Initial Environmental Examination

March 2021

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

Wastewater Treatment Plant Subproject in Serei Saophoan Town, Banteay Meanchey Province

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CURRENCY EQUIVALENTS

(as of March 2020)

Currency unit	–	riel (KR)
KR 1.00	=	$ 0.00025
$1.00	=	KR 4.000

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	Biochemical Oxygen Demand
CDIA	–	Cities Development Initiative for Asia
CEMP	–	Construction Environmental Management Plan
C-EHS	–	Contractor Environmental Health and Safety Officer
CMAC		Cambodia Main Action Center
COD	–	Chemical Oxygen Demand
CRVA	–	Climate Risk Vulnerability Assessment
DDPP	–	Detailed Design and Project Preparation
EA	–	Executing Agency
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
FGD	–	Focus Group Discussion
GHG	–	Greenhouse Gas
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
IEIA	–	Initial Environmental Impact Assessment
MAFF	–	Ministry of Agriculture, Forest, and Fishery
MoE	–	Ministry of Environment
MOWRAM	–	Ministry of Water Resources and Meteorology
MPWT	–	Ministry of Public Works and Transport
PDoE	–	Provincial Department of Environment
PMC	–	Project Management Consultants
PMC-I/NES	–	PIM-International and National Environment Specialists
PIU	–	Project Implementation Unit
PIU-SFP	–	PIU Safeguards Focal Point
PMU	–	Project Management Unit
PMU-ESO	–	PMU Environmental Safeguards Officer
PSC	–	Project Steering Committee
RCP	–	Representative Concentration Pathway
SHC	–	Sewer Household Connection
SPS	–	Safeguards Policy Statement
TS-1	–	Tonle Sap Urban Environmental Improvement Project
TSBR	–	Tonle Sap Biosphere Reserve
TSS	–	Total Suspended Solid
UXO	–	Unexploded Ordnance
WHO	–	World Health Organization
WWTP	–	Wastewater Treatment Plant

WEIGHTS AND MEASURES

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

GLOSSARY

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

NOTE

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

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1. EXECUTIVE SUMMARY

1.1. The Project

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

2. The Second Urban Environmental Management in the Tonle Sap Basin Project (TS-2) focuses on improvement of solid waste management through the development of controlled landfills, and improvement of wastewater treatment, through the development of wastewater treatment plants (WWTP) and storm water drainage. A summary of the project interventions and their locations is shown in Table 1.

Table 1: Summary of TS-2 Project Interventions

Sub-Project City	Wastewater Treatment Plant	Drainage	Landfill
Serei Saophoan	✓	✓	✓
Battambang	✓	x	✓
Stueng Saen	✓	✓	✓

3. The WWTP and Drainage subproject in Serei Saohoan Town, Banteay Meanchey Province focuses on improving wastewater collection and treatment, and stormwater drainage in Serei Saophoan Town. The proposed WWTP site is located in Kantout Village, Phneach Commune, Serei Soaphoan Town, in a lowland area with agricultural fields (wet rice fields). The wastewater network in Serei Soaphaon town is located in residential areas with markets, business places, local roads and other public services. There are no sensitive receptors, conservation areas/forest or ecological resources near the WWTP site. General site information are as follows:

- The site is located in a lowland area with rice fields (wet rice)
- About 0.5 km from a residential area (Kantout Village)
- About 0.5 km from rural road in Kantout Village.
- About 2 km from National Road-6
- About 2 km from a village development area (Navy village Area)
- About 5 km from Serei Saophoan Town.

4. The Project is classified as category B for environment and confirmed during the project preparation. This IEE covers the Serei Saophoan Wastewater and Drainage Subproject, and it has been undertaken in accordance with ADB Safeguards Policy Statement (SPS) 2009. Based on the IEE, an Environmental Management Plan has been prepared as a separate document. The IEE and EMP are based on the Initial Environmental Impact Assessments (IEIA) that was submitted to the Ministry of Environment (MOE) in December 2020 and approved by the Ministry of 11 February 2021. The IEE and EMP have been developed in conjunction with the finalization of the Detailed Engineering Design thereby ensuring consistency between environmental requirements and technical designs.

1.2. Key Findings

5. The environmental baseline study confirms that the local communities are the most sensitive receptors in the project area. The WWTP project site is dominated by rice fields and other agricultural land. No protected areas or habitats or species of conservation value were identified in the project area of influence.

6. The WWTP project site is located in an environment which contains many surface water bodies including ponds, rivers discharging to the Tonle Sap lake, and a network of irrigation canals used for paddy field cultivation. The surface water bodies in the area are known to be used by household for washing as well as for fishing. The EMP therefore focus on management and mitigation of potential water pollution impacts from runoff and effluents.

7. Impacts during construction will be localized and short-term and limited to the common impacts associated with any construction project and its associated earthworks. This includes the generation of noise, dust, pollutants and greenhouse gas emissions, traffic and waste. These impacts will particularly be pronounced in the urban core where excavation for pipe networks will be required in higher density areas.

8. The most significant environment risks associated with the subproject are related to the operation phase. The WWTP can cause environmental pollution if it is not managed and maintained effectively. Such pollution includes long term risks to groundwater and soils from poor plant management, odour, and medium-term risks to water quality from WWTP effluent discharges, potentially affecting aquatic flora and fauna and human health.

9. If effectively managed, the project facilities will bring about environmental improvements to the local project areas and urban core. Field visits show that the current environment is being contaminated with wastewater and the growing pressures on the urban areas means that this is likely to continue. The development of well-engineered stormwater drainage networks and wastewater collection and treatment facilities will mean that the pollution of the environment will be reduced and therefore the risks to human health and water quality, will be less. In addition, the communities will have improved disaster and climate change resilient infrastructure.

10. The new wastewater infrastructure will form the foundation for developing a citywide network of wastewater systems in the years ahead. In Serei Saophoan Town the intervention will be a catalyst to expansion of the city on the eastern side of the river, which is currently hampered by inadequate municipal infrastructure including drainage and wastewater management services.

11. The community consultations undertaken for this IEE show widespread support for the subproject as the residents recognize the need for improved wastewater collection and treatment. The communities are also subject to impacts from flooding and are therefore keen to see drainage improvements in their communities which will contribute to increased climate resilience.

1.3. Environmental Management Plan

12. The IEE and EMP aim to avoid impacts where possible and mitigate those impacts which cannot be eliminated to an acceptable and minimum level. The EMP includes detailed requirements for:

- Identify the potential impacts of project activities on environmental resources
- Mitigation and monitoring measures;
- Institutional arrangements and project responsibilities;
- EMP budget for implementation
- Capacity building and training requirements
- Public consultation and information disclosure
- Grievance Redress Mechanism (GRM) including clearly defined timescales and responsibilities.

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

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

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

15. The key mitigation measures during construction will include:

- Good construction practices will be adopted to ensure minimal disturbances of affected persons from construction related nuisances, such as noise, dust and pollutant emissions.
- Avoid or minimize emissions to protect the ambient air quality, surface water, groundwater quality, and soil quality
- Access to properties and agricultural land will be maintained and encroachment avoided to allow people to continue their activities unimpeded.
- The contractor shall prepare and implement a Construction Environmental Management Plan (CEMP) for the key activities which shall include detailed layout maps to ensure all stakeholders are clear on where activities will take place, and temporary impacts agreements with affected households.
- A community and occupational health and safety plan is required as part of the CEMP, emphasizing the need to address risks in particular to site operatives.

16. Mitigation and monitoring measures of environmental quality are also required for the operation phase. The importance of training in operations of the WWTP and environmental management will be emphasized to ensure that the investments are sustainable, and that operations are effectively maintained as per the WWTP design. Recognizing that operator performance is critical to environmental performance, a detailed long-term operator training plan and associated budget is provided in the capacity development component of this project.

17. A Grievance Redress Mechanism (GRM) will be established to receive and facilitate resolution of affected peoples' concerns and grievances associated with the implementation of the project and its social and environmental safeguards. The GRM is designed to promptly address affected people's concerns and complaints, using a transparent process that is readily accessible to all affected persons. The GRM will contain multiple entry points to allow affected people to approach the Contractor, PIU, their local leaders, the Ministry of Public Works and Transport or ADB.

1.4. Conclusion

18. This IEE was undertaken to determine the environmental issues and concerns associated with all subproject stages. The more significant impacts are associated with the operation stage. The assessment confirms that the project is classified as Category B for environment. The Subproject will not cause any significant adverse impacts that cannot be readily and effectively mitigated. The EMP contains adequate and sufficient measures that when implemented as designed ensure that all anticipated impacts on the natural environment and affected people will be mitigated to an acceptable level. The key parties involved in implementation of the mitigation measures are the construction contractors and the operators. They will be supported by qualified national and international environmental consultants within the Project Management Consultant teams. The implementation of the EMP will be closely monitored and reported on by the relevant stakeholders in the project.

19. The most significant impacts from the subproject are associated with the operation of the WWTP. Therefore, a comprehensive training and capacity building component is included in the project to ensure that the investment is both financially and environmentally sustainable and achieves anticipated outcomes.

20. Overall, the expected subproject outcome is improved urban environmental services in Serei Saophoan Town. The subproject is anticipated to bring environmental benefits to the population in the project area. It will serve to improve wastewater management, reduce pollution impacts and provide long term urban environmental improvements, health benefits and promote sustainable city development.

2. INTRODUCTION

2.1. Background and introduction

2.1.1. Project Outputs and Location

21. This IEE was developed in conjunction with the Detailed Engineering Design for Serei Saophoan Wastewater and Drainage Subproject in Serei Saophoan Town, Banteay Meanchey Province of the Second Urban Environmental Management in the Tonle Sap Basin Project (TS-2 Project).

22. The location of the Second Urban Environmental Management in the Tonle Sap Basin Project (TS-2) is in the three secondary cities of Serei Saophoan Town, Banteay Meanchey Province, Battambang Town, Battambang Province and Stueng Saen Town, Kampong Thom Province. These three towns of the provinces are located surrounding the Tonle Sap Lake Basin (see Figure 1).

Figure 1: Location of TS-2 Project Urban Centres

23. Output 1: Improved public services. The project will finance three wastewater sub-projects: (i) a new 8,500 m^3/day capacity WWTP at Battambang and 108.7 km of new sewers, (ii) a new 3,500 m^3/day capacity WWTP in Stung Saen and 49.1 km of new sewers in Stung Saen Town, Kampong Thom Province, and (iii) a new 3,500 m3/day capacity WWTP in **Serei Saophoan** and 109.9 km of new sewers. The project will finance two drainage sub-projects: (i) a 17.1 km drainage network in Stung Saen; and (ii) a 8.5 km drainage network in **Serei Saophoan.** The project will finance three controlled landfills: (i) 48,000 m^3 landfill in Stueng Saen; (ii) 130,000 m^3 landfill in Serei Saophoan and (iii) 350,000 m^3 landfill in Battambang. The project will also finance the provision of about 100 public toilets in markets and schools as well as provision of free latrines for 760 poor households.

24. Output 2: Improved institutional effectiveness. The project will strengthen institutional effectiveness through improving staff capacity in critical areas (including improved urban service delivery, O&M of urban facilities, public private partnerships and other institutional arrangements), supporting the establishment of urban service units, and dedicated consultant support for project management. As a long-term contribution to the sector, the project will promote gender inclusivity and finance scholarships in civil engineering for 15 women.

25. Output 3: Improved policy and planning environment. The project will develop urban development strategies and master plans for the city. It will develop a road map for financial sustainability for wastewater management (including a proposed road map and arrangement for tariffs, and mechanism for ensuring household connections). It will build community awareness on the benefits of proper sanitation and separate wastewater systems.

2.2. Objective of IEE

26. This IEE was developed in conjunction with the finalization of the Detailed Engineering Design for the Serei Saophoan Wastewater and Drainage Subproject in **Serei Saophoan** Town, Banteay Meanchey Province of the Second urban environmental management in the Tonle Sap Basin Project. The purposes of the IEE study are as follows:

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

2.3. ADB and Domestic Environmental Due Diligence

2.3.1. IEE Requirements

27. The classification of the subproject as environment category B has been confirmed during project preparation. This IEE for the Serei Saophoan Wastewater and Drainage Subproject has been prepared and updated in conjunction with the finalization of the Detailed Engineering Design. Based on the IEE, an Environmental Management Plan (EMP) has been prepared as a separate document. The IEE and EMP have been developed in accordance with ADB Safeguards Policy Statement (SPS) 2009 and Royal Government of Cambodia (RGC) environmental requirements, policies and guidelines and will be updated where necessary to meet the final detailed designs.

28. The requirements for Ministry of Environment (MoE) approvals under Cambodian law are set out in detail in Section 3.1.2. An approved company, registered with the Ministry of Environment (MoE) has prepared a separate IEIA report for the subproject, which was submitted to the MoE in December 2020 and received approval on 11 February 2021.

2.3.2. Structure of This Report

29. This IEE report follows the format prescribed in ADB SPS 2009. For the purposes of this subproject, this IEE includes the following information:

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

30. Appendices to this report contain the EMP for this subproject. The EMP are specifically designed to aid the construction contractors and operators in management of environmental impacts and therefore contain:

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

31. In addition, the EMP includes detailed receptor maps and site location maps to support contractors with preparation of site-specific Construction EMP (CEMP) that include specific protection and monitoring measures in respect of sensitive resources/receptors.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1. Environmental Assessment Requirements

3.1.1. Environmental Assessment Requirements of ADB

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

33. SPS 2009 environmental assessment requirements specify that:

- At an early stage of project preparation, the borrower/client will identify potential direct, indirect, cumulative, and induced environmental impacts on and risks to physical, biological, socioeconomic, and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected people and concerned nongovernment organizations. If potentially adverse environmental

impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle.

- The assessment process will be based on current information, including an accurate project description, and appropriate environmental and social baseline data;
- Impacts and risks will be analysed in the context of the project's area of influence;
- Environmental impacts and risks will be analysed for all relevant stages of the project cycle, including preconstruction, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration; and
- The assessment will identify potential transboundary effects as well as global impacts;

34. Other requirements of SPS 2009 include:

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

35. As stated in the "Guidelines for Climate Proofing Investments in the Water Sector: Water Supply and Sanitation, Climate Impacts", ADB (2016) there may be impacts from climate change on wastewater treatment. Warmer temperatures can mean (i) Increased operating challenges to biological and chemical processes of treatment facilities (ii) Increased temperatures and increased evaporation in receiving water bodies, changing chemical balances and increased eutrophication (iii) Reduced capacity to meet wastewater treatment requirements and standards. More frequent and/or intense extreme weather events can lead to •(i) increased risk of direct flood damage to treatment plant, pumping and conveyance, and outfall and (ii) Increased risk of untreated wastewater overflows contaminating water supply sources.

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

3.1.2. Environmental Assessments Requirements of Cambodia

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

- Sub-decree on EIA Process No. 72 (1999). This law provides the detailed guidelines for implementation of the EIA Process. Its Annex requires the conduct of IEIA or EIA on the following activities under the Project: (i) waste processing, burning activities, all sizes; (ii) wastewater treatment plants, all sizes; (iii) drainage systems, >5,000 ha.
- Declaration on Guideline for Conducting IEIA and EIA Reports No. 376 (2009). This declaration specifies the basic contents of IEIA/EIA Reports, which should include: (i) introduction; (ii) legal framework; (iii) project description; (iv) description of the existing environment; (v) public participation; (vi) assessment of, and mitigation measures for, significant environmental impacts; (vii) environmental management plan; (viii) cost-benefit analysis; and (ix) conclusion and recommendations.

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

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

40. A meeting held between the MoE, Ministry of Public Works and Transport (MPWT) and consultant teams for ADB projects on 6th December 2017 confirmed that for the projects and their sub-projects discussed, the following is required:

- EIA department agrees that this project needs to prepare IEIA / IESIA report which can be informed by the IEE report and incorporate the additional baseline environmental survey (air and water quality) results.
- The IEIA report for landfills should be prepared in separate report from other subprojects.
- The IEIA report for the drainage and sewerage can be prepared together in one IEIA report.
- EIA department agrees with and supports the project and will facilitate MoE to give a general approval letter to MPWT after receiving IEIA report and request letter from MPWT.

41. A registered company, authorized to complete IEIA reports in Cambodia, is required to submit the IEIA report on behalf of the project owner, MPWT.

3.2. National Environmental Policy and Legislation

3.2.1. Legal Framework for Environmental Management

42. In 1993 the new Constitution of Cambodia included environmental considerations for the first time. Specifically, Article 59 states: ‘’The State shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land,

water, air, wind, geology, ecological system, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, fish and aquatic resources''. This led to the establishment of the Ministry of Environment.

43. The hierarchy of legislation in Cambodia is:

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

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

3.2.2. Policies and legal instruments

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

46. The Environment Law has the following objectives:

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

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

- Sub-decree on Solid Waste Management (1999);
- Sub-decree on Water Pollution Control (2009);
- Sub-decree on Air Pollution Control and Noise Disturbance (2000), and
- Sub-decree on Management on Sewage System and Wastewater Treatment Plant (2017).

48. A summary of other legislative and policy instruments relevant to the project is presented in Table 2. A summary of national and international guidelines are listed in Table 3. The key environmental quality standards applied to the EMP for this IEE are presented in detail in Annex 1.

Table 2: Relevant Laws, Regulations and Guidelines

Law/Regulation/Guideline	Year	Summary
Royal Decree on the Protection of Natural Areas	1993	Classified 23 protected areas in Cambodia into four categories: (i) natural parks; (ii) wildlife sanctuaries; (iii) protected landscapes; and (iv) multiple-use areas.

Law/Regulation/Guideline	Year	Summary
		Designated the Tonle Sap (316,250 ha) as a multiple-use area or area necessary for the stability of the water, forestry, wildlife and fishery resources, for tourism, and for conservation of long-term existing natural resources with a view to assure sustainable economic development.
Law on the Protection of Cultural Heritage (NS/RKM/0196/26)	1996	Regulates the protection of national cultural heritage and cultural property in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Its Article 37 stipulates that in case of chance find of a cultural property during construction, work should be stopped and the person who found the property should immediately make a declaration to the local police, who shall, in turn, transmit the property to the Provincial Governor without delay.
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. Its Annex 2 provides the effluent standards, including effluents from wastewater stabilization ponds, and annex 4 and 5 contain water quality standards for public waters for the purpose of biodiversity conservation, and water quality standards for public waters and health, respectively. As per agreement with MoE, the effluent standards applicable to the subproject are those in Annex 2 of this Sub-decree for *public water area and sewer*
Sub-decree on Solid Waste Management (Sub-decree No. 36 ANK/BK),	1999	Article 1: Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity through using appropriate technical approaches. Article 2: This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste. Article 4: The Ministry of Environment shall establish guidelines on disposal, collection, transport, storage, recycling, minimizing, and dumping of household waste in provinces and cities in order to ensure the safe management of household waste. The authorities of the provinces and cities shall establish the waste management plan in their province and city for short, medium and long-term.
Sub-decree 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). Article 3 A. “Source of pollution” is defined and separates mobile sources (including transport) and fixed sources such as factories and construction sites. Article 3 B. “Pollutant” is defined as smoke, dust, ash particle substance, gas, vapour, fog, odour, radio-active substance

Law/Regulation/Guideline	Year	Summary
Law on Land (NS/RKM/0801/14)	2001	Provides that: (i) unless it is in the public interest, no person may be deprived of ownership of his immovable property; and (ii) ownership deprivation shall be carried out according to legal forms and procedures and after an advanced payment of fair and just compensation. (Article 5)
Royal Decree on the Establishment and Management of Tonle Sap Biosphere Reserve (Royal Decree No. NS/RKT/0401/070)	2001	Establishes the Tonle Sap Biosphere Reserve (TSBR) in accordance with the statutory framework of the World Network of Biosphere Reserves. Divides the TSBR into 3 zones: (i) core areas; (ii) buffer zone and (iii) flexible transition zone. Core area: set aside for long term protection, human activity is limited to monitoring and research. Buffer zone: is area surrounding the core areas helping to protect the environment. It may accommodate education and training activities. Transition area: may contain a variety of agricultural activities and human settlements. Here all stakeholders have to cooperate to achieve sustainable development
Environmental Guidelines on Solid Waste Management[1]	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.
Labour Law (1997) Decree No. CS/RKM/0397/01	1997	This law governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: Chapter VIII Health and Safety of Worker. The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace. Article 230: Workplaces must guarantee the safety of workers. However, the only specific occupational health and safety Prakas relates to the garment industry and brick manufacture. Chapter IX: Work-Related Accidents Article 248: All occupational illness, as defined by law, shall be considered a work-related accident. The law sets out how accidents should be managed in terms of compensation.
Law on Water Resources Management (NS/RKM/0607/016)	2007	Requires license/permit/written authorization for the: (i) abstraction & use of water resources other than for domestic purposes, watering for animal husbandry, fishing & irrigation of domestic gardens and orchards; (ii) extraction of sand, soil & gravel from the beds & banks of water courses, lakes, canals & reservoirs; (iii) filling of river, tributary, stream,

Law/Regulation/Guideline	Year	Summary
		natural lakes, canal & reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and to endanger human, animal and plant health. (Articles 12 & 22) Its Article 24 stipulates that Ministry of Water Resources and Meteorology (MOWRAM), in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Royal Decree on Protected Areas (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. The Law gives the Royal Government of Cambodia the authority to establish or modify Protected Areas (Article 9 and 10). A Protected Area shall be established by sub-decree. Article 11 divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone & community zone. Article 36 strictly prohibits all types of public infrastructure in the Core Zone & Conservation Zone; & allows development of public infrastructures in the Sustainable Use Zone & Community Zone with approval from the Royal Government at MoE's request. Article 41 provides for the protection of each protected area against destructive/harmful practices, such as destroying water quality in all forms, poisoning, using of chemical substances, disposing of solid and liquid wastes into water or on land. Article 44 requires all proposals & investments within or adjacent to protected area boundary an Environmental and Social Impact Assessment. The law defines Protected Area as "*An area of the State's public properties in land or water territories, including coasts and sea, located in the area established by a Royal Decree or a new area established in the jurisdiction of the Ministry of Environment. These areas are of physical and biological importance which requires management by law with the purpose of protecting and maintaining biological, natural and cultural resources, and shall be sustainably managed in every generation for environmental, social and economic benefits*". Each protected area shall be divided into four (4) management zoning systems: **1. Core zone:** management area(s) of high conservation values containing threatened and critically endangered species, and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defence sectors. **2. Conservation zone:** management area(s) of high conservation values containing natural resources,

Law/Regulation/Guideline	Year	Summary
		ecosystems, watershed areas, and Natural landscape located adjacent to the core zone. Access to the zone is allowed only with prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defense sectors. Small-scale community uses of Non-Timber Forest Products to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone. **3. Sustainable use zone:** management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community, and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the Ministry of Environment. **4. Community zone:** management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar).
Expropriation Law	2010	Defines the principles, mechanisms, and procedures of expropriation, and defining fair and just compensation for any construction, rehabilitation, and public physical infrastructure expansion project for the public and national interests and development of Cambodia.
Sub-Decree on Demarcation of 647,406 Hectare Flooded Forest Domain in Six Provinces adjacent to Tonle Sap Lake (Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom) (Sub-decree No. 197 ANKr/BK)	2011	Stipulates a zoning system for the area between the national highways and the Tonle Sap Lake system and the nature of agriculture activities that are permitted and banned in each zone.
Sub-Decree N.235 on Management of Sewage/Culvert System and Wastewater Treatment Plant	2017	**Article 3:** This sub-decree is implemented to the management on Sewage System and Wastewater Treatment Plant in urban municipality, province, city, district and resort/recreational area of Royal Government of Cambodia. This sub-decree is not implemented on Industrial Wastewater Management. **Chapter 2:** This Charter is presented the role and responsible of relevant agencies/institution: national level (MPWT, MoE and MoI), Provincial level (municipality, province, relevant provincial departments, city, district), and involved investment project owners.

Law/Regulation/Guideline	Year	Summary
		Article 25: The dispose of garbage, solid waste, oil waste, chemical waste, sludge waste from septic tank of WWTP factory into the pipe system, natural reservoir or into public water sources are prohibited.

Table 3: Key National Environmental Standards

Environmental Issue	National Standard	International Standard
Ambient air quality	Annex 1, Ambient Air Quality Standard, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Air Quality Guidelines, global update 2005
Noise	Annex 6, Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Guidelines for Community Noise, 1999
Groundwater quality	Drinking water Quality Standards, 2004	WHO Guidelines for Drinking-water Quality, Fourth Edition, 2011
Surface water quality	Annex 4, Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, and Annex 5, Water Quality Standards for Public Waters and Health, of Sub-decree on Water Pollution Control, 1999	US EPA National Recommended Water Quality Criteria Mekong River Commission (MRC)_ Technical Guidelines for the Protection of Aquatic Life MRC Technical Guidelines for the Protection of Human Health
Effluent quality (including leachate)	Annex 2, Effluent standard (Discharged wastewater to protected public water areas or public water areas and sewers), of Sub-decree on Water Pollution Control, 1999	EHS General Guidelines and Guidelines for Water and Sanitation

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

3.3. International Agreements

50. Cambodia is party to the following international environmental agreements relevant to the Project: (i) UNESCO World Heritage Convention, 1991; (ii) Convention on Biodiversity, 1995; (iii) UN Framework Convention on Climate Change, 1995; (iv) Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997; (v)

Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1999; (vi) Basel Convention on the Control of Transboundary Movements of the Hazardous Wastes and Their Disposal, 2001; (vii) Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer, 2001, and all Amendments, 2007; (viii) Climate Change Kyoto Protocol, 2002; and (ix) International Tropical Timber Agreement, 2006.

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

4. DESCRIPTION OF THE PROJECT

4.1. Rationale

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

53. Tonle Sap Basin. The Tonle Sap basin is home to about a third of Cambodia's population, and nearly half of the population depends on the lake's resources, particularly its fish, for their livelihoods. Rural-urban migration is occurring at unprecedented rates. Cambodia's urban population growth rate of about 4%, one of the highest in Southeast Asia, translates into significant growth in the basin's cities. In a largely rural region, the three project cities (whose populations range from 40,000 to 86,000), together with the cities of Siem Reap, Kampong Chhnang and Pursat, are key for economic growth and their development is linked to the surrounding environment. While flooding is important for maintaining the ecosystem services of the basin, severe flooding, including in the basin's urban areas located along rivers, can cause damage to life and property. The basin's urban areas are also sensitive to climate change, as they are located next to rivers and most experience flooding during the wet season.

54. Access to services. At present, wastewater services in urban areas (excluding Phnom Penh) are inadequate. While about 80% of the population has access to improved sanitation, a large proportion (69.3%) have individual systems (septic tanks) while access to wastewater

treatment is very limited (10.7%).[2] The main reasons for these service delivery gaps are (i) inadequate coverage and delivery of urban environmental infrastructure and services; (ii) inadequate management of public investments, and (iii) poor urban planning that doesn't consider environmental management and climate change events.

55. Institutional arrangements. The Ministry of Public Works and Transport (MPWT) is responsible for asset creation for urban sanitation, with the PDPWT responsible for operations and maintenance. Solid waste management is the responsibility of the city, although in practice the role of the city versus the Ministry of Environment is not always clear. Due to limited technical capacities at the provincial and municipal level, MPWT continues to be involved with the construction of large-scale infrastructure including wastewater treatment plants, sewerage networks.

56. The Project. General observations indicate that the expansion in infrastructure and service provision has not been matched by equitable distribution, with disproportionate access in the capital region and certain municipalities. In order to contribute to the provision of a quality urban environment to this fast-growing urban population, including in secondary urban centres, the Second Urban Environmental Management in the Tonle Sap Basin Project will support the government of Cambodia in improving urban services and enhancing climate and disaster risk resilience in participating towns in the Tonle Sap Basin. The project will directly build on a preparatory study conducted by the Cities Development Initiative for Asia (CDIA) program (hereinafter referred to as "CDIA study") which was completed in Q3 2017. The project is part of ADB's programmatic approach to resilient and environmentally sensitive urban development in the Tonle Sap Basin, and will build on an ongoing project, under which similar interventions are financed in two of the basin's towns, in Kampong Chhnang and Pursat (Tonle Sap Urban Environmental Improvement Project, TS-1).

4.2. Project Impact, Outcome and Outputs

57. The expected project impact is sustainable, inclusive, equitable and resilient growth achieved. The outcome of the Serei Saophoan Wastewater and Drainage Subproject in **Serei Saophoan Town,** Banteay Meanchay Province will be improved urban environmental services in participating cities. The project outcome includes:

58. Output 1: Improved urban services. The project will finance the wastewater sub-project: (iii) a new 3,500 m^3/day capacity WWTP in Serei Saophoan and 110.2 km of new sewers and this subproject also will finance for improving the drainage 8.5 km of drainage network in Serei Saophoan. The TS-2 project will also finance the provision of about 100 public toilets in markets and schools as well as provision of free household latrines for 760 poor households and free sewerage connections for all households.

59. Output 2: Improved institutional effectiveness. The project will strengthen institutional effectiveness by: (i) improving staff capacity in critical areas (including improved urban service delivery, O&M of urban facilities, public private partnerships (PPPs) and other institutional arrangements); (ii) supporting the establishment of urban service units; and (iii) providing dedicated consultant support for project management. As a long-term contribution to the sector, the project will promote gender inclusivity and finance scholarships in civil engineering for 15 women.

[2] Improved sanitation includes flush and/or pour flush to piped sewers, septic tanks, and pit latrines with slab. Government of Cambodia, Ministry of Planning. 2014. Cambodia Socio-Economic Survey. Phnom Penh.

60. Output 3: Improved policy and planning environment. The project will develop urban development strategies and master plans for city/town. It will develop a road map for financial sustainability for wastewater (including a proposed road map and arrangement for tariffs, and mechanism for ensuring household connections). It will build community awareness on the benefits of proper sanitation, separate sewerage systems and safe disposals.

4.3. Climate Change

61. Climate adaptation. The project is classified as being at medium risk from future climate change impacts. The project design includes climate adaptation and disaster risk reduction measures for the wastewater treatment plants in sub-project areas, these include raising the heights of platform formation, increased heights of bunds around wastewater treatment plant lagoons, raising the height of access roads and increased drainage. Drainage network pipes have been designed for 10-year flood return periods and a further safety factor for climate change is included, as the nearest (i.e. next largest standard pipe size adopted) which allows for extra drainage capacity. The Climate adaptation and incremental disaster risk reduction structural measures are estimated to cost $3,200,000, to be funded through the ADF grant ($1,270,000) and the loan ($1,830,000).

4.4. Existing Wastewater and Drainage System

62. Based on the CDIA 2010 study, around 70% of households have toilet facilities. Of these around 10% have septic tanks while the rest have pit latrines or other form of waste depository systems. At present, there is no sewerage system in the city. Most of the household wastewater is discharged directly into drainage pipes in the city, flowing into canals and the river without any treatment.

63. The physical topography of Serei Saophoan is quite hilly, which facilitates drainage operations. The central part of the city experiences localized flooding during rainfall events in the rainy season, in part because of lack of connections between upstream and downstream drains.

64. Overall, the existing drainage system is adequate, with some sections requiring upgrading or extensions. However, the practice by property owners of discharging their sewerage to the existing drainage has resulted in severe pollution of downstream drains with effluents causing odours under low flow conditions in the dry season. To mitigate the urban drainage issues in the central part of Serei Saophoan City, the existing drainage system along the national highway is incorporated into the design of the new drainage system under the subproject.

Figure 2: Existing Drainage System

4.5. Subproject Description

65. A detailed analysis of the engineering designs is provided in the Detailed Engineering Design Report. A summary of the designs relevant to the IEE is provided here.

66. Serei Saophoan is located in Banteay Meanchey Province on the banks of the Sisophon River, a major tributary to Tonlé Sap Lake. The city has good access to transport infrastructure via National Highway 5 and National Highway 6.

67. The project is designed to cover the main urban areas of Serei Saophoan. The service area for the wastewater and drainage collection works is situated in the four (4) urban sangkats of Ou Ambel, Kampong Svay, Tuek Thia and Preah Ponlea as displayed in Figure 3.

Figure 3: Service Area and Zones for Wastewater Collection in Serei Saophoan City

68. The design period for the project components is 20 years up to Year 2040 and the design is based on population growth forecasts in the service area from a baseline in 2017 with a population of 19,182 to 24,120 in 2040. The capacity of the wastewater network and treatment plant is based on a gradual increase in water use from currently 120 litre per capita per day to 150 litre per capita per day in 2040. When considering the proportion of water that is discharge to the wastewater system and also considering groundwater inflow and infiltration into groundwater, the total amount of wastewater from the service area is estimated at 3,500 m^3/day by 2040.

69. The main subproject components include:

- Construction of an urban drainage collection network for storm-water management;
- Construction of a primary and secondary wastewater collection network;
- Construction of tertiary sewer network, including service connections for households, commercial and institutional buildings;
- Construction of four (4) sewer pump stations and associated pumping mains;
- Construction of a 3,500 m^3/day Wastewater Treatment Plant (WWTP) above flood levels;
- Construction of administration, workshop, electrical and security buildings at WWTP;
- Upgrade and raise 3.0 km of access road to the WWTP site to be above flood levels;
- Construction of a dike about 2.5-3.0 m high around the WWTP for flood protection;
- Provision of Operations & Maintenance Equipment.
- Provision of necessary supporting facilities for construction of sub-project component including campsite, borrow area.

4.5.1. Sewer System and Pump Station Designs

70. The sewerage system designed for Serei Saophoan service area is divided into four zones in consideration of the topography, requiring four pump stations including a main pump station to transfer all wastewater flow to the WWTP. A plan of the proposed sewer system design is shown in Figure 5.

71. The gravity sewers and force mains were designed based on the estimated year 2040 peak dry weather wastewater flow as shown in Table 4. The lengths and depths of the sewer network are summarised in Table 5.

Table 4: Projected Dry Weather Wastewater Flow

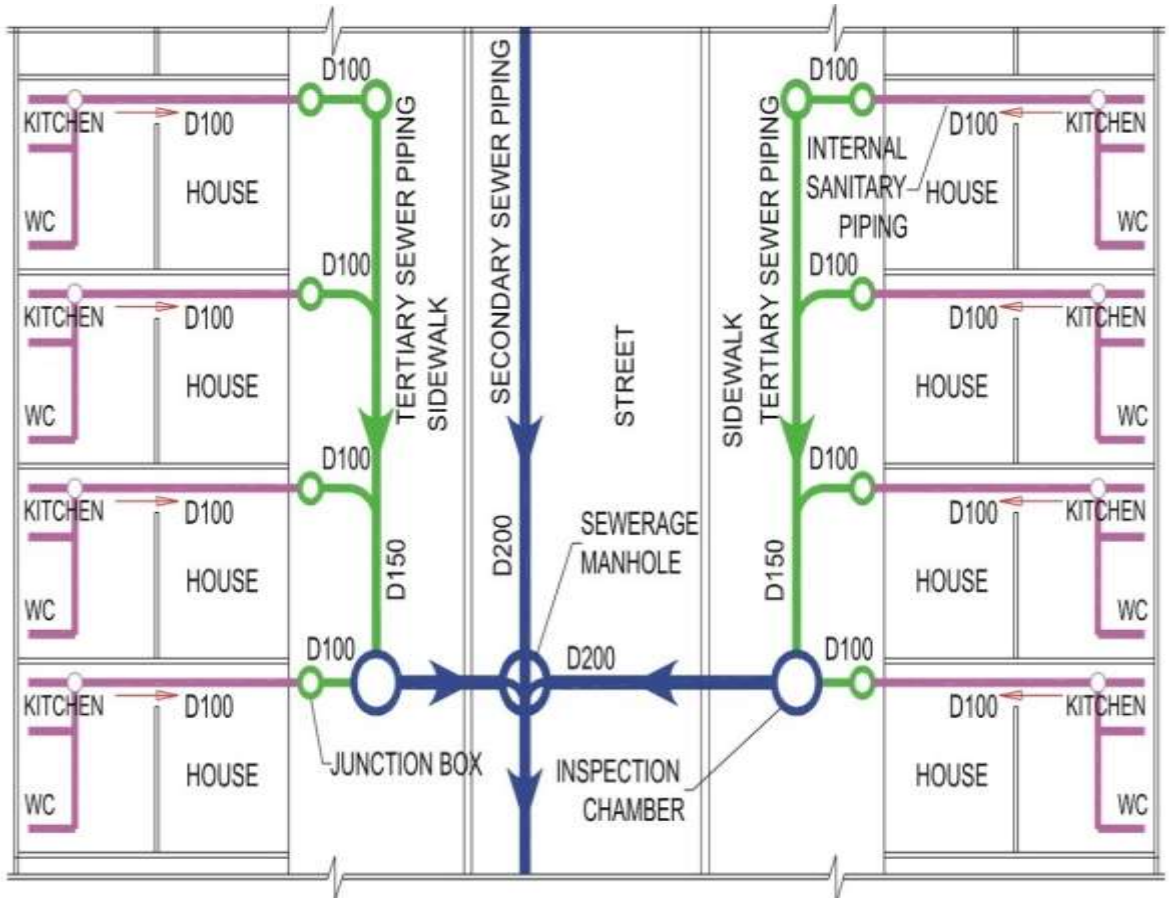
Sub-Catchment	Projected Dry Weather Wastewater Flow, Q, (m^3/day) Design Year 2040			
	Households Flow	Institutional & Commercial Flow	Avg. Q for Pumping	Peak Q for Pumping
PS-1 (MPS) Sub-Catchment	471	219	3641	6246
PS-2 Sub-Catchment	1215	92	1306	2279
PS-3 Sub-Catchment	677	34	711	1254
PS-4 Sub-Catchment	893	40	933	1647

Table 5: Sewer Network Piping Lengths and Depths

Depth (m)	Tertiary Sewer Pipe, HDPE (km)	Gravity Sewer HDPE (km)	Force Mains, HDPE (km)	Total (km)
Depth ≤ 1.50 m	59.0	23.2	9.8	92.0
1.5 m < Depth ≤ 3.0 m	4.4	11.8	0.3	16.5
Depth > 3 m	-	1.4	-	1.4
Total Length (km)	**63.3**	**36.5**	**10.1**	**109.9**

72. Included in the project design is a required tertiary sewer network and sewer household connections (SHC) all to be funded under the project (see conceptual design in Figure 4). SHC are service pipelines from the street sewer extended to an inspection opening or point just inside the property boundary line. The tertiary sewers and SHC are included as a crucial part of the wastewater treatment system and a pro-poor and social inclusion design feature.

Figure 4: Conceptual Design of Wastewater Piping Systems



Source: DDPP Team 2018

73. The key data for the pump stations are presented in Table 6 and their location is indicated in Figure 5. All pump station wet wells will be reinforced concrete structures designed for the containment of wastewater. The structures will be watertight, lined/coated for corrosion prevention, and designed for H-20 loading[3]. The main pump station is Pump Station No. 1 (MPS).

Table 6: Pump Station Key Data

Item	Pump Station No.1 (MPS)	Pump Station No.2 (PS-2)	Pump Station No.3 (PS-3)	Pump Station No.4 (PS-4)
Location Coordinates	X-278809.1035 Y-1502723.4654	X-280971.3701 Y-1502040.2623	X-276514.2220 Y-1502537.9808	X-279830.6777 Y-1505480.7385
Land Area	80 m^2	25 m^2	25 m^2	25 m^2
Existing Land Use	Residential Road Allowance	Residential Road Allowance	Residential Road Allowance	Residential Road Allowance

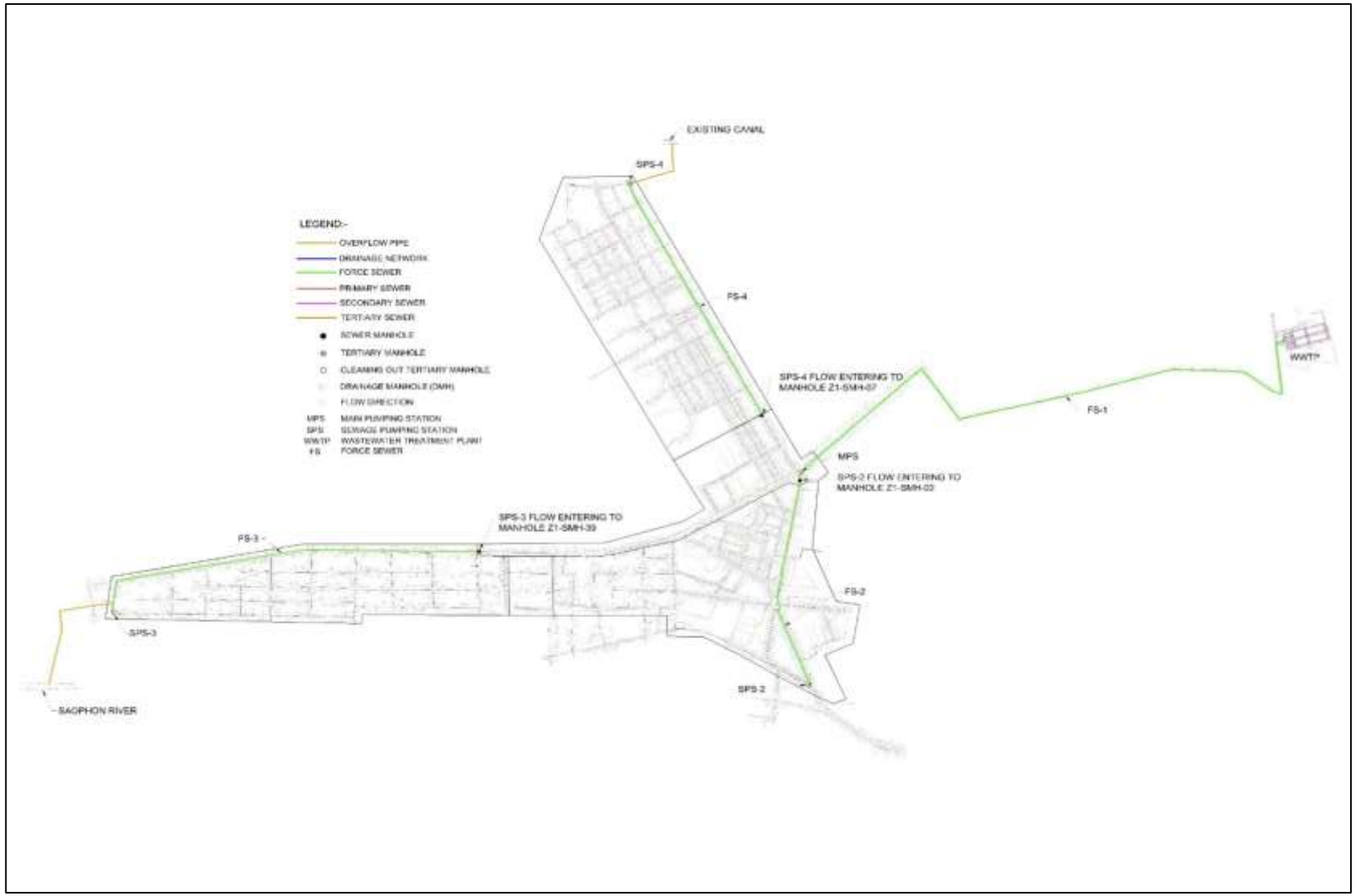
[3] This is the term used by AASHTO to describe normal moving traffic loading conditions up to 18-wheeler loading

Item	Pump Station No.1 (MPS)	Pump Station No.2 (PS-2)	Pump Station No.3 (PS-3)	Pump Station No.4 (PS-4)
Existing Elevation	15.03 m	12.94 m	15.47 m	11.90 m
Pump Configuration	2 duty + 1 standby Submersible	1 duty + 1 standby Submersible	1 duty + 1 standby Submersible	1 duty + 1 standby Submersible

74. As indicated in Table 6, the pump station wet wells will be equipped with a standby pump in case of malfunction of the duty pump. In addition, the wet wells will have two alarms, the first alarm will send a signal to the operator if the pump is not activated at the designed water level, and the second alarm will send a warning of imminent overflow from the wet well to an overflow tank.

75. The main pump station (MPS) will be equipped with an emergency generator located outdoor due to lack of space at the site. The generator shall have adequate ventilation and sound attenuating provisions to meet exterior noise level requirements. The generator will be connected to a fuel tank adequate for 24-hour continuous operation. The fuel tank will have secondary containment.

Figure 5: Serei Saophoan Wastewater System Layout Plan



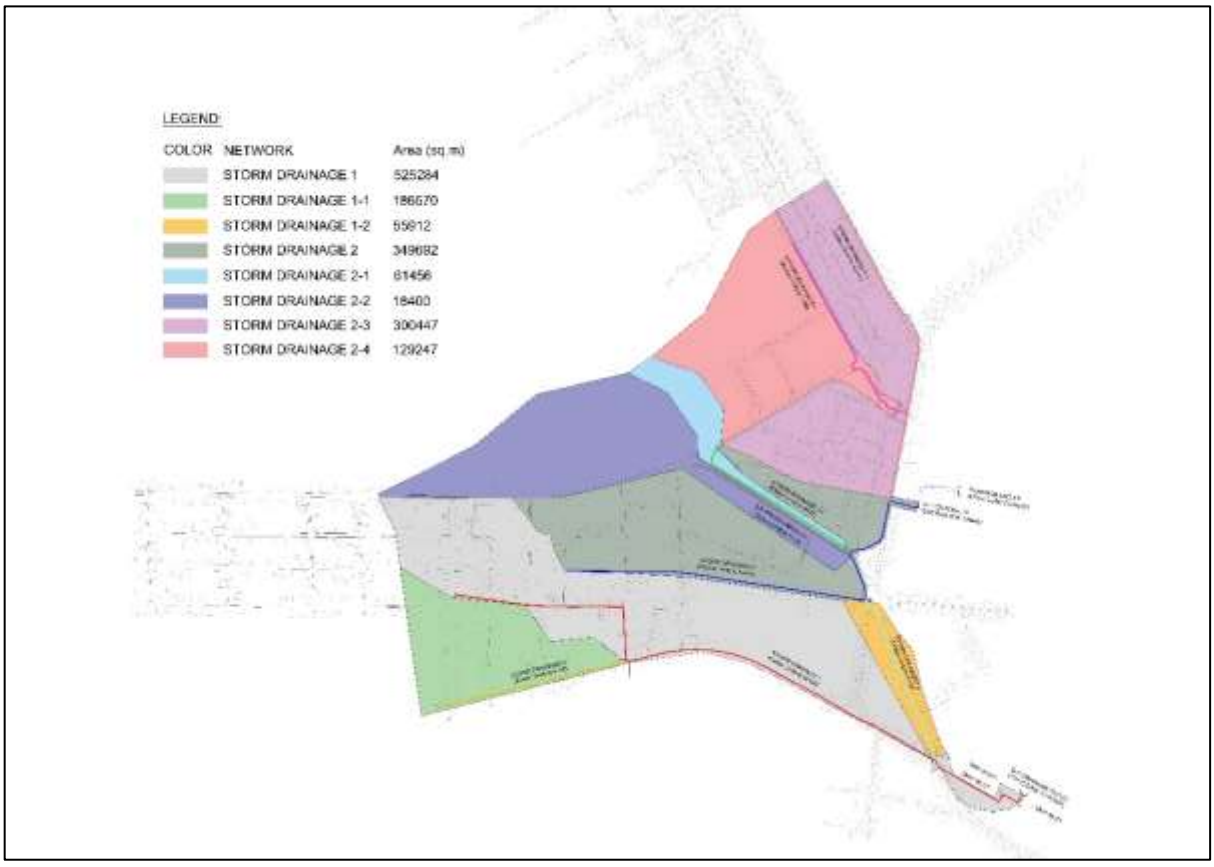
4.5.2. Drainage System Design

76. The primary objective of the drainage system is to mitigate flooding in the central market area upstream of the railway and the main urban centre. The service area is divided into eight sub-catchment areas in consideration of the topography, including flows from the existing drainage network. Drainage flows will be conducted to the two river outlets. The sub-catchments plan of the storm drainage system is shown in Figure 6.

77. The drainage network will consist of Reinforced Concrete U (RCU) Drains with a reinforced concrete cover. RCU drains facility easy maintenance and clean-up of debris and minimises the excavation depths. The covered RCU Drains are planned along the existing selected paved roads and for some of those roads it is proposed to install drainage lines on both sides of the road.

78. Reinforced concrete outlet structures are designed for the two drainage outlets to the river. At each outlet, a sluice gate is provided for periods when the river level is high to prevent backflow into the drainage network.

Figure 6: Stormwater Drainage Network and Catchments



4.5.3. Wastewater Treatment Plant Design and Technology

79. The site for the WWTP has been identified by Provincial Department of Public Works and Transport (PDPWT) and Town Authority, and the location has been approved by MoE. The location of the WWTP is shown in Figure 7. The distances to the nearest receptors and infrastructure are summarized below:

- The site is located on a flat lowland area with irrigation canals and rice fields.

- About 0.5 km from residential area (Kantout Village).
- About 0.5 km from a rural road in Kantout Village.
- About 2 km from National Road-6.
- About 2 km from village development area (Navy village Area).
- About 5 km from Serei Saophoan Town.
- The site is 0.6 km - 1 km from Saophoan River.
- No sensitive resources or sensitive ecology exist at or near the site.

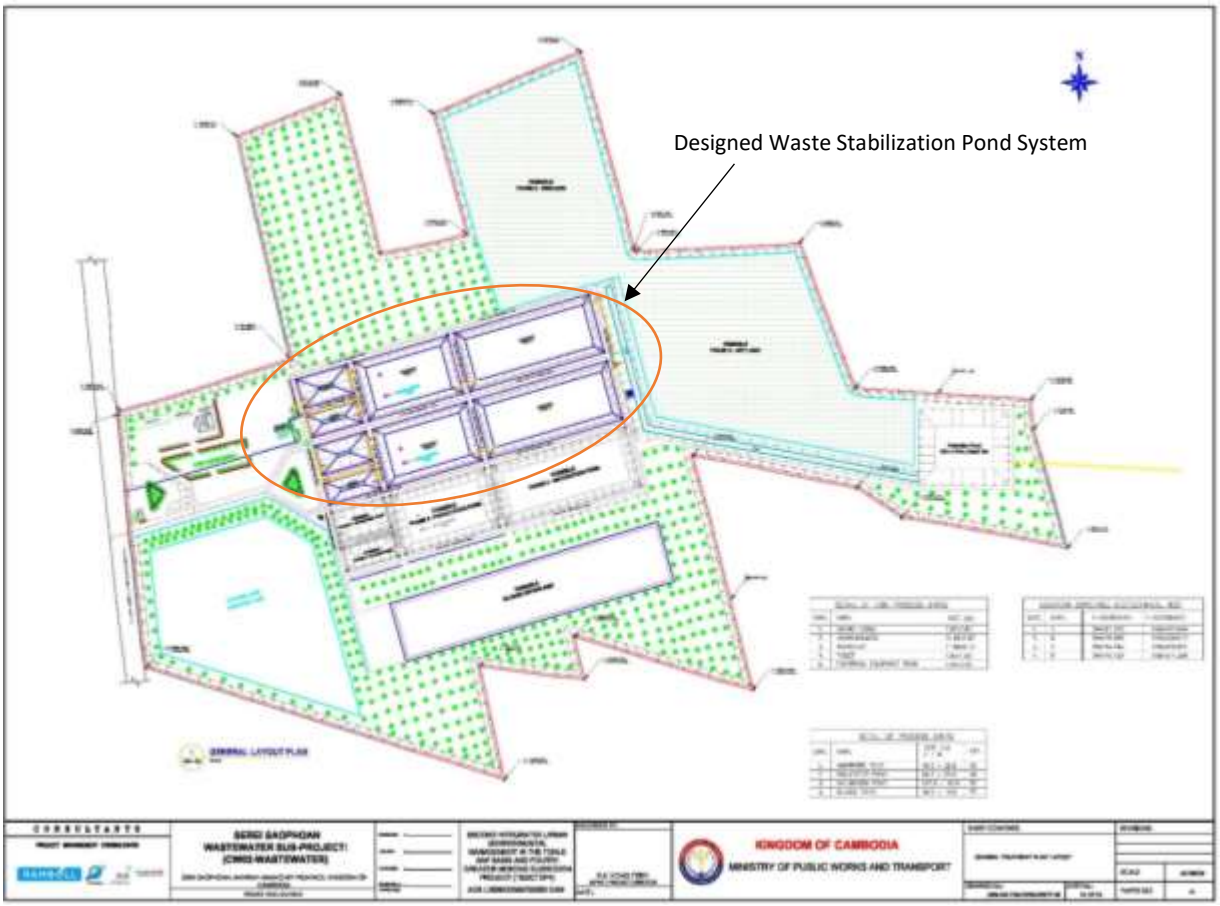
Figure 7: Location of the WWTP

80. The site can be accessed from the city centre via a network of existing asphalt and earth roads. The existing road will be upgraded and the elevation raised to 0.5 m above the maximum recorded flood level.

81. The WWTP site has an area of 10 ha. The treatment system with a capacity of 3,500 m3/day can be constructed on 3.5 ha of land, which allows for future expansion of the WWTP with a further 10,500 m3/d treatment capacity, for a total wastewater flow of 14,000 m3/d to serve an estimated population of 80,000 persons, by replicating the anaerobic, facultative and maturation ponds technology. The general layout plan for the designed waste stabilization pond system and future expansion is shown in **Error! Reference source not found.**.

82. The WWTP effluent will be discharged can be to an existing irrigation canal adjacent to the site, with flow to the Saophoan River through agricultural area (see Figure 7). The WWTP site experiences 2.5 m flooding for three months each year during the rainy season. Consequently, a 3 m high dike will be constructed around the WWTP site. The soil used for constructing the dike will be clay soil imported from another location.

Figure 8: Wastewater Treatment Plant Layout Plan for Designed Components and Future Expansion



83. Wastewater Treatment Design and Process. The basic components of the WWTP consist of a series of different types of waste stabilization ponds (anaerobic, facultative, maturation) that rely entirely on natural processes by algae and bacteria with sunlight as the only energy source. This is a well-established, low-cost, low-maintenance, highly efficient, entirely natural and sustainable technology for domestic wastewater treatment in tropical climates. Although the design (as is common practice) is based on BOD and faecal coliform removal – for which waste stabilization ponds are very effective - and not on removal of nutrients from the wastewater, the processes do also contribute to nutrient removal.

84. The WWTP will comprise two (2) wastewater treatment trains. The treatment plant layout is shown in **Error! Reference source not found.**. The two (2) trains will be able to accommodate the future wastewater flows until design year 2040 with a treatment capacity of 3,500 m^3/d:

- Inlet Screening Structure with channels for an automatic screen and a manually cleaned screen bypass;
- Septage Receiving Structure with manually cleaned screen;
- Two (2) Anaerobic Ponds in parallel with dimensions of 25 m (width) and 46 m (length), each pond;
- Two (2) Facultative Ponds in parallel with dimensions of 50 m (width) and 84 m (length), each pond;

- Two (2) Maturation Ponds in parallel with dimensions of 50 m (width) and 120 m (length), each pond;
- Two (2) Sludge Treatment/ Drying Ponds - dimensions of 19 m (width) and 46 m (length).

85. The main components of the waste stabilization pond process include the following steps (see general layout plan in Figure 9 and process diagram in Figure 10):

- Inlet and Wastewater Screening Facility. The WWTP inlet works receives wastewater pumped from the two (2) pumping stations. The WWTP inlet works will consist of an influent channel with automatic screen, screenings compaction and dewatering; and to allow for periodic maintenance, repair and cleaning without disruption of the treatment process, a bypass channel with a manually cleaned screen will be provided. The screenings from the pre-treatment processes will be disposed of to the new engineered landfill.

- Septage Receiving Facility**.** Septage is the sludge removed from septic tanks and thus similar in content to wastewater from households without septic tanks, however, with a much higher BOD content than the wastewater. The treatment of septage has been incorporated into the design of the treatment plant and this includes a BOD concentration of 5000 mg/L in the septage. The septage receiving chamber will be receiving septage wastewater coming from the mobile vacuum trucks. A coarse screen is provided in the chamber to remove large solids from the wastewater. The septage collection trucks can discharge the septage to the chamber. Septage flow from the chamber then connects to the inlet channel of fine screening facility, then flows to the WWTP ponds for further treatment in the anaerobic ponds. A water supply standpipe shall be provided to clean the screen, receiving chamber and concrete parking pad for the septage trucks.

- Summary of Pond Sizing Design Parameters for Year 2040:
    - WWTP Design Flow = 3,500 m^3/d
    - Influent BOD Concentration = 250 mg/L
    - Temperature = 24 ºC
    - Evaporation Rate = 5 mm/day
    - Influent Faecal Coliform Concentration = 5 x107 FC per 100 mL

- Anaerobic ponds. A first stage for treatment of high strength wastewaters, including mixtures of industrial/domestic wastewaters and septage with high organic loading:
    - Two (2) Anaerobic Ponds in parallel with dimensions of 25 m (width) and 46 m (length), each pond
    - Depth: 5 m
    - Retention time: 1 day
    - Percent removal for anaerobic pond at 24 ºC: 68%
    - BOD concentration of effluent: 80 mg/L

- Facultative ponds designed to be naturally aerated to maintain the biological activity of the bacteria. Floating baffles will be installed to provide hydraulic mixing, increase the retention time and to reduce the size of the ponds:
    - Two (2) Facultative Ponds in parallel with dimensions of 50 m (width) and 84 m (length), each pond
    - Depth of facultative pond: 2.5 m - 3.0 m
    - Number of floating baffle walls: 2
    - Number of treatment zones: 3
    - Area of 2 facultative ponds at 2.5 m depth: approx. 8,400 m^2

- Retention Time: 4 days
- Percent removal for anaerobic and facultative ponds at 24 ^{o}C: 88%

- Maturation ponds. Aerobic lagoons used as UV disinfection for bacteriological pollutant removal and tertiary or “effluent polishing” treatment. Floating baffles will be installed to provide hydraulic mixing, increase the retention time and to reduce the size of the ponds:

  - Two (2) Maturation Ponds in parallel with dimensions of 50 m (width) and 120 m (length), each pond.
  - Influent faecal coliform concentration: 5 x 107 MPN/100 mL
  - Effluent faecal coliform concentration at 24 ^{o}C: ≤ 1,000 MPN/100 mL
  - Depth of maturation pond: 1.5 m
  - Number of floating baffle walls: 2
  - Number of treatment zones: 3
  - Retention time: 4 days
  - Surface Area of 2 Maturation Ponds at 1.5 m depth = 12,000 m^2
  - Percent removal (total after treatment in all ponds) at 24 ^{o}C: ≥ 95%
  - Effluent from maturation ponds: 3,500 m^3/d.

- Sludge management. The water content of the sludge is very high, therefore, before final disposal further treatment of anaerobic sludge from the ponds is required to reduce water content and oxygen demand of the sludge. Two sludge lagoons will be constructed to provide flexibility and to ensure availability of a sludge lagoon when stabilization or drying is being performed in the other sludge lagoon. The excess supernatant wastewater in the sludge treatment/drying lagoon will flow by gravity back to the WWTP inlet for further treatment. During the sludge treatment/stabilization phase, a supernatant layer will be maintained to prevent odours from escaping, except for the stabilized sludge drying phase. The dewatered and dried sludge will be disposed of at the new landfill, or it will be used as soil conditioner or fertilizer if the chemical and bacteriological content are within applicable standards. The stabilized sludge will need to be removed from the drying ponds after 3-5 years.

- The DED assumes that the volume of sludge accumulated in an anaerobic pond will be 40 liters/ per person/year. Anaerobic ponds require desludging when they are one third full of sludge by volume. This occurs every 2−5 years, but for operational effectiveness, desludging will be done every year. Facultative ponds design has allowed for 300 mm of sludge accumulation, expected to take about 10 years.

  Sludge stabilization / drying ponds:

  - Two (2) Sludge treatment/ drying ponds with dimensions of 19 m (width) and 46 m (length).
  - Sludge application thickness: 3 to 4 m
  - Sludge drying time: 4 to 6 weeks, depending on the weather conditions.
  - Underdrains: 20 mm crushed stone

- WWTP Outlet Structure. The treated effluents from the WWTP will be discharged to an existing stream/canal leading to the Saophoan River (see Figure 7). The effluent outlet will flow to a cascade aerator that terminates in a collection channel at the base of the WWTP containment dike. The effluent will comply with the applicable effluent standards and will be suitable for use in agriculture.

Figure 9: Wastewater Treatment Plant General Layout Plan

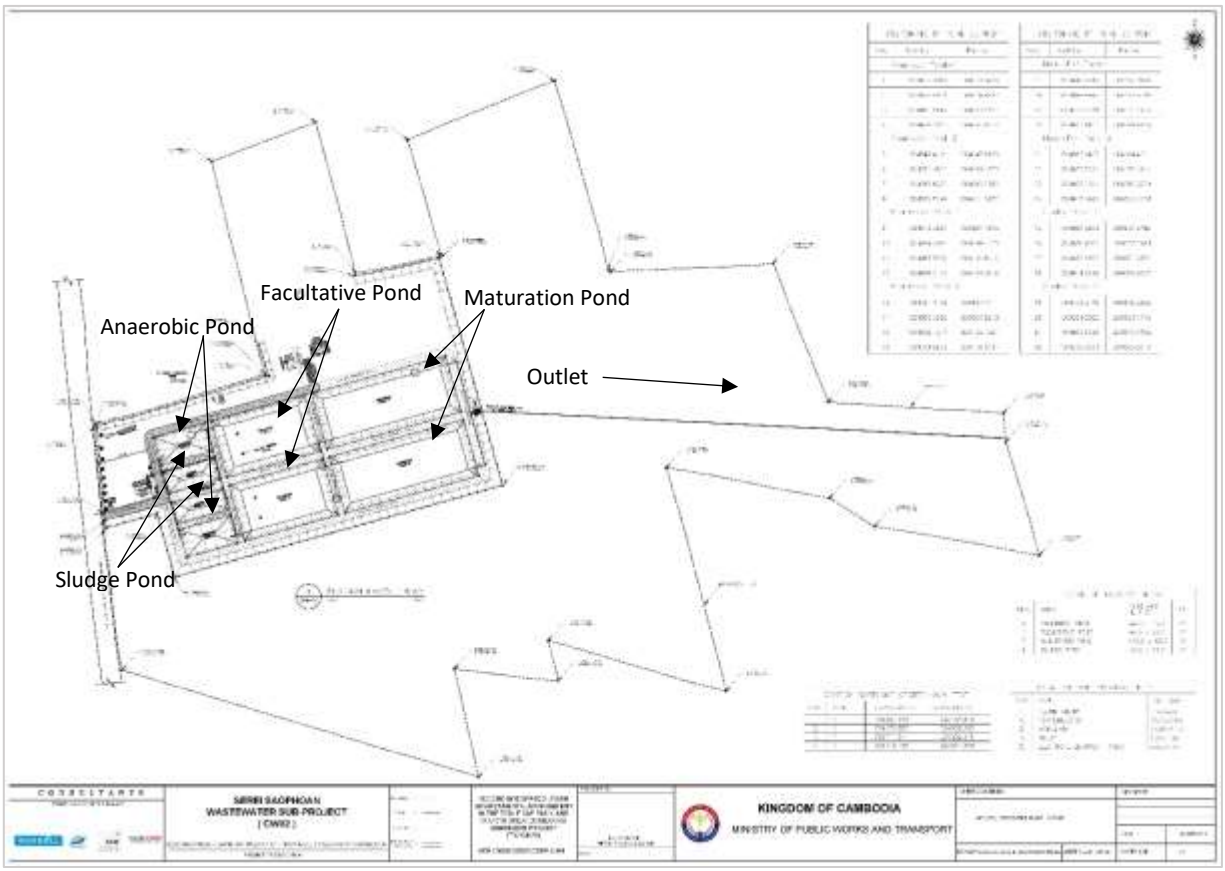
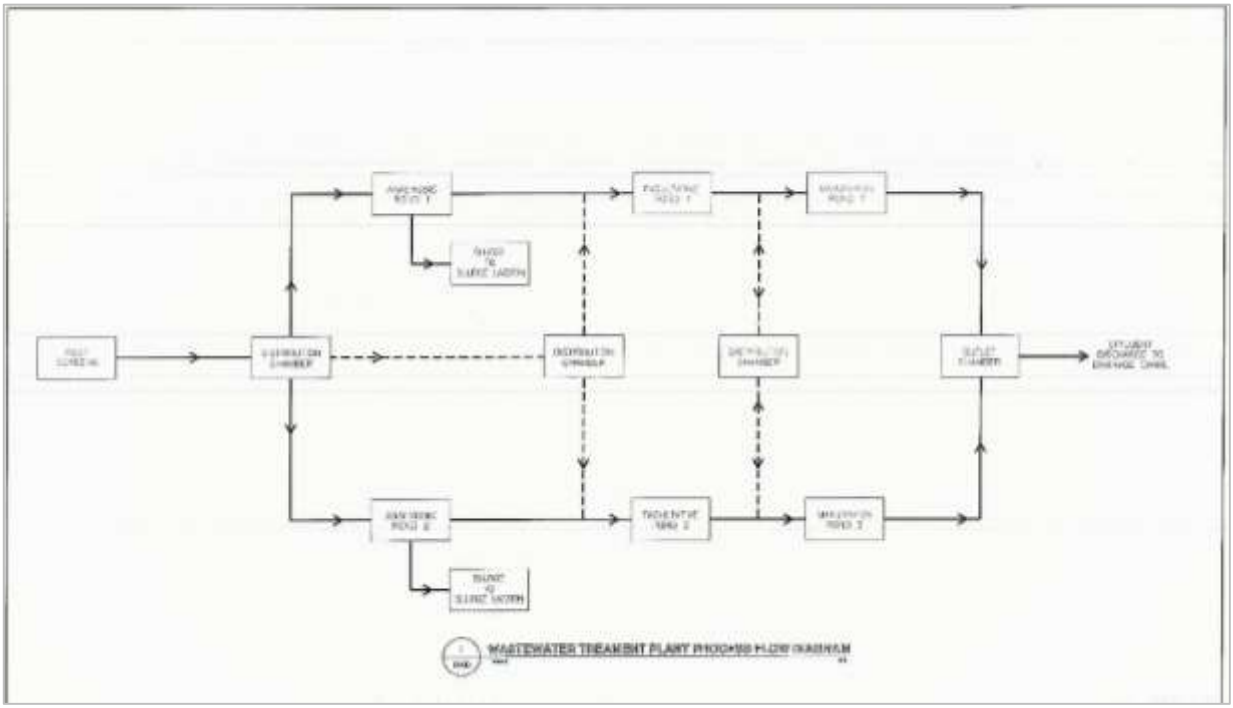


Figure 10: Wastewater Treatment Plant Process Flow Diagram



Source: Detailed Engineering Design Drawings, 2020

86. Treated effluent quality. The assumed concentrations of pollutants in the raw wastewater and the calculated concentrations after treatment are summarized in Table 7 and compared with the applicable effluent standards. As indicated in Table 7, the WWTP will be able to deliver water in a quality within the applicable effluent standards (Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 for public water area and sewer). Note that the Cambodian effluent standards do not include thresholds for bacteria, however the treated water will have a concentration of total coliform bacteria of less than 1,000 MPN/100 ml which is well below the Cambodian National Ambient Water Quality Standard of 5,000 MPN/100 ml.

Table 7: Wastewater Quality and Effluent Standards

Effluent Quality Parameter	Unit	Raw Influent[4]	Treated Effluent	Effluent Discharge Standards Cambodia[5]
pH		6.5-7.5	6.5-7.5	5-9
BOD_5	mg/L	500[6]	28	<80
COD	mg/L	750	50	<100
Total suspended solids (TSS)	mg/L	300	40	<120
Nitrates (NO_3)	mg/L	<1	< 10	< 20
Ammonia (NH_3)	mg/L	22	3.5	<7
Phosphate (PO_4)	mg/L	6	2.4	<6
Detergent (LAS)	mg/L	TBC[7]	TBC	<15
Oil and grease	mg/L	TBC	TBC	<15
Total coliform	MPN/100 mL	$1x10^6 – 1x10^7$	1,000	-[8]

87. The BOD5 and coliform removal rates used for the design are shown in Table 8.

Table 8: Anticipated BOD_5 and Coliform Percentage Reductions

Type of Pond System	BOD_5 Removal Rate (%)			Coliform Removal Rate (%)		
	12^0C	20^0C	25^0C	12^0C	20^0C	25^0C
Anaerobic, 3 x facultative, 3 x maturation *Equivalent to ponds baffled into 3 zones	94	95	95+	99.95	99.9996	99.99999

[4] Design wastewater characteristics have been assumed for design purposes in absence of actual data on the raw influent. Treated effluent characteristics calculated using well established treatment process performance criteria, the PIAC team's experience with similar plants and the assumed raw influent

[5] Adopted effluent discharge standards for Cambodia are those from Sub-decree 27 (1999), Annex 2, *Public Water Area and Sewer*, in accordance with agreement with MoE. Note that Annex 2 of Sub-decree 27 (1999) includes effluent standards for *Protected public water areas* and for *Public Water Area and Sewer,* and as the Subproject will not discharge effluents into any Protected Area (see definition in Table 2), the applicable effluent standards are those stipulated for *Public Water Area and Sewer.*

[6] Design BOD concentration of septage is 5,000 mg/L

[7] TBC: to be confirmed as it is highly local habits and culture dependent

[8] Annex 2 of Sub-decree 27 (1999) does not specify any effluent standard for coliform bacteria. However, for comparison, the ambient *Water Quality Standard for public water areas for bio-diversity conservation* sets an ambient water quality standard of 5,000 MPN/100 mL (Annex 4 of the same Sub-decree 27)

88. Administration and Other Buildings and Utilities. A single-story building will be constructed to commercial standard, with an architectural style suitable for the Cambodian government. The surrounding area will be landscaped, and the building will include the following:

a. Reception and waiting area
b. Plant manager's office
c. General offices
d. Meeting room
e. Male and female toilets
f. Laboratory
g. Kitchen
h. Storage area

- Workshop Building. A single-story building provided for performing maintenance and repairs of vehicles, pumps and equipment including a store for equipment and materials and an office.
- Generator Building. An enclosed fully ventilated building will be provided to house the back-up power generator and its fuel tank.
- Access and Internal Roads and Parking. The internal roads network and a site access road will be provided. These roads will allow truck access to facilities requiring regular attendance for maintenance. The roads will be surfaced with bitumen macadam and be designed for use by 10 tonnes gross weight vehicles.
- On-site drainage. Perimeter drainage channels will be provided to divert surface runoff away from the internal roads and other facilities.
- Access Gate and Perimeter Fencing and Lighting. An access gate fabricated from galvanized iron pipes (frame), welded with cyclone wire. Barb wires will be affixed on top of the gates for added security. Concrete posts will be used to hold the hinged gates. Lock assemblies and rollers will complete the fabricated gates. The perimeter fencing will be comprised of cyclone wire encased in galvanized iron pipe frame, affixed to galvanized iron pipe post with concrete footing, topped with 3 rows of barbed wire. Site lighting will be provided for the facility.
- Water Supply. Water supply will come from the Water Supply Company or a deep-well onsite. An overhead HDPE tank will be installed for water storage. Water will be supplied by gravity to administration and workshop buildings, and the inlet screening and septage receiving facility.
- Sanitation Facility. Wastewater from the toilets and showers will be collected by PVC sewer pipes and will be conveyed to the WWTP for treatment. A stand-alone toilet will be constructed at the septage receiving facility for use by the guard, O&M staff and septic truck operators.

89. Routine maintenance. The routine maintenance of the WWTP will include:

- Removing screenings and grit from the inlet and outlet works;
- Cutting grasses on the embankment, and removing it so that it does not fall in the ponds;
- Removing floating scum and floating macrophytes from the surface of the maturation and facultative ponds. This will be done to maximise the light energy reaching the pond algae, increase surface re-aeration, and prevent fly and mosquito breeding;

- Spraying scum on the surface of the anaerobic ponds and not removing it, since this will help the treatment processes;
- Removing any accumulated solids in the inlet and outlet works;
- Repairing any damaged embankment as soon as possible; and

  Repairing any damage of the fences or gates.

4.6. Associated & Existing Facilities

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

91. Existing Facilities. SPS 2009 states that for projects involving facilities and/or business activities that already exist, the borrower/client will undertake an environment and/or social compliance audit, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and Indigenous Peoples and Indigenous Peoples.

5. DESCRIPTION OF THE ENVIRONMENT

5.1. Project Area of Influence

92. All sub-project site options were visited for the preparation of this IEE, with particular attention paid to identifying:

- Sensitive natural environmental receptors such as water bodies, biodiversity and wildlife habitats;
- Sensitive human receptors and social-economic activities;
- Cultural and heritage sites; and
- Potential health and safety issues is including local traffic safety.

93. According to ADB's SPS 2009, the area of influence encompasses:

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

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

(iii) Effects from cumulative impacts from further planned development of the project, other sources of similar impacts. No cumulative impacts in this regard are anticipated as a result of this or similar projects.

(iv) Effects from unplanned but predictable developments caused by the project that may occur later or at a different location. As a result of this project, it is anticipated that the development of the urban centers will continue, leading to further developments around the sub-project areas.

94. The area of influence i.e. the area which is affected by the project, also depends on the environmental impact being considered. Local impacts with a narrow area of influence are

those impacts arising from noise, dust and amenity issues. A larger area of influence results from impacts which contribute to global issues such as the embodied carbon associated with the manufacture, supply and use of concrete products, and the carbon emissions associated with material transport. ADB's SPS 2009 requires the assessment to identify potential transboundary effects, such as air pollution, and global impacts, such as emission of greenhouse gases.

95. For the purposes of this IEE, the area of influence for amenity issues is taken to be 250 m, based on noise levels, as follows:

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

96. **Error! Reference source not found.** contains photographs and site descriptions from field visits to project sites and the area of influence.

5.2. Baseline Receptor Summary

97. This section of the IEE provides the environmental baseline (description of the environment) for the project facilities. A site-specific summary for key receptors is provided in Table 9**.** The distances given are approximate based on a centre point for each proposed site.

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

99. In addition to these facility specific receptors, housing, businesses and affected people's requirement for access are considered to be receptors. These receptors are found, for example, at locations where any excavations for pipe networks associated with the WWTP sub-projects. This is considered in the EMP mitigation measures.

Table 9: Summary of Environmentally Sensitive Receptors for WWTP Subproject

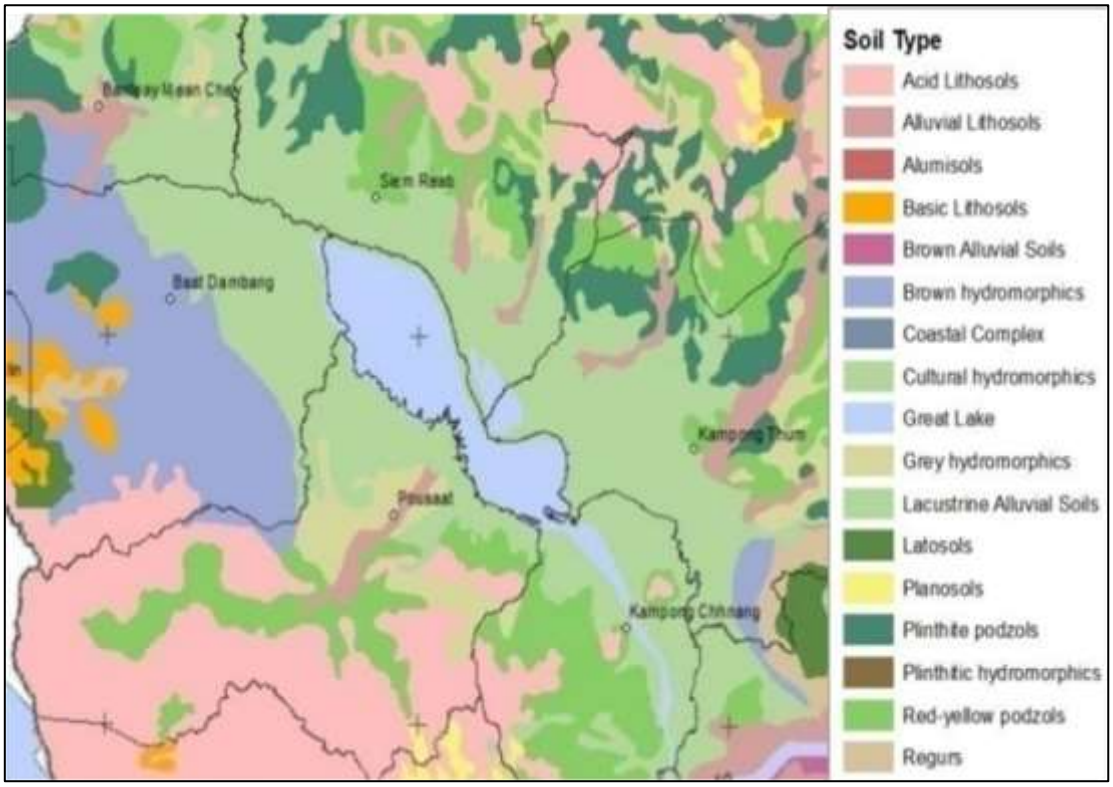
City/Town	Sub-Project	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
Serei Saophoan Town	Wastewater Treatment Plant	About 1 km from Saophon River	- About 0.5 km from residents (Kantout village) - About 4 km from National Road 6 - About 5 km from Serei Saophoan Town	Lowland wet rice fields (flooded in wet season)	None
Serei Saophoan Town	Drainage system	Near the Saophon River	- Within Serei Saophoan town - On the roadside and ROW	None	None

City/Town	Sub-Project	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
			- Locations are near the pagodas - Near the houses, business, and town utilities services		
Serei Saophoan Town	Sewer line	Certain section Near the Serei Saophoan River	- Within Serei Saophoan town - On the roadside and ROW Locations are near the pagodas - Near the houses, business, and town utilities services	None	None
Serei Saophoan Town	Pumping Station	PS2 close to the Saophon River, PS1 is in town	- Within Serei Saophoan town	None	None
Serei Saophoan Town	Pressurized sewer or forced main	None	- Within Serei Saophoan town and outside urban area up to WWTP - Along the road and within ROW	None	None
Serei Saophoan Town	Access road	Canal along the road	- None	None	None
Serei Saophoan Town	Borrow area	Not identified during IEE/EMP preparation	-	-	-
Serei Saophoan Town	Treated Effluent Discharge point	Irrigation canal	- None	None	None

5.3. Geography, Geology, Topography

100. The WWTP and sewerage system subproject in Serei Saophoan town is located in lowland of agricultural area and the drainage system is located in urban/town area of Bantey Manchey province is one of urban town that located surround the Tonle Sap Lake Basin. The area is dominated by the Tonle Sap lake and this has affected the soil characteristics. Figure 11 shows the sub-project areas which are dominated by alluvial soils and Serei Saophoan are as weel as Tonle Sap Basin area is in an area of brown hydromorphic soil which is associated with prolonged water saturation from groundwater and impeded drainage.

Figure 11: Soil Map of Tonle Sap Basin



Source: Dr Seng Vang Deputy Director, MAFF, presentation 2015, with UN FAO

101. The topography of the area is generally flat, forming part of the Tonle Sap floodplain area. As a result, the majority of the sub-project is located in lowland and flat low-lying areas around Tonle Sap Lake. The soil quality in Serei Saophoan is not much different from those of Battambang (Tonle Sap Basin area). Data on soil quality in Serei Saophoan is not available, however soil quality data in Battambang which is in the same basin as Serei Saophoan is represented as shown in Table 10.

Table 10: The Soil Quality in Battambang WWTP Site

No	Parameter	Unit	Result
1	pH	-	7.66
2	N	%	0.21
3	K	m.e/100g Soil	0.48
4	Ca	m.e/100g Soil	11.80
5	Mg	m.e/100g Soil	5.40
6	Na	m.e/100g Soil	0.87
7	Organic Matter	%	3.88
8	C/N	Unit	11
9	TP	%	0.06
10	Phosphorus	%	40
11	CEC	m.e/100g Soil	25.20
12	Electrical Conductivity	US/cm	39.5
13	Moisture	%	1.72
14	Clay	%	36.20
15	Fine Sediment	%	21.75
16	Coarse Sediment	%	20.74

No	Parameter	Unit	Result
17	Fine Sand	%	18.76
18	Coarse Sand	%	1.85

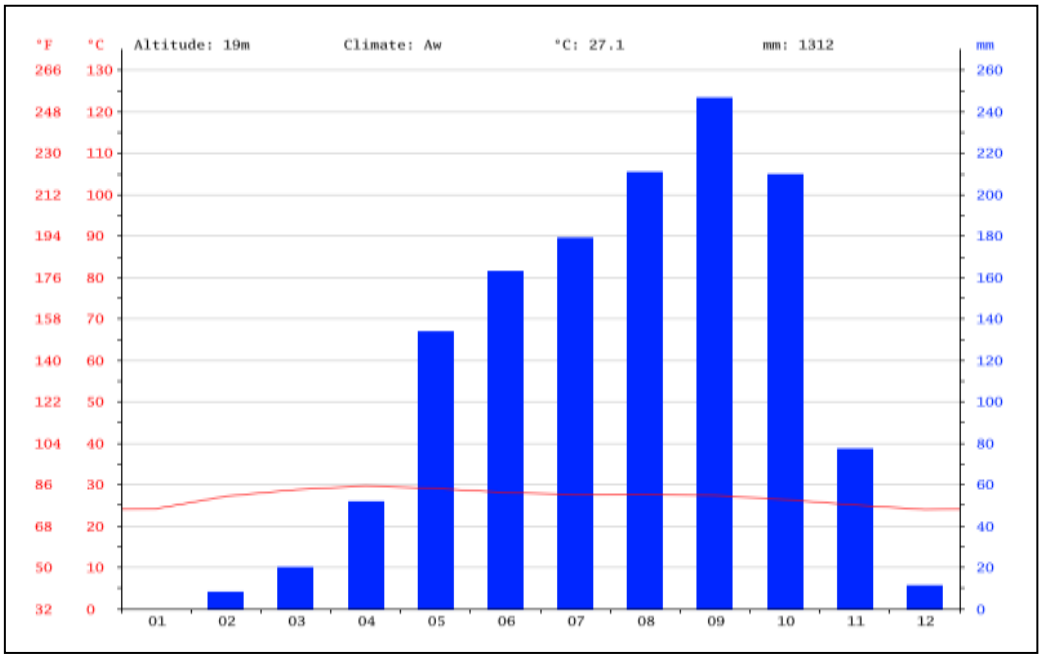
Source: MAFF Laboratory for IESIA Report November 2019
-Soil sample location is near the WTP site on the rice filed (X: 309288 - Y:14500141)
-The soil quality is analysed by laboratory of MAFF

5.4. Meteorology and Climate Change

102. Cambodia is situated in a tropical zone, between 10 and 14-degree latitude north of the equator. The climate is dominated by the monsoon cycle, with a distinct dry season and wet season. 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 wet season is from May to October, as southwest monsoon brings in moisture and rains from the Indian Ocean. Average temperature has minimal variations regionally and seasonally; within the Tonle Sap Basin (Siem Reap town) the average temperature ranges from 24°C in December/January to 31°C in April.

103. Precipitation. Siem Reap is not a sub-project town but is located between the sub-projects to the east and west of the Tonle Sap lake. Rainfall data for Siem Reap indicate that the average rainfall is approximately 1300mm; the distribution of rainfall throughout the year is shown in Figure 12.

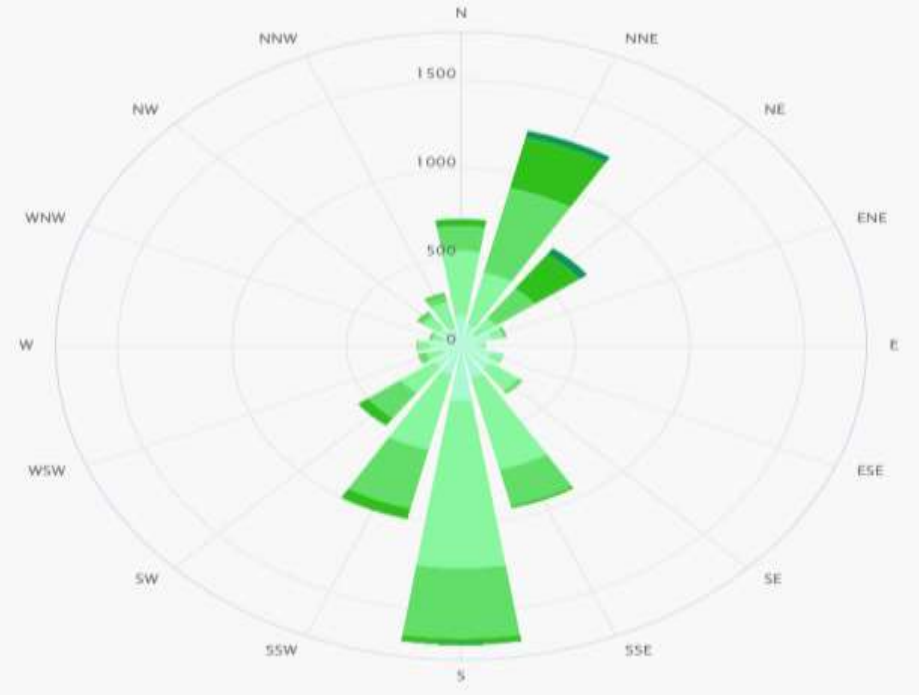
Figure 12: Rainfall Data for Siem Reap



Source : https://en.climate-data.org

104. Wind. Data on wind characteristics is limited for the project area but is available for Phnom Penh. Figure 13 shows there are two distinct wind directions in Phnom Penh, associated with the seasons. The cooler drier season is characterized by winds from the North, and the majority of winds are from the South, bringing warmer air.

Figure 13: Wind Rose for Phnom Penh



Source: www.meteoblue.com

105. **Climate Change Projections.** A Climate Risk and Vulnerability Assessment (CRVA) has been undertaken for this project based on site visits and climate change projections for the Year 2050 and RCP 8.5. The CRVA noted that many sites are vulnerable to flooding and as such mitigation measures in the design are required; the most significant climate change risks associated with the sub-projects are during operation. The WWTP subproject sites can be impacted by heavy rain and flooding. Increased temperatures and droughts can reduce potable water supplies which may directly impact the flows into the WWTPs. However, if effectively managed, the CRVA notes that new facilities will bring about improvements to the living conditions of the population of the project areas.

106. Table 11 shows the impacts from climate change on the sub-projects as identified by the CRVA. These issues are managed through design mitigation measures where appropriate.

Table 11: Impacts from Climate Change on Sanitation Infrastructure

Climate Change Factor	Impact
Warmer Temperatures	• Increased operating challenges to biological and chemical processes of treatment facilities. • Increased temperatures and increased evaporation in receiving water bodies, changing chemical balances and increased eutrophication. • Reduced capacity to meet wastewater treatment requirements and standards.
More Frequent and/or Intense Extreme Weather Events	• Increased risk of direct flood damage to treatment plant, pumping and conveyance, and outfall. • Increased risk of untreated wastewater overflows contaminating water supply sources. • Changes in quantity and quality of watershed runoff and in the resulting non-point source pollution loads to receiving waters.

107. Rainfall. The main change in rainfall will occur in the three wettest months of the year, August to September. In low lying areas flooding is generally caused by the rainfall in the wettest months of the year and lasts for several weeks. In such a case, changes in monthly rainfall are of more importance than rain falling over a shorter time period. Projections suggest that there will be little, if any, increase by 2030 but could increase by over 20% by 2070. The CRVA concludes that under Representative Concentration Pathway[9] (RCP) 6.0 with regards to changes in future precipitation:

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

5.5. Hydrology, Surface and Ground Water

108. The Saophoan River is a main river and water sources in subproject area of Serei Saophoan Town. The river borders the southern edge of the town before crossing the eastern part of the town approximately 5 km upstream the WWTP. The local water supply authority uses this water for households in the town, and in the rural areas the river is a source of irrigation, and people use the water household uses. There is limited information about the surface water quality in Saophoan River. The existing surface water quality in Saophoan River is shown in Table 12**.**

Table 12: Surface Water Quality is Saophoan River

N.	Parameter	Unit	Standards	Result
1	pH	mg/l	6.5-8.5	7.39
3	Total Suspended Solid (TSS)	mg/l	25-100	64.00
5	Biochemical Oxygen Demand (BOD_5)	mg/l	1-10	1.96
6	Chemical Oxygen Demand (COD)	mg/l	< 50	9.30
7	Oil and Grease	mg/l	< 5.0	5.90

Water quality sampling in Teuk Thla commune, upstream of Serei Saophoan Town.
Source: MoE Laboratory, National Road 5 Improvement Project, December 2019

109. Groundwater. Based on field visits and discussions with local authorities and people, all households in Serei Saophoan Town, use water from the town water supply authority and

some people in the rural area use water from Saophoan River for household consumption and irrigation. In the town areas, people don't use groundwater.

110. The soil strata at the WWTP site encountered by the geotechnical investigations[10] consists of 4-7 m of clay followed by shifting layers of clay with gravel and clay to the drilling depths of 10 m below ground. Groundwater was detected at greater depths during drilling and stabilized some hours after completion of the drillings at 2 m – 2.5 m below ground. This confirms low permeability in the upper clay layer.

5.6. Air Quality

111. Field visit observations indicate that the ambient air quality in the Serei Saophoan town and subproject sites is still good, as the project areas are located in rural areas without significant industrial/commercial activities that would cause air quality degradation. Typically, in Cambodia, outside Phnom Penh or town centres there are few industrial pollution sources (industrial sites) and the volume of vehicular traffic is low. Minor air quality problems may be caused by local traffic. Air quality data in the subproject site is not available at present.

5.7. Noise

112. Field visits and observation indicate that noise levels in the Serei Saophoan subproject of WWTP locations are not significant, due to project areas being located in rural areas, the site are covered by rice fields without industrial/commercial noise sources. The sewerage system network of sub-project is in urban area which can contribute to noise level which is primarily generated from traffic volume.

5.8. Natural Disasters

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

114. Table 13 presents the data of the Natural Disasters occurring between 2012-2014 in provinces of TS-2 Project. Flooding is the most severe impact to the population around the Tonle Sap basin. Number of affected households due to drought have increased in 2013 and 2014 significantly for the cities of Serei Saophoan and Stueng Saen. In addition, the socio-economic survey undertaken for this project (see Feasibility Study Volume 4) confirmed that 69% of respondents had experienced a flood where they are now living; the main sources of flooding were cited as drainage system (49%), river (27%) and canal (11%).

Table 13: Natural Disasters in 2012-2014

City/Town	Type	2012 Families Affected	2013 Families Affected	2014 Families Affected
Battambang	Flood	21	244	50
	Drought	0	7	74
	Storm	3	5	7

[10] Ramboll, OC Global, SCE and Tancons (Cambodia) Co., Geotechnical Investigation Report, Serei Saophoan Wastewater and Drainage Service Area, The Second Integrated Urban Environmental Management in Tonle Sap Lake in the Kingdom of Cambodia, ADB, December 2019

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

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

5.9. Physical Cultural Resources

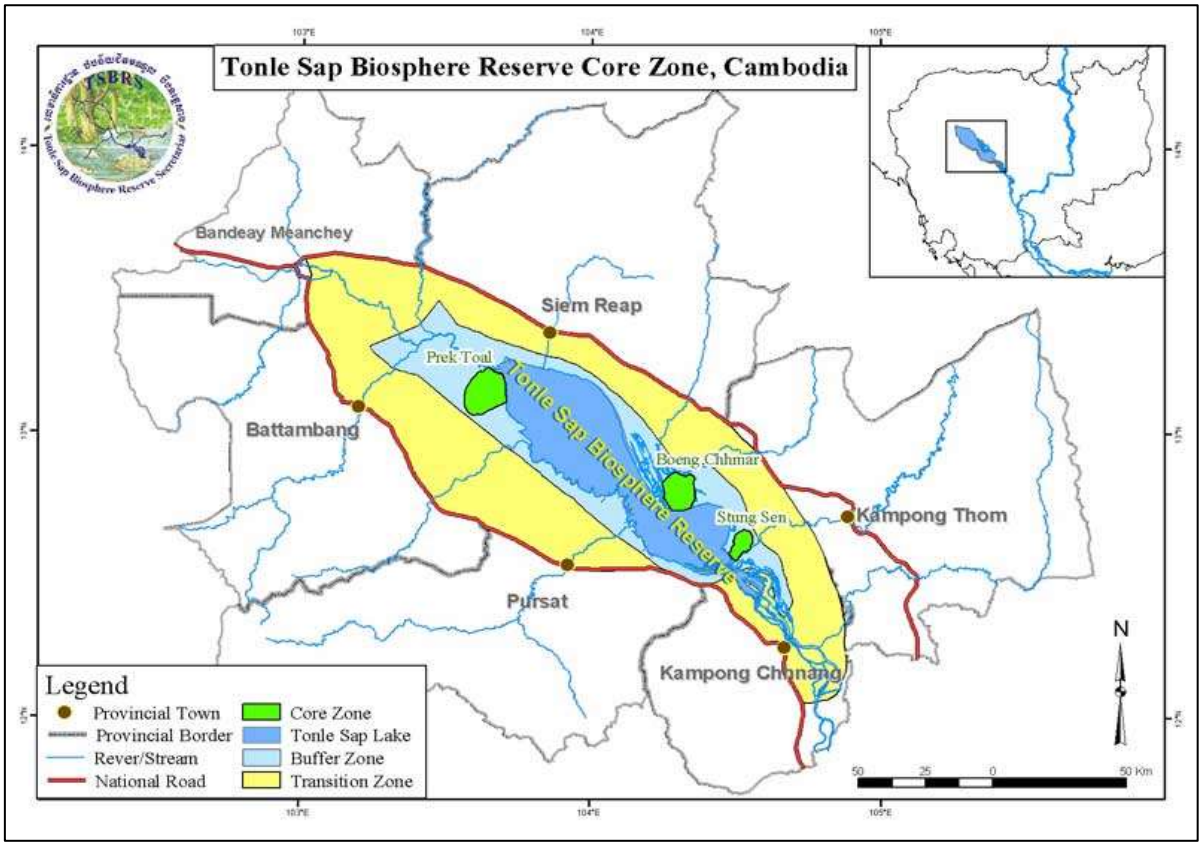
115. Around the subproject area there are a number of places of worship, in particular pagodas located in village areas, most in the town areas are near the roadway, and drainage sites. Serei Saophoan WWTP site is far from the cultural resources. Pagodas and cultural resources are located more than 2 km for the WWTP site. However, the wastewater and drainage networks will be constructed on roadsides in the urban area of Serei Saophoan Town in proximity to pagodas, so during construction of the wastewater and drainage systems cultural receptors will be carefully considered to ensure that any impacts are prevented or mitigated.

5.10. Special or Protected Areas

116. There are 23 Protected Areas in Cambodia, but the nearest to the project is the Tonle Sap Biosphere Reserve (TSBR) which is located in Kampong Chhnang, Pursat, Battambang, Siem Reap, Banteay Meanchey, and Kampong Thom provinces. The TSBR is classified as a multiple use zone and covers an area of 316,250 ha. It has three core zones which are strictly controlled for biodiversity and conservation. These are not within the area of influence and will not be impacted by the project; the nearest core zone of TSBR, approximately more than 50 km from the WWTP in the downstream part of subproject.

117. The Tonle Sap Authority was established by the Royal Government of Cambodia in 2009. It is mandated to coordinate the management, conservation and development of the Tonle Sap Lake region and TSBR. A map showing the TSBR and 03 core zones in shown in Figure 14**.**

Figure 14: Tonle Sap Biosphere Reserve (TSBR)



Source: TSBR

5.11. Ecological Resources

118. Flora. Biodiversity screening of the project sites using IBAT was carried out. The project area does not contain any protected areas or habitats of particular biodiversity value. The WWTP site is located in highly disturbed environments dominated by agricultural land use with scattered trees. There are however limited specific areas where trees are present within the project area. This is primarily a number of trees at the subproject sites, which includes a number of common species including rattan (*Calamus* sp), acacia (*Acacia auriculiformis*) bamboo (*Bambusa arundinacea*), snowy orchid (*Bauhinia acuminata*). It is noted that the species observed listed are not threatened, critical or endangered.

119. Fish Species. Cambodia is rich in fish biodiversity with at least 500 fish species recorded in the Cambodia's Mekong River and nearly 300 fish species in Tonle Sap Lake. During the preparation of the initial CDIA IEE for this project, interviews were held with local people regarding their understanding of fish species in the project area. The results were similar for all project towns. As an example, in Battambang, 34 species were named, with the most common being (including Khmer name) Trey Riel, *Henicorhynchus* sp (carp); Trey Andaing Toun, *Clarias macrocephalus* (catfish); Trey Phtuok/Raws, *Channa striata* (snakehead); Trey Kranh, and *Anabas testudineus* (climbing perch). It is noted that these species listed are not threatened, critical or endangered.

120. Bird Species. Cambodia has a number of protected bird habitats, including Prek Toal Core Zone on the Tonle Sap lake. This core zone will not be impacted upon by the project. As with fish species, the initial CDIA IEE preparation team undertook consultation with resident in all the sub-project areas in 2016 to identify actual bird species which are observed by local people. The people interviewed identified between 22 to 29 species of birds observed in their locality, with the majority being seen in Stueng Saen of Tonle Sap Lake. Table 20 lists the species noted for Stueng Saen. Heliopais Personata is the only endangered species. It is classified as endangered due to degradation of wetland and riverine lowland forest habitats in Asia. The favoured habitat is well vegetated wetlands, including swamps and lake edges. These types of habitat are not within the area of influence for the project; the closest most recent sighting of the species around the Tonle Sap is at Boung Chma (in 1998) which is approximately 65 km from Stueng Saen city.

Table 14: Locally observed bird species, Stueng Saen Residents

No	Khmer Name	English Name	Scientific Name	IUCN Status
1	Brocheav	Not known		
2	Chab krouch	Yellow-vented Bulbul	*Pycnonotus blanfordi*	LC
3	Chreng	Not known		
4	Ka-ek	Large-billed Crow	*Corvus macrorhynchos*	LC
5	Khlom	Not known	Not known	
6	Khvek	Not known	Not known	
7	Kleng Srak	Barn Owl	*Tyto alba*	LC
8	Kok	Great White Egret	*Egretta alba*	LC
9	Kreal	Not known	Not known	
10	Kro Sapropes	Grey Heron	*Ardea cinerea*	LC
11	Kroling Kroloung	Black-collared Starling	*Sturnus nigricollis*	LC
12	Kruoch Art	Barred Buttonquail	*Turnix suscitator*	LC
13	Lo Lok	Red Collared Dove	*Streptopelia chinensis*	No Data
14	Mann Teuk	White-breasted Water hen	*Amaurormis phoenocures*	No Data
15	Meam touchprey	Asian Barred Owlet	*Glaucidium cucloides*	No Data
16	Popich Thmar	Blue Rock Thrush	*Monticola solitarius*	LC
17	Popoul Teuk	Masked Finfoot	*Heliopais Personata*	Endangered
18	Preap	Not known	Not known	
19	Pro Vek	Lesser Whisling Duck	*Dendrocygna Javanica*	LC
20	Raneal	Not known	Not known	
21	Sa Rikakeo	Common Myna	*Acridotheres Tristis*	LC
22	Sek Kheav	Not known	Not known	
23	Stang	Black-shouldered Kite	*Elanus coeruleus*	No Data
24	Tea Prey	Garganey	*Anas querquedula*	LC
25	Tituy	Not known	Not known	
26	Toum	Purple Swamphen	*Porphyrio porphyrio*	LC
27	Tro Cheakkam	Barn Swallow	*Hirundo rustica*	LC
28	Trodok	Not known	Not known	

No	Khmer Name	English Name	Scientific Name	IUCN Status
29	Tung Propes	Spot-billed Pelican	*Pelecanus philippensis*	NT
Key: LC = Least Concern, NT = Near Threatened, No Data = taxon has not yet been assessed for the IUCN Red List				

Source: Adapted from CDIA, IEE, 2016 survey.

5.12. Socio-Economic Conditions

121. Socio-economic data were obtained from Commune/sangkat discussions with the DDPP team. The subproject area is located: for WWTP site in Phneat commune, Serei Saophoan town. The wastewater network system in located in town area: Kmpong Svay, Ou Ambel, Tuek Thla, Preah Ponlea, and Mkak Commune. Table 15 presents a summary of the socio-economic situation in the subproject areas and Table 16 shows the number of affected communes on which these data are based. The WWTP and wastewater system subproject sites and presents the population in subproject areas.

Table 15: Socio-Economic Data

Project City	No. Commune	Total Population	No. Female Headed HH	Khmer Islam Pop.	Vietname Pop.	Poor Level 1 HH*	Poor Level 2 HH*	% Poor (1+2)
Serei Saophoan	07	87885	2576	1175	55	1159	2260	15%
Souce: - Ministry of Interior classification HH= Household - DDPP Team, IEE 2018								

Table 16: Population of communes and villages in Subproject areas by commune

No	Commune	Total population	Female	Total family
Serei Saophoan Town				
1	Tuek Thla	15188	7605	3852
2	Kampong Svay	22797	11417	6140
3	Kaoh Pong Satv	4723	2408	1215
4	Mkak	8286	4223	2063
5	Ou Ambel	18584	8876	4591
6	Phneat	5188	2632	1334
7	Preah Ponlea	13119	6689	3317
	Total	**87885**	**43850**	**22512**

Source: Commune data book 2018

122. A Socio-Economic Survey of 1,478 respondents was undertaken during this DDPP of TS-2. A full analysis of the survey results is provided in Volume 4 of the Feasibility Study. However, a few key points relevant to environmental safeguards are summarized here, for all provinces:

- Electricity / Infrastructure. 97% of households are connected to the electricity grid Sanitation. Sixty-three percent of respondents have access to a latrine or

WC/Bathroom, outside their house. Eleven percent of respondents do not have a latrine. Where no latrine is available, the alternatives used include a neighbor's latrine (72%) a dug hole in the yard (11%) and open fields (9%). Ninety-three percentt of latrines are pour flush.

- Wastewater. Five percent of respondents said they are connected to the sewer system for water from their bathroom. The majority of responses are to the ground (37%), a separated septic tank (19%) and pit latrine (23%). Nine percent of the wastewater goes to water bodies including canals, rivers, streams or ponds.
- Waste Collection. 55 percent of respondents are aware of a waste collection service in their area, the remainder does not have the service offered. Of those who have a service available, 36% use it. Ninety-two of respondents have waste materials which they do not throw away. Of this, 99% of respondents sell recyclable waste to door-to-door collectors.

123. Water Users. Fifty-seven percent of households are connected to a piped water supply, of which 63% are connected to the public water supply and the remainder to a private connection. The responses showed that in the dry season, for those who are not connected to a piped water supply, some of the respondents use water from ponds and lakes and three responses stated ''canal''; as a water source. This indicates that there is potential for a small number of community residents to use the canal network as a water source. It is not known what subsequent treatment the resident may then undertake on the water, such as boiling, chemical or UV treatment.

5.13. Wastewater Treatment Plant Environment

124. Same as for the other TS-2 project towns, Serei Saopoan Town is affected by ineffective wastewater treatment, with evidence of wastewater contamination of waterways in many places. Discussions with residents during field visits confirm that ditches and canals are polluted by wastewater and that they often flood during heavy rain events and generate nuisance odours.

6. ANTICIPATED IMPACTS AND MITIGATION MEASURES

6.1. Project Environmental Benefits

125. The project is anticipated to have significant localized environmental benefits. Field visits show that the current environment is being contaminated with wastewater and the growing pressures on the urban areas means that without the subproject, this is likely to continue.

126. The development of well-engineered stormwater drainage and wastewater collection and treatment facilities, and effective operation and maintenance of these systems will reduce pollution of the environment and therefore lower the risks to human health and water quality.

127. These benefits will be dependent on the services and facilities being maintained and operated at the standard to which they are designed.

6.2. Environmental Impact Screening

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

(i) “Receptor”: the resource (human/natural environment/economic/social) which is potentially going to receive and have to cope with an impact.

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

(iii) “Magnitude”: the size of the potential impact. Impacts may be short-term and considered low magnitude (e.g. noise or temporary reduction of income during a short construction project) or high magnitude and long-term (e.g. the pollution of surface water or groundwater).

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

6.3. Impacts Associated with Project Location, Planning and Design

130. Measures and Actions during design and pre-construction. The mitigation of impacts from these design issues includes the following measures:

(i) Institutional set up and strengthening. (a) appointment of a Safeguards Focal Point within each PIU (PIU-SFP) (b) appointment of Environmental Safeguards Officer in the PMU (PMU-ESO)[11]; and (c) contracting of international and national Project Management Consultant for Environmental Safeguards (PMC- I/NES) will be carried out. Prior to the start of construction, an environmental capacity building and training program will be delivered by the PIC. The training will focus on ADB’s and Cambodia’s relevant environmental, health and safety laws, regulations and policies; implementation of the EMP, environmental monitoring, requirements for information disclosure, public consultation and the project GRM. Training will be provided to the PIUs, and contractors.

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

(iii) Updating the IEE and EMP (if required): Mitigation measures defined in this IEE and the associated EMP will be updated (as necessary) based on subsequent revisions to the final detailed engineering design. This will be the responsibility of the PMC with support from PMU. The revised documents will be submitted to ADB/PMU for approval and disclosure on ADB’s website if updated.

[11] CAM: Fourth Greater Mekong Subregion Corridor Towns Development Project will fund a full-time ESO position within PMU that can also support this project and TS1 during implementation.

(iv) EMP in bidding document. The sub-project specific EMP will be incorporated in the bid documents and construction contracts to provide basis for Contractors to develop package specific construction EMPs (CEMPs).

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

(vi) Site selection. A critical issue for the management of impacts on receptors, particularly a) residential areas, b) surface water including rivers and canals, and c) groundwater. The potential sites in this IEE are discussed in detail in terms of suitability in the Feasibility Study Report Volume 2 – Engineering Design.

(vii) Environmental Quality. Undertake key baseline surveys to inform detailed design and domestic IEIA preparation including water sampling and analysis of receiving waters of WWTP effluent, groundwater and water bodies of subproject sites.

(viii) The temporary impact agreement. Temporary Impact Agreements signed for restoring/rebuilding impacted assets or moving shops and stalls between contractor, HHs, and PIU.

6.4. Environmental Impact and Mitigation Measures during Construction

131. **Air Quality.** Moderate temporary air quality impacts during the construction stage of the project are anticipated due to fugitive dust generation associated with construction works, earth works and waste movement. The receptors sensitive to air quality are businesses and residents within the local area particularly downwind of the construction activities, and also, dust will be generated during the installation of pipe networks through excavations or construction in urban areas which are by their nature, densely populated.

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

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

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

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

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

(v) Fugitive dust and bio-aerosols from movement of waste from construction area

(vi) Fugitive dust from concrete batching plants.

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

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

(ii) Water will be sprayed frequently at construction sites, material handling areas, borrow pits, construction sites (road section), where fugitive dust is generated.

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

(iv) Construction vehicles and machinery will be maintained to a high standard to minimize emissions.

(v) Areas in which road excavations are required for wastewater and drainage pipe works will be notified adequately 1 month in advance of works starting.

134. **Noise.** Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise only during operation. Other noise sources include loading and unloading of equipment and materials. As set out in 5.1 (Area of Influence) receptors within a 250 m are likely to be subject to intermittent noise impacts above the WHO limit of one-hour LAeq 55 dBA. Significant noise impacts will be experienced by construction site operators. Construction machinery may produce noise levels up to 90 dB(A). For this project, no receptors other than construction workers will be this close to the machinery for extended periods of time.

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

(i) Maintain all exhaust systems in good working order; undertake regular equipment maintenance;

(ii) Restrict working hour of construction activities using heavy machinery between 8am-6pm. In any cases, the constructor shall be collaborated with local authorities and affected people to define proper working hours for the purpose to mitigate the impact of noise (in town, streets or near sensitive resources).

(iii) Provide advance warning to the community on timing of noisy activities. Seek suggestions from community members to reduce noise annoyance particularly related to noise sensitive activities at receptors such as periods of worship for pagodas. Public notification of construction operations will incorporate noise considerations; information procedure of handling complaints through the Grievance Redress Mechanism will be disseminated.

(iv) Ensure noise monitoring is undertaken near sensitive receptors, particularly dwellings when construction machinery is operational;

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

(vi) Use of mobile noise barriers in densely populated areas where excavations are taking place, and if necessary, provide fencing at construction zones.

136. **Flora and Fauna.** The baseline indicates that impacts on terrestrial flora and fauna will be negligible because the sub-projects are in highly disturbed environments, including an existing quarry and dumpsite and monoculture rice paddies. There are few mature trees likely to be impacted upon by the project sites. At preparation stage of this IEE, the locations of borrow sites are not known; during implementation, these sites may lead to loss of vegetation which depends on the site-specific location.

137. Potential impacts on terrestrial flora and fauna will be mitigated through the following measures:

(i) All trees over 3 m high in construction sites or access areas has to be protected from construction activities if they are not required to be removed. Any cutting of

trees shall be informed to DPWT and the relevant local authorities to obtain permission;

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

138. For some impacts on aquatic flora and fauna, see Impacts on Surface Water.

139. **Surface Water.** Construction will take place in areas which have a network of irrigation canals, used for both household water requirements such as laundry and bathing as well as for fishing. Short-term construction impacts may occur in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals and canal dredging. Also, some construction activity will be required at the riverbank where outfalls for stormwater drainage or wastewater overflow are required.

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

(i) Provision of adequate short-term drainage away from construction sites to prevent contaminated run off entering water bodies including canals.

(ii) Installation of temporary storm drains or ditches at construction sites to manage and control the flow and direction of surface water run off

(iii) Installation or construct the dikes or dams around the WWTP site to protect run-off and big flood flows in and out of WWTP.

(iv) Maintain irrigation water supplies during dry season works within or around irrigation canals.

(v) All wastes, especially hazardous waste shall be collated and stored in safety tanks, and contract to license subcontractor to dispose in local license dumping site.

(vi) Regularly conduct surface water quality monitoring in canal/streams near the WWTP site.

141. Stockpiles and materials will be stored at least 50 m from surface waters with drainage directed away from the irrigation canals or drainage channels and streams or water sources.

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

(i) No washing or repair of machinery within 50 m from surface waters including irrigation canals.

(ii) Pit latrines (for worker camps if required) to be located at least 200 m from surface waters, and in areas of suitable soil profiles and above the groundwater levels.

143. **Groundwater.** Groundwater is not anticipated to be affected by construction activities of the project. However, construction waste and hazardous waste must be properly managed (collected, segregated, and disposed) in accordance with applicable regulations to ensure that no waste generated by the construction work is dumped or littered. Likewise, hazardous materials mush be handled in accordance with the relevant Safety Data Sheets and IFC Environmental, Health and Safety Guidelines, and any spills or leakages must be cleaned-up immediately.

144. **Soil and Land.** Soil erosion is not anticipated given the nature of the sub-projects and their flat locations however borrow sites will cause local impacts to the land. The sub-projects

are in fertile agricultural locations and fertile topsoil is a valuable resource which requires protection measures, particularly for the construction areas which are located in and around rice fields where encroachment from inappropriate spoil disposal could have detrimental impacts.

145. Potential impacts on soil and land resources will be mitigated through the following measures, as defined in a Spoil and Borrow Site Management as set out in the EMP:

(i) Site specific spoil and borrow site management plan will be developed and approved by the relevant Municipal authority;
(ii) A map of all borrow sites will be developed and maintained with copies held by the Contractor and PIU;
(iii) Safety measures, if required, will be implemented to prevent access by members of the public and livestock;
(iv) Measures to rehabilitate the borrow sites include contouring of the slopes within each site and replanting sites with native species;
(v) Topsoil present on construction sites will be removed and stockpiled in a labelled area for use on rehabilitation of the site post-construction or rehabilitation of borrow sites;
(vi) No disposal of spoil or dredged material on agriculturally productive land or within 50 m of a water course.
(vii) Construction working areas will be clearly demarcated and encroachment onto adjacent areas avoided.

146. **Solid waste management.** Impacts on resource use and impacts associated with disposal will arise from waste generated during construction. This includes generation of inert wastes e.g. spoil, biodegradable wastes e.g. cleared vegetation, and hazardous wastes e.g. oily wastes. Impacts of disposal and wind-blown litter will be seen at the disposal sites and construction areas, whereas the impacts of resource use are national and global.

147. Potential impacts from waste arising will be mitigated through the following measures as defined in the Solid and Liquid Waste Management set out in the EMP:

(i) Preparation of a Waste Management Plan before construction which applies the waste hierarchy to ensure efficient use and management of resources with a priority to prevent waste at source as much as possible;
(ii) Effective management of materials on site through good housekeeping and work planning;
(iii) Clear arrangements for storage and transportation of all hazardous and non-hazardous waste to an authorized and approved disposal point as set out in the Waste Management Plan;
(iv) The wastes, especially hazardous waste shall be collated and stored in safety tanks and provide to license sub-contractor to dispose in local license dumping site.
(vi) Prohibit burning of waste at all times;
(vi) Provide all vehicles/drivers with plastic bags for waste collection and prevent any unauthorized waste disposal with particular attention paid to prevention of waste entering water ways including irrigation canals.

Community and Occupational Health and Safety. Construction of WWTP, sewer lines, stormwater drainage and access road will present health and safety risks not only to construction workers, but also to people living and working around the sites. Community risks come from unauthorized access to construction sites and construction traffic i.e. heavy vehicles which the community may not be used to on their neighbourhood roads. Occupational risks

come from a range of activities including the use of heavy machinery, earth moving, and use of chemicals. Can be inflicted diseases or HIV-AIDs from workers to workers, and to local people.

148. Due to the COVID-19 pandemic, workers and staff at constructing sites can be infected by the virus thereby putting themselves, their colleagues and people in the community at risk. Therefore, prevention and mitigation measures need to be put in place and the Contractor shall prepare and ensure implementation of procedures and plans to comply with applicable government regulations and guidelines on COVID-19.

149. Potential impacts on community and occupational health and safety will be mitigated through the following measures as defined in the Community and Occupational Health and Safety and Emergency Response set out in the EMP:

(i) Appropriate fencing, protective barriers, and buffer zones will be provided around all construction sites including barriers where needed on access roads and populated.
(ii) The construction campsites should be located outside and distance from residential area and fencing campsites with safety barriers and safety zones.
(iii) Sufficient signage giving health and safety warnings and information disclosure at all sites.
(iv) Worker education and awareness seminars for construction hazards will be given. A construction site safety program will be developed and distributed to workers.
(v) Conduct daily toolbox meetings (safety briefings)
(vi) An accident record book will be maintained where all major or minor accidents and incidents are recorded with actions taken.
(vii) Ensure that all workers are equipped with and use Personal Protective Equipment (PEE).
(viii) Provide enough safety signs, traffic safety control and regular monitoring the public safety or traffic safety management on construction sites on the streets in urban area.
(ix) Limited the driving speed in village/urban areas and other sensitive areas. Provide watering to reduce dust pollution in village and urban areas, when and where is dusty.
(x) Each Contractor shall appoint an Environment, Health and Safety Officer who is qualified engineer. Adequate first aid equipment will be made available on site.
(xi) Provision will be made for safety precautions when using 220 V to 240 V Electric Power tools if the workers are likely to be working within wet or flooded environments.
(xii) Provide the training or awareness on safety management and HIV-AIDs to construction staffs, workers and local people.
(xiii) Warning signs will be set up if mud is likely on public roads. Mud will be removed at the end of each day. Other spillages on public roads will be removed immediately.
(xiv) The Contractor will set out an Emergency Response Plan.

150. **Worker / Labour Impacts.** Construction sites worker camps can impact on the environment if not adequately managed or located. This will include impacts from latrines, waste and social impacts if an external (national or international) labour force is employed.

151. Potential impacts on the community and environment from work camps and external labour force will be mitigated through the following measures:

(i) If a camp for construction workers is required the contractor will set out a management plan which includes a map showing camp lay out, adequate accommodation and sanitation for male and female workers, relevant training and a plan of how camp areas will be restored to original condition after construction completed.

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

(iii) Priority will be given to employ local labour and retain evidence of how local labour recruitment efforts were undertaken.

152. **Socio-Economic Impacts** (**accessibility**). The installation of sewerage system will require the excavation parts of the road network. Works will be in urban areas where businesses and other activities take place. The community in and around these areas will be disrupted by the noise and dust, as described above, and by potentially impaired access (for themselves and their customers) to their properties and business operation. The community will have temporary impact on pavements/walkways, kerbs, minor secondary structures (signposts, eaves) and need for relocating small businesses for interim period during construction. Mitigation of temporary impacts will be under responsibility of the construction contractor.

153. Potential socio-economic impacts from road excavations will be mitigated through the following measures:

(i) Warning given to residents 4 weeks in advance of any excavations

(ii) Implement traffic management procedures to ensure smooth traffic. Provide traffic sign to control vehicle speeds and be able to warn drivers in advance for any changes to road surface or traffic direction

(iii) Provide adequate and safe pedestrian and vehicular (motorbike) access to enter and exit buildings across any open trenches.

(iv) Temporary restoring/rebuilding the impacted assets or relocation of shops and stalls through cooperation between construction contractor, HHs and PIU

(v) Define and adjust suitable working hours in urban areas or at sensitive sites. Open access road for entry and exit for business sites. Remove the unsuitable soil and materials(spoils) from construction sites which are in front of houses and shops,

(vi) Restoration or compensation of any damage to properties at an expense of the contractor.

(vii) Consideration and management of potential localized flood impacts.

6.5. Environmental Impact and Mitigation Measures during Operation

154. The most important risks to the environment by sub-projects are during the operation phase due to its long-term impacts. This is particularly the case for the operation of the WWTP and the pumping stations. These types of facilities can cause environmental pollution if they are not managed and maintained effectively. Such pollution may include long term risks to surface and groundwater quality from WWTP effluent.

155. The management of an operation and maintenance (O&M) budget for these facilitates is outside the scope of this IEE. However, the key mitigation measures for operational risk

management relate to the capacity development of the operating staff and national and sub-national / municipal governments who provide the budget for O&M.

156. The EMP for Serei Saophoan Wastewater and Drainage subproject includes capacity building and awareness raising on the management of environmental risks during operations.

157. The budget for site development has allowed provision of sanitation facilities, potable water supply, PPE, training and support on health protection.

158. **Surface Water**. No significant impacts on surface water are expected during the operation of the sewer and drainage networks, pumping stations and the WWTP. The WWTP effluent will be discharge to an irrigation canal next to it. However, discharge of the WWTP effluent which does not meet required standards may cause pollution to surface water quality and impact to aquatic life.

159. Simple mass balance calculations based on a conservative dry season low flow in the Saophoan River of 2 m^3/s and the design treatment capacity of 3,500 m^3/d or approx. 0.04 m^3/s indicate that the resulting concentrations of key water quality parameters in Saophoan River after mixing with the effluent are well within the Cambodian ambient water quality standards. A sample mass balance calculation for total suspended solids is presented in Table 17. In addition, during the dry season, it is likely that most of the effluent will be used for irrigation thus further increasing the dilution rate; and in the rainy season with high flows in Saophoan River, the effect of the effluent discharge on the river water quality will be negligible.

Table 17: Sample Mass Balance Calculation of total suspended solids concentration in Saophoan River after mixing with the WWTP effluent

Parameter	Unit	Value
Effluent discharge	m^3/s	0.04
Effluent discharge concentration	g/m^3	40.0
Effluent discharge mass per second	g/s	1.60
Flow in Saophoan River	m^3/s	2.00
Upstream concentration in Saophoan River[12]	g/m^3	20.00
Upstream load per second in Saophoan River	g/s	40.00
Saophoan River concentration after complete mixing	g/m^3	20.4
Downstream concentration in Saophoan River after complete mixing	mg/L	20.4
Calculated difference in downstream concentration	mg/L	0.4

160. In terms of water quality limits for use of the water discharged from the WWTP for irrigation, as a general rule, a waste stabilization pond system comprising anaerobic, facultative and maturation ponds produces an effluent suitable for unrestricted irrigation. The microbiological quality guidelines for wastewater use in agriculture recommended by FAO (see Annex 4) also indicate that the treated effluents can be used for irrigation of cereal crops, industrial crops, fodder crops, pasture and trees. Specific microbiological analyses will be undertaken upon start of operations based on the actual strength of the raw wastewater and

[12] The measured TSS level shown in Table 12 is 64 mg/L. There is likely considerable variation in TSS levels in the river, and a conservative low TSS concentration is assumed in the calculation

the performance of the treatment system to determine if the effluent can be used for unrestricted irrigation and aquaculture.

161. The access road level will be raised 0,5 m, (design of WWTP access road elevations is based on 1 in 5-year flood as per national standards) and the WWTP will be surrounded by a dike up to 2-3 m from ground level. These elevations will not impact on the drainage due to rainwater will flow to irrigation canal network for dispersion. The canal network in the area is such that any banked up water from the raised road will easily find alternative drainage paths. Thus, surface runoff movement will not be impeded nor exacerbate flooding of the area.

162. Mitigation and management measures will include:

(i) Final design ensures that the applicable effluent standards in Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 (public water area and sewer) are met.
(ii) Design includes appropriately sized sludge drying facilities. Issue of reuse/disposal of dried biosolids will be confirmed before plant commissioning.
(iii) O&M manual to be developed prior to commissioning will provide clear methods and procedures for all aspects of the WWTP, sewer and drainage operation, including the following key issues[13]:
    a. Sludge management including treatment, disposal and emergency situations
    b. Monitoring/ testing procedures and schedule for treated effluent and sludge, with approval by MOE. Work with MOE and MPWT to establish biosolids reuse quality requirements.
    c. Emergency procedures including schedule for testing and upgrading procedures
(iv) Procedures for storing, transporting and disposing of solid waste generated by the operations
(v) Commissioning phase of WWTP to ensure design discharge standards can be met.
(vi) Discharge to be tested prior to release into the environment. Monitoring and reporting on water quality in the recipient of the effluent discharge from the WWTP in line with the EMP. If the treated effluent consistently fails to meet discharge standards, operator to discuss and agree with MPWT and MOE on a way forward to return to compliance.
(vii) Provision of adequate budget for O&M to ensure regular effluent and surface water quality monitoring.
(viii) Meeting required operating standards to ensure effluents are treated effectively prior to discharge;
(ix) Regularly monitor the wastewater system structures and provide maintenance or corrective actions.
(x) Ensure the operational and maintenance plan for each facility includes an emergency response plan considering flooding.
(xi) Provision of effluent and receiving water body monitoring data to Provincial Department of Agriculture to enable assessment of effects of treated effluent application on crop yields.

163. **Noise**. No noise impacts are expected during normal operation of the pumping stations, since the stations will be equipped with submersible pumps installed in wet wells approximately 6 m below ground surface. The main pumping station is equipped with an emergency generator

[13] The Contractor may refer the applicable WB Group EHS Guidelines for WWTP operation, which are available at: www.ifc.org/ehsguidelines - The https://www.ifc.org/wps/wcm/connect/0d8cb86a-9120-4e37-98f7-cfb1a941f235/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES&CVID=jkD216C

in case of power outage. The generator will be equipped with adequate noise attenuating provisions to meet all exterior noise level requirements.

164. The operation of the WWTP does not involve any activities that would generate significant noise emissions, and due to its location approximately 500 m from the nearest residences, any occasional noisy activities are unlikely to cause any significant impacts.

165. Community and occupational health and safety (H&S). There will be ongoing occupational H&S risks to workers at the pump stations and WWTP, however these will be much reduced from the construction phase. Community risks attributable to the operation of the system are considered negligible.

166. The operator will develop and implement a H&S manual as part of the O&M manual which will include the following:

(i) A signed commitment from the operator to a) understand and b) comply with IFC Environmental Health and Safety guidelines (2007)
(ii) A training program for workers in workplace safety of WWTP operation
(iii) Provide all operational staff with appropriate PPE
(iv) Prevent public access to the WWTP and pumping stations with fencing and appropriate signage.
(v) Conduct safety orientation trainings including regular safety drills for workers.
(vi) Provision of appropriate and adequate PPE for workers (including regular training and drills on the use of PPE and other emergency equipment).

167. **Groundwater**. Groundwater infiltration into the sewers or seepage from the sewers into groundwater will be mitigated to the extent possible by using High Density Poly-Ethylene (HDPE) pipes tightly jointed by fusion welded joints[14], and the pump stations will be constructed with water-tight concrete. At the WWTP, the pond sides and bottoms will be constructed with a stone pitching over well-compacted clay – except for the facultative ponds which will be equipped with a HDPE liner over well-compacted clay. Normally, waste stabilization ponds eventually seal themselves[15] and considering the use of well compacted clay on top of at least 4 m of intact clay (see Para 109) and the additional lining of the facultative ponds, significant seepage to the groundwater is unlikely to occur. Even if, over time, some seepage and infiltration into the groundwater may take place, physical filtration and adsorption will limit the mobility of bacteria in soil. Bacteria are rarely free in the liquid phase of soil as most cells adhere to clay particles and bacteria cells tend to aggregate and form flocs and clumps which are more susceptible to filtration[16].

168. The safe distances between water wells and pollution sources recommended by the USEPA[17] are displayed in Figure 15. The figure shows that the safe distance between a water well and manure stacks is about 75 m, which indicates that with a distance of 500 m between the WWTP and the nearest residential area, the risk of polluting groundwater used for drinking water is negligible.

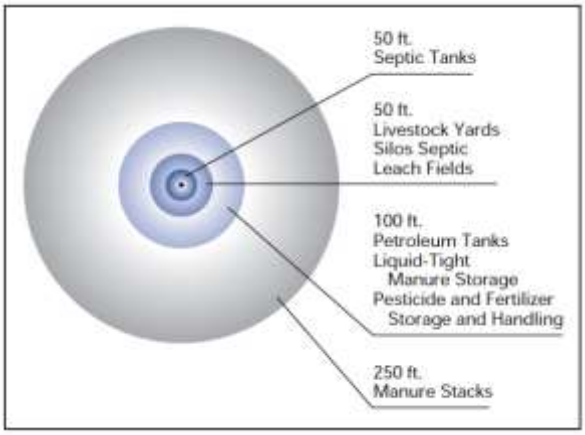
[14] Fusion welding is a process that uses heat to join or fuse two or more materials by heating them to melting point.

[15] Arthur, J. P. (1983), Design and Operation of Waste Stabilization Ponds in Warm Climates of Developing Countries, World Bank 1983

[16] Jamieson, R.C., Gordon, R.J., Sharples, K.E., Stratton, G.W. and Madani, A. 2002. Movement and persistence of fecal bacteria in agricultural soils and subsurface drainage water: A review. Canadian Biosystems Engineering/Le génie des biosystèmes au Canada 44:1.1-1.9.

[17] USEPA, January 2002, Drinking Water from Household Wells

Figure 15: Safe distances between water wells and pollution sources



169. Overflow at the pumping stations. The risk of overflow with raw wastewater at the pumping stations will be minimized by installation of alarm systems and overflow tanks with a minimum of two (2) hours emergency holding capacity at peak dry weather flow. Each pumping station will also be equipped with a standby pump in case of malfunction of the duty pump, and the main pumping station will have an emergency generator in case of power outage. In the event of overflow from the overflow tanks, the wastewater will be directed to the rainwater system and be discharged to Saophoan River.

170. Odour and Dust, wastewater treatment. During the operation of the WWTP generation of nuisance odour may occur. The most likely sources of odour are the inlet chamber, the anaerobic ponds and the septage receiving facility. For the wastewater, the travel time in the sewers is relatively short (less than one day) and septic conditions which would generate foul odour are therefore not likely to be present in the inlet chamber. Odour nuisance from anaerobic ponds is typically due to hydrogen sulphide, however, odour problems do not occur with sulphate concentrations in the raw wastewater less than 500 mg/L[18], and considering that typical sulphate concentrations in domestic wastewater is less than 100 mg/L, nuisance odours from the anaerobic ponds are not likely.

171. The septage receiving facility is the most likely source of odour problems at the WWTP. Septage has an offensive odour, and the discharge of septage from the vacuum trucks into the septage chamber can release odours. To minimise odour problems, the septage will be discharged directly into a fully covered chamber thus reducing the exposure of the septage to the atmosphere. Proper operation and maintenance of the facility will further reduce generation of odours from handling of septage (see also mitigation measures in Para 175).

172. Furthermore, the WWTP will be in an open paddy field area with a buffer of about 500 m to the nearest houses ensuring that any release of nuisance odour from the WWTP will not impact the local residents[19].

173. The operation of the WWTP does not include any activities that would generate dust.

174. Odour, pumping stations. The pumping stations will be located in the urban area and at each station there are houses within a 20 m radius. However, with proper operation and maintenance including hosing the wet wells to remove settled solids and considering that the

[18] IRC International Water and Sanitation Centre, 2004, Waste Stabilisation Ponds https://www.pseau.org/outils/ouvrages/irc_university_of_leeds_waste_stabilization_ponds_2004.pdf

[19] Kulig, A., Szyłak-Szydłowski, M., November 2019, Assessment of the Effects of Wastewater Treatment Plant Modernization by Means of the Field Olfactometry Method

cycle time of the pumps is less than 15 minutes, septic conditions are not likely to develop at the pumping stations. Nevertheless, the frequency and duration of odorous events will be closely monitored, and the stations will be made ready for installation of odour control measures in the future should this be warranted.

175. Potential mitigation measures to minimise nuisance odour will include:

(i) Regular monitoring and maintenance the operation of WWTP, culvert system, and pumping stations.
(ii) Quarterly meetings between operator and DPWT with residents and / or their representatives to identify odour or nuisance issues;
(iii) Movement of any sludge materials off site on days of low wind speed;
(iv) Provide Tree plantings (tree screen) and green place inside and around the WWTP site to reduce dust and odours;
(v) The sludge loading trucks shall be covered;
(vi) Provision of adequate budget for O&M
(vii) Conduct air quality monitoring inside and near the WWTP. The air quality shall comply with national standards of Sub-decree on Air Pollution and Noise Disturbance 2000;
(viii) Ventilation - to avoid septic conditions and generation of toxic gases in the pump stations wet wells, a venting system will be installed to provide air circulation. If necessary, ventilation stacks with odour filter treatment (carbon filters, biofilter) will be added.
(ix) Use quick-disconnect fittings between pumper truck and receiving station to minimize exposure of septage to the atmosphere.
(x) Wash-down facilities to clean up any spills, with drainage into the holding tank
(xi) Avoid free fall of septage by extending receiving pipes below the water surface
(xii) Introduce septage at slow controlled rates to avoid turbulence or agitation.
(xiii) Ventilate the air from the tank to an odour biofilter.
(xiv) Clean tanks, trucks and equipment daily.

176. Agricultural Yield. As discussed in Para 160, the effluent water quality will meet requirements for use in agriculture, possibly even for unrestricted use for irrigation and aquaculture. The provision of nutrient-holding treated effluents that meets the standards for irrigation will benefit the local farmers, and to control that the standards continue to be met, the effluent water quality will be carefully monitored, and the results reported to the Provincial Department of Agriculture.

177. Potential mitigation measures include:

(i) Provision of effluent analysis to the Provincial Department of Agriculture on a regular basis.
(ii) Regular monitoring the operation system of discharging wastewater into canals
(iii) Collaborate with MOE/PDoE to conduct monitoring of wastewater discharging quality from WWTP and surface water quality in stream or irrigated canal. The discharging wastewater quality shall be met to national standards of Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999.
(iv) Collaborate with MAFF/PDAFF to conduct soil quality monitoring of rice field is around the WWTP site, if pollute or receive complain or negative feedback from local farmers.

7. ANALYSIS OF ALTERNATIVES

7.1. No Project Alternative

178. The Rationale for this project sets out the need for this project. The project is required to meet the infrastructure and service provision requirements in secondary urban centers, which are currently lagging behind the capital region in particular.

179. Evidence from field work shows that the current state of wastewater treatment in Serei Saopoan Town is lacking, and the situation is leading to environmental risks and reducing the sustainability of the town. The 'do nothing' alternative would lead to an increasingly lower quality of the urban environment and pose higher health risks for the population.

7.2. Wastewater Treatment Design and Technology Alternatives

180. Alternative technological options are considered for wastewater treatment in detail in the Feasibility Study Report - Volume 2, Engineering Designs; a summary is provided here.

181. The assessment of the most appropriate technology is affected by factors including:

- Physical location – such as land availability and topography;
- Cost – including cost of construction and operation;
- Environmental performance – including impact on receiving water of effluent and obtainable effluent standards; and
- Technical capacity – operator experience within Cambodia.

182. Alternative options are considered for the WWTP technology and sludge management.

- Constructed Wetlands. This option was discussed with each city's PDPWT. The option was rejected due to operational and maintenance challenges associated with the technology which includes; Maintaining the embankments; Checking the water flow rate to the constructed wetland, to determine conformance with design; Replacing plants as required; Removing any unwanted weed species; Checking the plants for any sign of diseases; Prevention of invasive species plants impacting farmers on rice growing on adjacent agricultural land; Correcting erosion and slumping; and Checking for any signs of over-flooding for sub-surface flow constructed wetlands.
- Ponds-based technology. This option was agreed as the least capital cost, least O&M cost, lowest energy requirements, greatest ease of operations and shall produce a high-quality effluent with 95% reduction in pollutants. Environmentally, the requirements for a high standard of effluent and lowest energy requirements means this option is appropriate.

183. Options for sludge management included:

- A sludge stabilization and drying pond for stabilization, treatment and drying of sludge taken from the anaerobic lagoon;
- A sludge drying reed bed is an autochthonous macrophytes planted bed used for drying sludge taken from the anaerobic lagoon.
- A Small Anaerobic Lagoon used for septage primary treatment is similar to Option 1 for sludge stabilization, without the underdrain component of Option 1 Pond.

184. A sludge stabilization and drying pond is recommended because it provides effective, low-cost treatment and dewatering of sludge. It is similar to option 3, small anaerobic lagoon, but also provides dewatering. A septage receiving station will be installed with chamber and coarse screening, ahead of the automatic fine screen, with screened wastewater flow then transferred to the anaerobic ponds for further treatment as part of the WWTP waste stream.

185. Combined versus separate sewer system. Separate systems offer greater pollution control than combined systems. Separate systems convey all the wastewater to the treatment plant, while in combined systems, during high rainfall periods, overflows allow all pollutants to be discharged to the water bodies.

186. Under the urban sanitation policy of the Cambodia National Guidelines on Water Supply and Sanitation (2003) Item 4 states "The use of separate sewerage and drainage systems should be promoted and encouraged particularly in new installation areas". Consistent with the national policy, the design of a separate wastewater system will be developed in the central key areas of the sub-project cities.

187. Environmentally, the preferred option is a separate system; this negates the need for treatment of storm water flow and therefore its associated energy and carbon costs. In addition, the enhanced level of control over wastewater contaminated wastewater offered by a separate system is preferred.

8. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

8.1. Public Consultations during Project Preparation

188. During Project Preparation, meetings were held with stakeholders to obtain views and opinions on the project and this also assisted the project team with development of the sub-project outline designs.

CDIA Preparation Phase. During the preparation of the first IEE and EMPs for the sub-project, consultation took place within each sub-project area. An outline of the consultation meetings held is provided in Table 18. The details of these consultations are not repeated here but are available in the disclosed IEE documents for the CDIA phase. In general, the consultations found the sub-projects to be welcomed for the positive benefits they will bring, however concerns were raised regarding on the environmental and social impacts during implementation, arising primarily from construction.

Table 18: CDIA Phase Consultations Held

Location	Dates	Stakeholders or Groups Met*	
Battambang	From 15/12/16 To 03/01/2017	PDPWT PDoE PDWRAM PDLMUP Waste collection Company Local Authority Group Women Group Vulnerable Group	Sangkat Ou Kanthor Sangkat Kampong Thom Sangkat Kampong Roteh Sangkat Damrei Choan Khla Sangkat Kampong Krabau Sangkat Achar Leak

Location	Dates	Stakeholders or Groups Met*
PDoE	Provincial Department of Environment	
PDPWT	Provincial Department of Public work and Transportation	
PDWRAM	Provincial Department of Water Resources and Minerals	
PDLMUP	Provincial Department of Land Management and Urban Planning	
PDoP	Provincial Department of Planning.	

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

190. Household socio-economic surveys were undertaken for this project in January 2018 and included several questions relevant to environmental and social safeguards. The respondent views are summarized below. Where appropriate, corresponding mitigation measures are included in the EMP.

Table 19: Socio-Economic Survey Questions

Household Question	Response	EMP Response
Concerns over construction impacts (Dust, Noise, Water Quality, Other suggestions) – Rank two responses	Combining the two scores, 75% of responses included dust as a concern, 41% included noise, 15% included water quality and no other suggestions for concerns were given.	Mitigation measures for noise and dust Control of construction near water bodies
Connection to piped water supply	57% of households are connected to a piped water supply, of which 63% are connected to the public water supply and the remainder to a private connection	-
What is your main water sources during dry season? – Rank two responses	The majority of responses confirm piped water as the main water supply (833 responses) with the primary alternatives being bottled water (147 responses) own well (104 responses). No respondents use water from public or private ponds/lakes or a public well.	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
What is your main water sources during wet season? (if have piped water) – Rank two responses	The majority of responses confirm piped water as the main water supply (815 responses) with the primary alternatives being bottled water (80 responses) own well (46 responses) and the river (32 responses).	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
If you are not connected to pipe water supply. What is your main water sources during dry season? Rank two responses	The majority of responses confirm their own drilled well is used as a water supply (290 responses) with the primary alternatives being own drilled well (290) responses, own open well (128 responses), water seller (120 response), bottled water (121 responses) pond/lake (109 responses), rainwater (92 responses).	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher

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

Source: DDPP Team 2018

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

2. Present to the stakeholders and affected people the sites for subprojects in the provincial towns and inform them of the project activities;
3. Understand the main issues that may occur in the proposed sub-project areas, as raised by local people;
4. Understand the potential social and environmental resources located/used in the subproject sites;
5. Receiving issues, feedback, and comments from stakeholders or affected people regarding social, gender and environmental issues/resources in the proposed sites; and
6. Receiving comments and suggestions for mitigation measures to improve adverse impacts from project design, construction, and operation stages.

192. Inclusion of Affected People's Views. The mitigation measures in the EMP for this project reflect the result of the consultations during IEE preparation. The results of the consultation discussions are summarized in Table 20. Where appropriate, a response to the comment or concern is signposted in the EMP.

Table 20: Consultation FGD in Serei Saophoan Town

O Ambel and Preah Ponlear Commune, Serei SaophoanTown, BMC Province	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response

- Most people in O Ambel Commune use Town Water Supply for households and access electricity. - The solid waste collection services some houses, and some are not serviced, due to number of waste truck are limited, some people do not pay the collection fee, some areas have no truck access - In Preah Ponlear Commune, solid waste is a problem in our area. About 30% of total houses receive waste collection service, the remaining burn and dump waste - For households the waste truck comes 1 time/week, the poor sanitation and odour can be impact on environment and health.	None required
- In this Town public drainages is located only on main roads. Not on the small streets and no connection to houses. Some houses build own drainage/culvert without standards.	None required
- They are support the sub-project for improving Landfill and WWTP for Serei Saophoan Town - Most agreed with solid waste collection services but should collect 2-3 time/week.	None required
- There small impacts air and noise from movement equipment, we can accept them. - The main impacts for project activities are considered to environmental-social resources are in and near the sub-project sites of landfill and WWTP. - Provide the toilet or connect their toilet pipe to main/public wastewater/drainage system. - For our people, if the sub-project will start soon is very good for urban area	Environmental and social mitigation measures included in EMP
Kampong Svay and Teuk Thla Commune, Serei Sophorn Town, BMC Province	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response
- The landfill is located in Kangva Village, Kampong Svay Commune, in the upland area, and no houses are near the site. - Kampong Svay is located in urban area of Serei Saophoan Town. Most houses have solid waste collection service and a few houses are not this service, due to no access road (far from main road, and don't pay for waste collection fee). - They support improvement to the Landfill - this area is an upland site, far from houses, and no sensitive ecological resources in this area. - This landfill will improve our solid waste management in town, sanitation, good environment, and safety health.	None required
- SWM problems: Capacity of management and collection is limited (for household, the collection:1 time/week). Lack involvement from communities. We have old existing dumping site (no sanitation landfill) - The impacts of landfill sub-project on environment and social by odour, pest, fly, wastewater discharge, more we consider to operational landfill is long time operation. - During operation, this landfill should comply with new technology to reduce negative impacts on environment. Protection the environment from wastewater discharged from landfill (leachate). - Use mitigation measures to reduce smell, fly, and smoke from landfill. Use cover landfill for reducing smell. - Provide more sanitation waste trucks for collection solid waste from town to new landfill site, so the waste will not remain on the streets. - Most families agree to pay for solid waste collection service, if good service. - The Impacts during construction stage from dust, noise, and air pollution from construction is small issues, we think is no problem (short time in construction period only).	Training for operators is included in capacity development. Will include use of cover and measures to reduce nuisance
- Laws enforcement is lack (some people dispose solid waste on the pubic area or on streets). Public awareness and penalty should be implemented.	Included in Awareness Raising Campaign, defined in

	proposed TA Package
Phneat Commune, Serei Sophorn Town, BMC Province(WWTP sub-project)	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response
- The WWTP for Serei Saophoan Town is proposed 3 sites. All these proposed sites are on private land (rice field). - Phneat Commune is located in rural area, no drainage/culvert and no solid waste collection service to this commune.	None required
- The commune is located the downstream of Serei Saophoan River. During dry season this river water quality is polluted by wastewater from Serei Saophoan Town. - This WWTP sub-project is important for the urban town and for Phneat Commune too, because people in Phneat Commune use water from River for households use and irrigation. There are very a few people use water from ponds.	None required
- The solid waste in Phnea Commune is not problem (no waste collection service, the people burn waste and use for fertilizer). But there are a few waste dumps on the road and stream – probably from urban town houses.	None required
- The impacts are most concerning during operation stage. Is will increase odour that can be polluted to air quality. - I think, WWTP will impacted to our people in Phneat Commune, but we support this sub-project, because if we have WWTP will not pollute the water quality in river is good the aquatic life. Most people are fishing in this river.	Operator training on achieving effluent standards
During construction there are minor impacts from air, noise and movement equipment (not significant) because is temporary only during construction, the proposed site is located in the rice file and far from souses - WWTP is located far from Village (houses) - Provide the connection drainage from toilet pipe of Phneat Commune to main/public wastewater/drainage and to WWTP.	None required

8.2. Public Consultations during Project Implementation

193. Consultation during implementation. The Consolidated IEE for this sub-project contains details of the consultation undertaken during preparation of these sub-projects. In addition, consultation will take place during implementation. The PIU Safeguard Focal Point (PIU-SFP) will undertake consultation following the finalization of the detailed design, and again will conduct consultation interviews within 4-6 weeks of construction starting and then again every 3 months until the end of construction. This is set out in the Environmental Monitoring Plan provided in the Environmental Management Plan for each sub-project.

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

- Environmental impacts of civil works (e.g., solid & liquid waste, erosion, local flooding, pollution);
- Any unforeseen impacts caused accidentally e.g. through spillages;
- Civil nuisance (e.g., noise, dust, disrupted business activities & farming activity, social issues, community health and safety);
- Impaired use of access roads to disposal sites for sludge and wastes from WWTP (e.g. traffic issues, odour, dust and access); and
- GRM and its procedures including details of persons to contact and contact details.

195. In summary, informal monitoring interviews with affected people will focus on complaints about community disturbance from construction activities, as well as public

concerns about ecological protection, soil /land concerns and access issues. A sample Environmental Monitoring Interview Form is in the EMP for this project. This will contribute to project monitoring.

8.3. Consultation during Operation

196. The mitigation measures for this IEE specify that the WWTP operators, in collaboration with MPWT/PDPWT, MoE/PDoE, MAFF/PDAFF, Provincial-Town Authorities, and concerning agencies undertake quarterly consultation with local residents to discuss any operational impacts or concerns of operation project activities and make correct actions or responses.

8.4. Information Disclosure

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

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

(ii) The IEE will be disclosed on ADB's project website (www.adb.org);

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

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

9. GRIEVANCE REDRESS MECHANISM

198. A grievance redress mechanism (GRM), consistent with the requirements of the ADB Safeguard Policy Statement (2009) will be established to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM is accessible to all members of the community.

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

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

200. Full details of the GRM, its access points, and responsible parties are found in the EMP documents for each sub-project city.

10. ENVIRONMENTAL MANAGEMENT PLAN

201. A detailed EMP is prepared for the subproject. The EMP aims to avoid impacts where possible and mitigate those impacts which cannot be eliminated to an acceptable and minimum level. The EMP includes detailed requirements for:

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

202. The overall responsibility for EMP implementation and compliance with loan assurances lies with the Executing Agency, the Ministry of Public Works and Transport (MPWT). The EA has established a Project Steering Committee (PSC) and a Project Management Unit (PMU) based in Phnom Penh, responsible for general project implementation. The Implementing Agency is the Provincial Department of Public Works and Transport (PDPWT) in each sub-project city. The PDPWT will establish a Project Implementation Unit (PIU) in each province, comprising relevant provincial government representatives including the Provincial Department of the Environment.

203. A summary of the key functions for project implementation and therefore environmental safeguards is presented in Table 21**.**

Table 21: Key Roles for Project Implementation

Role	Abbreviation	Location	Summary fi overall function
Project Steering Committee	PSC	Phnom Penh	Policy and technical guidance for subproject implementation
Project Management Unit	PMU	Phnom Penh within MPWT	Responsible for general project implementation and reporting
PMU Environment Safeguards Officer	PMU-ESO	Phnom Penh within PMU	EMP compliance across the sub-projects for environmental and social safeguards
Project Implementation Unit	PIU	Provinces within PDPWT	Responsible for sub-project implementation
PIU Safeguards Focal Point	PIU-SFP	Provinces within PIU	Responsible for sub-project environmental and social safeguard monitoring
Contractor Environmental Health & Safety Officer	C-EHS	Construction Site	Mitigation measure implementation and reporting
Contractor Environmental Compliance Officer	C-EC	Construction Site	Mitigation measure implementation temporary impacts agreements and restoring/rehabilitation, and reporting.
Project Management Consultant	PMC	Phnom Penh	Project final design and implementation, support and capacity development

Role	Abbreviation	Location	Summary fi overall function
International and National Environment Specialists	PMC-I/NES	Phnom Penh within PMC team	Environmental safeguards and reporting support during design and implementation
Asian Development Bank	ADB	-	Review project progress, compliance with covenants and advise on corrective actions.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Conclusions

204. The EMP, if implemented as directed, will mitigate impacts on the natural environment and affected people to an acceptable level. The key parties for mitigation and monitoring measure implementation are the construction contractors and the operators. The implementation of the EMP will be closely monitored and reported on by the relevant stakeholders in the project.

205. The most significant impacts from the project will arise from facility operation, for the WWTP subproject. As a result, there is a comprehensive training and capacity building component to the project which is essential for ensuring the investment is both financially and environmentally sustainable and beneficial.

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

207. Overall, the project is anticipated to bring environmental benefits to the populations of the project cities. It will serve to improve wastewater management, reduce pollution impacts and will provide long term environmental improvements and health benefits.

11.2. Recommendations

208. During both construction and operation, it is important to continue informing and consulting with the local communities and affected people about the progress of work and any changes or unusual situations; and to receive feedback and recommendations that may help to alleviate nuisances and improve the performance of the systems.

209. The next step in implementation of the Environmental Safeguards is the preparation of the CEMP. The CEMP shall be based on the EMP, but with more detailed descriptions of the measures to be implemented by the Contractor. The CEMP will form the basis of the Environmental Management System of the Contractor during the construction phase. The CEMP shall provide the names of the Contractor's environment and health and safety officer(s) and the Contractor's GRM focal point. The CEMP shall contain a number of subplans dealing with specific topics, such as spoil and borrow site management, solid and liquid waste management, community and occupational health and safety, emergency response, COVID-19 prevention and response plan, and Construction workers camp management (if required).

210. The O&M manual will provide clear methods and procedures for all aspects of the WWTP and pump station operation including management and monitoring of treated effluents and sludge. Furthermore, effluent and receiving water body monitoring data will be provided to

the Provincial Department of Agriculture to enable assessment of the use of the effluents for agriculture.

Annex 1: Environmental Quality Standards

(1) Ambient Air Quality Standards

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

Parameter	Averaging Period	Standard	
		Unit	Value
Nitrogen Dioxide (NO2)	24 hours	mg /m^3	0.1
Sulfur Dioxide (SO2)	24 hours	mg /m^3	0.3
Carbon Monoxide (CO)	24 hours	mg /m^3	20
PM 2.5	24 hours		-
PM 10	24 hours		-

(2) Ambient Noise Standards

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

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

(3) Surface Water Quality Standard

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

Annex 2 of Sub-decree on Water Pollution Control

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

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	0C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD5 (5 days at 200 C)	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 60	< 120
6	Total Dissolved Solids	mg/l	< 1000	< 2000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate (NO3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO4)	mg/l	< 3.0	< 6.0
16	Cyanide (CN)	mg/l	< 0.2	< 1.5
17	Barium (Ba)	mg/l	< 4.0	< 7.0
18	Arsenic (As)	mg/l	< 0.10	< 1.0
19	Tin (Sn)	mg/l	< 2.0	< 8.0
20	Iron (Fe)	mg/l	< 1.0	< 20
21	Boron (B)	mg/l	< 1.0	< 5.0
22	Manganese (Mn)	mg/l	< 1.0	< 5.0
23	Cadmium (Cd)	mg/l	< 0.1	< 0.5
24	Chromium (Cr)+3	mg/l	< 0.2	< 1.0
25	Chromium (Cr)+6	mg/l	< 0.05	< 0.5
26	Copper (Cu)	mg/l	< 0.2	< 1.0
27	Lead (Pb)	mg/l	< 0.1	< 1.0
28	Mercury (Hg)	mg/l	< 0.002	< 0.05
29	Nickel (Ni)	mg/l	< 0.2	< 1.0
30	Selenium (Se)	mg/l	< 0.05	< 0.5
31	Silver (Ag)	mg/l	< 0.1	< 0.5
32	Zinc (Zn)	mg/l	< 1.0	< 3.0
33	Molybdenum (Mo)	mg/l	< 0.1	< 1.0
34	Ammonia (NH3)	mg/l	< 5.0	< 7.0
35	DO	mg/l	>2.0	>1.0
36	Polychlorinated Byphemyl	mg/l	<0.003	<0.003
37	Calcium	mg/l	<150	<200

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
38	Magnesium	mg/l	<150	<200
39	Carbon tetrachloride	mg/l	<3	<3
40	Hexachloro benzene	mg/l	<2	<2
41	DTT	mg/l	<1.3	<1.3
42	Endrin	mg/l	<0.01	<0.01
43	Dieldrin	mg/l	<0.01	<0.01
44	Aldrin	mg/l	<0.01	<0.01
45	Isodrin	mg/l	<0.01	<0.01
46	Perchloro ethylene	mg/l	<2.5	<2.5
47	Hexachloro butadiene	mg/l	<3	<3
48	Chloroform	mg/l	<1	<1
49	1,2 Dichloro ethylene	mg/l	<2.5	<2.5
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexaxhloro cyclohexene	mg/l	<2	<2

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

Annex 4 of Sub-decree on Water Pollution Control

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

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

a) River

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

b) Lakes and Reservoirs

Parameter	Standard	
	Unit	Value
pH	mg/l	6.5 – 8.5

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

Annex 5 of Sub-decree on Water Pollution Control:

Water Quality Standard in public water areas for public health protection

Source: - Ground water quality monitoring MoE, 2016.

- The CNDWQS Standard is National Standard of the Ministry Industry and Handicraft.

No	Parameter	Unit	Standard Value
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10

No	Parameter	Unit	Standard Value
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

(4) Groundwater Quality Standard

No	Parameter	Standard	
		Unit	Value (CNDWQS Standard)
1	pH	-	6.5-8.5
2	Turbidity	NTU	5.0
3	Dissolved Oxygen (DO)	mg/l	NV
4	Total Suspended Solid (TSS)	mg/l	NV
5	Chloride (Cl-)	mg/l	250
6	Nitrate (NO3)	mg/l	50
7	Phosphate (PO4)	mg/l	NV
8	Sulphate (SO4)	mg/l	250
9	(BOD)5	mg/l	NV
10	(COD) Mn	mg/l	NV
11	Aluminum (Al)	mg/l	0.2
12	Arsenic (As)	mg/l	0.05
13	Copper (Cu)	mg/l	1.0
14	Iron (Fe)	mg/l	0.3
15	Lead (Pb)	mg/l	0.01
16	Manganese (Mn)	mg/l	0.1
17	Mercury (Hg)	mg/l	0.001
18	Zinc (Zn)	mg/l	3.0
19	Total Coli form	MPN/100mlml	0

(5) Effluent Quality Standard

(Effluent from WWP and from Leachate Treatment Facility at the controlled disposal facility)

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

No	Parameter	Standard (Allowable limits for pollutant substance discharging) to		
		Unit	Value (Protected public water area)	Value (Public water area and sewer)
1	Temperature	0C	< 45	< 45
2	pH		6 – 9	5 - 9

No	Parameter	Standard (Allowable limits for pollutant substance discharging) to		
		Unit	Value (Protected public water area)	Value (Public water area and sewer)
3	BOD5 (5 days at 200 C)	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 50	< 80
6	Total Dissolved Solids	mg/l	< 1000	< 2000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate (NO3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO4)	mg/l	< 3.0	< 6.0
16	Cyanide (CN)	mg/l	< 0.2	< 1.5
17	Barium (Ba)	mg/l	< 4.0	< 7.0
18	Arsenic (As)	mg/l	< 0.10	< 1.0
19	Tin (Sn)	mg/l	< 2.0	< 8.0
20	Iron (Fe)	mg/l	< 1.0	< 20
21	Boron (B)	mg/l	< 1.0	< 5.0
22	Manganese (Mn)	mg/l	< 1.0	< 5.0
23	Cadmium (Cd)	mg/l	< 0.1	< 0.5
24	Chromium (Cr)+3	mg/l	< 0.2	< 1.0
25	Chromium (Cr)+6	mg/l	< 0.05	< 0.5
26	Copper (Cu)	mg/l	< 0.2	< 1.0
27	Lead (Pb)	mg/l	< 0.1	< 1.0
28	Mercury (Hg)	mg/l	< 0.002	< 0.05
29	Nickel (Ni)	mg/l	< 0.2	< 1.0
30	Selenium (Se)	mg/l	< 0.05	< 0.5
31	Silver (Ag)	mg/l	< 0.1	< 0.5
32	Zinc (Zn)	mg/l	< 1.0	< 3.0
33	Molybdenum (Mo)	mg/l	< 0.1	< 1.0
34	Ammonia (NH3)	mg/l	< 5.0	< 7.0

No	Parameter	Standard (Allowable limits for pollutant substance discharging) to		
		Unit	Value (Protected public water area)	Value (Public water area and sewer)
35	DO	mg/l	>2.0	>1.0
36	Polychlorinated Byphemyl	mg/l	<0.003	<0.003
37	Calcium	mg/l	<150	<200
38	Magnesium	mg/l	<150	<200
39	Carbon tetrachloride	mg/l	<3	<3
40	Hexachloro benzene	mg/l	<2	<2
41	DTT	mg/l	<1.3	<1.3
42	Endrin	mg/l	<0.01	<0.01
43	Dieldrin	mg/l	<0.01	<0.01
44	Aldrin	mg/l	<0.01	<0.01
45	Isodrin	mg/l	<0.01	<0.01
46	Perchloro ethylene	mg/l	<2.5	<2.5
47	Hexachloro butadiene	mg/l	<3	<3
48	Chloroform	mg/l	<1	<1
49	1,2 Dichloro ethylene	mg/l	<2.5	<2.5
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexaxhloro cyclohexene	mg/l	<2	<2

(6) Soil Quality Standard

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

Parameter	Standard	
	Unit	Value
pH		
Salinity	ppt	6-8
Oil & Grease	mg/kg	-
Chloride	mg/kg	-
Petroleum Hydrocarbons		
Kerosene hydrocarbons (c10-c14)	mg/kg	-
Diesel hydrocarbons (c15-c28) (mg/L)	mg/kg	-
Heavy oil hydrocarbons	mg/kg	-

Parameter	Standard	
	Unit	Value
(c29-c36) (mg/L)		
BTEX		
Ethylbenzene	mg/kg	0.018
Benzene	mg/kg	0.0068
Toluene	mg/kg	0.08
Xylene	mg/kg	2.4
Metals		
Nickel	mg/kg	50
Copper	mg/kg	63
Zinc	mg/kg	200
Arsenic	mg/kg	12
Cadmium	mg/kg	1.4
Lead	mg/kg	70
Iron	mg/kg	-
Chromium	mg/kg	64
Mercury	mg/kg	6.6

Annex 2: Field Notes & Descriptions

The proposed WWTP site-2 is located in Kantout Village, Pheat Commune, Serei Sophorn Town, BMC province. This area is rice field (wet rice field) during raining season, floods from 0.5 to 1 m deep in wet season There are not any sensitive resources and forest resources in / near the site. This site is located from:

- National Road 6 is about 1.5 km.
- Serei Sophorn Town is about 3 km
- Kantout Village with houses is about 0.5 km
- Serei Sophorn River is about 1 km in the downstream.
- In and around the area is paddy fields.

The existing environmental resources in and around WWTP site-2

The rural road in Kantout Village and access road from village to WWTP site

Rice filed is around the WWTP site

Annex 3: Consultation During IEE Preparation

Public Consultation Meetings: Focus Group Discussion (FGD)

The main objectives of FGDs are to:

7. Present to the stakeholders and affected people the sites for subprojects in the provincial towns and inform them of the project activities
8. Understand the main issues that may occur in the proposed sub-project areas, as raised by local people.
9. Understand the potential social and environmental resources located/used in the subproject sites.
10. Receiving issues, feedback, and comments from stakeholders or affected people regarding social, gender and environmental issues/resources in the proposed sites.
11. Receiving comments and suggestions for mitigation measures to improve any adverse environmental and social impacts from project design, construction, and operation stages.

Identification of Participants to Consultation Meeting

Stakeholders invited to attend FGDs were identified by National Social Specialist and National Environmental Specialist with assistance from commune chiefs of subproject areas. These focus group members come from:

12. Representative of communities or affected communities (men and women)
13. Chiefs/ deputy village chiefs, the villages are located in and close to the subproject sites
14. Commune chiefs/deputy commune chiefs and commune council members. These communes are located in and around the proposed subprojects sites.

The discussion questions concerned:

15. Physical Resources: Water resources and water quality, soil quality, and air quality (noise and odour)
16. Ecological Resources: forest/vegetation, wildlife and fish.
17. Social Issues/Resources: Land use, water use, agricultural activities, cultural resources, infrastructure, utility services, education, and cultural-touristic resources.

The format of the FGD is summarized as follows:

1. Introduction to the project - describe the project and potential construction activities.
2. Mitigation Measures. Describe potential mitigation measures (EMP) and monitoring
3. Consultation Discussion. Discussion on topics and questions:

18. A. How does the community use the environment & natural resources? Example: what are water sources (drinking, washing etc). Vegetation/Fish/Forest, land use etc
19. B. What are the community's concerns regarding Construction Impacts?
20. C. What are the community's concerns regarding Operation Impacts?
21. D. What are the Mitigation Measures the community would like during Construction?
22. E. What are the Mitigation Measures the community would like during Operation?

Summary of the results of consultations

On 09 to 12 February 2018 the National Social-Gender Specialist and National Environmental Specialist of the TA 9203-CAM: Second Urban Environmental Management in The Tonle Sap Basin Project undertook FGDs in the proposed sub-projects areas for Serei Saophoan Town. The key points from the consultation meetings are presented in section if this IEE.

Consultation pictures in Serei Saophoan Town, BMC Province



Consultation in O Ambel and Preah Ponlear Commune, Serei Sophorn Town




Consultation in Kampong Svay and Teuk Thla Commune, Serei Sophorn Town



Consultation in Phneat Commune, Serei Sophorn Town

Participants List for Consultations in BMC Province

1. Consultation in O Ambel and Preah Ponlear Commune, Serei Saophoan Town

No	Name	Agency Village/Commune	Position	Phone
1	Mr. Pen Im	O Ambel Commune	Village Chief	095 537 337
2	Mr. Moun Chhay	O Ambel Commune	Villager	
3	Mr. Kong Vey	O Ambel Commune	Villager	
4	Mr. Rin Reul	O Ambel Commune	Villager	
5	Mr. Seum Yeung	O Ambel Commune	Villager	
6	Mr. Chhorn Vannak	O Ambel Commune	Villager	
7	Mr. Yeun Oun	O Ambel Commune	Deputy Commune Chief	011 678 677
8	Mr. Oung Dara	O Ambel Commune	Deputy Commune Chief	097 363 2082
9	Mr. Lim Samnang	Preah ponlear Commune	Village Chief	012 447 283
10	Mr. Chhon Sileap	Preah ponlear Commune	Village Chief	092 271 746
11	Ms. Chhung Chamreun	Preah ponlear Commune	Villager	
12	Ms. Thong Youn	Preah ponlear Commune	Villager	
13	Ms. Yim Sithouy	Preah ponlear Commune	Villager	
14	Ms. Mom Sophorn	Preah ponlear Commune	Villager	
15	Mr. Lim Ky	Preah ponlear Commune	Villager	
16	Ms. Soa Bory	Preah ponlear Commune	Villager	
17	Ms. Eag Kunthear	Preah ponlear Commune	Villager	
18	Ms. Sok Lon	Preah ponlear Commune	Villager	
	Total: 18 persons (female: 07 persons)			

2. Consultation in Kampong Svay and Teuk Thla Commune, Serei Sophorn Town

No	Name	Agency Village/Commune	Position	Phone
1	Mr. Kong Sath	Kampong Svay Commune	Villager Chief	092 780 206
2	Ms. Long Srey Neat	Kampong Svay Commune	Deputy Village Chief	
3	Ms. Poa Yang	Kampong Svay Commune	Villager Chief	012 964 098
4	Ms. Son Yeum	Kampong Svay Commune	Deputy Villager Chief	
5	Ms. Touch leang	Kampong Svay Commune	Villager	
6	Mr. Chan Seur	Kampong Svay Commune	Villager	
7	Mr. Son Yim	Kampong Svay Commune	Villager	
8	Ms. Dein Solida	Kampong Svay Commune	Commune clerk	012 672 199
9	Mr. Tor Mouth	Kampong Svay Commune	Villager	
10	Mr. Chap Ron	Teuk Thla Commune	Village Chief	081 812 424
11	Mr. San Sivathan	Teuk Thla Commune	Village	
12	Mr. Ma Chheun	Teuk Thla Commune	Villager	

13	Mr. Chhun Savan	Teuk Thla Commune	Villager	
14	Ms. Thang Sareth	Teuk Thla Commune	Deputy Village Chief	092 604 838
15	Ms. Yim Channa	Teuk Thla Commune	Villager	
16	Ms. Noy Maleya	Teuk Thla Commune	Villager	
17	Ms. Soung Samei	Teuk Thla Commune	Villager	
18	Ms. Chhut Sareun	Teuk Thla Commune	Villager	
19	Ms. Muth Rin	Teuk Thla Commune	Villager	
	Total: 19 persons (female: 11 persons)			

3. Consultation in Phneat Commune, Serei Sophorn Town

No	Name	Agency Village/Commune	Position	Phone
1	Ms. Pouth Mary	Phneat Commune	Village Member	017 696 508
2	Mr. Tan Chhouy	Phneat Commune	Deputy Village Chief	012 199 1328
3	Ms. Mok Kim Ath	Phneat Commune	Villager	
4	Mr. Chhuth Polo	Phneat Commune	Village Chief	012 237 628
5	Ms. Bour Sareun	Phneat Commune	Villager	
6	Ms. Phath Youm	Phneat Commune	Villager	
7	Ms. Khim Buntha	Phneat Commune	Villager	
	Total: 07 persons (female: 05 persons)			

Annex 4: Wastewater Characterization For Use in Agriculture

FAO Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture together (Table A2-1), and typical dried sludge constituents and reuse guidelines are tabulated in this annex.

Table A2-1 Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture[20]

Category	Reuse condition	Exposed group	Intestinal nematodes[b] (arithmetic mean no. of eggs per litre[c]	Fecal coliforms (geometric mean no. per 100 mL[c])	Wastewater treatment expected to achieve the required microbiological quality
A	Irrigation of crops likely to be eaten uncooked, sports fields, public parksd[d]	Workers, consumers, public	≤ 1	≤ 1000[d]	A series of stabilization ponds designed to achieve the microbiological quality indicated, or equivalent treatment
B	Irrigation of cereal crops, industrial crops, fodder crops, pasture and trees[e]	Workers	≤ 1	No standard recommended	Retention in stabilization ponds for 8-10 days or equivalent helminth and faecal coliform removal
C	Localized irrigation of crops in category B if exposure of workers and the public does not occur	None	Not applicable	Not applicable	Pretreatment as required by the irrigation technology, but not less than primary sedimentation

Notes:

[a] In specific cases, local epidemiological, socio-cultural and environmental factors should be taken into account, and the guidelines modified accordingly.
[b] *Ascaris* and *Trichuris* species and hookworms.
[c] During the irrigation period.
[d] A more stringent guideline (<200 faecal coliforms per 100 ml) is appropriate for public lawns, such as hotel lawns, with which the public may come into direct contact.
[e] In the case of fruit trees, irrigation should cease two weeks before fruit is picked, and no fruit should be picked off the ground. Sprinkler irrigation should not be used.
Source: WHO (1989)

Dried sludge characteristics vary by region and depend on a number of factors such as local lifestyles and cultural practices. Therefore, these must be ascertained specific to a given wastewater system. Typical constituents for dried and digested sludge from Australia and Brazil are presented in Table A2-2. Similarly, setting guidelines values for the various parameters depend on a number of factors, most importantly, health risk for pathogen levels (degree of contact of the biosolids with users and whether plant is eaten raw or processed), uptake capacity of the soil for each chemical element), and toxicity level (heavy metals) in the soil. Data on sludge and soil characteristics is virtually non-existent in Battambang at present.

In view of the above, it is imperative that some studies be done on the sludge during the start-up years and appropriate guidelines be developed for the use of biosolids as soil conditioners including health safeguards. Therefore, the typical dried sludge characteristics and guideline

In developed countries the current practice is to determine a sludge application plan based on risk assessment, absorptive capacity of the soils and the intended method of application of the

[20] http://www.fao.org/3/t0551e/t0551e04.htm

biosolids to the land. The Australian guideline values shown in Table A2-2 are from a previous, 2008, version of the guidelines. These could form as useful reference until better understanding and more data are obtained for the conditions in Battambang.

In Table A2-2 Grade A dried biosolids refers to unrestricted use, safe to be handled. Grade B has restrictive use including handling and type of crop to which it can be applied. Grade 3 less restrictions and generally may be suitable only for forest application and landfill. The pathogen grades are assessed independently of the other contaminant grades.

Table A2-2 Sludge Characteristics

Sludge Quality Parameter	Unit	Typical Digested Sludge[1/]		Australian Guideline[1/]		
		Australia	Brazil	Grade A	Grade B	Grade C
pH		7.2	7.3	7.3	7.3	7.3
Phosphorus (P)	%	1.0	1.8	10[2/]		
Nitrogen (N)	%	1.5	5.8	5[2/]		
Potassium (K)	%	0.5	0.4	10[2]		
Organic carbon (TOC)	%	5.2	28			
Sulfur (S)	%	0.7	0.3			
Calcium (Ca)	%	3.5	4.3			
Manganese (Mn)	%	0.8				
Electrical conductivity ($EC_{1:5}$)	dS/m	6.0	0.4			
coliforms	MPN/g	6	20,300	<100	<1,000	$<2x10^6$
Arsenic (As)	mg/kg	6	15	20	20	60
Cadmium (Cd)	mg/kg	3	11	1	11	20
Copper (Cu)	mg/kg	800	255	100	750	2,500
Lead (Pb)	mg/kg	150	80	200	300	420
Mercury (Hg)	mg/kg	1.5	2.3	1	9	15
Nickel (Ni)	mg/kg	60	42	60	145	270
Zinc (Zn)	mg/kg	900	690	200	1,400	2,500

Notes”

1. UN-Habitat, 2008, *Global atlas of excreta, wastewater sludge, and biosolids management: Moving forward the sustainable and welcome uses of a global resource*.
2. Typical chemical fertilizer values, source Metcalfe and Eddy/Aecom, 2014. *Wastewater engineering – treatment and resource recovery*.