Initial Environmental Examination

Project No. XXXX
September 2014

CAM: Integrated Urban Environmental Management in the Tonle Sap Basin Project - Pursat Urban Area Environmental Improvements

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

Currency Equivalent
(Official exchange rate of the National Bank of Cambodia as of 26 March 2014)

Currency Unit	-	Riel (KHR)
USD 1.00	=	KHR 4,015
USD 0.000249	=	KHR 1.00

Abbreviations

ADB	Asian Development Bank
AP	affected person
C-EMP	Contractor's Environmental Management Plan
DPWT	Department of Public Works and Transport
EIA	environmental impact assessment
EIAR	environmental impact assessment report
EMP	environmental management plan
EMR	environmental monitoring report
ESS	environmental safeguard staff
GRM	grievance redress mechanism
IEC	information, education and communication
IEE	initial environmental examination
IEIA	initial environmental impact assessment
GoC	Government of Cambodia
HH/HHs	household/s
KHR	Cambodian Riel
MoE	Ministry of Environment
MPWT	Ministry of Public Works and Transport
MRC	Mekong River Commission
O&M	operation and maintenance
PDoE	Provincial Department of Environment
PMIS	project management and implementation support
PIU	project implementation unit
PMU	project management unit
PSC	project steering committee
USD	United States Dollar
WHO	World Health Organization
WWTP	wastewater treatment plant

Weights and Measures

C	-	Celsius/centigrade
dBA	-	decibel audible
ha	-	hectare/s
km		kilometer/s
km^2		square kilometer/s
kph		kilometer/s per hour
m		meter/s
m^3		cubic meter/s
masl		meter/s above sea level
mg/l		milligram/s per liter
mm		millimeter/s
ppsk		person/s per square kilometer
tpd		tonnes per day

NOTES

In the report, "$" refers to US dollars, unless otherwise stated.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff and may be preliminary in nature. The IEE and its environmental management plans will be updated during project implementation.

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

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I. EXECUTIVE SUMMARY

A. Purpose of the Report

1. This report gives an account of the initial environmental examination (IEE) of the proposed subprojects under the Pursat Urban Area Environmental Improvements Output of the Integrated Urban Environmental Management in the Tonle Sap Basin Project. The IEE was conducted as part of the project preparation primarily to: (i) identify and assess potential impacts arising from the implementation of the proposed Pursat Subprojects on the physical, biological, socio-economic and physical cultural environment; and (ii) recommend measures to avoid, mitigate, and compensate for adverse impacts. The IEE was carried out following the Safeguard Policy Statement (2009) of the Asian Development Bank (ADB) and with reference to the Law on Environmental Protection and Natural Resource Management (1996), Sub-decree on EIA Process (1999) and Declaration on General Guideline for Initial Environmental Impact Assessment (IEIA) and Environmental Impact Assessment (EIA) Reports (2009) of the Government of Cambodia. Several relevant reports/documents, sites reconnaissance, and consultations with communities and relevant government agencies have provided bases to the IEE.

B. Integrated Urban Environmental Management in the Tonle Sap Basin Project

2. The Integrated Urban Environmental Management in the Tonle Sap Basin Project (or, "Project") will contribute to the increased economic activities and environmental protection in towns around the Tonle Sap Basin. It responds to the need of the municipal governments for integrated urban environmental management in urban areas around the Tonle Sap. The project will improve urban services and enhance climate change resilience in Kampong Chhnang (KCH) and Pursat (PST) municipalities through urban area environmental improvements; community mobilization and environmental improvements; strengthened sector coordination and operations; and strengthened capacity for project implementation, and operations and maintenance (O&M).[1] The project follows the Tonle Sap Urban Areas Development Framework (TSUADF) and KCH and PST urban development strategies to 2030.[2]

3. It will have five outputs:
   - Output 1: Kampong Chhnang Urban Area Environmental Improvements
   - Output 2: Pursat Urban Area Environmental Improvements
   - Output 3: Community Mobilization and Environmental Improvements
   - Output 4: Strengthened Sector Coordination and Operations
   - Output 5: Strengthened Capacity for Project Implementation, Operation and Maintenance

4. The Ministry of Public Works and Transport (MPWT) is the executing agency of the Project. The Project Management Unit (PMU) of the MPWT will be the implementing agency. Project Implementation Units (PIUs) will be set up in each town to manage subproject implementation.

C. Pursat Urban Area Environmental Improvements

[1] The Asian Development Bank (ADB) provided project preparatory technical assistance. ADB. 2011. *Technical Assistance to the Kingdom of Cambodia for Preparing the Integrated Urban Environmental Management in the Tonle Sap Basin Project.* Manila. (TA 7986-CAM, $700,000, approved on 13 December 2011).

[2] An inter-ministerial prakas for the TSUADF is pending. Urban strategies approved on 31 July 2014 (MPWT Letter No. 009 PMU/MPWT/IEUMTB/14/30 July 2014 for KCH and No. 008 PMU/MPWT/IUEMTB/14/30 July 2014 for PST).

5. Pursat Town will benefit from the proposed investment to deliver Outputs 2, 3, 4 and 5 above. The subprojects for Pursat Urban Area Environmental Improvements are the subject of this IEE:

- Riverbank protection, improving a section of the embankment and stabilizing the embankment in two locations upstream
- Drainage system improvements, installing sewer pipes and constructing a pumping station and wastewater stabilization ponds; and
- Solid waste management, developing a controlled landfill, providing collection and landfill equipment, and remediating open dumps.

D. Summary of Impacts and Mitigation Measures

6. **Positive Impacts and Environmental Benefits**. When completed, the subprojects will bring about the following benefits, impacts and outcomes:

- Riverbank protection: (i) the benefit of a protected riverbank; (ii) relief from flooding from embankment failure, reduced embankment erosion and river sedimentation, reduced health and safety risks, and safe mobility/access during heavy rains or storms, as positive impacts; and (iii) safe, climate change-resilient communities/town as outcome.
- Drainage system improvements: (i) the benefit of improved storm- and wastewater management in the town center; (ii) relief from flooding, improved sanitation, reduced health and safety risks, and improved and safe mobility/access during heavy rains or storms, as positive impacts; and (iii) improved urban environment and safe and climate change-resilient communities/town as outcomes.
- Solid waste management: (i) the benefit of improved solid waste collection and disposal; (ii) reduced/potentially eliminated open and indiscriminate dumping and burning of solid wastes and relief from associated issues, e.g., fumes/uncontrolled gas emissions, odor, nuisance, water contamination and health and safety risks, as positive impacts; and (iii) improved urban environment and safe communities/town as the outcomes.

7. Overall, the subprojects will bring about improved urban environment and climate change-resilience, significantly contributing to a qualitative improvement in the lives of Pursat Town residents.

8. **Relative to Siting, Planning and Design**. The screening process revealed the following salient siting concerns: (i) sensitiveness of the Pursat River and its resources to impacts during construction, and in case of embankment failure during operation; (ii) urban development and settlements in the town center will be impacted on during drainage system improvements and embankment protection works; (iii) site of the existing non-functioning wastewater treatment plant (WWTP) is waterlogged during the rainy season; (iv) existing utility lines and crossing drains within the road rights-of-way in the town center that should be considered in design and during construction of drainage system improvements; and (v) conditions of access roads to the sites that will be subject to pressures from use by construction vehicles and equipment during construction and from use by waste collection trucks during operation of the controlled landfill.

9. Relative to design, the salient concerns would be the inadequate consideration/incorporation in the respective designs of the above-mentioned siting concerns and the following, among others:

- for the embankment protection works: (i) climate change and its impact on the hydrology of Pursat River; and (ii) capability of the operating institution for maintenance and repair;

- for the drainage system improvement works: (i) climate change and its impact on the stormwater runoff that will be combined with wastewater, and on wastewater treatment; (ii) sensitiveness of groundwater and soil in the WWTP vicinity, and (iii) capability of the operating institution for efficient operation, maintenance and repair (OM&R);
- for the controlled landfill: (i) climate change and its impacts on landfill operations, (ii) sensitiveness/vulnerability of the soil and groundwater in the vicinity, (iii) closure plan to restore (or at least mitigate the disturbance to and blend with) the landscape, (iv) adaptation measures for access and internal roads, water supply and buffer area; (v) capability of the operating institution to sustain an effective OM&R, and (vi) remediation plan for the dump sites;
- demand for, and availability of and sources for, fine and coarse aggregates;
- vulnerability to damages during natural hazard events; and
- existing utility lines and infrastructures in the sites.

10. In the preparation of the feasibility study and this IEE, some of the measures taken to minimize the subprojects' environmental and social impacts include, among others:

- The subprojects were prepared within a highly consultative and participatory process through workshops, socio-economic survey (SES) and focus group discussions.
- The IEE has incorporated the existing socio-economic and environmental conditions, issues and concerns raised in the SES.
- A resettlement plan has been formulated in a highly consultative, participatory manner.
- Preliminary design for the embankment protection has studied and/or considered: (i) Pursat River's hydrology and how it has been/is/going to be impacted on by climate change; (ii) existing barrages and past, ongoing and proposed relevant interventions; and (iii) existing settlements on top of the embankment and avoided involuntary resettlement.
- Preliminary design for the drainage system improvements has: (i) considered climate change impacts on stormwater flows in the Town center and on wastewater treatment; (ii) specified adaptation options such as the upgraded design and fabrication standards for the reinforced concrete (RC) sewer pipes and parts, design standard for the cushion base, and the cement material for the RC pipes; and (iii) considered the potential inadequate capability of the operating institution for OM&R.
- Preliminary design for the controlled landfill has: (i) included the appropriate leachate and gas management strategy and clay liner to protect groundwater and soil; (ii) recommended for a hydro-geological investigation during detailed design; (iii) considered climate change issues; (iv) proposed for the upgrade of the access road; (v) proposed for the greening of completed/capped waste cells and landscaping of the site; and (vi) recommended the institutional set-up for operations and its training.
- The proposed remediation of open dumps has considered the protection of the groundwater and soil, climate change issues, greening of completed/capped waste cells; and dealing with existing fumes and open burning as a priority.

11. **During Construction.** The identified direct impacts with potential moderate to high significance are: (i) dust and noise; (ii) potential soil erosion during embankment works and impacts on the Pursat River and its resources; (iv) temporary disturbance to the landscape; (v) impacts on vegetation beyond the subprojects' footprints; (vi) impacts on the socio-economic environment and resources from traffic, blocked/constricted accesses, accidental damages of utility lines and damages from use of existing access roads; and (vii) health and safety hazards. Potential indirect, induced and cumulative impacts are discussed in Section

V-F. A detailed set of mitigation measures are presented in the Environmental Management Plans (EMPs) in **Annexes F, G** and **H**.

12. **During Operation.** Direct impacts will mainly relate to the operation of the waste stabilization ponds (WSPs) and controlled landfill. In the operations of all subprojects, unsustained effectiveness of their services will result from inefficient operations, maintenance and repair. Potential salient impacts from the operation of the WSPs include: (i) odor and gas emissions, pests from ineffective treatment process; (ii) groundwater and soil contamination from overflow of untreated or inadequately treated wastewater and/or seepage of untreated wastewater due to ineffective liners or unattended cracked liners; and (iii) health and safety hazards of WSP workers.

13. The anticipated salient concerns from controlled landfill operations include: (i) air pollution from dust, gas, fumes and odor ; (ii) ground water and soil contamination from leachate and gas migration; (iii) impact on the landscape; (iv) pests/rodents/vermin, attraction of birds & stray animals; (vi) wind-blown litters; (vii) fire/explosion; (viii) health and safety hazards of, & nuisance for, community along the access road; and (ix) workers health and safety hazards. Inefficiently maintained pumping station associated with the improved drainage system would generate higher noise level, a health hazard to workers. Deferred repair of the pumping station would cause overflow of the WSPs. The anticipated salient concerns from the operation of the improved waste collection fleet and equipment include: (i) leachate drippings during collection, temporary storage in hook lift bins and haulage; (ii) odor, flies and pests at hook lift bins and their stations, pushcarts, open tipping trucks from lack of keeping the premises and equipment clean; and (iii) mud spread with fleet movement to and from the landfill.

14. Potential indirect, induced and cumulative impacts are discussed in Section V-F. A detailed set of mitigation measures are presented in the EMPs in **Annexes F, G** and **H**.

E. Information Disclosure, Consultation and Participation

15. The process in engaging stakeholders and affected people involved workshops, household socio-economic survey and safeguards-specific consultations. Workshops, which had the active involvement of representatives from national ministries and agencies, the six provinces and six municipalities, were held in April and June 2013 to obtain stakeholders agreement/confirmation on several aspects of project preparation. A Socio-Economic Survey (SES) was conducted on 19-22 July 2013. Environmental safeguard-specific consultations included: (i) formal discussions/meetings with relevant government institutions; (ii) some brief informal interviews with randomly picked relevant persons during site visits; and (iii) an environmental safeguard public meeting held on 24 October 2013 at the Peal Gnaek Pagoda, Pursat Municipality. **Annex E**

16. Stakeholder consultations will continue through subprojects implementation and operation. The PMU, PIU Contractors and/or Operators will inform the public on matters concerning the progress of the subprojects, adverse impacts, mitigation measures and environmental monitoring and grievances. To date, information have been disclosed during the environmental safeguard public meeting on 24 October 2013 at the Peal Gnaek Pagoda, Pursat Municipality: (i) Subproject descriptions, locations and components; (ii) environmental benefits, positive impacts and outcomes; (iv) potential salient environmental impacts and mitigation measures during construction and operation; (v) environmental monitoring that is open to community participation; (vi) general features of the proposed grievance redress mechanism; and (vii) status of compliance with GoC and ADB safeguards requirements. The IEE (in both English and Khmer), and the MoE-approved IEIA/EIA Reports (in Khmer), will be available at the PMU and PIU offices for consultation by stakeholders. Copies may

be made available upon request. The IEE and environmental monitoring reports will be disclosed on the websites of the ADB and MPWT/PMU.

F. Grievance Redress Mechanism

17. The MPWT, as executing agency of the Project will establish the project-specific grievance redress mechanism (GRM). The GRM will accommodate both informally- and formally-lodged, but project-related, grievances. Informally, an affected person (AP) can lodge a complaint directly to the Contractor during construction or the Operator during operation. Formally, the AP can lodge a complaint with the PIU, village or sangkat resettlement sub-committee, or IRC working group. the formal GRM approach comprises of four stages. In the first stage, the complaint is dealt with at the subproject-level by the: (i) PIU for environmental complaints; or (ii) village or sangkat resettlement sub-committee or IRC working group for social complaints. In the second, third and fourth stages, complaint can be raised to the District Office, Provincial Grievance Redress Committee, and Provincial Court, respectively.

G. Environmental Management Plan

18. The EMPs for each subproject have been formulated and are featured herein as **Annexes G, H** and **I.** The EMPs will be updated by the Project Management Unit (PMU) based on the detailed design, with technical assistance from the Environmental Specialists of the Project Management and Implementation Support (PMIS) Team that will be engaged under the Project's Output 5. EMPs will be implemented by the PMU, PIU, Detailed Design Consultants, Contractors for civil works, and the Operators of completed works. The marginal costs for implementing the EMPs are initially estimated to involve:

- USD 6,040 (or KHR 24.25 million) for securing approved IEIA/EIA Report;
- USD 49,400 (or KHR 198.3 million) of fixed costs to cover environmental monitoring prior to, and during, construction; and
- USD 36,700 (or KHR 147.5 million) annually for environmental monitoring during operation of the waste stabilization pond.

19. The estimated costs: (i) include taxes and contingencies for deficiencies in assumed unit costs, but exclude inflation; (ii) exclude the salaries of the ESS and his/her counterpart in the PIU, as they will be existing MPWT and DPWT staff seconded to the PMU and PIU, respectively; (iii) exclude the cost of USD 84,350 for technical assistance from, and "hands-on" training" by, Environmental Specialists that will be part of the PMIS Team for the both of Kampong Chhnang and Pursat Towns.

H. Conclusion

20. The IEE concludes that the proposed subprojects in Pursat Town are not environmentally critical. Except for the Embankment Protection on Pursat River, which by the nature of its intervention will be undertaken on the banks of the Pursat River, the two other subprojects are not within or adjacent to environmentally sensitive areas. With adequate mitigation measures, impacts will have lower significance.

21. The few impacts of high magnitude (without mitigation) will not be unprecedented and distinct. The extent of adverse impacts is expected to be local, confined within the subprojects' immediate and/or main areas of influence. With mitigation measures in place and ensuring that the bulk of works are completed (or at least almost complete) prior to the onset of the rainy season, the potential adverse impacts during construction would be highly/more site-specific.

22. The few adverse impacts of high significance during construction will be temporary and short-term (i.e., most likely to occur only during peak construction period). These will not be sufficient to threaten or weaken the surrounding resources. The preparation and implementation of a C-EMP that would address as minimum the requirements of the SPS-compliant subproject EMP will mitigate the impacts and lower their residual significance to at least "moderate" levels. . Simple/uncomplicated mitigation measures, basically integral to socially and environmentally responsible construction practices, are commonly used at construction sites in urban settings and are known to Contractors. Hence, mitigation measures would not be difficult to design and institute.

23. Direct impacts during operation will come from the wastewater treatment plant, controlled landfill, pumping station and waste collection, mainly from the first two facilities. Guided by Operation Manuals and strengthened by continuing capacity building program, wastewater treatment and controlled landfill operations are not expected to have long-term, persistent, permanent/irreversible adverse impact on human health and safety, air quality, water quality, soil quality, the biological environment, as well as the lifestyle and means of subsistence of nearest local communities. Indirect, induced and cumulative impacts during operation will be mainly positive than adverse.

24. The proposed subprojects will bring about the benefits of: (i) protected embankment on Pursat River, (ii) improved storm- and wastewater management in the town center, and (iii) improved solid waste collection and disposal. Positive impacts include: (i) relief from flooding from embankment failure and inadequate drainage system; (ii) improved sanitation with wastewater management; (iii) reduced or eradicated open and indiscriminate dumping of solid wastes and relief from associated issues, e.g., fumes and uncontrolled gas emissions, odor and nuisance, contamination of water resource and clogging of drains/sewers; and (iv) reduced health and safety risks Collectively, the subprojects will bring about improved urban environment and increased climate-change resilience, significantly contributing to a qualitative improvement in the lives of residents in Pursat Town.

25. Based on the above conclusions, although the subprojects may have some adverse environmental impacts, the preparation of an IEE would be sufficient to identify and address these impacts. No further special study or detailed EIA needs to be undertaken to comply with ADB's Safeguard Policy Statement. Under government policy, an IEIA Report for each subproject is required to start the environmental impact assessment process. The IEIA Reports will be based on this IEE.

II. POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

A. Policy and Legal Framework

26. The overarching policy on the protection of the environment and balance of abundant natural resources is set out in the 1993 Constitution of the Kingdom of Cambodia. Proceeding from, and conformable to, the Constitution, the Government of Cambodia has enacted a series of environmental laws, regulations and standards. Among these, the basic laws/policies that provide the framework within which environmental assessment is carried out in Cambodia are the:

- The Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-PKM-1296/36), enacted on 18 November 1996, requires the conduct of environmental impact assessment on every private and public project. (Articles 6 and 7)

- Sub-decree No. 72 ANRK.BK, dated 11 August 1999, the Sub-decree on EIA Process, provides the detailed guidelines for implementation of the EIA

Process. Its Annex requires the conduct of IEIA/EIA on the following activities under the Project: (i) waste processing, burning activities, all sizes; (ii) wastewater treatment plants, all sizes; and (iii) drainage systems, >5,000 ha. The Sub-decree has no stipulations on environmental assessment requirements for flood protection dykes, riverbank protection and local roads.

- Declaration on General Guideline for Preparing Initial Environmental Impact Assessment (IEIA) and EIA Report, a declaration issued by the Ministry of Environment in 2009, specifying the basic contents of IEIA/EIA Reports to 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 recommendation.

- Declaration on the Delegation of Power of Decision-Making on Project Development to the Provincial Department of Environment, 2005, providing for the PDoE to be the reviewing and approving authority of IEIA/EIA reports of projects costing below USD 2 Million.

- Joint Declaration between the MEF) and the MoE on the Determination of Service Fee for EIA Reviewing and Monitoring, 2012, specifying five levels of fee with a minimum of USD 500 and a maximum of USD 1,750.

27. Other laws, regulations and guidelines that provide general context/guide in the environmental assessment of subprojects are given in Table II-1. The key environmental quality standards applied in this IEE are: (i) Ambient Air Quality Standard, 2000; (ii) Maximum Standard of Noise Level Allowable in the Public and Residential Areas, 2000; (iii) Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, 1999; (iv) Water Quality Standards for Public Waters and Health, 1999; (v) Drinking Water Quality Standards, 2004; and (vi) Effluent Standard for Discharged Wastewater to Public Water Areas or Sewers, 1999, applicable also to landfills. **Annex A**

Table II-1 Other Relevant Laws, Regulations and Guidelines in Cambodia

Law/Regulation/Guideline	Year	Brief Description
Royal Decree on the Protection of Natural Areas	1993	Has classified the 23 protected areas in Cambodia into four categories, namely: (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 entertainment/ 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.
Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK)	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

Law/Regulation/Guideline	Year	Brief Description
		biodiversity are ensured. Its Annexes 2, 4 and 5 provide the industrial effluent standards, including effluent from wastewater stabilization ponds, water quality standards for public waters for the purpose of biodiversity conservation, and water quality standards for public waters and health, respectively.
Sub-decree on SW Management (Sub-decree No. 36 ANK/BK),	1999	Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity.
Sub-decree on Control of Air Pollution and Noise Disturbance (Sub-decree No. 42 ANK/BK	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).
Law on Land	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.
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 and closing/follow-up management of landfills to ensure public health and safety and environmental protection.
Law on Water Resources Management	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 MOWRAM, in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Protected Areas Law (Royal Decree No. NS/RKM/0208/007)	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. It 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

Law/Regulation/Guideline	Year	Brief Description
		& 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, e.g., destroying water quality in all forms, poisoning, using chemical substances, disposing of solid and liquid wastes into water or on land.
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 (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.

B. Administrative Framework

28. The Ministry of Environment (MoE) through its EIA Department supervises over and regulates the EIA Process. The MoE is responsible for: (i) review and approval of EIA reports in collaboration with other concerned ministries and (ii) monitors 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).

29. The Sub-Decree on EIA Process prescribes a period of 30 working days for review of IEIA report from the date of registration and another 30 working days for review of revised IEIA or EIA Report from receipt of report. If MoE fails to respond its findings and recommendations within the prescribed periods, it will be assumed that the submitted report is compliant. By virtue of MoE's Declaration on the Decentralization for Provincial Department of Environment, 2005, projects with a capital investment cost below USD 2 Million shall be reviewed and approved by the PDoE. (Table II-2)

30. From consultation with the MoE through the Deputy Director of the EIA Department, on 26 June 2013, it was learned that: [3]

- For projects comprising of subprojects, such as the IUEMTSB Project: (i) Subprojects that are mentioned in the Annex of Sub-decree No. 72 ANRK.BK, will require individual IEIA Reports; and (ii) Subprojects that are not mentioned in the Annex of Sub-decree No. 72 ANRK.BK can be covered in one IEIA Report.
- The IEEs prepared by the ADB PPTA Team, following ADB's SPS 2009, can be accepted as IEIA Reports.

31. In another consultation with the MoE Deputy Director held on 17 October 2013[4], it was pointed out that the final completion report is needed before any conclusion on requirements can be made.

[3] Consultation of PPTA National Environmental Specialist with Mr. Danh Serei, Deputy Director, EIA-MoE, on 26 June 2013.

[4] Consultation of PPTA National Environmental Specialist and ADB Mission Member with Mr. Danh Serei, Deputy Director, EIA-MoE, on 17 October 2013.

- Proponent is to undergo screening to determine the type of report to be prepared, an IEIA or EIA. Sufficient details on the subprojects will facilitate screening process. Depending on the screening results, MoE's EIA Department will: (i) recommend for individual report for each subproject or for some subprojects to be covered under one report; and (iii) determine IEIA or EIA requirement.
- For EIA Report, primary data for key receptors, social impact assessment, pre-FS Report will be required and should be in Khmer. This will be submitted by the MPWT as the official project proponent.
- Review process for IEIA is a maximum of 30 working days; for EIA, a maximum of 30 working days. However, the process could take almost a year for an EIA, including preparation, revision or additional requirements and review.

C. International Environmental Agreements

32. Cambodia is party to the following relevant international environmental agreements: (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; and (viii) Climate Change Kyoto Protocol, 2002.

33. 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 (AADMER), 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 April1995.

Table II-2 The GoC Environmental Impact Assessment Report Preparation, Appraisal, Approval and Implementation Process *

Steps in the Process	Responsible Entity
Preparation of Environmental Examination Application (EEA) & Initial Environmental Impact Assessment (IEIA) Report, and submission to the MoE together with a Pre-Feasibility Study (PFS) Report.	Project Proponent
Review of IEIA Report ▪ Review period is a maximum of 30 working days, from date of registration of IEIA Report and PFS Report. If MoE fails to respond its findings and recommendations within the prescribed period, it will be assumed that the IEIA Report is compliant. ▪ Review conclusion could either be any of the following: A. IEIA Report is approved. B. IEIA needs revision. C. An EIA Report is required.	MoE
Revision of IEIA Report or preparation of an EIA Report and submission to MoE together with a FS Report.	Project Proponent

Steps in the Process	Responsible Entity
▪ During EIA preparation, public involvement typically occurs during scoping, may also occur at any other stage in the preparation.	
Review & Approval of Revised IEIA & EIA Reports ▪ Review period is a maximum of 30 working days from receipt of revised IEIA Report or EIA Report and PFS Report. If MoE fails to respond its findings and recommendations within the prescribed period, it will be assumed that the Revised IEIA Report or EIA Report is compliant. ▪ Public involvement occurs during review.	MoE
Acknowledgement of findings & recommendations of approved IEIA &/or EIA Reports before project implementation.	Project Proponent
Implementation of approved IEIA or EIA Reports & its EMP	Project Proponent
Monitoring of project implementation if compliant with the approved IEIA or EIA Reports and its EMP.	MoE and PDoE

***** Applicable to IUEMTSB Project

III. DESCRIPTION OF THE SUBPROJECTS

A. Justification and Rationale

34. **Urbanization in Cambodia and in the Tonle Sap Basin.** Urbanization in Cambodia is taking place with minimal coordination and regulation, inadequate infrastructure and insufficient regard for the environmental impacts of development. The results include disorganized growth, inefficient land use, damage and loss of natural resources, and inadequate access to urban services. Problems are attributable to poor urban management, little strategic spatial planning, poor connectivity between urban planning and environmental management, and insufficient investment in infrastructure and community services. Urban planning and investments are needed to accommodate expanding urban populations, sustain economic growth in medium-sized cities that are moving up the value chain in terms of their production profiles and activities, and protect the environment..

35. The Tonle Sap Basin covers about one third of Cambodia. Within the Basin are six main urban centers, the capital towns of the six provinces around the Tonle Sap Lake, i.e., Kampong Chhnang, Pursat, Battambang, Serei Saophan, Siem Reap and Steung Saen. These urban centers are the focal points of economic growth in, and will be crucial to the development of, the Tonle Sap Basin as a whole. At the same time, they can have potentially adverse impacts on the Tonle Sap Lake and the environment surrounding it. The Lake's abundant resources have supported large human settlements throughout history. The Tonle Sap Basin is an important region for socio-economic development in Cambodia, but urban growth and developments over past decades have caused rapid degradation of the natural resource base that is essential for livelihood support.

36. **Pursat Town.** Pursat Town was selected as one of the two towns that the proposed Project would focus interventions on. It is situated within 25 km from the western edge of the Tonle Sap Lake, on the banks of the Pursat River. The part of the town east of National Road 5 (NR5) is situated in the "flexible transition area" of the Tonle Sap Biosphere Reserve. Government agencies of Pursat list poor environmental sanitation, i.e., a combination of flood, wastewater removal and solid waste management, as the Towns' biggest issue.

37. Flooding A major issue in Pursat is flooding. The town center lies in a depression and the natural slope of the town is away from the river. This was probably created by the training of the Pursat River and raising of embankments that have distorted the river's natural flow. There are issues with drainage and high water levels that cause annual flooding from both the Pursat River and rainfall. Flooding can last up to a few weeks. The worst affected area are the town center and along the river banks as the existing embankments are not high enough to protect the town and sandbags are required to protect roads and properties. The river level was reported as being particularly high during the last two years and damaged embankments. The embankment level is 4.90 m above datum and flood level reached 5.35 in 2011; in most years, reaches around 5.1 or 5.2 m. Hence, flood levels still overtop the embankment. The Municipality estimates that 12 km of embankment on the town side and 10 km on the other side of the river need immediate improvement to address the overtopping of the embankment, which is tending to be an annual event.

38. Pursat's topography does not lend itself to drainage and many of the natural drainage have been blocked as the town developed. Old small retention ponds have been filled in for development, reducing attenuation of storm flows. There is no properly planned drainage system. Drains have been built to alleviate some flooding. However, the issue of flooding remains and moves from one place to another. Only around 20%of the town roads have drains (NR5); while other main roads lack side drains. During heavy rains or storms, the town center floods, affecting some 80% of its resident population. Preventing flooding in Pursat town, therefore, requires combined interventions in strengthening the embankments to avoid the river flooding and improving the overall drainage system to prevent flooding during heavy rains or storms.

39. Wastewater. Designed to deal with stormwater, the existing drainage system functions as a combined sewerage system. Many of the system's manholes have household connections and receive wastewater, i.e., sullage and sewage. With large drains and shallow gradients, the velocity of the flow is low. During dry weather, with flow as mostly household wastewater, low velocity allows solids to settle and build up in the drains, blocking the flows. The accumulated solids can generate gas, particularly hydrogen sulphide (H_2S), which when mixed with water becomes acidic and can corrode the cement in the drains and cause them to fail. H_2S migration to houses is hazardous to health, safety and life. When inhaled, it can cause a range of health effects. It is also a highly flammable and explosive gas. In the absence of wastewater treatment, people are exposed to contact with raw sewage during flooding; and communities, exposed to rise in water-borne diseases. Combined interventions to resolve flooding and to manage wastewater would highly improve environmental sanitation in the town proper.

40. Solid Waste. In Pursat solid waste collection is limited and the method of final disposal is open dumping. Indiscriminately thrown solid wastes are common sights in open areas, drainage channels and water bodies. This situation has blocked the flows in the limited combined drainage system, thus contributing to flooding; and has led solid wastes to Pursat River in addition to those directly dumped onto it, thus harming the water resource.

41. Accurate waste generation data in Cambodia is very limited. No quantitative waste audits have been completed in Pursat Town to date. There is no waste data recording done on dumpsite operations as well. Based on PPTA Team's study, the town is estimated to generate 0.51 kg/person/day or 22 tpd in 2014. Based on PPTA Team's inspection, the waste stream is composed of 50-65% organic matter of which 35% is green waste, 10-15% plastic, 4-6% glass, 2-6% metal, 2-4% textiles, 1-2% wood, and 10-15 others e.g., coconut husks, disposal napkins.

42. It is further estimated that only about 30% or 10 tpd is collected daily at present. There are two dumps in Pursat, a closed dump and the currently active dump. The Toul Makak

Lech dump was commissioned in 2001 and was closed in 2004 in response to many neighborhood complaints. During the rainy season, the waste cells are under mud and water. In the dry season, some burnt wastes are exposed, but the cells are impounded with water and/or covered with regrowth. There are scattered litters in the road track access to the dump site. The existing Srah Srang dump site was commissioned in 2004. The approximately 1.5-ha land belongs to the private service provider, but reportedly will be transferred to the Municipality in 2024. Wastes have been burnt. At the time of inspection by the PPTA Team in May (dry season) there was active combustion; in August (wet season), the dump site was not burning but swarmed with flies and birds.

43. In addition to the obvious environmental damage caused by waste fires, uncontrolled burning represents a serious health and safety risk. Incomplete combustion of the various plastic types at the dump can result in the formation of carcinogenic by-products such as dioxins. These airborne pollutants are being breathed in by the truck drivers and waste pickers at the site, as well as by the farmers working in the adjacent rice fields. Odor, flies and sometimes litters from waste collection trucks are the complaints of households along the access roads. The Province, Municipality, as well as PDoE and DPWT, have expressed the priority need to improve solid waste management in the town. Augmenting the solid waste collection fleet and upgrading the method of final disposal should thus be another valuable intervention for improved urban environment in Pursat.

44. **The Integrated Urban Environmental Management in the Tonle Sap Basin Project.** By addressing the top two priority development issues and infrastructure needs of Pursat Town and building the institutional capacity of local authorities, the Project will help to improve the climate change resilience of, and flood protection and environmental sanitation in, Pursat. The Project will help develop the town to complement agricultural and industrial development and become a support center for the proliferation of the rural economy, trade, and industrial value chain development. It will promote sustainable urban development in the Tonle Sap Basin.

45. The subprojects proposed under the Project will deliver the following outputs:

46. **Output 2: Pursat Urban Area Environment Improvements** includes: (i) drainage system improvements; (ii) riverbank protection on Pursat River; and (iii) solid waste management through the development of a controlled landfill, provision of collection and landfill equipment, and remediation of the closed and existing dump sites.

47. **Output 3: Community Mobilization and Environmental Improvements** includes improved household sanitation for IDPoor 1 and 2 in the current municipality area; climate change and hygiene awareness and action; and community small-scale infrastructure improvements in pre-identified poor and vulnerable areas in each municipality. Small-scale infrastructure improvements will be prioritized by the communities and financed by the project, national government, and community.

48. **Output 4: Strengthened Sector Coordination and Operations** supports MPWT to convene national urban development task force meetings (twice per year); strengthens climate change regulations focusing on improved building codes in provincial towns around the Tonle Sap, including appropriate sanitation; and supports the establishment of pilot USUs (or special operating agencies) for improved delivery and management of decentralized urban services. **Output 5: Strengthened Capacity for Project Implementation, Operation and Maintenance** includes project implementation support services for the project management unit (PMU) and project implementation units (PIUs) in design and supervision, safeguards implementation and monitoring, gender mainstreaming, community development, accounting and financial management, procurement, disbursement, review and expansion of existing strategies (flood mitigation, stormwater

drainage, SWM, and disaster risk management), and skills enhancement and on-the-job training in urban planning and development, solid waste management, and O&M.

B. Pursat Urban Area Environmental Improvements

49. The Pursat Urban Area Environmental Improvements is the subject of this IEE. The Community Mobilization and Environmental Improvements will be subject to IEE as its activities are proposed and developed.

50. **Riverbank Protection.** The proposed embankment protection works has two components. One is to complement the ongoing works at the Provincial Governor's Office and improve the embankment at this location (Figure III-1). The other is to stabilize the embankment in two locations on the south bank upstream of the railway bridge (Figure III-2).

51. The works at the Provincial Governor's Office also aims to demonstrate improved embankment protection that can then be used as a model for future works. The 200-m section of embankment will be made of concrete, similar to the ongoing works, with the level of the top of the embankment at 16.90 masl, which provides a freeboard of around 400 mm from the previous highest flood level. However, the embankment works will also include reinforced concrete piles and geotextiles, with armor rock protection at the toe of the embankment.

52. Two areas upstream that are in danger of collapsing due to erosion will be protected by the construction of groynes. These areas have previously been protected by wooden groynes, which have been washed away. Thus, the project will place gabion groynes at 30 m intervals into the river at each of these two locations. As shown in Figure III-2, Point A will have five groynes, while Point B requires eight groynes due to its longer length.

Figure III-1 Location of Embankment Revetment (Strengthening) Works

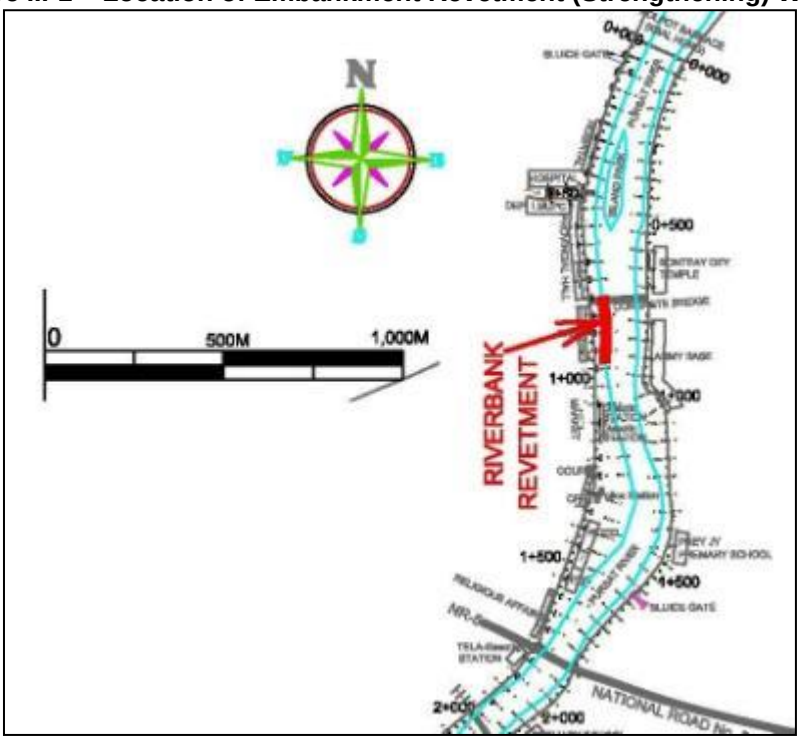
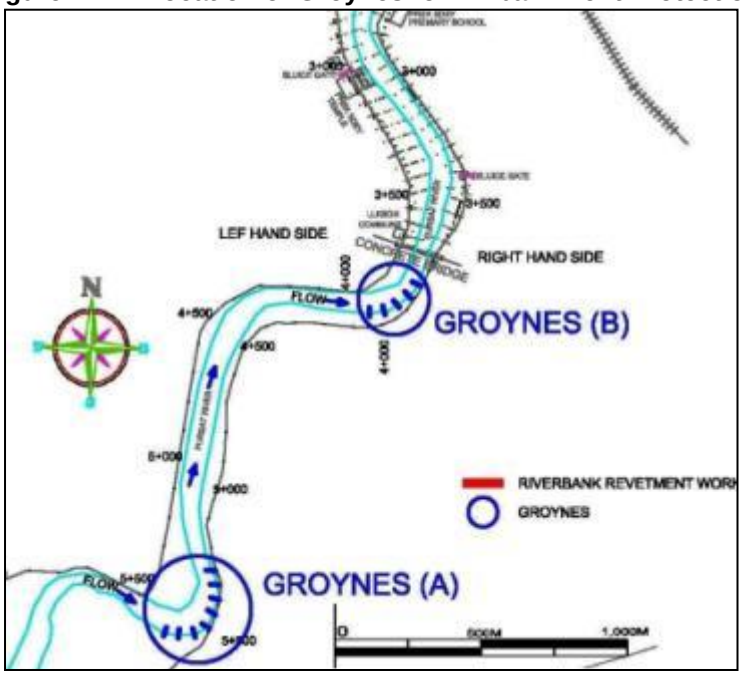


Figure III-2 Location of Groynes for Embankment Protection



53. **Drainage System Improvements.** The proposed drainage system improvements will involve the installation of 9.89 km of 600, 1,000, 1,500 and 1,750 mm diameter sewer pipes in the town center to accommodate both stormwater and household wastewater and is designed for a return period of 20 years. Adequate slopes will be maintained to ensure self-cleansing velocities are reached, i.e., adopting a gradient 1 in 500. This means that over the 2.5 km length of the longest sewer, the depth will be up to 8 m at some points, but at the outfalls the maximum depth will be 6 m and 4 m at the wastewater treatment plant (WWTP). Thus, the wastewater will be pumped from this point. To minimize pumping, three stormwater overflow structures will be constructed where the main storm drains meet an existing irrigation channel to divert excess stormwater.

54. Since there is an existing unused wastewater treatment facility, it was considered most optimal for rehabilitation. Basic treatment will be provided to the wastewater, using waste stabilization ponds (WSPs). The ponds will be preceded by preliminary treatment to screen large solids from the wastewater. Two types of pond are proposed: (i) 4-m deep anaerobic ponds, providing two-days' retention; and (ii) 1.5-m deep facultative ponds, providing 20-days' retention. The WSPs will require about 1.5 ha of the 2.2-ha site of the existing unused wastewater treatment facility. It is proposed, however, to optimize the use of the site for the development of the ponds to accommodate increases in wastewater flows and ensure a final effluent that would comply with national standards for pollutant substance discharge to public water area and sewer prescribed in Annex 2 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK), 06 April 1999 (featured as **Annex A.6** in this report). Effluent from the WSPs will discharge onto an open irrigation ditch (Kbal Hong Canal), close to the site and which connects to the Pursat River at about 1.3 km distance to the SE of the site. Based on preliminary design, the estimated BOD load of effluent from the WSPs would be 61 mg/l, which is less than 80 mg/l as prescribed in the aforementioned national standards (**Annex B**).

55. Figure III-3 illustrates the existing and proposed drainage system in the Pursat Town Center, also showing the locations of the WSPs and the open irrigation canal onto which the WSPs' effluent will be discharged. Figure III-4 presents the layout of the waste stabilization ponds. The drainage system improvement works can be implemented throughout the year.

56. **Solid Waste Management.** This subproject will: (i) develop Stage 1 of the proposed controlled landfill; (ii) procure waste collection and landfill equipment; and (iii) remediate the closed and existing dump sites.

57. The proposed controlled landfill will be developed at a site in Toul Makak Keut Village, Roleab Commune, Sampov Meas District, Pursat Municipality. The site, a government-owned land, was identified by the Municipal Government and considered optimal as it is 7 km east of the town center and about 1 km south of the NR5, far from habitation. Currently, access to the site from NR5 is through an existing road that will be upgraded under the subproject and extended to reach the landfill site proper.

Figure III-3 Layout Plan of Proposed Drainage System Improvements

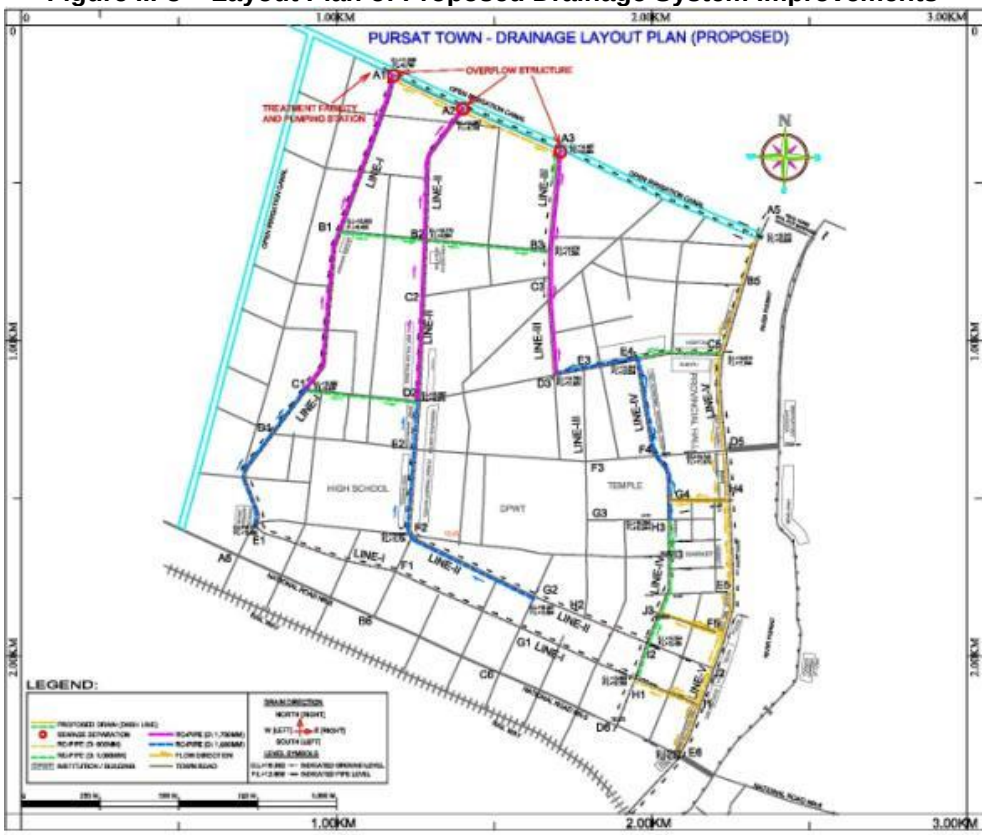
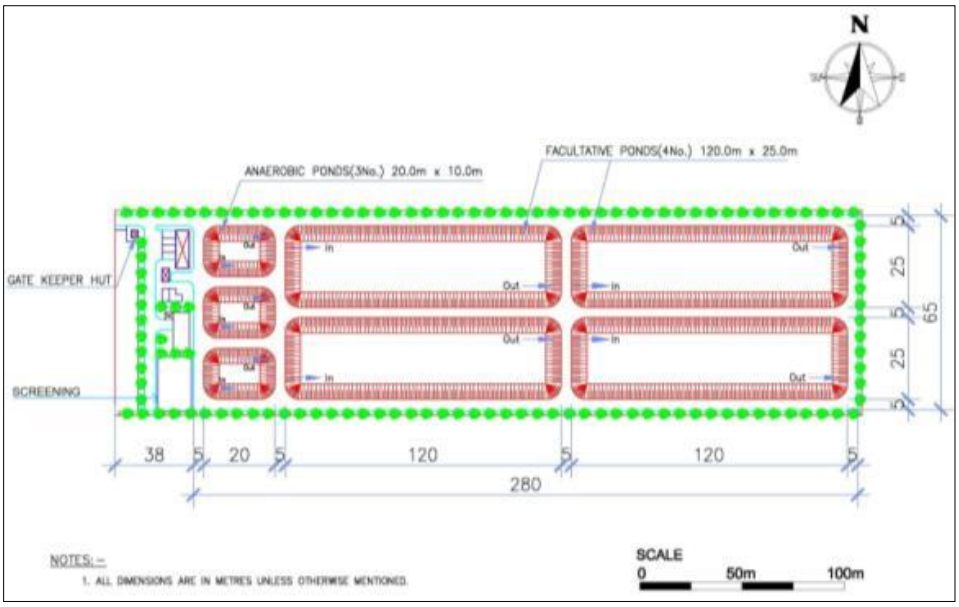


Figure III-4 Layout Plan of Waste Stabilization Ponds



58. The site consists of mainly sandy silt soil, with some areas exhibiting slight surficial cracking indicating some clay content, plasticity that is required to achieve low permeability necessary for the liner system. Local excavations indicated areas of gravel are present at depth. On the depth to water table, local landowners confirmed that wells need to be sunk to 30 m to achieve a reasonable water yield. Wells at depth of 10 m remain completely dry. Hence, it may be assumed that any excavation required in the construction of the landfill will still remain many meters above the water table as required. This will be confirmed as part of the hydrogeological assessment at detailed design.

59. The site does not have any major drainage issues. There is no water course crossing, or in close proximity to, the site. The site is reportedly free from flooding. The site is presently covered with brush and small shrubs, and surrounded by fields which are being prepared for rice paddies. Overall, the site is considered suitable for a long-term controlled landfill; provides appropriate buffers to sensitive developments; and has suitable hydrogeological profile, indicating some clay content.

60. The controlled landfill is proposed to be developed in four main stages, adopting a cell staging approach and staged development strategy (**Annex C**) that will attain a capacity sufficient for the landfill to operate for about 30 years. The four stages will occupy an area of about 6 ha, excluding any allowance for some small buildings, roads, recycling put down area and any buffers around the waste mound as shown in Figures III-5 and III-6.

61. Under the Project, only Stage 1 (one of the four stages) will be developed, providing an air space of 134,800 m3, enough for about 5 years of operation, to include:

- a 120 m by 120 m initial cell (Cell 1) of the proposed four cell system required for the 30-year development, including associated bulk earthworks and compacted clay liner system;
- the cell liner, costed as a compacted clay liner, with the clay to either be sourced on-site and reworked or imported from local clay pits;
- various buildings required, including a reception/gatekeepers hut, ablution blocks, meeting rooms, storage room, generator building, etc;
- access roads both internal and external to the site necessary to reach Cell 1
- areas to allow processing and stockpiling of recyclables;
- leachate pipe collection systems and pumping stations, together with re-injection and irrigation systems; (A leachate treatment plant is not required reducing both CAPEX and OPEX as well as operational complexity.)

- ground monitoring wells, 1 unit at each of 3 sides;
- stormwater drainage systems;
- potable and non-potable water supply; and
- ancillary works, such as landscaping, weighbridge, lighting and fencing.

62. Surface water management will include site's stormwater drainage system, ensuring effective slopes in waste cells, and providing sump pumps temporarily in the lower area of the cell to remove any impounded uncontaminated stormwater during significant rain event.

63. Leachate management will adopt the approach of minimizing generation and either re-injecting into the waste cell or irrigating/watering areas with clay liners. Leachate will be collected in the drains located in the bottom of the cells. From there, it will flow into a pumping station to allow the leachate to be returned to the top of the cell for reinjection or sprayed on the external batters (of waste cells) to encourage vegetation growth in dry weather. An area can be set aside in the site layout for future leachate treatment facilities. A leachate water balance has been completed to demonstrate that the expected leachate volume can be managed through reinjection and irrigation of previously worked cells, and future cell development areas if needed, without recourse to treatment and is presented in the Technical Appendices of the PPTA's Final Report – Solid Waste Management in Pursat. Considering climate change issues, Section 14 of the same report recommends the: (i) appropriate slopes for external batters, maintained vegetation on external batters, and appropriate sizes of peripheral drains to account for higher rainfall intensities; and (ii) a conscious plan to irrigate the vegetation on external batters during hotter and drier summers.

64. Groundwater quality will be monitored through monitoring wells that will be situated one at each of three sides, hydrogeologically upslope and downslope of the landfill cells. The volume of gas that will be produced during Stage 1, or even after the final overtopping following Cell 4 completion, is going to be too small. There is no need at this stage to make a final decision on landfill gas management. (More details, including gas generation estimates, as well as recommended gas treatment and controls that can be implemented at a later date when necessary, are presented in the same Technical Appendices mentioned above.)

65. For Stage 1 landfill operations, some 20,160 m^3 of soil cover material will be needed. This will come from the balanced cut-to-fill excavation program during cell development as described in the cell staging and staged development strategy presented in **Annex C**. One unit each of dozer, excavator, dump truck and water tank with pump will be provided for the landfill operations.

66. The following collection equipment will be procured to address the current deficiencies in waste collection: (i) two units of 20 m3 and 5 m3 compactor trucks; (ii) one unit of hook lift truck; (iii) 30 units of hook lift bins; (iv) one unit of 10-wheeler tipping dump truck; (v) two units of small motorized carts; and (vi) forty units of pushcarts.

67. The Toul Makak Lech and Srah Srang Dump Sites will be remediated on site. For the closed Toul Makak Lech Dump Site, preliminary engineering recommends only the: (i) covering of waste cells without disturbing the perimeter bunds; and (ii) installing two groundwater monitoring wells at appropriate locations (the need for these will be validated during detailed design). For the currently active Srah Srang dump site, remediation will involve extinguishing fire/s first before closure and after which closure will follow normal landfill operating procedures. **Annex D**

68. Remediation works will be undertaken by the Government simultaneously with the construction of the controlled landfill. While remediation works is designed by project

consultants, actions to arrest the intensification of present environmental issues/concerns and reduce remediation costs are in **Annex D**

C. Subprojects' Areas of Influence

69. The environments that will be potentially affected by the subprojects can be classified into: (i) "main project areas of influence", covering component sites (footprints) and areas within 200 m from their edges, considering the potential reach of noise, dust and socio-economic impacts; and (ii) "extended areas of influence" to include borrow areas/quarry sites, waste disposal sites, access routes to and from component sites and the resources in close proximity to them, sources of water for construction use, workers campsites and their immediate surroundings, and sources of labor. Based on review of satellite and land use maps and from sites visit, the potentially affected resources (excluding air, groundwater and soil) within the main areas of influence were identified. These include natural and artificial resources. Tables III-1 and III-2

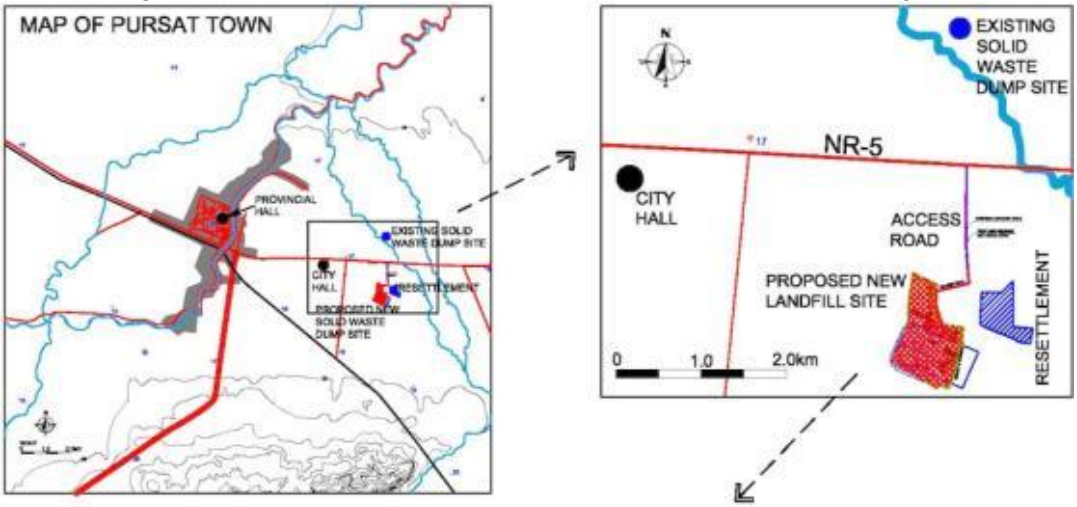
D. Category and Requirements

70. Under ADB classification, the Project is a Category B undertaking and an initial environmental examination (IEE) is required.

71. Under GoC policy and from consultation with MoE:[5] (i) projects listed in the Annex of the Sub-decree on EIA Process require individual IEIA Reports; projects not listed may be combined under one IEIA Report; (ii) the ADB IEE Report may serve as the IEIA Report; and IEIA/EIA reports from the Project will be appraised and approved by the Ministry of Environment (MoE). "Waste processing" and "wastewater treatment activities" of all sizes are listed in the Annex of the Sub-decree on EIA Process. Hence, three separate IEIA Reports (one for each subproject) will be required from the Pursat Urban Area Environmental Improvements Output. For the prompt implementation of the Project according to its timeline, GoC approvals of IEIA Reports should have been secured at the earliest prior to procurement and at the latest one (1) month prior to Notice of Award of Civil Works Contract. Table III-3

[5] Consultation of PPTA National Environmental Specialist with Mr. Danh Serei, Deputy Director, EIA-MoE, on 26 June 2013.

Figure III-5 Pursat Controlled Landfill – Location Plan and Layout



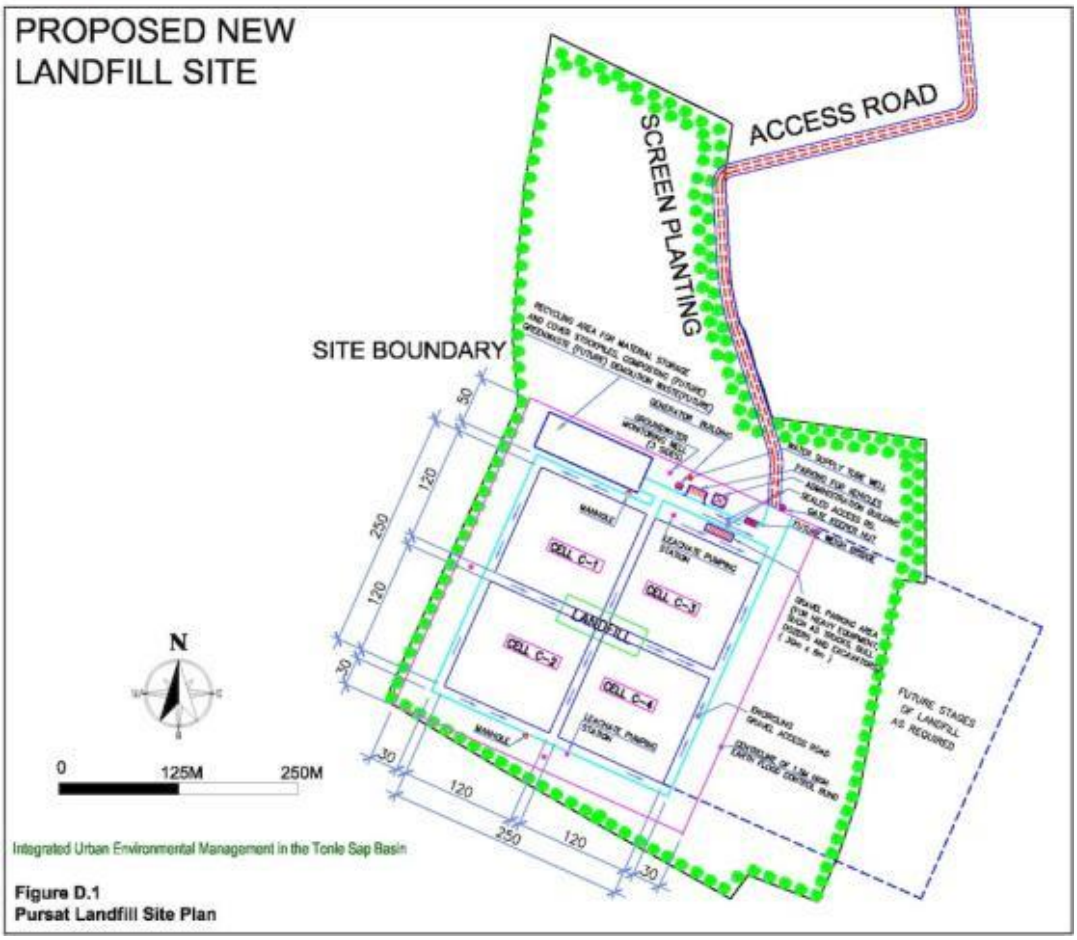


Figure III-6 Pursat Controlled Landfill – Sections

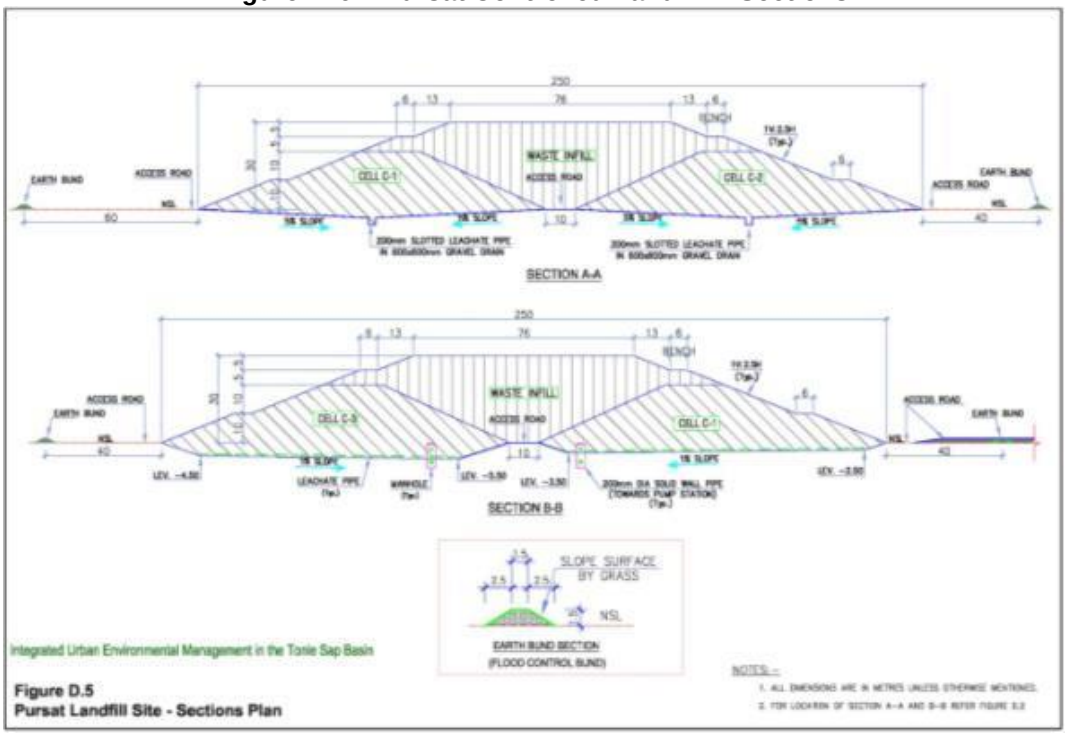


Table III-1 Potentially Affected Resource/s in Subproject's Area/s of Influence

Area of Influence	Potentially Affected Resources				
	Soil, Ground, Geology	Water Resources	Air	Land Use, Socio-econ. Resources	Other Ecological Resources[a]
1 Component sites & vicinities within at least 200 m from their edges [b]	■	■	■	■	-
2 Borrow areas/quarry sites & their areas of influence [c]	■	-	■	-	■
3 Waste disposal sites [c]	■	-	■	-	-
4 Access routes					
- To/from sources of chemicals for construction use & disposal sites [d]	■	■	■	■	-
- Used by construction-associated vehicles	-	-	■	■	-
5 Sources of water for use in construction & their downstream stretches	-	■	-	■	■
6 Workers' campsites & immediate surroundings (if outside 200 m from edges of component sites)[e]	■	■	■	■	-
7 Sources of labor for construction	-	-	-	■	-

[a] Areas of influence of borrow areas/quarry sites could have migratory species at certain periods of the year.

[b] Noise levels generated by construction equipment decrease at a rate of approximately six decibels (dB) per doubling of distance away from the source; (ii) the maximum noise level for receptors less than 5 m could be 93-95 dB; and (iii) within 200 m from a noise source, noise level exceeds WHO guideline of 50 dB.

[c] Expects that the following have no water resource to affect: (i) legally permitted borrow areas/quarry sites & Town's waste disposal sites; and (ii) potential Government project & other sites that would avail of the residual soil for filling.

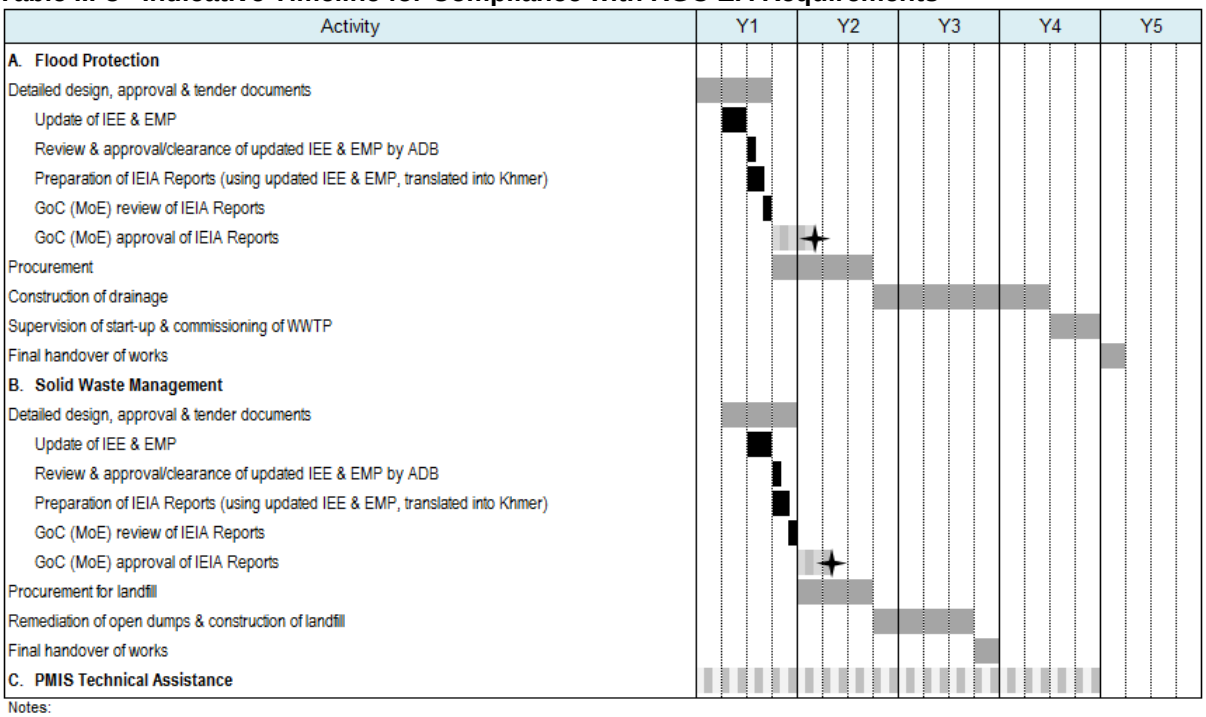
[d] Water resources that are crossed by, adjacent to, or close to access routes (including effective downstream stretches). "Close to", say within 50 m without any form of physical barrier in between water resource and access route.

[e] From poor sanitation practices, additional demand for water within the community, use of stove for heating and cooking, & if applicable, transport to and from component sites.

Table III-2 Identified Potentially Affected Resources in the Main Areas of Influence

Embankment Protection on Pursat River	Drainage System Improvements	Solid Waste Management
- Residents - Pursat River & an effective length Downstream, their aquatic resources - Flora in immediate vicinity - Central Market - Business establishments - Wat Lolok Sa Thmey	- Residents - Wat Pheal Nhek - Stharmi Pursat Primary, Pursat High, Pursat Secondary & Pursat Primary Schools - Univ.of Management & Economics - Sampov Meas Hospital - Central Market - Existing water & drainage lines - Nearby rice fields and their farmers	- Residents along access road - Adjacent rice fields & their farmers - Access road (poor condition) - Flora in immediate vicinity

Table III-3 Indicative Timeline for Compliance with RGC EA Requirements



Notes:
- Y1 is the start of Loan implementation, 1st activity being the preparation of the DEDs.
- Assumes environmental specialist is part of the DED Team; and therefore no independent procurement for such specialists.
- GoC appraisal period for IEIA report is 30 working days from receipt of application. Indicative timeline assumes no revision of IEIA Report required.
- Assumes current MoE review of summary IEEs prepared by the PPTA will conclude that no subproject will require the conduct of an EIA.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical/Chemical Environment

72. **Geographic Location.** Pursat Town, the capital of Pursat Province, is situated to the northwest of Phnom Penh. It borders with Battambang to the North, Tonle Sap Lake and Kampong Chhnang to the East, Kampong Speu and Koh Kong to the South and Thailand to the West. The Province adjoins about three-fourths of the western shoreline of the Tonle

Sap Lake. With a land area of about 352 km^2, Pursat Town lies midway between the Tonle Sap Lake in the east and Cardamom Mountains in the west, and is along the banks of the Pursat River. Pursat Town offers a perfect access to the Tonle Sap Lake in about 35 km.

73. **Climate.** Cambodia is situated in a tropical zone, between 10 and 14 degree latitude north of the equator. Its climate is influenced by the monsoon cycle and has two distinct seasons, the dry and rainy seasons. The northeast monsoon brings in the dry season from November to April. The dry season is cooler from November to January when cool air from Siberia flows in, and is dry and hot from February to April. The rainy season is experienced from May to October, as southwest monsoon brings in moisture and rains from the Indian Ocean. Average temperature has minimal variations regionally and seasonally. Weather is coolest in January and hottest in April. Relative humidity ranges between 65-70% in March and 85-90% in September. The rainy season accounts for about 80-90% of the annual rainfall, varying between 1,200 and 2,000 mm across the country. October is the wettest month; January/February, with the least rainfall or driest. Mean wind speed in Cambodia is low at about 2 m/s. December is known as the month of strong steady wind from the north. Typhoons, which often devastate coastal Vietnam, rarely cause damage in Cambodia. Annual evaporation is from 2,000 to 2,200 mm, i.e., highest in March and April at 200 mm to 240 mm and lowest in September-October at 120 mm to 150 mm.[6]
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74. Throughout the Tonle Sap Basin: (i) temperatures are fairly uniform; and (ii) annual rainfall varies between 800 and 2,000 mm. Records in the Pursat Rainfall Station (Pursat Town) in the past five years, 2008-2012, show an average annual rainfall of 1,500 mm.

Table IV-1 Monthly and Annual Rainfall, Pursat, 2008-2012

Year	Monthly Rainfall, mm												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	13.5	7.0	77.0	164.2	237.2	189.9	188.8	324.3	210.1	301.9	228.2	6.0	1,948.1
2009	1.6	28.4	56.2	117.9	108.0	126.0	146.1	185.6	175.2	162.7	34.9	0.0	1,142.6
2010	0.0	26.7	30.1	107.9	86.8	238.4	196.0	237.6	167.1	273.8	25.4	0.0	1,389.8
2011	0.0	0.7	62.7	51.3	114.3	106.1	201.0	214.9	206.1	418.1	69.2	44.0	1,488.4
2012	12.1	26.3	156.4	161.5	170.6	57.8	252.6	155.8	248.1	209.5	189.5	0.0	1,640.2
												Average	1521.8

Source: Provincial Department of Water Resources and Meteorology of Pursat Province

75. **Climate Change.** In the past 40 years (1971 to 2010), the northwest provinces of Cambodia, which include Kampong Chhnang, had been experiencing: (i) increasing trend in drought frequency and duration; (ii) a steady heat level in the initial decade of 1971-1980, decreasing trend in heat in 1980 till 1990, and a rising heat thereafter; (iii) increasing trend in flood frequency and duration in the initial 35 years and a decreasing trend in the period 2005-2010; and; (iv) steady rise in rainfall frequency and intensity. Climate change projections indicate a rise in temperature of 0.3-0.6^{o}C by 2025, delayed onset of monsoon, increase of wet season rainfall, decrease of dry season rainfall and more intense flood pulses.[7]

76. **Topography, Geology and Soils**. The Tonle Sap Basin-Mekong Lowlands is the largest topographic region, covering about 75% of the country. It consists mainly of plains with generally less than 100 masl elevations. Terrain is rolling and dissected as elevation rises. Pursat Town, its northern half lies in the vast plain of this region. Its southern half rises to higher elevations of nearly 450 masl midway and declines to about 100 masl approaching its southeast border. Underlain with rock of quaternary age, as most of Cambodia, Pursat Town consists of floodplains, deltaic deposits, alluvial fans and granite.

[6] Cambodia Environment Outlook. Ministry of Environment and UNEP. 2009.

[7] Strategic Program for Climate Resilience in Cambodia. A presentation to the PPCR Sub-Committee by T. Chankresna (MEF), M. Sophal (MoE) and the Royal Government of Cambodia. Cape Town. 28 June 2011.

The Town Proper, where subprojects will be implemented, is in relatively flat deltaic deposits at altitude between 12 and 16 masl. Soils consist of a mixture of often organic-rich silt, sand, clay and clay stones, such as alluvial soils, grey and cultural hydromorphics, acid lithosols, and red-yellow podzols. The alluvial soils are fresh, deposited annually, relatively young/recent, highly fertile and largely grown with rice. Grey hydromorphics are highly fertile; while cultural hydromorphics are moderately fertile. The red-yellow podzols developed from chemical weathering/decomposition of underlying parent material, generally have low fertility and are used for upland rice and non-rice crops.

77. **Surface Water**. Pursat River, one of the few rivers in Pursat Province, has its catchment area in the upland and mountainous areas of the Cardamom Mountain in the west, cuts through the Pursat Province and Pursat Town and empties into the Tonle Sap Lake in the east. It is about 250 km long. Downstream at Veal Commune (boundary of Pursat Town with Kandieng District), flow is less than that upstream at Bac Trakuon due to water diversion at Damnak Ampil Weir for irrigation. During the 12-year period of 1997-2008, average annual flow at Veal Commune was 2,132 MCM; at Bac Trakuon, 2,580 MCM.

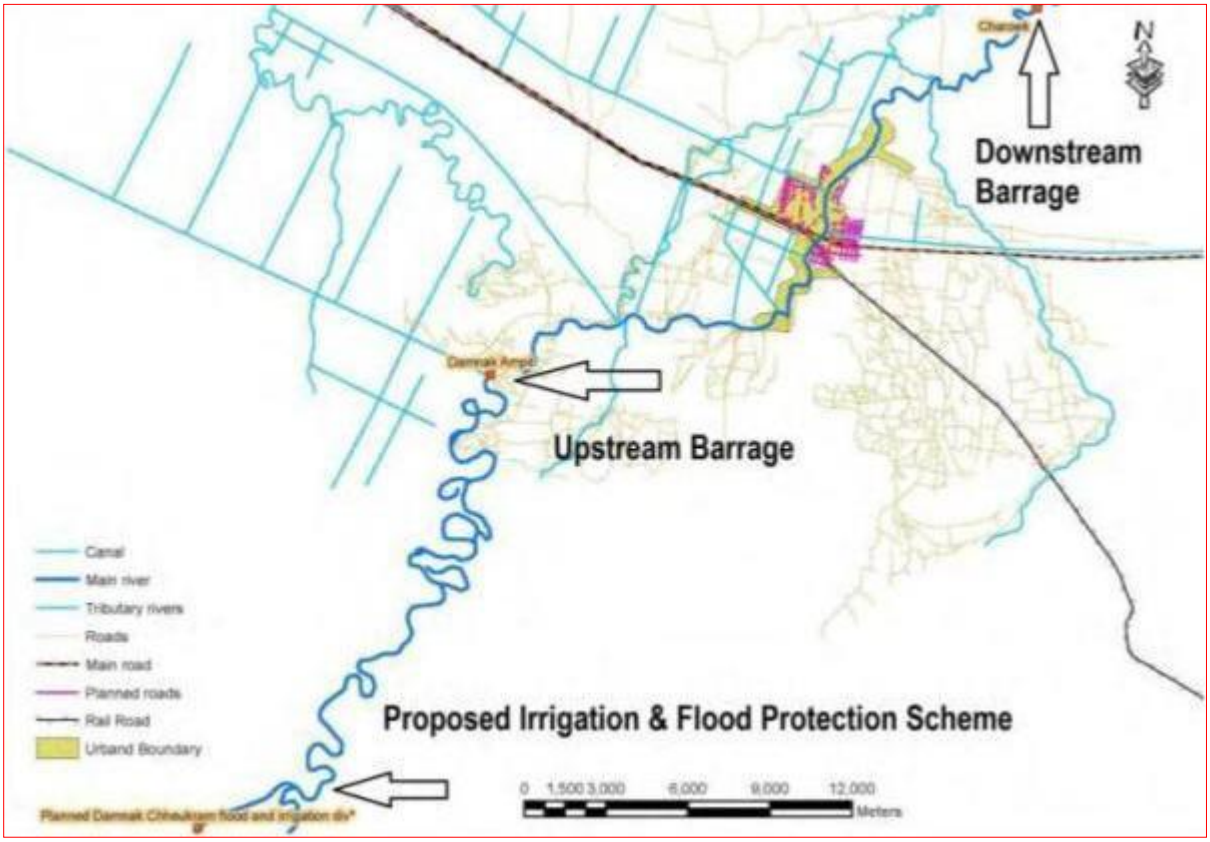
78. Pursat River provides mainly amenity value for the Town, as well as its main source of drinking water and of irrigation water for the surrounding agricultural areas. Most recent water quality monitoring results of samples taken from SE of the NR5 Bridge over Pursat River (shown in table IV-2) reveal exceedances in total coliform level over the standard limit during the dry season; and total suspended solids in the wet season. Due to low flow during the dry season, the low dilution of discharges from sanitation facilities would cause total coliform level to be high. In the wet season, runoff from the catchment areas in the upland and lowland would cause the level of suspended solids to rise. Figure IV-1 shows that the samples were taken upstream of the Town Proper. With more untreated urban wastewater being discharged downstream, levels of total coliform is expected to be higher downstream of the Town Proper.

Table IV-2 Pursat River Water Quality Monitoring Results, 2013

Parameter	Unit	Result		Standard/Guideline	
		04 Apr 2013	24 Jul 2013	Cambodian	MRC
TSS	mg/l	78.00	198.00	25 – 100	-
BOD	mg/l	2.65	1.35	1 – 10	-
COD	mg/l	3.74	3.72	-	< 4
Total Coliform	MPN/100 ml	4.6×10^4	4.3×10^2	< 5000	-

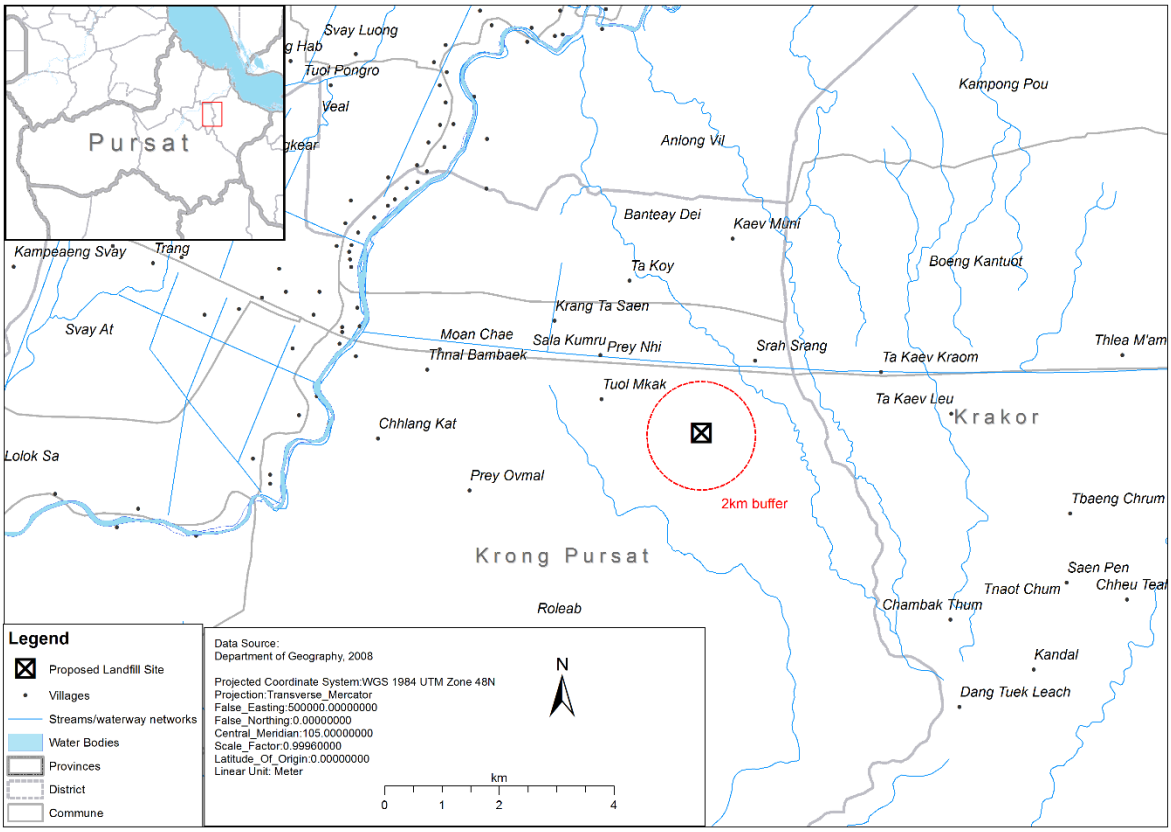
Source: Ministry of Environment. Department of Pollution Control. Laboratory Office.

Figure IV-1 Sampling Location



79. There are no natural water bodies and stream networks exist within 2-km radius from the proposed landfill site. Figure IV-2 shows the water networks nearby the project area.

Figure IV-2 Surface Water Networks nearby Proposed Landfill Site



80. **Groundwater.** Groundwater depth in the Tonle Sap Basin varies considerably. The water table changes with rainfall, specific local geomorphologic conditions, and the distance to the permanent water of the Tonle Sap Lake. Based on a preliminary investigation on groundwater resources in the Tonle Sap Basin[8], overall, the Tonle Sap Basin presents high yield and quality water supply. Its exploitation is somewhat minimal, except in the Siem Reap area. The Great Lake basin is dominated by recent alluvium covering the "Lake Proper" and surrounding areas extending between 5 to 30 km beyond the NR5 and NR6 ring roads, including Pursat Town. Extensive well-sorted sand and gravel, younger alluvium aquifers are good; their average depths range from less than 1 m to 50 m. Water quality is commonly fresh with high iron content near to the lake shores.[9]

81. Manganese is reported to be found in the groundwater in concentrations that might cause some consumer inconvenience (e.g., staining of laundry and sanitary ware, taste), though it is not believed to have any negative health effects. Although arsenic concentrations are found in the groundwater throughout Cambodia, they commonly do not pose a problem.[10] Most of domestic water supply wells are concentrated along the NR5 and NR6 where there is high population.

82. Baseline groundwater quality data including pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, NO_2, NO_3, Cl, SO_4, PO_4, As, Mn and Fe will be established by PMU as part of Environmental effects monitoring in Environmental Management Plan prior to construction phase.

8 As subcomponent of the Tonle Sap Rural Water Supply and Sanitation Sector Project (ADB-Grant 0018-CAM-SF).

9 Profile of Tonle Sap Sub-Area (SA-9C). Basin Development Plan Programme. Cambodia National Mekong Committee. February 2012.

10 Technical Note 10: Impacts on the Tonle Sap Ecosystem. Assessment of Basin-wide Development Scenarios. Basin development Plan Programme, Phase 2. Mekong River Commission. June 2010.

83. **Air Quality**. Ambient air quality can be described based on field observations on current sources of emissions, i.e., dust when strong winds blow over un-surfaced roads and when the low transport volume passes over un-surfaced roads during the dry season, smoke emissions from the existing dumpsites and smoke emissions from domestic cooking and burning of wastes. There are no industries located in the Town. Ambient air quality and noise level are typical to low density secondary towns and concentration levels are assessed to be within the national standard limits. Baseline Ambient air quality (PM2.5, PM10, SO2, NO2) and Ambient noise levels (Lmax, Lmin, Leq) will be established by PMU as part of Environmental effects monitoring in Environmental Management Plan prior to construction phase.

84. **Natural Hazards**.[11] Cambodia is exposed to floods, drought, storms, earthquakes, landslides and forest fires. Flood and drought are the main physical hazards, their regular occurrence often within the same year. For the period 1987-2007, floods had been more destructive. Storms are occasional events; earthquakes are of low intensities; landslides are rain-triggered; and forest fires are not very common. Forest fires, however, could become a serious threat if current rate of forest degradation continues, coupled with increasing events of drought and hotter days. Flooding is also expected to increase in terms of frequency, severity and duration with climate change.

Table IV-3 Natural Hazards in Cambodia

Earthquake	Flood	Landslide	Drought	Storm / Typhoon	Volcano Eruption	Forest Fire	Tsunami
X	XXX	X	XX	X	-	X	-

Extracted from Table A.1.1. Disaster Matrix By Country (1970-2009). ASEAN: Advancing Disaster Risk Financing and Insurance in ASEAN Member States: Framework and Options for Implementation. Volume 2: technical Appendices. April 2012. World Bank, GFDRR, ISDR & ASEAN. Source of data is DRMI, 2010:59. Disaster incidence ranges relative from XXX 'high" to X 'low".

Table IV-4 Summary of Natural Disasters in Cambodia, 1987-2007

Natural Disaster		Number of Events	Persons				Cost
			Killed	Injured	Homeless	Total Affected	('000 USD)
Flood	Total	12	1,125	53	275,805	9,514,614	327,100
	Average per event		94	4	22,984	792,885	27,258
Drought	Total	5	0	0	0	6,550,000	138,000
	Average per event		0	0	0	1,310,000	27,600

Lifted from: Strategic National Action Plan for Disaster Risk Reduction, 2008-2013. National Committee for Disaster Management and Ministry of Planning. Source of data is EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium).

85. Floods There are two major types of flood in Cambodia: (i) Mekong River flood and (ii) flash floods. Mekong River flood occurs with cumulative rainfall in the upper catchments throughout the rainy season, causing a slow but steady rise in water levels lasting for several days. This causes the Tonle Sap River to reverse its flow, expanding the Tonle Sap Lake to six times its dry season size. This event is worsened with heavy rains around the Tonle Sap Lake, affecting the provinces around the lake and the southern provinces. This event is most severe when heavy rains coincide with a tropical depression and storm.

86. Flash flood results with repeated heavy rainfall in the mountainous areas. Flash flood lasts for only a few days but often cause severe damages to crops and infrastructures, particularly in tributaries around the Tonle Sap Lake. Pursat is one of the Provinces that have been, and are prone to be, affected by flash floods. According to a map obtained from the Strategic National Action Plan for Disaster Risk Reduction, the flood-prone Pursat communes along Tonle Sap Lake are among the second priority flood-prone commune/s.

[11] Largely lifted from the Strategic National Action Plan for Disaster Risk Reduction, 2008-2013, National Committee for Disaster Management and Ministry of Planning.

87. Drought There are four characteristics of drought in the country (i) unpredictable delays in the onset of rainfall in the early part of the wet season; (ii) erratic variations in wet season rainfall onset, amount, and duration across different areas; (iii) early end of rainfall during the wet season; and (iv) occurrence of mini-droughts of three weeks or more during the wet season, which can damage or destroy rice crops without irrigation. Localized drought is also becoming increasingly apparent and significant in many areas, including areas that are also flood-affected. During the monsoon season of the year 2012, Cambodia experienced drought and flash flood. The drought affected 14 provinces. Pursat Provincewas moderately affected, between 5,000 and 10,000 ha of rice field impacted. The Strategic National Action Plan for Disaster Risk Reduction, 2008-2013, has no identified drought-prone commune in Pursat.

88. Storms Sheltered by surrounding mountain ranges, storms or typhoons affect Cambodia occasionally. During storms, damages are largely caused by floods. Damage is most severe when storms come during September and October when seasonal discharge of the Mekong River is high and a second significant peak to annual flood is generated (MRC 2007).

89. **Earthquake**. Based on the Seismic Hazard Map of Southeast Asia, produced by the Seismic Hazard Assessment Program (GSHAP), 1999, Cambodia lies within middle-low seismic hazard zone, with peak ground acceleration of 0.2-0.4 m/s^2 (or 0.02-0.04 g), 10% chance of exceedance in 50 years. From a correlation with the modified Mercalli scale, intensity IV earthquake has a PGA range of 0.03 g and below. The Earthquake Intensity Risk Zones Map of the UN International Strategy for Disaster Reduction (ISDR) shows Cambodia to be within the earthquake intensity I-V zone. The observed effects of intensity V earthquake would include earthquake being felt by nearly everyone; some glasses/windows broken; unstable objects overturned; and pendulum clocks may stop.

B. Biological Environment [12]

90. Cambodia has many diverse ecosystems, all supporting a variety of plants and animals. Its landscape includes extensive lowlands, including the alluvial plains surrounding the Tonle Sap Lake, where human population is largely rural and where most natural vegetation has been replaced by agricultural crops, particularly rice. Other major crops include maize, soybeans, mung beans, vegetables, groundnuts, and sesame. The Tonle Sap Lake and its wetlands and seasonally inundated forests, are part of the country's water systems that provide habitats harboring high levels of biodiversity. Protected areas found within Pursat Province include: (i) Phnom Aural[13], a wildlife sanctuary which lies east of Cardamom Mountains and occupies an area of 254,485 ha in the Provinces of Pursat, Kampong Chhnang and Kampong Speu; (ii) Tonle Sap Biosphere Reserve (TSBR), consisting of the Tonle Sap Lake and its floodplain, covering an area of about 1.48 million ha in the Provinces of Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom; and (iii) Central Cardamom Protected Forest, a 401,300-ha area in Central Cardamom Mountains, extending in the Provinces of Pursat, Koh Kong and Kampong Speu. Pursat Town is far from Phnom Aural Wildlife Sanctuary and Central Cardamom Protected Forest. It is partly within the transition zone of the TSBR, where the construction of some physical infrastructure is allowed. Pursat River, its tributaries and rice fields are the wetlands within Pursat Municipality. The protected area and type of wetland relative to the subproject sites are presented in Table IV-5. The subproject sites and their main areas of influence are not habitats of rare species of flora and fauna.

[12] This Section is lifted from the Cambodia Tropical Forestry and Biodiversity (118/119) Assessment. February 2011. USAID Cambodia.

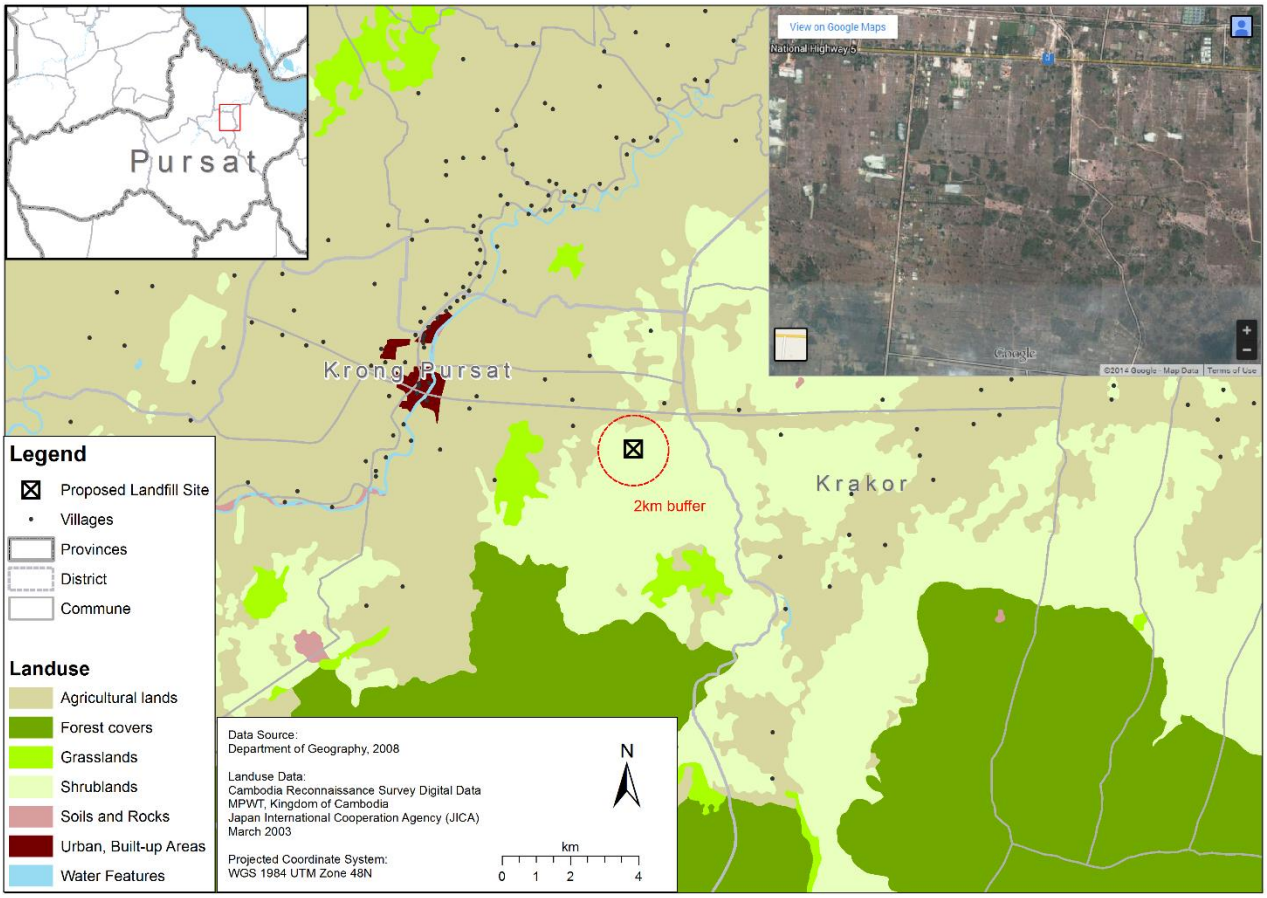
[13] Names and designations used are based on Protected Area Law, 2008

Table IV-5 Protected Area and Type of Wetland in Subproject Sites

Subproject	Protected Area	Wetland
Riverbank Protection	Within the transition zone of the TSBR, where some physical infrastructure is allowed	Pursat River
Drainage	Partly within the transition zone of the TSBR, where some physical infrastructure is allowed	-
Solid Waste Management Controlled landfill	-	-

91. Area around the project area of influence is predominantly agriculture and shrublands. Figure IV-3 shows the landuse categories in nearby proposed landfill site.

Figure IV-3 Landuse nearby the Proposed Landfill Site



C. Economic Environment

92. Economy.[14] Most of the economic activities around the Tonle Sap are based on fisheries or agriculture. Fish processing is widespread, while agriculture focuses on rice production in most places. Infrastructure facilities are largely absent, particularly in the floating or stilted villages. The few access roads are mostly in poor condition. Ports and landing sites lack basic infrastructure; however, contribute effectively to livelihood generation. The lake is used for transportation of people and goods, including petroleum products and fish. Most of the people transported are foreign tourists. Low water levels in the dry season limit the size and traffic of boats.[15]

93. The capital of Pursat Province, Pursat Municipality is easily accessible from and to Phnom Penh via the National Road 5 and the national railway. It lies along the GMS Southern Corridor. Agriculture and fisheries, services and small-and medium-scale businesses and tourism and traditional handicrafts make up the economic sector of the Municipality at present. Projects to upgrade National Road No.5 and the railway will further enhance the town's attractiveness for investors.

94. **Land Use and Urban Development.** In 2003, the general land use of Pursat Municipality consists of agricultural land (mainly rice land), forest covers in the south, shrubland, water (largely the Pursat River) some grassland and urban/built up areas, which has gone beyond the Municipal boundaries to the north along the Pursat River. The proposed drainage system improvement and riverbank protection works will be implemented in the urban area, the latter along the Pursat River. The proposed controlled landfill will be in the agricultural land.

95. **Infrastructure Development.** Road and Transport The national and provincial roads within the Pursat Municipality are bitumen-surfaced; while the municipal roads are a combination of bitumen, a few concrete but mainly laterite surfacing and unformed roads. The Municipality reports that only around 16% of the municipal roads are surfaced as shown in Table IV-7, although most of the roads in the core urban area are surfaced. Upgrading of roads, including residential roads, is in the process. Many of the roads lack roadside drains; while existing roadside drains are often silted up or blocked with solid waste. With relatively low traffic on municipal roads, in general, municipal road conditions are reasonable. The main issue is flooding of the roads during the wet season and dust and mud on un-surfaced roads during the dry and wet seasons, respectively. There is no formal street sweeping; while streetlights are present only along the NR5. The national railway passes through Pursat Town. Like Phnom Penh, local public transport mode is the tuk-tuk.

96. Water Supply Originally built in the 1930s, the water supply system was upgraded under an ADB-assisted project in 2006 that provided a new intake (at Pursat River and about 3 km upstream of the old one which was closed) and a water treatment plant adjacent to the new source with an installed capacity of 5,700 m3 per day but currently delivers 4,500 m3 daily. New primary mains were installed and existing ones replaced. The distribution system comprises around 96 km of ductile iron pipe, of which JICA completed about 9.44 km in the main urban area by early 2013, and UN HABITAT funded 17.164 km in 2013 to supply water to poor areas in the west of town along NR5 and along Pursat River. However, these extensions have possibly had an impact on system pressure and there is a need for additional overhead tanks to increase pressures towards the ends of the system. The Department of Industry, Mining and Energy has proposed for: (i) two overhead tanks near

[14] Pursat Krong Data Book 2009. Pursat Province. October 2009. National Committee for Sub-National Democratic Development (NCDD).

[15] Lifted from the Technical Note 10: Impacts on the Tonle Sap Ecosystem. Assessment of Basin-wide Development Scenarios. Basin Development Plan Programme, Phase 2. Mekong River Commission. June 2010.

NH5 towards Battambang and downstream on the Pursat River to increase pressure towards the ends of the distribution system; and two main lines of 1 km and another 5 km to serve unserved areas. Records for late 2012 show that of the 10,700 households, 5,600 (or 52%) were connected to the system; 1,900 (or 18%) were covered by tube wells; and 3,200 (or 30%) remained unserved.

97. Drainage and Sanitation There are two combined drainage systems in the town that meet near a non-functioning wastewater treatment plant (WWTP) in the northwest of the town away from the river. The existing WWTP was built on a 10-ha site in 2001 but has not been functioning due to blocked and broken inlets. Hence the dry weather flow diverts all the flow into a nearby irrigation ditch. All flow is by gravity with no pumping. The Provincial Government has been incrementally constructing drains. By the end of September 2013, a total of 5.64 km have been constructed.

98. Flood Protection The existing embankment along Stung Pursat Stream is no longer high enough to protect the town. At a level of 4.90 m above datum, flood levels usually reaching around 5.1 or 5.2 m (in 2011, 5.35 m) overtop the embankment; hence, requiring sandbags to be placed along the embankment. The high flood levels during the past two years also caused damages to the embankments. The Municipality estimates 12 km of embankment on the town side and 10 km on the other side of the river as needing improvement. Various barrages have been built across the river both upstream and downstream of the town. While most of these barrages have fallen into disuse or, or in one case, bypassed by the river changing course, two barrages remain operational. Both these barrages were constructed as part of irrigation programs in the 1990s and use automatic flap gates to cope with flood flows. With no means to regulate the flow of water in the river through the town during floods, these barrages could be an additional cause of flooding. Although The Greater Mekong Subregion (GMS) Project proposes to divert some flow from the Pursat River for irrigation, some embankment improvement works are still deemed necessary, but could be shorter.

99. Solid Waste Current waste collection is done by a fleet of two old vehicles with capacity of 11.5 m3. On average, the trucks combined haul 3.5 loads per day. Assuming the loads are 90% full, at a typical uncompacted raw waste density of 250-330 kg/m3, the total volume of solid waste hauled daily would be about 9 to 11 tpd. There is a third much smaller truck that does not haul waste daily. Current waste collection efficiency is about 30% of solid wastes generated in the town core. Presently, collected solid wastes are disposed of at Srah Srang dumpsite, about 5 km from the town. center.

D. Socio-economic Environment

100. **Population.** In 2011, Pursat Municipality had a total population of 63,773 persons. The total population included many rural villages within the Municipality. The PPTA Team has estimated the urban population within the Municipality to be only 42,085 and the total population of the urban agglomeration area, 49,044, in 2011. The 200-m embankment protection and drainage improvement works will take place in the town center where population density s highest.

101. **Ethnic Minorities.** The District Data Book 2009 reported that there was no family belonging to ethnic minority group present in Pursat Municipality in 2008. All 126 households surveyed in the PPTA's Socio-Economic Survey (SES) in 2013 were Khmers.

102. **Employment, Poverty and Vulnerable Households.** Of the 126 households surveyed in the SES, majority (nearly 45%0 of male household heads were not employed, followed by 17% as engaged in agriculture. In contrast, most of the surveyed female household heads, nearly 63%, were primarily engaged in wholesale or retail trade (62.5%),

followed by about 13% as engaged in agriculture. Overall, the proportion of those employed in the primary sector, i.e., agriculture (16.7%), fishing (2.4%), forestry (1.6%), in Pursat Municipality appeared much lower than provincial figures.

103. Based on the World Food Programme's identification of poor households survey in August 2012, poverty rates in the six municipalities around Tonle Sap Lake ranged from 22.6 to 31.8% in 2012. Pursat Municipality had the highest percentage of poor families, 31.8%. Based on Ministry of Planning's poverty threshold for urban areas apart from Phnom Penh, i.e., 132,386 KHR monthly per capita (or approximately 661,930 KHR per household of 5 members), the majority (59.5%) of households surveyed in Pursat are well above the poverty threshold. It should be noted, however, that around a fifth (21.4%) of the households are still below the poverty line, and 19.0% are only just above the poverty threshold and could thus still be vulnerable to shocks.

104. Of the 126 households surveyed in the SES, 13.5% were female-headed; (11% were headed by disabled persons; and 10% were headed by an elderly (over 65 years old). The SES data revealed half of the surveyed female-headed households with incomes just at or below the poverty line, underscoring the vulnerability of a proportion of female-headed households in the Project area.

105. **Security of Tenure and Housing.** According to the District Data Book 2009, in 2008: (i) of the total 12,859 households, 1,232 or nearly 9.5% were living on public land and 43 persons were without permanent housing; (ii) 37% of houses had zinc/fibro roof, 32% had tile roof and 28% had thatched roof; and (iii) 43% of houses had electricity. Of the 126 households surveyed in the SES, 94% own the house they live in; 88% own the lot they occupy; and the rest are either renting or not renting the houses and/or lots they live in/occupy.

106. **Access to/Levels of Basic Services.** Education In 2008, the ratios of primary students to class, classroom and teacher were lower than the national average ratios in the urban area. The ratios for total secondary students to class, classroom and teacher were above the national average ratios in the urban area. Based on the PPTA's SES, access to higher education among the heads of surveyed household appeared to have been fairly limited. The highest educational attainment of about 21% of them was primary level; of 18%, secondary level; and of 16%, high school graduate. Most of the surveyed male household heads (19%) attained secondary level of education; while most of the surveyed female household heads attained only primary level (nearly 38%).

107. Health Care. Pursat Province is divided into two health operational districts, one of which is based in Pursat Municipality (Sampov Meas Commune). A health operational district differs from administrative district boundaries. Hence, the Sampov Meas Health Operational District has operational jurisdiction beyond its administrative boundary. According to the District Data Book 2009, the said Health Operational District had 21 health centers and 4 health posts in 2008. Among these, 2 health centers were within the Pursat Municipality. The Sampov Meas Health Operational District served 378,450 persons in 2004-2005 with 2 doctors, 5 medical assistants, 148 nurses and 77 midwives. Ratios of persons: (i) to a doctor was 189,225; (ii) to a nurse was 2,557. The Pursat Provincial Hospital, located in Pursat Town, had 125 beds for patients with general disease and 37 beds for patients with tuberculosis. Ratio of persons to a bed for general diseases was 3,028.

108. Water Supply According to the District Data Book 2009, in 2008, only 27% of the total households in the Municipality had access to piped water supply. Rivers, lake, natural pond and/or reservoirs were the sources of potable water for 25%; ring wells and open dug wells by 22%; pumped/mixed wells by 12%; normal pond by 10%; and rain water by the

remaining 3%, of the total households. Some 14-92% of households in the communes were using water from unsafe sources during the dry season in 2008. Of the 126 households surveyed in the SES, 64% sourced drinking water from piped water supply connected to their houses; 10% from rivers/streams/springs; 9% used rain water; 8% from piped water supply in their compounds; 3% from protected dug wells; and the rest used water from boreholes, unprotected dug wells, 5-gallon containers and others.

109. Sanitation According to the Municipality, in 2012, 61% of the population had access to latrines. Of the 126 households surveyed in the SES, 80% had flush/pour flush toilets; 10%d pit latrines with septic tank; 3.2% had pit latrines without septic tank; and 6% had no latrines and used other's latrine. The remaining households had other form of sanitation facility or disposal method.

110. Drainage. Of the 126 households surveyed in the SES, 75% had no access to drains; 13% had access to earth drains; and the remaining 12% had access to closed and cement-lined open drains. About 75% said their communes flood during heavy rains and/or during river overflow. Of those served by drains, 79% reported drains to be too small; and about 11% reported their drains as clogged with sediments and/or solid wastes.

111. Solid Waste Collection In 2008, the percentage of households with access to solid waste collection by commune ranged from 0% in Chamraeun Phal, Lolok Sa, Svat At and Banteay Dei to 1.9% in Prey Nhi, 4.9% in Roleab and 29% in Phteah Prey. Of the 126 households surveyed in the SES, 11% had access to solid waste collection services while 81% burned their garbage. Some of the remaining would bury their garbage; some would throw their garbage anywhere.

112. Power Supply In 2008, the number of households that were connected to the power supply grid was 6,274 (or nearly 49% of total households in the Municipality. (This total does not include homes powered by generators or batteries.)

E. Physical Cultural Environment

113. There are no physical cultural resources that will be affected by the proposed subprojects. According to the Municipality, no chance finds of archaeological/historical relics have yet been experienced or reported.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Environmental Impacts and Benefits

114. The subprojects will bring about improved urban environment and climate change-resilience, significantly contributing to a qualitative improvement in the lives of residents in Pursat Town. It will help promote the implementation of the Tonle Sap Urban Areas Development Framework, and the Pursat Town Development Strategy 2030 which will guide future urban development in the Tonle Sap Basin (under preparation). Table V-1 presents the environmental benefits, positive impacts and outcomes of the proposed subprojects.

Table V-1 Environmental Benefits, Positive Impacts and Outcomes

Aspect	Subprojects		
	Embankment Protection on Pursat River	Drainage System Improvements	Solid Waste Management
Benefits	Protected embankment on Pursat River	Improved storm- and wastewater management	Improved solid waste collection and disposal
Positive impact	Relief from flooding from embankment failure Reduced erosion, reduced sedimentation of Pursat River Reduced health & safety risks Improved, safe mobility during heavy rains or storms	Relief from flooding Improved sanitation Reduced health and safety hazards Improved, safe mobility in the rainy season	Reduced/eradicated open & indiscriminate dumping & burning of SW & relief from its associated issues (fumes & uncontrolled gas emissions, odor, nuisance, contamination of water resources, clogging of drains, health & safety risks)
Outcome	Improved urban environment Safe, climate-resilient communities and Town	Improved urban environment Safe, climate-resilient communities and Town	Improved urban environment Safe communities and Town

B. Screening of Potential Impacts/Issues/Concerns

115. The screening process revealed the following salient siting concerns: (i) sensitiveness of the Pursat River and its resources to impacts during construction, and in case of embankment failure during operation; (ii) urban development and settlements in the town center will be impacted on during drainage system improvements; (iii) site of the existing unused WWTP is waterlogged during the rainy season; (iv) existing utility lines and crossing drains within the road rights-of-way in the Town center that should be considered in design and during construction of drainage system improvements; and (v) the states of the access roads to the sites that will be subject to pressures from use by construction vehicles and equipment during construction of all works and from use by waste collection trucks during operation of the controlled landfill.

116. Relative to design, the salient concerns would be the inadequate consideration/incorporation in the respective designs of the above-mentioned siting concerns, capability of operating institutions in OM&R, generated spoils, and the following:

- for the riverbank protection works, impacts climate change on the hydrology of Pursat River;
- for the drainage system improvement works: (i) impacts of climate change on the stormwater runoff that will be combined with wastewater and on wastewater treatment, (ii) sensitiveness of groundwater and soil in the vicinity of the WSPs' site to wastewater stabilization operations, and (iii) provisions for groundwater monitoring well at strategic locations near the WSP based on direction of groundwater flow and gradient;
- for the controlled landfill: (i) climate change and its impacts on landfill operations, (ii) potential sensitiveness/vulnerability of the soil and groundwater at the site and in the vicinity, (iii) closure/environmental restoration plan to restore (or at least mitigate the disturbance to and blend with) the landscape, and (iv) remediation plan for the dump sites existing in Pursat Town.

117. The identified direct impacts with potential moderate to high significance during construction are: (i) dust and noise; (ii) impacts on the Pursat River and its resources; (iii) soil erosion during embankment protection works; (iv) impacts of the construction of the

controlled landfill on the existing landscape; (v) impacts on vegetation beyond the subprojects' footprints, particularly along the banks of Pursat River and at the controlled landfill and its access road; (vi) impacts on the socio-economic environment and resources from traffic, blocked/constricted accesses, accidental damages of utility lines and other infrastructures within and adjacent to the drainage system improvement works, damages from use of existing access roads; and (vi) public and workers' health and safety hazards.

118. The potential indirect and induced impacts during construction with moderate and high magnitude and significance include: (i) contamination of Pursat River and impact on its resources from wastes, sediments, hazardous substances during heavy rains/flooding or collapse of exposed/unstable slopes or newly completed embankment protection works; (ii) traffic build up and extension during peak hours, increasing travel time and road safety hazards, in the town center during drainage system improvement works; and (iii) clogging of existing drainage system in the Town center with wastes and sediments from drainage system improvements works during heavy rains or flooding, exacerbating flooding in the town center and increasing health and safety hazards.

119. Considering the many planned projects in Pursat Town, the cumulative impacts during construction would be magnified levels of: (i) dust, noise, traffic, blocked accesses, health and safety hazards in the town center, (ii) potential risks to contamination of Pursat River and its resources; and (iii) dust, noise, traffic and road safety hazard at the junction of NR5 and the main access road to the landfill.

120. During operation, potential direct impacts mainly relate to the operation of the wastewater stabilization ponds and controlled landfill and the salient impacts/concerns are:

- Elevated levels of odor, gas emissions, pests from inefficient O&M of the wastewater stabilization ponds, e.g., from inadequate management of produced sludge, floating scum, screenings, grit and other accumulated solids.
- Groundwater and soil/land pollution from overflow of wastewater treatment plant and/or seepage/migration of wastewater due to ineffective pond liners or deferred action on cracked liners.
- Overflow of wastewater treatment plant and noise from inefficient operation and maintenance and deferred repair of pumping station.
- Leachate, air emissions, groundwater contamination, litters/pests/odor/dust, health and safety hazards with inefficient operation and maintenance of the new solid waste management facilities.
- Health and safety hazards of workers in the operation, maintenance and repair of completed drainage improvements and controlled landfills and newly acquired waste management equipment.

C. Impacts/Issues/Concerns and Mitigation Measures Relative to Siting, Planning and Design

121. In the preparation of the feasibility study, resettlement plan and this IEE, measures were taken to minimize some of the aforementioned siting and design issues and concerns and the subprojects' other potential environmental and social impacts:

- The subprojects have been prepared within a highly consultative and participatory process through workshops, socio-economic survey (SES) and community focus group discussions to: (i) inform stakeholders about the proposed Project; (ii) obtain the priority needs and concerns; and (iii) agree on the subprojects.
- The proposed riverbank protection works have taken into consideration the existing settlements on top of the embankment and have significantly avoided displacement and involuntary resettlement.

- All proposed works estimated the spoils that will be generated and to be managed. The excavated soils from drainage works will be reused as compacted backfill. The controlled landfill will use excavated soils as soil cover material for the entire life of Cell (Stage) 1.

Table V-2. Spoils Management

Subprojects	Excavated Soil	Excavated Rock	Removed Refuse	Demolition waste	Other
Riverbank Protection					
Cut/excavated	0	0	0	0	0
Used as compacted backfill	0	0	0	0	0
Residual	0	0	0	0	0
Drainage System Improvements					
Cut/excavated	40,000	0	0	0	0
Used as compacted backfill	40,000	0	0	0	0
Residual	0	0	0	0	0
Controlled Landfill					
Cut/excavated	20,200	0	0	0	0
Used as cover material	20,200	0	0	0	0
Used as compacted backfill	0	0	0	0	0
Residual	0	0	0	0	0

Obtained from the PPTA Engineers.

- The IEE has incorporated the existing socio-economic and environmental conditions, issues and concerns raised in the SES.
- A resettlement plan has been formulated in a highly consultative, participatory manner.
- An environmental safeguard public meeting was held to present/disclose the IEE and existence of EMPs for implementation.
- In project preparation, preliminary design and IEE, other planned and programmed projects have been taken into consideration.
- Preliminary design for the riverbank protection has studied and considered Pursat River's hydrology and how it has been/is/going to be impacted on by climate change, existing barrages and past, ongoing and proposed relevant interventions.
- Preliminary design for the drainage system improvements has: (i) considered climate change impacts on stormwater flows in the Town center and on wastewater treatment; (ii) specified adaptation options such as the upgraded design and fabrication standards for the reinforced concrete (RC) sewer pipes and parts, design standard for the cushion base, and the cement material for the RC pipes; and (iii) considered the potential inadequate technical and financial capability of the operating institution.
- Preliminary design for the controlled landfill has: (i) included the appropriate leachate and gas management strategy, proposed groundwater monitoring wells and clay liner to protect groundwater and soil; (ii) recommended for a hydro-geological investigation during detailed design; (iii) considered climate change issues; (iv) proposed for the upgrade of the access road; (v) proposed for the greening\ of completed/capped waste cells and landscaping of the site to somehow blend with the existing landscape in the area; and (vi) recommended the institutional set-up for operations and its training.

- The proposed remediation of open dumps have considered the protection of the groundwater and soil, climate change issues, greening of completed/capped waste cells; and dealing with existing fumes and open burning as a priority.

122. During detailed design, the above initial mitigation measures will be carried on and/or validated. Consultations will be held and feedback should be taken into account. The potential impacts, issues and concerns that could arise during construction and operation can be avoided or, at least, mitigated with sufficient incorporation/consideration of the following during the detailed design stage:

- The demand for, and availability of and sources for, fine and coarse aggregates to be assessed carefully during detailed design not only to mitigate delays in construction progress and avoid prolonged exposure of open or disturbed surfaces but also to avoid haphazard (and illegal) extraction of these materials. An Aggregates Management Plan (AMP) to be prepared during detailed design will serve as framework for the preparation of Contractor Aggregates Management Plan in the Contractor's EMP (C-EMP).
- Town's vulnerability to damages from other natural hazard events, existing utility lines and infrastructures in the sites, relevant feedback/suggestions obtained during stakeholder consultations, and adaptation measures for other integral components of the controlled landfill, such as access and internal roads (flexible pavement, granular protection/bedding, optimum compaction, appropriate gradient), water supply (collect and store rainwater), buffer area/landscaping (use submergence and drought tolerant plants).
- Construction schedules and, if relevant, designs of other ongoing and planned projects in Pursat Town to mitigate cumulative impacts.
- Appropriate environmental mitigation and monitoring measures are included in the EMP. To attract more environmentally responsible bidders, the SPS-compliant EMP will be part of the bidding document. Selected Contractor will be required to prepare a detailed C-EMP that will address as minimum the requirements of the EMP. The C-EMP will be quantitatively and qualitatively evaluated against the EMP by the PMU and cleared by the ADB prior to the commencement of any work on site. The Contract for civil works will explicitly stipulate the obligation of Contractor (and his/her Sub-contractors) to institute the mitigation measures properly and carry out environmental monitoring according to the ADB-cleared C-EMP. The Contract for civil works will stipulate some tie-up of progress payment and collection of performance bond with the performance in C-EMP implementation.

D. Impacts and Mitigation Measures during Construction

123. **Impacts on Air Quality**. Dust and noise will be salient during construction. Moderate increase of sulphur oxides and nitrogen oxides levels in the ambient air quality will be expected intermittently, such as when VOC-emitting activities are undertaken and when there is peak movement/operation of construction vehicles and equipment. Unmitigated vibration could lead to health consequences and permanent damages of sensitive structures. These issues/impacts will be temporary but, if not mitigated, will have potentials to result in long-term consequences in the health of the affected communities and the construction workers. Some measures to mitigate are: (i) apply segmentation of works; (ii) water stockpiles & exposed surfaces at least twice a day, or as necessary; (iii) enforce slower maximum speed (40 kph) en route to sites & (30 kph) in subproject access roads and sites; (iv) minimize drop heights & spray water when loading/unloading aggregates; (v) ensure trucks hauling cement, aggregates and spoils to have cover and maintain a minimum of 2 ft freeboard; (vi) locate VOC-emitting processes away from receptors, (vii) undertake prompt maintenance of vehicles/equipment; (viii) encase generators and locate them away

from receptors; (ix) limit noisy operations at daytime; and use least noisy and least vibrating equipment and tools.

124. **Impacts on Water Resources**. Pursat River will be at risk of pollution from the proposed embankment protection works caused by: (i) poorly managed construction sediments, wastes/spoils and hazardous substances; and (ii) poor sanitation practices of construction workers. Polluted Pursat River will be detrimental to the aquatic resources of the Pursat, which some households downstream rely on for food, as well as to the health of people relying mainly on the river and streams as sources of water for domestic uses.

125. There is no surface water body in, or near to, the controlled landfill and WSP sites. Groundwater table at the controlled landfill site is reportedly at 30 m below the ground surface and soil at the landfill site is sandy silt but clayey, indicating slow soil permeability rate and sufficient protection of the groundwater resource from any contamination during construction. Hydrogeological and soil investigations during the detailed design stage will confirm/validate the groundwater and soil conditions at the controlled landfill site and provide information of the same at WSP site.

126. Some mitigation measures: (i) use sediment traps, fences, nets, sand bags and/or earth berms;; (ii) store aggregates, spoils and wastes away from Pursat River and main surface drainage routes; (iii) dispose of spoils and wastes promptly; (iv) provide adequate sanitation facilities at work sites; (iv) enforce upon workers good sanitation practices; (v) implement proper solid and hazardous waste management; and (vi) complete riverbank protection works prior to the onset of the rainy season.

127. **Impacts on Soil**. Erosion of unstable sections of the embankment along Pursat River, near to the embankment improvement works, may be caused by construction works and/or vibration from movement and operation of construction vehicles/equipment. Soil removed by erosion may become airborne, creating dust, and/or be transported away by water into water bodies and pollute them. With guided land disturbance and coordinated activities, soil erosion will be mitigated.

128. The concern for possible indiscriminate borrow operations for aggregate materials is considered to be minimal. However, as preventive measure, the magnitude of this concern will be confirmed during detailed design and carefully addressed through the formulation of an Aggregates Management Plan as framework for the Contractor's EMP and requiring Contractor's to obtain aggregates only from sources with environmental clearance and license to operate and that still have high ratio of extraction capacity over loss of natural state.

129. **Impact on the Landscape**. The controlled landfill will be constructed in the middle of rice fields and shrubland. Excavations, removed trees and shrubs, indiscriminately parked construction vehicles and equipment, stockpiles of construction wastes/spoils and aggregates and other construction materials, storage structures, sanitation facilities and pits will disturb the existing landscape. This could be mitigated with planned and enforced orderly placement of construction amenities and stockpiles and observance of vehicle and equipment parking.

130. **Impacts on the Biological Environment**. The proposed subproject sites are not within or in close proximity to any protected area. The proposed riverbank protection works, however, will be implemented on the banks of Pursat River. The health of the aquatic life in Pursat River will be at risk with a contaminated Pursat River. Measures to manage solid wastes, stockpiles of aggregates and residual soils and storage and use of hazardous substances and the strict enforcement of good sanitation practices by construction workers will address this concern.

131. Shrubs, trees within the subprojects' footprints will be removed. A plan to replace the removed trees can be one of the detailed design outputs. Vegetation outside the footprints, particularly at the sites for embankment protection works and along the access roads to the controlled landfill site, will be potentially subject to trampling or hit by the movement and parking of construction vehicles/equipment, stockpiles of aggregates/excavated and residual soils/wastes, storage structures and movement of workers. This can be mitigated through the: (i) definition, during detailed design, of the land required for work easement; (ii) inclusion of this required land in the resettlement plan as temporary disturbance/loss, as appropriate; (iii) installation of adequate physical demarcation during construction mobilization to ensure confinement of construction activities within the subproject footprint and work easement areas.

132. **Impacts on the Socio-Economic Environment**. Traffic volume in Pursat Town is currently low. Traffic flow at the town center during the peak hours will experience some congestion. Delivery of people, goods and services will experience some stretch in travel time. Road users and the clients/patrons of the businesses and market and users of social institutions will be exposed to more road safety hazards. With mitigation measures in place such as segmentation of works, prior consultation/ coordination/collaboration with concerned local authorities, and adequate prior public information, traffic impacts would be moderated.

133. Blocking of accesses to houses, properties, business establishments, the central market and social institutions cannot be avoided win horizontal construction such as the drainage system improvement works, Excavations, storage of RC pipes for installations, loading and unloading activities, stockpiles of wastes/spoils and aggregates, storage of other construction materials, and indiscriminate parking of construction vehicles/equipment will create obstructions to accesses, give inconvenience and nuisance, disrupt daily domestic and economic activities and pose safety hazards. To mitigate: (i) agree on safe accesses to provide with affected households and local authorities; (ii) post clear signage (reflectorized) at active junctions/sections; and (iii) provide adequate lighting at active works sites and provide safe accesses.

134. In the main area of influence of the drainage system improvements, existing water supply lines, drainage system and possibly, some power supply poles will be exposed to potential accidental damage. In case of accidentally damage, service interruptions will be experienced and domestic, social and economic activities will be disrupted. Currently in a very poor state, further damage will be caused by construction trucks on the access road from NR5 to the controlled landfill site. To mitigate impacts: (i) during mobilization, contractor should consult/coordinate with relevant utility companies on/for the exact locations, planned relocation & set contact arrangements in case of damage/s; (ii) consult/coordinate with local road authorities regarding proposed actions to take in case of damaged roads; (iii) in case of accidental damage, immediately inform the concerned company and/or the PIU and PMU; (iv) give at least 1 week prior notice on planned service interruption due to relocation of power supply poles; and (v) plan to provide interim services/actions for damaged utilities/community infrastructures, e.g., scheduled power supply using generators, for street lighting, interim re-surfacing of damaged access roads.

135. The health and safety of the community/public and construction workers will be at high risk during construction. These people will be directly and indirectly exposed to crosscutting threats from construction's impacts on air quality; noise and vibration, traffic; blocked accesses to home, work, markets and social services, among others; open excavations; poorly managed construction wastes, wastewater and spoils; indiscriminate stockpiles of aggregates; hazardous substances transported to and stored on site; accidental spills of hazardous substances; reckless drivers of construction-associated vehicles; potential fire and explosion; and lack of awareness on the hazards posed by subproject implementation

on health and safety. Communicable and transmittable diseases may potentially be brought into the community by construction workers; and/or construction workers may also be potentially exposed to communicable and transmittable diseases in the community and in the workforce. The adequate conduct of community IEC and pre-mobilization orientation for workers will raise the awareness and prepare both stakeholders of the health and safety risks during construction. Responsible C-EMP/EMP implementation by contractors will mitigate the cross-cutting threats during construction. Contractors shall set up a first-response team linked to an ultimate-emergency response team.

136. Inadequate supply of safe/potable water in construction sites; inadequate sanitation facilities; poor sanitation practices on site; poor housing conditions; the handling and operation of construction equipment; handling of hazardous substances; exposure to extreme weather and non-observance of health and safety measures, pose additional threats to the health and safety of construction workers. The Contractors shall ensure: (i) accommodations for workers are safe and adequate and sufficiently supported with basic services; (ii) workers are provided with protective wears and observe the enforced use of these during work.

137. **Impacts on the Sustainability of Works**. During construction, seismic or extreme weather event may occur, causing damage or movement to unsettled/unfinished/uncured structures and affecting their structural integrity. After every event, conduct an engineering investigation of built structures & implement the necessary corrective measures without delay. Prepare written report on the investigation findings & if applicable, the planned or implemented corrective measures

138. **Assessment Summary.** Impacts during construction will be temporary and are expected to be local, confined within the active work sites and their immediate vicinities. Except during windy days, heavy rainfall and/or extreme weather event, dust, fine aggregates, sediments and wastes/ would not be the transported beyond these sites. With proper mitigation measures in place, such as: (i) special care taken at sensitive locations, e.g., riverbank protection sites along the Pursat River, works close to health care and educational institutions; and (ii) ensuring that, when practicable, works are properly phased, segmented and organized so that the bulk of works are completed (or at least almost complete) prior to the commencement of another phase/segment, the potential adverse impacts during construction would be minimized and kept highly site-specific. These impacts will not be sufficient to threaten or weaken the surrounding resources.

139. Measures to keep construction impacts to the minimum or acceptable levels are mostly good engineering and construction practices. A detailed set of mitigation measures are presented in the EMPs (**Annexes F, G** and **H**). The effective conduct of the following are crucial mitigation measures as well: (i) construction management by the Contractor; (ii) supervision of Contractor's EMP (C-EMP) implementation by the Contractor's Environmental Management Engineer; (iii) construction supervision by the PMU; (iv) monitoring of C-EMP implementation by the PMU; (v) observance of the Grievance Redress Mechanism by all concerned parties; and (vi) the participation of concerned communities in the monitoring of C-EMP implementation.

140. In case of chance find of buried physical cultural resource: (i) construction work or any activity should stop immediately; (ii) finder should make a declaration to the local police, who shall communicate it to the Provincial Governor at once; (iii) Governor shall in turn inform the competent authority and ensure protection of the found object/s and the site; (iv) competent authority shall, within 30 days from date of declaration, announce temporary suspension of works and the safeguarding measures to take; and (v) if no such measures are announced within 30 days, temporary suspension shall no longer apply and the competent authority shall decide on the permanent measures to take.

141. In case of chance find of UXO during construction: (i) Construction work should be immediately stopped and area, immediately secured. (ii) The local police should be immediately contacted for ensured security of the area and for them to communicate with the Cambodian Mine Action and Victim Assistance Authority (CMAA). (iii) PIU should immediately inform the PMU, which being based in Phnom Penh, could also coordinate the matter with the CMAA.

E. Impacts and Mitigation Measures during Operation

142. During operation, direct impacts will mainly relate to the operations of the WSPs and controlled landfill. In all three subprojects, inefficient operations, maintenance and repair will lead to unsustained effectiveness of their operations and services.

143. **Wastewater Stabilization Ponds (WSPs)**. Potential impacts of high significance include: (i) odor and gas emissions, pests from ineffective treatment and potentially, noise from any mechanical equipment from inefficient operation/maintenance/repair; (ii) groundwater and soil contamination from events of overflow of un- or inadequately treated wastewater and/or seepage/migration of untreated wastewater due to ineffective liners or unattended cracked liners; (iii) health and safety hazards of workers.

144. Some mitigation measures include: (i) conduct prompt routine maintenance, e.g., clearing/disposal of sludge, floating scum, screenings, grit, other accumulated solids to maximize effectiveness of the processes, pruning/removing grasses growing near the ponds to prevent them from falling and adding solids into the ponds, and/or spraying clean water or the removed floating scum from the facultative ponds on the surface of the anaerobic ponds; (ii) if volume allows or if feasible, capture emitted gases for some possible use in plant operation; (iii) fence in the WSPs and plant insect/pest-repellent trees/shrubs around at adequate distance from the ponds; (iv) undertake prompt maintenance of mechanical equipment; (v) monitor qualities of effluent and groundwater as prescribed in the EMP; (vi) keep the WSPs and pumping station premises clean; (vii) provide workers with protective wears and enforce observance of wearing them while at work; and conduct

145. **Controlled Landfill**. Potential impacts of high magnitude include: (i) air pollution from dust, gas, fumes and odor ; (ii) ground water contamination from leachate and gas migration; (iii) soil contamination from leachate and gas migration; (iv) impact on the landscape from scattered wastes, pests, fumes; (v) pests/rodents/vermin, bird & stray animal attraction; (vi) wind-blown litters; (vii) fire/explosion; (viii) health and safety hazards of, & nuisance for, community along the access road; and (ix) workers health and safety hazards.

146. Some mitigation measures include the: (i) application of soil cover; (ii) watering of access and internal roads and stockpiles of soil cover material; (iii) monitoring of groundwater and gas migration; (iv) implementation of the gas collection and flaring as soon as necessary; (v) recovering of recyclable materials that will emit volatile organics; (vi) leachate monitoring and maintenance of the leachate re-circulating system; (vii) using of litter fence around tipping area; (viii) open garbage trucks to have tarpaulin cover over hauled waste and to maintain 1.5 ft freeboard; (ix) setting up of a first-response team; (x) enforcing upon workers the use of protective wears provided them; (xi) conduct of regular training of landfill staff; and (xii) the conduct of engineering investigation after every seismic or extreme weather event & implementation of the necessary corrective measures without delay.

147. **Drainage Network and Pumping Station.** Inefficiently maintained drainage would emit gas and odor and would reduce capacity of drains. Inefficiently maintained pumps would generate higher noise level, which is a health hazard to workers, and would potentially

cause overflow of WSPs during heavy rains or storms. To mitigate; (i) promptly retrieve accumulated solids from sewers; and (ii) observe regular routine maintenance and prompt repair of pumps.

148. **Improved Waste Collection Fleet and Equipment**. The anticipated salient concerns include: (i) leachate drippings during collection, temporary storage in hook lift bins and haulage; (ii) odor, flies and pests at hook lift bins and their stations, pushcarts, open tipping trucks from lack of keeping the premises and equipment clean; (iii) mud spread with fleet movement to and from the landfill; and health and safety hazards of, & nuisance for, community along the access road and households near to the bin stations. The main measures to mitigate these concerns/impacts are ensuring cleanliness and technical maintenance of equipment and cleanliness of their parking/garage/station areas, as well as wetting or cleaning of tires prior to leaving the landfill particularly during the rainy season.

Broad Mitigation Measures of Direct Impacts during Operation. The magnitude of direct impacts arising from the operation of completed works will highly depend on the degree of environmental considerations made from the start of subproject development through to operation. Some basic measures are as follows: (i) effective supervision of detailed design and construction, and performance monitoring by the PMU; (ii) quality construction by the Contractors; (iii) sufficient provisions in the annual budget for operation, maintenance and repair, as well as for emergency response; (iv) undertaking the recommended environmental effects monitoring during operation; (v) prompt action to raised issues/concerns/ grievances; (vi) Operators to engage/designate a staff to oversee EMP implementation and prepare the required environmental monitoring reports; and (vii) conduct of engineering investigation after every natural hazard event, and prompt action on damages.

149. A detailed set of mitigation measures are presented in **Annexes F, G** and **H**.

F. Impacts and Mitigation Measures during Decommissioning of Open Dumps

150. The salient impacts from remediated dumps are leachate and gas. Soil cover and capping, peripheral drains, adequate side slopes of mounds, groundwater quality monitoring and vigilance on gas migration and prompt actions on groundwater contamination and gas migration are the main mitigation measures.

G. Indirect, Induced and Cumulative Impacts

151. **During Construction.** The proposed embankment protection and drainage improvement works will be the main generator of indirect and induced impacts; the controlled landfill works, to a lesser extent. During intensive rains or storms or in case of flooding or collapse of exposed slopes or newly completed protection works, construction wastes, sediments and hazardous materials would be brought to the Pursat River, polluting the river and posing risks to its resources. During heavy rains or storm and/or flooding, existing drainage systems in the Town center would face risks of being clogged with sediments and wastes from the drainage improvement works thus, exacerbating flooding. The volume of vehicle movements that will be generated and the likely closure/blocking of some roads/lanes leading to the construction sites will cause traffic to build-up in an extended length and choke points in the town center. There will be slower mobility, longer travel time; slower delivery of goods, people and services than usual. A greater number of people will be exposed to safety hazards from traffic and constricted road space. Apart from the applicable mitigation measures recommended in Table V-5, proper coordination with the relevant commune and village authorities, social service institutions and business associations should further mitigate indirect and induced impacts.

152. **Cumulative Impacts.** The screening of cumulative impacts considered the recently completed, planned and programmed projects known as of project preparation. The construction of the access road to the controlled landfill site will generate cumulative impacts of dust, noise, traffic and road safety hazards at the junction of NR5 in line with the extension of water supply line along NR5. The cumulative impacts of both of the embankment protection and drainage improvement works on air quality (dust and noise) and the socio-economic environment (traffic, blocked accesses, accidental damages to utility lines and infrastructure, damage on access roads, public and workers' health and safety) will be high in magnitude and significance. Potential risks of contamination of Pursat River and its resources will be of moderate magnitude and high significance. The magnification of the direct impacts during construction will be due to the possibility of simultaneous construction with at least four to five projects in overlapping areas of influence.

153. To bring cumulative impacts down to acceptable levels:

- Project proponents/implementers must agree to mitigate the magnification of direct impacts through responsible implementation of their respective EMPs.
- There must be adequate consultations with stakeholders and local traffic authorities and coordination among project proponents/implementers for a unified traffic management scheme and public information/disclosure.
- Provide temporary bypass routes in consultation with affected stakeholders and local authorities. This route must first be prepared (e.g., conditioned to accept the traffic spill, installed with signage) and maintained regularly as agreed on by the concerned projects.
- The grievance redress mechanism should be disclosed (through public meetings, display at strategic places and media) to the communities affected by the cumulative impacts.

154. **During Operation.** Indirect, induced and/or cumulative impacts will be the long-term positive benefits of protection and relief from flooding and improved wastewater and solid waste management, leading to improved urban environment, public health and safety and climate change-resilience, and ensuring an urban growth that proceeds sustainably.

H. Unanticipated Impacts during Construction and Operation

155. In the event, unanticipated impacts become apparent during project implementation, the borrower will: (i) inform and seek ADB's advice; (ii) assess the significance of such unanticipated impacts; (iii) evaluate the options available to address them; and (iv) update the IEE including EMP. ADB will help the borrower mobilize the resources required to mitigate any adverse unanticipated impacts or damage.

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

156. Stakeholder consultation and participation was an essential process in project preparation. The process in engaging stakeholders and affected people involved workshops, socio-economic survey and safeguards-specific consultations.

157. Workshops, which had the active involvement of representatives from national ministries and agencies, the six provinces and six municipalities, were held to obtain stakeholders agreement/ confirmation on several aspects of project preparation, including the set of criteria for town prioritization and the selection of priority towns and subprojects. The Inception Workshop of 25 April 2013 resulted, among others, in: (i) a stakeholders' agreement to focus current investments on two towns; (ii) the incorporation of stakeholder's feedback on the set of criteria for town prioritization; and (iii) arriving at the selection of Kampong Chhnang and Pursat for the current project preparation, based on the town

prioritization scoring exercise and recommendation of the executing agency. In the Interim Workshop of 24 June 2014, the stakeholders, among others: (i) confirmed the proposed subprojects for further design and feasibility; and (ii) provided their capacity development needs.

158. A Socio-Economic Survey (SES) was conducted on 19-22 July 2013. It has incorporated environmental queries recommended by the Environmental Specialists of the PPTA, such as those concerning access to and satisfaction/problems with the existing basic services, experiences with natural hazards, priority environmental issues, and perceived benefits from and adverse impacts of the Project. The survey covered 126 households, representing 5% of the total households in villages in which the proposed subprojects will be implemented. Most findings from the survey are presented in the description of socio-economic environment (Section IV-D); others are presented in **Annex E.**

159. Environmental safeguard-specific consultations included: (i) formal discussions/meetings with relevant government institutions; (ii) some brief informal interviews with randomly picked relevant persons during site visits; and (iii) an environmental safeguard public meeting. **Annex E**

160. In the environmental safeguard public meeting held on 24 October 2013 at the Peal Gnaek Pagoda, Pursat Municipality, attended by forty-nine (49) persons representing the population in the subproject sites, the following were presented: (i) general overview of the subprojects; (ii) subproject benefits, positive impacts and outcomes; (iii) potential salient environmental impacts from the subprojects; (iv) proposed measures to mitigate them; (v) existence & implementation of environmental management plans (EMPs) that include environmental mitigation and monitoring; (vi) existence and observance of a grievance redress mechanism during project implementation; and (vii) compliance with Government and ADB environmental safeguard policies. No question, issue or concern was raised during the public meeting.

Table VI-1 Environmental Safeguard Public Meeting

Date	Consultation Venue	Consulted Group	No. of Participants			Issues raised / Discussions / Responses / Outcomes
			Total	M	F	
24 Oct 2013	Peal Gnaek Pagoda, Pursat Municipality	Representatives from Subprojects' villages	51	21	28	No question, issue, concern raised.

161. Stakeholder consultations will continue through subprojects implementation and operation. All stakeholders must be invited and encouraged to participate in community consultations. To facilitate the engagement of stakeholders, the PMU and PIU will maintain good communication and collaboration with Commune Councils and Village Leaders. The PMU, PIU Contractors and/or Operators will be open to contact by the public on matters concerning the progress of the subprojects, adverse impacts, mitigation measures and environmental monitoring and grievances. Future stakeholder consultations will include the following:

- During detailed design, if there would be a major change in design/alignment/location, warranting an update of the IEE, at least one public consultation meeting early on in the IEE update should be held to solicit perceived impacts, issues, concerns and recommendations from affected communities.
- Prior to construction, the PMU and PIU will conduct an intensive information, education and communication (IEC) campaign to ensure sufficient level of awareness/information among the affected communities regarding the upcoming construction, its anticipated impacts, the grievance redress mechanism, contact

details and location of the PMU and PIU, and status of compliance with Government's environmental safeguard requirements, among others, are attained/provided. Billboards about the subprojects, implementation schedule and contact details of the executing agency, PMU, PIU and Contractors will have been set up at strategic locations within the subprojects' main areas of influence. The grievance redress procedure and details will have been posted at the offices of the PMU, PIU, Municipality and concerned Commune Councils and at the residences of concerned Village Leaders.

- During construction, regular random interviews will be conducted by the PMU and PIU every month to monitor environmental concerns of subproject communities.
- During operation and for a certain period during decommissioning of open dumps,, periodic random interviews will be conducted by the PMU and PIU and Operators to monitor the environmental concerns of communities.

162. To date, the following information have been disclosed during an environmental safeguard public meeting held on 24 October 2013 at the Peal Gnaek Pagoda, Pursat Municipality: (i) Sub-project/sub-component descriptions, locations and activities; (ii) environmental benefits, positive impacts and outcomes of the subprojects; (iv) potential salient environmental impacts and mitigation measures, particularly during construction and operation; (v) environmental monitoring that is open to active community participation; (vi) general features of the proposed environmental grievance redress mechanism; and (vii) status of compliance with GoC and ADB safeguards requirements.

163. The IEE (in both English and Khmer), as well as the MoE-approved IEIA/EIA Reports (in Khmer), will be available at the offices of the PMU and PIU for consultation by stakeholders. Copies may be made available upon request. The IEE and environmental monitoring reports will be disclosed on the website of the ADB and MPWT/PMU.

VII. GRIEVANCE REDRESS MECHANISM

A. Proposed Set-Up

164. The MPWT, as executing agency of the IUEMTSBP will establish the GRM, and its support system, including the setting up of the Grievance Redress Committee (GRC) at the subproject (provincial) level. The GRC will comprise of local sangkat or village leaders, representatives of the Municipality (involved in social and environmental concerns), and PIU social and environmental safeguard counterparts. The PMU's social and environmental safeguard staff will oversee the GRM implementation. Their counterparts in the PIUs will ensure the GRM implementation at the town level and will be responsible for keeping the PMU informed. Contractors and Operators will be required to designate their respective counterpart GRM staff. The village leaders, sangkat leaders and social and environmental safeguard staff of the Municipality will serve as grievance access points for APs preferring to approach their local leaders/government.

165. The GRM will accommodate both informally- and formally-lodged, but Project-related, valid grievances. The PMU, PIU and GRC will maintain records of all grievances received, whether informally- or formally-lodged, valid or invalid, and appealed. The PIU will immediately inform the PMU, as necessary, particularly when APs resort to appeal. The PMU will in turn immediately inform the ADB of the same. GRM implementation will be reported by the: (i) PIU in the Subproject's monthly progress reports, semi-annual monitoring reports during construction and annual monitoring reports during operation; and (ii) PMU in the Project's monthly progress report, semi-annual monitoring reports during construction and annual monitoring during operation.

166. Sufficient support system, including well GRM-oriented staff of Contractors and Operators, access point persons at the Municipality, villages and sangkats, communication facilities, documentation/recording, and reporting system, funds, posters declaring contact details and displayed at strategic locations, among others, will be in place to sustain the effective implementation of the mechanism.

B. Access to the Mechanism

167. Any person who has environmental concerns/issues pertaining to the subprojects during detailed design, construction and operation phases will have access to the mechanism free of charge. The PMU, through its social and environmental safeguard staffs and their counterparts in the PIUs, will ensure that:

- the public, especially the residents and regular passers-by, in the main areas of influence of the subprojects, are aware of their rights to access, and will have access to, the GRM free of administrative and legal charges; and
- the GRM is fully disclosed prior to construction: (a) in public consultations and IECs or social/community preparations, (b) through posters displayed in the offices of the PMU, PIU, Municipality and concerned Villages/Sangkats and at strategic places within the main areas of influence of subprojects (posters to include names and contact details of the head and social and environmental safeguard staffs of the PMU and PIU.

C. GRM Steps and Timeframe

168. **Informal Approach.** Informally, an affected person (AP) can lodge complaint directly to the Contractor during construction or Operator during operation. Contractor/Operator will immediately document and screen the complaint. If screening reveals the complaint as Project-related and valid, the Contractor/Operator will act within three days from receipt of complaint. Otherwise, the Contractor/ Operator will direct the AP with non-Project-related and/or invalid complaint to the PIU for the formal approach. The Contractor/Operator will secure a confirmation of completion of action from the AP. For at least a week after confirmation of completion, the PIU will monitor the effectiveness of the action/resolution taken. After which, PIU will secure a written confirmation of satisfaction from the AP. The Contractor/Operator shall report to the PIU all complaints received, eligible or ineligible, actions agreed on and taken, and confirmation of completed action.

169. **Formal Approach.** If informally lodged complaint is valid but is not acted on within three days from receipt of complaint, or if AP is not satisfied with the resolution undertaken by the Contractor/Operator, AP can access the formal mechanism, which comprises of four stages.

First Stage. (Day 1) Complaint is filed at the subproject (town) level, verbally or in writing, with the PIU, village or sangkat resettlement sub-committee, or IRC working group. Complaint is screened if project-related and valid, and AP is immediately informed of the screening results. An AP with complaint screened as non-Project-related and/or invalid will be advised that he/she can raise his/her complaint to the second stage; and receiving agent will formally forward the complaint to the District Office. Project-related and valid will be attended to as follows:

- For social complaints, by the village or sangkat resettlement sub-committee or IRC working group. (Presented in the Resettlement Plan Kampong Chhnang.)
- For environmental complaint, by the PIU; and the steps and timeframe involved in addressing environmental complaint at the first stage are presented below.

Step 1	Investigation, Discussion and Agreement (Day1/Day2)
PIU, together with the Contractor/Operator and AP, will investigate and discuss the complaint at the site within 2 days from filing of complaint. Agreement on actions and measures and time involved will be made with the AP. Agreement will be properly documented and filed; PIU, AP, Contractor/Operator will have copies.	
Step 2	Implementing the Agreed-on Resolution
- If required action is minor, i.e., not requiring further investigation and would be quick and easy to implement, the Contractor/Operator will immediately implement the agreed action. (starting Day2/Day3) - If required action is major, i.e., requiring further investigation and/or procurement of supplies/parts, the Contractor/Operator will: (i) immediately provide the most suitable interim measure to reduce the magnitude of the impact (starting Day 2/Day 3); and (ii) start work on the major action within 5 days from discussion (or not later than Day 8 since receipt of complaint). AP will be advised by the PIU that his/her complaint may be raised to the second level of the GRM, if he/she so prefers when: (i) minor action is not implemented within 2 days from discussion; (ii) interim measure prior to major action is not implemented within 2 days from discussion; or (iii) major action is not started within 5 days from discussion.	
Step 3	Confirmation of Completed Action
	Contractor/Operator will secure a written confirmation of completed action from the AP and furnish the PIU a copy.
Step 4	Confirmation of Satisfaction (1 week after confirmation of completed action)
	The PIU will monitor the effectiveness of the resolution for at least a week after receipt of confirmation of completed action from the Contractor/Operator. After which, PIU will secure a written confirmation of satisfaction from the AP.

Second Stage. For actions not taken within the agreed timeframe and when AP is dissatisfied with the action taken at the First Stage, AP can raise his/her complaint to the District Office. The District Office has 15 days within which to resolve the complaint to the satisfaction of all concerned. If the complaint cannot be solved at this stage, the District Office will bring the case to the Provincial Grievance Redress Committee.

Third Stage. The Provincial Grievance Redress Committee meets with the aggrieved party and tries to resolve the complaint. The Committee may ask for a review by an external monitor (EMO). Within 30 days of the submission of the grievance, the Committee must make a written decision and submit copies to the MPWT, EMO, PRS/IRC and the AP.

Fourth Stage. If the aggrieved AP does not hear from the Provincial Grievance Redress Committee or is not satisfied with the decision, he/she can bring the case to Provincial Court. This is the final stage for adjudicating complaints. The Court will make a written decision and submit copies to MPWT, EMA, PRS/IRC and the AP. If any party is still unsatisfied with the Provincial Court judgment, he/she can bring the case to a higher-level court. The RGC will implement the decision of the Court.

170. The Project's GRM should not impede access to the country's jurisdiction or administrative remedies. Accessing to both of the country's legal system and GRM can be done at the same time. If efforts to resolve disputes using the grievance procedures remain unresolved or unsatisfactory, AP has the right to directly discuss his/her concern/complaint with the ADB's Urban Development and Water Division, Southeast Asia Department through the ADB Cambodia Resident Mission (CARM). If AP is still not satisfied with the responses of CARM, he/she can directly contact the ADB Office of the Special Project Facilitator. The Office of the Special Project Facilitator procedure can carry on based on the accountability mechanism in parallel with the project implementation.

171. The PMU, PIU and GRC will keep records of all lodged and documented/referenced complaints, actions/resolutions taken, AP's written confirmations of completed action and satisfaction, complaints raised to higher levels, lessons learned. The number of grievances recorded and resolved and the outcomes will be displayed at the offices of PIU, PMU and

Municipality and reported in the monthly progress reports, semi-annual monitoring reports during construction and annual monitoring reports during operation, submitted to ADB

172. The PMU will do periodic review of the effectiveness of the GRM in each town and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address complaints. All costs involved in resolving complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the PMU. In cases where AP does not have the writing skills or are unable to express their grievances verbally, he//she may seek third-party assistance of his/her choice.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Mitigation

173. The recommended mitigation measures consist of actions, activities, plans and documents (including resettlement/compensation plan, environmental approval documents, Contractor's EMP) that need to be undertaken, observed, obtained, prepared to prevent, mitigate, or compensate for, the adverse impacts. The broad measures are outlined below; while the specific measures are presented in the Environmental Mitigation Plans (**Annexes F, G** and **H**):

- Ensuring incorporation in detailed design of adequate considerations and conditions relative climate change to sustain the structural integrity and effective operations of completed works.
- Ensuring the engagement of an environment-responsible Contractor by incorporating the SPS-compliant EMPs into the respective bidding documents, for use as basis in the preparation of the Contractor's EMP (C-EMP) by the selected Contractor, addressing as minimum the requirements of the EMP. C-EMP to be quantitatively and qualitatively evaluated against the EMP by the PMU and cleared by ADB prior to the commencement of any work on site. The contract for civil works to explicitly stipulate the obligation to institute the mitigation measures properly and carry out environmental monitoring according to the C-EMP. The Contract to stipulate some tie-up of progress payment and collection of performance bond with the performance in C-EMP implementation.
- A C-EMP that ensures good and environment-friendly engineering practices that avoid first, and (if unavoidable) mitigate, adverse impacts; and commitment from Contractor to fully implement the C-EMP.
- Quality construction supervision and environmental monitoring by the PMU.
- Conduct of engineering investigations of built structures after every seismic and extreme weather events during construction and operation. Disclose investigation reports.
- Sufficient funds for sustained quality of operation and maintenance.
- Observance of the GRM and prompt action/resolution of lodged grievances.

174. The Environmental Mitigation Plan attempts to be comprehensive to, among others: (i) point out that most measures are the usual good engineering practices and are, therefore, not difficult to institute; and (ii) facilitate monitoring/random inspection by the PMU/PIU and relevant institutions.

B. Monitoring and Reporting

175. Environmental monitoring will consist of environmental effects monitoring; and performance monitoring. Performance monitoring will monitor and evaluate the performance of the Design Consultant, Contractor, Operator, PMU and PIU in complying with, or adhering

to, the C-EMP/EMP. The Environmental Monitoring Plans are presented as **Annexes F, G** and **H**.

176. Environmental monitoring activities and findings shall be documented for purposes of reporting, recording, verifying, referring on and evaluating the environmental performance of the Subproject. The documentation shall also be used as basis in correcting and enhancing further environmental mitigation and monitoring.

177. Environmental Monitoring Reports (EMRs) shall be prepared as follows:

- Monthly, by the Contractor during construction and by the Operator during operation, to be submitted to the PIU. The 3rd, 6th, 9th and 12th Monthly EMRs to incorporate the quarterly and, if applicable, semi-annual reports on environmental quality monitoring.
- Monthly, by the PIU, incorporating the monthly reports of Contractors/Operators into the overall monthly progress report of Pursat Town subprojects, to be submitted to the PMU.
- Quarterly, by Contractor and Operator, or if applicable, by an engaged licensed laboratory, reporting on the results of environmental quality monitoring, as specified in the EMP. The 3rd, 6th, 9th and 12th Monthly EMRs to incorporate these quarterly and, if applicable, semi-annual reports on environmental quality monitoring
- Semi-annually during construction and annually during operation until loan closure or as agreed, by the PMU to be submitted to the ADB to fulfill the environmental agreement in the loan.

178. A draft outline for the Semi-Annual and Annual EMR is presented as **Annex I**. The monthly EMRs by the Contractor, Operator and PIU may adopt the outline, as applicable, to facilitate the preparation of the Semi-Annual and Annual EMRs.

C. Implementation Arrangements

179. **Implementation Schedule.** Environmental management will be implemented from the detailed design phase through to procurement, construction and operation. Table VIII-1 presents the indicative time frame of key EMP activities in relation to Subproject implementation schedule.

180. **Institutional Responsibilities.** The institutions that will have major and minor roles in environmental management include the Ministry of Public Works and Transport (MPWT), Department of Public Works and Transport (DPWT), Project Steering Committee (PSC), Project Management Unit (PMU), Project Implementation Unit (PIU), Project Management and Implementation Support (PMIS) Team's Environmental Specialists; the ADB, Design Consultant, Contractor, Operator, (if applicable) Licensed Laboratory, MoE/PDoE, Municipality of Pursat and the relevant Commune Councils. As executing agency, the MPWT will assign a qualified staff to the PMU to serve as full time Environmental Officer. The PMU Environmental Officer will assist each PIU. . The PSC, headed by the MPWT, will be responsible for deciding on environmental management matters that will require action from the senior-management level. The PMU will manage the day-to-day activities of the Subproject. Its PMU Environmental Officer will oversee and monitor the implementation of EMP. The PIU will provide technical support to the PMU Environmental Officer in carrying out the environmental management responsibilities at the town level. The PMIS Team will include an International and National Environmental Specialists, who will impart technical advice, guidance, support and "hands-on training" to the PMU and PIU in subproject environmental management, at least in the first two-three years of implementation. The ADB

will undertake reviews of relevant environmental documents for clearance purposes, and carry out periodic environmental review missions.

181. More specific responsibilities are presented in Table VIII-2. "Prior to construction" period covers the detailed design period until prior to awarding of civil works contract. Construction period covers the period after obtaining ADB's clearance for the C-EMP until commissioning for operation. Operation period commences at commissioning of the completed Subproject.

182. **Capacity Development.** Considering the limited capability of the Project's key players in environmental management, technical assistance from environmental specialists and capacity development during loan implementation will be needed. Capacity development will consist of hands-on training in implementing the responsibilities in EMP (as well as CMEI-EARF) implementation, complemented with a short-term series of lectures/seminars on relevant topics. It will be carried out through the PMIS environmental specialists. (**Annex J**)

183. While carrying out technical assistance, the environmental specialists will ensure that the EMP and CMEI-EARF implementation proceeds as a "hands-on" training for the PMU, particularly its environmental safeguard staff, as well as the PIUs, and will conduct lectures/seminars relevant to EMP and EARF implementation.

184. Preliminary Costs. The marginal costs for implementing the EMP are initially estimated to involve: Table VIII-4

- USD 6,040 (or KHR 24.25 million) for securing approved IEIA/EIA Report;
- USD 49,400 (or KHR 198.3 million) of fixed costs to cover environmental monitoring prior to, and during, construction; and
- USD 36,700 (or KHR 147.5 million) annually for environmental monitoring during operation of the waste stabilization pond.

185. The estimated costs: (i) include taxes and contingencies for deficiencies in assumed unit costs, but exclude inflation; (ii) exclude the salaries of the ESS and his/her counterpart in the PIU, as they will be existing MPWT and DPWT staff seconded to the PMU and PIU, respectively; and (iii) exclude the cost of USD 84,350 for technical assistance from, and "hands-on" training" by, the Environmental Specialists of the PMIS Team for the both of Kampong Chhnang and Pursat.

Table VIII-1 Environmental Management Implementation Schedule

A. Riverbank Protection and Drainage System Improvements

Activity	Indicative Time Frame
SUBPROJECT IMPLEMENTATION	
Detailed Design & Bidding Documents	Q1 - Q3 Y1
Procurement (until award of contract)	Q4 Y1 – Q3 Y2
Construction	Q4 Y2 – Q2 Y4
Supervision of Start-up & Commissioning of WWTP	Q3-Q4 Y4
Final Handover	Q1 Y5
ENVIRONMENTAL MANAGEMENT	
Overall	
1. Project Management and Implementation Support (PMIS)- Mobilization of Envi'l Specialist	Starting Q1 Y1 (for 3-4 yrs of intermittent inputs)
2. PMU's submission of Environmental Monitoring Report (EMR)	
- Quarterly EMR for Subproject's Quarterly Progress Report	- 15th day after effective quarter
- Semi-Annual EMR during construction for submission to ADB	- 15th day after effective 6-mo. period
- Annual EMR during operation for submission to ADB	- 15th day after effective year
Prior to Construction Mobilization	

Activity	Indicative Time Frame
1. Finalization of EMP, (if applicable) revision of IEE	Q2 Y1
2. ADB review & approval of revised IEE & EMP.	Q3 Y1
3. Obtaining IEIA Report approval	Q1 Y2 (at the latest)
4. Community preparation (including disclosure of Final IEE & its EMP)	Q3 Y2
5. Establishment of baseline data (as set out in the EMP)	Q1-Q2 Y2 (shall have been done prior to award of contract)
6. Preparation of C-EMP by selected Contractor, review of C-EMP against SPS-compliant EMP.	Q3 Y2, before start of works on site or establishment of construction-related facilities.
Construction Period Mobilization to Demobilization 1. Implementation of mitigation measures and conduct of environmental effects monitoring following the C-EMP.	Q4 Y2 – Q2 Y4
2. Submission of Environmental Monitoring Report (EMR)	Q4 Y2 – Q2 Y4
- Quarterly, by Contractor(including that of Licensed Laboratory, if applicable)	15th day after effective quarter
Operation Period (potentially could start even before DLP is over) 1. Implementation of mitigation measures & monitoring activities as specified in the EMP	Starting Q3-Q4 Y4
2. Submission of EMR	Starting Q3-Q4 Y4
- Quarterly, by Operator (including that of Licensed Laboratory, if applicable)	15th day after effective quarter

B. Solid Waste Management

Activity	Indicative Time Frame
SUBPROJECT IMPLEMENTATION	
Detailed Design & Bidding Documents	Q2 – Q4 Y1
Procurement (until award of contract)	Q1 – Q4 Y2
Construction	Q4 Y2 – Q3 Y3
Final Handover	Q4 Y3
ENVIRONMENTAL MANAGEMENT	
Overall	
1. Project Management and Implementation Support (PMIS)- Engagement of Envi'l Specialist	Q1 Y1 (for 3-4 yrs of intermittent inputs)
2. PMU's submission of Environmental Monitoring Report (EMR)	
- Quarterly EMR for Subproject's Quarterly Progress Report	- 15th day after effective quarter
- Semi-Annual EMR during construction for submission to ADB	- 15th day after effective 6-mo. period
- Annual EMR during operation for submission to ADB	- 15th day after effective year
Prior to Construction Mobilization	
1. Finalization of EMP, (if applicable) revision of IEE	Q3 Y1
2. ADB review & approval of revised IEE & EMP.	Q4 Y1
3. Obtaining IEIA/EIA Report approval	Q2 Y2 (1st month at the latest)
4. Community preparation (including disclosure of Final IEE & its EMP)	Q3 Y2
5. Establishment of baseline data (as set out in the EMP)	Q2 Y2 (shall have been done prior to award of contract)
6. Compensation/replacements due to land/ ROW acquisition	c/o Resettlement Plan
7. Preparation of C-EMP by selected Contractor, review of C-EMP against SPS-compliant EMP.	Q3 Y2, before start of works on site or establishment of construction-related facilities.
Construction Period	
Mobilization to Demobilization	
1. Implementation of mitigation measures and conduct of environmental effects monitoring following the C-EMP.	Q4 Y2 – Q3 Y3
2. Submission of Environmental Monitoring Report (EMR)	Q4 Y2 – Q3 Y3
- Quarterly, by Contractor(including that of Licensed Laboratory, if applicable)	15th day after effective quarter
Operation/Decommissioning Period (potentially could start even before DLP is over)	
1. Implementation of mitigation measures & monitoring activities as specified in the EMP	Starting Q3 Y3 (remediated dumps) Starting Q4 Y3 (controlled landfill)
2. Submission of EMR	Starting Q3 Y3
- Quarterly, by Operator (including that of Licensed Laboratory, if applicable)	15th day after effective quarter

D. Performance Indicators

186. The preliminary set of environmental performance indicators is meant to evaluate the effects of subprojects' implementation on the environment, i.e., whether or not it is enhancing, sustaining or deteriorating the state of the environment. The indicators are directed on two environmental areas that will be impacted on: (i) the natural resources and (ii) health and safety of the concerned people. The selected indicators are limited to only those that can be measured/gauged from activities during subprojects' implementation and that can be tracked over a defined period. (Table VIII-5)

IX. CONCLUSION AND RECOMMENDATIONS

187. The IEE concludes that:

- The proposed subprojects in Pursat Town are not environmentally critical.

- Except for the Embankment Protection on Pursat River, which by the nature of its intervention will be undertaken on the banks of the Pursat River, the two other subprojects are not within or adjacent to environmentally sensitive areas. Preventive and mitigation measures must be taken to ensure protection of Pursat River from contamination and sedimentation.
- The few impacts of high magnitude (without mitigation) will not be unprecedented and distinct. The closest comparable projects in the past would be the ADB-assisted water supply project completed in 2006 under the Provincial Towns Improvement Project and the JICA-assisted Project for Replacement and Expansion of Water Distribution Systems, completed in mid 2013.
- The extent of adverse impacts is expected to be local, confined within the subprojects' immediate and/or main areas of influence, quarry sites, waste disposal sites, and the routes to and from these sites. Except during windy days, heavy rainfall and extreme weather event, fugitive dust, fine aggregates, sediments and/or wastes would not be the transported beyond the aforementioned sites. With mitigation measures in place and ensuring that the bulk of works are completed (or at least almost complete) prior to the onset of the rainy season, the potential adverse impacts during construction would be highly/more site-specific.
- The few adverse impacts of high significance during construction will be temporary and short-term (i.e., most likely to occur only during peak construction period). These will not be sufficient to threaten or weaken the surrounding resources. The preparation and implementation of a Contractor's EMP that would address as minimum the requirements of the SPS-compliant Subproject EMP will mitigate the impacts and lower their residual significance to at least "moderate" levels. . Simple/uncomplicated mitigation measures, basically integral to socially and environmentally responsible construction practices, are commonly used at construction sites in urban settings and are known to Contractors. Hence, mitigation measures would not be difficult to design and institute.
- The proposed subprojects will be optimally engineered to avoid and/or minimize adverse impacts. As of preliminary design/feasibility study stage, measures have been respectively incorporated to initiate mitigation. (See Section V-C.)
- Direct impacts during operation will come from the wastewater treatment plant, controlled landfill, pumping station and waste collection, mainly from the first two facilities. Guided by Operation Manuals and strengthened by continuing capacity building program, the operations of controlled landfill and waste stabilization ponds are not expected to have long-term, persistent, permanent/irreversible adverse impact on human health and safety, air quality, water quality, soil quality, the biological environment, as well as the lifestyle and means of subsistence of nearest local communities.
- The indirect, induced and cumulative impacts during operation will be mainly positive than adverse.
- The proposed Subprojects will bring about the benefits of: (i) protected embankment on Pursat River, (ii) improved storm- and wastewater management in the Town center, and (iii) improved solid waste collection and disposal. Positive impacts include: (i) relief from flooding from embankment failure and inadequate drainage system; (ii) improved sanitation from wastewater management and treatment; and (iii) reduced or eradicated open and indiscriminate dumping of solid wastes and relief from its associated issues of fumes and uncontrolled gas emissions, odor and nuisance, contamination of water resources, health and safety risks and clogging of drains/sewers.
- Collectively, the three subprojects will bring about improved urban environment and increased climate-change resilience, significantly contributing to a qualitative improvement in the lives of residents in Pursat Town.

188. Based on the above conclusions, although the Subproject may have some adverse environmental impacts, the preparation of an IEE would be sufficient to identify and address these impacts. No further special study or detailed EIA needs to be undertaken to comply with the Safeguard Policy Statement of the ADB. Under GoC policy, an IEIA Report each for the solid waste management and drainage system improvements subprojects is required. Hence, three separate IEIA Reports will need to be prepared and submitted to the MoE to start the government environmental impact assessment process. The IEIA Reports will be based on this IEE.

Table VIII-2 Institutional Responsibilities

Institution	Prior to Construction	During Construction	During Operation and Decommissioning
MPWT	▪ Firm up the necessary collaboration with the MoE for the Subproject's compliance with GoC's environmental safeguard requirements on IEIA/EIA and EMP implementation.		
DPWT	▪ Firm up the necessary collaboration with PDoE & relevant provincial agencies on matters concerning the environmental management of the Subproject.		
PSC	▪ Decide on environmental management matters that will require action from the senior-management level. ▪ Ensure the allocation and timely disbursement of adequate resources for the conduct of environmental quality monitoring activities by the PMU prior to construction as required in the Environmental Monitoring Plan.	▪ Decide on environmental management matters that will require action from the senior-management level.	▪ Decide on environmental management matters that will require action from the senior-management level.
PMU	▪ Update IEE & EMP, as necessary. ▪ Coordinate with Design Consultant to ensure the incorporation of updated findings & mitigation measures in design & bidding documents. ▪ Ensure EMP is part of the bidding documents, EMP clauses are incorporated in bidding documents, contracts. ▪ Ensure MoE approval of IEIA/EIA Report has been secured prior to awarding of civil works. ▪ Review Contractor's EMP (C-EMP) against EMP.	▪ Conduct inspections and spot checks to monitor the performance of the Contractor in implementing the C-EMP/EMP ▪ Review Monthly EMRs of Contractor. ▪ Prepare the Project's Semi-Annual EMRs for submission to ADB.	▪ Conduct inspections and spot checks to monitor the performance of the Operator in implementing the EMP. ▪ Review Monthly & Annual EMRs of Operator. ▪ Prepare the Project's Annual EMR for submission to ADB, until loan closure or as agreed.
PIU	▪ Coordinate and collaborate relevant provincial agencies, as necessary. ▪ Conduct IEC, disclose updated IEE and EMP. ▪ Establish the baseline environmental quality through the conduct (by itself or by an engaged licensed laboratory) of the environmental quality monitoring as prescribed in the EMP ▪ Establish health & safety baseline conditions in affected villages. ▪ Prepare draft Semi-Annual EMR. Submit to PMU for finalization for Project's EMR.	▪ Collate and review monthly EMRs of Contractor, and submit to the PMU. ▪ If a licensed laboratory will be engaged to do independent environmental quality monitoring, oversee & manage the quarterly conduct of the environmental effects monitoring . Review results. ▪ Prepare the draft Semi-Annual EMR and submit to the PMU for finalization and incorporation to the Project's Semi-Annual EMR. ▪ Ensure/manage the observance of the GRM	▪ Collate and review monthly EMRs of Operator, and submit to the PMU. ▪ Prepare the draft Annual EMR and submit to the PMU for finalization and incorporation to the Project's Annual EMR. ▪ Ensure/manage the observance of the GRM

Institution	Prior to Construction	During Construction	During Operation and Decommissioning
PMIS	▪ Provide technical advice/assistance, IEE update ▪ Review bidding documents, review C-EMP against the EMP; confirm subproject readiness. ▪ Conduct lectures for capacity development.	▪ Provide technical advice/assistance,, e.g., preparation of Semi-Annual EMR for ADB, review of results of environmental effects monitoring.	
ADB	▪ Review and clear updated IEE/EMP ▪ Review bidding documents, clear C-EMP, confirm readiness of subproject.	▪ Review Semi-Annual EMR. ▪ Carry out review missions. .	▪ Review Annual EMR. ▪ Carry out review missions. .
Design Consultant	▪ Incorporate mitigation measures in design & bidding documents. ▪ Incorporate EMP as part of bidding documents, EMP clauses in bidding documents, contracts.		
Contractor	▪ Prepare a Contractor's EMP that addresses as minimum the requirements of the EMP.	▪ Implement mitigation measures & conduct internal EMP implementation monitoring. ▪ Conduct environmental quality monitoring as prescribed in SPS-compliant EMP. (If an independent Licensed Laboratory will not be engaged.) ▪ Prepare Monthly EMRs.	
Operator			▪ Implement mitigation measures & conduct internal EMP implementation monitoring. ▪ Prepare Monthly and Annual EMRs.
Licensed Lab (An option)	▪ Conduct baseline environmental quality monitoring as prescribed in the EMP.	▪ Conduct quarterly environmental effects monitoring & report results to the PMU/PIU accordingly.	
MoE/PDoE	▪ Review & approve IEIA/EIA Report.	▪ Monitor compliance with approved IEIA/EIA & EMP.	▪ Monitor compliance with approved IEIA/EIA & EMP.
Municipality	▪ Facilitate obtaining the necessary inputs from, and/or participation/cooperation of, concerned communes and villages through collaboration with their Commune Councils.	▪ Participate in the monitoring of the performance of Contractor in EMP implementation. ▪ Review EMRs & results of environmental effects monitoring. ▪ Assist in ensuring the observance of the GRM.	▪ Participate in the monitoring of the performance of Operator in EMP implementation. ▪ Review EMRs. ▪ Assist in ensuring the observance of the GRM.
Commune Councils	▪ Facilitate (& participate in) public consultation & disclosure, IEC, establishment of baseline community health & safety statistics.	▪ Participate in the monitoring of the performance of Contractor in EMP implementation. ▪ Review EMRs & results of environmental effects monitoring. ▪ Assist in ensuring the observance of the GRM.	▪ Participate in the monitoring of the performance of Operator in EMP implementation. ▪ Review EMRs. ▪ Assist in ensuring the observance of the GRM.

Table VIII-3 Proposed Topics and Estimated Cost for Capacity Development/Training in Environmental Safeguards

Topic	Target Participants	Timing	Duration	Estimated Cost (US$)	
				Lecturer	Venue & Attendance
1. By PMIS Environmental Specialists					
1.1 Legal Framework ▪ Relevant national laws, regulations & standards on environmental assessment & management ▪ ADB SPS 2009 ▪ Environmental assessment & review procedure under the CMEI-EARF 1.2 Environmental Assessment ▪ Rapid environmental assessment ▪ Initial environmental examination 1.3 Some Aspects of EA Process & Environmental Management ▪ Meaningful consultation & info disclosure ▪ Grievance redress mechanism ▪ Environmentally responsible procurement ▪ Occupational & community health and safety	PMU, PIUs PDoE, others Interested (min 4, max 10)	Early stage of PMIS	1 day	c/o PMIS	* 1,600
1.4 EMP Implementation, part 1 ▪ Institution arrangements & responsibilities ▪ Environmental quality monitoring ▪ Emergency response 1.5 EMP Implementation, part 2 ▪ Performance monitoring & indicators ▪ Environmental monitoring report	PMU, PIUs, PDoE, others interested (min 4, max 10)	Early stage of PMIS	1 day	c/o PMIS	* 1,600
1.6 Other relevant topics, such as: A Good engineering and construction practices as mitigation measures B Climate change adaptation (applicable to eligible activities/works under the Project) B.1 Climate change impacts on infrastructure B.2 CC-proofing of infrastructures C Other relevant topics that may be requested by the the MPWT/PMU/PIUs	MPWT, DPWT, PIUs, PMU Others Interested (max 30)	During Project Implementation	2-3 days	^ 1,500	** 14,000
			Sub-Total	1,500	17,200
			Grand Total	**18,700**	

* Estimated max. $150 per participant, to cover: (i) $100 for venue & meals; (ii) $60 for --- $30 per diem, $20 allowance for attendance, and 2-way share taxi transport --- participants coming from outside the venue city/town; and (iii) $20 allowance for attendance of participants from the venue city/town. Assumes at least 2 participants from venue city/town.

** Assumes at least 10 participants or one-third of max. no. of participants are from the venue city/town.

^ Includes fee, per diem and transport

Table VIII-4 Preliminary Costs for EMP Implementation

Activity			Fixed Cost		Recurrent (Annual) Cost	
			Amount	Source of Fund	Amount	Source of Fund
Project Readiness						
A. Preparation of GOC EA documents, appraisal/approval						
1 Preparation of GoC EA documents			c/o detailed engineering design		-	
2 IEIA/EIA Report review and approval			6,040.00	PMU counterpart		
Sub-Total		USD	6,040.00		-	
	(thousand)	KHR	24,250,600.00		-	
Environmental Effects Monitoring						
A. Riverbank Protection						
1 Pre-Construction *			1,930.00	PMU counterpart	-	
2 Construction			6,420.00	Civil works contract	-	
3 Operation			-			
Sub-Total		USD	8,350.00		-	
	(thousand)	KHR	33,525,250.00		-	
B. Drainage System Improvements						
1 Pre-Construction *			2,640.00	PMU counterpart	-	
2 Construction			26,400.00	Civil works contract	-	
3 Operation			-		10,836.00	Operator's budget
Sub-Total		USD	29,040.00		10,836.00	
	(thousand)	KHR	116,595,600.00		43,506,540.00	
C. Solid Waste Management						
1 Pre-Construction *			3,735.00	PMU counterpart	-	
2 Construction			8,268.00	Civil works contract	-	
3 Operation **			-		14,070.00	Operator's budget
4 Decommissioning of remediated dumps			-		11,828.00	Operator's budget
Sub-Total		USD	12,003.00		25,898.00	
	(thousand)	KHR	48,192,045.00		103,980,470.00	
Performance Monitoring						
A. Environmental Safeguards Staff & his/her counterpart in the PIU ^			-		-	
TOTAL		USD	55,433.00		36,734.00	
	(thousand)	KHR	222,563,495.00		147,487,010.00	
Project Implementation Support Technical Assistance						
Environmental Specialists ^^			84,350.00	Output 5	-	

* For establishing baseline prior to mobilization of civil works.

** No decommissioning applicable as Cell 1 will be overtopped when Cell 2 is completed..

^ It is expected that an Environmental Safeguards Staff (ESS) will be MPWT staff seconded/assigned to the PMU; and his/her counterpart in the PIU will be DPWT staff seconded to the PIU.

^^ Covers PMIS TA on EMP implementation in both Kampong Chhnang and Pursat.

Table VIII-5 Performance Indicators

A. Riverbank Protection

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Construction 1 Air emissions Ambient concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during construction - Results of pre-construction air quality monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction ambient level/s.	
		- No complaint lodged regarding health impact or nuisance	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance	- Grievance Redress Mechanism records/ report
2 Noise	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during construction - Results of pre-construction noise monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- % of excess over pre-construction ambient level	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe noise	- Grievance Redress Mechanism records/ report
3 Concentrations of pollutants in Pursat River	- Pre-construction concentration does not exceed the limit set in the national standard.	- Level should be equal or less than the limit set in the national standard.	- No. of parameters that exceeded, & % of excess/es of each over, the limits set in the national standard.	- Results of surface water quality monitoring during construction - Results of pre-construction surface water quality monitoring
	- Pre-construction ambient level exceeds the limit set in the national standard.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact, &/or impacts on fish resources due to river water pollution.	- % of the total HHs downstream of construction site that lodged complaint on health impact &/or impacts on fish resources due to river water pollution.	- Grievance Redress Mechanism records/ report

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
4 Generation of construction-related traffic, especially of big trucks - Public safety hazard/risks		- None or 0% of construction days with road accidents involving construction vehicles.	- % of total construction days with road accidents involving construction vehicles.	- Contractor's & PMU's EMRs - Contractor's Safety Team's records - Grievance Redress Mechanism records/ report - Records/reports of district/municipality police/traffic authorities
		- No accident should result in long-term or permanent injury or fatality.	- % of total construction days with accident that caused serious injuries &/or fatalities	
During Operation				
5 Flooding from the Pursat River due to overtopping		- No overtopping should occur.	- Frequency, say once in 5, 10...years	- Reports of local authorities - Field reconnaissance during flooding
		- No damage to, &/or loss of human life should result.	- Number of people injured and dead.	- Grievance Redress Mechanism records/ report

B. Drainage System Improvements

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Construction 1 Air emissions Ambient concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during construction - Results of pre-construction air quality monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction ambient level/s.	
		- No complaint lodged regarding health impact or nuisance	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance	- Grievance Redress Mechanism records/ report
2 Noise	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during construction - Results of pre-construction noise monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- % of excess over pre-construction ambient level	

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe noise	- Grievance Redress Mechanism records/ report
3 Generation of construction-related traffic, especially of big trucks - Public safety hazard/risks		- None or 0% of construction days with road accidents involving construction vehicles.	- % of total construction days with road accidents involving construction vehicles.	- Contractor's & PMU's EMRs - Contractor's Safety Team's records - Grievance Redress Mechanism records - Records/reports of district/municipality police/traffic authorities
		- No accident should result in long-term or permanent injury or fatality.	- % of total construction days with accident with serious injuries/fatalities.	
During Operation of WSPs				
4 Gas emissions CH_4, NH_4, CO_2, H_2S	- Pre-operation ambient level does not exceed the national standard.	- Level should be equal or less than the pre-operationlevel.	- No. of parameters that exceeded, & % of excess/es of each over, the national standard	- Results of air quality monitoring during operation - Results of pre-operation air quality
	- Pre-operation ambient level exceeds the national standards.	- Level should not exceed the pre-operation ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation ambient level/s.	
	- No complaint.	- No complaint lodged regarding health impact or nuisance	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance	- Grievance Redress Mechanism records/ report
5 Influent and effluent	- Pre-operation level does not exceed the national standard.	- Level should be equal or less than the pre-operation level.	- % of excess over the national standards.	- Results of influent & effluent monitoring during operation
	- Pre-operation level exceeds the national standards.	- Level should not exceed the pre-operation level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation ambient level/s.	
	- No complaint.	- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact	- Grievance Redress Mechanism records/ report
6 Groundwater resource problem	- Pre-operation concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-operation ground-water quality monitoring
	- Pre-operation concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- pre-operation ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-operation level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation level/s.	
	- No complaint.	- No complaint lodged regarding health impact due to deteriorating ground-water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality.	- Grievance Redress Mechanism records/ report

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
7 Concentrations of pollutants in Pursat River	- Pre-operation concentration does not exceed the limit set in the national standard.	- Level should be equal or less than the limit set in the national standard.	- No. of parameters that exceeded, & % of excess/es of each over, the limits set in the national standard.	- Results of surface water quality monitoring during construction - Results of pre-operation surface water quality monitoring
	- Pre-operation ambient level exceeds the limit set in the national standard.	- Level should not exceed the pre-operation level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation level/s.	
	- No complaint.	- No complaint lodged regarding health impact, &/or impacts on fish resources due to river water pollution.	- % of the total HHs downstream of construction site that lodged complaint on health impact &/or impacts on fish resources due to river water pollution.	- Grievance Redress Mechanism records/ report
8 Population of pests, insects, rodents vermin) Health & safety hazard	- No complaint.	- No community complaint lodged on health impact or nuisance from pests, insects, rodents from the landfill.	- % of the total HHs in WSP influence area that lodged complaint on health impacts & nuisance from pests, insects, rodents proven to have been introduced to community after WSP started operation.	- Grievance Redress Mechanism records & report
9 Damage during earthquake or extreme weather event	- No damage	- No damage duriing earthquake or extreme weather event	- No. of days of disruption in WSP services due to damage.	- Operator's field investigation report - Field spot checks & random interviews by PMU/PIU

C. Solid Waste Management

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Construction 1 Air emissions Concentrations of dust/ particulates (PM_{10}, $PM_{2.5}$), SO_2, NO_2 Concentrations of landfill gas, CH_4, CO_2, O_2, H_2S, CO	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during construction - Results of pre-construction air quality monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction ambient level/s.	
		- No complaint lodged regarding health impact or nuisance from severe dust.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe dust	- Grievance Redress Mechanism records/ report

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
2 Noise	- Pre-construction ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- % of excess over the more stringent limit between national standard & WHO Guidelines	- Results of noise monitoring during construction - Results of pre-construction noise monitoring
	- Pre-construction ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- % of excess over the less stringent limit between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction ambient level.	- % of excess over pre-construction ambient level	
		- No complaint lodged regarding health impact or nuisance from noise.	- % of total HHs in main area of influence that lodged complaint on health impact &/or nuisance due to severe noise	- Grievance Redress Mechanism records/ report
3 Groundwater resource problem	- Pre-construction concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-construction ground-water quality monitoring
	- Pre-construction concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact due to deteriorating ground-water quality. water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality. nuisance due to deteriorating groundwater quality.	- Grievance Redress Mechanism records/ report
4 Generation of construction-related traffic, especially of big trucks - Public safety hazard/risks		- None or 0% of construction days with road accidents involving construction vehicles.	- % of total construction days with road accidents involving construction vehicles.	- Contractor's & PMU's EMRs - Contractor's Safety Team's records - Grievance Redress Mechanism records/ report - Records/reports of district/municipality police/traffic authorities
		- No accident should result in long-term or permanent injury or fatality.	- % of total construction days with accident that caused serious injuries &/or fatalities	

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
During Operation of Controlled Landfill (1) and During Decommissioning of Remediated Dumps				
5 Air emissions				
5.1 Concentrations of landfill gas, CH_4, CO_2, O_2, H_2S, CO	- Pre-construction/pre-operation level at landfill site as baseline	- Level should not exceed the pre-operation level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-operation level/s.	- Results of landfill gas monitoring during operation - Results of pre-construction/ pre-operation landfill gas monitoring
		- No worker should get sick due to landfill gas.	- No. or workers that got sick from landfill gas.	- Clinical report/s.
		- No complaint lodged regarding impacts on health, plants, animals from landfill gas migration.	- % of the total HHs in influence area that lodged complaint on health impacts &/or nuisance due to gas migration.	- Grievance Redress Mechanism records/ report
5.2 Ambient air concentrations $PM_{2.5}$, PM_{10}, SO_2, NO_2	- Pre-construction or pre-operation ambient level does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of air quality monitoring during operation - Results of pre-construction or pre-operation air quality monitoring
	- Pre-construction or pre-operation ambient level does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction or pre-operation ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction or pre-operation ambient level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction or pre-operation ambient level/s.	
		- No complaint lodged regarding health impact or nuisance from severe dust.	- % of the total HHs that lodged complaint on health impact or nuisance.	- Grievance Redress Mechanism records/ report
6 Groundwater resource problem	- Pre-construction concentration does not exceed the more stringent limit between national standard & WHO Guidelines .	- Level should be equal or less than the more stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the more stringent limit/s between national standard & WHO Guidelines	- Results of groundwater quality monitoring during construction - Results of pre-construction ground-water quality monitoring
	- Pre-construction concentration does not exceed the less stringent limit between national standard & WHO Guidelines.	- Level should be equal or less than the less stringent limit between national standard & WHO Guidelines.	- No. of parameters that exceeded, & % of excess/es of each over, the less stringent limit/s between national standard & WHO Guidelines	
	- Pre-construction ambient level exceeds the less stringent limit between national standard & WHO Guidelines.	- Level should not exceed the pre-construction level.	- No. of parameters that exceeded, & % of excess/es of each over, the pre-construction level/s.	
		- No complaint lodged regarding health impact due to deteriorating ground-water quality.	- % of total HHs downstream that that lodged complaint on health impact &/or nuisance due to groundwater quality.	- Grievance Redress Mechanism records/ report

Indicator				Data Source
Output & Impact	Baseline Level Scenario	Target Outcome	Performance	
7 Fire & explosion		- No such incidence. - None or 0% of workers injured or lost life.	- % of days in a year when fire &/or explosion occurred due to landfill gas. - % of total workers that encountered injury/fatality from fire/explosion due to landfill gas.	- Hospital records - Village/Commune/Municipality report/s - Report of City Fire Department - Report of Operator's Safety Team/ Landfill Management
8 Population of pests, insects, rodents vermin) Health & safety hazard		- No community complaint lodged on health impact or nuisance from pests, insects, rodents from the landfill.	- % of the total HHs in landfill influence area that lodged complaint on health impacts & nuisance from pests, insects, rodents proven to have been introduced to community after landfill started operation.	- Grievance Redress Mechanism records & report
9 Damage during earthquake or extreme weather event		- No such incidence.	- No. of days of disruption in disposal services due to damage.	- Operator's field investigation report - Field spot checks & random interviews by PMU/PIU

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Annex A. Environmental Quality Standards Applied in the IEE

(Note: International Guidelines are presented, where applicable, to show comparison and will be useful if evaluation of quality monitoring results include checking of how subproject's environmental performance fare with international standards.)

A.1 Ambient Air Quality Standards

Parameter	Averaging Period	Cambodia's Ambient Air Quality Standard (mg/m^3) *	WHO Air Quality Guidelines (mg/m^3)	
			Global Update 2005	1999
CO	8-hour	20	-	10
	1-hour	40	-	30
	30-minute	-	-	60
	15-minute	-	-	100
NO_2	1-year	-	0.04	-
	24-hour	0.1	-	-
	1-hour	0.3	0.2	-
SO_2	1-year	0.1	-	
	24-hour	0.3	0.02	-
	1-hour	0.5	-	-
	10-minute	-	0.5	-
TSP	1-year	0.1	-	-
	24-hour	0.33	-	-
PM_{10}	1-year	-	0.02	-
	24-hour	-	0.05	-
$PM_{2.5}$	1-year	-	0.01	-
	24-hour	-	0.025	-
O_3	8-hour daily max.	-	0.1	-
	1-hour	0.2	-	-
Pb	1-year	-	-	0.0005
	24-hour	0.005	-	-

* Annex 1 of Sub-decree on Control of Air Pollution and Noise Disturbance (No. 42/ANK/BK of 10 July 2000)

A.2 Noise Level Standards

Receptor	Cambodia's Max. Standard of Noise Level Allowable in Public and Residential Areas (dB(A)) *		WHO Guidelines for Community Noise (dB(A))	
Quiet areas: (hospital, library, school, kindergarten)	06:00 - 18:00	45	07:00 - 22:00	55
	18:00 - 22:00	40		
	22:00 - 06:00	35	22:00 - 07:00	45
Residential areas: (hotel, administrative office, villa, flat)	06:00 - 18:00	60	07:00 - 22:00	55
	18:00 - 22:00	50		
	22:00 - 06:00	45	22:00 - 07:00	45
Commercial/service areas & areas of multiple business	06:00 - 18:00	70	07:00 - 22:00	70
	18:00 - 22:00	65		
	22:00 - 06:00	50	22:00 - 07:00	70
Small industrial factories mingling in residential area	06:00 - 18:00	75	07:00 - 22:00	70
	18:00 - 22:00	70		
	22:00 - 06:00	50	22:00 - 07:00	70

* Annex 6 of Sub-decree on Control of Air Pollution and Noise Disturbance (No. 42/ANK/BK of 10 July 2000)

A.3 Surface Water Quality Standards for Biodiversity Conservation

Parameter	Unit	Cambodia's Standard Value *		MRC Guidelines
		River	Lake & Reservoir	
pH	-	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
BOD_5	mg/l	1 - 10	-	-
COD	mg/l	-	1 - 8	< 4
SS	mg/l	25 - 100	1 - 15	-
DO	mg/l	2.0 - 7.5	2.0 - 7.5	> 5.0
Total N	mg/l	-	0.1 - 0.6	< 0.7
Total P	mg/l	-	0.005 - 0.05	0.13
Coliform	MPN/100 ml	< 5000	< 1000	-

* Annex 4 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

A.4 Surface Water Quality Standards for Public Health Protection

Parameter	Unit	Cambodia's Standard Value *
Carbon tetrachloride	µg/l	< 12
Hexachloro benzene	µg/l	< 0.03
DDT	µg/l	< 10
Endrin	µg/l	< 0.01
Dieldrin	µg/l	< 0.01
Aldrin	µg/l	< 0.005
Isodrin	µg/l	< 0.005
Perchloro ethylene	µg/l	< 10
Hexachloro butadiene	µg/l	< 0.1
Chloroform	µg/l	< 12
1.2 Trichloroethylene	µg/l	< 10
Trichloro ethylene	µg/l	< 10
Trichloro benzene	µg/l	0.4
Hexachloroethylene	µg/l	< 0.05
Benzene	µg/l	< 10
Tetrachloroethylene	µg/l	< 10
Cd	µg/l	< 1
Total Hg	µg/l	< 0.5
Organic Hg	µg/l	0
Pb	µg/l	< 10
Cr^{+6}	µg/l	< 50
As	µg/l	< 10
Se	µg/l	< 10
Polychlorobiohenyl	µg/l	0
CN	µg/l	< 0.005

* Annex 5 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

A.5 Groundwater Quality Standards

Parameter	Cambodia's Drinking Water Quality Standards, 2004		WHO Guidelines for Drinking-water Quality *	
	Unit	Maximum Value	Unit	Guideline Value
Physical/chemical				
Taste	-	Acceptable	-	-
Odor	-	Acceptable	-	-
Color	TCU	5	-	-
Turbidity	NTU	5	-	-
Residual Cl	mg/l	0.2 - 0.5	mg/l	0.2 (min. residual)
pH	-	6.5 - 8.5	-	None established
Al	mg/l	0.2	-	None established
NH_3	mg/l	1.5	-	None established
Chloride	mg/l	250	-	None established
Cu	mg/l	I	mg/l	2
Hardness ($CaCO_3$)	mg/l	300	-	None established
H_2S	mg/l	0.05	-	None established
Fe	mg/l	0.3	-	None established
Mn	mg/l	0.1	-	None established
Na	mg/l	200	-	None established
SO_4	mg/l	250	-	None established
TDS **	mg/l	800	-	None established
Zn	mg/l	3	-	None established
Inorganic constituents				
As	mg/l	0.05	mg/l	0.01
Ba	mg/l	0.7	mg/l	0.7
Cd	mg/l	0.003	mg/l	0.003
Cr	mg/l	0.05	mg/l	0.05
CN	mg/l	0.07	-	None established
Fe	mg/l	1.5	-	None established
Pb	mg/l	0.01	mg/l	0.01
Hg	mg/l	0.001	mg/l	0.006
Ni	mg/l	0.02	mg/l	0.07
NO_3	mg/l	50	mg/l	50
NO_2	mg/l	3	mg/l	3
Se	mg/l	0.01	mg/l	0.04
Bacteriological				
Thermotolerant (Fecal Coliform or E. Coli	MPN/100 ml	0	MPN/100 ml	Must not be detectable in any 100 ml sample.
Total coliform	MPN/100 ml	0	MPN/100 ml	

* Fourth Edition, 2011

* Conductivity (µS/cm) can aldo be measured and is roughly equivalent to twice the TDS value.

A.6 Effluent Quality Standards

Parameter	Unit	Cambodia's Allowable Limits for Pollutant Substance Discharge	
		To Protected Public Water Area	To Public Water Area & Sewer
Temperature	°C	< 45	< 45
pH	-	6 - 9	5 - 9
BOD_5 (at 200 °C)	mg/l	< 30	< 80
COD	mg/l	< 50	< 100
TSS	mg/l	< 50	< 80
TDS	mg/l	< 1000	< 2000
Grease and Oil	mg/l	< 5.0	< 15
Detergents	mg/l	< 5.0	< 15
Phenols	mg/l	< 0.1	< 1.2
NO_3	mg/l	< 10	< 20
Cl (free)	mg/l	< 1.0	< 2.0
Cl^-	mg/l	< 500	< 700
SO_4	mg/l	< 300	< 500
Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
PO_4	mg/l	< 3.0	< 6.0
CN	mg/l	< 0.2	< 1.5
Ba	mg/l	< 4.0	< 7.0
As	mg/l	< 0.10	< 1.0
Sn	mg/l	< 2.0	< 8.0
Fe	mg/l	< 1.0	< 20
B	mg/l	< 1.0	< 5.0
Mn	mg/l	< 1.0	< 5.0
Cd	mg/l	< 0.1	< 0.5
Cr^{+3}	mg/l	< 0.2	< 1.0
Cr^{+6}	mg/l	< 0.05	< 0.5
Cu	mg/l	< 0.2	< 1.0
Pb	mg/l	< 0.1	< 1.0
Hg	mg/l	< 0.002	< 0.05
Ni	mg/l	< 0.2	< 1.0
Se	mg/l	< 0.05	< 0.5
Ag	mg/l	< 0.1	< 0.5
Zn	mg/l	< 1.0	< 3.0
Mo	mg/l	< 0.1	< 1.0
NH_3	mg/l	< 5.0	< 7.0
DO	mg/l	> 2.0	> 1.0
Polychlorinated Byphemyl	mg/l	< 0.003	< 0.003
Ca	mg/l	< 150	< 200
Mg	mg/l	< 150	< 200
Carbon tetrachloride	mg/l	< 3	< 3
Hexachloro benzene	mg/l	< 2	< 2
DTT	mg/l	< 1.3	< 1.3
Endrin	mg/l	< 0.01	< 0.01
Dieldrin	mg/l	< 0.01	< 0.01
Aldrin	mg/l	< 0.01	< 0.01
Isodrin	mg/l	< 0.01	< 0.01
Perchloro ethylene	mg/l	< 2.5	< 2.5
Hexachloro butadiene	mg/l	< 3	< 3
Chloroform	mg/l	< 1	< 1
1.2 Dichloro ethylene	mg/l	< 2.5	< 2.5
Trichloro ethylene	mg/l	< 1	< 1
Trichloro benzene	mg/l	< 2	< 2
Hexaxhloro cyclohexene	mg/l	< 2	< 2

* Annex 2 of Sub-decree on Water Pollution Control (No. 27/ANRK/BK of 06 April 1999)

Annex B. Check on Pond Sizes and Load Removal

Item	Description	Unit	Quantity	Comments
1	**INFLUENT FLOW & CHARACTERISTICS**			
1.1	**Design Flow - Wastewater**	**m^3/d**	**1,110**	
	Wastewater Contribution per capita	l/cap.d	65	
	Equivalent Population	No.	17,077	
	BOD Contribution per capita	g/cap.d	45	
	Total Organic Load	kg/d	768	
	Reduction in BOD for existing septic tanks	%	30	
	Adjusted Total Organic Load	kg/d	538	
	Influent BOD Concentration	mg/l	485	
1.2	**Design Flow - Septage**	**m^3/d**	**5**	
	Influent BOD Concentration	mg/l	5,000	
	Organic Load	kg/d	25	
1.3	**Influent Bacterial Concentration (Typical)**	million./100 ml	**100**	
	Reduction in fecal coliforms from Septic Tanks used in Sewer System	%	50	
	Adjusted fecal coliform concentration	million./100 ml	50	
1.4	**Minimum Temperature**	**degrees C**	**25**	
2	**ANAEROBIC PONDS' CHECK**			
2.1	**Anaerobic Pond Loading and Design Hydraulic Retention Time**			
	Design Organic Loading (WW+septage)	kg/d	563	
	BOD Concentration of Influent	mg/l	505	
	Maximum Volumetric Loading to avoid odor problems	$g/m^3.d$	400	
	Design Volumetric Loading	$g/m^3.d$	300	
	Minimum Required Volume	m^3	1,876	
	Check Hydraulic Residence Time (HRT)	d	2	**Minimum is 1.25**
	Volume of aerobic ponds	m^3	2,220	**Thus OK**
2.2	**Estimated BOD Removal in Anaerobic Ponds**			
	Estimated BOD removal in anaerobic Ponds	%	60	Range 50 - 70%
	Selected Value for BOD Removal	mg/l	202	
3	**FACULTATIVE PONDS' CHECK**			
3.1	**Pond Loading and Required Surface Area**			
	Surface BOD Loading - Primary	kg/ha.d	380	
	Surface BOD Loading - Secondary	kg/ha.d	440	
	Selected Surface Loading	kg/ha.d	350	
	Influent BOD to Facultative ponds	mg/l	202	
	Minimum total surface area required	m^2	6,405	
3.2	**Pond Sizing**			
	Design Depth	m	2	
	Number of ponds	No.	4	
	Minimum ssurface area of each pond	m^2	1,601	
	Surface area of proposed ponds	m^2	3,125	**Thus OK**
3.3	**Estimated BOD Concentration in Effluent**			
	Estimated BOD Removal in Facultative Ponds	%	70	
	Effluent BOD	mg/L	61	**Less than 80 thus OK**

Obtained from PPTA Engineer's Final Report on Drainage and Embankment, January 2014

Annex C. Solid Waste Generation/Quantity Projections, Cell Staging and Staged Development Strategy

C.1 Population, Waste Mass and Controlled Landfill Volume Projections

YEAR	Province TOTAL	Provincial Annual Growth Rate	Urban Growth Rate	Projected Serviced Population	Rate of Waste Generation post HH Recycling	Daily Waste Generated	Percent Collected	Daily Waste Collected	Annual Waste Collected	Cumulative Waste Collected	Cumulative Airspace Consumed in Landfill	Landfill Capacity	YEAR
	2008 Census	2008 Census	Medium Growth Scenario		kg/person.day (0.50 increasing to 0.65 over 30 years)	Tonnes/day		Tonnes /day	Tonnes/ year	Tonnes	Cubic Metres (Waste density at 600kg/m3; 15% cover volume; 15% recycling at landfill	Cubic Metres (Stage 1 and Ultimate)	
2008	410,706												2008
2009	415,684	1.21											2009
2010	420,620	1.19											2010
2011	425,673	1.2	2.34	49,100									2011
2012	430,990	1.25	2.34	50,200									2012
2013	436,541	1.29	2.34	51,400	0.5								2013
2014	442,293	1.32	2.34	52,600	0.51								2014
2015	448,221	1.34	2.34	75,700	0.51								2015
2016	454,395	1.38	2.49	77,600	0.52								2016
2017	460,872	1.43	2.49	79,600	0.52								2017
2018	467,602	1.46	2.49	81,500	0.53								2018
2019	474,534	1.48	2.49	83,600	0.53	44	20	9	3,300	3,300	5,400		2019
2020	481,613	1.49	2.49	85,700	0.54	46	25	11	4,200	7,500	12,300		2020
2021	488,836	1.5	2.49	87,900	0.54	47	30	14	5,200	12,700	20,700		2021
2022	496,201	1.51	2.49	90,100	0.55	49	35	17	6,300	19,000	31,000		2022
2023	503,674	1.51	2.49	92,300	0.55	51	40	20	7,500	26,500	43,200		2023
2024	511,229	1.5	2.49	94,600	0.56	52	50	26	9,600	36,100	58,900		2024
2025	518,839	1.49	2.49	97,000	0.56	54	60	33	11,900	48,000	78,200		2025
2026	526,503	1.48	2.47	99,400	0.57	56	70	39	14,400	62,400	101,700		2026
2027	534,392	1.5	2.47	101,900	0.57	58	70	41	14,900	77,300	126,000	134,800	2027
2028	542,076	1.44	2.47	104,400	0.58	60	70	42	15,400	92,700	151,100		2028
2029	550,036	1.47	2.47	107,000	0.58	62	70	43	15,900	108,600	177,000		2029
2030	558,124	1.47	2.47	109,600	0.59	64	70	45	16,400	125,000	203,700		2030
2031		1.47	2.4	112,300	0.59	66	80	53	19,400	144,400	235,300		2031
2032		1.47	2.4	115,000	0.60	68	80	55	20,000	164,400	267,900		2032
2033		1.47	2.4	117,700	0.60	71	80	56	20,700	185,100	301,600		2033
2034		1.47	2.4	120,600	0.61	73	80	58	21,300	206,400	336,300		2034
2035		1.47	2.4	123,400	0.61	75	80	60	22,000	228,400	372,200		2035
2036		1.47	2.3	126,300	0.62	78	85	66	24,100	252,500	411,400		2036
2037		1.47	2.3	129,200	0.62	80	85	68	24,900	277,400	452,000		2037
2038		1.47	2.3	132,200	0.63	83	85	70	25,700	303,100	493,900		2038
2039		1.47	2.3	135,200	0.63	85	85	72	26,500	329,600	537,000		2039
2040		1.47	2.3	138,300	0.64	88	85	75	27,300	356,900	581,500		2040
2041		1.47	2.2	141,300	0.64	90	85	77	28,100	385,000	627,300		2041
2042		1.47	2.2	144,500	0.65	93	85	79	28,900	413,900	674,400		2042
2043		1.47	2.2	147,600	0.65	96	85	82	29,800	443,700	722,900		2043
2044		1.47	2.2	150,900	0.66	99	85	84	30,700	474,400	772,900		2044
2045		1.47	2.2	154,200	0.66	102	85	86	31,600	506,000	824,400		2045
2046		1.47	2.2	157,600	0.67	105	85	89	32,600	538,600	877,500	1,146,900	2046

The population projections are based on the Census figures and growth rates for urban areas. The growth rate for urban areas stated in the Census has been reduced as it is expected that most growth will occur in Phnom Penh rather than provincial cities. So a lower growth rate was adopted. The 'extended' populations have been assumed by 2015 - i.e. the municipalities will have extended their boundaries as they have indicated. Aftyer 2030 a reducing urban growth rate has been adopted for the enlarged service area to the 30 year time horizon.

C.2 Cell Staging

1. The first cell airspace is 134,800 cubic metres which is enough for about 5 years of operation. The second cell in isolation will provide a similar number of years of operation.

2. The next stage of landfilling will be over-topping both the first and second cells to develop a unified single cell which will provide a total of about 12 years capacity, going to a maximum height of approximately 30 metres above the base.

3. The excavation depths for the first cell were based on a number of factors;

- the desire to maximize the separation between the base of the controlled landfill and the water table thereby requiring the excavation depths to be minimised
- the need to provide a balanced cut to fill design such that there would not be excess soil at the completion of Cell 1 nor would there be a need for significant importation of cover material

4. In the end, the adopted excavation depth was approximately 1.4 metres on average. This will provide some 20,200 cubic metres of soil which can be used for cover material for the life of Cell 1.

5. After some 10 years of operation, the excavation levels can then be decided for Cells 3 and 4 to provide the right amount of soil cover based on operational experience to date, as well as protecting the ground water table. This decision does not have to be made until better information is available on actual waste generation rates and local hydrogeology.

6. The capacity of the completed controlled landfill incorporating over-topping of all four cells is some 1,466,900 cubic metres. This will be sufficient capacity for about 30 years of operation. The total mass taken to the site is expected to increase from an estimated 26 tonnes per day in 2016 to over 103 tons per day 30 years later.

7. This cell staging approach is appropriate as most controlled landfills develop the first cells to provide about 5 years of operation and the ultimate site to provide at least 30 years capacity.

C.3 Staged Development Strategy

1. A possible staged excavation and filling program would be as follows;
   - excavate and prepare Stage 1 for filling.
   - fill Stage 1 to the levels shown, while excavating and preparing Stage 2 for filling.
   - fill Stage 2 to the levels shown
   - fill the infill area above Cells 1 and 2 while excavating and preparing Stage 3 for filling.
   - fill Stage 3 to the levels shown.
   - fill the infill area above Cells 1, 2 and 3 while excavating and preparing Stage 4 for filling.
   - fill Stage 4 to the levels shown
   - fill the final infill areas to levels shown on as the final landform

2. The design balances the need for cover material over the life of the landfill with approximately 15% of the airspace consumed as cover. The volume of cover available may be increased or decreased by several means:
   - raising or lowering the base of the future landfill cell areas.
   - varying the slope of the base between a minimum of 1 per cent and a maximum of 10 per cent.
   - varying the thickness of daily cover between 100mm and 150mm depending upon the effectiveness/performance of the waste compaction operation.
   - winning cover from previously placed temporary (internal) batters when placing new waste against them.

Annex D. Environmental Audit Report – Existing Open Dumps

1. The ADB SPS 2009 provides that when the project involves existing activities or facilities, environmental audits will be performed to determine the existence of any areas where the project may cause or is causing environmental risks or impacts. In proposing for the development of a controlled landfill, the associated facilities that will pose environmental risks are the: (i) "closed" dumpsite in Toul Makak Lech Village; and (ii) the existing open dumpsite in Srah Srang Village. This annex, therefore, presents an environmental audit or due diligence of the two open dumpsites and recommends actions for their remediation.

Site Audit/Due Diligence Procedure

2. The site audit/due diligence was carried out using information obtained from (i) key informant interviews; (ii) few brief random interviews; (iii) site visit by the PPTA Environmental Specialists, and (iv) largely from site investigation by the PPTA Solid Waste Specialists.

3. Key informant interviews were conducted during meetings of the Solid Waste Specialists (in May) and Environmental Specialists (in August) with the Municipality and Provincial Department of Environment (PDoE). Brief random interviews were conducted by the Environmental Specialists with: (i) one of the nearest households to the closed dumpsite; (ii) a scavenger couple present at the existing dumpsite during the site visit; and (iii) the household staying within the existing dumpsite as permitted by the owner of the site. Site visit was conducted by the Environmental Specialists in August during the rainy season. Site investigation was conducted by the Solid Waste Specialists in May during the dry season.

4. The main limitations of the audit/due diligence are the: (i) absence of environmental quality monitoring information that would have supported the findings and observations of the site visit and investigation; (ii) absence of a site plan showing the extent, dimensions and locations of areas with waste deposits that would have provided basis for estimating remediation costs; and (iii) lack of opportunity to go back to the sites, local authorities and land owner, for discussion and obtain feedback on the findings and areas of concern and recommended actions for remediation and their proposed funding source/s.

5. The audit/due diligence assumes that even though the waste disposal operations in the existing dump site is on private land, the Municipality and the PDoE have some responsibility over the environmental risks involved in such operations, considering that:

- It is the Municipality that benefits from the operations, i.e., its wastes being collected, hauled and disposed of.
- The Sub-decree on Solid Waste Management rests the responsibility of: (i) establishing guidelines on, and monitoring of, solid waste management on the MoE; and (ii) collecting, transporting, storing, recycling, minimizing and dumping of wastes upon the local administrative authorities --- with the objective of ensuring the protection of human health and the conservation of biodiversity.

Applicable Laws, Regulations and Standards

6. The national laws, regulations, standards, policy and guideline that are applicable and/or relevant to solid waste management are briefly discussed below.

Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-RKM-1296/36) 1996	Article12 - MoE to collaborate with concerned ministries to establish an inventory list indicating: (i) sources, types & quantities of pollutants & wastes that are imported, generated, transported, recycled, treated, stored, disposed, or released into the airspace, water, land or on land surface; (ii) sources, types & quantities of all toxic & hazardous substances that are imported, produced, transported, stored, used, generated, treated, recycled, disposed, or released into airspace, water, land or on land surface; & (iii) sources, types & extent of disturbances by noise & vibrations.
Sub-decree on EIA Proces (Sub-decree No. 72 ANRK.BK) 1999	The detailed guidelines for implementation of the EIA Process. Its Annex requires the conduct of IEIA/EIA on "waste processing, burning activities of all sizes".
Sub-decree on Solid Waste Management (Sub-decree No. 36 ANRK/BK) 1999	Regulates solid waste management to ensure the protection of human health & conservation of biodiversity. This Sub-decree applies to all activities related to disposal, storage, collection, transportation, recycling, dumping of garbage & hazardous waste. Article 4 - (i) MoE to establish guidelines on disposal, collection, transport, storage, recycling, minimizing & dumping of household waste in provincial & city areas in order to ensure that the management of household waste in a safe manner; & on which (ii) authorities in the provinces & cities to formulate their waste management plans for short, medium & long-term implementation. Article 5 – responsibility of collection, transport, storage, recycling, minimizing & dumping of wastes rests on provincial & city authorities. Article 6 - MoE to monitor the disposal, collection, transport, storage, recycling of household wastes. Article 7 – strictly prohibits waste disposal in public areas or any unauthorized site.
Sub-decree on The Joint Declaration Min. of Interior and Min. of Environment on Solid Wastes & Litter Management in Cambodia	Provides a mechanism for joint cooperation & responsibility among relevant agencies to effectively manage solid wastes & litter at provincial & municipal levels aimed at protecting public health, environmental quality & biodiversity. Specifies penalties of between USD2.5 & USD25 for illegal disposal.
Environmental Guidelines on Solid Waste Management, 2006	Applies to all activities related to discarding, storage, collection, transport, recycling, treatment, composting & disposal of all kinds of solid waste. Contains: (i) guideline in the formulation of a solid waste management plan; (ii) a landfill ordinance; (iii) composting ordinance; (iv) guideline in medical waste management; & (v) guideline on environmental education. Landfill Ordinance requires landfills 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 GHGs (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; & (iv) provide information & technical recommendation on the construction, operation & closing/follow-up management of landfills.
Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK), 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. Article 2 – Sub-decree applies to all sources of pollution & all activities that cause pollution of the public water areas. Article 8 - strictly prohibits disposal of solid waste or any garbage or hazardous substances into public water areas or into a public drainage system; & storage or disposal of solid waste or any garbage & hazardous substances leading to pollution water of the public waters. Annexes 2, 4 & 5 provide the standards for industrial effluent applicable to effluent from leachate treatment facilities, water quality for public waters for biodiversity conservation, & water quality for public waters & health, respectively.
Sub-decree on Control of Air	Regulates ambient air quality (Annex 1), hazardous substances in

Pollution and Noise Disturbance (Sub-decree No. 42 ANK/BK, 2000	the air (Annex 2), pollution substances in ambient air from stationary sources (Annex 3), gas emissions from mobile sources (Annex 4), noise emission from vehicles on public roads (Annex 5), noise emission in public and residential areas (Annex 6), & noise control at workplaces (Annex 7). Annexes 1, 2, 3 & 7 are relevant to landfill operations. Annexes 4, 5 & 6 are relevant to waste collection operations.
The National 3R Strategy in Cambodia	Intends to establish an efficient solid waste management system to build on the 3Rs giving jobs, incomes to people, reducing waste amount at dumpsites, without causing severe risks & hazards to the environment, biodiversity & public health. The Strategy states two target years, 2015 & 2020, for the country's 3R achievement.

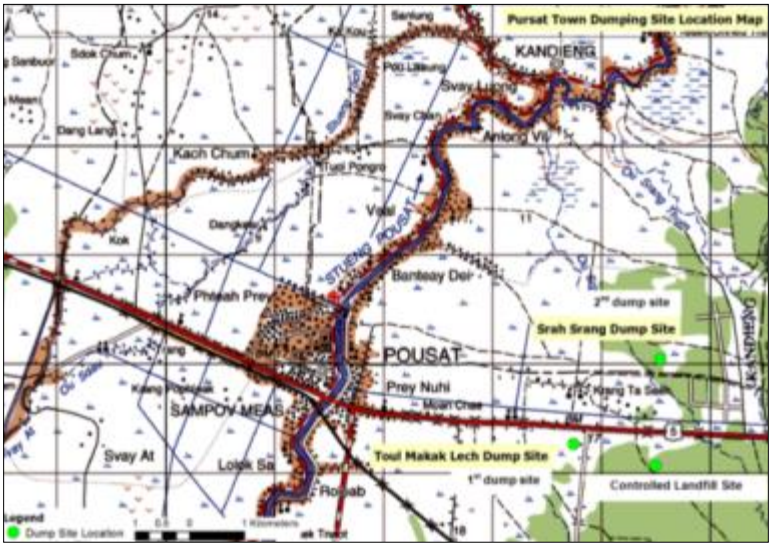
7. The environmental quality standards applicable to the remediation of the dumps are the: (i) Ambient Air Quality Standard, 2000; (ii) Maximum Standard of Noise Level Allowable in the Public and Residential Areas, 2000; (iii) Drinking Water Quality Standards, 2004; and (vi) Effluent Standard for Discharged Wastewater to Public Water Areas or Sewers, 1999, applicable to landfills.

Description of the Existing Open Dumps

8. **Toul Makak Lech Dump Site.** The "closed" dump site is referred to as the Toul Makak Lech Dump Site. It is situated in Toul Makak Lech Village, Roleab Commune, Sampov Meas District (Pursat Municipality) and is about 4 km E of the Town center and S of the National Road 5. It was commissioned in 2001 and was closed in 2004 in response to many neighborhood complaints. The site is public land, originally a total of 2 ha in area, but has become small when parcels of the land were distributed to the households that had informally settled within.

9. Based on the site investigation by the PPTA Solid Waste Management Specialist:
   - The dump site consists of 2 cells both approximately 50 m x 15 m, and formed by pushing up a soil bund 1 to 2 m high, and then filling with waste.
   - There are also small piles of waste and windblown litter around the site.
   - All exposed waste, apart from the windblown litter, has been burnt which will obviously greatly reduce the organic content and liberate most volatiles.
   - One cell is filled to bund level and covered with regrowth including bramble and grass. There were no signs of leachate leaching out of the encircling bund.
   - Other cell is filled in a meter or so of encircling bund top, has ponded water and hyacinth plus water tolerant grasses. There are signs of cattle access into this cell to either drink the water or eat the vegetation. The impounded water was relatively clear and not exhibiting organic contamination from waste leading to anaerobic conditions and gasification. There was no typical leachate odor. One cell end is extended at the level of the bund top with a mixture of soil and waste, covered with bramble and thorn regrowth.
   - The local soil is a sandy silt but with some clay content. Some local dams were full of water which was impounded stormwater not groundwater. Some of the excavations showed clay slicks, thus confirming the clay content of the soil.

Figure 1. Locations of the Closed and Existing Dump Sites



10. During rainy season, the waste cells are under mud and water as shown in Photo 1. In the dry season as related above from the site investigation of the Solid Waste Specialists in May, there are some exposed burnt wastes, but the cells are impounded with water and/or covered with regrowth. In both seasons, therefore, the wastes are no longer noticeable. There are scattered litters in the road track (access to the dump site), which can be easily collected by the Commune or Municipality using a small cart. There are other scattered wastes elsewhere around the site from fly-dumping. (Photo 2)

Photo 1. Toul Makak Lech Dump Site

Site in the rainy season. No sign of solid waste. This photo was taken in August.

11. According to one nearest household, they have not experienced problems with the water from their open dug well. At the time when the dump site was still in operation, odor and flies were their complaints. She has not heard of any complaint on groundwater problems in the village.

Photo 2. Litters in the Access Road Track of Toul Makak Lech Dump Site

12. **Srah Srang Dump Site.** The existing dump site is referred to as the Srah Srang Dump Site. It is situated in Srah Srang Village, Prey Nhi Commune, Sampov Meas District (Pursat Municipality), and is about 5 km E of the Town center, N of National Road 5. It was commissioned in 2004. The land, about 1.5 ha in area, belongs to the private service provider, but will be transferred to the Municipality in 2024. The service provider delivers three truck loads of waste to the site daily, Monday to Sunday. Access to the site is through a rutted laterite road. There is no natural water course in or near to the site. The drain along it is a former borrow pit. The site and its vicinity do not flood, according to the Municipality.

13. Waste is located predominantly in a U shaped area that is 100 m long by 70 m wide. The dumped waste is approximately 20 m wide and two m high around the U shaped disposal area. A further disposal area continues along for another 70 m and again is approximately 20 m wide and up to two m high. Wastes are also dumped on both sides of an old road alignment that is severely environmentally degraded. There is also the evidence of illegal fly dumping along the access road at more than 10 locations. Waste has been previously burnt and there was active combustion at the time of inspection in May (dry season). During the site visit in August (rainy season), the dump site was not burning, but swarmed with flies and birds.

14. The drain adjacent to the site contained water that had obvious leachate stains, but not to the extent of making the water anaerobic and resulting in gasification. There was no obvious leachate odour from the drain. The drain also exhibited signs of surficial cracking indicating substantial clay content. This was confirmed by the presence of slide marks from the excavator bucket along the drain slopes. Given the significant amount of clay in the local soils, it would not be expected that leachate would migrate vertically into the water table below.

15. According to the interviewed scavenger couple, there are 30 scavengers, young and old, operating at the dump site. Most of them are from the Sra Srang Village. The scavenger couple said they operate from 9:00 AM to 6:00 PM with a break during lunchtime and earn USD 50 monthly. During the dry season, when the dump site is burning, they have coughs.

16. Four households, working for the service provider, reside at the dump site. They source water for drinking from an open dug well across their place, outside the dump site. In the dry season, they boil the water from the open dug well for drinking. In the wet season, they collect rain water. They experience skin diseases and frequently have diarrhea. The children do attend school, but have to walk for about 4 to 5 km each way.

Photo 3. Srah Srang Dump Site

Water course (not natural). It is a site drainage channel, a former borrow pit.

Findings and Areas of Concern

17. The salient areas of concern include uncontrolled waste fires and smoke particularly in the dry season, unmanaged leachate, and populations of vermin, flies and birds particularly in the wet season. The following discussion is part of Solid Waste Management of the Final Report and is based on site investigation conducted by the Solid Waste Specialists in May 2013 (at the end of the dry season). Findings from the sites visit of the Environmental Specialists in the wet season are added in (*in italics*).

18. **Existing Fires.** In addition to the obvious environmental damage caused by waste fires, uncontrolled burning represents a serious health and safety risk. Incomplete combustion of the various plastic types at the dump site can result in the formation of carcinogenic by-products such as dioxins. These airborne pollutants are being breathed in by the waste truck drivers, waste pickers, four households staying at the site and farmers of adjacent/nearby rice fields. There are also many safety issues associated with such fires at the disposal site. There may be pressure vessels (gas tanks, pressure cans, etc.) deposited at the site which can explode at the elevated temperatures associated with combustion. Any heavy smoke also presents a major safety problem by severely limiting sight distances. As a result, there is a much greater risk of collisions between vehicles or vehicles and people at the site. The presence of the fire, and also the associated intensity of smoke generation, appears to have been accepted by the local community as a normal aspect of waste management. This is not the case and urgent effort will be required to address this perception problem prior to attempting to remediate the site.

19. In summary, urgent action is required to prevent new fires starting and to stop ongoing. The surface fires should be extinguished and then deeper fires progressively excavated and extinguished as part of the initial activities leading to eventual full remediation.

20. *During the site visit in August in the rainy season, there was no waste fire or smoke. The seasonal occurrence of waste fire and smoke should not be a reason to defer action to prevent waste fire and smoke and to continue exposing the waste haulers, waste pickers, four households staying at the site and farmers of adjacent rice fields to the associated health and safety hazards.*

21. **Existing Leachate.** A number of drains and contiguous water courses were inspected in and around the dumping site. While there was some obvious leachate contamination of the water in drain, the visual extent of the leachate contamination appeared only minor. The water was not black and anaerobic with gasification occurring, but rather just showed some colouration of the water column. Some of the nearby water ponds appeared aerobic/oxic and were visually uncontaminated by leachate. As it was the end of the dry season at the time of inspection, leachate migration from the waste piles would be minimal unless the mound was fully saturated. It is also noted that most of the organics at the site have either degraded due to natural decomposition processes or been incinerated. Therefore, there is very little organic material in the refuse mounds to produce a high biological strength leachate. Whilst the leachate may be weak organically, it may still of course contain inorganics such as heavy metals and biocides. In general, the amount of leachate flow and peripheral contamination was apparently low for such uncontrolled facilities but this is no reason to accept this ongoing pollution.

22. Photo 3 shows the extent of leachate contamination of the water in the drain in the month of August (rainy season). The water is not murky black, indicating weak leachate contamination as of August. However, regardless of the strength of leachate contamination, it is still leachate contamination and should be addressed.

23. **Other Existing Environmental Issues.** Very few vermin were observed on the sites, probably because of the extent and intensity of the fires. There were a number of birds present, but the infestation was not of grave concern. Flies were generally at fairly low densities for such uncontrolled dumping, again due to the burning of putrescible organics such as food scraps.

24. *During the site visit in August, the level of odor was not disturbing. Vermin was not in large population to be noticed easily. Flies were swarming, and birds were in noticeably large population.*

Summary

25. Based on these various impacts, as well as the aesthetic and public health issues, the dump sites require either in-situ (on-site) remediation or hauling to the proposed controlled landfill site.

Remediation Plan

26. The following discussion is part of Solid Waste Management of the Final Report and is based on site investigation conducted by the Solid Waste Specialists in May 2013 (end of the dry season).

27. **Recommended Management Option.** There are two options for managing the dumps:

- One option is through on-site remediation by pushing the previously deposited wastes into a suitable mounded shape, compacting the waste and then covering it with soil, applicable to dumping areas that are small and remote from sensitive areas such as water courses.
- The other option is by excavating and extinguishing the waste, loading it onto trucks and hauling it to the controlled landfill once it is operational, applicable to dumping areas with significant amount of waste and that are potentially environmentally and socially damaging.

28. For both the Toul Makak Lech and Srah Srang Dump Sites, on-site remediation is recommended due to the following reasons, opportunities and/or constraints:

- The volumes of waste are relatively small. The Toul Makak Lech Dump Site operated for 3 years only for the Town market's wastes and household wastes around the market. The Srah Srang Dump Site has been operating for about 9 years but is estimated to have been receiving only 30% of the total waste generated daily in the Municipality.
- The wastes have been burnt so the leachate will be of lower strength organically.
- There is no hazardous industry in the Municipality, which would result in heavy metals and biocides in the waste, leading to a hazardous leachate potential.
- The soil profile contains some clay, thus limiting leachate migration and providing attachment sites for any heavy metals in the leachate.
- Rainwater infiltration leading to leachate generation could be mitigated by pushing the wastes to suitable mounded shape, compacting the wastes, covering the wastes with soil.
- The Sra Srang Dump Site is flood free.
- The Toul Makak Lech Dump Site is almost totally covered with mud, water and regrowth.

29. **On-Site Remediation.** The proposed Solid Waste Management Subproject has included the remediation of old dump sites in the scope of physical works to be designed in detail and constructed. It has indicated the remediation works to be simultaneously undertaken with the construction of the controlled landfill. The most recent proposed arrangement is that the dump sites will be closed by the contractor appointed to build the controlled landfill. It will be overseen by the PMU and PIU. The Government and private land owner of the existing dump site have signified in their intention for the closure of the dump sites through a letter sent to the PPTA Team. The subsequent discussions refer to the option of on-site remediation of existing waste deposits.

30. Closure Protocols In most cases unless the waste pile is extensive and causing local environmental, social or aesthetic concern, it should just be shaped, compacted and covered with soil as per normal landfill operating procedures. A key factor in limiting on-going leachate generation from any remediated secondary dumping sites will be providing reasonable slopes for the final mound shape. The external batters should be graded at the usual 1V:2.5H and the crown should still have a minimum of 5% slope. This will allow for differential settlement throughout the waste mass over time, which can result in ponding of rain water in settled areas if the surface is flat, resulting in excessive infiltration and subsequent leachate formation. Applying cover material is essential. The decision on whether to remediate on site or haul the waste to the landfill will be decided on a case by case basis.

31. Landfill Gas Systems Most remediated dumps just allow landfill gas to escape passively through the cap. This is a very common approach and has few drawbacks in terms of safety or environment. This does not present a safety risk as methane concentrations are minimal in the open atmosphere even relatively close to the final cap. Landfill gas is toxic to tree growth and so if vegetation such as large trees have roots penetrating through the cover material into the waste mass, then they will be stunted or even die. A common alternative to a gas interception system is to provide an extra depth of soil over the impermeable layer for any locations where large trees are proposed.

32. One option for gas management includes installing a rubble layer on the top 1/3 of the final mound surface to facilitate landfill gas migration to passive vents. The gas would then be freely vented to atmosphere through a number of six metre high passive stacks. This system facilitates a path for methane rich landfill gas to vent to atmosphere, which has climate change considerations. However most of the organics in the landfill have already been removed by fire so the quantities of landfill gas to be emitted will not be large.

33. Overall, the inclusion of a gas blanket is not considered necessary as the:
- site is very small;
- gas quantities will be relatively small because of the fires on site to date have removed most of the historically-deposited waste organics;
- there will not be any buildings with basements constructed on the site which could lead to explosive gas pockets forming; and
- growing media plus clay cap will provide sufficient root depth for grasses and small shrubs to survive. If larger trees are to be planted, a localised thickening of the surface growth media will provide sufficient root protection against landfill gas impacts on tree vitality.

34. Leachate Management The proposed final cover design and batter slopes will minimise rainfall infiltration and therefore, leachate generation. Given that the soil has extensive clay content, and the dumping site is very small, it is considered appropriate not to require the installation of a liner under the entire waste mound. Retrospectively installing such a liner would require that all waste is removed and then replaced. This will be a huge cost for what is considered to be of little environmental benefit. To minimise the amount of leachate entering the water table under the site, it is important to minimise the leachate forming within the mound. This is firstly done by profiling the mound and providing suitable final cover, which minimises the volume of leachate generated.

35. An option for further reducing the leachate head would be to provide a peripheral leachate interceptor drain. However this would usually only be required for large dumps and not the locally small size. The interceptor would usually consist of a gravel filled drain under the toe of the final cover. Within the gravel drain would be a 200mm diameter slotted pipe laid at grade. The pipe may be encased with geotextile to limit the intrusion of silt. The pipe would drain to one or more leachate pumping stations. The leachate pumping stations would lift the leachate to irrigate newly planted areas in the dry weather encouraging vegetation cover. This would involve running a permanent pipe to the top of the mound and then having a relocatable pipe attached to this outlet. The relocatable pipe would be moved around the areas to be irrigated as required.

36. Escaping landfill gas is fully saturated and this also passively removes leachate.
Given the relatively small size of the sites, it is recommended that compaction, shaping and application of soil cover should be sufficient without the need for leachate interceptors and pumping stations.

37. Fire Control Fires at waste disposal sites are extremely hard to manage. Small areas of surface combustion can be controlled with water and subsequent application of the soil cover material. However, areas that are smoking due to underground combustion cannot be extinguished just by applying water at the location of smoke egress. Landfills are anisotropic and the smoke plumes resulting from fires at depth often surface some distance laterally from the actual subsurface fire source. Therefore, no matter how much water is applied at the point of smoke emission, there is no guarantee that this water will reach the combustion source. The only way to extinguish subsurface fires is to excavate until the combustion source is reached. The combusting material can then be removed, spread and watered until the fire is extinguished, and the waste then returned to the cell only once it has returned to ambient temperature. Even for small spot fires, this can be a very time consuming and expensive activity.

38. This fire control program will also need to include an education component to remove any belief that merely applying soil as final cover will extinguish all fires in the long term, especially in the upper parts of the waste piles. Any new fires starting in the fresh waste piles, or restarting in the previously worked areas, should be immediately and fully

extinguished as the highest priority. This may require the preparation of a temporary cleared area or intermediately covered existing waste area for placement and management of excavated burning waste.

39. Environmental Management To support such a remediation scheme for a large closure activity, it will usually be necessary be necessary to install a number of groundwater monitoring wells. Such wells may have to be installed for the existing sites but this is unlikely given the small size of the dumping sites. They would be located in such a way as to provide hydrogeologically appropriate upslope and downslope sampling locations for the final mound footprint.

40. If the sampling indicates that groundwater contamination is occurring, then deleaching wells can be installed retrospectively within the waste mound. Groundwater contamination is considered extremely unlikely if the waste is placed correctly, compacted, shaped appropriately, covered and equipped with leachate interceptors systems, in accordance with the general specifications above.

41. Given the small size of the site involved, and the future installation of monitoring wells for the controlled landfill, these additional monitoring wells are not considered necessary.

42. Climate Change Issues The climate change predictions for, and the criteria used in conceptualizing the climate resilience measures for other infrastructure investments in, Cambodia were considered. Locally, the main effect of climate change on solid waste management will be hotter drier summers and more intense rainfall events in the wet season. The hotter and drier summers means that grass and other vegetation planted on waste mounds die due to lack of water and heat stress. This will be overcome by a conscious plan to irrigate the greens. The more extreme wet weather events will be managed by ensuring that the: (i) external batters are protected against erosion resulting from the higher rainfall intensities, e.g., through vegetation, sufficient compaction and slope; and (ii) top of the mound or the plateau area has sufficient grade to lead stormwater away from it. As appropriate, peripheral drainage infrastructure may have to be provided to account for higher rain fall intensities to collect the stormwater runoff on mound sides and divert it away.

Immediate Actions Required

43. Remediation works will be undertaken by the Government simultaneously with the construction of the controlled landfill. While remediation works is designed by project consultants, actions to arrest the intensification of present environmental issues/concerns and reduce remediation costs are below

44. Commitments to close both sites have been sought in October 2013. They serve as assurance that the immediate actions will be implemented, as further discussed and designed during implementation. This will be closely monitored by the PMU and reported monthly by the PMU to the ADB. A loan covenant is included in the loan agreement.

Table D.1 Required Immediate Actions for the Toul Makak Lech Dump Site

Issue	Immediate Action	Responsible Institution/s
Fly dumping practices	Require Commune Council to enforce the provisions of the Joint Declaration of Min. of the Interior & Min. of Environment on Solid Wastes & Litter Management to stop fly-dumping.	Municipality
	Enforce anti fly-dumping, illegal dumping and littering.	Commune Council
	Install legible warning signs against fly-dumping, illegal dumping and littering at strategic points in the village & immediate vicinity of the dump site.	

Issue	Immediate Action	Responsible Institution/s
	Provide waste collection services in the Toul Makak Lech Village to complement the enforcement against fly-dumping.	Municipality
	Collaborate with the HHs residing around the dump site to act as watchers.	Commune Council and Municipality
Wind-blown litters & "fly-dumped" wastes in access road track & vicinity of site	Collect these litters and waste and place them within the partially full cell.	Municipality

Table D.2 Required Immediate Actions for the Srah Srang Dump Site

Issue	Immediate Action	Responsible Institution
Safety in the execution of the required immediate actions	Planning and programming the: (i) extinguishing of ongoing fires/smoke and preventing re-ignition; and (ii) prevention of new fires to start	Municipality, Private Land Owner, DPWT, PDoE
Ongoing fires/smoke	Extinguish ongoing fires and prevent re-ignition: (i) For small area of surface combustion, through watering and subsequent soil cover. (ii) For sub-surface combustion, progressively excavate until the combustion source is reached. Cart the combusting material to a prepared area and spread, water to extinguish the fire. Once it has returned to ambient temperature, reload the waste to the cell or transfer it to the active cell and then apply intermediate cover soil to prevent it from re-igniting. (iii) Remove & extinguish burning tires & other large items on fire.	Private Land Owner (Operator) will be mainly responsible. Municipality to assist through the provision of spreading equipment, water truck, excavator, and/or dozer and some cover soil.
Potential spreading of fire/burning	Do not allow new fires to start by applying intermediate cover soil (300 mm thick) over all previously worked areas not smoking or burning or in	
Start of fire/burning in new areas	Compact the wastes (at least 3 passes). Then, apply intermediate cover soil (300mm thick) over the compacted waste.	Private Land Owner (Operator)

Remediation of Toul Makak Lech Dump Site

45. For the Toul Makak Lech Dump Site, preliminary engineering recommends the following works, which should be validated during detailed design from detailed site investigation:

- Cover of the waste cells with 600 mm think of soil with low permeability and profiled to result in a minimum 5% slope. Do not disturb the perimeter bund of both the full and partially full cells.
- Install two groundwater monitoring wells, situated as appropriate based on the direction of groundwater flow and gradient.

Remediation of the Srah Srang Dump Site

46. For the Srah Srang Dump Site, extinguish fires and smoke first before closure as described above. Close the waste cell or dumping area as follows:

- Load and haul the waste deposited outside the U-Shaped dumping area for placement within the U-shaped dumping area.
- Push the waste forming the U-shaped dumping area over the top of the waste hauled from the external areas, including all the fly dumping waste along the access roads and other isolated patches of waste, to form one consolidated waste mound. Profile the consolidated mound to have a minimum of 5% fall on the plateau area, and 1V:2.5H slopes around the resulting perimeter bund.
- Compact the waste as per normal controlled landfill operations, at least 3 passes.
- Cap the final mound with an impermeable layer of 600 mm of compacted clay.

- Install a 600 mm thick layer of growing media (loam or compost) on top of the impermeable clay cap.
- Installation at least two groundwater monitoring wells, strategically situated in such a way as to provide hydrogeologically upslope and downslope sampling locations for the final mound footprint, as appropriate based on groundwater flow direction and gradient. If sampling indicates that groundwater contamination is occurring, deleaching wells can be installed retrospectively within the waste mound.

Annex E. Notes of Consultations

Information not for disclosure

Annex F. (Draft) Environmental Mitigation and Monitoring Plans – Riverbank Protection

Environmental Mitigation Plan

A. Prior to Construction Phase

A.1 Detailed Engineering Design

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Supervise & Monitor
1 Unsustained effectiveness of service of completed works due to inadequate consideration during design of (any one or combination of) the following: - climate change & the hydrology of the Pursat River - scale of settlement between embankment & river - vulnerability to other natural hazards - relevant feedback from stakeholders - design adaptation options for integral components, such as slopes, road	1.1 Incorporate Pursat River's hydrology & climate change- induced flood level. 1.2 Design to explore alternatives that would mitigate to least possible involuntary resettlement. 1.3 Design to seismic design criteria as regulated in Cambodia 1.4 Design to incorporate relevant issues, concerns & experience of local residents pertaining to existing embankment's coping with climate change events as raised during consultations. 1.5 Few adaptation options for flood and drought. - For slopes: appropriate gradient. If appropriate, landscape with plant species that are both flood- and drought-tolerant, e.g., growing vetiver plant. Optimum degree of compaction. - For road: optimum degree of compaction, use flexible pavement.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*
2 Unsustainable supply of gravel, stone, rock, sand, soil, or unsustainable extraction of these materials to meet construction demand	2.1 Prepare an Aggregates Mgnt Plan (AMP): - confirming location of legal sources for required aggregates - estimating the demand for, & supply from confirmed sources of, aggregates - specifying measures to effectively minimize potential risks of aggregates extraction, transport, loading & unloading - specifying environmental requirements should Contractor opt to operate its own borrow area to serve as basis for Contractor's AMP. 2.2 Specify in bidding documents & contract Contractor's obligation to obtain aggregates only from quarries still operating within allowed extraction threshold according to their environmental clearances & permits to operate.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*

A.2 Obtaining Approvals, and Community Preparation

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
3 Overall environmental concerns/impacts of the Subproject	3.1 Obtain IEIA/EIA approval for the Subproject.	Not applicable	c/o PMU's counterpart budget	PMU	PMIS Envi Sp/ ADB*
4 Potential communicable/transmittable diseases brought with entry of workers & overall health & safety hazards during construction	4.1 Intensive awareness program on communicable/transmittable diseases, e.g., SARS, H1N1, STD, HIV/AIDS, tuberculosis, and diseases that may be brought with entry of workers & on the health and safety hazards during construction.	All affected villages	c/o PMU's counterpart budget	PMU/PIU with health & village officials	PMIS Envi Sp/ ADB*

A.3 Procurement & Prior to Mobilization

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
						Implement	Review/Evaluate &/or Monitor
5	Engagement of environmentally irresponsible contractor for civil works	5.1	A SPS-compliant EMP, as part of bidding documents.	Not applicable	-	PMU	PMIS Envi Sp/ ADB*
		5.2	EMP to be appended to the Contract for basis of preparation of Contractor's EMP (C-EMP) & for compliance.				
		5.3	Contract to require Contractor's submission of monthly environmental monitoring report, outline appended in Contract.				
		5.4	Contract to stipulate some tie up of progress payment & collection of performance bond with performance in C-EMP implementation.				
		5.5	Selected Contractor to prepare detailed C-EMP that addresses as minimum the requirements of the SPS-compliant EMP.				
		5.6	C-EMP to be quantitatively & qualitatively evaluated against EMP.				
		5.7	ADB to clear C-EMP before start of any work on site or establishment of construction-related facilities.				
6	UXO "chance find"	6.1	Workers' pre-orientation workshop to include procedures to follow in case of UXO "chance find". First-response team to coordinate & undergo orientation on management of UXO "chance find" event.	Not applicable	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

B. Construction Phase

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
						Implement	Monitor
PHYSICAL / CHEMICAL ENVIRONMENT							
7	Dust/suspended particles from: - earthworks - dry exposed surfaces - stockpile of dry soils, sand, cement - transport of aggregates, cement, residual soil for disposal & wastes - loading/unloading of fine aggregates, cement and other materials - movements of construction vehicles/ equipment	7.1	Implement segmentation/sectioning of works, as appropriate.	Entire alignment	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
		7.2	Water dry unpaved/exposed surfaces, stockpiles of sand & excavated materials , at least twice daily, or as necessary.	Active work segment	c/o Construction running, set up costs (preliminaries)		
		7.3	Protect stockpiles of soil/sand with a wind barrier/screen. Or, confine stockpiles well within the sites with hoarding.				
		7.4	Wash/wet tires prior to exiting construction sites to remove mud/ dirt. Provide wetting facilities at exit.				
		7.5	Provide hoarding around active sites, where applicable, of not less than 2 m high from ground level, & to extend at least 10 m from edges of segment.	Active work segment, close to settlements			
		7.6	Cover trucks securely, especially those carrying aggregates & cement, with tarpaulin. Trucks to maintain min. 2 feet freeboard.	At entire hauling route	c/o Supplier's cost		
		7.7	Limit speed of all construction-related vehicles in access road to, and in, site to maximum of 30 kph.	Access road to, and in, construction site	-		
		7.8	Minimize drop heights when loading/unloading soil onto trucks/ ground. Spray water on soil being loaded/unloaded.	At the site			

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
8 Noise generated by/from, among others: - the operation of equipment, movement of vehicles (especially those diesel-fed & without effective mufflers) - such processes as drilling/excavation, pavement breaking, concrete mixing, earthmoving, unloading of aggregates, rock crushing	8.1 Use only equipment that emit least noise, e.g. electrically powered equipment, hydraulic tools, those with efficient mufflers. Allow only well-maintained equipment/vehicles	At the site	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	8.2 Set up noise barriers, e.g.: - hoarding around active site, min. 2 m high from ground level; - sound-absorbing enclosure around generator sets; - consider locating site office &/or storage structures such that these can act as noise barriers.				
	8.3 Restrict use of noisy equipment from 8AM-5PM. Overtime work should: not go beyond 9PM, observe regulated noise level, not use noisy equipment, be coordinated with village/commune, & be announced to affected communities at least 5 days in advance.	At the site	-		
	8.4 Strictly enforce upon workers compliance with wearing of ear mufflers, especially those operating the equipment.				
	8.5 Locate noisy generators at max. distance from nearest receptors.				
	8.6 Limit engine idling to a max. of 5 minutes.				
	8.7 Minimize drop heights when loading/unloading coarse aggregates.				
	8.8 Spread out schedule of material, spoil & waste transport, in the day (off-peak traffic hours), or early evening.				
9 Deterioration of surface water resource from improper/inadequate management of the following: - sewage/wastewater - solid & hazardous wastes - sediments, silts - hazardous construction materials	9.1 Provide adequate sanitation facilities, adequate water supply. Strictly enforce observance of sanitation practices.	Active work segment, field offices &, if applicable, workers camp	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.2 Implement an eco-friendly solid/hazardous waste management: - practices waste minimization, reuse and segregation - has adequate covered storage bins/containers, color-coded clearly marked to avoid mixing, especially hazardous wastes - has separate enclosed storage areas for solid & hazardous wastes, that can contain spills, clearly marked/labelled - networks with private individuals/entities that are into waste recovery & recycling to reduce wastes brought to landfills - implements prompt disposal at the Municipality's landfill - coordinates with PDoE the disposal of hazardous waste - workers & hazardous waste contractors to observe safety measures/system when handling hazardous wastes				
	9.3 Implement measures to mitigate sedimentation/siltation. - stockpile on flat grounds & away from, not obstructing, main surface drainage routes, limit to max height of 2 m. - dispose of unsuitable & excess soils as soon as possible	Active work segment			

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
	- avoid stockpiling more aggregates than needed - use any combination of silt fences, sediment basins/traps, sandbags, barrier nets, earth berm/bund, perimeter dike, speed stilling humps, seeding, mulching, establishing general vegetation, whichever would be appropriate.	Active work segment	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.4 Manage the use and storage of hazardous substances: - install visible caution signage at storage areas , secure them from unauthorized entry or use. Must be able to contain spillage. - locate stationary ground storage at least 30 m away from water bodies or groundwater well. Raise to min 1 foot above highest flood level. Or, use mobile storage. - have equipment clearly leaking oil repaired off-site at once. - no vehicle maintenance & refuelling to be allowed at the site. - use less hazardous substances. - store no more hazardous substances on site than needed. - have spill clean up materials for all types of hazardous substances readily available on site.	At the site			
10 Soil erosion due to: - movement & vibration from works & vehicles	10.1 Coordinate work program & ins and outs of vehicles.	Active work segment	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	10.2 Implement measures to mitigate vibration: - During mobilization, identify vibration-sensitive areas &/or structures in the main influence area to plan for the appropriate technology, equipment/ tools & procedure level to apply or use. - Schedule separately ground-impacting activities in a site as much as possible to reduce the intensity of impact. - Limit engine idling to a max. of 5 minutes. - Limit speed to max. 40 kph en route to sites, 30 kph in access road to, & in, site.				
	- Use available equipment & tools that emit least vibrations (as per manufacturer's specifications), or equipped with shock absorber. - Maintain equipment/tools according to specifications.	Active work segment	c/o Construction mobiliz'n & running costs (prelim)		
	10.3 Install signage to warn public/workers on the vulnerable slopes.	Entire alignment			
	10.4 Avoid disturbing more slopes than necessary.	Entire alignment	-		
BIOLOGICAL ENVIRONMENT 11 Impairment of aquatic life in Pursat River	11.1 Implement the appropriate recommended measures to mitigate the deterioration of surface water resources. (No. 9 above)	Entire alignment	c/o Construction (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	11.2 Install clear signage at strategic location along the Pursat River to remind workers of the significance of the water resource.				

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
12 Loss of vegetation within & beyond Subproject footprints, from: - un-guided works un-directed movement of equipment - haphazard stockpiling of materials - haphazard parking of equipment	12.1 During detailed design, determine the required temporary access roads and work easements for temporary disturbance. Include, as appropriate, in the resettlement plan for the rightful compensation.	Not applicable	-	Design Consultant	PMU/PIU & PMIS Envi Sp/ ADB*
	12.2 Prior to clearing & grubbing, physically mark limits for construction footprints, including work easements & if applicable, the required temporary access roads	At active work segment & the required temporary access roads	c/o Construction mobiliz'n cost (preliminaries)	Contractor	
	12.3 Install reflectorized guides, signage &/or markers to direct vehicular/ equipment traffic, storage, stockpiles, parking and works.				
	12.4 Stockpile materials/spoils & park construction vehicles/equipment only in designated areas (with least or no vegetation, as possible)	At active work segment	-		
SOCIO-ECONOMIC ENVIRONMENT					
13 Traffic & road lane blocking, due to: - movements of construction vehicles/ equipment in & out of the main area of influence - roadside parking of construction vehicles & equipment - stockpiling of aggregates, excavated soils, spoils within access road ROW	13.1 Coordinate with village/commune/municipal traffic authorities for: - a scheme to jointly manage the junctions & mitigate impact on main roads; - parking of construction trucks & equipment - stockpiling of aggregates and construction spoils - safe access of private vehicles and pedestrians.	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	13.2 Spread out schedule for materials delivery in non-peak hours.	Active work segment			
	13.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.				
	13.4 Stockpile no more aggregates than needed in the short term.				
	13.5 Dispose of spoils away from active work face at end of day's work.				
	13.6 Post traffic (flag) persons at effective junctions during entire working hours.	Effective junctions	c/o Construction running & mobiliz'n costs (preliminaries)		
	13.7 Post billboards on road/lane closure, traffic rerouting plan at strategic places, min. 1 week prior to effectivity.	Strategically in main influence area			
14 Blocked accesses to properties, social services, economic activities & sources of livelihood, by: - active work segment - parked construction vehicles/equipment - stockpile of aggregates & spoils	14.1 In coordination with village/commune authorities, conduct information campaign during mobilization -- on work phasing & schedules, anticipated access blocking, & provisions for safe access & temporary car parking for blocked garages/driveways.	Affected communities	-	Contractor & PMU/PIU	PMIS Envi Sp/ ADB*
	14.2 At least one week prior to actual access blocking, notify the affected properties. Work together/agree with property owners & concerned villages for the alternative accesses and parking areas.				
	14.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.	Active work segment		Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	14.4 Stockpile no more aggregates than needed in the short term.				
	14.5 Store spoils away from accesses. Dispose of them away from active work face at the end of each day's work.				

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
	14.6 Provide safe access to blocked properties/assets, e.g., steel planks of adequate grade, width and length, &, if needed, with guide rail & adequate signage and lighting.	Affected properties	c/o Construction running cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
15 Accidental damage to power supply poles, water supply pipes, causing disruptions in domestic activities and socio-economic services & activities	15.1 During mobilization: - coordinate work activities & schedule with power supply company, set contact arrangements in case of damage & unavoidable relocation; - post work activities & schedules at strategic places	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	15.2 In case of accidental damage, advise concerned utility company at once. Facilitate quick restoration by clearing obstructions & lending assistance (workers, equipment, tools) in the repair.				
	15.3 Give at least 1 week prior notice on planned service interruption due to relocation of existing utilities. power supply poles,				
16 Community health & safety hazards from, among others: - dust, noise, gas emissions, odor, vibration - affected water resources - inadequate waste/wastewater mgnt - spillage of hazardous substances - fire, explosions, collapse of work structures - blocked accesses to properties, social services, economic activities & sources of livelihoods - open excavations/disturbed areas - movement of construction-associated vehicles/equipment - fire/explosion - rise of communicable/transmittable diseases with entry of workers	16.1 Implement recommended measures to mitigate: - dust, gas emission, odor, noise, vibration - deterioration of surface & groundwater resources & adverse impacts of wastes & hazardous substances - traffic, road blocking	Active work segment	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	16.2 Emergency response preparedness (procedures, trained staff, equipment, tools & supplies, good link to ultimate responders).				
	16.3 Provide safe accesses to blocked properties, social services, economic activities & sources of livelihood.				
	16.4 Install adequate/appropriate lighting & clear signage/warning at, & reflector barrier/hoarding around, active work face/disturbed areas.				
	16.5 Implement work segmentation to minimize disturbing more areas than could be worked at & restored in a day or in short periods.	Entire subproject footprint	-		
	16.6 Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation.				
	16.7 In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.				
	16.8 Remind construction workers regarding responsible practices for health and safety of community.	Not applicable			
17 Workers' health & safety hazards from: - dust, noise, gas emissions, vibration - inadequate waste/wastewater management	17.1 Conduct workers' orientation, prior construction, on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances and noisy & vibrating equipment.	Not applicable	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
- exposure to hazardous substances - exposure to the weather - poor sanitation practices - open pits, disturbed areas - operating equipment & handling of tools - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases in subproject communities - fire, explosion, collapse of disturbed soils & worked-on structures	17.2 Implement recommended measures to mitigate dust, gas emission, noise, vibration; and to manage wastes & hazardous substances	Active work segment	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	17.3 Provide protective wears, e.g., eye & nose masks, ear mufflers, helmets, gloves, appropriate footwear, etc. Enforce their use by workers while at work.				
	17.4 Install adequate lighting, safe accesses to & from active work areas.				
	17.5 Minimize impact from operating noisy/vibrating equipment/tools by ensuring workers' daily exposure value (ELV) is kept within the standard limit, as specified by manufacturer, through shifts to allow breaks from continuous use of equipment by individual worker.	Active work segment	-		
	17.6 Provide safe accommodations.	Workers' camp/s	c/o Construction mobiliz'n & running costs (preliminaries)		
	17.7 Provide adequate water for washing & safe drinking, and adequate sanitation and waste management facilities. Enforce observance of good hygiene, sanitation & waste management practices.	Workers' camp/s & active work segment			
	17.8 Set up emergency response team, equipped with adequate staff, equipment, tools & supplies, and with good link to ultimate responders.	Field office			
	17.9 Arrange with nearest primary & tertiary health institutions for health & emergency care of workers.	Not applicable	-		
	17.10 Enforce upon drivers/operators of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	In & outside construction sites			
	17.11 In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Active work area			
PHYSICAL CULTURAL ENVIRONMENT 18 Damage to physical cultural resource in case of chance find	18.1 Stop work & secure site immediately. Make a declaration to local police. Resume work only when told so by the authority mandated under the Law on the Protection of Cultural Heritage.	Active work area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
SUSTAINABILITY OF WORK 19 Damage during seismic or extreme weather event	19.1 After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	Entire subproject footprint	c/o Construction contingency cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
Sub-Total (Prior to Construction and During Construction)		USD	-		

C. Operation Phase

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	PMU	PMIS Envi Sp / ADB*	Operator	PMU & ADB*
20 Unsustained effectiveness of services due to inefficient operation, maintenance & repair	20.1 Sufficient budget and technical capacity for operation, maintenance and repair.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
21 Damages during seismic or extreme weather events	21.1 After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	Entire improved system	c/o Operations emergency or contingency cost	-	-	-	Implement	Monitor
Sub-Total (During Operation)		USD	-					
TOTAL		USD	-					

[a] No marginal costs. During construction, most costs on Contractors are included in preliminaries. During operation, costs are integral part of annual budget of Operator.

* Preliminarily, PMIS Envi Sp will be provided by combined 20 man-months in the first 3-4 years of Project implementation. After PMIS period, monitoring is assumed to be done thru ADB Review Missions until loan closure.

Environmental Monitoring Plan

I. ENVIRONMENTAL EFFECTS MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
A.	**Prior to Construction Phase** During procurement prior to awarding of contract for civil works						
1	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	**1 upstream & 1 downstream sections more urbanized side**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once**	**1,190.00**	**Licensed Lab (for PMU)**	**PMIS Envi Sp ADB ***
2	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise. Results as baseline data before mobilization.*	**1 upstream & 1 downstream sections more urbanized side**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once**	**130.00**		
3	**Surface water quality** **a) pH, BOD, TSS, COD, DO, Total P, Total N, E-coli, coliform** **b) Cd, Total Hg, Pb, Cu, Cr^{+6}, As, Se, CN** *Review results against Annex 5 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	**Pursat River** **1 upstream & 1 downstream**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once for parameters a) & b)**	**610.00**		
4	**Community health & safety conditions** **- Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases** **- incidence of accidents (vehicular, fire, etc) & crime** *Information as baseline data before mobilization.*	**Villages along alignment of works**	**Information from Commune Council, relevant commune health center, Mun. Health Department, Mun. Government**	**Once**	-		
	Sub-Total (Prior to Construction for baseline data)				**1,930.00**		
B.	**Construction Phase**						
5	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	**1 upstream & 1 downstream reaches of active section**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once quarterly**	**3,570.00**	**Licensed Lab (for Contractor)**	**PMU/PIU** **PMIS Envi Sp ADB ***
6	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	**1 upstream & 1 downstream reaches of active section**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once quarterly**	**390.00**		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring		Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
7	Surface water quality a) pH, BOD, TSS, COD, DO, Total P, Total N, E-coli, coliform b) Cd, Total Hg, Pb, Cu, Cr^{+6}, As, Se, CN *Review results against Annex 5 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	Pursat River 1 upstream & 1 downstream	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once for parameters a) in the 1st quarter. Once for parameters a)+b) the 2nd quarter.	2,460.00		
8	Community health & safety - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Village/s of active section	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once, quarterly	-		
9	Workers' health & safety - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Not applicable	Records of Safety Engineer	Once, quarterly	-		
	Sub-Total (Construction)				6,420.00		
	Sub-Total (Prior to Construction and During Construction)				8,350.00		

II. PERFORMANCE MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
	A. Prior to Construction Phase **A.1 Detailed Design Preparation**						
1	Completion of detailed design & O&M Manual incorporates EMP requirements.	Not applicable	Review of detailed design documents.	Once, prior to finalization Once, prior to approval	Design Consultant	PMU/PIU PMISEnviSp/ADB	-
	A.2 Obtaining Environmental Clearance						
2	IEIA/EIA Report approval obtained	Not applicable	IEIA/EIAR approval document from MoE.	Once, at least 30 days prior to contract award	PMU/PIU	PMIS Envi Sp ADB *	
3	Intensive awareness program on health and safety hazards, communicable/transmittable diseases, on the grievance redress mechanism	All communes along the alignment	Review of relevant report of the PMU/PIU's Social, Environmental & Communication Teams.	Once, at least 30 days prior to contract award			
	A.3 Procurement						
4	Procurement process complied with EMP requirements: SPS-compliant EMP part of bidding documents.	Not applicable	Verifying if EMP among bidding documents.	Once, prior to procurement			
	C-EMP/EMP compliance stipulated in Contract Contract stipulates some tie up of progress payment & collection of performance bond with performance in C-EMP/EMP implementation.	Not applicable	Review of Draft & Final Contract.	Once, during draft Once, prior to signing			

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
	A.4 Post-Procurement Prior to Mobilization						
5	Preparation by selected Contractor its C-EMP, addressing Subproj. EMP requirements as minimum, & includes (but not limited to) plans for: aggregates mgnt; excavation mgnt (linked to removed soil mgnt); dust, noise & vibration controls; gas emission mitigation; sedimentation controls; solid & hazardous waste mgnt; traffic mgnt (to be coordinated with authorities); occupational health & safety; grievance redress; emergency response; environmental monitoring & reporting.	Not applicable	Verifying existence of C-EMP. Evaluating C-EMP against Subproj EMP.	Once prior to mobilization	Contractor	PMU/PIU PMIS Envi Sp ADB *	-
6	Have C-EMP cleared by ADB.	Not applicable	Verifying existence of ADB clearance.	Once prior to mobilization	PMU	PMIS Envi Sp ADB *	
7	Environmental quality monitoring for baseline data according to the EMP.		As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	Once prior to mobilization	Licensed Lab (for PMU)		
	B. Construction Phase						
8	Environmental mitigation implemented according to the C-EMP/EMP.	Active section	Site inspections, random spot checks.	Regular & random	Contractor	PMU/PIU PMIS Envi Sp ADB *	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Monthly			
			Review of records of workers accidents & sick leave.	Monthly			
			Consult relevant commune health center.	Monthly			
			Consult Mun. Health Department.	Monthly			
9	Environmental effects monitoring conducted according to the EMP.	As prescribed in Part I-A. (above)	As prescribed in the Environmental Effects Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-A of this Environmental Monitoring Plan.	Licensed Lab (for Contractor)		
10	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Main area of influence	Review of lodged grievances.	Regular and random	Contractor		
			Consulting village/commune authorities.	Monthly			
11	UXO "chance find" dealt with properly and encountered no injury and/or fatality.	All sections	Review Monthly EMR.	Monthly			
12	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	All sections	Review of investigation & remediation works report.	Latest, 1 week after each event			
13	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
14	Quarterly EMR on impacts monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on impacts monitoring.	Quarterly	Licensed Lab (for Contractor)		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
15	Semi-annual EMR submitted promptly following prescribed outline.	Not applicable	Review of the Semi-annual EMR.	Semi-annually	Contractor & PMU/PIU	PMIS Envi Sp ADB *	-
C.	**Operation Phase**						
16	Measures to mitigate non-sustainability of operation instituted, i.e., allocating adequate budget for proper maintenance & repair, environmental mitigation.	Not applicable	Site inspections, random spot checks, verifying promptness in maintenance & repair, & implementing mitigation measures.	Regular & random	Operator	PMU/PIU, PMIS Envi Sp ADB *	-
17	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	All sections	Review of lodged grievances.	Regular and random			
			Consulting village authorities.	Quarterly			
18	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	All sections	Review of investigation & remediation works report.	Latest, 1 week after each event			
19	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
20	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMISEnviSp/ADB	
TOTAL COST							-

Annex G. (Draft) Environmental Mitigation and Monitoring Plans – Drainage System Improvements

Environmental Mitigation Plan

A. Prior to Construction Phase

A.1 Detailed Engineering Design

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Supervise & monitor
1 Inadequate consideration of the following in design would adversely impact on the sustainability of effectiveness of service & environmental performance of completed works: - climate change & its impacts on storm-water runoff & wastewater treatment - WWTP site's vulnerability to water - logging - sensitiveness of groundwater & soil in WWTP site & its vicinity to wastewater stabilization operations - location of existing crossing utility lines/infrastructure - vulnerability to other natural hazards - relevant feedback from stakeholders	1.1	Incorporate climate change-induced stormwater runoff, impacts on wastewater treatment operations, adaptation options in design of other integral components of the works, e.g., restoring disturbed roads with flexible pavements, peripheral drains around the WWTP, flood- &/or drought-tolerant trees as screens around the WWTP.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB *
	1.2	Design to ensure disturbed section of road is re-surfaced to climate-change resilient quality.				
	1.3	Investigate the following during design for incorporation: - WWTP site's degree of vulnerability to water-logging - depth of water table &soil characteristics in WSP site & vicinity				
	1.4	Design to include at least 2 groundwater monitoring wells.				
	1.5	Design to incorporate the locations of existing utility lines, e.g., water supply pipes, power supply poles.				
	1.6	Apply seismic design criteria as regulated in Cambodia.				
	1.7	Design to incorporate relevant issues, concerns & experience of local residents pertaining to existing drainage & flooding problems.				
2 Unsustainable supply of gravel, stone, rock, sand, soil, or unsustainable extraction of these materials to meet construction demand	2.1	Prepare Aggregates Mgnt Plan (AMP)as basis for Contractor's AMP: - confirming location of legal sources for required aggregates - estimating demand for, & supply from sources of, aggregates - specifying measures to effectively minimize potential risks of aggregates extraction, transport, loading & unloading - specifying environmental requirements should Contractor opt to operate its own borrow area.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp ADB *
	2.2	Specify in bidding documents & contract Contractor's obligation to get aggregates only from quarries still operating within extraction threshold allowed in their environmental clearances & permits to operate.				

A.2 Obtaining Approvals, and Community Preparation

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
3 Loss of land use, secondary structures, trees	3.1	Finalize Resettlement/Compensation Plan, after Det. Measurement Surveys, through highly consultative & participatory process.	All affected villages	c/o detailed design cost	Det. Design Resettlement Sp	PMU/PIU & PMIS Res. Sp
	3.2	At least 30 days before awarding of contract for civil works, losses shall have been fully compensated for according to the approved resettlement & compensation plan.	All affected villages	c/o resettlement cost	PMU/PIU	PMIS Res. Sp/ ADB

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
4 Overall environmental concerns/impacts of the Subproject	4.1 Obtain IEIA/EIA approval for the Subproject.	Not applicable	c/o PMU's counterpart budget	PMU	PMIS Envi Sp/ ADB *
5 Potential communicable/transmittable diseases brought with entry of workers & overall health & safety hazards during construction.	5.1 Intensive awareness program on communicable/transmittable diseases, e.g., SARS, H1N1, STD, HIV/AIDS, tuberculosis, and diseases that may be brought with entry of workers & on the health and safety hazards during construction.	All affected villages	c/o PMU's counterpart budget	PMU/PIU with health & village officials	PMIS Envi Sp/ ADB *

A.3 Procurement & Prior to Mobilization

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Review/Evaluate &/or Monitor
6 Engagement of environmentally irresponsible contractor for civil works	6.1 A SPS-compliant EMP, as part of bidding documents. 6.2 EMP to be appended to the Contract for basis of preparation of Contractor's EMP (C-EMP) & for compliance. 6.3 Contract to require Contractor's submission of monthly environmental monitoring report, outline appended in Contract. 6.4 Contract to stipulate some tie up of progress payment & collection of performance bond with performance in C-EMP implementation. 6.5 Selected Contractor to prepare detailed C-EMP that addresses as minimum the requirements of the SPS-compliant EMP. 6.6 C-EMP to be quantitatively & qualitatively evaluated against EMP. 6.7 ADB to clear C-EMP before start of any work on site or establishment of construction-related facilities.	Not applicable	-	PMU	PMIS Envi Sp/ ADB *
7 UXO "chance find"	7.1 Workers' pre-orientation workshop to include procedures to follow in case of UXO "chance find". First-response team to coordinate & undergo orientation on management of UXO "chance find" event.	Not applicable	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

B. Construction Phase

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
PHYSICAL / CHEMICAL ENVIRONMENT					
8 Dust/suspended particles from: - earthworks - dry exposed surfaces - stockpile of dry soils, sand, cement - transport of aggregates, cement, residual soil for disposal & wastes - loading/unloading of fine aggregates, cement and other materials - movements of construction vehicles/ equipment	8.1 Implement segmentation/sectioning of works, as appropriate. 8.2 Water dry unpaved/exposed surfaces, stockpiles of sand & excavated materials , at least twice daily, or as necessary. 8.3 Protect stockpiles of soil/sand with a wind barrier/screen. Or, confine stockpiles well within the sites with hoarding. 8.4 Wash/wet tires prior to exiting construction sites to remove mud/ dirt. Provide wetting facilities at exit. 8.5 Provide hoarding around active sites, where applicable, of not less than 2 m high from ground level, & to extend at least 10 m from edges of segment.	Entire alignment Active work sites Active work sites, close to settlements	- c/o Construction running, set up costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
	8.6 Cover trucks securely, especially those carrying aggregates & cement, with tarpaulin. Trucks to maintain min. 2 feet freeboard.	At entire hauling routes	c/o Supplier's cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	8.7 Limit speed of all construction-related vehicles in access road to, and in, site to maximum of 30 kph.	Access road to, and in, active work sites	-		
	8.8 Minimize drop heights when loading/unloading soil onto trucks/ ground. Spray water on soil being loaded/unloaded.	At the sites			
9 Noise generated by/from, among others: - the operation of equipment, movement of vehicles (especially those diesel-fed & without effective mufflers) - such processes as drilling/excavation, pavement breaking, concrete mixing, earthmoving, unloading of aggregates, rock crushing	9.1 Use only equipment that emit least noise, e.g. electrically powered equipment, hydraulic tools, those with efficient mufflers. Allow only well-maintained equipment/vehicles	At the sites	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.2 Set up noise barriers, e.g.: - hoarding around active site, min. 2 m high from ground level; - sound-absorbing enclosure around generator sets; - consider locating site office &/or storage structures such that these can act as noise barriers.				
	9.3 Restrict use of noisy equipment from 8AM-5PM. Overtime work should: not go beyond 9PM, observe regulated noise level, not use noisy equipment, be coordinated with village/commune, & be announced to affected communities at least 5 days in advance.	At the sites	-		
	9.4 Strictly enforce upon workers compliance with wearing of ear mufflers, especially those operating the equipment.				
	9.5 Locate noisy generators at max. distance from nearest receptors.				
	9.6 Limit engine idling to a max. of 5 minutes.				
	9.7 Minimize drop heights when loading/unloading coarse aggregates.				
	9.8 Spread out schedule of material, spoil & waste transport, in the day (off-peak traffic hours), or early evening.				
SOCIO-ECONOMIC ENVIRONMENT					
10 Traffic & road lane blocking, due to: - movements of construction vehicles/ equipment in & out of the main area of influence - roadside parking of construction vehicles & equipment - stockpiling of aggregates, excavated soils, spoils within access road ROW	10.1 Coordinate with village/commune/municipal traffic authorities for: - a scheme to jointly manage the junctions & mitigate impact on main roads; - parking of construction trucks & equipment - stockpiling of aggregates and construction spoils - safe access of private vehicles and pedestrians.	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	10.2 Spread out schedule for materials delivery in non-peak hours.	Active work sites			
	10.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.				
	10.4 Stockpile no more aggregates than needed in the short term.				
	10.5 Dispose of spoils away from active work face at end of day's work.				
	10.6 Post traffic (flag) persons at effective junctions during entire working hours.	Effective junctions	c/o Construction running & mobiliz'n costs (preliminaries)		
	10.7 Post billboards on road/lane closure, traffic rerouting plan at strategic places, min. 1 week prior to effectivity.	Strategically in main influence area			

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
11 Blocked accesses to properties, social services, economic activities & sources of livelihood, by: - active work sites - parked construction vehicles/equipment - stockpile of aggregates & spoils	11.1 In coordination with village/commune authorities, conduct information campaign during mobilization -- on work phasing & schedules, anticipated access blocking, & provisions for safe access & temporary car parking for blocked garages/driveways.	Affected communities	-	Contractor & PMU/PIU	PMIS Envi Sp/ ADB*
	11.2 At least one week prior to actual access blocking, notify the affected properties. Work together/agree with property owners & concerned villages for the alternative accesses and parking areas.				
	11.3 Park construction vehicles & equipment & stockpile construction aggregates & spoils according to approved/coordinated scheme.	Active work sites	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	11.4 Stockpile no more aggregates than needed in the short term.				
	11.5 Store spoils away from accesses. Dispose of them away from active work face at the end of each day's work.				
	11.6 Provide safe access to blocked properties/assets, e.g., steel planks of adequate grade, width and length, &, if needed, with guide rail & adequate signage and lighting.	Affected properties	c/o Construction running cost (preliminaries)		
12 Impacts on existing utilities/infrastructure - Accidental damage to power supply poles, water supply pipes, causing disruptions in domestic activities & socio-economic services & activities. - Clogging of existing drainage system with sediments, wastes - Pressure on access roads in Town center from heavy construction vehicles/ equipment	12.1 During mobilization: - coordinate work activities & schedule with power & water supply companies, set contact arrangements in case of damage & unavoidable relocation; - post work activities & schedules at strategic places	Main influence area	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	12.2 In case of accidental damage, advise concerned utility company at once. Facilitate quick restoration by clearing obstructions & lending assistance (workers, equipment, tools) in the repair.				
	12.3 Give at least 1 week prior notice on planned service interruption due to relocation of existing utility lines.				
	12.4 Implement an eco-friendly solid/hazardous waste management: - practices waste minimization, reuse and segregation - has adequate covered storage bins/containers, color-coded clearly marked to avoid mixing, especially hazardous wastes - has separate enclosed storage areas for solid & hazardous wastes, that can contain spills, clearly marked/labelled - networks with private individuals/entities that are into waste recovery & recycling to reduce wastes brought to landfills - implements prompt disposal at the Municipality's landfill - coordinates with PDoE the disposal of hazardous waste - workers & hazardous waste contractors to observe safety measures/system when handling hazardous wastes.	Active work sites	c/o Construction running cost (preliminaries)		
	12.5 Implement measures to mitigate sedimentation/siltation. - stockpile on flat grounds & away from, not obstructing, main surface drainage routes - avoid stockpiling more aggregates than needed				

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
	- dispose of unsuitable & excess soils as soon as possible - use any combination of silt fences, sediment basins/traps, sandbags, barrier nets, speed stilling humps, as appropriate.	Active work sites	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	12.6 Implement measures to mitigate impacts on relevant access roads: - Establish database on (photos of) roads' pre-construction conditions. Monitor regularly to update database. - Agree with local authorities on at least 3 alternative access routes. - Program/spread out the ins & outs of heavy construction trucks, using the agreed on routes alternatively. - Drivers to observe maximum load & speed limit. - Provide interim filling of created road to mitigate safety risks. - For roads clearly damaged by subproject- associated truck traffic/passage, repair damaged road to pre-construction quality following construction.	Main influence area			
13 Community health & safety hazards from, among others: - dust, noise - traffic, blocked/constricted accesses - spillage of hazardous substances - inadequate waste/wastewater mgnt - open excavations/disturbed areas - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases with entry of workers - fire/explosion	13.1 Implement recommended measures to mitigate: - dust, noise, traffic, blocking of accesses	Active work sites	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	13.2 Manage the use and storage of hazardous substances: - install visible caution signage at storage areas , secure them from unauthorized entry or use. Must be able to contain spillage. - locate stationary ground storage at least 30 m away from water bodies or groundwater well. Raise to min 1 foot above highest flood level. Or, use mobile storage. - have equipment clearly leaking oil repaired off-site at once. - no vehicle maintenance & refuelling to be allowed at the site. - use less hazardous substances. - store no more hazardous substances on site than needed. - have spill clean up materials for all types of hazardous substances readily available on site.				
	13.3 Implement eco-friendly solid/hazardous waste management. (10.4)				
	13.4 Provide adequate sanitation facilities, adequate water supply in sites. Strictly enforce observance of sanitation practices.				
	13.5 Implement work segmentation to minimize disturbing more areas than could be worked at & restored in a day or in short periods.	Entire subproject footprint	-		
	13.6 Install adequate/appropriate lighting & clear signage/warning at, & reflector barrier/hoarding around, active work face/disturbed areas.	Active work sites	c/o Construction mobiliz'n cost		
	13.7 Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	To and from the sites	-		
	13.8 Remind construction workers regarding responsible practices for health and safety of community.	Not applicable			

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
	13.9	In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Active work sites	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
14 Workers' health & safety hazards from: - dust, noise, gas emissions, vibration - inadequate waste/wastewater management - exposure to hazardous substances - exposure to the weather - poor sanitation practices - open pits, disturbed areas - operating equipment & handling of tools - movement of construction-associated vehicles/equipment - rise of communicable/transmittable diseases in subproject communities - fire, explosion, collapse of disturbed soils & worked-on structures	14.1	Conduct workers' orientation, prior construction, on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances and noisy & vibrating equipment.	Not applicable	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	14.2	Implement recommended measures to mitigate dust, gas emission, noise, vibration; and to manage wastes & hazardous substances	Active work sites			
	14.3	Provide protective wears. Enforce their use by workers while at work.				
	14.4	Install adequate lighting, safe accesses to & from active work areas.				
	14.5	Minimize impact from operating noisy/vibrating equipment/tools by ensuring workers' daily exposure value (ELV) is kept within the standard limit, as specified by manufacturer, through shifts to allow breaks from continuous use of equipment by individual worker.	Active work sites	-		
	14.6	Provide safe accommodations.	Workers' camps	c/o Construction mobiliz'n & running costs (preliminaries)		
	14.7	Provide adequate potable/non-potable water & sanitation & waste management facilities. Enforce observance of good sanitation & waste management practices.	Workers' camps & active work sites			
	14.8	Set up emergency response team, equipped with adequate staff, equipment, tools & supplies, with good link to ultimate responders.	Field office			
	14.9	Arrange with nearest primary & tertiary health institutions for health & emergency care of workers.	Not applicable	-		
	14.10	Enforce upon drivers/operators of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	In & outside construction sites			
	14.11	In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Active work sites			
PHYSICAL CULTURAL ENVIRONMENT 15 Damage to physical cultural resource in case of chance find	15.1	Stop work & secure site immediately. Make a declaration to local police. Resume work only when told so by the authority mandated under the Law on the Protection of Cultural Heritage.	Active work sites	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
SUSTAINABILITY OF WORK 16 Damage during seismic or extreme weather event	16.1	After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	Completed works	c/o Construction contingency cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
Sub-Total (Prior to Construction and During Construction)			USD	-		

[a] No marginal costs. During construction, most costs on Contractors are included in preliminaries. During operation, costs are integral part of annual budget of Operator.

* Preliminarily, PMIS Envi Sp will be provided by combined 20 man-months in the first 3-4 years of Project implementation. After which, monitoring is assumed to be done thru ADB Review Missions until loan closure.

C. Operation Phase

	Potential Environmental Impacts		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Operation Phases			Operation Phase	
						Det. Design Consultant	PMU	PMIS Envi Sp / ADB*	Operator	PMU & ADB*
17	Air, gas emissions, odor	17.1	Haul & dispose of sludge from sewers & WSP in controlled landfill, or as allowed by the Government.	WSPs	c/o Operations running cost	-	-	-	Implement	Monitor
		17.2	Undertake regular maintenance of the WSP. Keeping its premises clean.							
		17.3	Line WSP perimeter fence with trees, but should not be too close to ponds.							
18	Deterioration of surface water quality	18.1	Undertake water and effluent quality monitoring as prescribed in the EMP and institute prompt corrective actions.	WSPs	c/o Operations running cost	-	-	-	Implement	Monitor
		18.2	Undertake regular maintenance of facility (ponds & mechanical equipment) and implement upgrade of process and facility as soon as warranted, to ensure effective treatment.							
		18.3	Accommodate finishing pond/s in future expansion of the facility.							
19	Deterioration of groundwater and soil quality	19.1	Undertake water and effluent quality monitoring as prescribed in the EMP and institute prompt corrective actions.	WSPs	c/o Operations running cost	-	-	-	Implement	Monitor
		19.2	Conduct thorough engineering investigation of ponds after every seismic & extreme weather events. Implement corrective action without delay.							
		19.3	Do not plant trees too close to allow its roots to destroy the liners.							
		19.4	Mow or deweed the open grounds regularly to prevent worms from populating within the facility & digging holes into the liners.							
20	Community health & safety hazards	20.1	Undertake environmental effects monitoring as prescribed in the EMP and institute prompt corrective actions.	Nearby communities	c/o Operations running cost	-	-	-	Implement	Monitor
		20.2	Undertake regular maintenance of system (network, pumping station, stabilization ponds & mechanical equipment) and implement upgrade of process and facility as soon as warranted, to ensure effective treatment.	Entire system						
		20.3	Secure WSP from unauthorized entry.	WSPs						
		20.4	Set up an operational first-response team equipped with trained staff, equipment & supplies.							
		20.5	In the event of an upcoming extreme wet weather event, institute measures to mitigate impacts of potential unanticipated overflow, which should be included in the O&M Manual. Warn the nearest communities timely.							

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	PMU	PMIS Envi Sp / ADB*	Operator	PMU & ADB*
21 Workers health & safety hazards	21.1 Undertake regular maintenance of facility (ponds & mechanical equipment) and implement upgrade of process and facility as soon as warranted, to ensure effective treatment. Provide protective wears & enforce their use. 21.2 Conduct workers' orientation on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances, among others. Conduct regular drills in case of overflow & natural hazard.	WSP	c/o Operations running cost	-	-	-	Implement	Monitor
22 Unsustained effectiveness of services due to inefficient operation, maintenance & repair	22.1 Sufficient budget and technical capacity for operation, maintenance and repair.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
23 Damages during seismic or extreme weather events	23.1 After every seismic or extreme weather event, conduct engineering investigation of built structures & implement corrective measures without delay.	Entire improved system	c/o Operations emergency or contingency cost	-	-	-	Implement	Monitor
Sub-Total (During Operation)		USD	-					
TOTAL		USD	-					

Environmental Monitoring Plan

I. ENVIRONMENTAL EFFECTS MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
A.	**Prior to Construction Phase** During procurement prior to awarding of contract for civil works						
1	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	Town proper and WSP site	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	2,380.00	Licensed Lab (for PMU)	PMIS Envi Sp ADB *
2	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise. Results as baseline data before mobilization.*	Town proper and WSP site	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once	260.00		
3	**Community health & safety conditions** **- Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases** **- incidence of accidents (vehicular, fire, etc) & crime** *Information as baseline data before mobilization.*	Affected villages	Information from Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once	-		
	Sub-Total (Prior to Construction for baseline data)				2,640.00		
B.	**Construction Phase**						
4	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Active work sites	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once quarterly	23,800.00	Licensed Lab (for Contractor)	PMU/PIU PMIS Envi Sp ADB *
5	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	Active work sites	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once quarterly	2,600.00		
6	**Community health & safety** **- Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases** **- incidence of accident, fire & crime**	Village/s of active work sites	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once, quarterly	-	Contractor	

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
7	**Workers' health & safety** - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Not applicable	Records of Safety Engineer	Once, quarterly	-	Contractor	PMU/PIU PMIS Envi Sp ADB *
	Sub-Total (Construction)				26,400.00		
	Sub-Total (Prior to Construction and During Construction)				29,040.00		
C.	**Operation Phase**						
8	**Gas monitoring** CH_4, NH_4, CO_2, H_2S *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	WSPs	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	2,618.00	Operator	PMU/PIU PMIS Envi Sp ADB *
9	**Influent & effluent** pH, BOD, COD, TSS, TDS, NO3, DO, PO4, pathogens *Review results against Annex 2 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	WSPs	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, every 2 months	4,026.00		
10	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	2 outside WSP, based on direction of flow and gradient	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	1,752.00		
11	**Surface water quality at Pursat River** a) pH, BOD, TSS, COD, DO, Total P, Total N, E-coli, coliform b) Cd, Total Hg, Pb, Cu, Cr^{+6}, As, Se, CN *Review results against Annex 5 of Sub-decree No.27/ANRK/BK (1999). Results as baseline data before mobilization.*	Pursat River 1 upstream & 1 downstream of outfall of unused irrigation channel	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once for parameters a) & b)	2,440.00		
12	**Workers' health & safety** - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Not applicable	Records of Safety Engineer	Once, quarterly	-		
	Sub-Total (During Operation)				10,836.00		

II. PERFORMANCE MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
A.	**Prior to Construction Phase**						
	A.1 Detailed Design Preparation						
1	Completion of detailed design & O&M Manual incorporates EMP requirements.	Not applicable	Review of detailed design documents.	Once, prior to finalization Once, prior to approval	Design Consultant	PMU/PIU PMISEnviSp/ADB	-
	A.2 Obtaining Environmental Clearance						
2	IEIA/EIA Report approval obtained	Not applicable	IEIA/EIAR approval document from MoE.	Once, at least 30 days prior to contract award	PMU/PIU	PMISEnviSp/ADB	
3	Intensive awareness program on health and safety hazards, communicable/transmittable diseases, on the grievance redress mechanism	Affected villages	Review of relevant report of the PMU/PIU's Social, Environmental & Communication Teams.	Once, at least 30 days prior to contract award			
	A.3 Procurement						
4	Procurement process complied with EMP requirements: SPS-compliant EMP part of bidding documents.	Not applicable	Verifying if EMP among bidding documents.	Once, prior to procurement			
	C-EMP/EMP compliance stipulated in Contract	Not applicable	Review of Draft & Final Contract.	Once, during draft Once, prior to signing			
	Contract stipulates some tie up of progress payment & collection of performance bond with performance in C-EMP/EMP implementation.						
	A.4 Post-Procurement Prior to Mobilization						
5	Preparation by selected Contractor its C-EMP, addressing Subproj. EMP requirements as minimum, & includes (but not limited to) plans for: aggregates mgnt; excavation mgnt (linked to removed soil mgnt); dust, noise & vibration controls; gas emission mitigation; sedimentation controls; solid & hazardous waste mgnt; traffic mgnt (to be coordinated with authorities); occupational health & safety; grievance redress; emergency response; environmental monitoring & reporting.	Not applicable	Verifying existence of C-EMP. Evaluating C-EMP against Subproj EMP.	Once prior to mobilization	Contractor	PMU/PIU PMIS Envi Sp ADB *	-
6	Have C-EMP cleared by ADB.	Not applicable	Verifying existence of ADB clearance.	Once prior to mobilization	PMU	PMISEnviSp/ADB	-
7	Environmental quality monitoring for baseline data according to the EMP.		As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	Once prior to mobilization	Licensed Lab (for PMU)		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
B.	**Construction Phase**						
8	Environmental mitigation implemented according to the C-EMP/EMP.	Active work sites	Site inspections, random spot checks.	Regular & random	Contractor	PMU/PIU PMIS Envi Sp ADB *	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Monthly			
			Review of records of workers accidents & sick leave.	Monthly			
			Consult relevant commune health center.	Monthly			
			Consult Mun. Health Department.	Monthly			
9	Environmental effects monitoring conducted according to the EMP.	As prescribed in Part I-A. (above)	As prescribed in the Environmental Effects Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-A of this Environmental Monitoring Plan.	Licensed Lab (for Contractor)		
10	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Main area of influence	Review of lodged grievances.	Regular and random	Contractor		
			Consulting village/commune authorities.	Monthly			
11	UXO "chance find" dealt with properly and encountered no injury and/or fatality.	Active work sites	Review Monthly EMR.	Monthly			
12	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Completed works	Review of investigation & remediation works report.	Latest, 1 week after each event			
13	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
14	Quarterly EMR on impacts monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on impacts monitoring.	Quarterly	Licensed Lab (for Contractor)		
15	Semi-annual EMR submitted promptly following prescribed outline.	Not applicable	Review of the Semi-annual EMR.	Semi-annually	Contractor & PMU/PIU	PMISEnviSp/ADB	-
C.	**Operation Phase**						
16	Measures to mitigate non-sustainability of operation instituted, i.e., allocating adequate budget for proper maintenance & repair, environmental mitigation.	Not applicable	Site inspections, random spot checks, verifying promptness in maintenance & repair, & implementing mitigation measures.	Regular & random	Operator	PMU/PIU, PMIS Envi Sp ADB *	-
17	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Area of influence	Review of lodged grievances.	Regular and random			
			Consulting village authorities.	Quarterly			
18	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Completed works	Review of investigation & remediation works report.	Latest, 1 week after each event			
19	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
20	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMISEnviSp/ADB	
TOTAL COST							-

Annex H. (Draft) Environmental Mitigation and Monitoring Plans – Solid Waste Management

Environmental Mitigation Plan

A. Prior to Construction Phase

A.1 Detailed Engineering Design

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
						Implement	Supervise & monitor
1	Unsustained effectiveness of service of completed works due to inadequate consideration during design of (any one or combination of) the following: - climate change & its impacts on waste disposal operations - vulnerability of site to seismic event - design adaptation options for integral components, such as road & water supply, buffer/landscaping/tree screen stormwater management, among others - technical & financial capacity of the operator to sustain controlled landfill operations	1.1	Few design adaptation options to consider: - For roads: flexible pavement, optimum degree of compaction - For landscaping/greening: combine drought- & submergence-tolerant plants, - For water supply: collect and store rainwater - For waste mound: appropriate gradient, drought & flood tolerant groundcover - For soil cover: optimum degree of compaction, appropriate gradient, appropriate soil type that could seal off rain water & at the same time is less plastic when dry.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp/ ADB*
		1.2	Apply seismic design criteria as regulated in Cambodia.				
		1.3	Design of stormwater management to ensure as much stormwater as possible is kept away from contact with waste cell.				
		1.4	Prepare O&M Manual. Implement continuing capacity development. Manual to include the required annual budget to guide LGU on the amount needed to allocate promptly to sustain effective operations.				
2	Inadequate consideration of the following during design: - vulnerability of the soil & groundwater resource to waste disposal operations - reducing disturbance of waste disposal operations to the landscape - impact of the operations on the access road and the community along the access road - impacts of the hook lift bins on the communities where these will be stationed.	2.1	Consult proper authorities (&/or academic experts) on the hydro-geological & soil conditions in the area.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp ADB*
		2.2	Ensure detailed design incoporates the groundwater monitoring wells proposed in the preliminary landfill design.				
		2.3	Incorporate at least 2 groundwater monitoring wells in the design for remediation of open dumps.				
		2.4	Allocate green buffer/introduce tree screens along landfill perimeter to mitigate disturbance of waste diposal operations to existing landscape.				
		2.5	Consult the communities along the access road and communities near to hook lift bin stations. Relevant feedback to be considered.				
		2.6	At best, include access road improvement as an integral part of the development of the controlled landfill.				
		2.7	Or, at least discuss with Provincial/Municipal Govt. to synchronize upgrade of access road with the development of the controlled landfill.				
3	Unsustainable supply of gravel, stone, rock, sand, soil, clay or unsustainable extraction of these materials to meet construction demand & soil cover to meet operational demand.	3.1	Prepare an Aggregates Mgnt Plan (AMP) linked to the staged development (cut-to-fill) strategy proposed for the development of the controlled landfill: - confirming location of legal sources for required aggregates - estimating the demand for, & supply from confirmed sources of, aggregates	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp ADB*

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Supervise & monitor
		- specifying measures to effectively minimize potential risks of aggregates extraction, transport, loading & unloading - specifying environmental requirements should Contractor opt to operate its own borrow area to serve as basis for Contractor's AMP.	Not applicable	c/o Design cost	Design Consultant	PMU & PMIS Envi Sp ADB*
		3.2 Specify in bidding documents & contract Contractor's obligation to get aggregates only from quarries still operating within extraction threshold allowed in their environmental clearances & permits to operate.				

A.2 Obtaining Approvals, and Community Preparation

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
						Implement	Monitor
4	Loss of land	4.1	Finalize Resettlement/Compensation Plan, after Det. Measurement Surveys, through highly consultative & participatory process.	All affected villages	c/o detailed design cost	Det. Design Resettlement Sp	PMU/PIU & PMIS Res. Sp
		4.2	At least 30 days before awarding of contract for civil works, lost lands shall have been fully compensated for according to the approved resettlement & compensation plan.	All affected villages	c/o resettlement cost	PMU/PIU	PMIS Res. Sp/ ADB
5	Overall environmental concerns/impacts of the Subproject	5.1	Obtain IEIA/EIA approval for the Subproject.	Not applicable	c/o PMU's counterpart budget	PMU	PMIS Envi Sp/ ADB*
6	Potential communicable/transmittable diseases brought with entry of workers & overall health & safety hazards during construction.	6.1	Intensive awareness program on communicable/transmittable diseases, e.g., SARS, H1N1, STD, HIV/AIDS, tuberculosis, and diseases that may be brought with entry of workers & on the health and safety hazards during construction.	All affected villages	c/o PMU's counterpart budget	PMU/PIU with health & village officials	

A.3 Procurement & Prior to Mobilization

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
						Implement	Review/Evaluate
7	Engagement of environmentally irresponsible contractor for civil works	7.1	A SPS-compliant EMP, as part of bidding documents.	Not applicable	-	PMU	PMIS Envi Sp/ ADB*
		7.2	EMP to be appended to the Contract for basis of preparation of Contractor's EMP (C-EMP) & for compliance.				
		7.3	Contract to require Contractor's submission of monthly environmental monitoring report, outline appended in Contract.				
		7.4	Contract to stipulate some tie up of progress payment & collection of performance bond with performance in C-EMP implementation.				
		7.5	Selected Contractor to prepare detailed C-EMP that addresses as minimum the requirements of the SPS-compliant EMP.				
		7.6	C-EMP to be quantitatively & qualitatively evaluated against EMP.				
		7.7	ADB to clear C-EMP before start of any work on site or establishment of construction-related facilities.				

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
8 UXO "chance find"	8.1 Workers' pre-orientation workshop to include procedures to follow in case of UXO "chance find". First-response team to coordinate & undergo orientation on management of UXO "chance find" event.	Not applicable	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

B. Construction Phase---covering construction of controlled landfill (1) and remediation of open dumps (2)

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
PHYSICAL / CHEMICAL ENVIRONMENT					
9 Dust/suspended particles (1)&(2) from: - earthworks - dry exposed surfaces - stockpile of dry soils, sand, cement - transport of aggregates, cement residual soil for disposal & wastes - loading/unloading of fine aggregates, cement and other materials - movements of construction vehicles/ equipment	9.1 Confine clearing, grubbing & excavation according to the Staking Plan & Excavation Phasing Plan &/or Staged Development Strategy.	Landfill site	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	9.2 Water dry unpaved/exposed surfaces, stockpiles of sand & excavated materials , at least twice daily, or as necessary.	At the sites	c/o Construction running, set up costs (preliminaries)		
	9.3 Protect stockpiles of soil/sand with a wind barrier/screen.				
	9.4 Wash/wet tires prior to exiting construction sites to remove mud/ dirt. Provide wetting facilities at exit.				
	9.5 Cover trucks securely, especially those carrying aggregates & cement, with tarpaulin. Trucks to maintain min. 2 feet freeboard.	At entire hauling route	c/o Supplier's cost	Supplier	
	9.6 Limit speed of all construction-related vehicles in access road to, and in, site to maximum of 30 kph.	Access road to, and within, landfill Access road to dump sites	-	Contractor	
	9.7 Minimize drop heights when loading/unloading soil onto trucks/ ground. Spray water on soil being loaded/unloaded.	At the sites			
10 Noise generated (1)&(2) by/from, among others: - the operation of equipment, movement of vehicles (especially those diesel-fed & without effective mufflers) - such processes as drilling/excavation, earthmoving, unloading of aggregates, rock crushing, cement mixing	10.1 Use only equipment that emit least noise, e.g. electrically powered equipment, hydraulic tools, those with efficient mufflers. Allow only well-maintained equipment/vehicles	At the sites	c/o Construction mobiliz'n cost (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	10.2 Sound-absorbing enclosure around generator set/s.				
	10.3 Locate noisy generators at max. distance from workers.	At the sites	-		
	10.4 Strictly enforce upon workers compliance with wearing of ear mufflers, especially those operating the equipment.				
	10.5 Limit engine idling to a max. of 5 minutes.				
	10.6 Minimize drop heights when loading/unloading coarse aggregates.				
11 Gas emissions, burning/smouldering (2)	11.1 Control small areas of surface combustion with water and subsequent soil cover.	Dump sites	c/o remediation cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	11.2 For subsurface combustions, excavate the waste until combustion source is reached. Remove, then spread and water combusting material until fire is extinguished. Return to cell once it is back to ambient temperature.				
	11.3 Require workers to wear protective wears.				
	11.4 Equip work sites with adequate water for controlling fire.				
12 Odor, flies/vermin/insects/rodents (2)	12.1 Require workers to wear protective wears, particularly cap attached with a net to protect the entire head & neck, well-covered body, appropriate shoes, safety eye protector, nose-mouth mask, etc.	Dump sites	c/o remediation cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*

Potential Environmental Impacts/Concerns		Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
					Implement	Monitor
BIOLOGICAL ENVIRONMENT						
13 Loss of vegetation within & beyond Subproject footprints, (1) from: - un-guided works un-directed movement of equipment - haphazard stockpiling of materials - haphazard parking of equipment	13.1	During detailed design, determine the required temporary access roads and work easements for temporary disturbance. Include, as appropriate, in the resettlement plan for the rightful compensation.	Not applicable	-	Design Consultant	PMU/PIU & PMIS Envi Sp/ ADB*
	13.2	Prior to clearing & grubbing, physically mark limits for construction footprints, including work easements & if applicable, the required temporary access roads	Access road to controlled landfill	c/o Construction mobiliz'n cost (preliminaries)	Contractor	
	13.3	Install reflectorized guides, signage &/or markers to direct vehicular/ equipment traffic, storage, stockpiles, parking and works.				
	13.4	Stockpile materials/spoils & park construction vehicles/equipment only in designated areas (with least or no vegetation, as possible)	At active work segment of access road to controlled landfill	-		
14 Safety hazards for grazing & stray farm or domestic animals from construction trucks on access road (1)	14.1	Enforce limit of speed to 30 kph along access road.	Access road to, and within, controlled landfill	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	14.2	Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	Access road to dump sites			
SOCIO-ECONOMIC & CULTURAL ENVIRONMENT						
15 Damage to access road from the many construction vehicles passing over daily during the construction period (2)	15.1	Enforce speed limit.	Not applicable	c/o Construction mobiliz'n cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	15.2	Coordinate & agree with the Municipality regarding road ruts caused by construction trucks. Implement agreed on responsibility.				
16 Health & safety hazards of (& nuisance for) community along access road & the few farmers working at the adjacent rice fields, from: dust, noise, movement of vehicles and equipment, rise of communicable/ transmittable diseases with the entry of workers (1)&(2)	16.1	If dust level is high (during dry season), water adequate portions of the access road with residence/s along it.	Access roads	c/o Construction running costs	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	16.2	Limit speed to 30 kph on access road. No unnecessary blowing of horn.	Access roads	-		
	16.3	Enforce upon drivers of construction-associated vehicles & equipment to implement safe/defensive driving & operation.				
	16.4	Adequate IEC prior to mobilization for community preparedness. IEC to include potential rise of communicable/transmittable diseases with entry of workers.	Villages of controlled landfill and dump sites and workers' camps	c/o PMU's counterpart budget	PMU/PIU	PMIS Envi Sp/ ADB*
17 Workers' health & safety hazards from any combination of following: (1)&(2) - dust, noise, gas emissions, fumes, odor - leachate from existing waste cell - exposure to wastes & hazardous substances - exposure to the weather - poor sanitation practices - fire, odor in existing waste cells - open pits, disturbed areas - operating equipment & handling of tools - movement of construction-associated vehicles/equipment - rise of communicable/transmittable	17.1	Conduct workers' orientation, prior construction, on occupational health & safety hazards, strict observance of safety measures, emergency response procedures, & use/handling of hazardous substances and noisy & vibrating equipment.	Not applicable	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	17.2	Implement recommended measures to mitigate dust, gas emission, noise, vibration; and to manage wastes & hazardous substances	At the sites			
	17.3	Provide & enforce use of protective wears, e.g., eye & nose masks, ear mufflers, helmets, gloves, appropriate footwear, etc.				
	17.4	Control fire at existing dump. Equip site with adequate water for fire extinguishing.				
	17.5	Install adequate lighting, safe accesses to & from active work areas.				
	17.6	Minimize impact from operating noisy/vibrating equipment/tools by ensuring workers' daily exposure value (ELV) is kept within the standard limit, as specified by manufacturer, through shifts to allow breaks from continuous use of equipment by individual worker.	At the sites	-		

Potential Environmental Impacts/Concerns	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities	
				Implement	Monitor
diseases in the village - fire, explosion, collapse of disturbed grounds, or worked-on cell	17.7 Provide safe accommodations.	Workers' camps	c/o Construction mobiliz'n & running costs (preliminaries)	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
	17.8 Provide adequate water for washing & safe drinking, and adequate sanitation and waste management facilities. Enforce observance of good hygiene, sanitation & waste management practices.	Workers' camps & work sites			
	17.9 Set up emergency response team, equipped with adequate staff, equipment, tools & supplies, and with good link to ultimate responders.	At the sites			
	17.10 Arrange with nearest primary & tertiary health institutions for health & emergency care of workers.	Not applicable	-		
	17.11 Enforce upon drivers/operators of construction-associated vehicles & equipment to implement safe/defensive driving & operation.	In & outside construction sites			
	17.12 In case of "chance find" of UXO, immediately stop work, implement evacuation procedures, secure area. Contact local police to ensure security of the area involved & to communicate the Cambodian Mine Action and Victim Assistance Authority.	Controlled landfill			
PHYSICAL CULTURAL ENVIRONMENT 18 Damage to physical cultural resource in case of chance find (1)	18.1 Stop work & secure site immediately. Make a declaration to local police. Resume work only when told so by the authority mandated under the Law on the Protection of Cultural Heritage.	Controlled landfill	-	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
SUSTAINABILITY OF WORKS 19 Damage during seismic or extreme weather event (1)&(2)	19.1 After every seismic or extreme weather event, conduct engineering investigation of waste cell, built structures & facilities and implement corrective measures without delay.	Controlled landfill and dump sites	c/o Construction contingency cost	Contractor	PMU/PIU & PMIS Envi Sp/ ADB*
Sub-Total (Prior to Construction and During Construction)		USD	-		

C. Operation Phase of Controlled Landfill

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	Contractor	PMU/PIU, PMISEnviSp	Operator	PMU/PIU & ADB*
20 Dust - in dry season & on windy days - from trucks entering/leaving especially from tipping face - from loading/unloading of soil cover, unloading of wastes - from soil covering activity - from borrowing activity - from wind-blown stockpile of soil cover material	20.1 During dry season, water access & internal roads, stockpile of soil cover, twice a day or more as necessary.	Landfill	c/o Operations running & safety costs	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	20.2 Spraying water when spreading soil cover.							
	20.3 Seeding of exposed areas as soon as possible							
	20.4 Protect stockpile soil cover with a wind break/shield (artificial or natural or combination).	Borrow/stockpile area						
	20.5 Enforce on all open trucks hauling garbage, aggregates, soil cover & similar materials to have proper cover & maintain min. 2 feet freeboard.	To, from landfill	c/o respective Operations Costs					
	20.6 Limit vehicle speed inside facility to maximum of 30 kph.	Landfill	-					
	20.7 Minimize drop heights when loading/unloading soil onto trucks/waste cell and when unloading wastes.							

Potential Environmental Impacts	Recommended Mitigation Measures	Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
				Pre-Operation Phases			Operation Phase	
				Det. Design Consultant	Contractor	PMU/PIU, PMISEnviSp	Operator	PMU/PIU & ADB*
21 Production of landfill gas, gas migration, potential explosion & loss of deep-rooted vegetation	21.1 Provide gas collection & vents.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
	21.2 Install appropriate bottom liner, sides liner.							
	21.3 Apply soil/alternative cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	21.4 Initially, vent gas. Flaring may be done occasionally, as necessary, but process to be kept simple.							
	21.5 Implement landfill gas monitoring per EMP. Use result to evaluate effectiveness of system. (Gas is expected to be generated after 5 years from start of operation.)							
	21.6 In case landfill gas monitoring reveals high content of hazardous compounds, e.g., halogenated compound: - filter gas, prior to flaring; the filtered should not be burned, but should be handled carefully & disposed of properly. - implement separation of cells for organic & other wastes - implement use of collected gas suitable for each cell							
	21.7 In case of gas migration: - establish a buffer area; create an impermeable wall between buffer area and waste cell - set up monitoring well within buffer area after the wall & implement continuous monitoring.							
22 Odor, vermin/pests/ insects/rodents, bird & animal attraction	22.1 Apply soil/alternative cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	22.2 Apply pest control, as needed, but should use non-persistent one.							
	22.3 Apply rodent/vermin controls, as necessary, e.g., bait stations.							
	22.4 Install movable perimeter (litter) fence around active cell to prevent stray animals from feeding on wastes prior to soil cover.							
	22.5 Undertake landscaping, perimeter greening, creating a buffer area, planted with trees & shrubs that repel insects, e.g., eucalyptus, citronella (Pelargonium citrosum), neem (Azadirachta indica); trees and shrubs that bear sweet smelling flowers, e.g., ylang-ylang (Cananga odorata), champaca (Michelia champaca), sampaguita (Jasminum sambac), champasak. (Plumeria rubra or Plumeria alba), among others.	Landfill	c/o Operations running cost					
	22.6 Install perimeter fencing at least around landfill area.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
23 Noise from truck movements/ equipment operation could pose hazard to workers	23.1 Limit speed inside facility to maximum of 30 kph.	Landfill	-	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
	23.2 Spread out arrivals of trucks.							
	23.3 Enforce no blowing of horn inside the facility.							
	23.4 Enforce upon workers to wear ear mufflers.	Landfill	c/o Operations running cost					
	23.5 Use low-noise landfill equipment & to be turned off when idle.							
	23.6 Program borrowing activity (soil cover). Use low-noise equipment, with muffler, well maintained, for borrowing & hauling.	Borrow area						

Potential Environmental Impacts		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Operation Phases			Operation Phase	
						Det. Design Consultant	Contractor	PMU/PIU, PMISEnviSp	Operator	PMU/PIU & ADB*
24	Wind-blown litters	24.1	Provide movable litter fence around tipping area & active waste cell.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		24.2	Require open garbage trucks (dump trucks) to maintain minimum 2 feet freeboard and tarpaulin cover.	To, from Landfill	-					
25	Mud spread	25.1	Include washing facility for truck tires.	Landfill	c/o Project Cost	Include in design	Implement	Supervise & monitor	-	-
		25.2	Enforce upon trucks to have tires washed before leaving landfill.	Not applicable	-	Include in O&M Manual	-	-	Implement	Monitor
26	Groundwater contamination from leachate & gas migration	26.1	Install/provide the following: - appropriate bottom & sides liners - perimeter surface runoff drains - leachate management system - groundwater monitoring wells	Landfill	c/o Project Cost	Include in design	Implement	Supervise & monitor	-	-
		26.2	Apply soil/alternate cover daily.	Landfill	c/o Operations running cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		26.3	Apply capping to completed cells.							
		26.4	Conduct leachate & groundwater monitoring as prescribed in EMP.							
27	Leachate drippings from trucks hauling wastes, odor & litters from open garbage trucks	27.1	Require waste trucks to ensure no leachate drippings during transport.	To, from Landfill	-	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		27.2	Require open waste trucks to maintain min. 2 feet freeboard & provide the appropriate cover.							
		27.3	Require trucks to wash body & tires prior to exit from landfill.	Landfill/Landfill						
28	Fire/explosion from gas build build up, heat, etc.	28.1	Equip landfill with adequate/appropriate fire-fighting equipment & water supply.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
		28.2	Monitor landfill gas per EMP. Install gas collection & treatment, when gas monitoring results reveal necessity.	Landfill	c/o Operations cost	Include in design & O&M Manual	-	Supervise & monitor	Implement	Monitor
		28.3	Set up trained Safety Team (as initial responders) linked to the fire department & other ultimate responders.							
		28.4	Conduct regular fire/explosion/emergency drills	Landfill	-	Include in O&M Manual	-	Supervise & monitor		
		28.5	Enforce a "No Smoking" Policy within the landfill premises.							
29	Community health & safety hazards, nuisance (from waste collection trucks along access road - leachate drippings, dust litters from open litter dump truck	29.1	Conduct IEC regarding the hazards & risks of completed/operated sub-components.	Toul Makak Keut Village & relevant villages	c/o Operations safety cost	Include in O&M Manual	-	-	Implement	Monitor
		29.2	Install perimeter fencing.	Landfill	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
		29.3	Install sufficient warning signs against unauthorized entry							
		29.4	Implement measures to mitigate dust, gas, leachate, pests/ insects/ rodents, incidence of fire/explosion, leachate drippings from trucks.	Landfill	c/o Operations running cost	Include in O&M Manual	-	-	Implement	Monitor
		29.5	Secure premises against unauthorized entry by public.							
		29.6	Collaborate with Village officials for community safety	Toul Makak Keut Village	-					
30	Workers' health & safety hazards	30.1	Conduct a comprehensive orientation on the O&M Manual, to include health and safety risks & mitigation measures.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
		30.2	Set up emergency response mechanism & train workers of their roles & responsibilities in the mechanism.	Not applicable	-	Include in O&M Manual	-	Supervise & monitor		

Potential Environmental Impacts		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Operation Phases			Operation Phase	
						Det. Design Consultant	Contractor	PMU/PIU, PMISEnviSp	Operator	PMU/PIU & ADB*
		30.3	Have workers undergo semi-annual physical examinations & be provided with appropriate vaccinations. Establish & update workers' health baseline data.	Not applicable	c/o Operations social/safety cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
		30.4	Provide the required protective wear, i.e., clothing, cap, hand glove, ear muffler, nose/mouth mask, eye wear, footwear (boots) for workers' use while at work.							
		30.5	Enforce observance of good sanitation practices.	Landfill	-					
		30.6	Provide workers access to adequate sanitation facilities and potable water supply.	Landfill	c/o Project Cost	Include in design	Implement	Supervise & monitor		
31	Unsustained sanitary operations due to insufficient operational & financial capabilities.	31.1	Ensure O&M Manual specifies capacity development, budget requirements for O&M.	Not applicable	c/o Design cost	Include in design	-	Supervise & monitor	-	-
		31.2	Implement regular/continuing capacity development.	Not applicable	c/o Operations running cost	-	-	-	Implement	Monitor
32	Damages during seismic or extreme weather events	32.1	After every seismic or extreme weather event, conduct engineering investigation of built cells, structures & facilities and implement corrective measures without delay.	Landfill	c/o Operations safety cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
Sub-Total (During Operation of Controlled Landfill)				USD	-					

D. Decommissioning Phase of Remediated Dump Site

Potential Environmental Impacts		Recommended Mitigation Measures		Location	Estimated Cost [a] (USD)	Institutional Responsibilities Per Phase				
						Pre-Decommission Phases			Decommission Phase	
						Det. Design Consultant	Contractor	PMU/PIU, PMISEnviSp	Operator	PMU/PIU & ADB*
33	Leachate generation	33.1	Profile mound with side batters to a 1v:2.5h slope.	Remediated dump	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
		33.2	Install final capping with at least 2% slope.							
		33.3	Monitor groundwater quality per EMP.	Remediated dump	c/o Decomm. cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
34	Production of landfill gas, gas migration, potential explosion & loss of deep-rooted vegetation	34.1	Apply soil cover and install final capping of mound.	Remediated dump	c/o Project cost	Include in design	Implement	Supervise & monitor	-	-
		34.2	Install a rubble layer on top 1/3 of the mound surface, as an option.							
		34.3	Provide perimeter wire-fencing around waste mound/s, at least 50 m from mound & prohibit unauthorized entry.							
		34.4	Monitor gas emissions per EMP.	Remediated dump	c/o Decomm. cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
35	Damages during seismic or extreme weather events	35.1	After every seismic or extreme weather event, conduct engineering investigation of built cells, structures & facilities and implement corrective measures without delay.	Remediated dump	c/o Decomm. cost	Include in O&M Manual	-	Supervise & monitor	Implement	Monitor
Sub-Total (During Decommissioning of Remediated Dump Site)				USD	-					
TOTAL				USD	-					

[a] No marginal costs. During construction, most costs on Contractors are included in preliminaries. During operation, costs are integral part of annual budget of Operator.

* Preliminarily, PMIS will be provided by combined man-months only in the first 2-3 years of Project implementation. After PMIS period, monitoring assumed to be done thru ADB Review Missions until loan closure.

Environmental Monitoring Plan

I. ENVIRONMENTAL EFFECTS MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
A.	**Prior to Construction Phase** During procurement prior to awarding of contract for civil works						
1	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines. Results as baseline data before mobilization.*	**Within sites & outside sites (controlled landfill & dump sites)**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once**	**3,570.00**	**Licensed Lab (for PMU/PIU)**	**PMIS Envi Sp ADB ***
2	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise. Results as baseline data before mobilization.*	**Within site & outside site (controlled landfill & dump sites)**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once**	**390.00**		
3	**Groundwater quality** **pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, NO_2, NO_3, Cl, SO_4, PO_4, As, Mn, Fe** *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011. Results as baseline data before mobilization.*	**Within site & outside site (controlled landfill & dump sites)**	**Analytical methods outlined in Cambodia's Drinking Water Quality**	**Once**	**522.00**		
4	**Community health & safety conditions** **- Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases** **- incidence of accidents (vehicular, fire, etc) & crime** *Information as baseline data before mobilization.*	**Villages of controlled landfill & dump sites**	**Information from Commune Council, relevant health center, Mun./Prov'l Health Department, Municipality**	**Once**	**-**	**PMU/PIU**	
	Sub-Total (Prior to Construction for baseline data)				**4,482.00**		
B.	**Construction Phase**						
5	**Ambient air quality** **$PM_{2.5}$, PM_{10}, SO_2, NO_2** *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	**Within site & outside site (controlled landfill & dump sites)**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once, quarterly**	**8,330.00**	**Licensed Lab (for Contractor)**	**PMU/PIU** **PMIS Envi Sp ADB ***
6	**Ambient noise levels** **Lmax, Lmin, Leq** *Review against the more stringent values between Annex 6 of Sub-Decree No. 42/ANK/BK (2000) & WHO Guidelines for Community Noise.*	**Within site & outside site (controlled landfill & dump sites)**	**Analytical methods outlined in the guideline of the MoE, or applied by. MoE.**	**Once, quarterly**	**910.00**		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
7	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	Within site & outside site (dump sites)	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	522.00	Licensed Lab (for Contractor)	PMU/PIU PMIS Envi Sp ADB*
8	**Community health & safety** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Villages of controlled landfill & dump sites)	Information from, & close coordination with, Commune Council, relevant health center, Mun./Prov'l Health Department, Municipality	Once, quarterly	-	Contractor	
9	**Workers' health & safety** - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Workers' camp & work site (controlled landfill & dump sites)	Records of Safety Engineer	Once, quarterly	-		
	Sub-Total (Construction)				9,762.00		
	Sub-Total (Prior to Construction and During Construction)				14,244.00		
	C. Operation Phase						
10	**Ambient air quality** $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Within site & outside site (controlled landfill)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	9,200.00	Licensed Lab (for Operator)	PMU/PIU PMIS Envi Sp ADB*
11	**Leachate Quality** pH, Al, NH_3, Cl, SO_4, NO_3, NO_2, Cu, Pb, H_2S, Fe, Mn, Na, TDS. Zn. As. Ba. Cd. CN. Hα. Ni. Cr^{-3} Cr^{6+} *Review results against Annex 2 of Sub-decree No.27/ANRK/BK (1999).* *Review results also against Cambodia's Drinking Water Quality Standards (2004) to check magnitudes of exceedance, as groundwater is the resource to protect at the site.*	2 at sump at lower end of waste cells (Where leachate gathers at pump area) (controlled landfill)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, annually	490.00		
12	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	3 within site and 2 outside site (controlled landfill)	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	4,380.00		

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Estimated Annual Cost (USD)	Responsibility	
						Implement	Compliance Monitoring
13	**Community health & safety** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire.	Village of controlled landfill	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once semi-annually	-	Operator	PMU/PIU PMIS Envi Sp ADB
14	**Workers' health & safety** - Incidences of illness due to work - Incidences of work-related accident, injuries/deaths to emergencies, crime involving workers	Landfill site	Records of Safety Officer.	Once semi-annually	-		
	Total Annual Cost (Operation)				14,070.00		
D.	**Decommissioning Phase of Remediated Dumps**						
15	**Ambient air quality** $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO_2, O_2, CH_4 *Review against the more stringent values between Annex 1 of Sub-Decree No.42/ANK/BK (2000) & WHO Ambient Air Quality Guidelines.*	Within site & outside site (remediated dump sites)	Analytical methods outlined in the guideline of the MoE, or applied by. MoE.	Once, quarterly	4,600.00	Licensed Lab (for Operator)	PMU/PIU / PMIS Envi Sp ADB*
16	**Groundwater quality** pH, turbidity, conductivity, hardness, E. Coli, total coliform, F, As, Mn, NO_2, NO_3, Cl, SO_4, PO_4, Fe, Pb, Cu, Cd, Cr(-3), Cr(+6) *Review results against the more stringent values between Cambodia's Drinking Water Quality Standards (2004) & WHO Guidelines for Drinking-water Quality, 2011.*	2 within site and 1 outside site (remediated dump sites)	Analytical methods outlined in Cambodia's Drinking Water Quality Standards, 2004	Once, quarterly	2,628.00		
17	**Community health & safety** - Incidence of diseases associated with respiratory, nervous circulatory & digestive systems, skin, cancer, communicable/transmittable diseases - incidence of accident, fire & crime	Villages of dump sites	Information from, & close coordination with, Commune Council, relevant commune health center, Mun. Health Department, Mun. Government	Once semi-annually (at least for 1st 5 yrs., may be reduced thereafter depending on conditions)	-		
	Total Annual Cost (Decommissioning)				7,228.00		

II. PERFORMANCE MONITORING

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
A.	**Prior to Construction Phase**						
	A.1 Detailed Design Preparation						
1	Completion of detailed design & O&M Manual incorporates EMP requirements.	Not applicable	Review of detailed design documents.	Once, prior to finalization Once, prior to approval	Design Consultant	PMU/PIU & PMISEnviSp/ADB	-
	A.2 Obtaining Environmental Clearance						
2	IEIA/EIA Report approval obtained	Not applicable	IEIA/EIAR approval document from MoE.	Once, at least 30 days prior to contract award	PMU/PIU	PMIS Envi Sp	
3	Intensive awareness program on health and safety hazards, communicable/transmittable diseases, on the grievance redress mechanism	Villages of controlled landfill & dump sites	Review of relevant report of the PMU/PIU's Social, Environmental & Communication Teams.	Once, at least 30 days prior to contract award			
	A.3 Procurement						
4	Procurement process complied with EMP requirements: SPS-compliant EMP part of bidding documents.	Not applicable	Verifying inclusion of EMP in bidding documents.	Once, prior to procurement			
	C-EMP/EMP compliance stipulated in Contract	Not applicable	Review of Draft & Final Contract.	Once, during draft			
	Contract stipulates some tie up of progress payment & collection of performance bond with performance in C-EMP/EMP implementation.			Once, prior to signing			
	A.4 Post-Procurement Prior to Mobilization						
5	Preparation by selected Contractor its C-EMP, addressing Subproj. EMP requirements as minimum, & includes (but not limited to) plans for: aggregates mgnt; excavation mgnt (linked to removed soil mgnt); dust, noise & vibration controls; gas emission mitigation; sedimentation controls; solid & hazardous waste mgnt; traffic mgnt (to be coordinated with authorities); occupational health & safety; grievance redress; emergency response; environmental monitoring & reporting.	Not applicable	Verifying existence of C-EMP. Evaluating C-EMP against Subproj EMP.	Once prior to mobilization			
6	Have C-EMP cleared by ADB.	Not applicable	Verifying existence of ADB clearance.	Once prior to mobilization			
7	Environmental quality monitoring for baseline data conducted according to the EMP.	Controlled landfill & dump sites & their vicinities	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	Once prior to mobilization	Licensed Lab (for PMU/PIU)	PMISEnviSp/ADB	
B.	**Construction Phase**						
8	Environmental mitigation implemented according to the C-EMP/EMP.	Controlled landfill & dump sites	Site inspections, random spot checks.	Regular & random	Contractor	PMU/PIU PMISEnviSp/ADB	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Monthly			

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
			Review of records of workers accidents & sick leave.	Monthly			
			Consult relevant commune health center.	Monthly			
			Consult Mun. Health Department.	Monthly			
9	Environmental effects monitoring conducted according to the C-EMP/EMP.	Controlled landfill & dump sites & their vicinities	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-B of this Environmental Monitoring Plan.	Licensed Lab (for Contractor)		
10	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records.	Regular and random	Contractor		
			Consulting village/commune authorities.	Monthly			
11	UXO "chance find" dealt with properly and encountered no injury and/or fatality.	Controlled landfill & dump sites & their vicinities	Review Monthly EMR.	Monthly			
12	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Controlled landfill & dump sites & their vicinities	Review of investigation & remediation works report.	Latest, 1 week after each event			
13	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
14	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Licensed Lab (for Contractor)		
15	Semi-annual EMR submitted promptly following prescribed outline.	Not applicable	Review of the Semi-annual EMR.	Semi-annually	Contractor & PMU/PIU	PMISEnviSp/ADB	
C.	**Operation Phase of Controlled Landfill**						
16	Operation following the O&M Manual & EMP	Controlled landfill	Site inspections, random spot checks.	Regular & random	Operator	PMU/PIU, PMISEnviSp/ADB	-
			Consulting affected residents.	Random			
			Review of lodged grievances.	Quarterly			
			Review of records of workers accidents & sick leave.	Quarterly			
			Consulting relevant commune health center.	Quarterly			
			Consulting Mun. Health Department.	Quarterly			
17	Measures to mitigate non-sustainability of operation instituted, i.e., allocating adequate budget for proper sanitary landfill operations, maintenance & repair, & environmental effects monitoring.	Operator's Office	Site inspections, random spot checks, verifying promptness in maintenance & repair, & environmental impacts monitoring.	Regular & random	Operator	PMU/PIU, PMISEnviSp/ADB	-
18	Environmental effects monitoring conducted according to the EMP.	Controlled landfill & vicinity	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-C of this Environmental Monitoring Plan.	Licensed Lab (for Operator)	PMU/PIU, PMISEnviSp/ADB	

	Aspects/Parameters to be Monitored	Location	Means of Monitoring	Frequency	Responsibility		Estimated Cost (USD)
					Implement	Compliance Monitoring	
19	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records. Consulting village authorities.	Regular and random Quarterly	Operator	PMU/PIU, PMISEnviSp/ADB	-
20	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Controlled landfill	Review of investigation & remediation works report.	Latest, 1 week after each event			
	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
21	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Licensed Lab (for Operator)		
22	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMISEnviSp/ADB	
C.	**Decommissioning Phase of Remediated Dumps**						
23	Environmental effects monitoring conducted according to the EMP.	Remediated dump sites & vicinities	As prescribed in the Environmental Impacts Monitoring (Part I-A) of this Environmental Monitoring Plan.	As prescribed in Part I-C of this Environmental Monitoring Plan.	Licensed Lab (for Operator or Mun. Govt)	PMU/PIU, PMISEnviSp/ADB	
24	Informally lodged grievances acted on promptly and successfully &/or Grievance Redress Mechanism observed.	Not applicable	Review of GRM records. Consulting village authorities.	Regular and random Quarterly	Operator of Mun. Govt.		
25	Engineering investigation after each seismic &/or extreme weather event, and, if applicable, remediation works taken.	Remediated dump sites	Review of investigation & remediation works report.	Latest, 1 week after each event			
26	Monthly EMR submitted promptly using prescribed outline	Not applicable	Review of Monthly EMR.	Monthly			
27	Quarterly EMR on effects monitoring submitted promptly.	Not applicable	Review of Quarterly EMR on effects monitoring.	Quarterly	Licensed Lab (for Operator)		
28	Annual EMR submitted promptly using prescribed outline.	Not applicable	Review of the Annual EMR.	Annually	Operator, PMU	PMISEnviSp/ADB	
TOTAL COST							-

Annex I. Draft Outline for the PMU's Environmental Monitoring Report

This outline and the performance assessment and rating are mainly suggested and will be finalized according to applicability during the detailed design stage. The level of detail and comprehensiveness would depend on the degree of complexity of social and environmental impacts.

1. Introduction
- 1.1 Purpose of the Report
- 1.2 Project Overview
- 1.3 Physical Progress of the Project

2. Environmental Requirements in Project Loan and Grant Agreements & Subproject Contractual Arrangements

3. Conformance to the EARF
(This section reports on CMEI Output's conformance to the EARF.)

4. Environmental Mitigation [a]
(This section reports on the implementation of the Environmental Mitigation Plan.)

5. Environmental Monitoring [b]
(This section reports on the implementation of the Environmental Monitoring Plan.)
- 5.1 Environmental Impacts Monitoring
- 5.2 Environmental Performance Monitoring

6. Grievance Redress [c]
(This section reports on the number of grievances received and acted on, and the performance in observing the GRM.)

7. Emergency Response [d]
(This section reports on the incidence of emergency situation, emergency response level, and, if applicable, the casualties encountered.)

8. Preparation and Submission of EMRs [e]
(This section reports on the performance in reporting by respective parties.)

9. Overall Environmental Performance [f]

10. Summary of Key Issues, Actions and Lessons Learned
- 10.1 Key Issues Identified
- 10.2 Actions Taken/To be Taken
- 10.3 Lesson Learned

11. Conclusion & Recommendations

Annexes
- A Environmental Impacts Monitoring Results
- B Performance Monitoring/Inspection Reports
  (To include regular site monitoring/inspection and unannounced spot check reports, random informal public consultations on site, photographs)
- C Other supporting documents/information

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[a] Assessment of/rating for:
(i) performance in mitigation measures implementation

5	Very good	100% of required mitigation carried out
4	Good	76-99% of required mitigation carried out
3	Fair	51-75% of mitigations carried out
2	Poor	26-50% of mitigations carried out
1	Very poor	0-25% of mitigations carried out

(ii) effectiveness of implemented mitigation *

5	Very good	100% effective
4	Good	76-99% effective
3	Fair	51-75% effective
2	Poor	26-50% effective
1	Very poor	0-25% effective

* Use state of received grievances, findings from regular monitoring/inspections, unannounced spot checks, informal random public consultations on site, state of workers health and safety, and (every quarter) the results of environmental impacts monitoring --- as bases for assessing effectiveness.

b

Assessment of/rating for:

(i) performance in environmental impacts monitoring

5	Very good	100% of required environmental impacts monitoring carried out
4	Good	76-99% of required environmental impacts monitoring carried out
3	Fair	51-75% of environmental impacts monitoring carried out
2	Poor	26-50% of environmental impacts monitoring carried out
1	Very poor	0-25% of environmental impacts monitoring carried out

(ii) results environmental impacts monitoring

5	Very good	within the more stringent value between international and national standards
4	Good	within the less stringent value between international and national standards
3	Fair	in excess of the less stringent value between international and national standards, but equal or less than the baseline value
2	Poor	1-3% in excess of the baseline value
1	Very poor	>3% in excess of the baseline value

(iii) performance monitoring

5	Very good	All target regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out
3	Fair	Not all target regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out
1	Very poor	No regular site monitoring/inspections, unannounced spot checks, informal public consultations carried out

c

Assessment of/rating for:

(i) performance in grievance redress

5	Very good	100% closed promptly
4	Good	76-99% closed promptly
3	Fair	51-75% closed promptly, no appeal
2	Poor	26-50% closed promptly, 1-3 appeals
1	Very poor	0-25% closed promptly, >3 appeals

(ii) number of grievances received

5	Very good	0 or no valid grievance received
4	Good	1-3 valid grievance/s received
3	Fair	4-5 valid grievances received
2	Poor	6-10 valid grievances received
1	Very poor	>10 valid grievances received

d

Assessment of/rating for emergency response:

5	Very good	no emergency case, no emergency response necessary
4	Good	1st response, no injury, no casualty
3	Fair	1st response/ultimate response, 1-3 injured
2	Poor	1st response/ultimate response, >3 injured, no casualty
1	Very poor	1st response/ultimate response, with casualty

e

Assessment of/rating for EMR preparation/submission:

5	Very good	submitted promptly on prescribed deadline
3	Fair	submitted after prescribed deadline, but before overall Project Progress Report submission
1	Very poor	not submitted and therefore not incorporated in Project Progress Report

f

Overall performance could be described in qualitative terms by subproject, city and Project. Or, rating system could be applied. This would require weights to be assigned to each indicator, each subproject and each city to arrive at the overall Project performance.

Annex J.
Terms of Reference for PMIS Environmental Specialists (International and National Consultants)

Person & Task	Person-Months	Minimum Qualifications	Minimum Work Experience
International Environment Specialist	4	Masters Degree in environmental science, engineering, planning or equivalent	10 years' experience in environmental management & assessment in developing countries. Experience in south east Asia and of urban development or related projects financed by multilateral development funding agencies is required.
Environment Specialist	12	Degree in environmental science, engineering, planning or a related discipline	5 years of experience in environmental management, safeguards or environmental impact assessments. Experience on urban development or related assignments funded by multilateral development financing institutions would be beneficial. Fluency in written and spoken English is required

Environment Specialist (International, 4 person months)

- Assist the PMU in the conduct of the following for proposed Community Mobilization and Environmental Improvements (CMEI) subprojects, to include the: (i) review, finalization and confirmation of the results of the rapid environmental assessment (REA) and categorization; and (ii) basic environmental assessment and preparation of report for compliance with EARF and RGC requirements.
- Ensure ADB Environment safeguard category remains B.
- Assist the PMU in ensuring the incorporation of relevant mitigation measures in the detailed designs, coordinated public consultations and disclosure/information dissemination with the social/resettlement team, and that the RGC's environmental assessment requirements will not cause delay in the commencement of the construction phase.
- Finalize and update the IEEs and EMPs, as necessary, based on the detailed engineering designs, and ensure consistency, where applicable, with other safeguard plans.
- In coordination with the Solid Waste Management Specialist, finalize remediation and closure plans for all three dumpsites in coordination with the government/Municipality and monitor implementation. Assist the PMU in preparing for procurement by: (i) ensuring that the SPS-compliant EMP is part of the tender documents and civil works contracts; and (ii) establishing and incorporating environmental criteria, scoring and weight in the evaluation of bids in coordination and agreement with the procurement committee.
- Assist the PMU in ensuring that contractors prepare their respective contractor's EMP (C-EMP) based on the SPS-compliant EMP and actual site conditions and in evaluating the contractor's EMPs (C-EMPs).
- Assist the PMU in preparing for the activation of the grievance redress mechanism, undertaking pre-construction environmental quality monitoring as recommended in the EMP, and reviewing/evaluating Contractor's EMPs to ensure they are fully responsive to the SPS-compliant EMPs.
- Design a tool or system to facilitate effective consultations, monitoring/inspection and reporting by the PMU.
- Coordinate with the MOE and TSA on regulatory compliance issues—for water quality in the the Tonle Sap, noise and dust from construction sites, sanitation in workers campsite, etc.

- Provide training lectures/seminars on the EMP and its implementation.
- During construction and operation, guide the PMU in supervising, monitoring, and reporting EMP implementation.
- Assess the operation/observance of the grievance redress mechanism, and recommend improvements.
- Review the results of the environmental effects monitoring. Recommend investigations and recommend corrective actions, as necessary
- Assist the PMU and PIUs in follow up consultations.
- Conduct visits to work sites to provide guidance to, and advise the PIUs and operators on environmental management concerns arising during project construction and operation, respectively, and recommend corrective measures.
- Prepare the necessary status reports for compliance with the conditions set out in approved Royal Government of Cambodia's IEE/IEIA Reports.
- Assist in the preparation of semi-annual environmental monitoring reports (EMRs) and finalize the monthly EMRs for input to the PMU's semi-annual safeguards monitoring report for submission to the ADB.
- Recommend measures to ensure effective EARF and EMP compliance/ implementation, as necessary.
- Ensure that capacity development in environmental managemnt is carried out through "hands on" training during the implementation of the EARF and EMPs.

Environment Specialist (National, 12 person months)

The national consultant will support the international consultant in carrying out the tasks below:

- Support the PMU in the conduct of the following for proposed Community Mobilization and Envrionmental Improvements (CMEI) subprojects, to include the: (i) review, finalization and confirmation of the results of the rapid enviornmental assessment (REA) and categorization; and (ii) basic environmental assessment and preparation of report for compliance with EARF and RGC requirements.
- Support the PMU in ensuring the incorporation of relevant mitigation measures in the detailed designs, coordinated public consultations and disclosure/information dissemination with the social/resettlement team, and that the RGC's environmental assessment requirements will not cause delay in the commencement of the construction phase.
- Finalize and update the IEEs and EMPs, as necessary, based on the detailed engineering designs, and ensure consistency, where applicable, with other safeguard plans.
- With the international specialist, finalize remediation and closure plans for all three dumpsites in coordination with the government/Municipality and monitor implementation
- Support the PMU in preparing for procurement by: (i) ensuring that the SPS-compliant EMP is part of the tender documents and civil works contracts; and (ii) establishing and incorporating environmental criteria, scoring and weight in the evaluation of bids in coordination and agreement with the procurement committee.
- Support the PMU in ensuring that contractors prepare their respective contractor's EMP (C-EMP) based on the SPS-compliant EMP and actual site conditions and in evaluating the contractor's EMPs (C-EMPs).
- Support the PMU in preparing for the activation of the grievance redress mechanism, undertaking pre-construction environmental quality monitoring as recommended in the EMP, and reviewing/evaluating Contractor's EMPs to ensure they are fully responsive to the SPS-compliant EMPs.
- Design a tool or system to facilitate effective consultations, monitoring/inspection and reporting by the PMU.

- Coordinate with the MOE and TSA on regulatory compliance issues—for water quality in the the Tonle Sap, noise and dust from construction sites, sanitation in workers campsite, etc.
- Provide training lectures/seminars on the EMP and its implementation.
- During construction and operation, guide the PMU in supervising, monitoring, and reporting EMP implementation.
- Assess the operation/observance of the grievance redress mechanism, and recommend improvements.
- Review the results of the environmental effects monitoring. Recommend investigations and recommend corrective actions, as necessary
- Support the PMU and PIUs in follow up consultations.
- Conduct visits to work sites to provide guidance to, and advise the PIUs and operators on environmental management concerns arising during project construction and operation, respectively, and recommend corrective measures.
- Prepare the necessary status reports for compliance with the conditions set out in approved Royal Government of Cambodia's IEE/IEIA Reports.
- Assist in the preparation of semi-annual environmental monitoring reports (EMRs) and finalize the monthly EMRs for input to the PMU's semi-annual safeguards monitoring report for submission to the ADB.
- Ensure that ADB's environment safeguard categorization remains B. Recommend measures to ensure effective EARF and EMP compliance/ implementation, as necessary.
- Ensure that capacity development in environmental managemnt is carried out through "hands on" training during the implementation of the EARF and EMPs.