Initial Environmental Examination

February 2021

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

Battambang Wastewater Subproject (Lot2), Battambang Province

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

CURRENCY EQUIVALENTS

(as of March 2020)

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

ABBREVIATIONS

ADB	–	Asian Development Bank
AH	–	Affected Households
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 Mine Action Center
COD	–	Chemical Oxygen Demand
CRVA	–	Climate Risk Vulnerability Assessment
DRP	–	Detailed Resettlement Plan
EA	–	Executing Agency
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
FGD	–	Focus Group Discussion
GDR	–	General Department of Resettlement
GHG	–	Greenhouse Gas
GRM	–	Grievance Redress Mechanism
I/NES	–	International and National Environmental Specialists
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
IESIA	–	Initial Environmental and Social Impact Assessment
EMI	–	Environmental Monitoring Institute
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
PDPWT	–	Provincial Department of Public Works and Transport
PGRC	–	Provincial Grievance Redress Committee
PIU	–	Project Implementation Unit
PIU-SFP	–	PIU Safeguards Focal Point
PMC	–	Project Management Consultants
PMC-I/NES	–	PIM-International and National Environment Specialists
PMU	–	Project Management Unit
PMU-ESO	–	PMU Environmental Safeguards Officer
PPTA	–	Project Preparatory Technical Assistance
PRSC	–	Provincial Resettlement Subcommittee
PSC	–	Project Steering Committee
RCP	–	Representative Concentration Pathway
RGC	–	Royal Government of Cambodia
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
km^2	–	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 (TS2 Project) will support the Government of Cambodia in improving urban services and enhancing climate resilience in the Tonle Sap Basin. The project is part of ADB's programmatic approach in the Tonle Sap Basin, and will build on an ongoing project, under which similar interventions are financed in two of the basin's towns.

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

Table 1: Summary of TS2 Project Interventions

Subproject City	WWTP	Drainage	Landfill
Serei Saophoan	✓	✓	✓
Battambang	✓	x	✓
Steung Saen	✓	✓	✓

3. The Battambang Wastewater subproject (Lot 2) is designed to cover the areas of Sangkat Rottanak and Sangkat Prek Preah Sdach located at the east side of Battambang (Figure 3) with the construction of a separate sewer system network, pumping stations, and WWTP (on the East part of Sangke River).

4. With a design period of 20 years, the project components/facilities are planned up to Year 2040. The project includes the following investments:

- Construction of a primary, secondary and tertiary sewer collection network, including sewer household connections (SHCs);
  - 43 km primary and secondary gravity sewer pipeline
  - 9.7 km pressurized sewer pipeline
  - 56 km of Ø160 mm tertiary sewers for SHCs within project timescale
- Construction of two primary sewer pumping stations and associated pumping mains;
- Construction of four secondary sewer pumping stations and pumping mains;
- Construction of a 8,500 m^3/day WWTP
- Construction of administration, workshop, generator and security buildings at the WWTP;
- Upgrade and raise 4 km of access road to the WWTP site;
- Provision of operations & maintenance equipment.

5. This WWTP site is in a lowland area surrounded by rice fields. The subproject site is located from:

- Sangke River about 4-5 km to the west
- BTB Town about 5-6 km to the south
- Norea Primary-Secondary School and Christian School about 2 km from WWTP site
- Cultural resources (pagoda) about 3-4 km to the south
- Provincial Road about 3-4 km to the west
- National Road N.5 about 5 km from WWTP site

6. The Project is classified as category B for environment and confirmed during the project preparation. This consolidated IEE addresses Battambang Wastewater subproject (Lot 2) and it has been undertaken in accordance with ADB Safeguards Policy Statement (SPS) 2009. A

separate Environmental Management Plan (EMP) has been prepared. The IEE and EMP have been updated after the Detailed Engineering Design (DED) have been completed and incorporate the findings from the Initial Environmental and Social Impact Assessment (IESIA) approved by the Ministry of Environment (MoE) in May 2020 (Annex 6). The IEE and EMP will be further updated when necessary.

1.2. Key Findings

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

8. The subproject sites are located in an environment which contains many surface water bodies including ponds, rivers discharging to the Tonle Sap lake and river, and a network of irrigation canals used for paddy field cultivation. The surface water bodies in the area are known to be used for household uses, such as washing as well as fishing. Management of run-off and potential pollution impacts are a key focus of the EMP measures.

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

10. The most significant environment risks associated with the subproject are related to the operation phase. The sewer system (including pumping stations) and WWTP can cause environmental pollution if they are not managed and maintained effectively. Such pollution can include long term risks to odour, and medium-term risks to water quality from WWTP effluent discharges, potentially affecting aquatic flora and fauna and human health.

11. When effectively managed, the project facilities will bring environmental improvements to Battambang. Field visits show that the current environment is contaminated by both sewage and leachate from the waste dumping site and the growing pressures on the urban areas means that this is likely to continue. The development and operation of well-engineered waste management and wastewater treatment facilities will reduce pollution of the environment and the risks to human health. In addition, the municipalities will have improved disaster and climate change resilient infrastructure.

12. In Battambang, the new wastewater infrastructure will form the foundation for developing citywide wastewater systems in the years ahead. 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.

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

1.3. Environmental Management Plan

14. 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
- GRM including clearly defined timescale and responsibilities.

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

16. The Project Management Consultant (PMC) will be responsible for ensuring adequate training during project implementation including the following:

- 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.

17. The key mitigation measures during construction will include:

- Implementation of good construction practices to ensure minimal disturbance of nearby residents and communities from construction related nuisance, such as noise, dust and other emissions.
- Avoid or minimise emissions to protect the ambient air quality, surface water and 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 site specific Construction Environmental Management Plans (CEMP) for the key activities including detailed layout maps to ensure that all stakeholders are clear on where activities will take place, including 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 construction sites.

18. Mitigation and monitoring measures of environmental quality are also required for the operation phase. The importance of training in operations of WWTP and environmental management should be emphasized if the investments are to be sustainable, and operations are to be 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 the project.

19. A 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

20. 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 to ensure

that when implemented as designed will mitigate all anticipated impacts on the natural environment or affected people to an acceptable level. The key parties responsible for mitigation measure implementation are the construction contractors and the WWTP operators. They will be supported by qualified national and international environmental consultants within the PMC teams. The implementation of the IEE and EMP will be closely monitored and reported on by the relevant stakeholders in the project.

21. The most significant risks are associated with the operation of the WWTP. As a result, 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 the anticipated outcomes.

22. Overall, the expected project outcome is to improve urban environmental services in participating cities. The project is anticipated to bring environmental benefits to the populations of the project cities. It will serve to improve sewage and waste management, reduce pollution impacts and provide long term urban environmental improvements, health benefits and promote sustainable city development.

23. The next step of environmental safeguards implementation is the preparation of the CEMP. The CEMP is based on the EMP and it develops in more details the measures to be implemented by the contractor. The CEMP will be the backbone of the environmental management system of the operator and will be supported by associated sub-plans which will deal with specific topics, such as health and safety, waste management, soil and borrow sites management, traffic management, etc.

24. When operations will start, the operator shall also develop its own environmental management system, specific to the operations.

25. Environmental assessment in Cambodia is governed by Sub-decree on EIA Process No. 72 (1999) and Declaration on Guideline for Conducting IESIA and EIA Reports No. 376 (2009). The MoE through its Environmental Impact Assessment (EIA) Department regulates and monitors the EIA Process. The project owner (public or private) is required to submit the necessary project document (IESIA/EIA report) to MoE for review and approval.

26. A meeting held between the MoE, MPWT and consultant teams for ADB projects on 6th December 2017 confirmed that this project requires and IESIA report by a registered authorized company in Cambodia. The IESIA was approved in May 2020.

2. INTRODUCTION

2.1. Background and introduction

2.1.1. Project Outputs and Location

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

28. The TS2 Project will improve urban environmental services in Battambang, Banteay Meanchey Province, Battambang Town, Battambang Province and Steung Saen Town, Kampong Thom Province, three of Cambodia's provincial cities located around the Tonle Sap lake (Figure 1).

Figure 1: Location of TS2 Project Urban Centres

Source: Detailed Engineering Design Report, SCE 2019.

29. The TS2 Project has three outputs:

- Output 1: Improved public services. The project will finance wastewater, drainage and solid waste management subprojects: (i) a new 8,500 m^3/day capacity wastewater treatment plant (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 Steung Saen Town, Kampong Thom Province, and (iii) a new 2,500 m^3/day capacity WWTP in Serei Saophoan and 78.2 km of new sewers. The project will finance two drainage subprojects: (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 Stung 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.

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

2.2. Objective of the IEE

30. The first Initial Environmental Examination (IEE) was prepared during the Project Preparatory Technical Assistance (PPTA) and approved by ADB in May 2018. The first IEE was prepared for all the subprojects within the TS2 Project.

31. This IEE has been prepared for The Battambang Wastewater Subproject (Lot2) in Battambang Province based on the completed Detailed Engineering Design (DED), the Environmental Management Plan (EMP) for Battambang wastewater subproject has also been updated and included in this IEE (Annex 4).

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

- To understand the existing natural and social environments which 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 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 disclosure 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 protection.
- To develop Environmental Management Plan for implementation and monitoring for the project activities in whole project stage.
- To ensure the project will contribute in economic development of Cambodia with sustainable environment.

2.3. ADB and Domestic Environmental Due Diligence

2.3.1. IEE Requirement

33. The project classification of environment category B was confirmed during project preparation. This consolidated IEE for the subproject has been prepared and updated based on the DED. The EMP for the subproject has been updated and is attached to the IEE. The IEE and EMP have been undertaken in accordance with ADB Safeguards Policy Statement (SPS)

2009 and Royal Government of Cambodia (RGC) environmental requirements, policies and guidelines.

34. The requirements for MoE approvals under Cambodian law are set out in detail in Section 3.2.1 *Legal Framework for Environmental Management*. An approved company registered with the MoE has prepared. The IESIA was approved in May 2020 (Annex 6). The findings from the IESIA have been incorporated in the IEE and EMP.

2.4. Structure of The Report

35. 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.

36. 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.

37. In addition, the EMP includes detailed receptor maps and site location maps to support contractors with preparation of site-specific 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

38. 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.

39. 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.
- The assessment will identify potential transboundary effects as well as global impacts.

40. Other requirements of SPS 2009 include:

- Alternatives analysis. 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.
- EMP. 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);

- 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.

41. 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 and solid waste disposal. 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 sewage overflows contaminating water supply sources.

42. 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

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

- Sub-decree on EIA Process No. 72 (1999). The sub-decree provides the detailed guidelines for implementation of the EIA Process. Its Annex requires the conduct of IESIA 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 IESIA and EIA Reports No. 376 (2009). This declaration specifies the basic contents of IESIA/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 significant environmental impacts and mitigation measures; (vii) environmental management plan; (viii) cost-benefit analysis; and (ix) conclusion and recommendations.

44. 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 IESIA/EIA reports in collaboration with other relevant ministries, and (ii) monitoring of the project proponent's implementation of the EMP throughout the different project phases. MoE operates at the municipal and provincial levels through its Provincial Department of Environment (PDoE).

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

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

- EIA department agrees that this project needs to prepare IESIA/IESIA report which can be informed by the IEE report and incorporate the additional baseline environmental survey (air and water quality) results.
- The IESIA report for landfills should be prepared in separate report from other subprojects.

- The IESIA report for the drainage and sewerage can be prepared together in one IESIA report.
- EIA department agrees with and supports the project and will facilitate MoE to give a general approval letter to MPWT after receiving IESIA report and request letter from MPWT.

47. A registered company, authorized to complete IESIA reports in Cambodia, is required to submit the IESIA report on behalf of the project owner, MPWT (IESIA was approved in May 2020).

3.2. National Environmental Policy and Legislation

3.2.1. Legal Framework for Environmental Management

48. 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.

49. 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.

50. 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

51. 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.

52. 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.

53. 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 Sewer system and Wastewater Treatment Plant (2017).

54. A summary of national and international guidelines are in Table 2 and Table 3. The key environmental quality standards applied to the EMP for this IEE are listed and presented in detail in Annex 1. The most stringent limit (national or international) shall apply.

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. 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 Annexes 2, 4 and 5 provide the effluent standards, including effluent from wastewater stabilization ponds, water quality standards for public waters for the purpose of biodiversity conservation, and water quality standards for public waters and health, respectively. 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 as 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.

Law/Regulation/Guideline	Year	Summary
		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 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 some types of infrastructure and development are allowed with approval of the IESIA. 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.

Law/Regulation/Guideline	Year	Summary
Labour Law (1997) Decree No. CS/RKM/0397/01	1997	This law governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: Chapter VIII Health and Safety of Worker. The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace. Article 230: Workplaces must guarantee the safety of workers. However, the only specific occupational health and safety Prakas relates to the garment industry and brick manufacture. Chapter IX: Work-Related Accidents Article 248: All occupational illness, as defined by law, shall be considered a work-related accident. The law sets out how accidents should be managed in terms of compensation.
Law on Water Resources Management (NS/RKM/0607/016)	2007	Requires license/permit/written authorization for the: (i) abstraction & use of water resources other than for domestic purposes, watering for animal husbandry, fishing & irrigation of domestic gardens and orchards; (ii) extraction of sand, soil & gravel from the beds & banks of water courses, lakes, canals & reservoirs; (iii) filling of river, tributary, stream, natural lakes, canal & reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and to endanger human, animal and plant health. (Articles 12 & 22) Its Article 24 stipulates that Ministry of Water Resources and Meteorology (MOWRAM), in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Royal Decree 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

Law/Regulation/Guideline	Year	Summary
		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, 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

Law/Regulation/Guideline	Year	Summary
		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 Sewer 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. **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

Environmental Issue	National Standard	International Standard
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

55. 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 subprojects.

3.3. International Agreements

56. 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.

57. 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

58. 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 Steung Saen (Kampong Thom Province), have significant spillover effects to rural areas, where poverty is more acute.

59. 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 projects 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.

60. Access to services. At present, wastewater and solid waste services in urban area (excluding Phnom Penh) is 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 sewerage and wastewater treatment is very limited (10.7%).[2] More than 75% of households in Cambodia's urban areas (excluding Phnom Penh) do not have access to solid waste services. The main reasons for these service delivery gaps are (i) inadequate coverage and delivery of urban environmental infrastructure and services; (ii) inadequate management of public investments, and (iii) poor urban planning that doesn't consider environmental management and climate change events.

61. Institutional arrangements. The 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 MoE 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 WWTP and sewerage networks.

62. 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 centers, the TS2 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

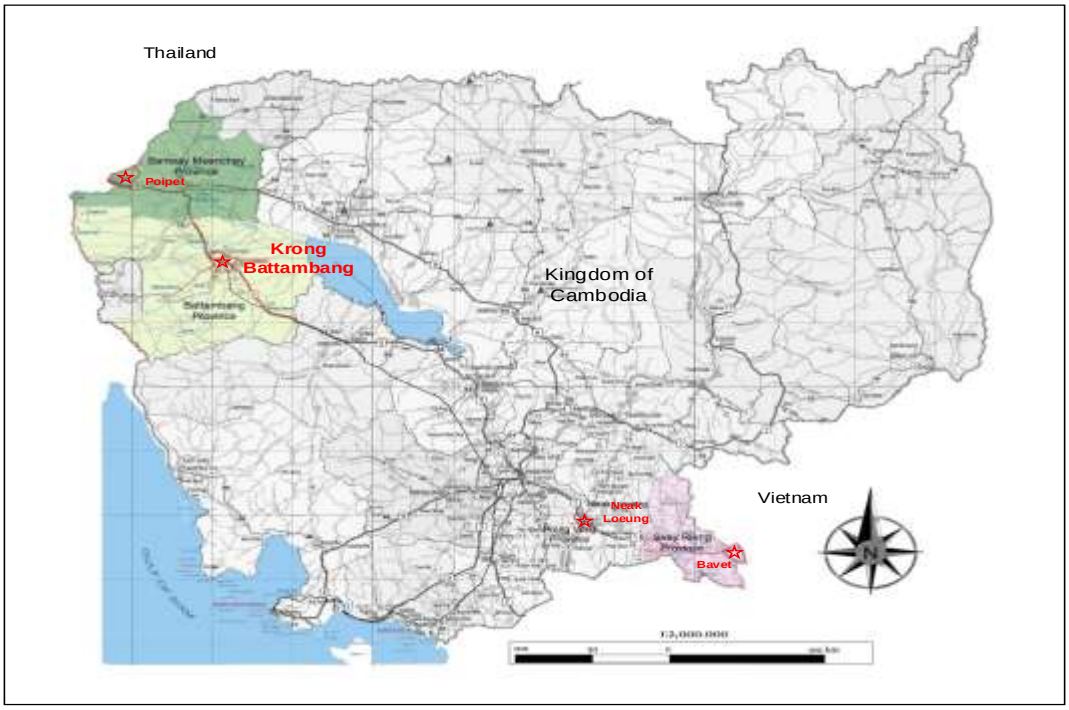
[2] Improved sanitation includes flush and/or pour flush to piped sewers, septic tanks, and pit latrines with slab. Government of Cambodia, Ministry of Planning. 2014. Cambodia Socio-Economic Survey. Phnom Penh.

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. Subproject description

63. Battambang is situated in the north-western part of Cambodia, about 300 km via National Road No. 5 from the capital city of Phnom Penh (Figure 2). The city is strategically located as a traditional trading centre for agricultural products, processing thereof and the provision of services for the region.

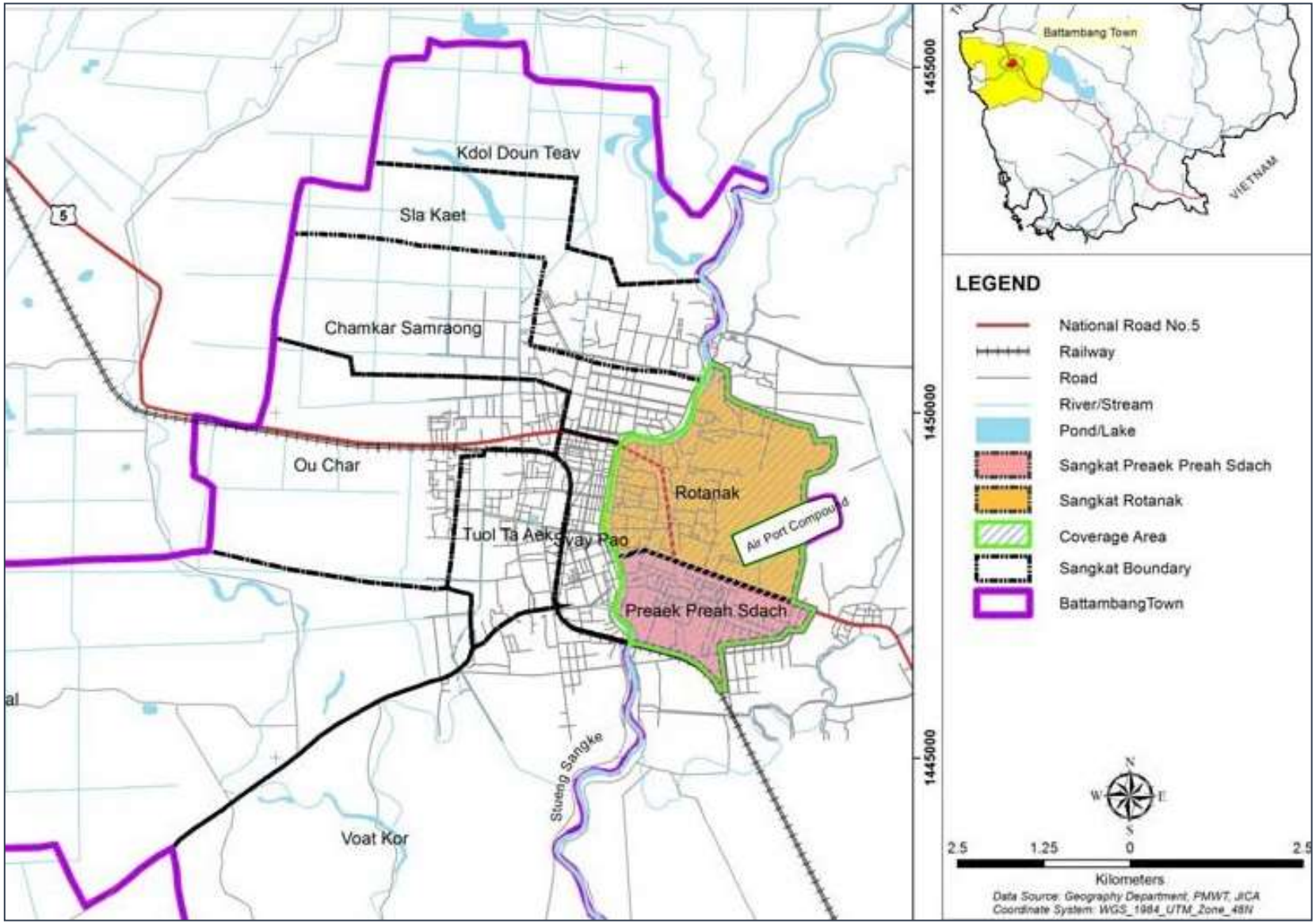
Figure 2: Battambang Location Map



Source: Detailed Engineering Design Report, SCE 2019

64. The subproject is designed to cover the areas of Sangkat Rottanak and Sangkat Prek Preah Sdach located at the east side of Battambang (Figure 3) with the construction of separate sewer system network, pumping stations, and WWTP.

Figure 3: Battambang Wastewater Subproject (Lot2) Coverage Area



65. The project design is in the context of an existing project sewer system prepared by the GMS: Southern Economic Corridor Towns Development Project. The drainage and sewage components will be implemented in two stages as follows:

- Stage 1 – Construction of storm-water drainage system under GMS: Southern Economic Corridor Towns Development Project (not part of this subproject).
- Stage 2 – Construction of separate sewer system, including tertiary sewers, service connections, pump stations and WWTP under this project (this subproject).

66. With a design period of 20 years, the project components/facilities are planned up to Year 2040. The project will include the following investments:

- Construction of a primary, secondary and tertiary sewer collection network, including sewer household connections (SHCs);
  - 43 km primary and secondary gravity sewer pipeline
  - 9.7 km pressurized sewer pipeline
  - 56 km of Ø160 mm tertiary sewers for SHCs within project timescale
- Construction of two primary sewer pump stations and associated pumping mains;
- Construction of four secondary sewer pump stations and pumping mains;
- Construction of an 8,500 m^3/day WWTP
- Construction of administration, workshop, generator and security buildings at WWTP;
- Upgrade and raise 4 km of access road to the WWTP site;
- Provision of operations & maintenance equipment.

67. Implementation schedule and contracting modality: The subproject is being procured through an ad measurement (item rate) contract. The DED for this subproject was completed in 2019, and the construction contract was signed on 14 August 2020 (REF: CW01 Lot 2, M.T.A Construction Co. Ltd JV with No. 203 Research Institute of Nuclear Industry). The construction period is expected to be 36 months, starting in December 2020.

4.3. Detailed Description of Sewer System and Pump Station Designs

68. The sewer system for the east Battambang service area is divided into two primary catchment areas in consideration of the topography as well as the locations of the two existing sites for the North and South main pumping stations. A plan of the sewer system design is shown in Figure 4.

69. The gravity sewers and force mains were designed based on the estimated year 2040 peak dry weather sewage flow as shown in Table 4.

Table 4: Design Flows for Sewer System Network

Sub-Catchment	Projected Dry Weather Sewage Flow, Q (m^3/day)			
	2030		2040	
	Avg. Q	Peak Q	Avg. Q	Peak Q
North Sub-Catchment	2,230	4,860	2,750	5,860
South Sub-Catchment	3,290	6,850	4,050	8,170

70. The requirements for the sewer network piping designs are shown in Table 5 for the sewerage system of East Battambang.

71. Gravity Primary and Secondary Sewers. All flows from sewer system will be collected by tertiary sewers then conveyed to the main gravity sewers flowing into four network pump stations, then to either the North or the South main pumping station. The North and South main pumping stations will then pump the wastewater directly to the WWTP.

Table 5: Sewer Length and Diameters by Length

Depth of Cover, m	Gravity Sewer Mains					
	HDPE PE100, PN 8, SDR 21					
	200 mm	250 mm	355 mm	450 mm	560 mm	Sub-Total
1-2	15,487	-	-	-	-	15,487
2-3	12,148	376	-	284	55	12,863
3-4	5,292	1,127	-	983	1,750	9,152
4-5	2,157	1,137	736	140	836	5,006
5-6	128	145	100	-	155	528
Total Length	35,212	2,785	836	1,407	2,796	**43,036**
	Force Mains:					
	Steel Pipe				**HDPE PE 100, PN12.5, SDR 13.6**	
	100 mm	**150 mm**	**200 mm**	**200 mm**	**315 mm**	**400 mm**
Total Length	11	66	50	2,100	3,000	4,500

72. Gravity Tertiary Sewers. All pipelines are below the existing ground surface with appropriate grade slopes and diameters. The tertiary sewers will receive flows from house lateral sewer connections which discharge into the sewer mains then to the pumping stations.

73. Force mains. Force/pressure mains are to be provided to carry flows from the lift and pump stations to their designated discharge points.

74. Pumping Stations. Two (2) main pumping stations and four (4) network pumping stations are required for the sewer system as shown in Table 6 and Table 7 (Figure 5 and Figure 6). As indicated in Table 7, all pumping station wet wells will be equipped with a standby pump in case of malfunction of the duty pump. In addition, all 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.

Figure 4: Battambang Sewer System Plan

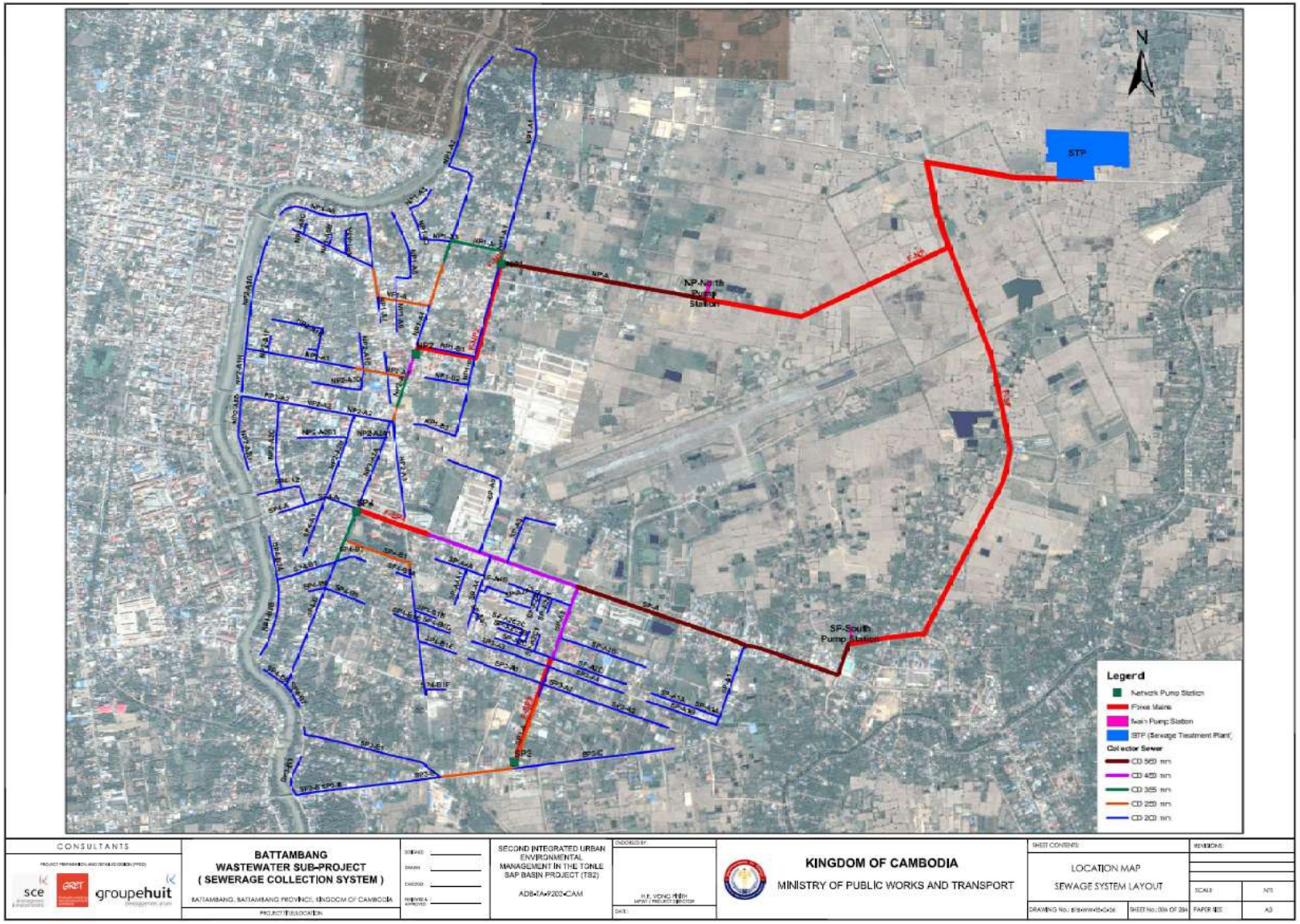


Figure 5: North Main Pumping Station Layout

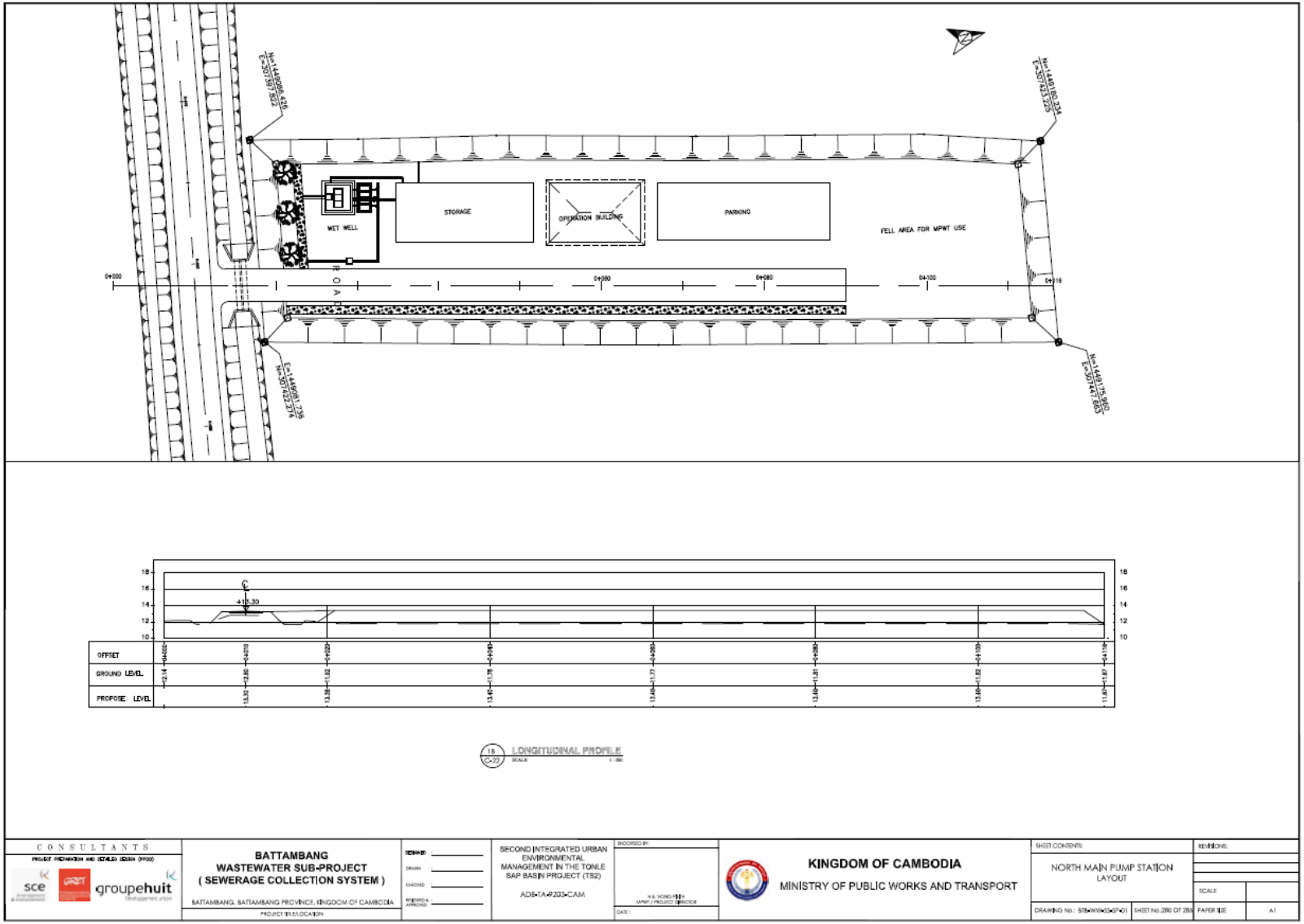


Figure 6: South Main Pumping Station Layout

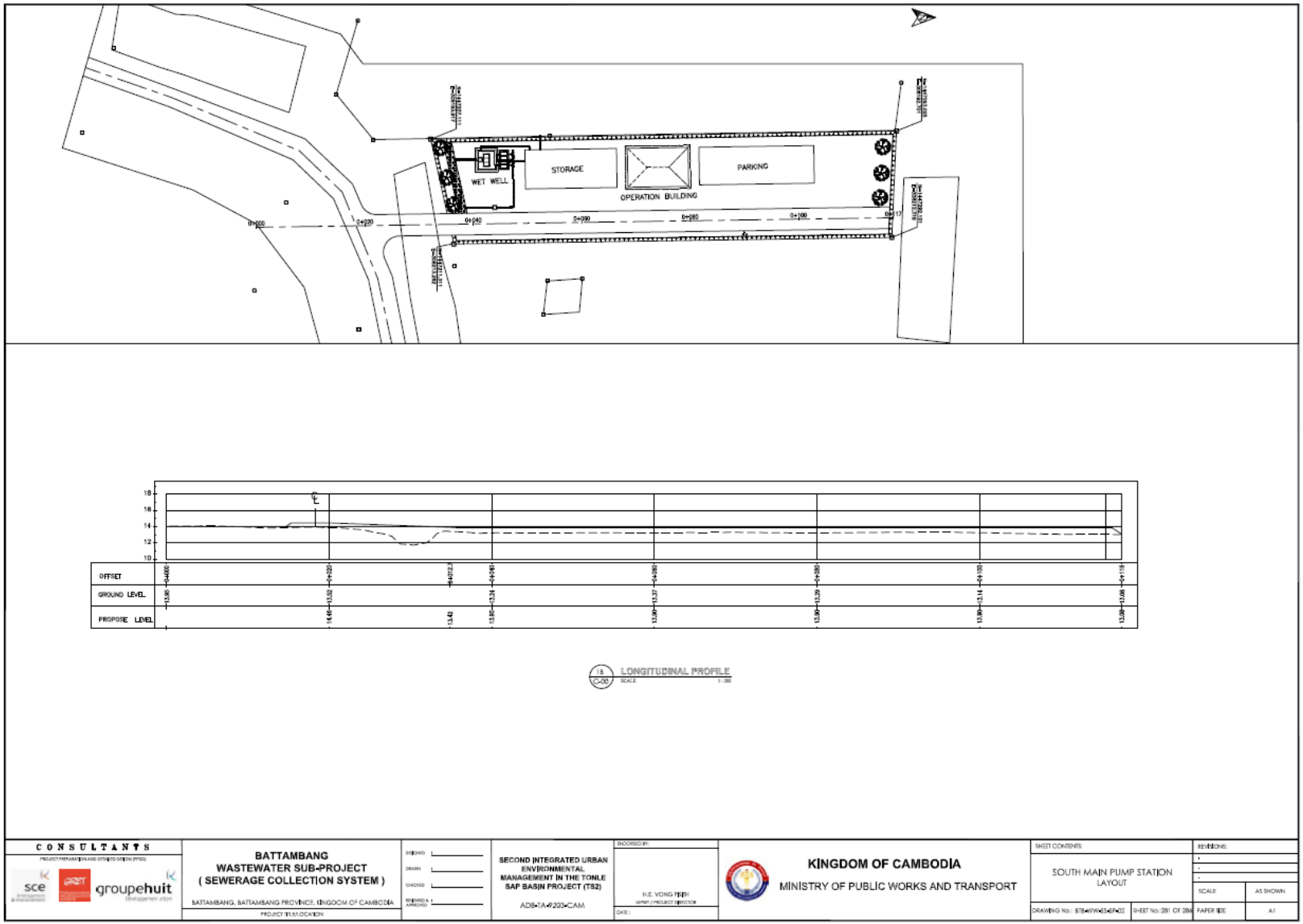


Table 6: Main Pumping Stations

Item	North Main Pumping Station (N-MPS)	South Main Pumping Station (S-MPS)
Location	Sangkat Rottanak, just north of the Airport along Street 609	Sangkat Anlong Vil, Sangkae District, just south of the Airport
Area	Approximately 2,450 m^2	Approximately 1,660 m^2
Existing Land Use	Agricultural	Agricultural / Residential
Existing Ground Elevations	12.5m – 11.5m	13.5m – 12.5m
Road Access	Around 3 km road distance from the center of east Battambang (Street 609 is still unpaved)	Less than 200 meters from National Road Number 5 via a concrete paved city road
Availability of Public Water Supply	None	None
Availability of Electrical Supply	Electrical poles are across the road at the site, no power lines	Electrical supply is 100m away

Table 7: Sewer Network Pumping Stations

Lift/Pump Station	Minimum Structure Size (wet well)	Pump Capacity	Pump Configuration (Duty + Standby)	Force Mains
Lift Stations				
NP1	2.5 Dia., 6.3 m Depth	1 x 37 lps @ 10 m Head	1 + 1 Submersible	200 mm x 20 m
NP2	2.5 Dia., 6.8 m Depth	1 x 34.3 lps @ 20 m Head	1 + 1 Submersible	200 mm x 950 m
SP3	2.5 Dia., 7 m Depth	1 x 27.5 lps @ 14 m Head	1 + 1 Submersible	200 mm x 650 m
SP4	2.5 Dia., 6.4 m Depth	1 x 37.6 lps @ 16 m Head	1 + 1 Submersible	200 mm x 450 m
Main Pumping Stations				
NP	3 (W) x 3 (L)., 6.2 m Depth	1 x 68.1 lps @ 28 m Head	1 + 1 Submersible	315 mm x 3,000 m
SP	3.5 (W) x 3.5 (L)., 7.3 m Depth	1 x 93.3 lps @ 23 m Head	1 + 1 Submersible	400 mm x 4,500 m

75. Additional elements of the North and South pumping stations consist of the following facilities:

(1) Operations Building - A single-story building including an office, operations staff quarters, toilet, shower, the Motor Control Center and electrical controls.

(2) Generator Building - An enclosed and ventilated building near the pumping plant will be provided to house a back-up power generator connected to an outdoor fuel tank with adequate capacity for 24-hour continuous operation and with secondary containment. The generator building will be provided with adequate ventilation and sound attenuating provisions to meet all exterior noise level requirements.

(3) Internal Roads, Parking and Drainage - Internal roads will be provided to allow truck and visitor access to the facilities. The roads will be surfaced with asphalt and designed for use by 10-Ton gross weight vehicles. Parking spaces will be provided. Perimeter drainage will

be provided to divert surface run-off to the existing channel in front of each site. The channels will also serve as a discharge points for each pump stations overflow pipes.

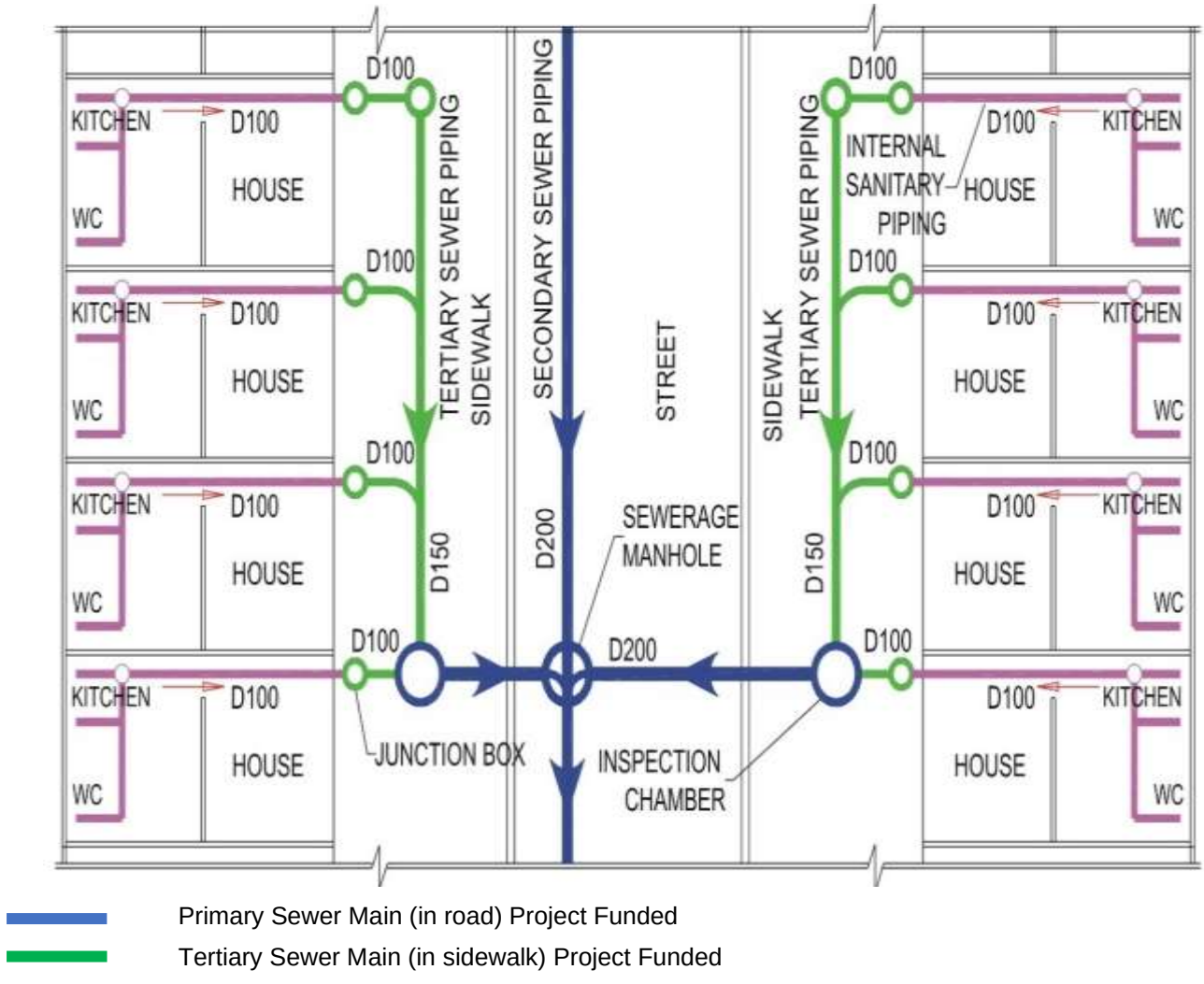
(4) Site Fencing and Lighting - Perimeter fencing will be galvanized steel wire mesh fixed to galvanized steel posts set in a concrete footing. The fence will be topped with 3 rows of barbed wire. Double hinged galvanized steel access gates shall be used for entry and security. Site lighting will be installed for the facility.

(5) Water Supply - Water supply will come from the WSC and will include all appurtenances such as valves, meter, standpipes, etc.). One overhead HDPE tank will be installed for water storage. Water will be supplied using PVC water pipes.

(6) Sanitation Facility - Wastewater from the toilet and bath for both pumping stations will be collected by a 150 mm diameter PVC sewer and conveyed to the pump station wet well.

76. Included in the project design is a required tertiary sewer network and SHC all to be funded under the project, as shown in Figure 7. 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 were not included in the pre-feasibility study for this project but are included here as a crucial part of the wastewater treatment system and a pro-poor and social inclusion design feature.

Figure 7: Design Relationship & Interface between the Sewerage Piping Systems



4.4. Detailed Description of Wastewater Treatment Plant

77. A detailed analysis of the WWTPs designs is provided in Feasibility Study Report Volume 2 – Engineering Designs. A summary of the designs relevant to this IEE is provided here. The subproject adopts a technically viable solution that conforms with the standard wastewater treatment processes presented in IFC's 2007 Environmental, Health, and Safety Guidelines[3], projected storm water runoff and wastewater generation, and the required treated effluent quality. As agreed in the meeting between MoE and MPWT on 8 September 2020, the WWTP effluent quality shall comply with the *Public Water Area and Sewer* standard in Annex 2 of Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999.

78. An alternatives analysis for the wastewater and drainage pipeline system (separate verses combined systems) and wastewater treatment (including the potential for constructed wetlands) was conducted. A lagoon-based system is proposed for the wastewater treatment, as this represents the lowest life-cycle cost solution, is easy to maintain and will be able to comply with the applicable effluent standards.

79. Water demand and use determines the required WWTP capacity. The Commercial and Institutional Water Demand Projections are based on the application of 15% of the total domestic population for each Commune/Sangkat and adding to the total population in the calculation of sewage flows. This is in accordance with international norms and is a conservative projection of the future flows from these sources, taking into consideration the current and future growth in the commercial sector including hotels, guesthouses, restaurants, schools and institutions for each subproject city/town.

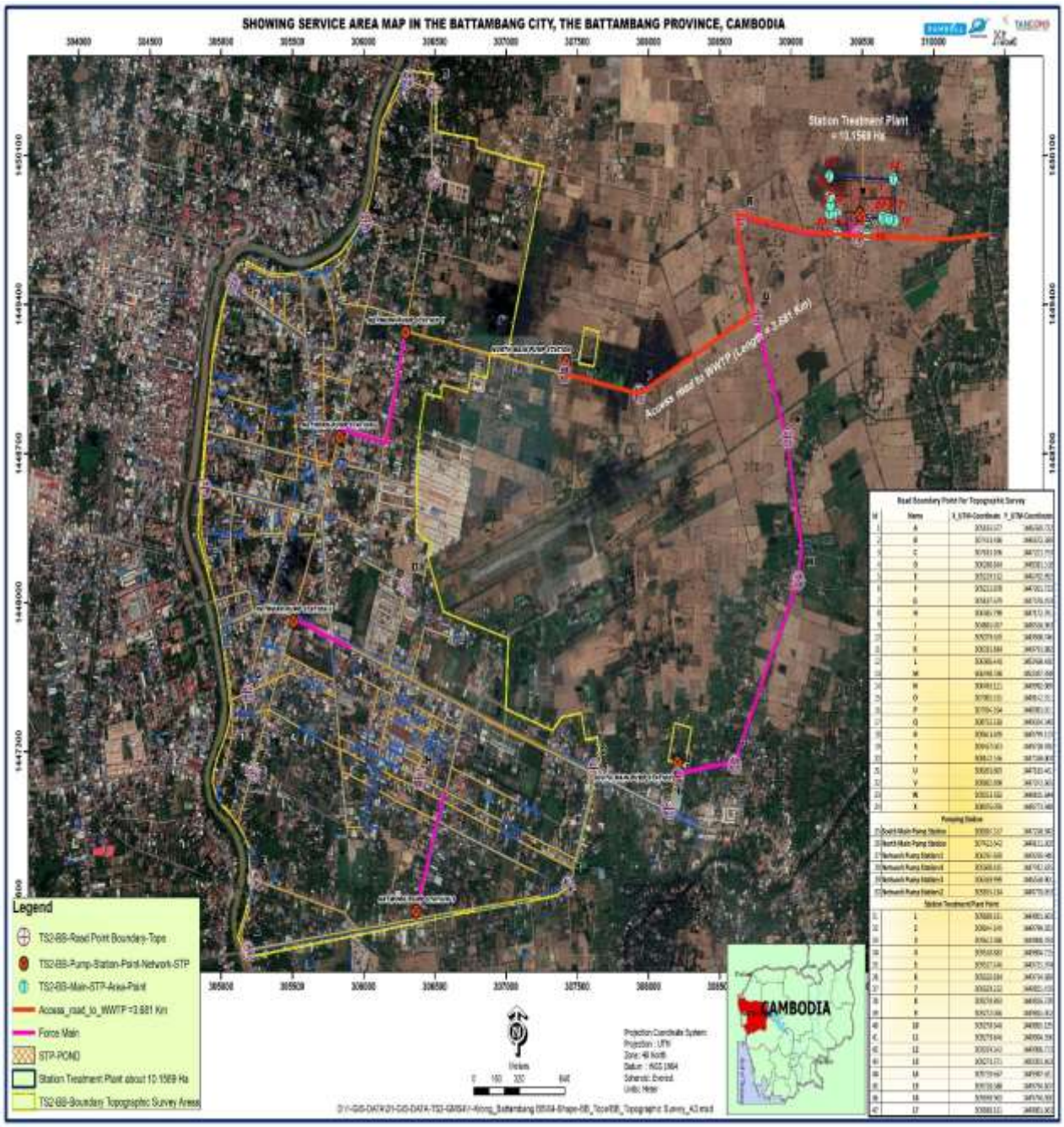
80. The WWTP will be located within a flat seven (7) hectare property acquired by the city government that is situated just outside the city in District of Sangkae (Figure 8). The site is currently an agricultural area used for rice cropping. The site can be accessed from the city center via a network of concrete and bitumen macadam roads until one reaches Street 601 which is an existing earth/laterite road. The existing access road will be upgraded and the elevation raised to 0.5 m above the maximum recorded flood level.

81. The WWTP site is located in proximity to the following infrastructure and sensitive resources:

- Sangke River is about 4-5 km to the west
- Battambang Town (Centre) is about 5-6 km to the south
- Norea Primary-Secondary School and Christian School is about 2 km
- Cultural resources (pagoda) is about 3-4 km to the south
- Provincial Road is about 3-4 km to the west
- National Road N.5 is about 5 km from WWTP site.

[3] International Finance Corporation 2007, *Environmental, Health, and Safety Guidelines for Water and Sanitation*, IFC, Washington DC.

Figure 8: Location of WWTP and Service Areas of Battambang Town



82. 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.

83. The WWTP comprises two (2) wastewater treatment trains. The treatment plant layout is shown in Figure 9 and the process flow diagram is presented in Figure 10. Train one (1) will treat 4,250 m^3/d when the house connections included in the project are completed. Train two (2) will be able to accommodate the future wastewater flows until design year 2040 with a full treatment capacity of 8,500 m^3/d.

84. The components and sizes of the main WWTP treatment units for are as follows:

- 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 36.8 m (width) and 51 m (length), each pond. The DED assumed the volume of sludge accumulated in an anaerobic pond will be 40 litres/per person/year.
- Two (2) Facultative Ponds in parallel with dimensions of 70.5 m (width) and 128 m (length), each pond;
- Two (2) Maturation Ponds in parallel with dimensions of 76.5 m (width) and 216 m (length), each pond;
- One (1) Sludge treatment/ drying pond - dimensions of 32 m (width) and 60 m (length)
- Administration and Other Buildings. A two (2) 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:
    - Reception and waiting area
    - Plant manager's office
    - General offices
    - Meeting room
    - Male and female toilets
    - Laboratory
    - Kitchen
    - Storage area
- Workshop Building. A single-story building provided for storing equipment and materials, an office as well an area for carrying-out minor repairs of equipment.
- 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 divert surface run-off away from the internal roads and other facilities.
- Access Gate, Perimeter Fencing and Lighting. An access gate fabricated from galvanised 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 galvanised iron pipe frame, affixed to galvanised iron posts 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. 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 sewage stream for treatment.

85. The technology is based on a pond system. Each step of treatment represents a progressively more advanced technology which leads to an enhanced pollutant removal efficiency and includes a mechanical screening followed by secondary biological/physical treatment processes and sludge management.

86. The screenings from the pre-treatment processes are generally disposed of to landfill. 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. Should the automatic screen stop working e.g. due to power outage, the flow will overflow into the bypass channel and be manually screened. A 6 mm screen will remove 25-45% of the Biochemical Oxygen Demand (BOD) and 25-40% of Total Suspended Solids (TSS).

87. Sewerage Secondary Treatment. A combination of anaerobic and facultative lagoons with maturation ponds for disinfection. The lagoon technology is a stable system that allows a high-quality effluent to be produced. Floating baffles will be applied in the facultative and maturation ponds to provide hydraulic mixing, reduce short circuiting and to increase the hydraulic retention time - thereby also reducing the necessary size of the ponds.

88. Sludge management. Two sludge decanting and drying lagoons will be constructed, to provide WWTP operations flexibility and to ensure availability of a sludge lagoon when treatment or drying is being performed in the other sludge lagoon. Sludge will periodically be extracted at approximately 4% solids content from the anaerobic pond using a mobile pump to the sludge lagoon where it will be settled, decanted and solar dried. The excess supernatant wastewater in the sludge treatment/drying lagoon will flow by gravity back to the WWTP inlet for treatment. During sludge settling, a supernatant layer will be maintained to prevent odours, except for the stabilized sludge drying phase. Dried sludge (min. 20-25% solids content) will be removed before the onset of the rainy season and disposed in the newly constructed engineered landfill, in accordance with MoE guidelines for sludge disposal. Anaerobic ponds require desludging when they are one third full of the sludge by volume. This occurs every 2−5 years, but it is operationally better to remove some sludge every year. Facultative ponds store any sludge for their design life.

89. The design parameters for each treatment step are summarized below with reference to the flow diagram in Figure 10.

Inlet screening – An automatic fine screen

Anaerobic ponds, A first stage for treatment of high strength wastewaters, including mixtures of industrial/domestic wastewaters and septage with high organic loading:

- Design loading: 340 g BOD/m^3 d
- Depth: 5 m
- Retention time: 1 day
- Volume of anaerobic pond: 2 x 4,250 = 8,500 m3
- 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:

- Design surface loading: 330.5 kg BOD/ha day
- Depth of facultative pond: 2.5-3.0 m
- Number of floating baffle walls: 2
- Number of treatment zones: 3
- Area of 2 facultative ponds at 2.5 m depth: approx. 1.5 Ha
- Retention Time: 4 days
- Percent removal for anaerobic and facultative ponds at 24 ^oC: 88%

Maturation ponds aerobic lagoons used as UV disinfection for bacteriological pollutant removal and tertiary or “effluent polishing” treatment:

- Influent faecal coliform concentration: 5 x107 MPN/100 mL
- Effluent faecal coliform concentration at 24 ^oC: ≤ 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
- Percent removal (total after treatment in all ponds) at 24 ^oC: ≥ 95%
- Surface area of 2 maturation ponds at 1.5 m depth: approx. 2.4 ha
- Effluent from maturation ponds: 8,240 m^3/d.

Sludge stabilization / drying ponds:

- Sludge application thickness: 3 to 4 m
- Sludge drying time: 4 to 6 weeks, depending on the weather conditions.
- Underdrains: 20 mm crushed stone

90. **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.

Figure 9: Wastewater Treatment Plant Layout Plan

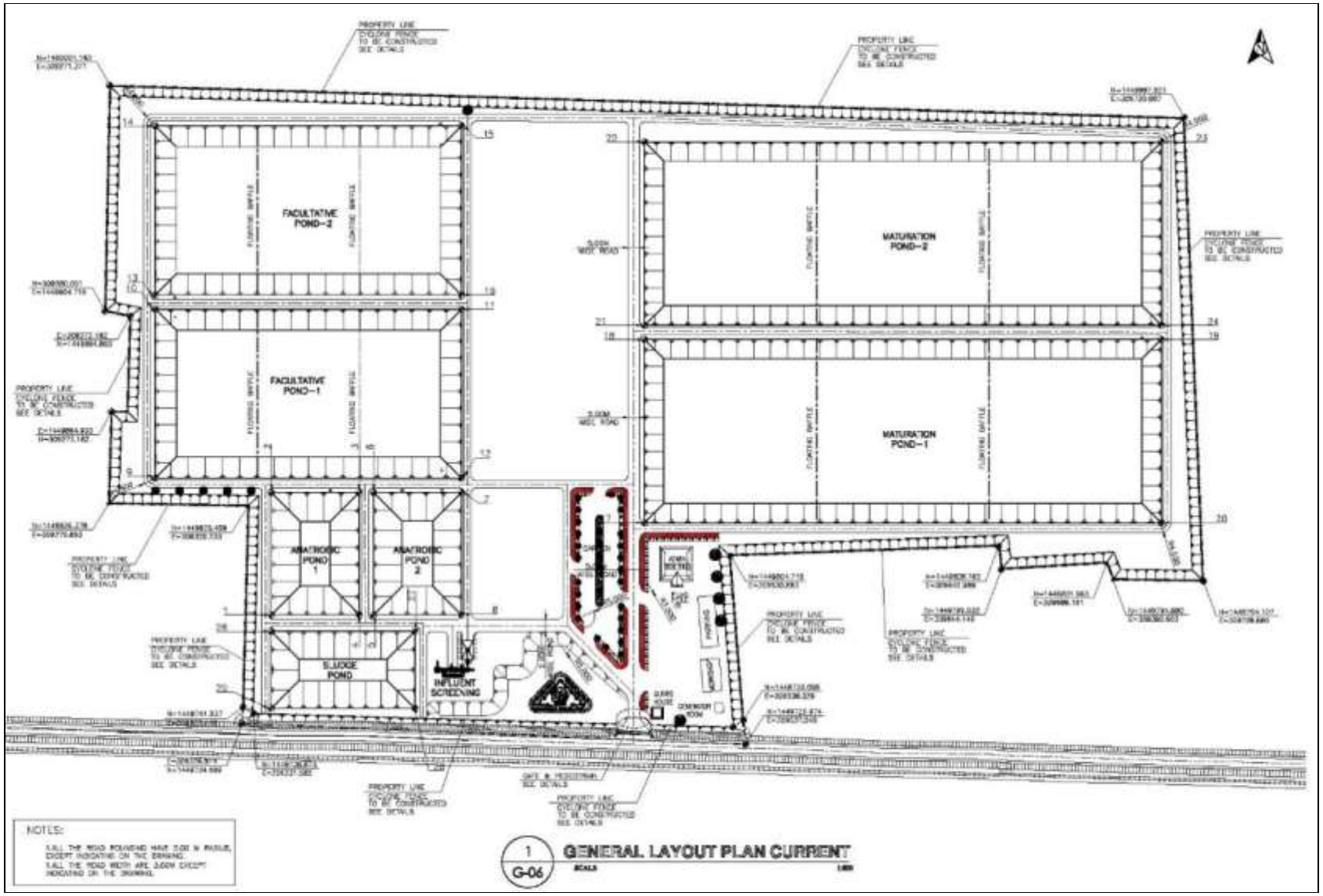
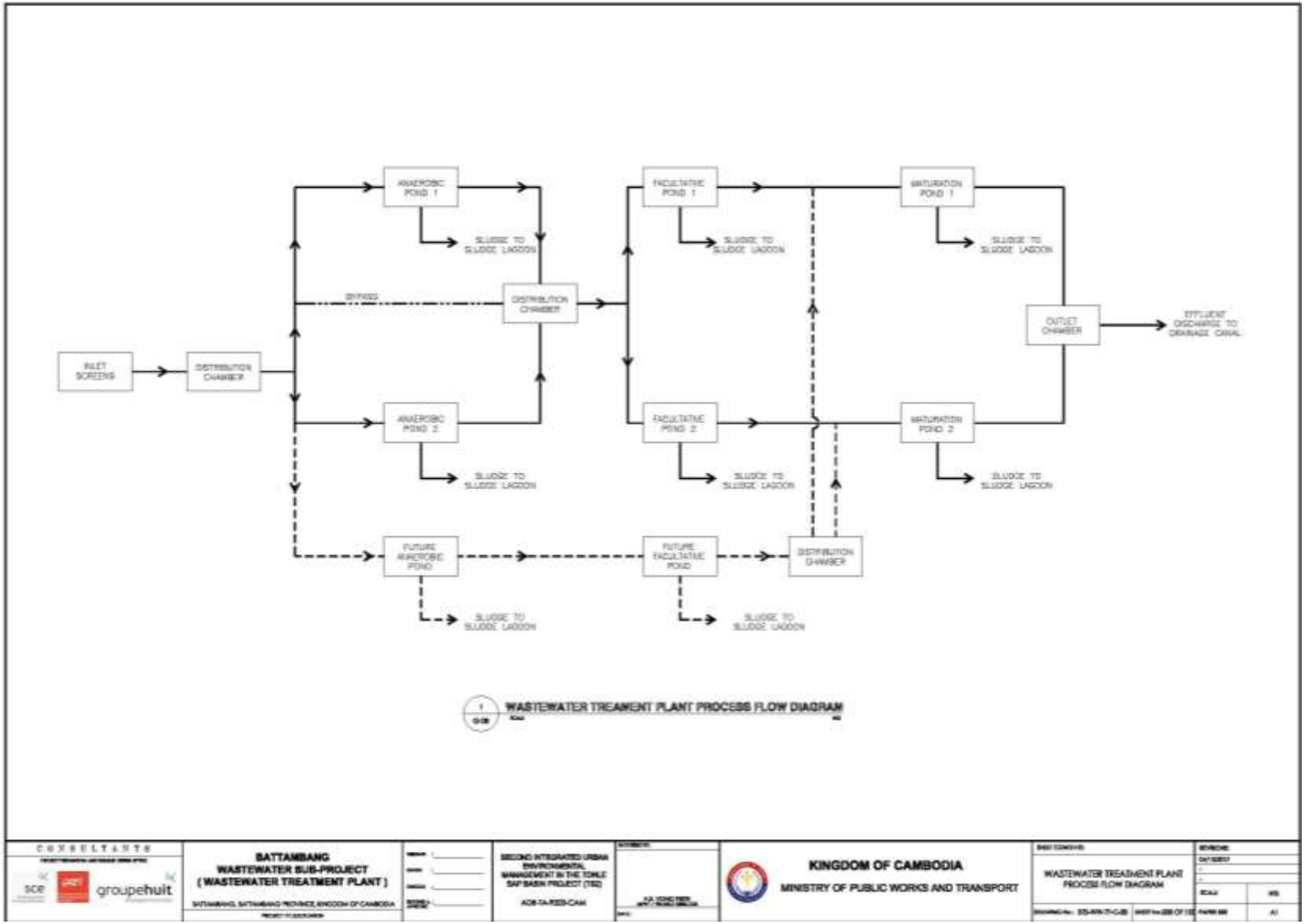


Figure 10: Wastewater Treatment Plant Process Flow Diagram



91. Effluent Management. The WWTP has been designed to consistently remove pollutants to reach the effluent standards in Table 8, as required under Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 and as confirmed by the Ministry of Environment in a letter to the Ministry of Public Works and Transport of 07 October 2020 (attached in Annex 1: Environmental Quality Standards).

Table 8: Wastewater Quality and Effluent Standards

Effluent Quality Parameter	Unit	Design Wastewater Characteristics[1/]		Effluent Discharge Standards
		Raw Influent	Treated Effluent	Cambodia[2/]
pH		6.5-7.5	6.5-7.5	5-9
BOD_5	mg/L	250	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[3/]	TBC	<15
Oil and grease	mg/L	TBC	TBC	<15
Total coliform	MPN/100 mL	$1x10^6 – 1x10^7$	1,000	-[4/]

Notes

1. Design wastewater characteristics have been assumed for design purposes in absence of actual data on the raw influent corresponding to medium strength domestic wastewater. Treated effluent characteristics calculated using well established treatment process performance criteria, the PC team's experience with similar plants and the assumed raw influent.
2. Adopted effluent discharge standards for Cambodia are those from Sub-decree 27 (1999), Annex 2, *Public Water Area and Sewer*, in accordance with guidance from MoE. The values are provided in Annex 1 to this report. 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.*
3. TBC: To be confirmed as it is highly local habits and culture dependent.
4. 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, 1999). The values are provided in Annex 1 to this report.

92. The BOD_5 and coliform removal rates used for the design are shown in Table 9

Table 9: 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

93. Effluent Discharge. The effluent will be discharged to the nearby small canal. The water flows from the canal to the O Monui stream which is connected to a network of irrigation ditches or canals. As indicated in Figure 11, the water flows north in O Monui Stream/irrigation ditches for about 12 km before it reaches the Sangke River (Battambang river). Both the small canal and O Monui normally only carry water after rain. Therefore, the receiving water body will be the Sangke River, where no impact is expected from WWTP operation due to the large dilution effect (average river flow is 3 m^3/s, WWTP effluent is 0,1 m^3/s, a dilution of 30 times will be achieved). Sangke river 10-year return period of drought flow is 0.97 m^3/s, while minimum average flow from the period 1997 – 2010 was 2.44 m^3/s[4]. Therefore, the dilution factor would be 9.7 times for the 10-year return period of drought, and 24.4 times for the minimum average flow.

Table 10: Surface water quality at Sangke River

N.	Parameter	Unit	(ii) Sangke River
1	pH	mg/l	7.3
2	Total Dissolved Solid (TDS)	mg/l	87.0
3	Total Suspended Solid (TSS)	mg/l	88.0
4	Dissolved Oxygen (DO)	mg/l	6.6
5	Biochemical Oxygen Demand (BOD_5)	mg/l	1.93
6	Chemical Oxygen Demand (COD)	mg/l	4.7
7	Oil and Grease	mg/l	9.47
8	Detergent	mg/l	-
9	Sulphate (SO_4)	mg/l	8.0
10	Total Nitrogen (TN)	mg/l	1.8
11	Total Phosphorus (TP)	mg/l	0.15
12	Lead (Pb)	mg/l	-
13	Arsenic (AS)	mg/l	0.002
14	Cadmium (Cd)	mg/l	-
15	Iron (Fe)	mg/l	15.68
16	Mercury (Hg)	mg/l	-
17	Cu		0.006
18	Ni		0.01
19	Zn		0.38
20	Phenol		-
21	Total Coliform	MPN/100ml	$1.1x10^3$

94. The outfall pipeline will be laid under a stretch of large rocks to provide additional aeration and coliform reduction, as well as erosion protection for the canal. As an added public safety measure the canal will be fenced off on both sides for a distance of 200 m downstream from the point of discharge and signs will be erected to warn the public not to enter the fenced off section of the canal.

[4] https://openjicareport.jica.go.jp/pdf/12111225_01.pdf

Figure 11: Flow path of the discharge to the Sangke River

4.5. Construction Methods

95. The construction period is 30 months. This takes into account the wet season from June to October.

96. The construction will be carried out by conventional construction methods, wherein no special equipment is required. The contractor is responsible for the detailed construction methodologies and for ensuring that all proposed works satisfy the technical specifications.

97. All excavations for sewers will be undertaken as open trench excavations; however, for deeper excavations, sheet piling with bracing may be required.

4.6. Associated & Existing Facilities

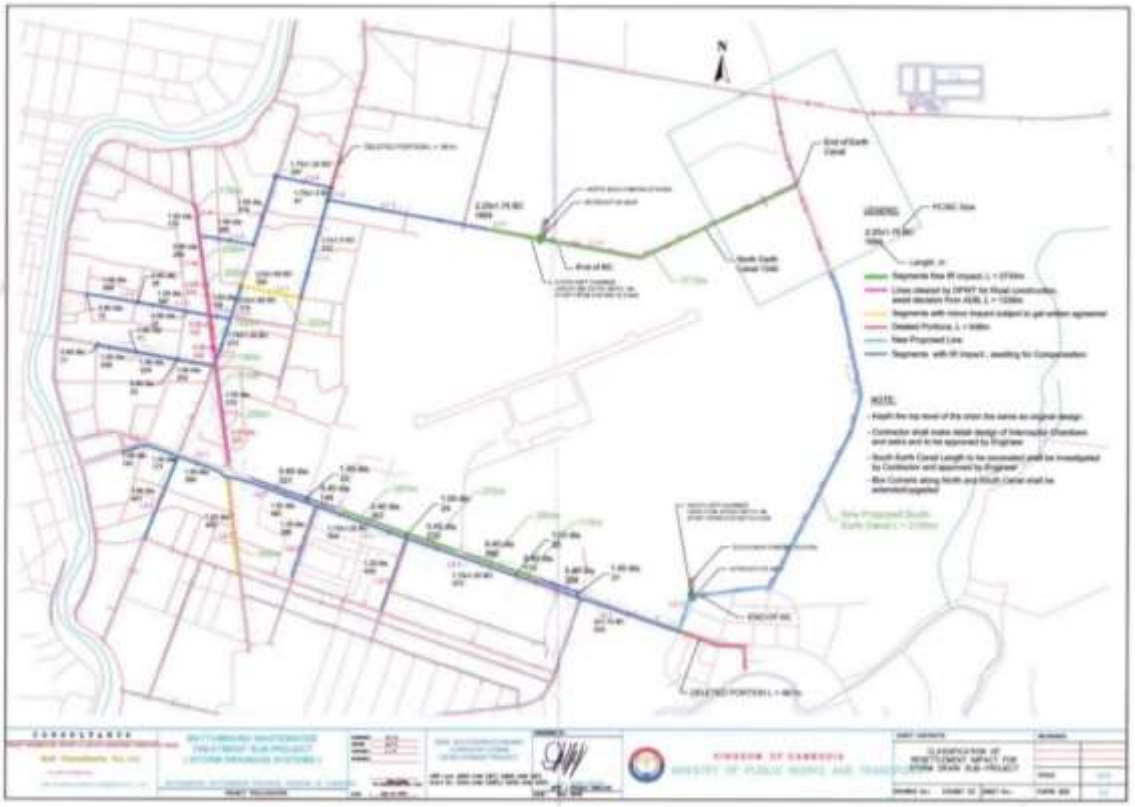
98. Associated Facilities. SPS 2009 defines associated facilities as “facilities that are not funded as part of a project but whose viability and existence depend exclusively on the project, or whose goods or services are essential for successful operation of the project. This project does not include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

99. 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.

100. Based on the CDIA 2010 study, around 70% of households in both sangkats Prek Preah Sdach and Rottanak have toilet facilities. Currently there is no sewer system in either of the two sangkats. Approximately 9% of the households have septic tanks. The remainder use pit latrines or other method of waste disposal.

101. The physical topography of Battambang is quite flat. Battambang had an old drainage system in poor condition. The antiquated drainage system was replaced by the GMS: SECTDP project (ADB) (Figure 12).

Figure 12: Drainage System Plan



4.7. Climate Change

102. Incorporation of a Program for Climate Resilience (PPCR) is an integral part of the TS2 Project. The PPCR will promote the mainstreaming of climate resilience in the Project. As originally envisioned for this project, the outcome is the safe, climate-resilient, cost-effective, all-year operational, flood proof, separated wastewater system with treatment plant in Battambang City.

103. Possible Impacts of Climate Change. Excerpts from the Strategic Program for Climate Resilience (SPCR), prepared for the PCCR, Royal Government of Cambodia, Asian Development Bank, 2011:

> *According to the latest technical assessment, Cambodia 's temperature has been rising steadily over the past 50 years. The average temperature has increased since 1960 by 0.8°C, and the frequency of unusually hot days and nights has increased. A further 0.3 to 0.6°C increase is expected by 2025, and some studies suggest temperatures may increase from 0.7°C to 2.7°C by the 2060s. All climate change models agree that average rainfall in Cambodia will increase, but the magnitude of change is uncertain. Estimates of the increase vary from as little as 3% to as much as 35% by the year 2100. Mean annual rainfall is predicted to increase, with the most significant increase in the wet season. In contrast, water flows in the dry season are predicted to decrease.*
>
> *The urban area of Battambang is undergoing a process of urbanization which is expected to accelerate with the increasing trade and traffic flows in the Tonle Sap basin. The inability of the carrying capacity of the present storm drainage systems coupled with future climatic events such as increased precipitation during the rainy season and possible occurrence of cloudbursts due to increased urban heat islands in these cities would cause sudden heavy rainfall which if not foreseen in the design and construction of urban infrastructures would lead to severe flooding in just a short*

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

104. The climate resilience measures of the proposed infrastructure investments under the Project are intended to address the above possible future events.

105. Incorporating Climate Resilience Measures in the Detailed Design DED. This Subproject supports climate resilience in Battambang through installation of sewer pipes that would reduce adverse impact of perennial flooding and contamination of the local environment. Adaptation to flooding caused by climate change for critical flood mitigation structures will in general be designed to accommodate a 50-year return period and adjusted with a Climate Change compensation due to expected increase in annual precipitation of 5%.

106. The factors considered in design adjustments include cost-effectiveness, current climate variability and potential future risk. A margin of safety risk as an additional 0.5 m height has been applied in the design of the structures above the projected design flood levels.

5. DESCRIPTION OF THE ENVIRONMENT

5.1. Project Area of Influence

107. All subproject 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.

108. 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 subproject areas.

109. 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.

110. 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 80 dBA at 15 m and concrete mixer 79 dBA at 15 m. Source: Construction Noise Handbook (www.fhwa.dot.gov), US Department of Transport.
- Noise attenuation factor: a conservative 6 dBA each time the distance from the point source is doubled. Source: US Occupational Safety and Health Administration (www.osha.gov/dts/osta/otm/new_noise/). Note that in soft vegetated environments such as in agricultural fields, the noise attenuation will be significantly increased meaning the area of influence could be narrowed. However, this would not be the case where vegetation is removed.
- Calculation: At 250 m the noise at a receptor is approximately 55 dBA (WHO limit).

111. See Annex 2: Field notes & Descriptions for photographs and site descriptions from field visits to all project sites and the areas of influence.

5.2. Baseline Receptor Summary

112. 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 11. The receptors and site facilities are also shown on map images in the EMP. The distances given are approximate based on a centre point for each proposed site. These receptors are explored in more detail in the following sections describing the environmental baseline conditions.

113. The proximity of the pumping stations to residences, businesses or public buildings is indicated on the satellite images inserted in Table 12[5]. As discussed in Para 190 and Para 191, with proper operation and maintenance, the pumping stations are unlikely to give rise to odour nuisances; however, as an extra precaution, the pumping stations will be made ready for installation of ventilation stacks with odour filters (for example carbon filter or biofilter), should that prove to be warranted.

114. In addition to these facility specific receptors, housing, businesses and affected people's requirement for access are considered to be receptors (Figure 14). These receptors are found, for example, at locations where any excavations for pipe networks associated with the WWTP subproject. This is considered in the EMP mitigation measures.

Table 11: Summary of Environmentally Sensitive Receptors.

City/Town	Subproject	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
BTB Town	Wastewater Treatment Plant	- About 4 km from Sangke River - About 1 km from O Kambot stream and 1.5 km from O Monui Stream	- About 2 km from Norea School and about 1.5 km Christian School - About 3-4km from cultural site and pagoda - About 4 km from provincial road and 5 km from NR nN.5 - About 6km from BTB town center.	Lowland wet rice fields	None
BTB Town	Sewer System	Within Battambang town. Discharge at WWTP	The subproject is in town, there are: houses, school, hospital, offices, markets, shops,	Town area	None

[5] The 20 and 30 m radius indicated on the maps in Table 12 are based on: Environment Protection Authority (2019), Sewage Pumping Station Environmental Guidelines, Environment Protection Authority, Hobart, Tasmania, October 2019

City/Town	Subproject	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
			and pagodas and local utility services along the roads.		
BTB Town	Pump Station (6 nos.)	Discharges to the WWTP	Housings close to the pump stations. Table 12	Town area	None
BTB Town	Treated Effluent Discharge Location	Nearby irrigation canal	Water from canal is for rice cultivation	Lowland wet rice fields	None

Table 12: Pump station indicative receptors (red 20 m, green 30 m)

PSI 1 houses < 20 m
1 houses < 30 m

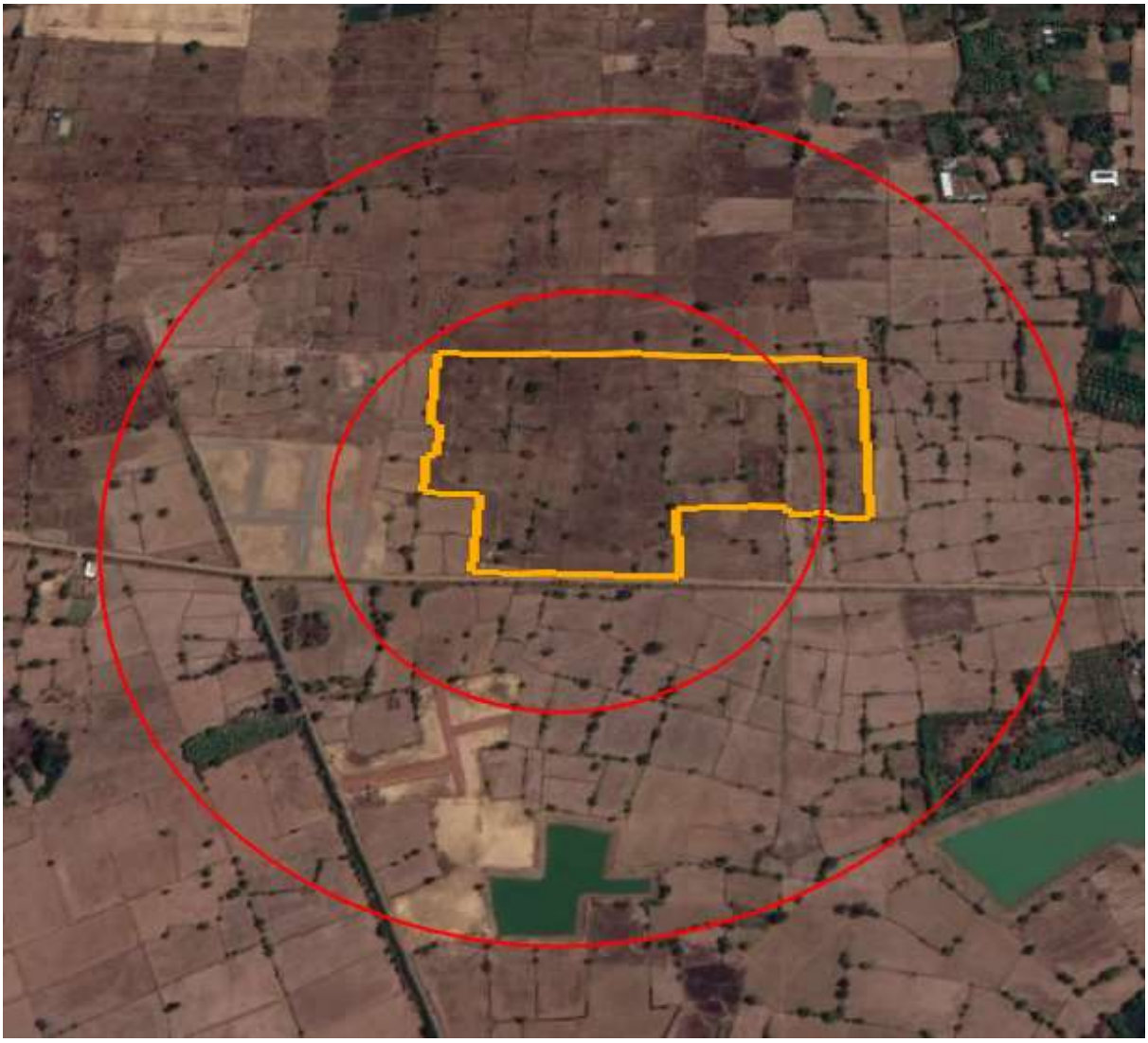
PS2 2 houses < 20 m
4 houses < 30 m

PS3 1 houses < 20 m
2 houses < 30 m

PS4 1 houses < 20 m
2 houses < 30 m

	
MPS1 0 houses < 20 m 1 houses < 30 m	**MPS2** 0 houses < 20 m 0 houses < 30 m

Figure 13: WWTP 250 and 500 m buffer zone



5.3. Geography, Geology, Topography

115. Battambang wastewater subproject is located in lowland of agricultural area and urban/town area within Tonle Sap Lake Basin (Figure 15 and Figure 16). The area is dominated by the Tonle Sap lake and this has affected the soil characteristics. Figure 15 shows that the subproject areas are dominated by alluvial soils and Battambang is in an area of brown hydromorphic soil which is associated with prolonged water saturation from groundwater and impeded drainage.

Figure 14: Environmentally Sensitive Receptors for Battambang Wastewater Subproject

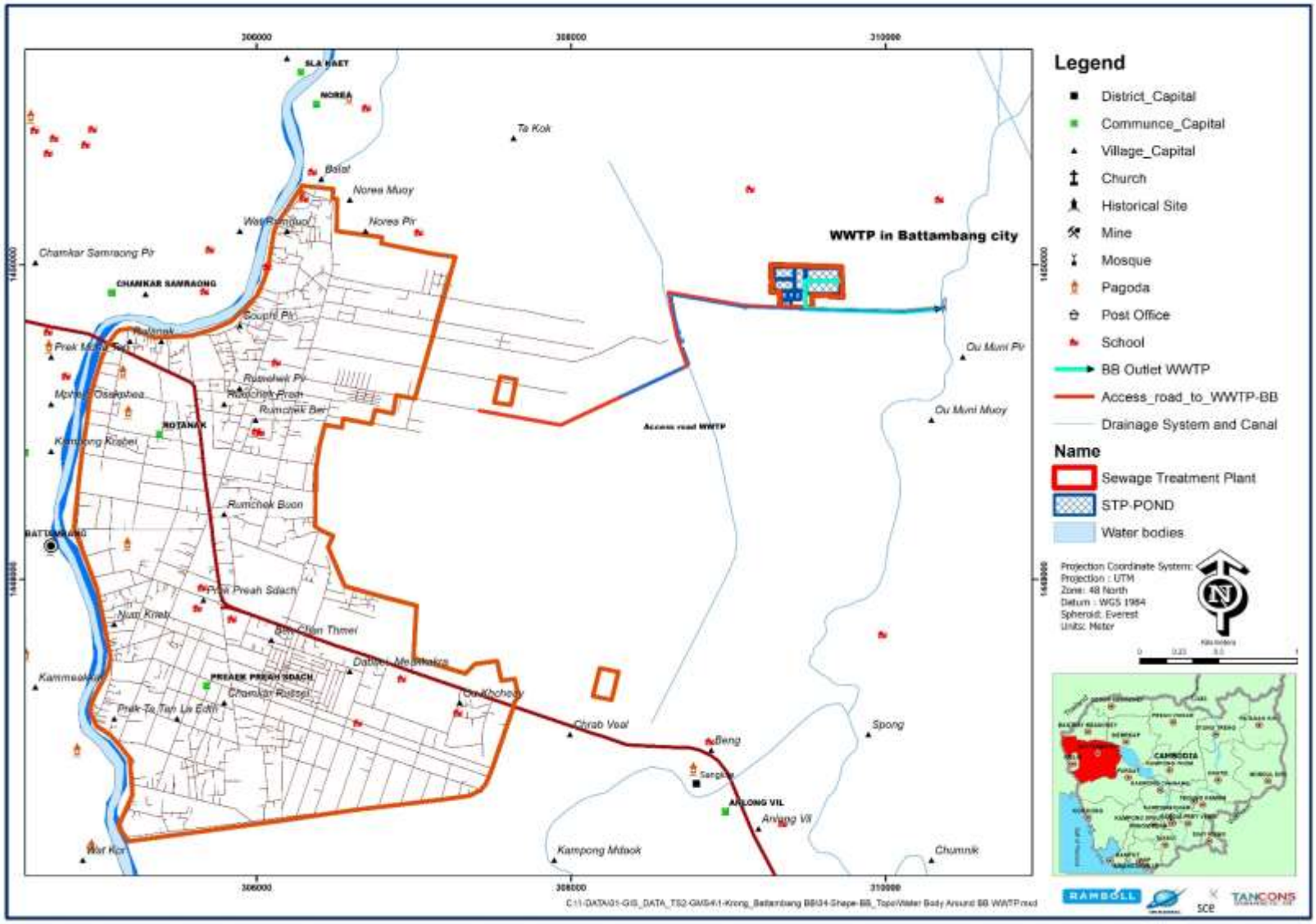


Figure 15: Soil Map of Tonle Sap Basin

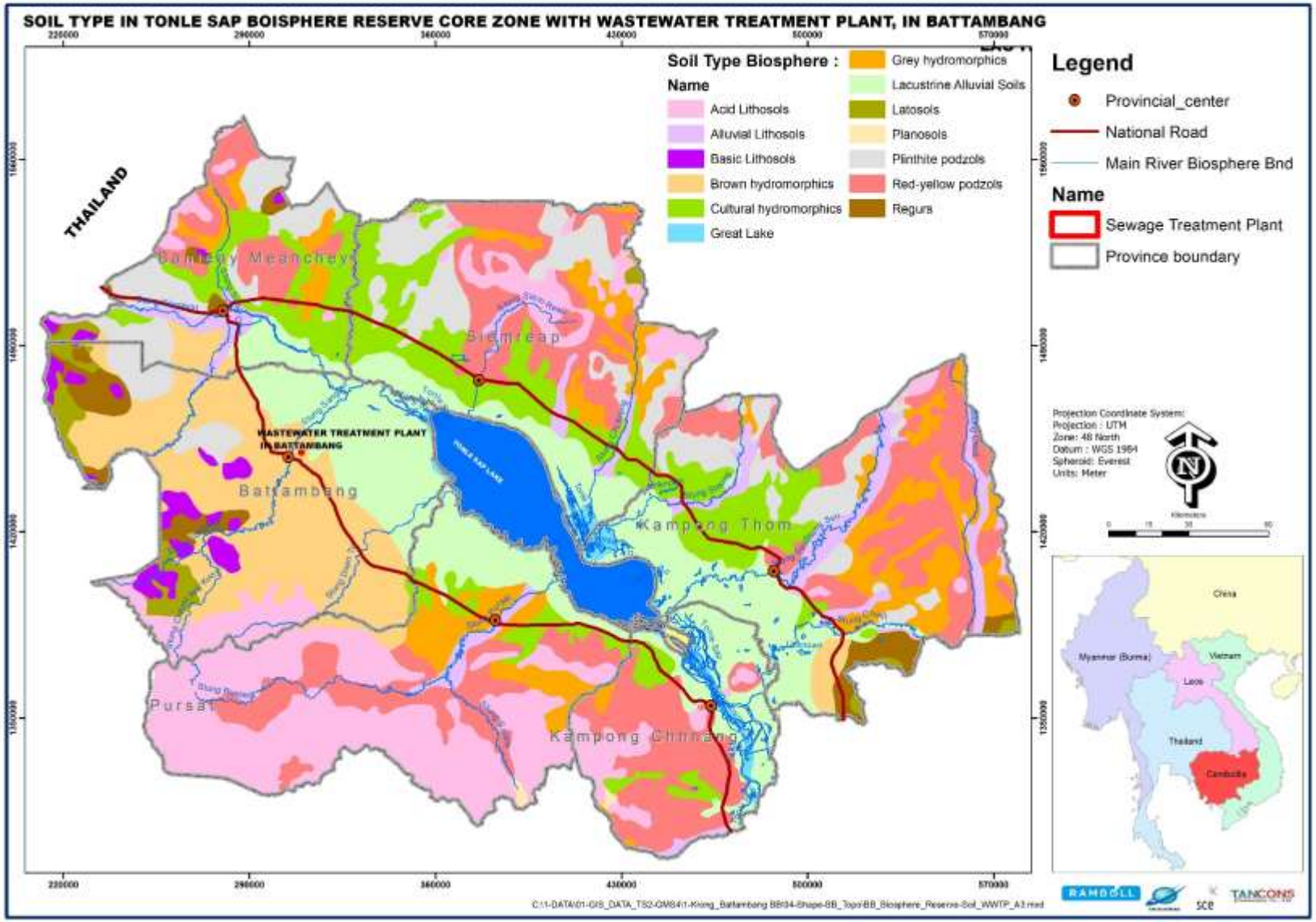
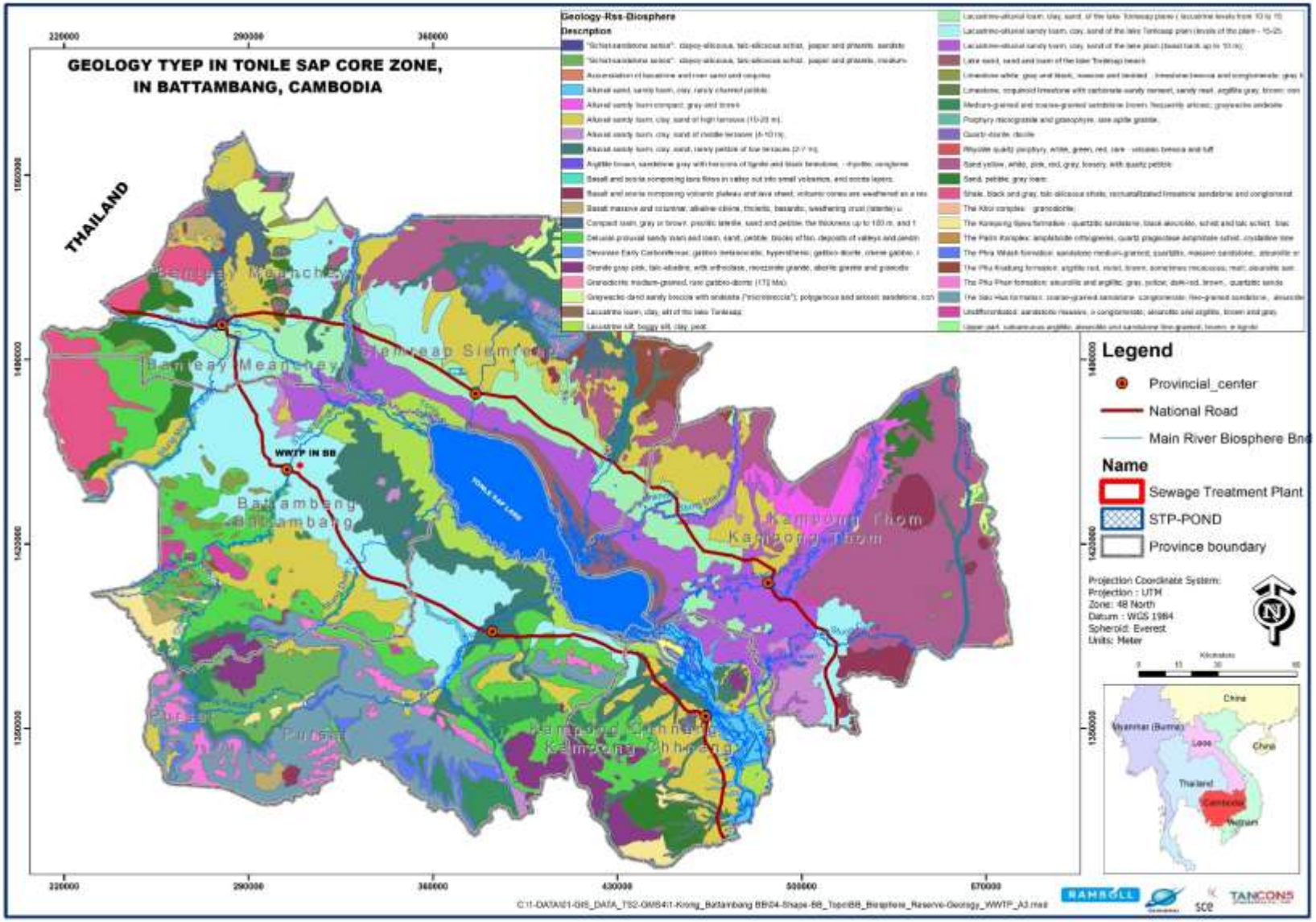


Figure 16: Geology Map of Tonle Sap Basin



116. The topography of the area is generally flat, forming part of the Tonle Sap floodplain area. As a result, the majority of the subproject is located in lowland and flat low-lying areas of urban provincial town around Tonle Sap Lake. Table 13 shows the soil quality in the WWTP site (X: 309288 - Y:14500141).

Table 13: Soil Quality in the 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	Electrode Conductivity	US/em	39.5
13	Moisture	%	1.72
14	Clay	%	36.20
15	Fine Sediment	%	21.75
16	Coarse Sediment	%	20.74
17	Fine Sand	%	18.76
18	Coarse Sand	%	1.85

Source: MAFF Laboratory for IESIA Report November, 2019

5.4. Meteorology and Climate Change

117. 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 (Table 14).

Table 14: Temperature in Battambang. 2014-2018

Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2014	14.5	18.4	23.7	21.8	23.7	24.7	24.2	24.2	23.5	22.9	21.7	17.5
2015	16.2	18.5	24.1	23.3	25.1	23.9	23.6	24.8	22.7	23.5	22.5	17.3
2016	13.9	13.5	20.0	18.4	23.4	23.5	23.9	24.0	23.0	23.0	21.5	18.3
2017	19.5	19.0	21.4	20.0	21.0	21.9	23.9	24.6	23.1	23.2	20.3	4.7
2018	16.8	15.5	21.1	19.4	23.0	24.5	23.8	24.0	22.5	23.0	21.0	20.5

Source: Meteorological Department, MOWRAM, 2018

118. Precipitation. Table 15 summarizes rainfall data for Battambang between 2014 to 2018.

Table 15: Rainfall Data in Battambang from 2014-2018 (mm)

	Month											
Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2014	0	0.4	2.4	84.1	46.9	66.2	190.8	146.6	88.2	208.7	40.4	6.7
2015	0.3	9.4	6.92	30.8	66.6	147.9	72.9	174.9	281.3	214.2	90.1	0
2016	11.7	1	1.2	17.4	115	100.4	157.6	95.9	197	177.2	65.2	14.6
2017	18.8	0.1	96.8	107.6	118.7	192.7	134.3	185.3	145	241.7	90.1	6.5
2018	8.5	3.2	96	88	157	108.7	155.3	125.5	204.3	126.1	19.7	26.7

Source: Meteorological Department, MOWRAM, 2018

119. Wind. Table 16 summarizes wind direction and speed in Battambang province form 2013 - 2017. The cooler drier season is characterized by winds from the South West, and the majority of winds are from the South – South West, bringing warmer air.

Table 16: The wind direction and wind speed data in Battambang Province from 2013-2017

Year / Month		Jan	Feb	Mar	Aril	May	June	July	Aug	Sept	Oct	Nov	Dec
2013	Wind direction	NE	E	S	SE	S	W	SW	SW	W/SE	N	N	N
	Wind speed	4	4	4	5	7	7	8	8	8	4	6	4
2014	Wind direction	NE	ESE	WSW	NW	SSW	WSW	SW	WSW	SW	NE/SW	NE	N
	Wind speed	4	6	4	5	5	5	6	6	6	7	5	4
2015	Wind direction	E	S	SW	SE	SW	SW	WSW	WSW	W	SSW	SW	NE
	Wind speed	6	5	4	5	7	5	6	5	6	4	4	5
2016	Wind direction	SE	SE	S	SSW	SW	SW	SW	SSW	WSW	SE	E	NE
	Wind speed	4.2	5.3	4.2	6	7	6.2	5.1	8	5.1	8	5	9
2017	Wind direction	ENE	E	NE	NE	SSW	SW	SSW	SSW	W	WSW	NE	E
	Wind speed	5	4	3	6	8	10	12	9	13	10	4	5

Source: Meteorological Department, MOWRAM, 2018. Note**:** N: North S: South E: East W: West Climate Change Projections.

120. 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 subproject is during operation. The 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 WWTP. 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.

121. Table 17 shows the impacts from climate change on the subproject as identified by the CRVA. These issues are managed through design mitigation measures where appropriate.

Table 17: 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 sewage 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.

122. 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 rain will increase a little by 2030 but could increase over 20% by 2070. The CRVA concludes that under Representative Concentration Pathway (RCP) 6.0 with regards to changes in future precipitation:

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

5.5. Hydrology, Surface and Ground Water

123. The Sangke River is a main river and water sources in Battambang Town. The River crosses the town and is about 4 km west of from the WWTP site. The local people use water from Sangke River for irrigation, and any social purposes. The water quality is not routinely monitored by MoE. The O Kambot and O Monui streams are located 1 km and 1.5 km form WWTP site, these streams only carry water during the rainy season (Figure 17). The farmers use water from these streams for supplementary wet rice crops and vegetable crops during the rainy season. The quality of water sampled from O Kambot and O Monui streams following rain are shown in Table 18.

124. The WWTP effluent will discharge to the canal next to it (Figure 14), which flows to O Monui and then to Sangke River. Therefore, the receiving body of water (in dry periods) will normally be the Sangke River, where no impact is expected from WWTP operation due to the large dilution effect. Following rain events or during flooding, WWTP effluent will join the flowing O Monui stream where it will be diluted before joining the Sangke River, and being further diluted. No eutrophication is expected due to the short residence time in O Monui prior to dilution in the Sangke River. The ambient quality of O Monui water, and O Kambot was tested during the IESIA study (O Kambot is small stream north of the WWTP which connects with O

Monui). Water quality in both streams was tested as a requirement of the IESIA and the results are included in Table 18.

Table 18: Surface Water Quality O Kambot and O Monui

N.	Parameter	Unit	Standards[1]	Result O Kambot	Result O Monui
1	pH	mg/l	6.5 - 8.5	7.40	7.16
2	Total Dissolved Solid (TDS)	mg/l	-	49.00	21.00
3	Total Suspended Solid (TSS)	mg/l	25 - 100	29.00	15.00
4	Dissolved Oxygen (DO)	mg/l	2 - 7.5	5.20	6.60
5	Biochemical Oxygen Demand (BOD_5)	mg/l	1 - 10	2.80	1.40
6	Chemical Oxygen Demand (COD)	mg/l	-	7.84	3.92
7	Oil and Grease	mg/l	-	6.95	4.27
8	Detergent	mg/l	-	0.02	ND
9	Sulphate (SO_4)	mg/l	-	4.99	0.72
10	Total Nitrogen (TN)[2]	mg/l	-	1.88	1.02
11	Total Phosphorus (TP)[2]	mg/l	-	0.28	0.13
12	Lead (Pb)	mg/l	< 0.01	0.003	0.0003
13	Arsenic (AS)	mg/l	< 0.01	0.002	0.001
14	Cadmium (Cd)	mg/l	< 0.001	ND	ND
15	Iron (Fe)	mg/l	-	1.33	0.28
16	Mercury (Hg)	mg/l	< 0.0005	0.0003	0.0002
17	Total Coliform Bacteria	MPN/100ml	< 5000	$2.1x10^3$	$1.4x10^3$

Source: MoE for IESIA report, November 2019

- Surface water quality in O Kambot Stream (X: 309966, Y: 1450644)
- Surface water quality in O Monui Stream (X: 310094, Y:1449118)

[1] Sub-decree 27 (1999), Ambient Water Quality Standard, Annex 4: Public water areas for bio-diversity conservation (Rivers), and for metals from Annex 5: Water Quality Standard in public water areas for public health protection

Figure 17: O Monui Stream during dry season (April 2020)

125. Groundwater. Based on field visits and discussions with local authorities and local people, local people use water from Provincial Water Supply Authority for household consumption, some of them use water from river and canals for irrigation. The field observation did not find water wells located in or near the WWTP site.

126. The soil strata at the WWTP site encountered by the geotechnical investigations[6] consists of 11 m of clay. Groundwater was detected at greater depths during drilling and

[6] Es International Consultants Co., Ltd. (Esicons), Survey Report, The Soil Investigation, The Second Integrated Urban Environmental Management in Tonle Sap Lake in the Kingdom of Cambodia, ADB, June 2018

stabilized a few hours after completion of the drillings at 0.5 m – 0.8 m below ground. This confirms low permeability in the clay layer.

5.6. Air Quality

127. Results of field visits indicate that air quality in the subproject site is still good, as the project areas are located in rural area without significant industrial/commercial zones to cause air quality degradation. Typically, in Cambodia, outside Phnom Penh or town centres there are few industrial pollution sources and the volume of vehicular traffic is low. Table 19 shows the existing air quality data in WWTP site conducted by MoE laboratory.

Table 19: Air Quality data in Battambang WWTP site

No	Parameter	Unit	National Standards	Result
1	Carbon Monoxide (CO)	mg/m^3	20 (8 hours)	0.12
2	Nitrogen Dioxide (NO2)	mg/m^3	0.1 (24 hours)	0.010
3	Sulphur Dioxide (SO2)	mg/m^3	0.3 (24 hours)	0.005
4	O_3	mg/m^3	0.5	0.06
5	Total Suspended Particles (TSP)	mg/m^3	0.33 (24 hours)	0.068
6	(Pb)	mg/m^3	0.005	ND
7	Methane (CH_4)	mg/m^3	-	ND
8	PM 10	mg/m^3	0.05	0.021
9	PM 2.5	mg/m^3	0.025	0.009

Sources: MoE Laboratory for IESIA report, SBK January 2020.

5.7. Noise

128. Field visits and observation indicate that noise levels in the WWTP site are not significant, due to project area is located in rural area without industrial/commercial noise sources (Table 20). The sewer system network of the subproject is in urban area which are subject to noise level primarily from traffic volume.

Table 20: Noise Level on WWTP site (X:309292 and Y:1449786).

Period	Survey time	Noise Level dB(A)			Standards dB(A)
		LAeq	LAmax	LAmin	
Day	6:00 - 7:00	51.6	68.6	35.5	70
	7:00 - 8:00	44.5	62.9	35.7	
	8:00 - 9:00	41.5	53.4	35.4	
	9:00 - 10:00	38.3	47.0	36.5	
	10:00 - 11:00	40.2	57.9	37.0	
	11:00 - 12:00	38.8	43.7	35.3	
	12:00 - 13:00	40.0	49.3	34.7	
	13:00 - 14:00	40.7	52.1	35.4	
	14:00 - 15:00	42.4	56.9	38.1	
	15:00 - 16:00	42.3	55.5	36.0	
	16:00 - 17:00	42.7	55.0	35.2	
	17:00 - 18:00	42.2	55.4	36.3	
Evening	18:00 - 19:00	43.5	56.3	35.2	65
	19:00 - 20:00	44.1	59.4	34.8	
	20:00 - 21:00	41.8	59.7	35.9	
	21:00 - 22:00	42.4	52.1	37.4	
Night	22:00 - 23:00	36.5	55.8	27.5	
	23:00 - 00:00	38.5	58.7	27.9	
	00:00 - 1:00	38.4	46.9	29.9	
	1:00 - 2:00	36.2	48.8	25.5	

Period	Survey time	Noise Level dB(A)			Standards dB(A)
		LAeq	LAmax	LAmin	
	2:00 - 3:00	40.9	52.3	35.0	50
	3:00 - 4:00	41.2	51.5	35.8	
	4:00 - 5:00	42.7	53.5	37.2	
	5:00 - 6:00	43.3	52.6	35.4	
The Average in 24 hours		**14.4**	**54.4**	**35.5**	

Source: MoE Laboratory and IESIA report, SBK, January 2020

5.8. Natural Disasters

129. 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.

130. Table 21 presents the existing data of the Natural Disasters occurring between 2012-2014 in provinces of TS2 Project and shows that the largest impact on the population around the Tonle Sap, in the project area, is flooding. Also, of note is the increase in drought affected households in 2013 and 2014 for the cities of Serei Saophoan and Steung Saen but not Battambnag. 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 21: Natural Disasters 2012-2014

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

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

5.9. Physical Cultural Resources

131. The WWTP site is located in rural area and it is surrounded by rice fields. Battambang town centre is located 6 km from the WWTP site. Cultural resources are located more than 1.5 km from the WWTP site (Table 11). Within Battambang town there are number of places of worship, in particular pagodas. The sewer system are in RoW of the road, where there might exist few pagodas. Temporary impacts to these cultural resources (e.g. accessibility) will only occur during construction. Impacts and mitigations measure have been addressed in section 6.

5.10. Special or Protected Areas

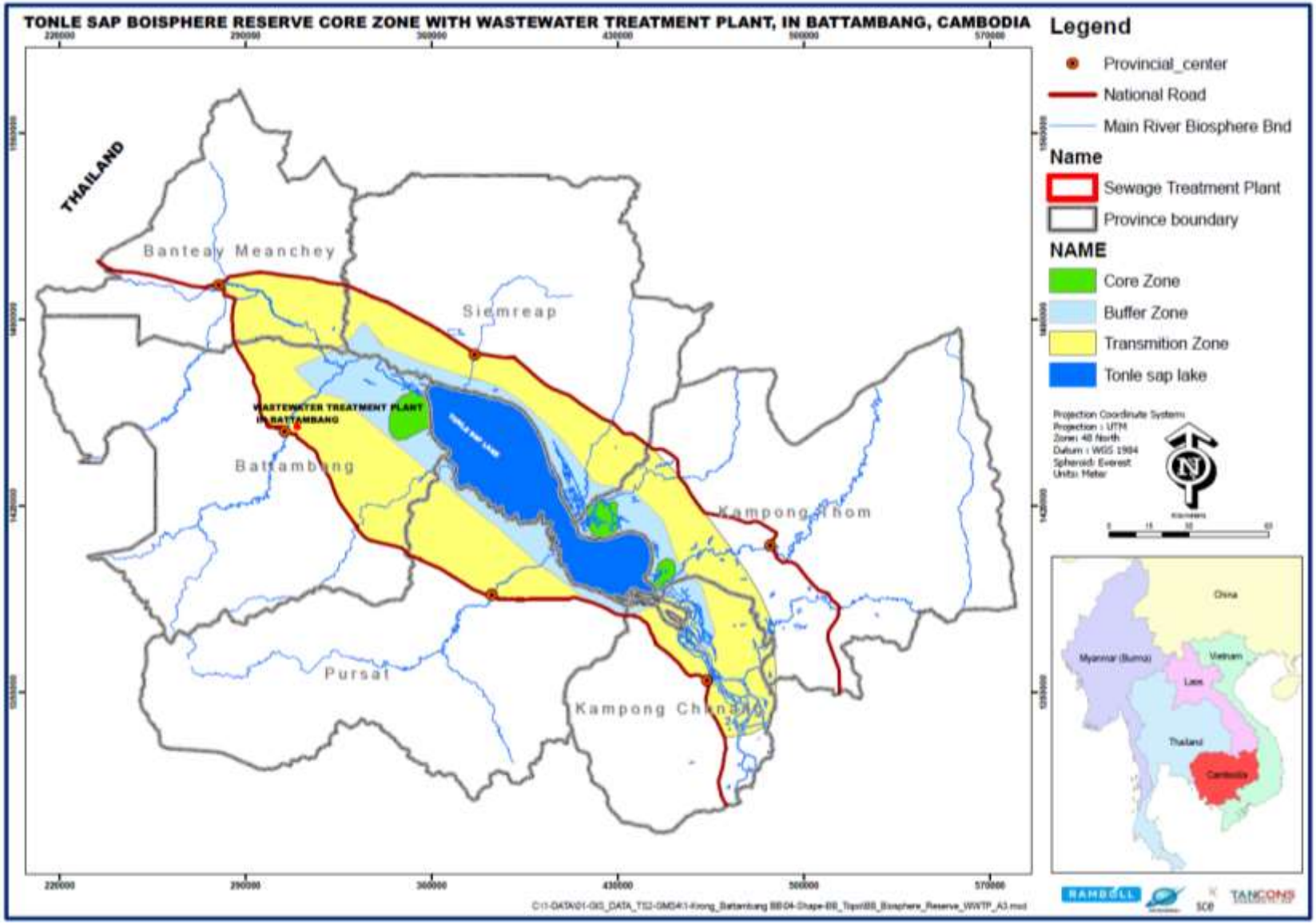
132. There are 23 Protected Areas in Cambodia, the nearest to the project site is the Tonle Sap Biosphere Reserve (TSBR) which is located in Kampong Chhnang, Pursat, Battambang, Siem Reap, Banteay Meanchey, and Kampong Thom provinces. The TSBR is classified as a

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 is Battambang province, approximately 40 km in the downstream part from Battambang Town.

133. 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 18.

134. The WWTP will be located in the transition zone of TSBR where some physical infrastructure and development are allowed with approval of the IESIA (Annex 6). Compliance with the conditions set out in approved IESIA/IEE report, implementation of the EMP (mitigation and monitoring) will prevent and minimize impacts.

Figure 18: Tonle Sap Biosphere Reserve (TSBR)



5.11. Ecological Resources

135. Flora. Biodiversity screening of the project sites using IBAT (Annex 8) was carried out during the PPTA (). The project area does not contain any protected areas or habitats of particular biodiversity value. This subproject 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.

136. 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. IESIA team conducted further consulting and investigations on fish resources, which are detailed in Annex 5.

137. 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 by the project. As with fish species, the initial CDIA IEE preparation team undertook consultation with people resident in all the subproject areas in 2016 to identify actual bird species which are observed by local people. The people interviewed identified between 29 species of birds observed in their locality, with the majority being seen in Steung Saen. Table 22 lists the species noted for Steung 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 Battambang city.

Table 22: Locally observed bird species, Steung 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

No	Khmer Name	English Name	Scientific Name	IUCN Status
16	Popich Thmar	Blue Rock Thrush	*Monticola solitarius*	LC
17	Popoul Teuk	Masked Finfoot	*Heliopais Personata*	Endangered
18	Preap	Not known	Not known	
19	Pro Vek	Lesser Whisling Duck	*Dendrocygna Javanica*	LC
20	Raneal	Not known	Not known	
21	Sa Rikakeo	Common Myna	*Acridotheres Tristis*	LC
22	Sek Kheav	Not known	Not known	
23	Stang	Black-shouldered Kite	*Elanus coeruleus*	No Data
24	Tea Prey	Garganey	*Anas querquedula*	LC
25	Tituy	Not known	Not known	
26	Toum	Purple Swamphen	*Porphyrio porphyrio*	LC
27	Tro Cheakkam	Barn Swallow	*Hirundo rustica*	LC
28	Trodok	Not known	Not known	
29	Tung Propes	Spot-billed Pelican	*Pelecanus philippensis*	NT
Key: LC = Least Concern, NT = Near Threatened, No Data = taxon has not yet been assessed for the IUCN Red List				

Source: Adapted from CDIA, IEE, 2016 survey.

5.12. Socio-Economic Conditions

138. Socio-economic data were obtained from Commune/sangkat discussions with the PPTA team. The WWTP site is located in Anlong Vill commune, Sangke District and the sewer systems is located in Rottanak and Prek Preah Sdach Commune, Battambang Town. Table 23 presents a summary of the socio-economic situation in the subproject areas and shows the number of affected communes on which these data are based. Table 24 presents the population in subproject areas.

Table 23: Socio-Economic Data

Project City	No. Commune	Total Population	No. Female Headed HH	Khmer Islam Pop.	Vietnamese Pop.	Poor Level 1 HH*	Poor Level 2 HH*	% Poor (1+2)
Battambang	10	150,312	5603	4005	305	2502	4255	22%

Source: - Ministry of Interior classification HH= Household

139. Socio-Economic Survey. Survey of 1478 respondents was undertaken during this DDPP. A full analysis of the results from the survey is provided in Volume 4 of the Feasibility Study report. Few key points relevant to environmental safeguards are summarized and combined for all provinces:

- Electricity / Infrastructure. 97% of households are connected to the electricity grid.
- Sanitation. 63% of respondents have access to a latrine or WC/Bathroom, outside their house. 11% 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%). 93% of latrines are pour flush.
- Sewage. 5% 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%). 9% of the sewage goes to water bodies including canals, rivers, streams or ponds.

- Waste Collection. 55% of respondents are aware of a waste collection service in their areas, the remainder do not have the service offered. Of those who have a service available, 36% use it. 92% of respondents have waste materials which they do not throw away. Of this, 99% of respondents sell recyclables to door to door collectors.

Table 24: Population of communes and villages in Subproject areas

No	Commune	Village	Total family	Female	Total population
	Battambang Town				
1	Rottanak				
		Rumchek-1	360	1,160	2,517
		Rumchek-2	200	620	1,303
		Rumchek-3	290	802	1,505
		Rumchek-4	790	2,241	4,345
		Rumchek-5	227	626	1,238
		Sophy-1	300	807	1,613
		Sophy-2	360	791	1,552
		Rottanak	460	1,239	2,403
			2,987	**8,286**	**16,476**
2	Prek Preah Sdach				
		Prek Preah Sdach	281	810	1,372
		Prek Taloun	230	638	1,115
		13 Makara	749	2,122	4,012
		O Kcheay	320	1,034	1,987
		Lar Eath	246	739	1,460
		Nom Kream	171	369	741
		Bek Chann	301	897	1,741
		Chamkarussey	328	467	1,826
			2,626	**7,476**	**14,254**
	Samgke District				
3	Anlong Vil				
		Chrap Veal	336	701	1,350
		Beng	362	1,212	2,173
			698	**1,913**	**3,523**

Source: Commune Data Book 2018.

140. Water Users. The Socio-Economic survey identified that 57% of households are connected to a piped water supply, of which 63% are connected to the public water supply and the remainder to a private connection. The responses showed that in the dry season, for those who are not connected to a piped water supply, some of the respondents use water from ponds and lakes.

6. ANTICIPATED IMPACTS AND MITIGATION MEASURES

6.1. Project Environmental Benefits

141. The project is designed and anticipated to have significant localized environmental benefits. Field visits show that the current environment is being contaminated with sewage and the growing pressures on the urban areas means that this is likely to continue.

142. The development of well-engineered wastewater treatment facilities mean that the pollution of the environment will be reduced and therefore the risks to human health and water quality, will be less.

143. 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

144. 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 groundwater).

145. Where an impact may occur, if there is no receptor to potentially receive the impact, then mitigating actions will not require. This follows the source-pathway-receptor model, whereby in order 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

146. 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)[7]; 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.

[7] 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.

(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 coordinating and reporting on GRM. The PIUs/PMU will issue public notices to inform the public within the project area of influence of the GRM contact information (GRM website address, PIU/PMU address and telephone number, PIU/PMU contact point email address) and local entry points (e.g. contractors and country-system via Grievance Redress Committee.

(iii) Updating the IEE and EMP: Mitigation measures defined in this IEE and the associated EMPs have been updated based on final technical 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.

(iv) EMP in bidding document. The subproject specific EMP was 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 for landfill sites. The potential sites in this IEE were discussed in detail in terms of suitability in the Feasibility Study Report Volume 2 – Engineering Design.

(vii) Environmental Quality. Baseline surveys have been undertaken to inform the detailed design and domestic IESIA including water analysis of receiving waters for WWTP effluent and water bodies of subproject sites.

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

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

6.4. Environmental Impact and Mitigation Measures during Construction

147. **Impedance of traffic.** Pipe placing will involve impedance to traffic, including access to individual properties. The input is temporary and will be mitigated by requiring the contractor to:

(i) Provide notices to the public advising of timing and duration of construction work and the effects on traffic routes during construction;
(ii) Place "safety first" traffic signs and warning signs,
(iii) Identify and mark detours when necessary;

(iv) Arrange temporary traffic signals;
(v) Liaise regularly with traffic police;
(vi) Clearly demarcate construction sites and fence-off excavations; and
(vii) To the extent practicable, schedule work that blocks roadways to periods of low traffic.

148. **Air Quality.** Moderate temporary and localized air quality impacts during the construction stage of the project are anticipated due to fugitive dust generation associated with construction works (breaking of surfaces, loading and unloading), earth works and vehicle/equipment movement. The receptors for lower air quality are businesses and residents within the local area particularly downwind of the construction activities.

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

(i) Asphalt and 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 for construction sites, material handling areas, borrow pits, construction sites (road section), bypass roads - where fugitive dust may be 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 sewage and drainage pipe works will be notified adequately 1 month in advance of works starting.
(vi) Enforce a speed limit of 20 km/h at all construction sites.

150. **Noise.** Noise impacts will be temporary and localized at all construction sites from operation of construction equipment and vehicle movement. 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 the project, no receptors other than construction workers will be this close to the machinery for extended periods of time.

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

(i) Maintain all exhaust systems in good working order; undertake regular equipment maintenance in accordance with the manufacturer's instructions;
(ii) Restrict construction activities using heavy machinery work between 8 am-6 pm. In any case, the constructor shall be collaborated with local authorities and affected people to select proper working hours for mitigate the noise impact (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 pagoda worship. 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, if necessary provide fencing construction zones.

152. **Flora and Fauna.** The baseline indicates that impacts on terrestrial flora and fauna will be negligible because the subproject is in highly disturbed environments, including monoculture rice paddies. There are few mature trees likely to be impacted upon by the construction sites.

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

(i) All trees over 3 m in construction sites or access areas to be protected from construction activities if they are not required to be removed. The cutting trees shall be informed and permitted from DPWT and local authority;
(ii) Where possible, material from existing licensed borrow and quarry sites will be used. If new sites are needed, they will be subject to due diligence and approval by ADB and the relevant PDoE to ensure that sensitive habitats are avoided and that an appropriate restoration plan using native species is agreed following re-contouring.

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

155. **Surface Water.** Construction will take place in areas which have a network of canals. These canals normally carry water during the rainy season. Short term construction impacts may be seen in terms of increased turbidity when access roads improvement or other construction is taking place adjacent to the canals.

156. 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 for construction sites to manage and control the flow and direction of surface water runoff.
(iii) Installation or building the dikes or dams around the WWTP site to protect run-off and big flood flows in and out of WWTP.
(iv) Maintenance of 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 licensed dumping site.
(vi) Regularly conduct surface water quality monitoring in canal/streams near the WWTP site.

157. 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.

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

(i) No washing or repair of machinery within 50m of surface waters including irrigation canals.
(ii) Pit latrines (for worker camps if required) to be located at least 200m from surface waters, and in areas of suitable soil profiles and above the groundwater levels.

159. **Groundwater.** It is not anticipated that groundwater quality will be affected by construction activities. Construction and hazardous wastes have to be properly managed (collection, store, and disposal) to avoid un-sanitation or waste disposal in public areas.

160. **Soil and Land.** Soil erosion is not anticipated given the nature of the subproject and their flat locations, however borrow sites will cause local impacts to the land. The subproject is 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.

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

(i) Site specific spoil and borrow site management plan will be developed and approved by the relevant Municipal authority;
   a. Excavated areas are rapidly refilled on completion of works.
   b. Stabilize soils once the pipeline is in place.
   c. Place silt fences around temporary piles of excavated material.
   d. Avoid excavation of trenches in wet weather to the extent practicable.

(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.

162. **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.

163. Potential impacts from waste generation will be mitigated through the following measures as defined in the Solid and Liquid Waste Management is 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 house-keeping 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 contract license sub-contractor to dispose in local license dumping site.

(vi) Prohibit burning of waste at all times and illegal disposal areas;

(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.

164. **Community and Occupational Health and Safety.** Construction sites and access roads 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, excavation, trench work, earth moving, and use of chemicals. This can be inflicting diseases or HIV-AIDs from workers to workers, and to local people. The sewer and drainage construction activities will affect local business and decrease their income. Due to COVID-19 pandemic, workers and staff at constructing site can be infected by the virus, then some prevention and mitigation measures need to be applied. Contractor will prepare standard operation plans and comply with applicable government regulations and guidelines on COVID-19.

165. Potential impacts on community health and safety will be mitigated through the following measures as defined in the Community and Occupational H&S and emergency response plan set out in the EMP:

(i) Nomination of 'Contractor focal point' for GRM, complaints register and complaints form.
(ii) Appropriate protective barriers, fencing, lighting, and buffer zones which will be provided around all construction sites, at excavations and trenches, including barriers where needed on access roads and populated areas.
(iii) Measures to safeguard vulnerable structures close by due to vibration / differential settlement from deep excavation works.
(iv) Use of sheet piling with bracing for deep excavations.
(v) Safety measures, if required, to prevent access by members of the public and livestock to any borrow site excavations
(vi) Warning signs which 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.
(vii) Signage and speed controls if public roads are to be affected by construction traffic.
(viii) Sufficient signage giving community dangers/warnings and information disclosure outside all construction sites, include example warnings.

166. Potential impacts on occupational health and safety will be mitigated through the following measures as defined in the Community and Occupational H&S and emergency response plan set out in the EMP:

(i) Nomination of 'Contractor focal point' for GRM, complaints register and complaints form.
(ii) All workers are equipped with- and use PPE.
(iii) Specifications for the PPE to be used on site and the contractor's approach to enforcement of its use by workers.
(iv) Use sufficient signage giving occupational H&S warnings and information disclosure within all construction sites – sub-plan to include example warnings.
(v) The contractor should conduct pipe laying in a manner that has minimum impact on the health, safety and convenience of businesses, residences and users of the street area. This includes the following:
    a. Minimize the period of time that a segment of excavation is kept open by not allowing trenching to outpace pipe-laying by more than a day or so. Trenches should be backfilled, and ground levelled after installation of piping.
    b. Place only bedding and pipe materials at the location that will be used within the next few days work, well out of the line of traffic. Clean up and remove from the site any excess spoil, wood used for shoring and construction materials upon completion of the segment. Compact soil in trench and clean surrounding pavement areas to reduce blowing dust.

c. Provide temporary bridging across the trench at entries to residences and businesses. Otherwise, provide tape barriers to reduce the possibility of an accident.
d. Once work is complete on a segment, pavement surfaces and masonry works (curbs, abutments, stairs, drains, drives, etc.) should be repaired and returned to original condition.

(vi) The construction approach should minimize the time that any one segment is under construction or roadway/walkway left un-repaired to reduce the construction impact, done by limiting the length of open trench to 100 m or less.
(vii) The contractor should avoid trenching where damage might occur to buildings and provide shoring and backfill with sand/cement admixture to prevent caving.
(viii) Specify measures for protection of excavation and trenches through sloping, shoring, shielding, and Larssen sheet piles; trench access and egress; trench inspection procedures after rainstorm and at start of shift; storage of heavy equipment and surcharge loads kept away from trench edges.
(ix) Provide worker education and awareness seminars for construction hazards. A construction site safety program will be developed and distributed to workers.
(x) Conduct daily toolbox meetings (safety briefings)
(xi) Provide periodic training on working in confined spaces;
(xii) Log book of job safety environmental analyses (prior to entry to confined space)
(xiii) Details of the site accident record book which will be maintained where all major or minor accidents and incidents are recorded with actions taken.
(xiv) An environment, H&S qualified engineer will be engaged for the contract and adequate first aid equipment made available on site.
(xv) 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
(xvi) Provision will be made for safety precautions when using mains electric power tools if the workers are likely to be working within wet or flooded environments.
(xvii) The contractor will set out an Emergency Response Plan and develop emergency response procedures prior to construction as detailed in the EMP.

167. **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) labor force is used.

168. Potential impacts on the community and environment from work camps and external labor supplies 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 given to use of local labor and retain evidence of how local labor recruitment efforts were undertaken.

169. **Socio-Economic Impacts** (**accessibility**). The installation of sewage pipes will require the excavation of parts of the road network. This is 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 businesses. 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. Temporary impacts will be responsibility of the construction contractor.

170. 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) Adequate traffic management to ensure routes for vehicles are not blocked and signage is provided to reduce speeds and show drivers in advance of any changes to road surface or traffic direction
(iii) Adequate pedestrian and vehicular access to enter buildings and properties across any open trenches ensured, particularly commercial premises during open hours.
(iv) Contractor to open trench equivalent to one-day's work at any one the time and cover the trenches at night for safety so as to provide access to properties.
(v) Temporary restoring/rebuilding impacted assets or moving shops and stalls between construction contractor, HHs and PIU
(vi) Select suitable working hours in urban areas or sensitive sites. Open access road for entry for businesses sites. Remove out the unsuitable soil and materials from construction sites which are remaining in front of houses and shops,
(vii) Restoration or compensation of any damage at expense of contractor.
(viii) Consideration and management of potential localized flood impacts.
(ix) A Chance Find Procedures will be implemented as necessary.

6.5. Environmental Impact and Mitigation Measures during Operation

171. The largest risks posed to the environment by the subproject is during the operation phase. This is particularly the case for the operation of the WWTP and pump stations. These types of facilities can cause environmental pollution if they are not managed and maintained effectively. Such pollution can include long term risks to surface and ground water quality from WWTP effluent.

172. The management, 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.

173. The EMP for Battambang Wastewater subproject includes capacity building and awareness raising on the management of environmental risks during operations.

174. The budget for site development has allowed for provision of sanitation facilities, potable water supply, PPE, training and support on health and registration of waste pickers to prevent unauthorized access. This is further defined in the resettlement plan for the project.

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

176. Surface Water.

177. The effluent from the WWTP will be discharged to an existing constructed canal next to it, which flows east to O Monui stream (Figure 14). O Monui stream flows to Sangke River through flat agricultural land and serves as a source of irrigation for farms and houses located along the stream (see Figure 11). According to information from local people, the canal and O Monui only have flowing water during the rainy season. During the dry season, O Monui has pools of stagnant water and sections that are dried-up (see Figure 17 & Figure 19). Local people also informed that the stream flows north which also matches terrain elevations on Google Earth images, but the precise flow path(s) will depend on the level of water in O Monui.

Figure 19 Pictures of O Monui in the Wet and Dry Season

	
O Monui stream in the dry season (IESIA 2020)	O Monui stream in the wet season (IESIA 2020)

178. The WWTP is designed to comply with the applicable effluent standards and when properly operated and maintained, the treated effluent is not expected to generate any significant water quality problems for the ambient water quality in the final recipient, the Sangke River. Simple mass balance calculations based on the mean minimum stream flow recorded in the Sangke River from 1997 to 2010 of 2.44 m^3/s and the design treatment capacity of 8,500 m^3/d or approx. 0.1 m^3/s (see also Para 93) indicate that the resulting concentrations of key water quality parameters in Sangke 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 25.

Table 25 Sample Mass Balance Calculation of total suspended solids concentration in Sangke River after mixing with the WWTP effluent

Parameter	Unit	Value
Effluent discharge	m^3/s	0.10
Effluent discharge concentration	g/m^3	40.0
Effluent discharge mass per second	g/s	4.00
Flow in Sangke River	m^3/s	2.44
Upstream concentration in Sangke River[8]	g/m^3	20.00
Upstream load per second in Sangke River	g/s	48.80
Sangke River concentration after complete mixing	g/m^3	20.8

[8] Although Table 10 indicates much higher TSS levels in the river, TSS levels are likely to vary considerably, so in this calculation a low TSS concentration is assumed

Parameter	Unit	Value
Downstream concentration in Sangke River after complete mixing	mg/L	20.8
Calculated difference in downstream concentration	mg/L	0.8

179. The O Monui stream, which receives the treated wastewater runs dry during the dry season. There is no detailed information available about the duration, timing or frequency of such dry periods, but based on accounts of local people and the Consultant's own observations, it is likely that there are prolonged periods with dry stream bed intermittent with pools of stagnant water. When the WWTP starts operating this will change and during the otherwise dry periods, the discharge from the WWTP will provide a constant flow of water in the stream. The travel time in the dry season for the water from the point of discharge into O Monui down to the confluence with Sangke River is estimated to be roughly 0.5 to 1.5 days (calculated based on a stream length of 12 km, assumed cross-section of between 0.5 m^2 and 1 m^2 and a flow rate of 0.1 m^3/s). Although there will be some breakdown of BOD, this indicates that there is not enough time for significant breakdown of BOD in O Monui and there is also not enough time for significant algae growth in the stream. However, there are uncertainties associated with these estimations and it will be necessary to closely monitor the performance of the treatment processes and the water quality in the recipients.

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

181. 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). This elevation will not impact on the drainage due to rainwater will flow to the 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 (Figure 14). Thus, surface runoff movement will not be impeded nor exacerbate flooding of the area.

182. Potential mitigation measures will include:

(i) The final design of the WWTP ensures that the applicable effluent standards are met (Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 Annex 2, for public water area and sewer).
(ii) Design includes appropriately sized sludge drying facilities. Issue of reuse/disposal of dried biosolids will be confirmed before plant commissioning.
(iii) An operation and maintenance manual for the plant will be developed prior to commissioning. The manual will provide clear methods and procedures for all aspects of the operation and maintenance of the WWTP including the following key issues[9]:

[9] The Contractor may refer the applicable WB Group EHS Guidelines for WWTP operation, which are available at: www.ifc.org/ehsguidelines

- Preventive maintenance
- Sampling and testing
- Data understanding and interpretation
- Corrective actions
- Algae management
- Sludge management including pond removal, treatment, disposal and emergency situations
- Emergency procedures including schedule for testing and upgrading procedures
- Procedures for storing, transporting and disposing of solid waste generated by the operations

(iv) Commissioning phase of WWTP to ensure design discharge standards can be met.

(v) Discharge to be sampled and tested at the point of discharge into the environment. Monitoring and reporting on the quality of the receiving water for effluent discharge from 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.

(vi) Provision of adequate budget for operation and maintenance to ensure regular effluent and surface water quality monitoring.

(vii) Meeting required operating standards to ensure effluents are treated effectively prior to discharge;

(viii) Regularly monitor the sewage system structures and provide maintenance or corrective actions.

(ix) Ensure the operational and maintenance plan for each facility includes an emergency response plan considering flooding.

(x) 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.

183. **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 pipes tightly jointed by fusion welded joints[10], and the pumping stations will be constructed with water-tight concrete structures. At the WWTP, the pond sides and bottoms will be constructed with a stone pitching over well-compacted soil – except for the facultative ponds which will be equipped with a HDPE liner over well-compacted soil. Normally, waste stabilization ponds eventually seal themselves[11]and considering the use of well compacted clay on top of at least 11 m of intact clay (see Para 126) 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[12].

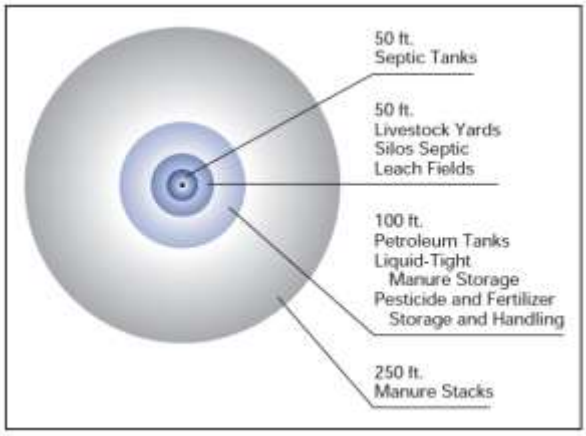
[10] Fusion welding is a process that uses heat to join or fuse two or more materials by heating them to melting point.

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

[12] 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.

184. The safe distances between water wells and pollution sources recommended by the USEPA[13] are displayed in Figure 20. 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.

Figure 20: Safe distances between water wells and pollution sources



185. **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 stations 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.

186. **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 sewage, 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[14], and considering that typical sulphate concentrations in domestic wastewater is less than 100 mg/L nuisance odours from the anaerobic ponds are not likely.

187. 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, and proper operation and maintenance of the facility will further reduce generation of odours from handling of septage (see Para 191).

188. Furthermore, the WWTP will be in an open paddy field area with a buffer of about 500 m to the nearest houses - including the nearest houses in the dominating downwind direction.

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

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

[14] 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

190. **Odour, pumping stations**. At the two Main Pumping Stations there are no houses within a 20 m radius, but at the four network pumping stations, there are 1-2 houses within a 20 m radius (see Para 113 and Para 114). However, with proper operation and maintenance and considering that the cycle time of the pumps is less than 30 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.

191. Potential mitigation measures of odour will include:

(i) Regular monitoring and maintenance the operation of WWTP, culvert system, and pumping stations. In case of not compliance, the operator will apply the following mitigation measures:
   i. Conduct an odour audit to identify operational measures that can prevent and mitigate odour problems.
   ii. Landscaping with trees and shrubs around the facility shall be done to position them as wind breaks.

(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) Washing wheels of vehicles before they leave site if they are muddy from accessing sites to prevent dust increasing to nearby houses;

(v) Provide tree plantings (tree screen) and green place inside and around the WWTP site to reduce dust and odours;

(vi) The sludge loading trucks to be covered; and

(vii) Provision of adequate budget for O&M

(viii) 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.

(ix) 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 or biofilters) will be added.

(x) Use quick-disconnect fittings between pumper truck and receiving station to minimize exposure of septage to the atmosphere.

(xi) Wash-down facilities to clean up any spills, with drainage into the holding tank.

(xii) Avoid free fall of septage by extending receiving pipes below the water surface.

(xiii) Introduce septage at slow controlled rates to avoid turbulence or agitation.

(xiv) Ventilate the air from the tank to an odour biofilter.

(xv) Clean tanks, trucks and equipment daily.

192. **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 emergency generators in case of power outage. The generators will be installed in separate buildings with adequate noise attenuating provisions to meet all exterior noise level requirements.

193. 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 and about 1000 m from the nearest community, any occasional noisy activities are unlikely to cause any significant impacts.

194. **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 risk attributable to the operation of the system should be negligible.

195. The contractor 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).

196. **Agricultural Yield.** While treated effluent discharges will have a benefit during the dry season as the nutrient-rich water will be available to nearby farmers for irrigation, adverse impact on farmers could arise if the effluent quality drops below the discharge standards. Effluent used for crop irrigation may not be appropriate for all crops (Annex 7). 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

197. 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 centres, which are currently lagging behind the capital region in particular.

198. Evidence from field work shows that the current stage of wastewater treatment and waste management in the project cities/towns of TS2 project, including this subproject, is lacking, and that the situation is leading to environmental risks and reducing the sustainability of the cities. In order for the cities to become more 'liveable' and improve their urban environmental situation, the project with the 'do nothing' alternative would lead to an increasingly lower quality urban environment for the residents of the Tonle Sap region.

7.2. Wastewater Treatment Design and Technology Alternatives

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

200. 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.

(a) 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 will 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.

(b) 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 under-drains component of Option 1 Pond.

(c) 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 sewage flow then transferred to the anaerobic ponds for further treatment as part of the WWTP waste stream.

(d) 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.

(e) 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 sewer system will be developed in the central key areas of the subproject cities.

(f) 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 sewage contaminated wastewater offered by a separate system is preferred.

8. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

8.1. Public Consultations during Project Preparation

201. 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 subproject outline designs.

202. CDIA Preparation Phase. During the preparation of the first IEE and EMPs for the subproject, consultation took place within each subproject area. An outline of the consultation meetings held is provided in Table 26. 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 subprojects to be welcomed for the positive benefits they will bring, however concerns were raised regarding impacts during implementation, arising primarily from construction.

Table 26: 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
PDoE PDPWT PDWRAM PDLMUP PDoP	Provincial Department of Environment Provincial Department of Public work and Transportation Provincial Department of Water Resources and Minerals Provincial Department of Land Management and Urban Planning Provincial Department of Planning		

203. 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.

204. Household socio-economic surveys were undertaken for this project in January 2018 and included a number of questions relevant to environmental and social safeguards. The respondent views are summarized in Table 27. Where appropriate, corresponding mitigation measures are included in the EMP.

Table 27: 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	-

Household Question	Response	EMP Response
	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), rain water (92 responses). 3 responses were also 'canal' as an alternative water source.	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
If you are not connected to pipe water supply, what is your main water sources during WET season? Rank 2 responses	509 responses confirmed rainwater to a water source. The remainder being own drilled well (275) responses, own open well (125 responses), water seller (51 responses), bottled water (66 responses) pond/lake (68 responses), own pond (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 odor control.	Mitigation measures and budget for house improvements included for houses close to landfill sites.

205. 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:

- Present to the stakeholders and affected people the sites for subprojects in the provincial towns and inform them of the project activities;

- Understand the main issues that may occur in the proposed subproject areas, as raised by local people;
- Understand the potential social and environmental resources located/used in the subproject sites;
- Receiving issues, feedback, and comments from stakeholders or affected people regarding social, gender and environmental issues/resources in the proposed sites; and
- Receiving comments and suggestions for mitigation measures to improve adverse impacts from project design, construction, and operation stages.

206. Inclusion of Affected People's Views. The mitigation measures in the EMPs for this project reflect the result of the consultations during IEE preparation. The results of the consultation discussions are summarized the following in Table 28. Where appropriate, a response to the comment or concern is signposted in the EMP.

Table 28: Consultation FGD in Battambang Town

Consultation in Prek Preah Sdach Commune, BTB Town (Landfill and WWTP Subproject)	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response
Waste: - In our commune the solid waste and waste water are the major problems (i) waste collector (CINTRI Company) can't collect from all the households and the waste truck comes is about 1week/time. (ii) some areas are small access roads, waste truck cannot access them (iii) lack involvement from communities, a few households do not pay for waste collection fee, so they dump their waste instead	Project will improve waste management with institutional/tariff improvements
Wastewater - Waste water is a problem too caused by very old culverts without maintenance. Some villages do not have culverts and have seasonal flooding due to run-off and wastewater.	Project WWTP and network improvements will support this
- This project is important for our commune as same as for BTB Town to manage our environment and sanitation, we support to this project, because BTB Town is developing.	None required
- The people use Town Water Supply for households, and use pond water for crops, farming, and washing 20%) - There are no sensitive ecological resources in this area – it is an urban village area. Some people they plant vegetable and irrigate with pond water.	None required – project will not impact on water supply
Waste: - Awareness on Environmental waste management and promote public involvement. - Increase the number of waste truck 2-3 time/week - Provide small truck or cart for waste collection - All the families agree to pay for solid waste collection service, if service is good.	None required
- Enforcement environmental waste laws, the penalty should be implemented	Included in Awareness Raising Campaign, defined in proposed TA Package
Consultation in Rotanak Commune, BTB Town (Landfill and WWTP Subproject)	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response
We support this project for improvement our environment and sanitation as well as run-off (flooding) and waste management in BTB Town.	None required
- The key problem is wastewater and waste: (i) the drainage system is poor and causes flooding. Old and not maintained. (ii) Solid waste –	None required

many problems with CINTRI e.g. Limited capacity and equipment (collecting only on main roads (1 time/week) and small roads are in accessible (Rumchak1, 2, and 3 Village). A few houses do not want to pay for waste collection fee.	
All the people in Rottanak Commune use water from Town Water Supply for households use	None required
There are no sensitive impacts of improving landfill and WWTP, because Rottanak Commune is located in the Town area, far from project locations. But can be impacts can occur from truck transport of waste (without covering trucks may drop waste or wastewater)	Mitigation measures request waste (operation) and construction materials to be covered during transport
- This project will benefit for our commune for wastewater and solid waste management.	None required
- Please provide suitable and enough drainage/culverts for wastewater in BTB Town. Increase the capacity and equipment of waste collection company.	Designed for population predictions and climate change predictions
Awareness of waste laws and enforcement is lacking	Included in Awareness Raising Campaign, defined in proposed TA Package
Consultation in Norea Commune, Sangke District, BTB Province (WWTP and Drainage Subproject)	
Issues/Comments/Suggestions raised by the Stakeholders	EMP Response
- In Norea Commune most houses are not on the drainage system, a few have for some houses are near the road (own culverts). - There are some houses with access to solid waste collections for those houses which are near the access road and Sangke River.	None required
WWTP suggestions: (i) The rice is around the WWTP. (ii) need water quality which allows people to use water for rice crops; the WWTP needs a protection dam to manage the flood/water in and out of the WWTP site. (iii) Use the proper technique for operating the WWTP to reduce pollution to downstream water quality.	Design includes run off control. Training for operators is included in capacity development.
- During operation stage, the wastewater from WWTP will discharge via Ou Monui Stream. Consider the wastewater discharge quality from WWTP, because some people use water from this stream for households and vegetable farm.	Training for operators is included in capacity development.
smell/odor from WWTP can impact on people are near the subproject site management of wastewater discharge to protect rice field during operation	Training for operators is included in capacity development.
- Plant trees around the WWTP site to reduce odours	Site includes buffer zone
- The impacts of construction stage on social and environment is small and temporary (moving equipment, air and noise) because the WWTP is far from villages and now there are no houses near the construction site.	None required

8.2. Public Consultations during Project Implementation

207. Consultations, public meetings and village discussions with the affected households (Ahs) and the local authorities were conducted (i) during project PPTA stage of draft resettlement plan (RP) preparation, and during (ii) DED and Detailed Measurement Survey (DMS) and (iii) preparation of the Detailed Resettlement Plan (DRP). The first public consultation and focus group discussions at PPTA stage was conducted in February 2018. Both public consultation meeting and focus group discussions provided good opportunity to the AHs to express their concerns mainly about actual impacts on land and the viability of farming

on marginal lands after acquisition, DMS, compensation payments and GRM. All issues were fully discussed and addressed, consistent with the Project's participatory approach.

208. During the Subproject design, the second public consultations with AHs was conducted on one-to-one due to restrictions and safety requirements caused by COVID-19 pandemic from April to July 2020. During the consultations, the AHs were explained on the subproject scope, entitlements, and compensation for lost assets, GRM, including contact persons, and processes of conducting DMS/SES.

209. Third consultation took place 2 and 25 April 2020 (two separate consultations) with PDOWRAM to agree on access road along the irrigation canal and WWTP effluent discharge.

210. Fourth consultation was done in 28-30 May 2020 covering market vendors (77 participants, including 4 males and 73 females), WWTP access road to AHs (9 participants, including 3 males and 6 females) and mobile vendors (10 participants, including 3 males and 7 females). The consultation explained to the attendees about the Project and Subproject and its benefits, the scope of works, resettlement impacts, the ADB and RGC policies on compensation, eligibility, entitlements, contractor responsibility for temporary impact and GRM processes.

211. Fifth consultation took place on 29 May 2020 with the single vulnerable AH on eligibility and entitled to participate in the income restoration plan (IRP). This included a final consultation conducted with farmers impacted by a loss of land use along the access road to WWTP site and at WWTP site (11 participants, including 10 male and 1 female).

212. Consultation during implementation. The Consolidated IEE for this subproject contains details of the consultation undertaken during preparation and DED of this subproject. In addition, consultation will take place during pre-construction and construction. The PIU Safeguard Focal Point (PIU-SFP) 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 subproject.

213. 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, odor, dust and access); and
- GRM and its procedures including details of persons to contact and contact details.

214. 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

215. 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

216. 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.

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

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

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

9. GRIEVANCE REDRESS MECHANISM

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

221. 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).

222. Full details of the GRM, its access points, and responsible parties are found in the EMP documents.

10. ENVIRONMENTAL MANAGEMENT PLAN

223. A detailed EMP is provided for Battambang wastewater subproject. The EMPs 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:

- 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.

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

225. A summary of the key functions for project implementation and therefore environmental safeguards is presented in Table 29.

Table 29: 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 subprojects for environmental and social safeguards
Project Implementation Unit	PIU	Provinces within PDPWT	Responsible for subproject implementation
PIU Safeguards Focal Point	PIU-SFP	Provinces within PIU	Responsible for subproject environmental and social safeguard monitoring
Contractor Environmental Health & Safety Officer	C-EHS	Construction Site	Mitigation measure implementation and reporting
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
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

226. This IEE was undertaken to determine the environmental issues and concerns associated with all subproject stages but considers the most significant impacts and risks to be associated with the operation stage where the environmental benefits from improved and expanded wastewater collection and treatment will be realized, while risk of environmental pollution could arise if the wastewater systems are not managed and maintained effectively. The assessment confirms that the project is classified as Category B for environment. There are no significant adverse impacts that cannot be readily mitigated.

227. 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 EMPs will be closely monitored and reported on by the relevant stakeholders in the project.

228. The construction related impacts are temporary and local and associated with the construction of sewer system in urban areas. The most significant risks and potential impacts of the project are associated with the operation phase of the WWTP and the sewer system and may occur if the facilities are not managed and maintained effectively. If the WWTP is not maintained at sufficient operational level, surface and groundwater is at risk of pollution from the WWTP effluent. Inadequate maintenance of the collection system or pump stations may result in localized pollution associated with accidental discharge of untreated wastewater.

229. The management of an operation and maintenance (O&M) budget for these facilities is outside the scope of this IEE however the key mitigation measures for operational risk management relate to the capacity development of the operating staff and national and sub-national / municipal governments who provide the budget for O&M. The importance of training in operations and management should be emphasized if the investment is to be sustainable and adequate operations are maintained as per design.

230. As a result, the WWTP operator training will include training on the management of environmental risks during operations. The technical specifications include requirements for preparation of O&M manuals and training programs including during start-up, at commissioning, and in trial operation as well as development of maintenance programs.

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

232. Overall, the project is anticipated to bring environmental benefits to the population of Battambang and the Tonle Sap catchment more broadly through collection and treatment of wastewater. It will serve to improve sewage and wastewater management, reduce pollution impacts and will provide long term environmental improvements and health benefits.

233. A meeting held between the MoE, MPWT and consultant teams for ADB projects on 6th December 2017 confirmed that this project requires and IESIA report by a registered authorized company in Cambodia. The IESIA was approved in May 2020 (Annex 6).

11.2. Recommendations

234. The next step of the Environmental Safeguards implementation is the preparation of the CEMP, which is to be based on the EMP, but it develops in more details the measures to be implemented by the Contractor. The CEMP will form the basis of the Environmental Management System of the Contractor during the construction phase. It will nominate the Contractor environment, H&S officer(s) and the Contractor GRM focal point and will be

supported by associated sub-plans which will deal with specific topics, such as Materials spoil and borrow site management, Solid and liquid waste management, Community and occupational H&S and emergency response, COVID-19 response plan, and Construction workers camp management (if required).

235. The O&M manual will provide clear methods and procedures for all aspects of the WWTP and pump station operation on sludge management including treatment, disposal and emergency situations and monitoring/ testing procedures and schedule for treated effluent and sludge, with approval by MOE. Further, it is recommended that effluent and receiving water body monitoring data are provided to the Provincial Department of Agriculture to enable assessment of effects of treated effluent application on crop yields.

Annex 1: Environmental Quality Standards

(1) Ambient Air Quality Standards

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

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

(2) Ambient Noise Standards

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

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

(3) Water Quality Standards

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 standards for pollution sources discharging wastewater to 'protected public water area' and to 'public water areas and sewer'

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	0C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD_5 (5 days at 200 ºC)	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 60	< 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 (NO_3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO_4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO_4)	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

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
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 (H)	mg/l	< 0.002	< 0.05
29	Nickel (Ni)	mg/l	< 0.2	< 1.0
30	Selenium (Se)	mg/l	< 0.05	< 0.5
31	Silver (Ag)	mg/l	< 0.1	< 0.5
32	Zinc (Zn)	mg/l	< 1.0	< 3.0
33	Molybdenum (Mo)	mg/l	< 0.1	< 1.0
34	Ammonia (NH_3)	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
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. 27 ANRK.BK on Water Pollution Control, MOE, 1999.

a) River

Parameter	Standard	
	Unit	Value
pH	mg/l	6.5 – 8.5
BOD_5	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
COD	mg/l	1 – 8
Suspended Solid	mg/l	1 – 15
Dissolved Oxygen	mg/l	2.0 - 7.5
Coliform	MPN/100ml	< 1000
Total Nitrogen	mg/l	1.0 – 0.6
Total Phosphorus	mg/l	0.005 – 0.05

Annex 5 of Sub-decree on Water Pollution Control:

Water Quality Standard in public water areas for public health protection

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

(4) Groundwater Quality Standard

Source: - Ground water quality monitoring MoE, 2016.

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

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 (NO_3)	mg/l	50
7	Phosphate (PO_4)	mg/l	NV

No	Parameter	Standard	
		Unit	Value (CNDWQS Standard)
8	Sulphate (SO_4)	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

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

Unofficial translation of letter from the Ministry of Environment to the Ministry of Public Works and Transport confirming the applicable effluent standards for the project

Kingdom of Cambodia

Nation Religion King

Ministry of Environment

No: 1309 SCN.BS

Yours Respectfully

Senior Minister, Minister of Public Works and Transport

Subject: Refer to the second request to review on the derogation the effluent standard

Reference: - Letter No. 2674 SK/ABTK dated 28 July 2020 of the Ministry of Public Works and Transport

- Report of the Meeting between Ministry of Environment and Ministry of Public Works and Transport dated 8 September 2020

As mentioned in the above subject and reference, I have the pleasure to inform H.E Senior Minister that the treated effluent from the wastewater treatment plant will not implement with the compliance to the Annex 2 of the sub-decree no. 235 ANKR.BK dated 25 December 2017 on the Management of Sewerage and Wastewater Treatment System because centralized wastewater treatment plant is under jurisdiction of sub-decree no. 27 date 26 April 1999 on the Water Pollution Control in which the treated effluent standard shall comply with the table of Annex 2 of this sub-decree itself.

In this regard to the request made by the Ministry of Public Works and Transport to review the derogation the effluent parameters standard from the centralized wastewater treatment plant, is already below the allowable effluent standard.

As mentioned above, please H.E Senior Minister kindly be informed.

Please accept, H.E Senior Minister, the assurances of my highest consideration.

Phnom Penh, 7 October 2020

Minister

Signature and stamp

Say Sam Al

Annex 2: Field notes & Descriptions

WWTP Subproject in Battambang Town

- The WWTP is located in Bang Village, Anlong Vil Commune, Sangke District, BTB Province.

- The site is lowland area. Most of areas is rice filed (wet rice crop) covering around the proposed site. There are no sensitive receptors and sensitive forest or ecological resources near the proposed site. The location is located as follows:

- Sangke River is about 4km.
- O Kambot and O Monui Stream is about 1km and 1.5km
- BTB Town is about 5-6 km
- Norea Primary-Secondary School and Christian School is about 1.5 km
- Cultural site and pagoda are about 3-4 km
- Provincial Road is about 3-4 km
- National Road N.5 is about 5km.

<table>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">The existing environmental condition in proposed WWTP, BTB Town</td></tr>
<tr><td colspan="2">  </td><td>  </td></tr>
<tr><td colspan="2">The existing access road to site</td><td>Christian School</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Primary and secondary school</td><td colspan="2">Cultural Resources in Runchek Village, Rotanak Commune</td></tr>
</table>

Annex 3: Consultation During IEE Preparation

Public Consultation Meetings: Focus Group Discussion (FGD)

The main objectives of FGDs are to:

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

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

The discussion questions concerned:

- Physical Resources: Water resources and water quality, soil quality, and air quality (noise and odor)
- Ecological Resources: forest/vegetation, wildlife and fish.
- 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:

- A. How does the community use the environment & natural resources? Example: what are water sources (drinking, washing etc). Vegetation/Fish/Forest, land use etc
- B. What are the community's concerns regarding Construction Impacts?
- C. What are the community's concerns regarding Operation Impacts?
- D. What are the Mitigation Measures the community would like during Construction?
- 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 subprojects areas for Battambang Town. The key points from the consultation meetings are presented in section if this IEE.

Consultation pictures in BTB Town

Consultation in Prek Preah Sdach Commune, Battambang Town

Consultation in Rotanak Commune, Battambang Town

Participants List for Consultations in BTB Province

1. Consultation in Rrek Preahsdach Commune, BTB Town, BTB Province

No	Name	Agency Village/Commune	Position	Phone
1	Mr. Leuk Sam Ath	Rrek Preahsdach Commune	Villager	092 752 092
2	Mr. Thean Phong	Rrek Preahsdach Commune	Villager	092 265 019
3	Ms. Seng Lyna	Rrek Preahsdach Commune	Villager	
4	Ms. Oun Rany	Rrek Preahsdach Commune	Villager	
5	Ms. Om Naran	Rrek Preahsdach Commune	Villager	
6	Ms. Tim Sokhom	Rrek Preahsdach Commune	Villager	
7	Ms. Heng Bunthay	Rrek Preahsdach Commune	Village Chief	092 254 963
8	Ms. Houm Pisin	Rrek Preahsdach Commune	Deputy Village Chief	
9	Ms. Van Sarum	Rrek Preahsdach Commune	Villager	
10	Ms. Pin Saveun	Rrek Preahsdach Commune	Villager	
11	Ms. Soun Touch	Rrek Preahsdach Commune	Villager	
12	Ms. Om Maly	Rrek Preahsdach Commune	Villager	
13	Ms. Ros Sreyneth	Rrek Preahsdach Commune	Village Member	070 920 598
	Total: 13 persons (female: 11 persons)			

2. Consultation in Rottanak Commune, BTB Town, BTB Province

No	Name	Agency Village/Commune	Position	Phone
1	Mr. Reas Son	Rumchak-4 Village, Rottanak	Village Chief	092 738 831
2	Ms. Kao Sras	Rumchak-4 Village, Rottanak	Villager	
3	Mr. Chan Oeun	Rumchak-4 Village, Rottanak	Villager	
4	Mr. Teu Savoun	Rumchak-5 Village, Rotatnak	Village Chief	017 340 509
5	Mr. Chham Lap	Rumchak-5 Village, Rotatnak	Deputy Village Chief	078 964 923
6	Mr. Bun Nann	Rumchak-5 Village, Rotatnak	Villager	
7	Mr. Real Sambo	Rumchak-1 Village, Rottanak	Villager	
8	Ms. Pem Poa	Rumchak-1 Village, Rottanak	Villager	
9	Ms. Theun Theap	Rumchak-1 Village, Rottanak	Villager	
10	Mr. Leap Chhorn	Rumchak-1 Village, Rottanak	Villager	
11	Mr. Sim Samnang	Rumchak-2 Village, Rottanak	Deputy Village Chief	012 263 475
12	Mr. Leng Dy	Rumchak-2 Village, Rottanak	Villager	
13	Ms. Chhay Phary	Rumchak-2 Village, Rottanak	Villager	
14	Mr. Ngorn Sam Ol	Rumchak-3 Village, Rottanak	Deputy Village Chief	
15	Ms. Phan Sophorn	Rumchak-3 Village, Rottanak	Villager	
16	Mr. Mork Neth	Rumchak-3 Village, Rottanak	Villager	
17	Mr. Liv San	Rumchak-3 Village, Rottanak	Villager	
18	Mr. San Vuthchheun	Rumchak-3 Village, Rottanak	Villager	
19	Mr. Chheum Chheat	Rumchak-3 Village, Rottanak	Villager	
20	Ms. Song Piseth	Rottanak Coomune	Commune Clerk	092 505 559
21	Mr. Touch Phany	Rumchak-3 Village, Rotanek	Village Chief	071 777 826
	Total: 21 persons (female: 06 persons)			

Annex 4: Environmental Management Plan- Battambang WWTP subproject

See EMP Report

Annex 5: Fish Resources

Fish species name received from consultation on 28 November 2019 at Sophy Pi Village, Rattanak Commune, Battambang.

No.	Khmer Name (Latin)	English Name	Scientific Name	Origin	IUCN Read List 05/11/2018
1.	Trey Kranh	Climbing perch	*Anabas testudineus*	Anabantidae	DD
2.	Trey Kompleanh Plook	Moonligth gourmi	*Trichohodus mirolepis*	Osphronemidae	Unknown
3.	Trey Kompleanh Srae	Three spot gourami	*Trichohodus trichopterus*	Osphronemidae	Unknown
4.	Trey Ptouk /Trey Rours	Climbing perch	*Anabas testudineus*	Anabantidae	DD
5.	Trey Konchhos Bay	White-line catfish	*Mystus albolineatus*	Bagridae	LC
6.	Trey Konchhos	-	*Mystus wolffi*	Bagridae	Unknown
7.	Trey Jangva Rornong	Lesser double-lipped carp	*Lobocheilos melanotacnia*	Cyprinidae	Unknown
8.	Trey Jangva Moul	Pale rasbora	*Rasbora aurotaenia*	Cyprinidae	LC
9.	Trey Orndeng Reong	Walking catfish	*Clarrias bartachus*	Clarriidae	Unknown
10.	Trey Orndeng Tun	Bighead walking catfish	*Clarrias macrocephalus*	Clarriidae	Unknown
11.	Trey Chhloon	Frecklefin eel	*Macrognathus maculatus*	Mastacembelidae	LC
12.	Trey Ptoong	Halfbeak	*Zenarchopterus ectuntio*	Hemiramphidae	Unknown
13.	Trey Jangva Toch	-	*Rasbora amplistriga*	Cyprinidae	LC
14.	Trey Jangva Steung	Leaping barb	*Chela laubuca*	Cyprinidae	Unknown
15.	Trey Jangva Srae	-	*Amblypharyngodon chulabhornae*	Cyprinidae	LC
16.	Trey Slaart	Bronze featherback	*Notopterus notopterus*	Notopteridae	LC
17.	Trey Chlang	Asian redtail catfish	*Hemibagrus sp. (cf. nemarus)*	Bagridae	Unknown
18.	Trey Kreum Khda	Croaking gourami	*Trichopsis vittata*	Belontiidae	LC
19.	Trey Kontrung Preng	Durkyfin glassy perchlet	*Parambassis wolffii*	Ambassidae	LC
20.	Trey Srorka Khdarm Krahom	Beardless barb	*Cyclocheilichthys apogon*	Cyprinidae	LC

The fish species from site investigation with fisher-man

No.	Khmer Name	English Name	Scientific Name	Origin	IUCN Read List 05/11/2019
1.	Trey Kranh	Climbing perch	*Anabas testudineus*	Anabantidae	DD
2.	Trey Kompleanh Plook	Moonligth gourmi	*Trichohodus mirolepis*	Osphronemidae	unknown
3.	Trey Kompleanh Srae	Three spot gourami	*Trichohodus trichopterus*	Osphronemidae	unknown
4.	Trey Konchhos Bay	White-line catfish	*Mystus albolineatus*	Bagridae	LC
5.	Trey Konchhos	-	*Mystus wolffi*	Bagridae	unknown
6.	Trey Konchhos Steung	-	*Mystus atrifasciatus*	Bagridae	LC
7.	Trey Riel Angkarm	Lesser silver mud carp	*Cirrhinus lobatus*	Cyprinidae	LC
8.	Trey Srorka Khdarm	White eye barb	*Cyclocheilichthys armatus*	Cyprinidae	LC
9.	Trey Sleuk Russey	-	*Paralaubuca barroni*	Cyprinidae	LC
10.	Trey Chlang	Asian redtail catfish	*Hemibagrus sp. (cf. nemarus)*	Bagridae	unknown
11.	Trey Ptoong	Halfbeak	*Zenarchopterus ectuntio*	Hemiramphidae	unknown
12.	Trey Chror Kaeng	Sickle fin barb	*Puntioplites falcifer*	Cyprinidae	LC

Source: IESIA report. SBK January 2020

Annex 6: IESIA

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
លេខ: ៥៥៧៦ សជណ.ប.ស្ត

សូមគោរពជូន
ឯកឧត្តមទេសរដ្ឋមន្ត្រី រដ្ឋមន្ត្រីក្រសួងសាធារណការ និងដឹកជញ្ជូន

កម្មវត្ថុ ៖ ករណីសំណើសុំពិនិត្យ និងផ្តល់យោបល់លើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ក្រុងបាត់ដំបង នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំណាក់កាលទី២ នៅខេត្តបាត់ដំបង របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន

យោង ៖
- ព្រះរាជក្រមលេខ នស/រកម/១២៩៦/៣៦ ចុះថ្ងៃទី២៤ ខែធ្នូ ឆ្នាំ១៩៩៦ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ
- អនុក្រឹត្យលេខ ៧២ អនក្រ.បក ចុះថ្ងៃទី១១ ខែសីហា ឆ្នាំ១៩៩៩ ស្តីពីកិច្ចដំណើរការវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន
- លិខិតលេខ ១១២២ សក/កប១២ ចុះថ្ងៃទី២០ ខែមីនា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ២៤៧ សក/កប១២ ចុះថ្ងៃទី២២ ខែមករា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ៤៨៨២ សក/កប១២ ចុះថ្ងៃទី១៥ ខែវិច្ឆិកា ឆ្នាំ២០១៩ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ២៨៦ សជណ ប.ស្ត ចុះថ្ងៃទី០៥ ខែមីនា ឆ្នាំ២០២០ របស់ក្រសួងបរិស្ថាន
- លិខិតលេខ ១៥៨២ វ.ហ.ប.ស្ត ចុះថ្ងៃទី១៧ ខែធ្នូ ឆ្នាំ២០១៥ របស់នាយកដ្ឋានវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន នៃក្រសួងបរិស្ថាន

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមគោរពជម្រាបជូន **ឯកឧត្តមទេសរដ្ឋមន្ត្រី** មេត្តាជ្រាបថា ក្រសួងបរិស្ថានឯកភាពលើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ក្រុងបាត់ដំបង នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំណាក់កាលទី២ ដែលមានទីតាំងស្ថិតនៅសង្កាត់រតនៈ សង្កាត់ព្រែកព្រះស្តេច ក្រុងបាត់ដំបង និងឃុំនរា ស្រុកសង្កែ ខេត្តបាត់ដំបង របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន (ម្ចាស់គម្រោង) ដោយម្ចាស់គម្រោងត្រូវគោរពតាមកិច្ចសន្យាការពារបរិស្ថានលេខ ១៥២០ សក/កប១២ ចុះថ្ងៃទី២៤ ខែមេសា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន។

អាស្រ័យដូចបានគោរពជម្រាបជូនខាងលើ សូម **ឯកឧត្តមទេសរដ្ឋមន្ត្រី** មេត្តាជ្រាប និងចាត់ចែងដោយសេចក្តីអនុគ្រោះ។

សូម **ឯកឧត្តមទេសរដ្ឋមន្ត្រី** មេត្តាទទួលនូវសេចក្តីគោរពពីខ្ញុំ។

ថ្ងៃព្រហស្បតិ៍ ១៤កើត ខែពិសាខ ឆ្នាំជូត ទោស័ក ព.ស ២៥៦៤
រាជធានីភ្នំពេញ ថ្ងៃទី ០៧ ខែឧសភា ឆ្នាំ២០២០

ជ. រដ្ឋមន្ត្រី
រដ្ឋលេខាធិការ

នេត្រ ភក្ត្រា

ចម្លងជូន៖
- ទីស្តីការគណៈរដ្ឋមន្ត្រី
- ក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ
- ក្រសួងរៀបចំដែនដី នគរូបនីយកម្ម និងសំណង់
- ក្រសួងធនធានទឹក និងឧតុនិយម
- រដ្ឋបាលខេត្តបាត់ដំបង
- មន្ទីរបរិស្ថានខេត្តបាត់ដំបង
- ឯកសារ កាលប្បវត្តិ

អាគារមរតកតេជោ ដីឡូលេខ៥០៣ ផ្លូវកៅស៊ូមាត់ទន្លេបាសាក់ សង្កាត់ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទ: 023 235 004 / 023 235 006

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន
លេខ: [illegible] សក/កចន២

ជម្រាបជូន
ឯកឧត្តមរដ្ឋមន្ត្រីក្រសួងបរិស្ថាន

ម្ចាស់គម្រោង តំណាងដោយ **ឯកឧត្តមទេសរដ្ឋមន្ត្រី រដ្ឋមន្ត្រីក្រសួងសាធារណការ និងដឹកជញ្ជូន** មានអាសយដ្ឋាន មហាវិថីព្រះនរោត្តម ខណ្ឌដូនពេញ រាជធានីភ្នំពេញ។

សូមធ្វើកិច្ចសន្យាការពារបរិស្ថាន

ដើម្បីរួមចំណែកធានានូវនិរន្តរភាពបរិស្ថានក្នុងកិច្ចដំណើរការអភិវឌ្ឍន៍ប្រទេសជាតិ ក្រសួងសាធារណការ និងដឹកជញ្ជូន (ម្ចាស់គម្រោង) សូមធ្វើកិច្ចសន្យាការពារបរិស្ថានចំពោះក្រសួងបរិស្ថាន **សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ក្រុងបាត់ដំបង នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំណាក់កាលទី២** ដែលមានទីតាំងស្ថិតនៅសង្កាត់គេនៈ សង្កាត់ព្រែកព្រះស្តេច ក្រុងបាត់ដំបង និងឃុំនរា ស្រុកសង្កែ ខេត្តបាត់ដំបង ដូចប្រការដូចខាងក្រោម៖

ប្រការ ១.

ធានាទទួលខុសត្រូវ និងអនុវត្តនូវខ្លឹមសារ ដែលបានរៀបរាប់នៅក្នុងរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ក្រុងបាត់ដំបង នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំណាក់កាលទី២ ដែលក្រសួងបរិស្ថានបានឯកភាព។

ប្រការ ២.

ធានាផ្តល់របាយការណ៍អង្កេតតាមដានបរិស្ថាន (Environmental Monitoring Report) រៀងរាល់ ០៦ខែម្តង នៅក្នុងដំណាក់កាលសាងសង់ និងប្រតិបត្តិគម្រោង ជូនក្រសួងបរិស្ថាន ដើម្បីពិនិត្យ និងវាយតម្លៃ។

ប្រការ ៣.

ទទួលខុសត្រូវធ្វើការសម្អាត និងប្រមូលសំរាម សំណល់រឹងទីប្រជុំជន ដោយត្រូវអនុលោមតាមបទប្បញ្ញត្តិមាត្រា១៥ មាត្រា១៦ មាត្រា១៧ មាត្រា១៨ និងមាត្រា២៥ នៃអនុក្រឹត្យលេខ ១១៣ អនក្រ.បក ចុះថ្ងៃទី២៧ ខែសីហា ឆ្នាំ២០១៥ ស្តីពីការគ្រប់គ្រងសំរាម សំណល់រឹងទីប្រជុំជន។

ប្រការ ៤.

ធានាផ្តល់របាយការណ៍សង្ខេបនៃការសិក្សាលម្អិត (Summary Detailed Design Report) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ក្រុងបាត់ដំបង នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំណាក់កាលទី២ ដែលមិនបានលម្អិតនៅក្នុងរបាយការណ៍ IESIA ដើម្បីដាក់ជូនក្រសួងបរិស្ថានពិនិត្យ និងផ្តល់យោបល់។

ប្រការ ៥.

ក្នុងករណីក្រសួងបរិស្ថានតម្រូវឱ្យម្ចាស់គម្រោងធ្វើការកែប្រែនូវបច្ចេកទេសបរិស្ថានណាមួយ ដើម្បីឱ្យសមស្របទៅតាមគោលការណ៍ណែនាំ និងកម្រិតបទដ្ឋានបរិស្ថាន ម្ចាស់គម្រោងនឹងទទួលអនុវត្តទៅតាមគោលការណ៍ណែនាំនោះទាំងស្រុង។

ប្រការ ៦.

ទៅថ្ងៃអនាគត បើម្ចាស់គម្រោងមានគម្រោងពង្រីកបន្ថែម ឬផ្លាស់ប្តូរ ឬកែសម្រួលរបាយការណ៍សិក្សាសមទ្ធិលទ្ធភាព (Feasibility Study Report) ឬផ្នែកសកម្មភាព ម្ចាស់គម្រោងនឹងរាយការណ៍ជូនក្រសួងបរិស្ថានឱ្យបានមុន ០១ខែ។

ប្រការ ៧.

អនុញ្ញាតឱ្យមន្ត្រីជំនាញពីក្រសួងបរិស្ថាន ឬមន្ទីរបរិស្ថានខេត្តបាត់ដំបង ដែលមានលិខិតបញ្ជាបេសកកម្មត្រឹមត្រូវ ដើម្បីធ្វើការត្រួតពិនិត្យនៅទីតាំងគម្រោង។

ប្រការ ៨.

ក្នុងករណីដែលម្ចាស់គម្រោងពុំបានគោរពតាមប្រការណាមួយ ឬអនុវត្តផ្ទុយពីកិច្ចសន្យានេះ ឬលិខិតបទដ្ឋានគតិយុត្តចូលជាធរមានផ្សេងៗទៀត ម្ចាស់គម្រោងនឹងទទួលខុសត្រូវចំពោះមុខច្បាប់ជាធរមាន។

ថ្ងៃ...ខែ...ឆ្នាំជូត ទោស័ក ព.ស...
រាជធានីភ្នំពេញ ថ្ងៃទី...ខែ...ឆ្នាំ២០២០

ជ. ផ្នែមន្ត្រីក្រសួងសាធារណការ និងដឹកជញ្ជូន

ស៊ួយ សាន

បានឃើញ និងគោរពជូន
ឯកឧត្តមរដ្ឋមន្ត្រីក្រសួងបរិស្ថាន មេត្តាពិនិត្យ និងសម្រេច
លេខ:...ដ.ប.ស
ថ្ងៃ...ខែ...ឆ្នាំជូត ទោស័ក ព.ស...
រាជធានីភ្នំពេញ ថ្ងៃទី...ខែ...ឆ្នាំ២០២០
ប្រធាននាយកដ្ឋានវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន

ជាវ ឆ្នាំ សើរ

បានឃើញ និង ឯកភាព
ថ្ងៃ...ខែ...ឆ្នាំជូត ទោស័ក ព.ស...
រាជធានីភ្នំពេញ ថ្ងៃទី...ខែ...ឆ្នាំ២០២០
ជ. ផ្នែមន្ត្រីក្រសួងបរិស្ថាន
ផ្នែលេខាធិការ

នេត្រ ភក្ត្រា

Annex 7: Wastewater Characterization

The sewage characteristics adopted for design purposes and the effluent discharge standards adopted as per Sub-decree 27 (1999), FAO Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture together with the Australian guidelines for reuse of sludge from wastewater treatment plants together with typical dried sludge constituents.

Table A2-1 Wastewater Quality and Effluent Standards

Effluent Quality Parameter	Unit	Design Wastewater Characteristics[1/]		Effluent Discharge Standards
		Raw Influent	Treated Effluent	Cambodia[2/]
pH		6.5-7.5	6.5-7.5	5-9
BOD_5	mg/L	250	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	<6.0
Detergent (LAS)	mg/L	TBC[3/]	TBC[4/]	<15
Oil and grease	mg/L	TBC[3/]	TBC[4/]	<15
Total coliform	MPN/100 mL	$1x10^6 – 1x10^7$	1,000	-[5/]

Notes

1. 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 PC team's experience with similar plants and the assumed raw influent.
2. 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.

3 TBC – to be confirmed as it is highly local habits and culture dependent.

4. TBC – to be confirmed as it is highly local habits and culture dependent.

5. 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, 1999). The ambient water quality standards are provided in Annex 1 to this report.

Table A2-2 Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture[15]

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

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

In Table A2-3 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 A2-3 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*.

Annex 8: IBAT

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Integrated Biodiversity Assessment Tool

Protected Areas and Key Biodiversity Areas

The following sites are found within the selected buffer distances:

Features within 1 km

There are no features within 1 km.

Features within 10 km

There are no features within 10 km.

Features within 20 km

National-level protected areas		
IUCN Category V-VI	Tonle Sap Biosphere	3,243 ha