connected to pipe water supply. What is your main water sources during dry season? Rank two responses	The majority of responses confirm their own drilled well is used as a water supply (290 responses) with the primary alternatives being own drilled well (290) responses, own open well (128 responses), water seller (120 response), bottled water (121 responses) pond/lake (109 responses), rainwater (92 responses). 3 responses were also 'canal' as an alternative water source.	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher.
If you are not connected to pipe water supply, what is your main water sources during wet season? Rank 2 responses	509 responses confirmed rainwater to a water source. The remainder being own drilled well (275) responses, own open well (125 responses), water seller (51 responses), bottled water (66 responses) pond/lake (68 responses), own pond (13responses).	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
During Construction, what mitigation measures would you like to see to reduce any potential impacts on you and your environment	The main responses are spray water on the road (to avoid dust) (62%), Ensure the security of road traffic (lighting) (17%) Limit the hours of work during the day (noise) (10%). 8% had no concerns. Alternative responses include concerns over construction safety, traffic safety (10 responses) and concern over impact to land or access (9 responses).	Traffic management to be implemented by contractor via the Community and Occupational Health and Safety and Emergency Response Sub-Plan Noise and dust control measures to be used.
If you are living close to the new landfill site, would you be interested in mitigation measures?	Glass in windows 35% Tree screens 22% Fly screen 26% 'Other' responses include operational requests to bury waste after it is deposited (28 responses) and requests for odouar control.	Mitigation measures and budget for house improvements included for houses close to landfill sites.

Source: Consultant Team 2018

343. Focus group discussions (FGD). FGDs were conducted by the PPTA social and environmental team in 9th-12th February 2018 at the project sites. The objectives of the FGDs were to:

- Present to the stakeholders and affected people the sites for subprojects in the provincial towns and inform them of the project activities;
- Understand the main issues that may occur in the proposed subproject areas, as raised by local people;
- Understand the potential social and environmental resources located/used in the subproject sites;
- Receiving issues, feedback, and comments from stakeholders or affected people regarding social, gender and environmental issues/resources in the proposed sites; and

- Receiving comments and suggestions for mitigation measures to improve adverse impacts from project design, construction, and operation stages.

344. Inclusion of Affected People's Views. The mitigation measures in the EMPs for this project reflect the result of the consultations during IEE preparation. The results of the consultation discussions are summarized in the following Table 34. Where appropriate, a response to the comment or concern is included in the EMP.

Table 34: Consultation FGD in Stueng Saen town for Landfill site

(1) Srayov Commune, Stueng Saen town, KPT Province (Landfill subproject)	
Issues/Comments/Suggestions raised by the Stakeholders	**EMP Response**
- We understand that the provincial authorities proposed the one site in Srayov Commune for the Landfill. - Srayov Commune is rural commune of Stueng Saen Town, we don't have solid waste collection service (people burn, dispose in the ground, and use as fertilizer).	None required
- We support landfill improvement in our area, but the project should study to check that this site is suitable for landfill. The proposed site is located in a lowland area, wet rice fields (private land) and this area is flood by rainy water during rainy season (0.5-1m deep).	The site was not selected due to flood issues.
- During operation stage, we are considering the impacts of project on water quality for rice crop, soil quality, increasing dust on the access road to landfill, increasing flies, pests – all affect communities.	Training for operators is included in capacity development. Will include use of cover and measures to reduce nuisance
- The impacts of project during construction (from air, noise, and dust) are small and short time, not big issues. - The general we support to this subproject for management our environment, because now solid waste in Stueng Saen town is lacking management and no sanitary landfill yet.	None required
- The waste truck is covered truck, limited driving speed in village and urban areas. - Provide maintenance of access road from NR-6 to landfill and watering to reduce dust. - The Srayov Commune lacks water supply and electric power for households use.	Speed limits will be adhered to Waste trucks will be covered Dust suppression measures are included
(2) Trapaeng Russey Commune, Kampong Svay District	
Issues/Comments/Suggestions raised by the Stakeholders	**EMP Response**
- The Kampong Svay Commune is located in a rural area, far from Stueng Sen Town about 12 km. There are no sewers and no solid waste collection service in this commune (solid waste is dumped in the ground, burned, and used as fertilizer for crops). - There are 02 proposed landfill sites are located in Trapaeng Russei Commune (in private land). These proposed landfills are located in upland areas of Kampong Svay Commune. There is small farm and most is scrub land. All the land areas are private land. - We support these proposed sites for improvement new landfill for dumping solid waste from Stueng Sen Town, now the town has no landfill	None required
- During construction, the main issue is land use, because these landfills belong to private owners. Small impacts of dust, air, odour, and noise from construction equipment, but are short term so not a big problem.	Dust, odor, and noise mitigation measures are in EMP Land ownership outside EMP scope.
- The impacts are more concerning during operation stage: (i) increasing dust on the access road to landfill, (ii) increasing odour, (iii) increasing air pollution from landfill (smell and smoke), and flies-pests (public safety).	Training for operators is included in capacity development.

The project and the implementing agencies should consider negative impacts and prepare mitigation policies especially impacts on social and human health	Will use soil cover to reduce odour nuisances.
Provide maintenance of access road from NR-6 and NR62 to landfill site and provide watering to reduce dust pollution from waste trucks, during operation of the landfill. Use sound technology for reducing the flies, pests, and smell from landfill. A dam should be built around the landfill site for protection from flooding	Training for operators is included in capacity development Drainage control measures included in design

8.2. Public Consultations during Project Design

345. Additional field visits and stakeholder consultations were conducted during the DED studies, including presentations to MPWT/PMU and PIU on layout designs. A consultation was done in 12-13 February 2020 covering waste pickers in existing dumpsite. The consultation explained to the attendees about the Project and its benefits, the scope of works, resettlement impacts, the ADB and RGC policies on compensation, eligibility, entitlements, contractor responsibility for temporary impact, cut-off date of 12 February 2018 and GRM.

346. Another consultation took place on 10 March 2020 with 22 participants (11 males and 11 females), including waste pickers eligible and entitled to participate in the income restoration plan (IRP). The consultation included details of GRM, IRP eligibility, vocational training options, current employment opportunities in Steung Saen and special support to vulnerable affected households.

347. Table 35 summarizes the public consultations undertaken with the participants.

Table 35: Summary of Consultations

Date	Location	Topic and Summary of Discussions	Participants
12 February 2020	City Hall meeting room, Kampong Thom	Initial consultation with waste pickers to inform affected households on Project description and ADB policy (SPS 2009), Details about Involuntary Resettlement, and project Resettlement Framework and compensation, Details about Income Restoration Program of the project, Details about PRSC and GRM and how to process formal complaint letter, cut-off date, and upcoming DMS/SES.	20 people (female 10, Male 10)

348. Table 36 summarizes the key discussion points on the questions from the AHs and responses provided at consultative meetings.

Table 36: Summary of key Discussion Points

Date	Question	Answer / EMP
12 February 2020	(1) Can we continue waste picking at the new landfill? (2) How far is the new landfill from the existing landfill? (3) If possible, project can facilitate us by transport to the new site of landfill, because we don't have any transport and especially it is so far from our house. (4) I don't know how I can earn income after I have to stop waste picking. Unfortunately, now we just know that profession and it is closely located to our residence. When it will close forever, and the new dumpsite is located so far from our village I cannot go to the new landfill. This is because I don't have any vehicle and I am so poor	(1) Provincial Implementation Unit is willing to allow waste pickers to continue your work at new site of landfill, but this will need to be confirmed with MPWT (2) Around 15 km from the existing landfill. (3) We will follow up with your suggestion. However, it is unlikely for the province or the project to have any transportation to the new landfill. (4) We know and worry about your difficult livelihood situation when the project closes the existing dumpsite. To respond to you losing livelihoods and income earning possibilities, the project will provide option for you and your family members to participate in income restoration program. Otherwise, the city

Date	Question	Answer / EMP
		hall also still allows you to continue waste picking at new site. The project cannot organize transport for support though.

349. The new solid waste management site is being purchased using willing buyer willing seller approach from one landowner. The only impact is on waste pickers at the current landfill site that will be closed. The waster pickers are included in the income restoration program in the Draft Resettlement Plan. The new landfill site has been screened and classified category B for involuntary resettlement impact only due to the economic displacement of waste pickers. Therefore, GDR role is limited to land acquisition and compensation and the Income Restoration Program (IRP) training of the waste pickers.

350. Another consultation took place on 27 and 28 August 2020 together with MoE with the objectives of: (1) Visit the location and condition of proposed landfill site; (2) Investigate sensitive environmental and social resources near the proposed landfill (water source, farm crops, and house, including the houses close to the landfill); and (3) Reporting, comment and approve of selection landfill site. MoE approved the site for the landfill. MoE recommendations are summarized in Table 37 and filed report is included in Annex 4:

Table 37: Summary of key Discussion Points

Recommendation	PMC
Locate the cells to the south far away from water resources.	Cells have been designed in the south, the distance of the buffer between the site and the stream has been set at 500 m.
Provide proper protection the impact on surface water and ground water quality.	Design includes protection measure for water and groundwater (ref: section 4.5).
Provide tree planting around the landfill site and green park/space in landfill site for mitigate the odour.	Design includes planting trees around selected boundaries of the site, and also opening glass windows.
Ensure the leaching wastewater and run off from landfill is not discharge or flow outside	Design ensures and prevents leachate and run off being discharged without treatment. Notice Surface Water Drainage (ref: section 4.5.8) includes separate drainage for uncontaminated run off (rainwater which has not been in contact with solid waste or other pollution source) to flow out of the landfill.

8.3. Public Consultants during Project Construction

351. The Consolidated IEE for this subproject contains details of the consultation undertaken during preparation of the subproject. In addition, consultation must take place during construction. The PIU Safeguard Focal Point (PIU-SFP) will undertake consultation following the finalisation of the detailed design, and again will conduct consultation interviews within 4-6 weeks of construction starting and then again every 3 months until the end of construction. This is set out in the Environmental Monitoring Plan provided in the EMP.

352. It is suggested that the consultations take the form of meetings and site-based discussions and include the following:

- Environmental impacts of civil works (e.g., solid & liquid waste, erosion, local flooding, pollution).
- Any unforeseen impacts caused accidentally e.g. through spillages.

- Civil nuisance (e.g., noise, dust, disrupted business & farming activity, social issues, community health and safety).
- Impaired use of access road to landfill site (e.g. traffic issues and access); and
- GRM and its procedures including details of persons to contact and contact details

353. In summary, informal monitoring interviews with affected people will focus on complaints about community disturbance from construction activities, as well as public concerns about ecological protection, soil / land concerns and access issues. A sample Environmental Monitoring Interview Form is in the EMPs for this project. This will contribute to project monitoring.

8.4. Consultation during Operation

354. During subproject operation stage. the mitigation measures for this IEE specify that the landfill operates, in collaboration with PDPWT undertake quarterly consultation with local residents to discuss any operational environmental and social impacts or concerns to provide proper mitigation measures or response plans.

8.5. Information Disclosure

355. Environmental information on the project, including the IEE and other safeguards information will be disclosed in accordance with ADB's Public Communications Policy (2011) and SPS (2009). This includes:

(i) The EMP will be translated into Khmer and be available for review PDPWT offices;

(ii) The IEE will be disclosed on ADB's project website (www.adb.org), current available version in ADB project website is IEE May 2018.;

(iii) Copies of the IEE are available upon request; and

(iv) Quarterly and Semi-annual environmental monitoring reports on project's compliance with the EMP and other necessary information will be available at www.adb.org.

356. The updated Public Information Brochure (PIB) published in Khmer was also distributed and explained to the affected households during DMS. Another set of PIB with compensation package will be prepared and translated in Khmer will be directly disseminated to the affected households as well as posted at the Sangkat or Town Offices.

357. Public information and disclosure about the subproject will be continued during the construction in the Project areas. The updated PIB will be distributed after contract award to update the affected households especially regarding the works construction schedule and any potential temporary impacts. The PIB contains information about the project, entitlements or compensation for the affected households, the local GRM, PGRC members, including agencies (i.e., ADB, MPWT/PMU, etc.) so that affected households are clear about whom they should contact with their concerns.

358. Particular attention in disclosure will be given to women, the poor and other vulnerable affected households. All consultation and disclosure activities will be properly documented; minutes of meetings, photos, and attendance sheets will be prepared and recorded.

9. GRIEVANCE REDRESS MECHANISM

359. A grievance redress mechanism (GRM), consistent with the requirements of the ADB Safeguard Policy Statement (2009) has been 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.

360. The Access Points to the GRM are critical for ensuring it is useable for affected people (APs). The GRM Access points for this project, as set out in this GRM Mechanism will be:

- The Contractors
- District and Commune Councils
- The PIU office
- The Provincial Department of Public Works and Transport (PDWT).

361. Full details of the GRM, its access points, and responsible parties are found in the EMP documents for this subproject.

10. ENVIRONMENTAL MANAGEMENT PLAN

362. A detailed EMP has been prepared for the Stueng Saen Solid Waste Management Subproject. The EMP is a standalone separate document (dated march 2021). The EMP aims to avoid impacts where possible and mitigate those impacts which cannot be eliminated to an acceptable and minimum level. The EMP includes detailed requirements for:

- Mitigation and monitoring measures;
- Institutional arrangements and project responsibilities;
- EMP budget for implementation
- Capacity building and training requirements
- Public consultation and information disclosure
- GRM including clearly defined timescale and responsibilities.

363. The overall responsibility for EMP implementation and compliance with loan assurances lies with the Executing Agency, the MPWT. The EA will establish a Project Steering Committee (PSC) and PMU based in Phnom Penh, responsible for general project implementation. The Implementing Agency is the PDPWT in each town. The PDPWT has established a PIU in each province, comprising relevant provincial government representatives including the PDoE.

364. A summary of the key functions for project implementation and therefore environmental safeguards is presented in Table 38.

Table 38: Key Roles for Project Implementation

Role	Abbreviation	Location	Summary of Overall Function
Project Steering Committee	PSC	Phnom Penh	Policy and technical guidance for subproject implementation
Project Management Unit	PMU	Phnom Penh within MPWT	Responsible for general project implementation and reporting
PMU Environment Safeguards Officer	PMU-ESO	Phnom Penh within PMU	EMP compliance across the subprojects for environmental and social safeguards
Project Implementation Unit	PIU	Provinces within PDPWT	Responsible for subproject implementation
PIU Safeguards Focal Point	PIU-SFP	Provinces within PIU	Responsible for subproject environmental and social safeguard monitoring
Contractor Environmental Health & Safety Officer	C-EHS	Construction Site	Mitigation measure implementation and reporting
Project Management Consultant	PMC	Phnom Penh	Project final design and implementation, support and capacity development
International and National Environment Specialists	PMC-I/NES	Phnom Penh within PMC team	Environmental safeguards and reporting support during design and implementation
Asian Development Bank	ADB	-	Review project progress, compliance with covenants and advise on corrective actions.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Conclusions

365. This IEE was undertaken to determine the environmental issues and concerns associated with the subproject activities, based on the DED. The assessment confirms that the project is classified as Category B for environment. There are no significant adverse impacts that cannot be readily mitigated if mitigation measures are implemented effectively. The EMP associated with this IEE proposes measures that will mitigate or compensate impacts on the natural environment and affected people to an acceptable level.

366. The most significant impacts from the project are expected during operations. The design of the facilities aims at preventing these impacts and there is a comprehensive training and capacity building component to the project which is essential for ensuring that the implementation of the project is both financially and environmentally sustainable and achieves anticipated outcomes.

367. The key parties for mitigation measure implementation are the construction contractors and the operators. They will be supported by qualified national and international environmental consultants within the PMC teams. The implementation of this EMP will be closely monitored and reported on by the relevant stakeholders in the project.

368. Overall, the expected project outcome is improved urban environmental services in Kampong Thom Province. The project is anticipated to bring environmental benefits to the populations of the project service area and Steung Saen city in particular. It will serve to improve waste management in town, reduce pollution impacts and provide long term urban environmental improvements, health benefits and promote sustainable city development.

369. The next step of Environmental Safeguards implementation is the preparation of the Contractors Environmental Management Plan (CEMP), which is to be based on the EMP, but is expected to include more detailed measures to be implemented by the Contractor. The CEMP will be the backbone of the Environmental Management System of the contractor and will be supported by associated sub-plans which will deal with specific topics, such as Health and Safety, Waste management, Soil and Borrow sites management, traffic Management, etc.

370. When operations start, the operator shall develop an Environmental Management Plan specific to the operational phase.

371. The Grievance Redress Mechanism has been established, as outlined in this IEE and the EMP. It will ensure that all unplanned impacts which cause grievances for affected people are managed and a satisfactory outcome brought about swiftly.

11.2. Recommendations

372. The next step of the Environmental Safeguards implementation is the preparation of the CEMP, which is to be based on the EMP, but it develops in more details the measures to be implemented by the Contractor. The CEMP will form the basis of the Environmental Management System of the Contractor during the construction phase. It will nominate the Contractor's environment, H&S officer(s) and the Contractor's GRM focal point and will be supported by associated subplans which will deal with specific topics, such as Materials spoil and borrow site management, Solid and liquid waste management, Community and occupational H&S and emergency response, COVID-19 response plan, and Construction workers camp management.

373. The O&M manual will provide clear methods and procedures for all aspects of the landfill management and monitoring/ testing.

Annex 1: Environmental Quality Standards

(1) Ambient Air Quality Standards

Source: Sub-decree No. 42 ANRK.BK on Air Pollution Control and Noise Disturbance, MoE 2000.

Parameter	Averaging Period	Standard	
		Unit	Value
Nitrogen Dioxide (NO2)	24 hours	mg /m3	0.1
Sulfur Dioxide (SO2)	24 hours	mg /m3	0.3
Carbon Monoxide (CO)	24 hours	mg /m3	20
PM 2.5	24 hours		-
PM 10	24 hours		-

(2) Ambient Noise Standards

Source: Sub-decree No. 42 ANRK.BK on Air Pollution Control and Noise Disturbance, MoE, 2000.

Areas	Time Period (24 hours)	Standard	
		Unit	Standard Value
Area is not identified	Day time (from 6:00am to 6:00pm)	Noise Level dB(A)	70.0
	Evening Time (from 6:00pm to 11:00pm)	Noise Level dB(A)	65.0
	Night-time (from 11:00pm to 6:00am)	Noise Level dB(A)	50.0

(3) Surface Water Quality Standard

Referring to Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999, the standards of water quality are divided as follows:

Annex 2 of Sub-decree on Water Pollution Control

Effluent standard for pollution sources discharging wastewater to public water areas or sewer

Note: The effluent standards applicable to the Subproject are those for discharge to "Public water area and sewer"

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	0C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD5 (5 days at 200 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 (NO3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO4)	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

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
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 (NH3)	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	Hexaxhloro cyclohexene	mg/l	<2	<2

Remark: The Ministry of Environment and the Ministry of Agriculture, Forestry and Fishery shall collaborate to set up the standard of pesticides which discharged from pollution sources.

Annex 4 of Sub-decree on Water Pollution Control

Water Quality Standard in public water areas for bio-diversity conservation

a) River

Parameter	Standard	
	Unit	Value
pH	mg/l	6.5 – 8.5
BOD5	mg/l	1 – 10
Suspended Solid	mg/l	25 – 100
Dissolved Oxygen	mg/l	2.0 - 7.5
Coliform	MPN/100ml	< 5000

Source: Sub-decree No. 42 ANRK.BK on Water Pollution Control, MOE, 1999.

b) Lakes and Reservoirs

Parameter	Standard	
	Unit	Value
pH	mg/l	6.5 – 8.5
COD	mg/l	1 – 8
Suspended Solid	mg/l	1 – 15
Dissolved Oxygen	mg/l	2.0 - 7.5
Coliform	MPN/100ml	< 1000
Total Nitrogen	mg/l	1.0 – 0.6
Total Phosphorus	mg/l	0.005 – 0.05

Annex 5 of Sub-decree on Water Pollution Control:

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	Diedrin	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

(4) Drinking Water Quality Standards (DWQS), Ministry of Energy, Mines and Industry, January 2004

The standards are applicable as the minimum requirement to all sources of drinking water in both urban and rural areas, public or private water supply regardless of its source including groundwater, surface water, rainwater, intended for human consumption.

Drinking Water Quality Standards

No	Parameter	Standard	
		Unit	Value
1	pH	-	6.5-8.5
2	Turbidity	NTU	5.0
3	Dissolved Oxygen (DO)	mg/l	NV
4	Total Suspended Solid (TSS)	mg/l	NV
5	Chloride (Cl-)	mg/l	250
6	Nitrate (NO3)	mg/l	50
7	Phosphate (PO4)	mg/l	NV
8	Sulphate (SO4)	mg/l	250
9	(BOD)5	mg/l	NV
10	(COD) Mn	mg/l	NV
11	Aluminium (Al)	mg/l	0.2
12	Arsenic (As)	mg/l	0.05
13	Copper (Cu)	mg/l	1.0
14	Iron (Fe)	mg/l	0.3
15	Lead (Pb)	mg/l	0.01
16	Manganese (Mn)	mg/l	0.1

No	Parameter	Standard	
		Unit	Value
17	Mercury (Hg)	mg/l	0.001
18	Zinc (Zn)	mg/l	3.0
19	Total Coliform	MPN/100mlml	0
20	*Escherichia coli (E. coli)*	MPN/100mlml	0

(6) Soil Quality Standard

Parameter	Standard	
	Unit	Value
pH		
Salinity	ppt	6-8
Oil & Grease	mg/kg	-
Chloride	mg/kg	-
Petroleum Hydrocarbons		
Kerosene hydrocarbons (c10-c14)	mg/kg	-
Diesel hydrocarbons (c15-c28) (mg/L)	mg/kg	-
Heavy oil hydrocarbons (c29-c36) (mg/L)	mg/kg	-
BTEX		
Ethylbenzene	mg/kg	0.018
Benzene	mg/kg	0.0068
Toluene	mg/kg	0.08
Xylene	mg/kg	2.4
Metals		
Nickel	mg/kg	50
Copper	mg/kg	63
Zinc	mg/kg	200
Arsenic	mg/kg	12
Cadmium	mg/kg	1.4
Lead	mg/kg	70
Iron	mg/kg	-
Chromium	mg/kg	64
Mercury	mg/kg	6.6

Source: Cambodia National Quality Standards for Agriculture, Ministry of Agriculture, Forest, and Fishery (MAFF).

USEPA Effluent Limitations for Landfills compared with Cambodian Effluent Standards:

USEPA Effluent Standards[10]						Cambodian Effluent Standards
Parameter	Unit	Hazardous Waste Landfill	Hazardous Waste Landfill	Municipal Solid Waste Landfill	Municipal Solid Waste Landfill	Public water area and sewer
		Daily Max	Monthly Average	Daily Max	Monthly Average	
BOD5	mg/L	220	56	140	37	< 80
pH		6-9	6-9	6-9	6-9	5-9
Total Suspended Solids	mg/L	88	27	88	27	< 120
Ammonia (as N)	mg/L	10	4.9	10	4.9	< 7
Arsenic	mg/L	1.1	0.54			< 1.0

[10] Source: US Code of Federal Regulations, Title 40, Chapter I, Subchapter N, Part 445 Landfills Point Source Category, https://ecfr.federalregister.gov/ accessed on 21-Mar-2021

USEPA Effluent Standards[10]						Cambodian Effluent Standards
Parameter	**Unit**	**Hazardous Waste Landfill**	**Hazardous Waste Landfill**	**Municipal Solid Waste Landfill**	**Municipal Solid Waste Landfill**	**Public water area and sewer**
Chromium	mg/L	1.1	0.46			< 1.5[11]
Zinc	mg/L	0.535	0.296	0.20	0.11	< 3.0
Phenol	mg/L	0.048	0.029	0.026	0.015	< 1.2

The USEPA effluent limitations include parameters for which there are no Cambodian standards, and these parameters are therefore not listed in the above table.

The USEPA effluent standards represent limitations attainable by the application of the best practicable control technology currently available (in the USA). For hazardous waste landfills, EPA promulgated effluent limitations based on a treatment system consisting of equalization, chemical precipitation, biological treatment, and multimedia filtration.

For non-hazardous waste landfills, EPA promulgated effluent limitations based on the following treatment: equalization, biological treatment, and multimedia filtration.[12] These are technologies that are currently being applied across the landfill sector in the US and include methods that are more advanced than the methods currently practised in Cambodia.

Compared with leachate treatment methods currently available / practiced in Cambodia, the technologies considered for the US standards are more advanced (not surprisingly) which is therefore also reflected in the somewhat more stringent limitations for some of the parameters.

[11] This is the sum of the Chorm-3 and Chrom-6 standards

[12] USEPA, Development Document for Final Effluent Limitations Guidelines and Standards for the Landfills Point Source Category, January 2000

Annex 2: Site Field Notes & Descriptions

Solid Waste Management Subproject , Stueng Saen town

1. Proposed Landfill Site:

The proposed landfill site is located in Trapaeng Russey and Snor Village, Trapaeng Russey Commune, Kampong Svay District, Kampong Thom Province. This land area belongs to private land (government will buy, if project approves) and located in upland (no flood, only runoff from heavy rain in rainy season). This proposed site-2 is located from:

- Stueng Saen Town is about 8 km
- National Road 6 is about 2 km and from National Road 62 is about 4 km
- Trapaeng Russey Village (where are houses, school, and pagoda) is about 2-3 km.
- The site is private land and the small area in this site is cashew tree farm located in site.
- There are not any sensitive receptors in/near the proposed site. Some locations of this site are shrub land with some small trees/vegetation. (Name of vegetation/trees in this site is presented in table below).

2. Trees/vegetation in the proposed landfill site

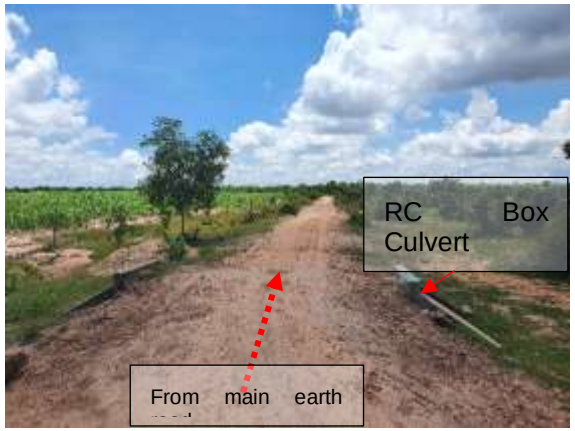
No	Scientific Name	English Name	Khmer Name	Family Name	Remarks
In landfill site					
1	Bambusa Arundinacea Wild	Bamboo	Reussey Prey	Gramimeae	
2	Combretum Quadrangutare	Sangke	Sangke	Combretaceae	
3	Dipterocarpus Intricatus Dyer	No	Trach	Dipterocarpaceae	
4	Dipterocarpus Obtusifolius	No	Tbeng	Dipterocarpaceae	
5	Dipterocarpus Tuberculatus Roxb	No	Khlong	Dipterocarpaceae	
6	Lagerstroemia Florbunda Jack	Wild Guava	Trabek Prey	Lythraceae	
7	Bauhinia Acuminata	Cheung Kou	Cheung Kou	Leguminosae	
8	Phy Llantus Emblica	Cactus Tree	Kantuot Prey	Euphorbiaceae	
9	Calamus sp.	Vine/Rattan Specy	Voir/Pdav	Palmae	
10	Sindora Cochinchinensis H. Baill	Ko Koh Tree	Ko Koh	Leguminosae	
On the access roads to the sites					
1	Acacia Auriculiformis	Acacia	Acacia	Mimosaceae	
2	No	Eucalyptus	Prag Khyal		
3	No	Rain Tree	Chamkiri		
4	No	Palm Tree	Tnort		

Source: - Consultant Team 2018
- List of tree species, FA/DANIDA, 2004

The existing condition of forestland or forest resources and vegetations are on the landfill site

TS2-01: **Stueng Saen Landfill sites observation**

<table>
<tr>
<td>The existing Stueng Saen Dumpsite We did not see any activities at this site (dumping, waste picking)
 
</td>
<td>There are paddy fields and flooded areas around the dumpsite.
  </td>
<td>The embankment was built arround the open dumpsite.
  </td>
</tr>
<tr>
<td>The Earth road Inside of the old dumpsite, most part of this dumpsite was covered by soil.
  </td>
<td>Closed waste pile: this part was closed and vegetated
  </td>
<td>The dumpsite is 1-3 km from residential areas
  </td>
</tr>
</table>

The New Stueng Saen Landfill: arround the new landfill site are mostly farms (cane, cashews, mango,…). There is no flood, and no residents living around this site. 	The access road (laterite road) to the new landfill connected with Road N.6. The electricity line also has been onside road to the new landfill. 	The existing access road into the new landifll site 
The existing open canal in front of the site, along the main laterite road. 	Cane farm in the North of new landfill site 	The tree plants inside the new landfill area 

Annex 3: Terms of Reference for the Environmental Compliance Audit of the Existing Dumpsite

Background

The Royal Government of Cambodia has obtained a loan and grant from the Asian Development Bank (ADB) towards the cost of the Second Integrated Urban Environmental Management in the Tonle Sap Basin Project (TS2 Project). The TS2 project includes the Stueng Saen Solid Waste Management Subproject in Stueng Saen town, Kampong Thom Province. The Subproject entails the construction of a new controlled engineered landfill.

Purpose and requirement of Environmental Compliance Audit

The existing dumpsite in Stueng Saen Town is an *Existing Facility*[13] of the wider ADB project "Second Urban Environmental Management in the Tonle Sap Basin Project" and the closure and remediation of the dumpsite require that an Environmental Compliance Audit (ECA) is conducted of that facility pursuant to the SPS (2009), para 10 of Appendix 1 and para 12 of Appendix 4.

The dumpsite closure and remediation will be undertaken as a separate sub-project.

Scope of the ECA for the dumpsite

The ECA will be carried out in two phases where phase 1 is a preliminary assessment of the risks, possible solutions and the need for immediate mitigation measures at the dump site to minimise on-going pollution and risks to human health as much as practical until the long-term solution can be implemented. Phase 2 of the ECA concerns more detailed site investigations and analyses as a basis for making a decision on the long-term solution and to provide information for the preparation of the detailed remediation design.

Phase 1

Activities

Phase 1 includes the following activities:

1. Site visit(s) to identify existing activities or conditions that may cause or contribute to pollution or spread of infections:
    a. Evidence of open burning
    b. Evidence of vectors (e.g. rats, insects, birds)
    c. Evidence of windblown waste
    d. Direct field assessment of odours
    e. Drainage and waterbodies
    f. Leachate seepage
    g. Mapping of waste piles (active and non-active) and the dumpsite boundary

[13] *Existing Facilities 12. For projects involving facilities and/or business activities that already exist or are under construction, the borrower/client will undertake an environment and/or social compliance audit, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and Indigenous Peoples. The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard. Appendix 4 principles and requirements for borrowers/clients and to identify and plan appropriate measures to address outstanding compliance issues. Where noncompliance is identified, a corrective action plan agreed on by ADB and the borrower/client will be prepared. The plan will define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance. The audit report (including corrective action plan, if any) will be made available to the public in accordance with the information disclosure requirements of the Safeguard Requirements 1–3. For environment category A projects involving facilities and/or business activities that already exist or are under construction, the borrower/client will submit the audit report to ADB to disclose on ADB's website at least 120 days prior to ADB Board approval. If a project involves an upgrade or expansion of existing facilities that has potential impacts on the environment, involuntary resettlement, and/or Indigenous Peoples, the requirements for environmental and social impact assessments and planning specified in Safeguard Requirements 1-3 will apply in addition to compliance audit.*

h. Inspect incoming waste or recently dumped waste to characterize the waste types
i. Presence of informal recyclers
j. Distance to sensitive receptors
k. Review of any existing permits or authorizations for the dumpsite
l. Documentation will include drone photos, videos, onsite photos, field observation notes, GPS tracks and waypoints.

2. Interviews with waste management personnel, government officials, informal recyclers, and farmers owning adjacent land:
    a. Date dumpsite was commissioned (became operational);
    b. Current operator and responsible authority of dumpsite
    c. Current disposal practices;
    d. Types of solid waste disposed in dumpsite (e.g. domestic, hospital, construction, industrial);
    e. Rate of solid waste disposal at dumpsite (tonne/day or tonne/month);
    f. Local water management, water use, flood risk;
    g. Existing groundwater wells;
    h. Relevant water quality data.

Site visits and interviews may be combined.

Analyses

Phase 1 includes the following analyses:

1. Preparation of georeferenced drone pictures of the dumpsite and its immediate surroundings.
2. Preparation of preliminary drawings and maps with Google Earth backdrop approximately to scale and elevations from onsite GPS data based on the above documentation identifying waste pits or trenches, waterbodies, vegetation, surrounding land use, sensitive receptors, and groundwater wells.
3. Rough estimation of the spatial extent of the waste dump and total volume of waste.
4. Analysis of applicable government laws and regulations (non-exhaustive list below, missing regulations will be identified and included in the analysis) to clarify whether the design and operation of the existing dumpsite is in compliance and to clarify requirements applicable to the closure of the dumpsite.
    a. Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK) 2009;
    b. Guidance on Selection of Landfill Sites (2016);
    c. Sub-decree on Solid Waste Management (Sub-decree No. 36 ANK/BK) 1999;
    d. Environmental Guidelines on Solid Waste Management in Kingdom of Cambodia, Ministry of Environment, 2006.
5. Preliminary identification and assessment of existing pollution and other health risks and development of practical and affordable immediate actions to eliminate or minimise the risks including cost estimates for such actions.
6. Preparation of a simple Environmental Management Plan covering the immediate mitigation measures at the dumpsite.
7. Preliminary analysis of alternative long-term solutions aiming at a preliminary ranking and identification of important information gaps to be filled in Phase 2. Key considerations include future land use, risks to human health and the environment, remediation costs, spatial development plans, and real estate prices.

Expected Results

Phase 1 is designed to provide the following results:

1. Legal requirements to dumpsite closure
2. Preliminary analysis of alternative long-term solutions
3. Final Phase 2 investigation programme
4. Action plan, Environmental Management Plan and cost estimates for immediate mitigation measures at the dumpsite.

The results will be documented in a concise report and presented to the Project Steering Committee and ADB for their decisions on the next steps.

Phase 2

The objectives of the Phase 2 investigations are to determine the long-term solution to the remediation of the dumpsite and to provide information for the preparation of the detailed remediation design.

The scope of the Phase 2 investigations consists of the activities listed below and possibly additional activities which will be determined in Phase 1.

Activities

1. Interviews (continued from Phase 1) with waste management personnel and government officials with knowledge about the dumpsite:
    a. the number and depth of waste cells;
    b. underlying waste cell lining material if any;
    c. extent of active surface runoff collection and drainage;
    d. extent of leachate and gas collection and treatment;
    e. extent of septage disposal and management;
    f. waste recycling process used by local waste pickers; and
    g. scheduling of transport of solid waste to dumpsite.
2. Obtain documentation for land ownership of the dumpsite.
3. Obtain existing data on groundwater quality near the dumpsites from PDoE (if available).
4. Determine distance of nearest surface waters (stream, lake) that could be affected by the dumpsite, and obtain existing surface water quality data.
5. Determine distance of nearest residences or businesses from the dumpsite.
6. Determine number of full-time and part-time informal recyclers that work (and live) at the dumpsite
7. Identify any other use of the dumpsite area.
8. Consult with the surrounding community and the informal recyclers to determine if there are past or present environmental, social, or human health issues associated with the operation of the existing dumpsite.

Additional Optional Activities

Phase 1 will result in a preliminary ranking of long-term solutions and to enable a final decision, it is likely that Phase 2 will have to include certain physical site investigations. These investigations will be designed to support reliable risk assessments and to determine a reasonably accurate spatial extent of the waste deposits.

The optional investigation programme may include one or more of the activities listed below. Other activities may also be considered.

1. Drilling programme. Short drillings in selected waste cells to determine the depth and composition of the waste and to collect samples of leachate or groundwater and landfill gas for chemical analyses.
2. Groundwater monitoring wells. Establishment of monitoring wells upstream and downstream the dumpsite to determine the local hydrogeological conditions, groundwater flow direction, groundwater table elevation and seasonal fluctuations, and groundwater quality.
3. Sampling and chemical analyses of leachate seepage.
4. Sampling and analysis of surface water quality in nearby waterbodies.
5. Detailed topographic survey of the dumpsite and its immediate surroundings.

Expected Results

Phase 2 is designed to provide the following results:

1. Recommendations on the future land use of the remediated dumpsite
2. Analysis and ranking of alternative long-term solutions
3. Description of the preferred long-term solution including monitoring and aftercare.
4. Cost estimate

The results will be documented in a concise report and presented to the Project Steering Committee and ADB for their decisions on the next steps.

Annex 4: Consultation During IEE Preparation

Public Consultation Meetings: Focus Group Discussion (FGD)

The main objectives of FGDs are to:

1. Present to the stakeholders and affected people the sites for subprojects in the provincial towns and inform them of the project activities
2. Understand the main issues that may occur in the proposed subproject areas, as raised by local people.
3. Understand the potential social and environmental resources located/used in the subproject sites.
4. Receiving issues, feedback, and comments from stakeholders or affected people regarding social, gender and environmental issues/resources in the proposed sites.
5. Receiving comments and suggestions for mitigation measures to improve any adverse environmental and social impacts from project design, construction, and operation stages.

Identification of Participants to Consultation Meeting

Stakeholders invited to attend FGDs were identified by National Social Specialist and National Environmental Specialist with assistance from commune chiefs of subproject areas. These focus group members come from:

6. Representative of communities or affected communities (men and women)
7. Chiefs/ deputy village chiefs, the villages are located in and close to the subproject sites
8. Commune chiefs/deputy commune chiefs and commune council members. These communes are located in and around the proposed subprojects sites.

The discussion questions concerned:

9. Physical Resources: Water resources and water quality, soil quality, and air quality (noise and odor)
10. Ecological Resources: forest/vegetation, wildlife and fish.
11. Social Issues/Resources: Land use, water use, agricultural activities, cultural resources, infrastructure, utility services, education, and cultural-touristic resources.

The format of the FGD is summarized as follows:

1. Introduction to the project - describe the project and potential construction activities.
2. Mitigation Measures. Describe potential mitigation measures (EMP) and monitoring
3. Consultation Discussion. Discussion on topics and questions:

12. A. How does the community use the environment & natural resources? Example: what are water sources (drinking, washing etc). Vegetation/Fish/Forest, land use etc
13. B. What are the community's concerns regarding Construction Impacts?
14. C. What are the community's concerns regarding Operation Impacts?
15. D. What are the Mitigation Measures the community would like during Construction?
16. E. What are the Mitigation Measures the community would like during Operation?

Summary of the results of consultations

On 09 to 12 February the National Social and Gender Specialist and National Environmental Specialist of the TA 9203-CAM: Second Urban Environmental Management in The Tonle Sap Basin Project undertook FGDs in the proposed subprojects areas for Stueng Sen Town. The key points from the consultation meetings are presented in Section above of this IEE.

Consultations for Stueng Saen town, Kampong Thom Province



Consultation meeting with commune lerders and FGD in Srayov Commune, Stueng Sen Town, Kampong Thom



Consultation meeting with commune lerders and FGD in Trapaeng Russey Commune, Kampong Svay District , Kampong Thom Province

1. List of consultation in Srayov Commune, Stueng Saen town, KPT

No	Name	Agency Village/Commune	Position	Phone
1	Mr. Harm Chheav	Srayov Commune	Group Leader	O88 850 4809
2	Mr. Srey Nhel	Srayov Commune	Village Chief	092 628 046
3	Mr. Seang Yeung	Srayov Commune	Group Leader	
4	Mr. Chean Cheam	Srayov Commune	Villager	
5	Mr. Porn Phit	Srayov Commune	Villager	
6	Ms. Chhun Nath	Srayov Commune	Villager	
7	Mr. Chhup Darith	Srayov Commune	Villager	
8	Mr. Chhup Ron	Srayov Commune	Villager	
9	Mr. Horn Kea	Srayov Commune	Villager	
10	Mr. Chhup Lim	Srayov Commune	Villager	
11	Mr. Sim Lim	Srayov Commune	Villager	
12	Ms. San Sineth	Srayov Commune	Villager	
	Total: 13 persons (female: 02 persons)			

2. List of consultation in Trapaeng Russei Commune, Kampong Svay District, KPT

No	Name	Agency Village/Commune	Position	Phone

1	Ms. Seng Pich	Trapaeng Russei Commune	Village Member	
2	Mr. Hong Khoth	Trapaeng Russei Commune	Deputy Village Chief	097 699 8723
3	Ms. Hing Neng	Trapaeng Russei Commune	Villager	
4	Mr. Ving Sandap	Trapaeng Russei Commune	Villager	
5	Ms. Seng Veun	Trapaeng Russei Commune	Villager	
6	Mr. Chhorn Yeun	Trapaeng Russei Commune	Villager	
7	Mr. But Phorn	Trapaeng Russei Commune	Villager	
8	Mr. Rim Rithy	Trapaeng Russei Commune	Villager	
9	Ms. Khe Sokha	Trapaeng Russei Commune	Villager	
10	Ms. Sem Mom	Trapaeng Russei Commune	Villager	
11	Ms. Van Ne	Trapaeng Russei Commune	Villager	
12	Ms. Chheng Ngip	Trapaeng Russei Commune	Villager	
13	Ms. Dem Khan	Trapaeng Russei Commune	Villager	
14	Mr. Nang Nem	Trapaeng Russei Commune	Village Chief	012 162 6981
15	Ms. Pin Kao	Trapaeng Russei Commune	--	
16	Ms. Sem Khom	Trapaeng Russei Commune	--	
17	Ms. Van Vanna	Trapaeng Russei Commune	--	071 708 8357
18	Ms. Ngim Navy	Trapaeng Russei Commune	--	
19	Ms. Kong Vy	Trapaeng Russei Commune	--	
20	Ms. Tea Teang	Trapaeng Russei Commune	--	
	Total: 07 persons (female: 05 persons)			

Second Urban Environmental Management in the Tonle Sap Basin Project

Activity Report

Component	Site visit for Subproject TS2
Type of Activity	Site visit at Stueng Sean city, Kampong Thom
Subproject/s	Landfill in Stueng Sean, Kampong Thom province
Start date	27-08-2020
End date	28-08-2020
Planned Activities	MoE team conducted the site visits and consultation meeting with local authorities of proposed landfill site
Activities Carried Out	Site investigation on sensitive environmental and social resources are located near the landfill site and meeting with PMU, PDPWT/PIU, PDoE, Stueng Sean town authority, and Trapeang Russey commune leaders.
Appendix 1: Participants	

Appendix 2: Pictures	

Mr. Yim Chamnan National Environmental Specialist	

Consultation Meeting with Local agencies and Trapeang Russey Commune Authority

On 27 August 2020, after visiting the landfill site at 11:00am, the MoE team conducted the consultation meeting with PMU, PDPWT/PIU Staffs, PDoE, town authority, commune authority, PMC, and SBK team. Meeting Attendees are shown in Appendix 1.

The objectives were:

- Visit the location and condition of proposed landfill site
- Investigate sensitive environmental and social resources are setting near the proposed landfill (water source, farm crops, and house).
- Reporting, comment and approve of selection landfill site

Meeting discussion:

The proposed consultation: Find out the key environmental and social resources are near the landfill site. receive issues, comments, and feedbacks for local agencies on the process of selection landfill site and waste management in Stueng Seam town. Provide recommendations.

The key considers:

- The proposed landfill site is located in Trapeang Russey and Snoar village, Trapeang Russey commune, Kampong Svay district, Kampong Thom Province. (the landfill site is in Snoar village and access road is in Trapeang village).
- The site is in rural area and far from town. There is no house near the site. (2 small farming hose houses or cottages/ looking farm are near the site is on the north part)
- The Anlong Thlok Stream or Bos Makak Stream is located about 0.5 km on the north of landfill site
- All the local agencies and commune authority are supported this selected site for control landfill in Stueng Sean town. This landfill will provide for waste collection from Kampong Svay district and Prasath Ballang district too.

Conclusion

Generally, the landfill site section can be accepted in Kampong Thom province for building the control landfill in Stueng Sean town. But only water sources (Or Bos Makak Tream) is located on the north and downstream of site, should be considered.

- The MoE team commented, we can use this proposed landfill site, but for protection the impact on water sources.
- The cells of control landfill (dumping waste) should be located on the south of this proposed site as much as possible to far from water sources (Or Bos Makak).
- Provide proper protection the impact on surface water and ground water quality.
- Provide tree planting around the landfill site and green park/space in landfill site for mitigate the odor.
- Ensure the leaching wastewater and run off from landfill is not discharge or flow outside.
- The MoE team will submit site report to leader and MoE will issues official comment letter to MPWT/PMU.

Appendix 1: List of Participants

No	Name	Sex	Institution	Position	Phone
1	Duong Samkeat	M	IEA Department, MoE	Deputy director	012 880 240

No	Name	Sex	Institution	Position	Phone
2	So Kunthy	M	--	Vice chief office	011 646 264
3	Yav Deth	M	--	Vice chief office	092 664 097
4	Souch Narun	M	--	Vice chief office	097 797 007
5	Chhum Tola	M	PDPWT	Director of PIU	012 971 317
6	Yin Nguok	M	PDPWT	Deputy director	012 610 279
7	Chhuoy Kosal	M	Stueng Seam Town	Deputy governor	012860 103
8	Aong Buntheun	M	PDoE	Deputy department	012 583 467
9	Pou Manith	M	MPWT/PMU	Deputy department	012 803 203
10	Sras Sarun	M	PDPWT	PIU staff	089 813 383
11	Ouch Vanny	M	Trapeang Russey commune	Commune leader	092 911 664
12	Yim Chamnan	M	PMC	NES	012 945 546
13	Khen Seyla	F	SBK Team	Environment	069 545 523

Appendix 2: Pictures

Site visit on Landfill site in Trapeang Russey commune. The existing condition of vegetation in landfill site	
	
The water sources (Or Anlong Thork Stream) is downstream of the landfill site	
	
Consultation meeting with local agencies at PDPWT meeting room.	

Annex 5: COVID Prevention and Mitigation Measures

1. Prevention Measures

Below is a checklist for prevention measures.

N.o	Preventing measures to COVID-19, some measures are needed to be implemented as below:	Yes	No
1	Dissemination about COVID-19 prevention and mitigation measures to staff and workers through orientation or distributing leaflet/poster at information/safety board at each construction and camp site;		
2	Daily checking temperature of staff and workers prior starting the works;		
3	Staff and workers have to wear masks all the time and properly;		
4	Do not share personal items or supplies such as phones, pens, notebooks, tools, etc.;		
5	Avoid common physical greetings, such as handshakes;		
6	Maintain a minimum physical distance of one metre from others if possible;		
7	Wash hands often with soap and water for at least 20 seconds after using the washroom, before handling food, after blowing nose, coughing, or sneezing, and before smoking. If hands are not visibly soiled, and soap and water are unavailable, alcohol-based hand sanitizer can be used;		
8	All offices and jobsites implement additional cleaning measures of common areas. All door handles, railings, ladders, switches, controls, eating surfaces, shared tools and equipment, taps, toilets, and personal workstation areas are wiped down at least twice a day with a disinfectant, such as disinfectant wipes. Individuals are responsible for cleaning and disinfecting their workstations;		
9	Commonly touched surfaces on vehicles and equipment are thoroughly cleaned and disinfected at the end of shifts and between users;		
10	Coughing or sneezing into a tissue or the bend of your arm, not your hand; And dispose of any tissues you have used as soon as possible in a lined waste basket and wash your hands afterwards;		
11	Complying with any instructions announced by Ministry of Health accordingly		

Response measures: Possible cases of COVID-19

Below is a checklist for prevention measures:

N.o	Responding measures if there is a COVID-19 case, some measures are needed to be implemented as below:	Yes	No
1	Individuals who have been potentially exposed to the virus, or who are exhibiting flu-like symptoms such as fever, tiredness, coughing, or congestion are instructed to: ▪ Not come to work; ▪ Contact their supervisor and/or human resources department; ▪ Stay at home and self-isolate; and ▪ Contact local health authorities for further direction.		
2	Such individuals are required to follow the directions of the local health authority and may not return to work until given approval by the proper health authorities;		
3	Individual who begin to display flu-like symptoms on site are instructed to avoid touching anything, take extra care to contain coughs and sneezes, and return home immediately to undergo self-isolation as directed by the local health authority;		
4	All areas on site potentially infected by a confirmed or probable case are barricaded to keep individuals two meters away until the area is properly cleaned and disinfectted.		

Note: Additional COVID-19-related checklist/form, please go to this link:

http://www.cdcmoh.gov.kh/resource-documents/covid-19-documents/494-2019-ncov-documents-management

Annex 6: Ecological resources

Forest / Vegetation Resources

The existing vegetation species are in subproject area

No.	Types of Plant	Scientific Name	Species
Forest or Wood Rank.1			
1	Krakah	*Sindora cochinchinensis, Baill.*	Caesalpiniaceae
2	Trasek	*Peltophorum dasyrrhachis Kurz, var*	Caesalpiniaceae
3	Porpel	*Shorea roxburgshii, G.Don.*	Dipterocarpaceae
Forest or Wood Rank.2			
4	Tbaeng	*Dipterocarpus obtusifolius, Teysm.*	Dipterocarpaceae
5	Trarch	*Dipterocarpus intricatus*	Dipterocarpaceae
Forest or Wood Out off Rank			
6	Kontout Prey	*Phyllanthus emblica*	Euphobiaceae
7	Trorbaek Prey	*Lagerstroemia floribunda*	Lythraceae
8	Jompus Tea	*Cyanotis cristata*	Commelinaceae
9	Sombok Mourn	*Barringtonia angusta*	Lecythidaceae
10	Romdoul Si Plae	*Goniothalamus repevensis*	Annonaceae
11	Dangkeab Kdaam	*Antidesma ghaesembilla*	Euphorbiaceae
12	A'hoa	*Diospyros ehretioides*	Ebenaceae
13	Nhenh	*Melastoma sanguineum*	Melastomaceae
14	Khlong	*Ternstroemia penangiana*	Theaceae
15	Anchaanh	*Gmelina asiatica*	Verbenaceae
16	Angkunh Sva	*Bauhinia bassacensis*	Leguminosae
17	Trormung Sek	*Suregada multiflorum*	Euphorbiaceae
18	Rorkar	*Bombax ceiba*	Bombacacea
19	Srorm Dav	*Oroxylum indicurn*	Bignoniaceae
20	Phluu	*Cyclea peltata*	Menispermaceae
21	Tuntrean Khaet	*Chromolaena odorata*	Compositae
22	Bonla S'et	*Acacia concinna*	Leguminosae
23	Voal Meas	*Cassytha filiformis*	Lauraceae
24	Voal Snaeng Ko	*Streptocaulon juventas*	Asclepiadaceae
25	Voal Chhuy	*Steptocaulon juventas*	Asclepiadaceae
26	Voal Sav Mao	*Passiflora foetida*	Passifloraceae
27	Pdao Preah	*Korthalsia bejaudii*	Palmae
28	Ruessey Prech	*Arundinaria pusilla*	Gramineae

Source: IESIA Report SBK November 202

Wildlife (Bird)

Bird Species in subproject area

No.	Khmer Name (Local Name)	(English Name)	(Scientific Name)	CITES	IUCN RedList
1	Krouch Inn	Indochinese Bushlark	*Mirafra marionae*		LC
2	Klaeng Sraak	Barn Barn-Owl	*Tyto alba*	II	LC
3	Trajeak Kam Kontuy Chhek	Fork-tailed Swift	*Apus pacificus*		LC
4	Sek Aat	Blossom-headed Parakeet	*Psittacula roseata*	II	NT
5	Kok Kruong Toch	Little Egret	*Egretta garzetta*		LC
6	Kok Kruong Mo Chhum	Intermediate Egret	*Ardea intermedia*	III	LC
7	Chharb Ptaes	Eurasian Tree Sparrow	*Passer montanus*		LC
8	Teav Kheav	Indian Roller	*Coracias benghalensis*		LC
9	Reek	Common Myna	*Acridotheres tristis*		LC
10	Lor Lork Toch	Peaceful Dove	*Geopelia striata*		LC
11	Lor Lork Traeng	Red Collared Dove	*Streptopelia tranquebarica*		LC
12	Lor Lork Bay	Spotted Dove	*Spilopelia chinensis*		LC
13	Lor Lork Bay Thom	Oriental Turtle Dove	*Streptopelia orientalis*		LC
14	L'oudh Thom	Greater Coucal	*Centropus sinensis*		LC
15	L'oudh Sbov	Lesser Coucal	*Centropus bengalensis*		LC
16	Lvea Jek	Oriental Magpie Robin	*Copsychus saularis*		LC
17	Sat Jam Trapaeng	Coral-billed Ground Cockoo	*Carpococcyx renauldi*		VU
18	Krouch Inn Veal Sre	Paddyfield Pipit	*Anthus rufulus*		LC
19	Orn Tep Kmao	Black Drongo	*Dicrurus macrocercus*		LC
20	Khrouch Truung Sor	Japanese Quail	*Coturnix japonica*		NT
21	Mourn Prey	Red Junglefowl	*Gallus gallus*		LC
22	Saek Saom	Alexandrine Parakeet	*Psittacula eupatria*	II	NT
23	Kook Mtes Tum	Cinnamon Bittern	*Ixobrychus cinnamomeus*		LC
24	Kook Sambork Trapaeng	Yellow Bittern	*Ixobrychus sinensis*		LC
25	Chharb Srok	Plain-backed Sparrow	*Passer flaveolus*		LC
26	Chharb Jangkrong	Scaly-breasted Munia	*Lonchura punctulata*		LC
27	Meam Thom Kouk	Brown Wood Owl	*Strix leptogrammica*	II	LC
28	Trajeak Kam Kontuy Ksae Pi	Wire-tailed Swallow	*Hirundo smithii*		LC
29	Trajeak Kam Derm Tnoat	Asian Palm Swift	*Cypsiurus balasiensis*		LC
30	Porpul Jompus Leung	Thick-billed Green Pigeon	*Treron curvirostra*		LC
31	Preab Srok	Rock Dove	*Columba livia*	III	LC
32	Kok Ko	Cattle Egret	*Bubulcus ibis*	III	LC
33	Kok Kruong Thom	Great Egret	*Casmerodius albus*	III	LC
34	Chharb Si Ruy Veal Tumneab	Thickell's Blue-Flycatcher	*Cyornis tickelliae*		LC

No.	Khmer Name (Local Name)	(English Name)	(Scientific Name)	CITES	IUCN RedList
35	Chharb Kontuy Kontrai Sor-Kmao	Slaty-backed Forktail	*Enicurus schistaceus*		LC
36	Chharb Dountah Kumrob Krom Kontuy Kras	Radde's Warbler	*Phylloscopus schwarzi*		LC
37	Chor Jaat Toch Chung Knorng Krahom	Black-backed kingfisher	*Ceyx erithaca*		LC
38	Tah Vao Kompoy	Chestnut-winged Cuckoo	*Clamator coromandus*		LC
39	Trardev Vech Toul	Red-wattled Lapwing	*Vanellus indicus*		LC
40	Trorses Toch Kompoy Leung	Lesser Yellownape	*Picus chlorolophus*		LC
41	Sarika Keo Kbal Leung	Golden-crested Myna	*Ampeliceps coronatus*		LC
42	Sarika Keo Krabei	White-vented Myna	*Acridotheres grandis*		LC
43	Chharb Doun Tah Jenhjerm Leung	Yellow-browed Warbler	*Phylloscopus inornatus*		LC

Source: Consultation with local people. IESIA Report SBK November 2020

Wildlife Species in subproject area

No.	Khmer Name (Local Name)	(English Name)	(Scientific Name)	CITES	IUCN Red List
1	Pror Jeav	Bats	*Order CHIROPTERA*		LC
2	Tunsay Kul	Lepus peguensis	*Siamese Hare*		LC
3	Korng Hech	Maritime Striped Squirrel	*Tamiops maritimus*		LC
4	Korng Haen	Berdmore's Squirrel	*Menetes berdmorei*		LC
5	Komprok Tpoal Krahorm	Red-cheecked Squirrel	*Dremomys rufigenis*		LC

Source: Consultation with local people. IESIA Report SBK November 2020

Reptile Species in subproject area

No.	Khmer Name (Local Name)	(English Name)	(Scientific Name)	CITES	IUCN Red List
1.	Pous Vek Dombok	Indochinese Spitting Cobra	*Naja siamensis*	II	VU
2.	Pous Vek Rorneam	King Cobra	*Ophiophagus hannah*	II	VU
3.	Pous Vek Krabei	Monocle cobra	*Naja kaouthia*	II	LC
4.	Bongkouy Soun Chhbar	Garden Fence Lizard	*Calotes versicolor*		
5.	Tok Kae	Tokay Gecko	*Gekko gecko*		LC
6.	Pous Ksae Ko	Common Butterfly Lizard	*Leiolepis belliana*		LC
7.	Pous Slab Kongkep	Barron's Kukri Snake	*Oligodon barroni*		LC
8.	Tlan Toch	Burnmese Python	*Python molurus bivittatus*	II	VU
9.	Chheas Krohorm	Common Butterfly Lizard	*Leiolepis belliana*		LC
10.	Tlan Thom	Reticulated Python	*python reticulatus*	II	LC

No.	Khmer Name (Local Name)	(English Name)	(Scientific Name)	CITES	IUCN Red List
11.	Tlaen Chnoot Knorng	Common sun skink	*Eutropis multifasciata*	I	LC
12.	Tlaen Chnoot Knorng Thom	Speckled Forest Skink	*Mabuya macularia*		
13.	Bongkouy Kloun Kmao	Northern Forest Crested Lizard	*Calotes emma alticristatus*		
14.	Pous Punlaek Tnoat Khbal Uch	Barren's Kukri Snake	*Oligodon barroni*		LC
15.	Pous Kray Kloun Chrung Klei	Malayan Krait	*Bungarus candidus*		LC
16.	Pous Dey	Common Pipe snake	*Cylindrophis ruffus*		LC
17.	Pous Punleak Kheav Kontuy Krohorm	White-lipped Pit Viper	*Trimeresurus albolaris*		
18.	Pous Punleak Kheav Pnek Krohorm Thom	Big-eyed Pit-viper	*Trimeresurus macrops*		LC
19.	Pous Prey	Indochinese Ratsnake	*Pytas korros*		
20.	Pous Prey Chnoot Khbal Por Kmao	Radiated Ratsnake	*Elaphe radiata*		LC
21.	Trorkout	Common Monitor	*Varanus bengalensis*	I	LC
22.	Pous Punleak Tnoat Uch Prophes	Banded kukri Snake	*Oligodon fasciolatus*		LC
23.	Pous Prey Kbal Vaun Sor	Speckel-bellied Keelback	*Rhabdophis chrysargos*		LC

Source: Consultation with local people. IESIA Report SBK November 2020

Type of fish from fishery in landfill subproject area

No.	Khmer Name (Local Name)	English Name	*Scientific Name*	Species	IUCN Read List
1.	Trey Kompleanh Plouk	Moonligth gourmi	*Trichohodus mirolepis*	Osphronemidae	unknown
2.	Trey Kompleanh Srea	Three spot gourami	*Trichohodus trichopterus*	Osphronemidae	unknown
3.	Trey Ptouk/Trey Ros	Climbing perch	*Anabas testudineus*	Anabantidae	DD
4.	Trey Kranh	Climbing perch	*Anabas testudineus*	Anabantidae	DD
5.	Trey Kabh Chos Bay	White-line catfish	*Mystus albolineatus*	Bagridae	LC
6.	Trey Kanh Chos		*Mystus wolffi*	Bagridae	unknown
7.	Trey Chongva Ronong	Lesser double-lipped carp	*Lobocheilos melanotacnia*	Cyprinidae	unknown
8.	Trey Chongva Mol	Pale rasbora	*Rasbora aurotaenia*	Cyprinidae	LC
9.	Trey Chongva Touch		*Rasbora amplistriga*	Cyprinidae	LC
10.	Trey Chongva Touch		*Rasbora amplistriga*	Cyprinidae	LC
11.	Trey Chongva Stueng	Leaping barb	*Chela laubuca*	Cyprinidae	unknown
12.	Trey Chongva Srea		*Amblypharyngodon chulabhornae*	Cyprinidae	LC
13.	Trey Orn Deng Rueng	Walking catfish	*Clarrias bartachus*	Clarriidae	unknown
14.	Trey Orn Deng Toun	Bighead walking catfish	*Clarrias macrocephalus*	Clarriidae	unknown
15.	Trey Chlounh	Frecklefin eel	*Macrognathus maculatus*	Mastacembelidae	LC
16.	Trey Ptong	Halfbeak	*Zenarchopterus ectuntio*	Hemiramphidae	unknown
17.	Trey Slat	Bronze featherback	*Notopterus notopterus*	Notopteridae	LC

No.	Khmer Name (Local Name)	English Name	*Scientific Name*	Species	IUCN Read List
18.	Trey Chlang	Asian redtail catfish	*Hemibagrus sp. (cf.nemarus)*	Bagridae	unknown
19.	Trey Krem Kdar	Croaking gourami	*Trichopsis vittata*	Belontiidae	LC
20.	Trey Korn Trong Preang	Durkyfin glassy perchlet	*Parambassis wolffii*	Ambassidae	LC
21.	Trey Srorka Kdam Kror Horm	Beardless barb	*Cyclocheilichthys apogon*	Cyprinidae	LC
22.	Trey Chak Keang	Snail eating barb	*Puntioplites proctozysron*	Cyprinidae	unknown
23.	Kom Pues Srea		*Neocaridina Sp.*	Macrobrachium	unknown
24.	Kdam Sror Ngea	Black rice crab	*Somaniathelpusa Sp.*	Parathelphussidae	unknown
25.	Kdam Srea	Black rice crab	*Somaniathelpusa Sp.*	Parathelphussidae	unknown
26.	Kdam Krong Ngie/Kdam Krong Chhmol	Black ric crab	*Somaniathelpusa sexpunctata*	Parathelphussidae	unknown
27.	Khchoav	Aeruginose Snail	*Mekongina pongensis*	Viviparidae	unknown
28.	Khyong Krang/Khyong Kut Teal	Pila snail	*Pila scutata*	Pilidae	LC

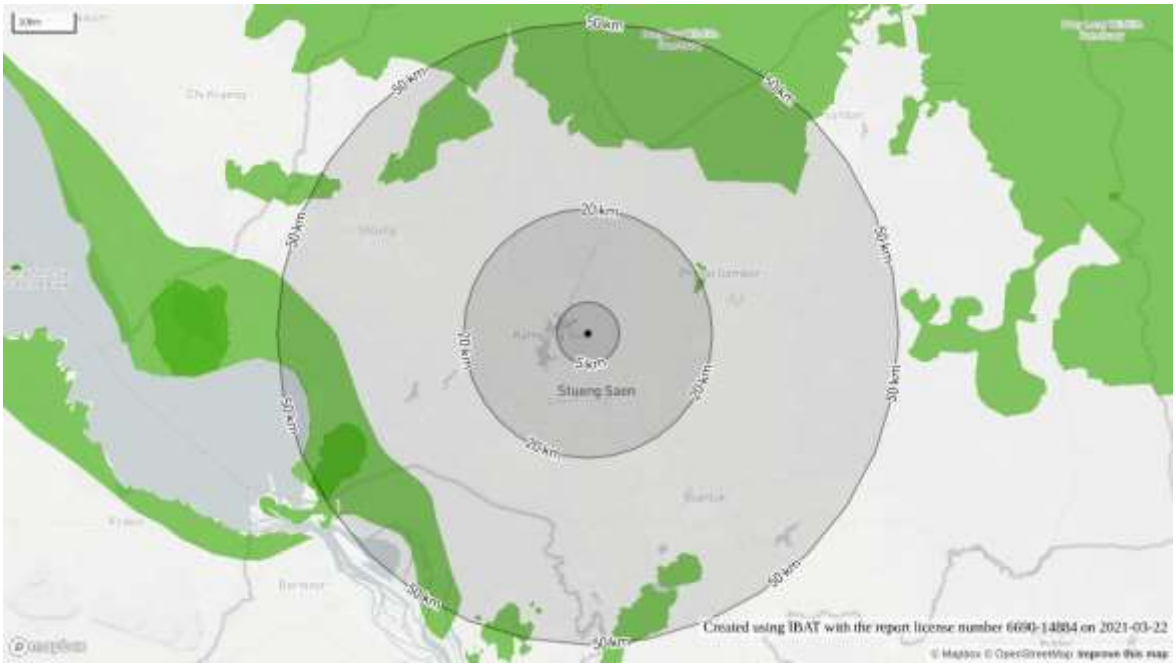
Source: Consultation with local people in Trapaeng Russey Village, Trapaeng Russey Commune. IESIA Report SBK November 2020

Annex 7: IBAT Report on Protected Areas, Key Biodiversity Areas, Ramsar Sites and UNESCO World Heritage Sites

A report on the proximity of the new landfill to protected areas and key biodiversity areas has been generated using the IBAT tools. The maps below show key biodiversity areas and protected areas within buffer distances of 5 km, 20 km and 50 km.

Key Biodiversity Areas

Protected Areas



Integrated Biodiversity Assessment Tool

PROXIMITY REPORT
STUENG SAEN LANDFILL

Country: Cambodia

Location: [12.8, 104.9]

Date of analysis: 22 March 2021 (GMT)

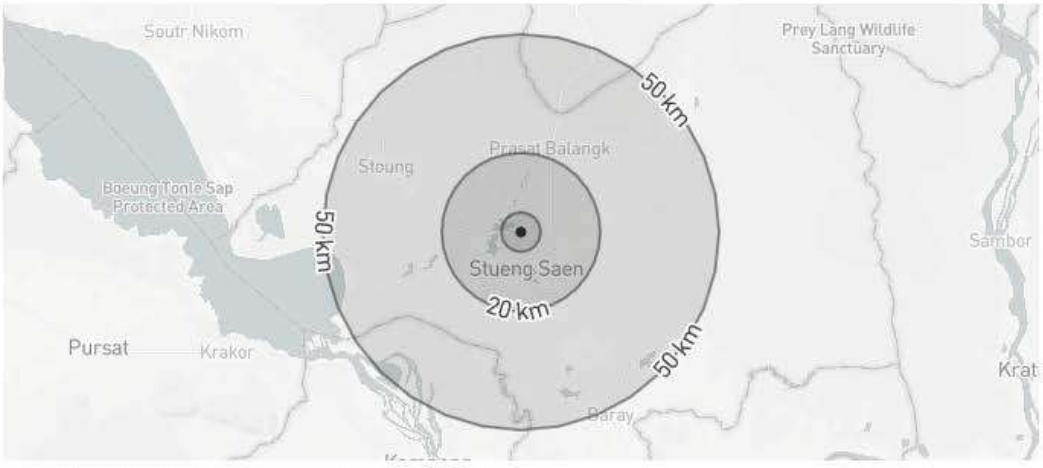
Buffers applied: 5 km | 20 km | 50 km

Generated by: Peter Gammelgaard Jensen

Organisation: ADB

Overlaps with:

Protected Areas	9
Key Biodiversity Areas	7
IUCN Red List	85



Displaying project location and buffers: 5 km, 20 km, 50 km

About this report

This report presents the results of [6690-14884] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 5 km, 20 km, 50 km.

This report is one part of a package generated by IBAT on 22 March 2021 (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.

WARNING: IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the Sensitive Data Access Restrictions Policy for the IUCN Red List. This relates to sensitive Threatened species and KBAs triggered by sensitive species.

Data used to generate this report

- UNEP-WCMC and IUCN, 2021. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - March 2021.
- BirdLife International (on behalf of the KBA Partnership), 2020. Key Biodiversity Areas - October 2020.
- IUCN, 2021. IUCN Red List of Threatened Species - January 2021.

Protected Areas

The following protected areas are found within 5 km, 20 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Within buffer of
Sambor Prey Kuk	20 km
Boeng Paer	50 km
North Tonle Sap	50 km
NorthWest Corridor	50 km
Phnom Neang Kong Rey- Phnom Touk Meas	50 km
Stung Sen Core Area (Ramsar Site)	50 km
Stung Sen Core Area (Ramsar Site)	50 km
Tonle Sap	50 km
Tonle Sap	50 km

Key Biodiversity Areas

The following key biodiversity areas are found within 5 km, 20 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance
Stung / Prasat Balang	5 km
Northern Santuk	20 km
Stung / Chi Kreng / Kampong Svay	20 km

Area name	Distance
Stung Sen / Santuk / Baray	20 km
Kampong Laeng	50 km
Lower Stung Sen	50 km
Veal Srongae	50 km

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
Pangasianodon gigas	Mekong Giant Catfish	ACTINOPTERYGII	CR	Decreasing	Freshwater
Pangasius sanitwongsei	Giant Pangasius	ACTINOPTERYGII	CR	Decreasing	Freshwater
Aquilaria crassna	Agarwood	MAGNOLIOPSIDA	CR	Decreasing	Terrestrial
Batagur affinis	Southern River Terrapin	REPTILIA	CR	Decreasing	Terrestrial, Marine, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Catlocarpio siamensis	Giant Carp	ACTINOPTERYGII	CR	Decreasing	Freshwater
Datnioides pulcher	Siamese Tiger Perch	ACTINOPTERYGII	CR	Decreasing	Freshwater
Houbaropsis bengalensis	Bengal Florican	AVES	CR	Decreasing	Terrestrial
Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
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
Laubuka caeruleostigmata	Flying Minnow	ACTINOPTERYGII	EN	Decreasing	Freshwater
Cuon alpinus	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
Cuora amboinensis	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Hylobates pileatus	Pileated Gibbon	MAMMALIA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Lutra sumatrana	Hairy-nosed Otter	MAMMALIA	EN	Decreasing	Terrestrial, Marine, Freshwater
Panthera tigris	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
Pterocarpus macrocarpus	Burma Padauk	MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Dipterocarpus retusus		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Dipterocarpus dyeri		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Hopea ferrea		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Anisoptera costata		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Dipterocarpus intricatus		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Hopea thorelii		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Vatica philastraena		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Nycticebus bengalensis	Bengal Slow Loris	MAMMALIA	EN	Decreasing	Terrestrial
Trachypithecus germaini	Indochinese Silvered Langur	MAMMALIA	EN	Decreasing	Terrestrial
Viverra megaspila	Large-spotted Civet	MAMMALIA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Fluvitrygon oxyrhyncha	Longnose Marbled Whipray	CHONDRICHTHYES	EN	Unknown	Freshwater
Pangasianodon hypophthalmus	Striped Catfish	ACTINOPTERYGII	EN	Decreasing	Freshwater
Pavo muticus	Green Peafowl	AVES	EN	Decreasing	Terrestrial
Asarcornis scutulata	White-winged Duck	AVES	EN	Decreasing	Terrestrial, Freshwater
Heliopais personatus	Masked Finfoot	AVES	EN	Decreasing	Terrestrial, Freshwater
Sterna acuticauda	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
Mycteria cinerea	Milky Stork	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
Leptoptilos dubius	Greater Adjutant	AVES	EN	Decreasing	Terrestrial, Freshwater
Calostoma insigne		AGARICOMYCETES	EN	Decreasing	Terrestrial
Bos gaurus	Gaur	MAMMALIA	VU	Decreasing	Terrestrial
Helarctos malayanus	Sun Bear	MAMMALIA	VU	Decreasing	Terrestrial
Lutrogale perspicillata	Smooth-coated Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Macaca fascicularis	Nicobar Crab-eating Macaque	MAMMALIA	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Panthera pardus	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
Pteropus lylei	Lyle's Flying Fox	MAMMALIA	VU	Decreasing	Terrestrial
Tenualosa thibaudeaui	Mekong herring	ACTINOPTERYGII	VU	Decreasing	Freshwater
Ursus thibetanus	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial
Dipterocarpus gracilis		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Hopea odorata		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Parashorea stellata	White Seraya	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Dipterocarpus alatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Shorea roxburghii	White Meranti	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Hopea pierrei		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Shorea guiso	Red Balau	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Macaca fascicularis ssp. fascicularis	Long-tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Macaca leonina	Northern Pig-tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
Rusa unicolor	Sambar	MAMMALIA	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Aonyx cinereus	Asian Small-clawed Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Wallago attu		ACTINOPTERYGII	VU	Decreasing	Freshwater
Bagarius yarrelli		ACTINOPTERYGII	VU	Decreasing	Freshwater
Osphronemus exodon	Elephant Ear Gourami	ACTINOPTERYGII	VU	Decreasing	Freshwater
Oxygaster pointoni		ACTINOPTERYGII	VU	Decreasing	Freshwater
Epalzeorhynchos munense	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
Datnioides undecimradiatus		ACTINOPTERYGII	VU	Decreasing	Freshwater
Cirrhinus microlepis	Small Scaled Mud Carp	ACTINOPTERYGII	VU	Decreasing	Freshwater
Pangasius krempfi		ACTINOPTERYGII	VU	Decreasing	Marine, Freshwater
Python bivittatus	Burmese Python	REPTILIA	VU	Decreasing	Terrestrial
Mulleripicus pulverulentus	Great Slaty Woodpecker	AVES	VU	Decreasing	Terrestrial
Buceros bicornis	Great Hornbill	AVES	VU	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Rhyticeros undulatus	Wreathed Hornbill	AVES	VU	Decreasing	Terrestrial
Carpococcyx renauldi	Coral-billed Ground-cuckoo	AVES	VU	Decreasing	Terrestrial
Columba punicea	Pale-capped Pigeon	AVES	VU	Decreasing	Terrestrial
Grus antigone	Sarus Crane	AVES	VU	Decreasing	Terrestrial, Freshwater
Sterna aurantia	River Tern	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila heliaca	Eastern Imperial Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Leptoptilos javanicus	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Acrocephalus tangorum	White-browed Reed-warbler	AVES	VU	Decreasing	Terrestrial, Freshwater
Clanga hastata	Indian Spotted Eagle	AVES	VU	Decreasing	Terrestrial
Arctonyx collaris	Greater Hog Badger	MAMMALIA	VU	Decreasing	Terrestrial
Physignathus cocincinus	Chinese Water Dragon	REPTILIA	VU	Decreasing	Terrestrial, Freshwater

Recommended citation

IBAT Proximity Report. Generated under licence 6690-14884 from the Integrated Biodiversity Assessment Tool on 22 March 2021 (GMT). 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.

Based on the IBAT Report a more detailed analyses of the landfill site in relation to protected areas and key biodiversity areas has been undertaken as summarized here below.

1) Stung Sen Core Area

Designation: UNESCO Biosphere Reserve, Core area of Tonle Sap Biosphere Reserve, and IBA Lower Stueng Saen KH019

Distance to the new landfill: 39 km southwest of the landfill

Threat assessment: Negligible

Description: The Stung Sen site is located along the south-eastern edge of the Tonle Sap Lake, and mainly comprises seasonally flooded freshwater swamp forests. Along the Stung Sen River, there are gallery forests, low-stature shrub land, inundated and submerged trees, and extensive mats of herbaceous and aquatic vegetation which provide habitat for a variety of species. The vegetation of Stung Sen is strongly influenced by the exchange of water between the Mekong River, the Stung Sen River and the Tonle Sap Lake, and the area is subject to an annual flooding cycle that makes it extremely fertile. The Site is an important spawning ground for several fish species such as Jullien's golden carp (*Probarbus jullieni*) and small-scale mud carp (*Cirrhinus microlepis*), a migratory pathway and feeding ground for waterbirds, and an important habitat for mammals. It is regionally important for supporting a number of globally threatened species such as the critically endangered Mekong giant carp (*Catlocarpio siamensis*); the endangered yellow-headed temple turtle (Heosemys annandalii) and Indochinese silvered langur (*Trachypithecus germaini*); and the vulnerable lesser adjutant (Leptoptilos javanicus) and smooth-coated otter (*Lutrogale perspicillata*).

2) Stung / Chi Kreng / Kampong Svay

Designation: KBA, IBA No KH016

Area: 52,317 ha

Distance to the new landfill: 13.7 km southwest of the landfill

Threat assessment: Negligible

Site description: The IBA comprises one of the largest remnant tracts of contiguous semi-natural grassland within the Tonle Sap inundation zone. Wet season rice is cultivated along the IBA's northern fringe adjacent to RN6. The seasonally inundated grassland supports the highest densities of breeding

Bengal Floricans *Houbaropsis bengalensis* found in Cambodia to date, and the IBA supports a highly significant population of this species. Other bird species that use the site for feeding include a number of large waterbirds dispersing from the Tonle Sap breeding colonies, including Painted Stork *Mycteria leucocephala* and Lesser Adjutant *Leptoptilos javanicus*. The IBA also supports a substantial wintering population of Manchurian Reed Warbler *Acrocephalus tangorum*, as well as small numbers of wintering Greater Spotted Eagle *Aquila clanga*.

3) Stung Prasat Balang

Designation: KBA, IBA No KH017

Area: 105,647 ha

Distance to the new landfill: 5.2 km northwest of the landfill

Threat assessment: Negligible

Site description: The IBA comprises an area of deciduous dipterocarp forest, interspersed with patches of seasonally inundated grassland, seasonal pools and streams. The IBA is one of the only currently known non-breeding areas for Bengal Florican *Houbaropsis bengalensis* in Cambodia. The species visits the site when its breeding areas in the inundation zone of Tonle Sap Lake are flooded. In addition, the wetland habitats at the IBA are used as a feeding area by a number of large waterbird species. Regionally significant species such as Woolly-necked Stork (12 birds recorded in 2002) and Asian Openbill (27 birds recorded in 2002).

4) Boeng Paer

Designation: Wildlife sanctuary

Distance to the new landfill: 30 km

Threat assessment: Negligible

Description: The Boeng Paer wildlife sanctuary is protected at national level. It hosts wild cattle and deer, large water birds and elephants, as well as important archaeological site.

5) Temple Zone of Sambor Prei Kuk, Archaeological Site of Ancient Ishanapura

Designation: UNESCO World Heritage Site

Distance to the new landfill: 17 km to northeast of the landfill

Threat assessment: Negligible

Site Description: The archaeological site of Sambor Prei Kuk, “the temple in the richness of the forest” in the Khmer language, has been identified as Ishanapura, the capital of the Chenla Empire that flourished in the late 6th and early 7th centuries AD. The property comprises more than a hundred temples, ten of which are octagonal, unique specimens of their genre in South-East Asia. Decorated sandstone elements in the site are characteristic of the pre-Angkor decorative idiom, known as the Sambor Prei Kuk Style. Some of these elements, including lintels, pediments and colonnades, are true masterpieces. The art and architecture developed here became models for other parts of the region and lay the ground for the unique Khmer style of the Angkor period.

6) Northern Santuk

Designation: KBA, IBA

Distance to the new landfill: 16.6 km southeast of the landfill

Threat assessment: Negligible

Site description: The vegetation of the IBA chiefly comprises degraded deciduous dipterocarp forest, interspersed with seasonal wetlands and patches of paddy rice cultivation. The IBA is one of the only areas

in Cambodia currently known to support non-breeding Bengal Floricans *(Houbaropsis bengalensis*), which visit the site during the wet season when their breeding areas in the inundation zone of Tonle Sap Lake are flooded. Also during the wet season, the seasonal wetlands at the IBA support a number of other globally threatened and near-threatened bird species, including Painted Stork (*Mycteria leucocephala*), Lesser Adjutant (*Leptoptilos javanicus*) and Greater Adjutant (*Leptoptilos dubius*).

7) Stung Sen / Santuk / Baray

Designation: KBA, IBA No KH021

Area: 109,081 ha

Distance to the new landfill: 16.7 km south of the landfill

Threat assessment: Negligible

Site description: The IBA is located to the south of Kampong Thom town, within the inundation zone of Tonle Sap Lake. The IBA comprises and one of the largest remnant tracts of seasonally inundated grassland within the Tonle Sap floodplain. At the height of the wet season (August-October), the whole IBA is inundated. Parts of the IBA lie within Tonle Sap Multiple Use Area, designated under the 1993 Royal Decree on Protected Areas, and Tonle Sap Biosphere Reserve. The IBA is a very important breeding site for Bengal Florican *Houbaropsis bengalensis*. A number of non-breeding waterbirds visit the site, including adjutants *Leptoptilos spp*., Painted Stork *Mycteria leucocephala* and Asian Openbill *Anastomus oscitans*. In addition, the IBA supports a substantial wintering population of Manchurian Reed Warbler *Acrocephalus tangorum*. Non-bird biodiversity includes Long-tailed Macaque (*Macaca fascicularis*), and Silvered Langur (*Semnopithecus cristatus*).

8) Veal Srongae

Designation: KBA, IBA No KH020

Area: 5,467 ha

Distance to the new landfill: 29 km

Threat assessment: Negligible

Site description: The IBA is an area of seasonally inundated grassland located within the inundation zone of Tonle Sap Lake. The seasonally inundated grassland is surrounded by dense tall scrub and swamp forest and there are numerous seasonal pools and lakes. The southern part of the IBA is situated within Tonle Sap Multiple Use Area of the Tonle Sap Biosphere Reserve. During the dry season, the IBA supports a breeding population of Bengal Florican *Houbaropsis bengalensis* and the IBA is visited by a number of non-breeding large waterbirds, including Painted Stork *Mycteria leucocephala*, Asian Openbill *Anastomus oscitans*, Lesser Adjutant *Leptoptilos javanicus* and Greater Adjutant *L. dubius*. Other regionally significant species occur at the site such as Grey Heron, Great Egret, Little Cormorant, Brahminy Kite and Asian Openbill. Non-bird biodiversity includes Long-tailed Macaque (*Macaca fascicularis*) and Silvered Langur (*Semnopithecus cristatus*).

9) Assessment

Six out of the identified 8 sites that are located within a distance of 50 km are more than 15 km from the landfill site, and the two remaining sites are 5-12 km from the landfill. There is therefore no direct disturbance of biodiversity in these areas. The construction and operation of the landfill will not cause nor contribute to any increase in illegal wildlife hunting, harvesting of biological resources or encroachment in these areas. The landfill is practically a zero-discharge facility and any occasional loud noise from the landfill would due to the distance be completely attenuated.

Sources:

BirdLife International (2021) Important Bird Areas factsheets downloaded from http://www.birdlife.org on 22/03/2021.

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