Initial Environmental Examination

February 2022

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

Wastewater and Drainage Subproject (Lot 1), Stueng Saen City, Kampong Thom Province

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

CURRENCY EQUIVALENTS

(as of March 2020)

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

ABBREVIATIONS

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

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

WEIGHTS AND MEASURES

dBA	–	A-weighted Decibel
km	–	Kilometre
km2	–	Square kilometre
LAeq	–	Equivalent Continuous Level 'A weighting' - 'A'-weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies
m	–	Meter
°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.

TABLE OF CONTENTS

List of tables

List of figures

1. EXECUTIVE SUMMARY

1.1. The Project

1. Second Urban Environmental Management in the Tonle Sap Basin Project (TS-2 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 TS-2 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 infrastructure 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	Wastewater Treatment Plant	Drainage	Landfill
Serei Saophoan	✓	✓	✓
Battambang	✓	-	✓
Stueng Saen	✓	✓	✓

3. The Stueng Saen Wastewater and Drainage Subproject is designed to cover the main urban areas of Stueng Saen. The subproject comprises the following works:

    - Construction of a primary and secondary separate sewage collection network:
        - 9.1 km gravity sewer pipeline
        - 7.5 km pressurized sewer pipeline
    - Construction of tertiary sewer network (32.5 km of Ø160 mm), including 2,930 service connections for households (SHCs), and commercial and institutional buildings.
    - Construction of two (2) sewer pumping stations and associated pumping mains.
    - Construction of a 3,500 m^3/d Wastewater Treatment Plant (WWTP) above flood levels.
    - Construction of administration, workshop, generator and security buildings at the WWTP.
    - Upgrade and raise 1.5 km of access road to the WWTP above flood levels.
    - Construction of 27.9 km of collection network for stormwater management including removal of 19 km existing drains.
    - Provision of Operation & Maintenance Equipment.

4. The selected WWTP site is located in Beung Chhumnich Lake, Prek Sbov Village, O Kantor Commune, Stueng Saen City, Kampong Thom Province. This site is in a lowland area surrounded by rice fields. The WWTP is located:

    - about 0.8 km from Prek Sbov Village and school
    - about 1 km from Stueng Saen River
    - about 4 km from Stueng Saen City
    - about 2 km from National Road 6 (bypass road)
    - in an area with irrigation canals and rice fields for two-season rice cultivation.

- in a flat lowland area with no sensitive resources and no sensitive ecology near the site.

5. The Project is classified as category B for environment as confirmed during the project preparation. The has been undertaken in accordance with ADB Safeguards Policy Statement (SPS) 2009 and Cambodia's Law on Environmental Protection and Natural Resource Management (Preah Reach Kram/NS-PKM-1296/36) 1996, and its sub-decrees and implementing guidelines. A separate Environmental Management Plan (EMP) has been prepared (latest version dated February 2022), which is part of the bidding documents. The IEE and EMP have been updated in conjunction with the finalization of the Detailed Engineering Design (DED) including the subsequent Variation Order No. 3 ensuring consistency between engineering designs and environmental mitigation measures. The previous IEE/EMP of May 2018 prepared and disclosed during the preparation of the TS-2 Project covering all the TS-2 subprojects is available on ADB's website[1]. The IEE and EMP also incorporate the findings of 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

6. 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.

7. The subproject sites are located in an environment which contains many surface water bodies including ponds and 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 by households for washing and fishing. Management of run-off and potential pollution impacts are a key focus of the EMP measures.

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

9. The most significant environmental impacts and risks of the subproject are associated with the operation phase. The sewer system and WWTP can cause environmental pollution if they are not managed and maintained effectively. Such pollution includes long-term risks to surface water, odour, and medium-term risks to water quality from WWTP effluent discharges, potentially affecting aquatic flora and fauna and human health.

10. If effectively managed, the project facilities will bring environmental improvements to Stueng Saen City. Field visits show that the current environment is being contaminated with sewage and the growing pressures on the urban areas mean that this is likely to continue. The development and operation of separate wastewater collection network and well-engineered wastewater treatment facilities will reduce pollution of the environment and the risks to human health and water quality. In addition, the city will benefit from improved disaster and climate change resilient infrastructure.

[1] https://www.adb.org/projects/documents/cam-50102-002-iee

11. In Stueng Saen City, the new wastewater infrastructure will form the foundation for developing city wide 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.

12. The community consultations undertaken for this IEE show widespread support for the subproject as the residents recognize the need to improve waste management and sewage treatment. The communities are also subject to impacts from flooding and therefore are keen to see drainage improvements which will contribute to increased climate resilience.

1.3. Environmental Management Plan

13. 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:

    - Summary of potential impacts
    - Mitigation and monitoring measures;
    - Institutional arrangements and project responsibilities;
    - EMP budget for implementation
    - Capacity building and training requirements
    - Public consultation and information disclosure
    - Grievance Redress Mechanism (GRM) including clearly defined procedures and responsibilities.

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

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

    - EMP adjustment and implementation - Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting.
    - GRM – 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.

16. The key mitigation measures during construction will include:

    - Good construction practices will be adopted to ensure minimal disturbance of affected persons from construction related nuisance, such as noise, dust and emission of pollutants.
    - Avoid or minimize 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 Construction Environmental Management Plan (CEMP) for the key activities including detailed layout maps to ensure that all stakeholders are clear on where activities will take place, including temporary impact agreements with affected households.

- The contractor shall obtain approval of the CEMP from the PMU before starting construction works.
- The Contractor shall assign a full-time environment, health and safety officer for the entire three-year construction period, who will be responsible for CEMP implementation and supervision and for ensuring compliance with applicable Cambodian environmental, health and safety legislation and with relevant IFC Environmental, Health and Safety guidelines.
- A community and occupational health and safety plan is required as part of the CEMP.

17. Appropriate occupational health and safety measures for the construction workers will be implemented. Typical health and safety procedures include effective measure to prevent collapse or cave-in of deep excavations, safe driving and operation of heavy construction equipment, and correct use of PPEs to minimize the risk of injury and exposure to loud noise and dust. Proper hygiene and safety procedures will be implemented to prevent transmission of the SARS-CoV-2 virus[2], HIV and other pathogens. The contractor's environment, health and safety officer (see ***Para 16***) will be responsible for ensuring that occupational and community health and safety standards including GRM are maintained in compliance with applicable Cambodian legislation and with relevant IFC Environmental, Health and Safety guidelines, and for ensuring that repeated training of the construction workers in occupational health and safety is undertaken.

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 this project.

19. A GRM has been 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 contains 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, the measures will mitigate all anticipated impacts on the natural environment and affected people to an acceptable level. The key parties for mitigation measure implementation are the construction contractors and the operators. They will be supported by qualified national and international environmental consultants within the PMC teams. The implementation of the IEE and EMP will be closely monitored and reported on by the relevant stakeholders in the project.

[2] SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) is the causal agent of COVID-19 (Coronavirus Disease 2019)

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

22. Overall, the expected subproject outcome is to improve urban environmental services in Stueng Saen City. The subproject is anticipated to bring environmental benefits to the population and it will serve to improve sewage management, reduce pollution impacts and provide long term urban environmental improvements, health benefits and promote sustainable city development.

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

24. This IEE has been prepared for the Stueng Saen Wastewater and Drainage Subproject (Lot1). This IEE has been updated in conjunction with the completion of the detailed engineering design (DED) and the subsequent Variation Order No. 3. The Environmental Management Plan (EMP) for the subproject was included in the bidding documents.

25. The contractor is required to prepare the Construction Environmental Management Plan (CEMP) which must be approved by the PMU/PMC prior to start construction. The CEMP shall be prepared in accordance with the EMP and shall include detailed measures and sub-plans dealing with specific topics, such as health and safety, waste management, soil and borrow sites management, traffic management, etc. to be implemented by the contractor. The CEMP will be the backbone of the environmental management system of the contractor.

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

27. 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.

28. A meeting held between the MoE, MPWT and consultant teams for ADB projects on 6 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. Introduction

29. 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 (TS-2 Project).

30. The TS-2 project will improve urban environmental services in Serei Saophoan, Banteay Meanchey Province, Battambang Town, Battambang Province and, Stueng Saen City, 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.

31. The TS-2 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 Stung 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. Objectives of the IEE

32. The first Initial Environmental Examination (IEE) covering all subprojects within the TS-2 Project was prepared during the Project Preparatory Technical Assistance (PPTA) and cleared by ADB in May 2018.

33. This IEE has been prepared for the Stueng Saen Wastewater and Drainage Subproject (Lot1). The IEE has been updated in conjunction with the completion of the detailed engineering design (DED) and the subsequent Variation Order No 3[3]. The Environmental Management Plan (EMP) for the subproject has also been updated (latest version dated February 2022).

34. The objectives of the IEE study for the subproject are as follows:

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

[3] Variation Order No. 3 involves removal of 19 km of existing poor or non-functioning drainage structures and measures to manage sanitary wastewater from the disconnected households during construction as well as disposal of excess soil and concrete structures

2.3. ADB and Domestic Environmental Due Diligence

2.3.1. IEE Requirements

35. The project classification of environment category B was confirmed during project preparation. This IEE covering the subproject has been prepared and updated based on the DED and the subsequent Variation Order No. 3. 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.

36. 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 for this subproject. The IESIA was approved in May 2020 and the findings from the IESIA have been incorporated in this IEE.

2.3.2. Structure of This Report

37. This IEE report follows the format prescribed in ADB SPS 2009 and includes the following information:

- The policy legal and administrative framework;
- A description of the subproject;
- The environmental baseline for the subproject locations;
- Analysis of alternatives for the subproject interventions; and
- Information on disclosure and consultation.

38. The Environmental Management Plan (EMP) for the Subproject is a standalone document that determines the environmental mitigation measures and sets out the environmental monitoring programmes for all phases of project implementation. The EMP is structured in the following main sections:

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

39. Based on the EMP, the Contractor is required to develop the Construction Environmental Management Plan (CEMP), which shall include specific protection and monitoring measures taking sensitive receptors into account. The contractor shall obtain approval of the CEMP from the PMU/PMC before starting construction works.

3. LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1. Environmental Assessment Requirements

3.1.1. Environmental Assessment Requirements of ADB

40. 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.

41. 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 analyzed in the context of the project's area of influence.
- Environmental impacts and risks will be analyzed 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.

42. Other requirements of SPS 2009 include:

- Analysis of alternatives. There is a requirement to examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no project alternative. SPS 2009 states that this is only for projects which have ''significant adverse environmental impacts that are irreversible, diverse, or unprecedented'' i.e., category A projects. This does not apply to this category B IEE but is included for completion.
- 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.

43. 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 drainage. 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.

44. 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

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

- Sub-decree on EIA Process No. 72 (1999). This law provides the detailed guidelines for implementation of the EIA Process and designates roles and responsibilities for preparation, review and approval of EIA and IESIA reports.
- Sub-decree on EIA Classification for Development Projects No. 21 (2020) determines the types and sizes of project that have to undertake a full EIA or an IESIA.
- 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, and mitigation measures for, significant environmental impacts; (vii) environmental management plan; (viii) cost-benefit analysis; and (ix) conclusion and recommendations.

46. 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 the EMP implementation of Project Proponents/Owners throughout the different project phases. MoE operates at the municipal and provincial levels through its Provincial Department of Environment (PDoE).

47. 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 IESIA/EIA report, it should take a maximum of 30 working days for a decision.

48. A meeting held between the MoE, Ministry of Public Works and Transport (MPWT) and consultant teams for ADB projects on 6th December 2017 confirmed that for the projects and their 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.

- 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.
- A registered company, authorized to prepare IESIA reports in Cambodia, is required to submit the IESIA report on behalf of the project owner (MPWT) to MoE for review and approval.

49. The preparation of the IESIA for the Stueng Saen Wastewater and Drainage Subproject started in August 2019 following approval by MOE of the terms of reference for the study. After submission of the first draft IESIA in November 2019, MOE conducted a site visit in and based on comments from the ministry, the second draft IESIA was submitted for consideration at an inter-ministerial meeting in February 2020. The final IESIA incorporating comments from the inter-ministerial meeting was approved by MOE in May 2020.

3.2. National Environmental Policy and Legislation

3.2.1. Legal Framework for Environmental Management

50. 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.

51. 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.

52. 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

53. 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.

54. 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.

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

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

56. A summary of national and international guidelines is provided 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***.

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 all stakeholders have to cooperate to achieve sustainable development
Environmental Guidelines on Solid Waste Management[4]	2006	Contains a Landfill Ordinance that regulates landfill requirements to: (i) reduce as far as possible the adverse effects of waste disposal on the environment; (ii) preserve groundwater, surface water & air quality & to reduce emissions of greenhouse gases (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; and (iv) provide information and technical recommendation on the construction, operation and closing/follow-up management of landfills to ensure public health and safety and environmental protection.
Labour Law (1997) Decree No. CS/RKM/0397/01	1997	This law governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: Chapter VIII Health and Safety of Worker. The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace.

Law/Regulation/Guideline	Year	Summary
		Article 230: Work places 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 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

Law/Regulation/Guideline	Year	Summary
		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 indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar).
Expropriation Law	2010	Defines the principles, mechanisms, and procedures of expropriation, and defining fair and just compensation for any construction, rehabilitation, and public physical infrastructure expansion project for the public and national interests and development of Cambodia.
Sub-Decree on Demarcation of 647,406 Hectare Flooded Forest Domain in Six Provinces adjacent to Tonle Sap Lake (Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom) (Sub-decree No. 197 ANKr/BK)	2011	Stipulates a zoning system for the area between the national highways and the Tonle Sap Lake system and the nature of agriculture activities that are permitted and banned in each zone.
Sub-Decree N.235 on Management of Sewage/Culvert System and Wastewater Treatment Plant	2017	**Article 3:** This sub-decree is implemented to the management on Sewage System and Wastewater Treatment Plant in urban municipality, province, city, district and resort/recreational area of Royal Government of Cambodia. This sub-decree is not implemented on Industrial Wastewater Management. **Chapter 2:** This Charter is presented the role and responsible of relevant agencies/institution: national level (MPWT, MoE and MoI), Provincial level (municipality, province, relevant provincial departments, city, district), and involved investment project owners.

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

Table 3: Key National and International Environmental Standards

Environmental Issue	National Standards	International Standards
Ambient air quality	Annex 1, Ambient Air Quality Standard, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Air Quality Guidelines, global update 2005
Noise	Annex 6, Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Guidelines for Community Noise, 1999
Groundwater quality	Drinking water Quality Standards, 2004	WHO Guidelines for Drinking-water Quality, Fourth Edition, 2011
Surface water quality	Annex 4, Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, and Annex 5, Water Quality Standards for Public Waters and Health, of Sub-decree on Water Pollution Control, 1999	USEPA 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	IFC EHS General Guidelines, April 2007 IFC EHS Guidelines for Water and Sanitation, December 2007 IFC EHS Guidelines for Waste Management Facilities, December 2007 USEPA Effluent Limitations

57. 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 Plan for the subproject.

3.3. International Agreements

58. 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.

59. 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.

60. Cambodia also supports the global efforts against climate change by being a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 1996. Cambodia has adopted and ratified the Paris Agreement, and in 2020 the Government submitted an updated Intended Nationally Determined Contribution, which puts forward mitigation targets and adaptation actions towards a cleaner and greener economy to improve the lives of the citizens, in particular the vulnerable. The 2030 mitigation targets include reduction of methane emissions by better management of industrial wastewater in the food and beverage sector aiming at a reduction of 5-10% of total methane emissions in the wastewater sector.

4. DESCRIPTION OF THE PROJECT

4.1. Rationale

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

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

63. 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%).[5] 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.

64. Institutional arrangements. 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.

65. General observations indicate that the expansion in infrastructure and service provision have not been matched by equitable distribution but is characterised by disproportionate access in the capital region and certain municipalities. To contribute to the provision of a quality urban

[5] 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.

environment to this fast-growing urban population, including in secondary urban centres, the Second Urban Environmental Management in the Tonle Sap Basin Project will support the government of Cambodia in improving urban services and enhancing climate and disaster risk resilience in participating towns in the Tonle Sap Basin. The Project will directly build on a preparatory study conducted by the Cities Development Initiative for Asia (CDIA) program (hereinafter referred to as "CDIA study") which was completed in Q3 2017. The project is part of ADB's programmatic approach to resilient and environmentally sensitive urban development in the Tonle Sap Basin, and will build on an ongoing project, under which similar interventions are financed in two of the basin's towns, in Kampong Chhnang and Pursat (Tonle Sap Urban Environmental Improvement Project, TS-1).

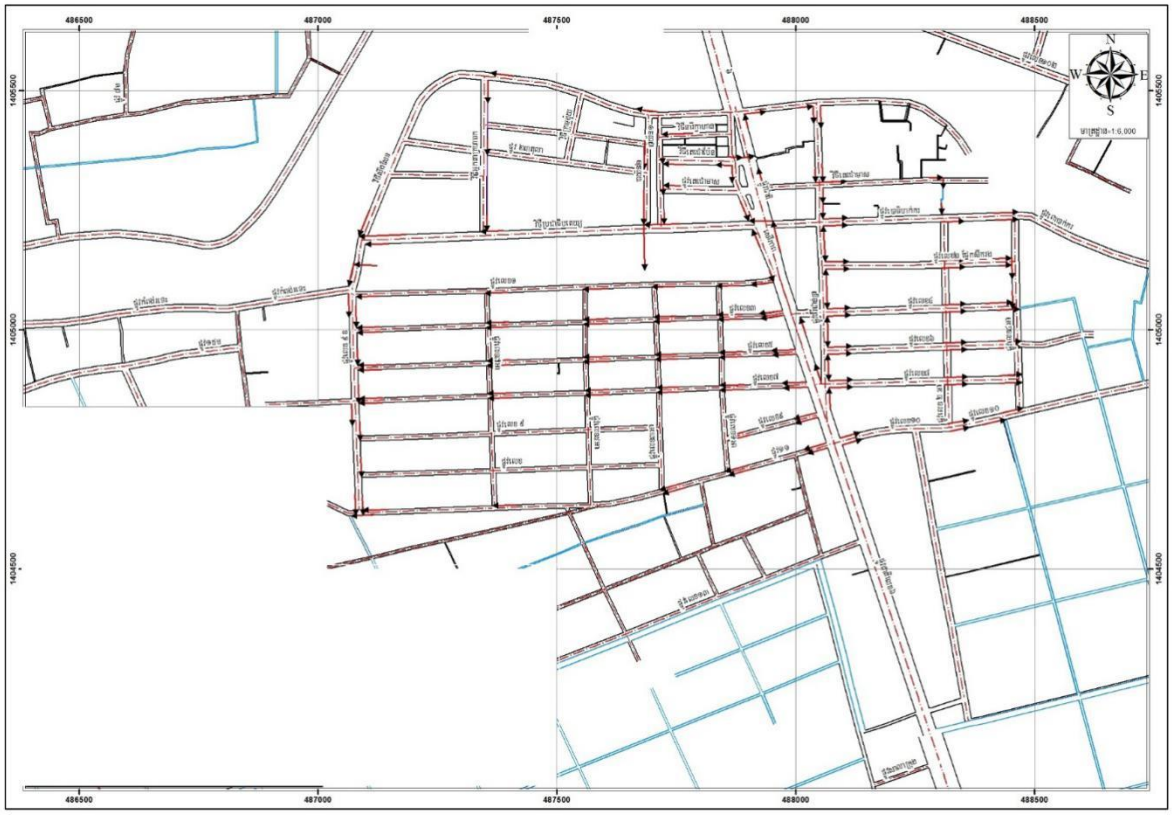
4.2. Existing Wastewater and Drainage System

66. Based on the CDIA 2010 study, around 70% of households have toilet facilities. Of these around 10% have septic tanks while the rest have pit latrines or other form of waste depository systems. At present, there is no sewerage system present within the city. Most of household wastewater are discharged directly into existing drainage pipes along the national highways passing into canals, the river and open fields without any proper treatment. Similar conditions as reported in the CDIA 2010 study were observed regarding the existing drainage systems in the project area.

67. The physical topography of Stueng Saen City is quite flat, creating problematic operating circumstances for drainage. The central part of the city experiences localized flooding during rainfall events in the rainy season, in part due to property owners filling low-lying areas to minimize or prevent flooding of their properties, resulting in discontinuity of flow between upstream and downstream drains.

68. Consequently, the old drainage system is in poor condition (***Figure 2***). The practice by property owners of connecting their sewerage to the existing drainage has resulted in severe pollution of downstream drains with effluent causing odours under low flow conditions in the dry season. This subproject will deliver improved water services (See ***Section 4.3***).

Figure 2: Existing Drainage System Source: (CDIA, 2010)



4.3. Subproject description

69. Stueng Saen is situated in the central part of Cambodia, about 150 km via National Road No. 6 from the capital city of Phnom Penh (***Figure 3***). The city is a traditional trading centre for agricultural products, processing thereof and the provision of services for the region.

70. The project is designed to cover the main urban areas of Stueng Saen. The service area for the sewage and drainage collection sections in the three (3) urban sangkats is shown in ***Figure 4***.

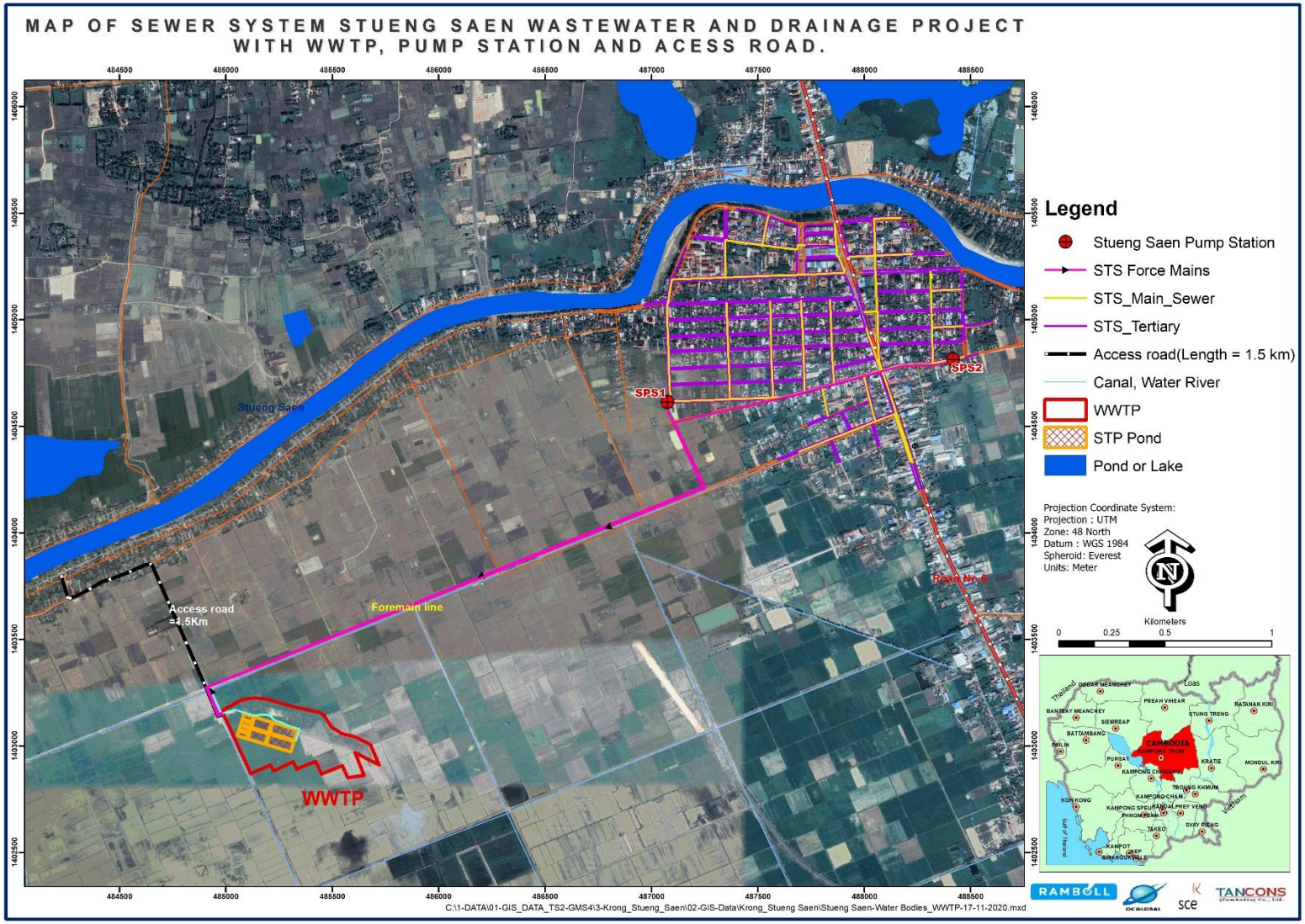
Figure 3: Stueng Saen Location Map

Source: Detailed Engineering Design Report, SCE 2019

71. The design period is 20 years with the project components/facilities planned up to year 2040. The investment works to be implemented under Stueng Saen Wastewater and drainage subproject comprise the following works:

- Construction of a primary and secondary separate sewage collection network.
  - 9.1 km gravity sewer pipeline
  - 7.5 km pressurized sewer pipeline
- Construction of 32.5 km tertiary sewer network (Ø160 mm), including 2,930 service connections for households (SHCs), commercial and institutional buildings.
- Construction of two (2) sewer pump stations and associated pumping mains.
- Construction of a 3,500 m^3/d WWTP above flood levels.
- Construction of administration, workshop, generator and security buildings at WWTP.
- Upgrade and raise 1.5 km of access road to the WWTP above flood levels.
- Construction of 26.8 km stormwater collection network including removal of 19 km existing drainage lines.
- Provision of Operations & Maintenance Equipment.

Figure 4: Service Area for Sewage and Drainage Collection



4.4. Detailed Description of the Wastewater and Drainage Systems and Pump Station Designs

4.4.1. Wastewater Collection System

72. The sewerage system for Stueng Saen service area was divided into two primary catchment areas in consideration of the topography, requiring two pumping stations. A plan of the proposed sewer system design is shown in ***Figure 4***.

73. The gravity sewers and force mains were designed based on the estimated year 2040 peak dry weather sewage flow as shown in ***Table 4***. The requirements for the sewer network piping designs are shown in ***Table 5***.

Table 4: Design Flows for Sewage Network

Sub-Catchment	Projected Dry Weather Sewage Flow, Q (m^3/day)			
	2030		2040	
	Avg. Q	Peak Q	Avg. Q	Peak Q
PS1 Sub-Catchment	1,600	3,650	1,780	4,010
PS2 Sub-Catchment	880	2,150	980	2,370

Table 5: Length and Diameters by Length

Depth of Cover, m	Gravity Sewer Mains				
	HDPE PE100, PN 8, SDR 21				
	200mm	250mm	355mm	450mm	Sub-Total
1-2	3,140	-	265	-	3,405
2-3	2,871	-	137	-	3,008
3-4	354	812	1,311	-	2,477
4-5	-	-	203	10	213
Total Length	**6,365**	**812**	**1,916**	**10**	**9,103**
	Force Mains:				
	Steel Pipe			**HDPE PE 100, PN12.5, SDR 13.6**	
	150mm			250mm	355mm
Total Length	**25**			**4,350**	**3,100**

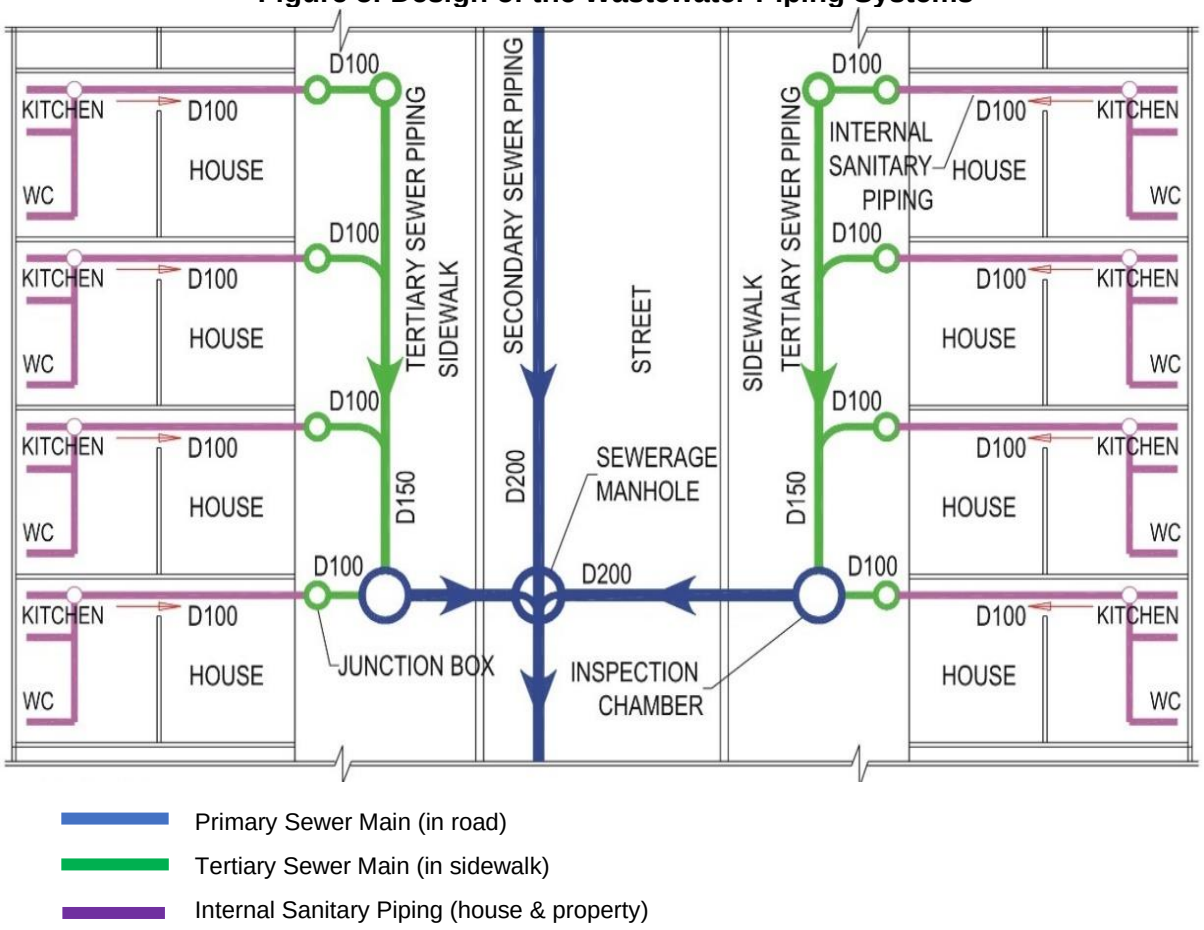
74. Primary and Secondary Gravity Sewers (***Figure 4***): All flows into the sewer system will be collected by tertiary sewers then conveyed to the main gravity sewers flowing into the two network pumping stations, that will then pump the sewage flow directly to the WWTP.

75. Tertiary Gravity 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 and then to the pumping stations.

76. Included in the project design is a required tertiary sewer network and sewer household connections (SHC) all to be funded under the project, as shown in ***Figure 5***, 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 the subproject but are included here as a crucial part of the sewage treatment system and a pro-poor and social inclusion design feature.

Figure 5: Design of the Wastewater Piping Systems



4.4.2. Pumping Stations

77. Two (2) main pumping stations are required for the wastewater collection system as shown in ***Table 6*** and ***Table 7***.

Table 6: Pumping Stations Sites

Item	Pump Station No. 1 (PS1)	Pump Station No.2 (PS2)
Location	Sangkat Kampong Thom	Sangkat Damrei Chan Khla
Area	Approximately 30 m^2	Approximately 30 m^2
Existing Land Use	Residential Road Allowance	Residential Road Allowance
Existing Ground Elevations	13.5m – 12.5m	13.5m – 12.5m
Availability of Public Water Supply	Yes	Yes
Availability of Electrical Supply	Electrical Supply is available	Electrical supply is available

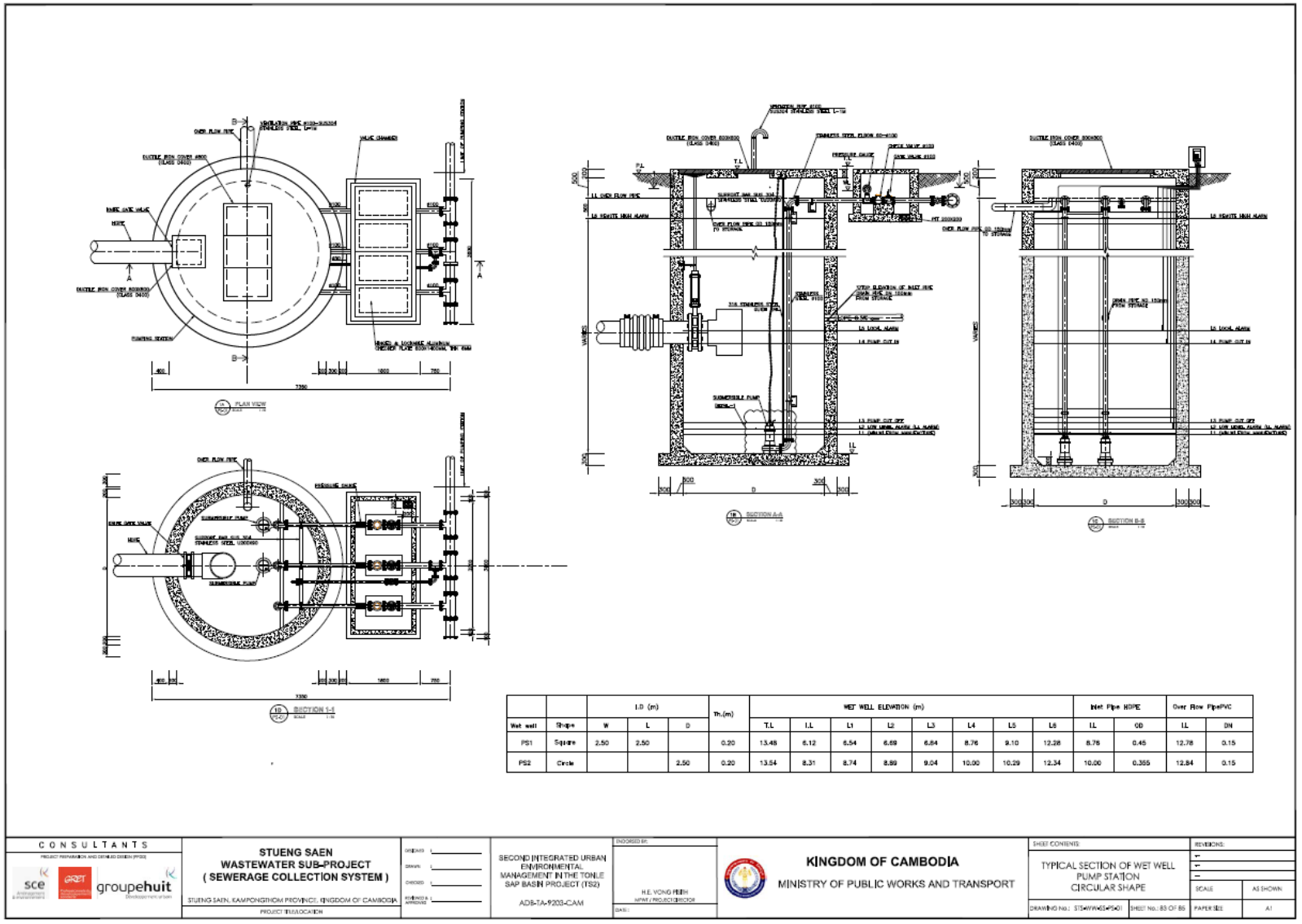
Table 7: Specifications for the Wastewater Pumping Stations

Lift/Pump Station	Minimum Structure Size (wet well)	Pump Capacity	Pump Configuration (Duty + Standby)	Force Mains
PS1	2.5 x 2.5m, 7.7m Depth	1 x 88.3lps @ 25m Head	1 + 1 Submersible	355mm x 12.5m
PS2	2.5 Dia., 5.3m Depth	1 x 28.8lps @ 25m Head	1 + 1 Submersible	250mm x 950m

78. As indicated in ***Table 7***, the pumping station wet wells will be equipped with a standby pump in case of malfunction of the duty pump. In addition, the wet wells will have two alarms, the first alarm will send a signal to the operator if the pump is not activated at the designed water level, and the second alarm will send a warning of imminent overflow from the wet well to an overflow tank.

79. Each pumping station will be equipped with an emergency generator located in a separate building with adequate ventilation and sound attenuating provisions to meet all exterior noise level requirements. Each generator will be connected to a fuel tank adequate for 24-hour continuous operation. The fuel tanks will have secondary containment and be located outside under a non-combustible rain canopy.

Figure 6: Typical section of wet well pump station



		I.D (m)			Th.(m)	WET WELL ELEVATION (m)								Inlet Pipe HDPE		Over Flow PipePVC	
Wet well	Shape	W	L	D		T.L	I.L	L1	L2	L3	L4	L5	L6	I.L	OD	I.L	DN
PS1	Square	2.50	2.50		0.20	13.48	6.12	6.54	6.69	6.84	8.76	9.10	12.28	8.76	0.45	12.78	0.15
PS2	Circle			2.50	0.20	13.54	8.31	8.74	8.89	9.04	10.00	10.29	12.34	10.00	0.355	12.84	0.15

CONSULTANTS

sce groupehuit

STUENG SAEN
WASTEWATER SUB-PROJECT
(SEWERAGE COLLECTION SYSTEM)

STUENG SAEN, KAMPONGTHOM PROVINCE, KINGDOM OF CAMBODIA

PROJECT TITLE/LOCATION

SECOND INTEGRATED URBAN ENVIRONMENTAL MANAGEMENT IN THE TONLE SAP BASIN PROJECT (TS2)

ADB-TA-9203-CAM

H.E. VONG PEITH
MPWT / PROJECT DIRECTOR

KINGDOM OF CAMBODIA
MINISTRY OF PUBLIC WORKS AND TRANSPORT

SHEET CONTENTS:
TYPICAL SECTION OF WET WELL PUMP STATION CIRCULAR SHAPE

DRAWING No.: STS-WW-65-P-S-01 | SHEET No.: 65 OF 85

REVISIONS:

SCALE: AS SHOWN

PAPER SIZE: A1

4.4.3. Removal of Existing Drainage System

80. In accordance with Variation Order No. 3 approximately 19 km of the existing and basically non-functioning drains will be removed. The new drainage system will be installed in the same trenches thereby avoiding installation in the streets which would have made the streets narrower.

81. The existing drainage system that will be removed is indicated in ***Figure 7***.

82. The removal of the existing drains involves the following activities:

- PIU and the Contractor to consult with the affected households to obtain their consent
- Disconnecting and blocking all household connections to the drains
- Excavation of approximately 10,000 m^3 of soil
- Excavation of approximately 2,700 m^3 of concrete drains (some reinforced)
- Handover of salvageable concrete pipe elements to the municipality
- Crushing of non-salvageable concrete and removal of rebar to be sold as iron scrap
- Reuse of crushed concrete where possible
- Disposal of soil and non-reusable crushed concrete at a site within the premises of the WWTP but outside the fenced area.
- Regular emptying of private and commercial septic tanks and land application of the septage on agricultural land 15 km from the City.

Figure 7 Existing Drains to be removed

83. Household wastewater is currently being discharged to the existing drains after passing through individual septic tanks. Therefore, during construction and until the new wastewater collection system and the WWTP are operational, the wastewater (septage) from these households must be managed. The household connections to the drains will be blocked and the wastewater will be stored in the septic tanks which will then be emptied by vacuum trucks on a regular basis. The wastewater and sludge collected from the septic tanks are proposed to be deposited on flat agricultural land approximately 15 km from the construction site as indicated in ***Figure 8*** (coordinates: 12°47'2.92"N 104°50'34.43"E).

Figure 8 Overview Map with location of the proposed septage disposal site

84. When undertaken with proper environmental and health and safety measures as prescribed in this IEE and the associated EMP, land application of septage is an economical and environmentally sound method of handling septage that provides nutrients to the soil and decreases the reliance on chemical fertilizers for agriculture.

85. The simplest and most common method for disposal of septage is land application, which is also the method chosen here.

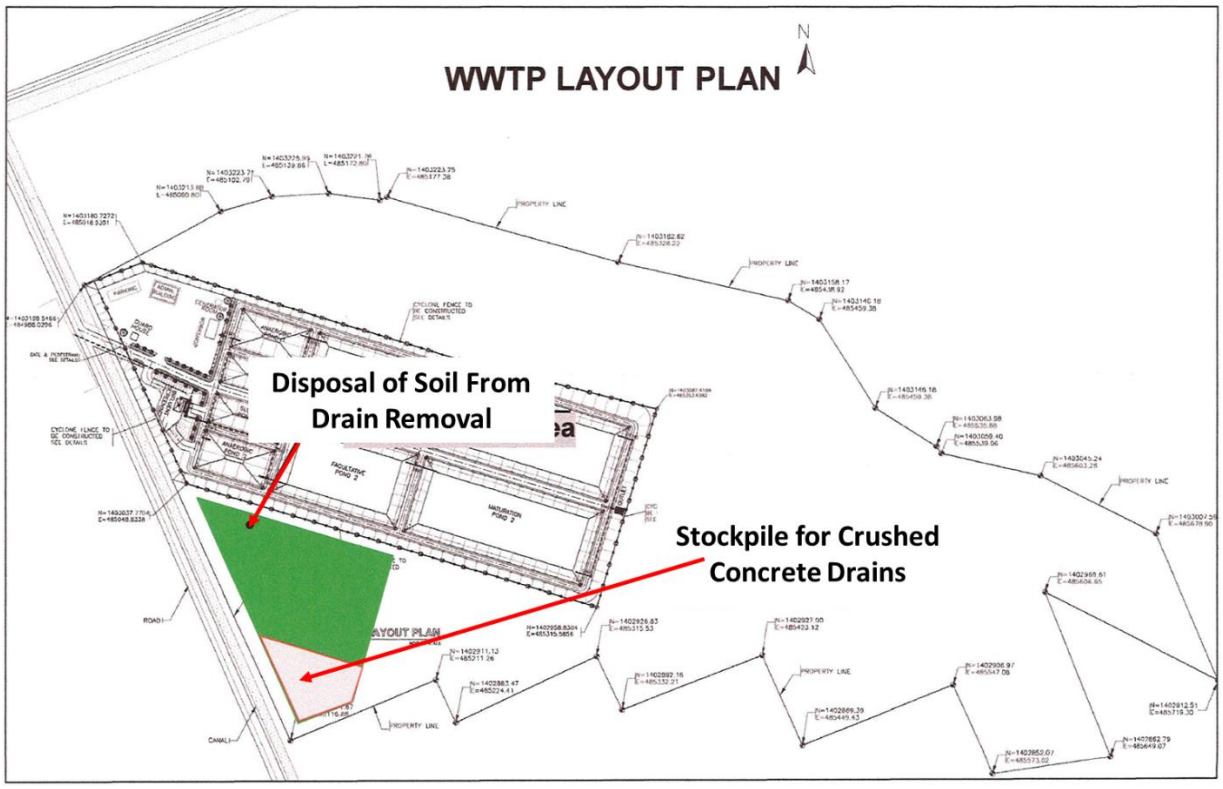
86. Subject to the requirements stipulated in this IEE and the associated EMP, acceptable land application methods include: 1) subsurface incorporation or 2) burial in trenches or pits.

87. The Contractor shall demonstrate that the proposed land application method complies with the requirements stipulated in this IEE and the associated EMP.

88. According to the initial method statement prepared by the Contractor, the operation will include pumping of septic tanks belonging to an estimated 826 households and 142 commercial enterprises every 6 months. A vacuum truck will carry 4 m^3 of septage per trip and over the 20 months period that this activity is expected to last there will be an estimated total of 3,576 trips varying from about 120 trips per month during the first 6 months to about 220 trips per month thereafter.

89. The removal of the existing drains includes excavation and disposal of about 10,000 m^3 of soil and 2,700 m^3 (6,450 tons) of concrete structures. The excess soil will be deposited within the WWTP site boundaries as indicated in ***Figure 9***. The concrete structures shall be excavated with great care not to damage the elements and salvageable concrete elements shall be handed over to the municipality for reuse in other projects. The remaining concrete shall be crushed, and rebar shall be separated for sale as scrap metal. The crushed concrete shall preferably be used for slope stabilization (including stabilization of the soil deposit slopes), or as aggregate in construction works to the extent that the materials have the required properties. The crushed concrete may be stockpiled next to the soil deposit as indicated in ***Figure 9***. Usage for other ongoing construction works in the city should also be considered. Any unused concrete may be deposited together with the soil.

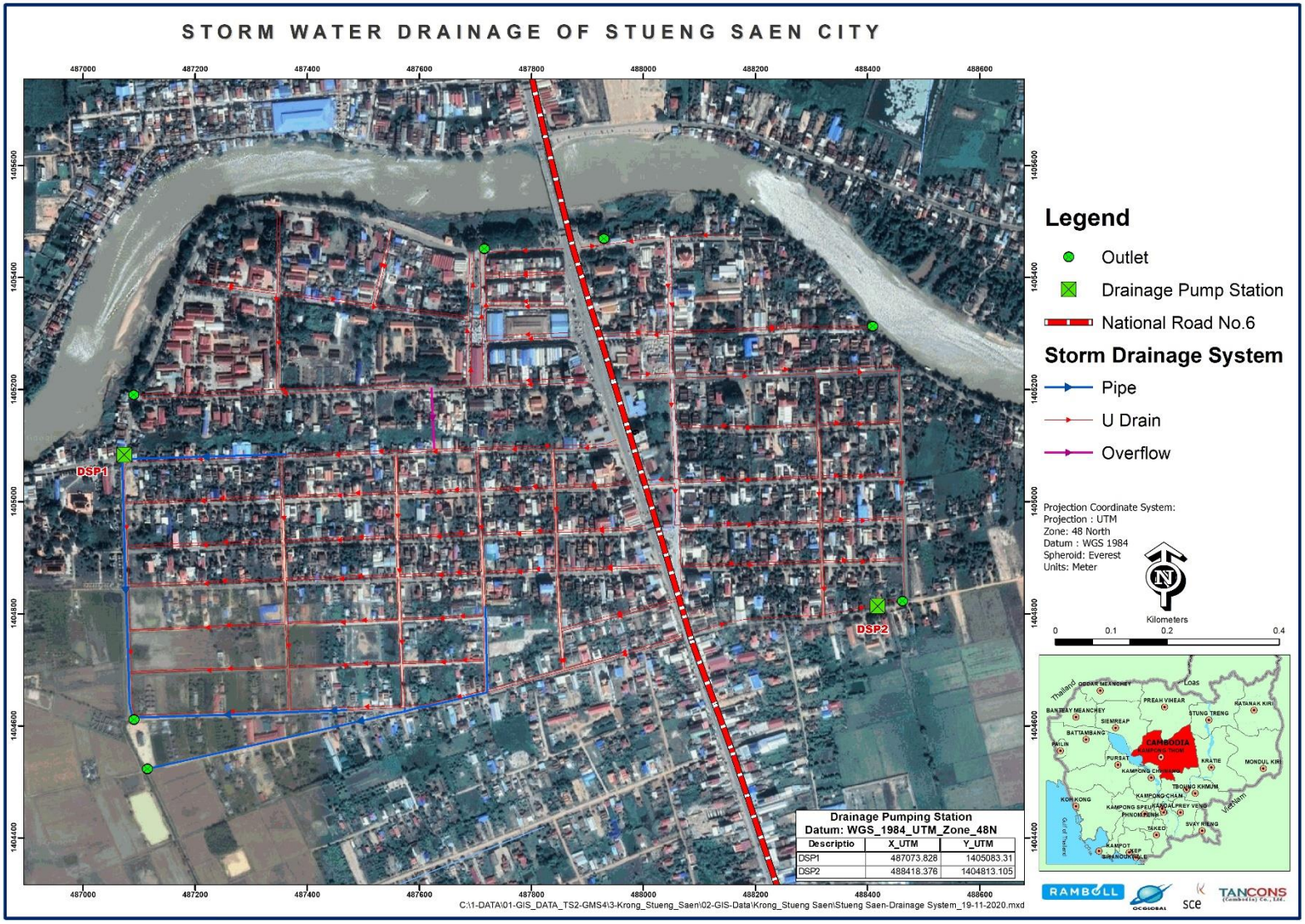
Figure 9 Disposal Site for Soil and Concrete from Removal of Existing Drains



4.4.4. Drainage System Improvements

90. The majority of the city of Stueng Saen drains naturally to either rice paddies and/or the Stueng Saen River. It has been agreed with MPWT that only the central area of the city shall receive a storm drainage system under the project (***Figure 10***). The drainage will be improved by the installation of a pipe network of varying diameters (Ø500 mm- Ø1000 mm). The outfall for the drainage networks is into a natural drainage area including rivers (directly or via canals), streams and ponds, depending on the location. The drainage is gravity fed, reducing the energy and maintenance requirements.

Figure 10: Stueng Saen storm water drainage



91. The drainage investment is summarized in ***Table 8*** and comprises:

- Reinforced concrete pipes for the drainage network, since they are least cost, the preferred material for drainage construction and the pipes can be constructed locally; Installation of 27.9 km of concrete U-Drains and 3,2 km of pipes in the urban core.
- Drainage outlet points to Stueng Saen river.

Table 8: Drainage Collection System

Item Description	Unit	Quantity
Reinforced concrete U-Drains 0.5 m wide with varying depth (0.5 m to 1.5 m), excavation, lean concrete, and compacted backfill.	m	27.900,00
Reinforced concrete covers for U-Drains, 0.5 m wide.	m	27.900,00
Reinforced Concrete Pipes, 1000mm internal diameter, includes compacted stone, lean concrete and backfilling.	m	2.700,00
Reinforced Concrete Pipes, 800 mm internal diameter, lean concrete & compacted backfill.	m	500,00
Construction of reinforced concrete chambers 1.2 m x 1.2 m, excavation, compacted backfill and covers.	No	85,00
Construction of reinforced concrete chambers 2 m x 2 m internal, excavation, compaction & backfilling.	No	160,00
Twinned reinforced concrete pipe culverts 1000 mm diameter each, 12 m long for surface outflow, compacted stone, lean concrete and backfilling.	No	2,00
Single reinforced concrete pipe culvert 1000 mm, 12 m long, compacted stone, lean concrete and backfilling	No	1,00
Single Cell Box Culvert 2 m x 2m, 12 m long, and wing walls	m	24,00
Twined Box Culverts 2 m x 2 m each, 12 m long.	m	24,00

4.5. Detailed Description of Wastewater Treatment Plant

92. A detailed analysis of the WWTP designs is provided in the 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 general engineering guidelines, projected storm water runoff and wastewater generation, and the required treated effluent quality. 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.

93. Waste Stabilization Ponds (WSPs) were the selected technology in the Pre-Feasibility Studies prepared by the CDIA Consultants. There is good practical experience in operating WSPs in several Cambodian cities. For Stueng Saen, it is the optimal wastewater treatment solution, providing very good levels of treatment with the lowest possible construction and operating costs. WSPs are the lowest life-cycle cost solution and are easy to maintain.

94. The site for the WWTP (***Figure 4*** and ***Figure 11***) is located in Prek Sbov Village, O Kantor Commune, Stueng Saen City, Kampong Thom Province. The site is partially on public land and partially privately owned rice fields purchased by General Department of Resettlement (GDR) through a willing buyer – willing seller arrangement. This site is in lowland area and is prone to flooding during the rainy season. There are rice fields (wet-dry rice) around the site. This WWTP site is located from sensitive resources:

- about 0.8 km from Prek Sbov Village and school

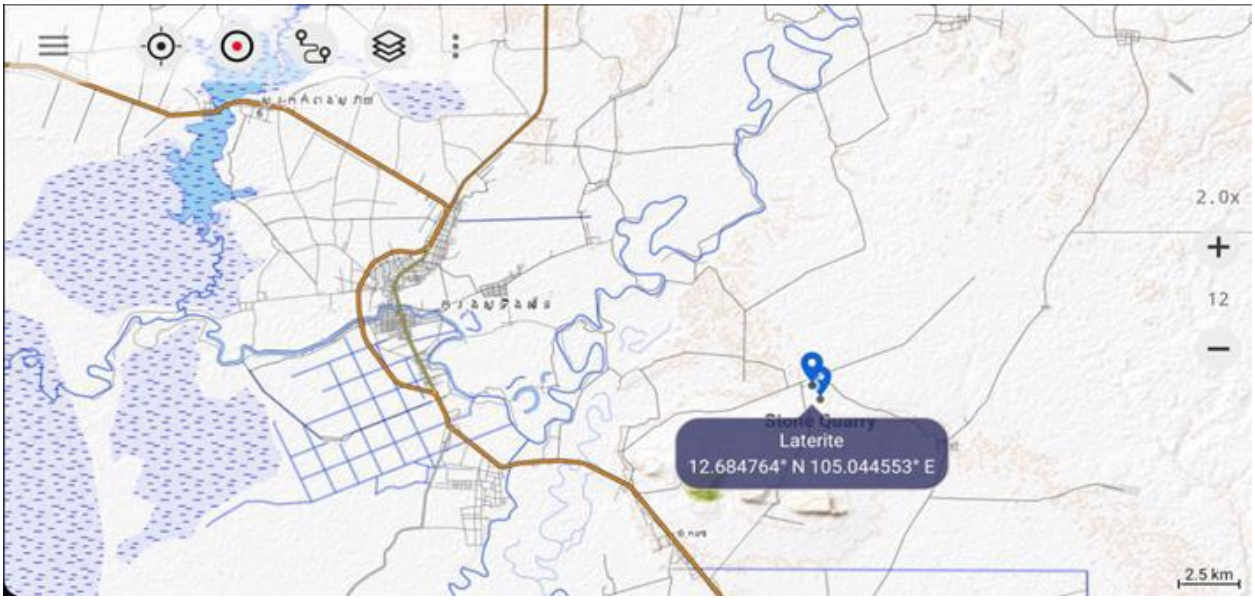
- about 1 km from Stueng Saen River
- about 4 km from Stueng Saen City
- about 2 km from National Road 6 (bypass road)
- in an area with irrigation canals and rice fields for two-season rice cultivation.
- in a flat lowland area with no sensitive resources and no sensitive ecology near the site.

95. The WWTP site has an area of 10 ha; however, the treatment plant will only occupy 3.5 ha, so there is sufficient space for future expansions should that be necessary. The site is reasonably close to the city centre, and 800 m from the nearest residential area. The treated effluent from the plant will be discharged to a 4-ha seasonal pond from where the water is conveyed to the irrigation canal network that connects to the Stueng Saen River at different points (see ***Figure 11***).

Figure 11: Discharge flow path to Stueng Saen River

96. The primary disadvantage is that the WWTP site experiences 2-3 m flooding for three months each year during the rainy season; however, this will be mitigated by constructing a 3 m high embankment. The soil used for constructing the embankment will need to be clay soil imported from a borrow pit located 30 km from Stueng Saen Town (***Figure 12***). Impacts on the drainage due to the WWTP and road elevation are addressed in Section 6.5 Environmental Impact and Mitigation Measures during Operation.

Figure 12: Location of Borrow pit



97. **Wastewater Treatment Design and Process**. As mentioned above, 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.

98. The WWTP will comprise two (2) sewage treatment trains. The treatment plant layout is shown in ***Figure 15***. The two (2) trains will be able to accommodate the future sewage flows until design year 2040 with a treatment capacity of 3,500 m^3/d.

99. The main components of the wastewater treatment in the waste stabilization pond process include the following (see layout plan in ***Figure 15*** and process diagram in ***Figure 16***):

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

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

treatment in the anaerobic ponds. A water supply standpipe shall be provided to clean the screen, receiving chamber and concrete parking pad for the septage trucks.

- Summary of Pond Sizing Design Parameters for Year 2040
    - WWTP Design Flow = 3,500 m^3/d
    - Influent BOD Concentration = 500 mg/L
    - Temperature = 24 ºC
    - Evaporation Rate = 5 mm/day
    - Influent Faecal Coliform Concentration = 5 x107 FC per 100 mL
- Anaerobic ponds. A first stage for treatment of high strength wastewaters, including mixtures of industrial/domestic wastewaters and septage with high organic loading:
    - Two (2) Anaerobic Ponds in parallel with dimensions of 25 m (width) and 46 m (length), each pond
    - Depth: 5 m
    - Retention time: 1 day
    - Percent removal for anaerobic pond at 24 ºC: 68%
    - BOD concentration of effluent: 80 mg/L
- Facultative ponds designed to be naturally aerated to maintain the biological activity of the bacteria. Floating baffles will be installed to provide hydraulic mixing, increase the retention time and to reduce the size of the ponds:
    - Two (2) Facultative Ponds in parallel with dimensions of 50 m (width) and 84 m (length), each pond
    - Depth of facultative pond: 2.5 m - 3.0 m
    - Number of floating baffle walls: 2
    - Number of treatment zones: 3
    - Area of 2 facultative ponds at 2.5 m depth: approx. 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. Floating baffles will be installed to provide hydraulic mixing, increase the retention time and to reduce the size of the ponds:
    - Two (2) Maturation Ponds in parallel with dimensions of 50 m (width) and 120 m (length), each pond.
    - Influent faecal coliform concentration: 5 x 107 MPN/100 mL
    - Effluent faecal coliform concentration at 24 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%
    - Effluent from maturation ponds: 3,500 m^3/d.
- Sludge management. The water content of the sludge is very high, therefore, before final disposal further treatment of anaerobic sludge from the ponds is required to reduce water content and oxygen demand of the sludge. Two sludge lagoons will be constructed to provide flexibility and to ensure availability of a sludge lagoon when stabilization or drying is being performed in the other sludge lagoon. The excess supernatant wastewater in the sludge treatment/drying lagoon will flow by gravity back to the WWTP

inlet for further treatment. During the sludge treatment/stabilization phase, a supernatant layer will be maintained to prevent odours from escaping, except for the stabilized sludge drying phase. The dewatered and dried sludge will be disposed of at the new landfill, or it will be used as soil conditioner or fertilizer if the chemical and bacteriological content are within applicable standards.

- The DED assumes that the volume of sludge accumulated in an anaerobic pond will be 40 liters/ per person/year. Anaerobic ponds require desludging when they are one third full of sludge by volume. This occurs every 2−5 years, but for operational effectiveness, desludging will be done every year. Facultative ponds store any sludge for their design life.

  Sludge stabilization / drying ponds:

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

- Manholes Flow and Control Chambers. Manholes are appropriately spaced for maintenance purposes and will have an inside diameter of 1.5 m. Flow control chambers used to control the direction of the flow will be equipped with manually operated Penstocks. The chambers will have inside dimensions of 1.5 m x 1.5 m.

- WWTP Outlet Structure. The WWTP effluent outlet (Figure 15) will flow to a cascade aerator terminating in a diffuser drainage channel at the base of the WWTP containment dike, thereby aerating the water before it is discharged to a 4-ha seasonal pond (***Figure 13***) from where the water is conveyed to the irrigation canal network (***Figure 14***) that connects to the Stueng Saen River at different points. The seasonal pond is used by farmers for irrigation in the dry season and is naturally refilled during the rainy season to a depth of 2.5 m - 3.0 m. The water quality in the pond/irrigation canal at the point of discharge has been analysed and the results are presented in ***Table 17***.

Figure 13: WWTP site	**Figure 14: The existing canal and rice fields near WWTP site**
	

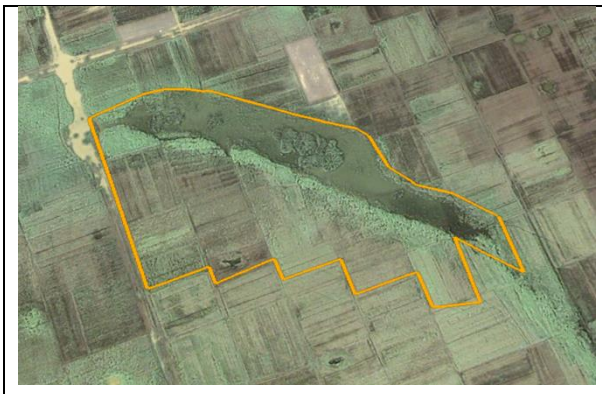
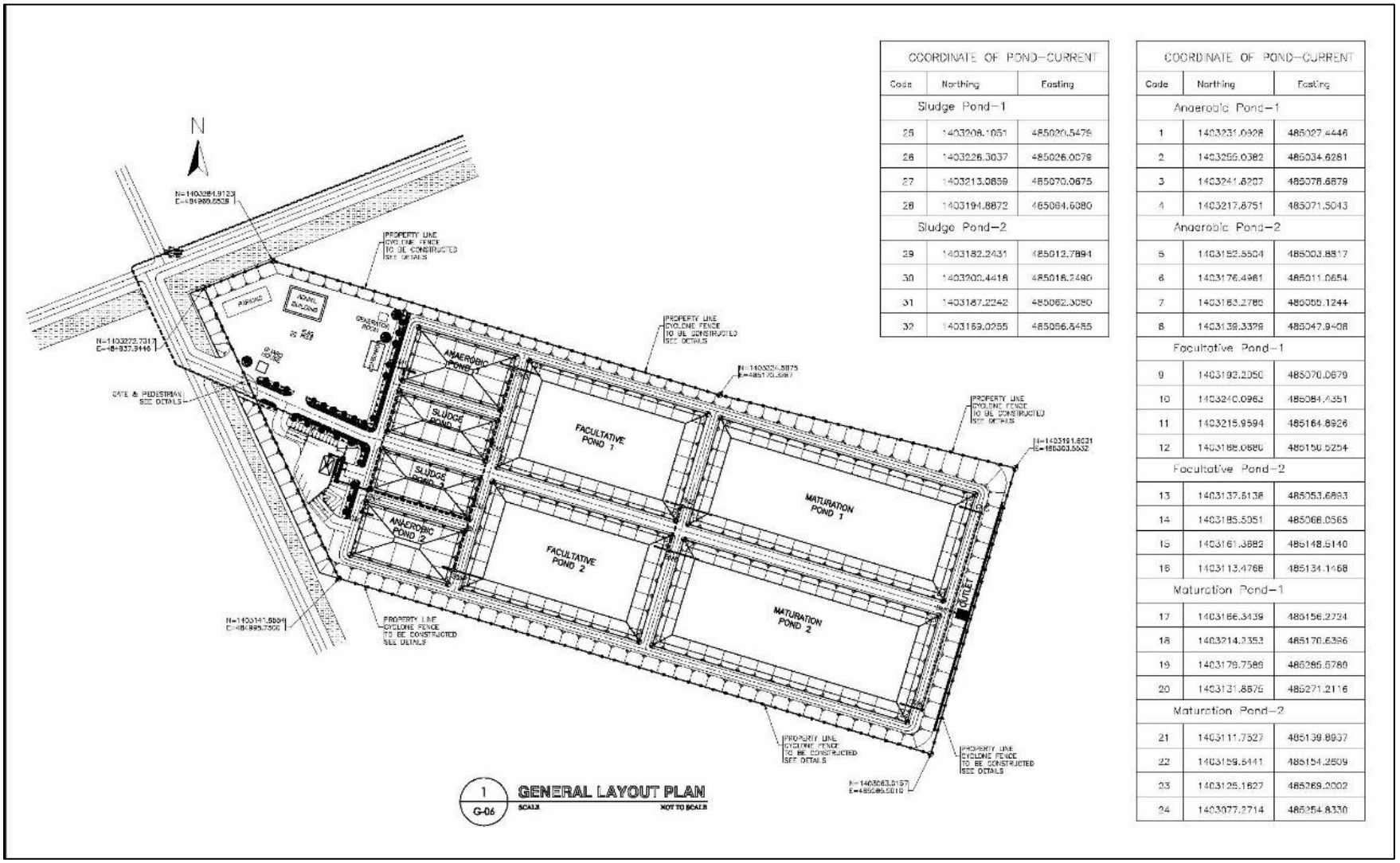
	
11/2009	08/2014
	
09/2017	08/2019

Figure 15: WWTP Layout

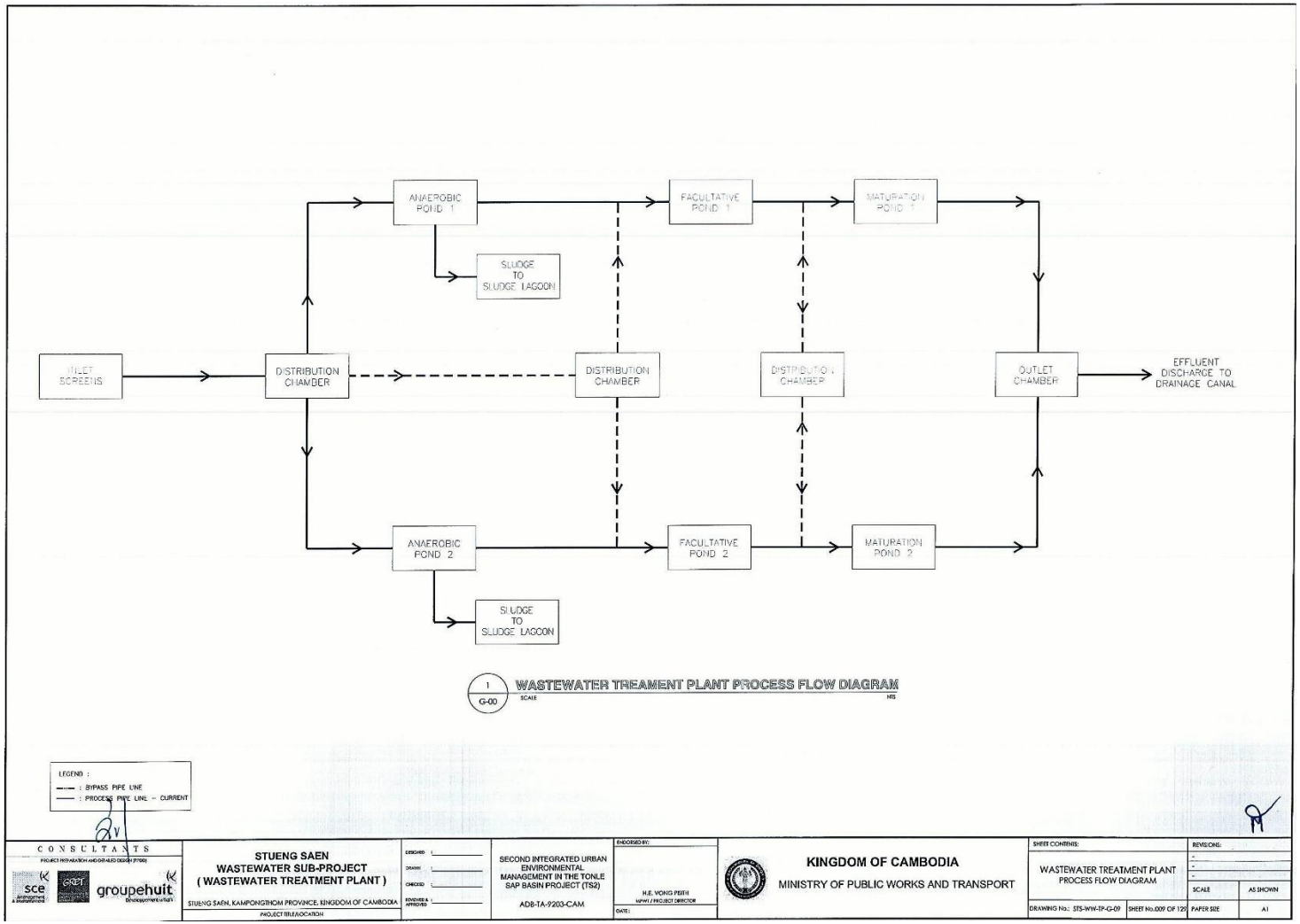


COORDINATE OF POND-CURRENT		
Code	Northing	Easting
Sludge Pond-1		
25	1403208.1051	485020.5479
26	1403226.3037	485026.0078
27	1403213.0859	485070.0675
28	1403194.8872	485064.6080
Sludge Pond-2		
29	1403182.2431	485012.7894
30	1403200.4418	485018.3490
31	1403187.2242	485062.3080
32	1403169.0255	485056.8485

COORDINATE OF POND-CURRENT		
Code	Northing	Easting
Anaerobic Pond-1		
1	1403231.0928	485027.4446
2	1403255.0382	485034.6281
3	1403241.8207	485078.6879
4	1403217.8751	485071.5043
Anaerobic Pond-2		
5	1403152.5504	485003.8817
6	1403176.4961	485011.0654
7	1403163.2765	485055.1244
8	1403138.3329	485047.9408
Facultative Pond-1		
9	1403193.2050	485070.0679
10	1403240.0963	485084.4351
11	1403215.9594	485164.8926
12	1403168.0680	485150.5254
Facultative Pond-2		
13	1403137.5138	485053.6883
14	1403185.5051	485068.0565
15	1403161.3882	485148.5140
16	1403113.4768	485134.1468
Maturation Pond-1		
17	1403166.3439	485156.2724
18	1403214.3353	485170.6396
19	1403179.7589	485285.5789
20	1403131.8675	485271.2116
Maturation Pond-2		
21	1403111.7527	485139.8937
22	1403159.5441	485154.2609
23	1403125.1627	485269.2002
24	1403077.2714	485254.8330

Source: Detailed Engineering Design Report, SCE 2019

Figure 16: Wastewater Treatment Plant Process Flow Diagram



Source: Detailed Engineering Design Report, SCE 2019

100. Treated effluent quality. The assumed concentrations of pollutants in the raw wastewater and the calculated concentrations after treatment are summarized in ***Table 9*** and compared with the applicable effluent standards. As indicated in ***Table 9***, the WWTP will be able to deliver water in a quality within the applicable effluent standards (Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 for public water area and sewer). Note that the Cambodian effluent standards do not include thresholds for bacteria, however the treated water will have a concentration of total coliform bacteria of less than 1,000 MPN/100 mg/L which is well below the Cambodian National Ambient Water Quality Standard of 5,000 MPN/100 ml.

Table 9: Wastewater Quality and Effluent Standards

Effluent Quality Parameter	Unit	Raw Influent[6]	Treated Effluent	Effluent Discharge Standards Cambodia[7]
pH		6.5-7.5	6.5-7.5	5-9
BOD_5	mg/L	500[8]	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[9]	TBC	<15
Oil and grease	mg/L	TBC	TBC	<15
Total coliform	MPN/100 mL	$1x10^6$ – $1x10^7$	1,000	-[10]

101. The BOD5 and coliform removal rates used for the design are shown in ***Table 10.***

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

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

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

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

[10] 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)

Table 10: 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

World Bank: Design and Operation of Waste Stabilization Ponds in Warm Climates of Developing Countries

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

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

- Workshop Building. A single-story building provided for 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 T 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 and Perimeter Fencing and Lighting. An access gate fabricated from galvanized iron pipes (frame), welded with cyclone wire. Barb wires will be affixed on top of the gates for added security. Concrete posts will be used to hold the hinged gates. Lock assemblies and rollers will complete the fabricated gates. The perimeter fencing will be comprised of cyclone wire encased in galvanized iron pipe frame, affixed to galvanized iron pipe post with concrete footing, topped with 3 rows of barbed wire. Site lighting will be provided for the facility.
- Water Supply. Water supply will come from the Water Supply Company. An overhead HDPE tank will be installed for water storage. Water will be supplied by gravity to administration and workshop buildings, and the inlet screening and septage receiving facility.
- Sanitation Facility. Wastewater from the toilets and showers will be collected by PVC sewer pipes and will be conveyed to the WWTP for treatment.

103. **Routine maintenance.** The routine maintenance of the WWTP will include:

- Removing screenings and grit from the inlet and outlet works;

- Cutting grasses on the embankment, and removing it so that it does not fall in the ponds;
- Removing floating scum and floating macrophytes from the surface of the maturation and facultative ponds. This will be done to maximise the light energy reaching the pond algae, increase surface re-aeration, and prevent fly and mosquito breeding;
- Spraying scum on the surface of the anaerobic ponds and not removing it, since this will help the treatment processes;
- Removing any accumulated solids in the inlet and outlet works;
- Repairing any damaged embankment as soon as possible; and
- Repairing any damage of the fences or gates.

4.6. Associated & Existing Facilities

104. 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.

105. 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.

4.7. Climate Change

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

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;
- Cultural and heritage sites; and
- Potential health and safety issues.

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

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

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

(iii) Effects from cumulative impacts 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 centres 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. 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 Leq 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: Site Field notes & Descriptions for photographs and site descriptions from field visits to subproject sites and the areas of influence.

5.2. Baseline Receptor Summary

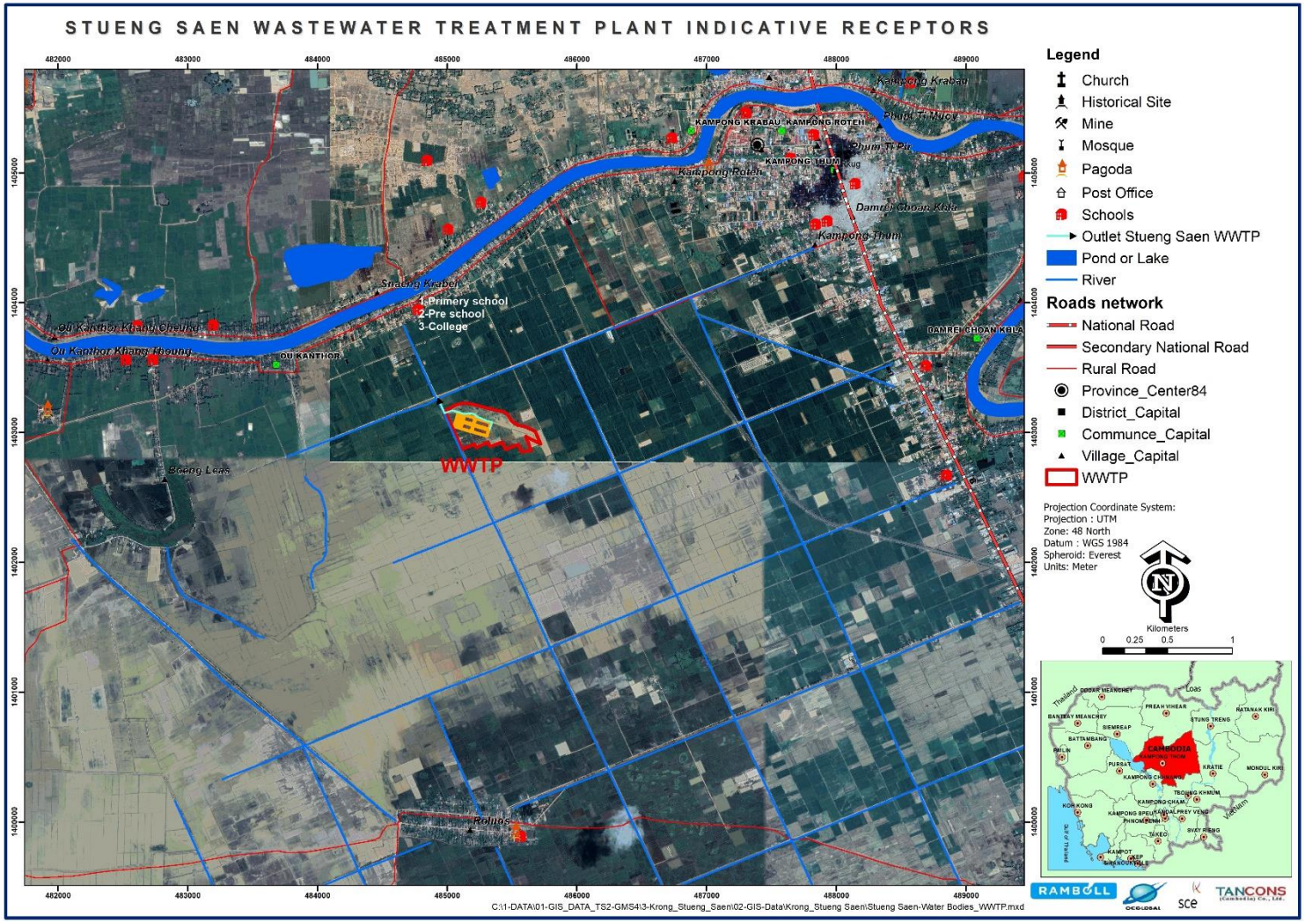
112. This section of the IEE provides the environmental baseline (description of the environment) for the project facilities. A site-specific summary for key receptors is provided in ***Table 11*** and their locations are indicated in ***Figure 17, Figure 18*** and ***Figure 19***.

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

Table 11: Summary of Subproject Components and Environmentally Sensitive Receptors

Subproject Component	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/ Ecological Receptors	Protected Area Status
Wastewater Treatment Plant	Effluent discharge to irrigation canals surrounding the site and then to Stueng Saen River about 1 km from the WWTP	School: 1 km northwest at Prek Sbov Nearest housing800 m north of the WWTP Distance to City: 3 km	Lowland rice fields	None
Wastewater Collection System	None	The subproject is in town, there are: houses, school, hospital, offices, markets, shops, and pagodas and local utility services along the road	The town area	None
2 Pump Stations	None	Housing across the road (<50 m)	Peri-urban, gardens, some cultivation, shrubs, trees	None
Stormwater Drainage System	Discharge to Stueng Saen River	Urban area with houses, school, hospital, offices, markets, shops, and pagodas and local utility services along the roads	Road and roadsides with street trees	None
Proposed Septage Disposal Site (septage from houses disconnected to the drainage system during construction)	1.8 km east of lake	650 m south of residential area along Road No 6 400 m to nearest single houses along local road	Agricultural land use	None

Figure 17: Stueng Saen: Wastewater and Drainage subproject, indicative receptors



114. The proximity of the pumping stations to residences, businesses or public buildings is indicated on the satellite images inserted in ***Figure 18***[11]. As discussed in ***Section 6.5.7***, 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 filters), should that prove to be warranted.

Figure 18: Pump station indicative receptors (red 20 m; yellow 30 m).

SPS1
0 houses < 20 m
1 houses < 30 m

SPS2
1 house < 20 m
2 houses < 30 m

115. Receptors relevant to the proposed septage disposal site are indicated in ***Figure 19***.

Figure 19 Receptors near the proposed septage disposal site

116. In addition to these facility specific receptors, housing, businesses and affected people's requirement for access are considered to be receptors. These receptors are found, for

[11] The 20 and 30 m radius indicated on the maps in Figure 18 are based on: Environment Protection Authority (2019), Sewage Pumping Station Environmental Guidelines, Environment Protection Authority, Hobart, Tasmania, October 2019

example, at locations where any excavations for pipe networks associated with the construction works. This is considered in the EMP mitigation measures.

5.3. Geography, Geology, Topography

117. This subproject is located in the urban provincial town of Kampong Thom Province. The area is dominated by the Tonle Sap Lake and this has affected the soil characteristics. As shown in ***Figure 20***, the subproject areas are dominated by alluvial soils, Stueng Saen has areas of red-yellow podzols from which minerals such as iron have been leached.

118. 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. **Error! Reference source not found.** shows the soil quality in the WWTP site.

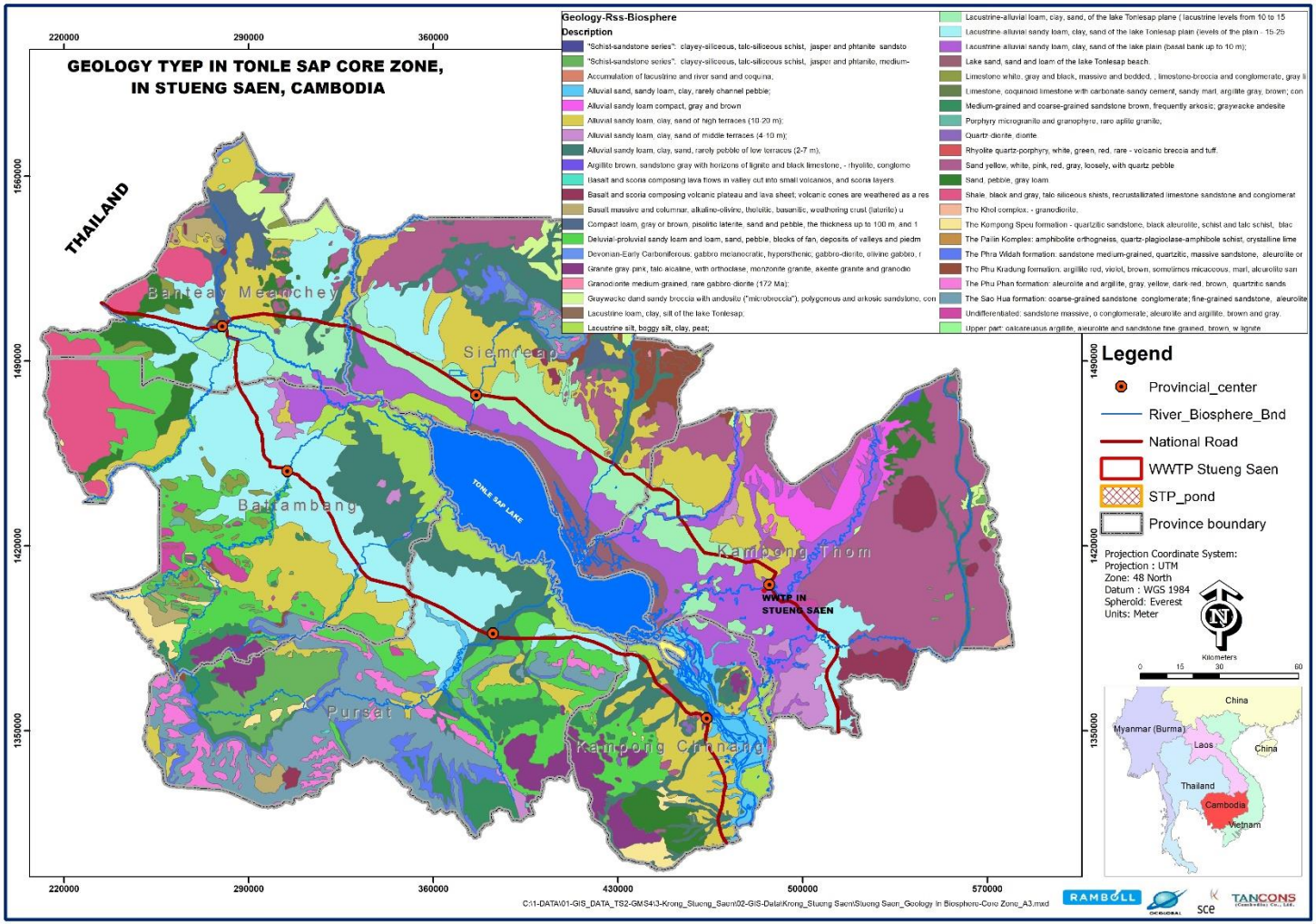
Table 12: The Soil Quality in WWTP Site

No	Parameter	Unit	Result
1	pH	-	5.30
2	N	%	0.17
3	K	m.e/100g Soil	0.56
4	Ca	m.e/100g Soil	7.80
5	Mg	m.e/100g Soil	2.80
6	Na	m.e/100g Soil	0.57
7	Organic Matter	%	3.14
8	C/N	Unit	11
9	TP	%	0.04
10	Phosphorus	%	30
11	CEC	m.e/100g Soil	25.20
12	Electrode Conductivity	US/em	39.50
13	Moisture	%	1.72
14	Clay	%	36.20
15	Fine Sediment	%	21.75
16	Coarse Sediment	%	20.47
17	Fine Sand	%	18.76
18	Coarse Sand	%	1.85

Source: MAFF Laboratory for IESIA Report Dec, 2019

- Soil sample location is near the WTP site
- The soil quality is analysed by laboratory of MAFF

Figure 20: Soil Map of Tonle Sap Basin



5.4. Meteorology and Climate Change

119. 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 (***Table 13*** and ***Table 14***).

Table 13: The Max of Temperature in Kampong Thom Town. 2014-2018

Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2014	31.1	33.4	34.3	34.3	35.0	32.0	32.0	33.9	33.7	33.4	34.3	34.2
2015	33.7	35.0	37.1	39.4	37.7	38.5	35.7	34.2	34.3	33.9	34.6	35.0
2016	34.5	35.8	38.7	40.6	39.1	37.7	36.0	34.3	34.4	33.4	33.9	33.5
2017	34.0	35.5	36.3	36.7	36.3	35.0	34.3	33.8	33.5	33.2	33.1	32.7
2018	35.8	33.4	36.5	37.5	34.9	34.0	34.4	34.0	33.5	34.5	35.0	35.0

Source: Meteorological Department, MOWRAM, 2018

Table 14: The Min of Temperature in Kampong Thom Town. 2014-2018

Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2014	16.8	17.5	22.3	22.7	24.0	24.1	23.5	23.8	23.1	22.0	22.0	18.5
2015	17.0	18.6	23.0	23.5	23.2	23.9	23.2	23.2	23.7	23.7	23.7	18.9
2016	16.2	15.9	21.0	24.5	24.4	23.4	20.5	23.6	20.0	21.5	22.7	20.0
2017	19.0	20.0	21.5	23.0	24.1	23.2	23.0	23.6	24.0	22.7	22.1	15.5
2018	16.0	21.8	20.5	20.4	23.2	23.5	23.7	21.1	20.5	20.0	20.0	20.5

Source: Meteorological Department, MOWRAM, 2018

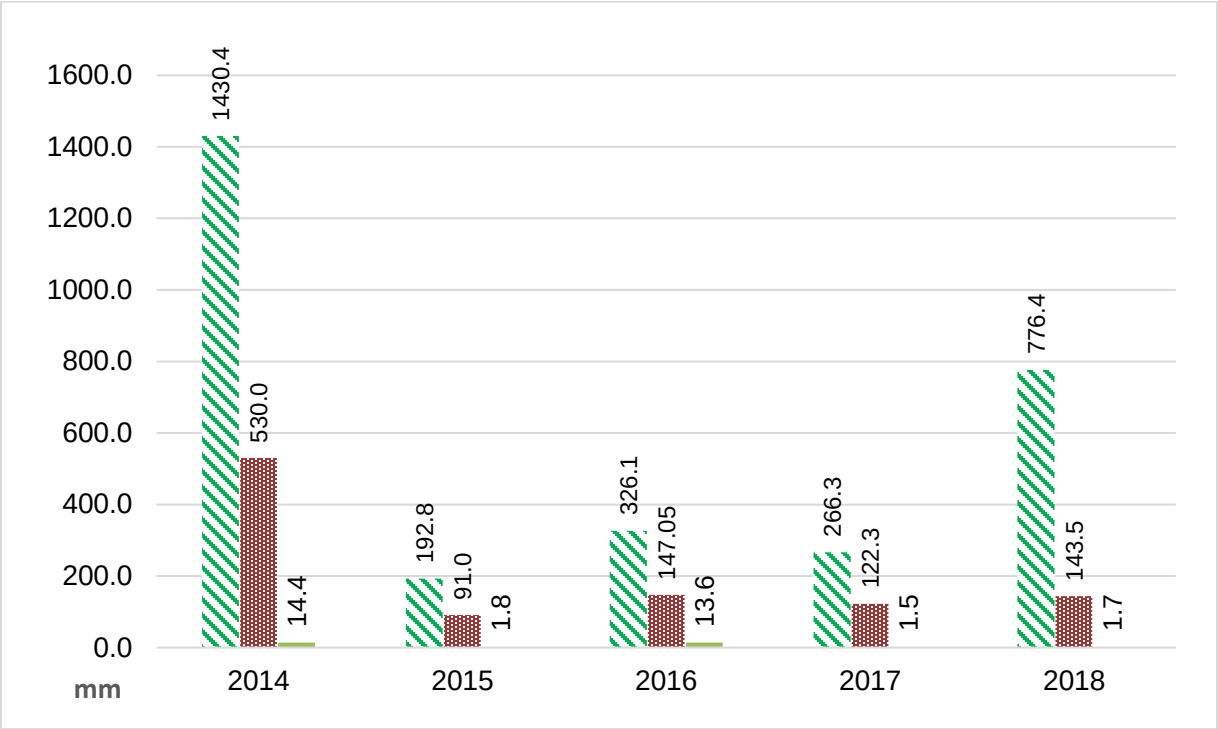
120. **Precipitation.** *Error! Reference source not found.* ***Figure 21*** summarizes rainfall data for Stueng Saen between 2015 to 2018.

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

122. **Climate Change Projections.** A Climate Risk and Vulnerability Assessment (CRVA) has been undertaken for this project based on site visits and climate change projections for the Year 2050 and RCP 8.5. The CRVA noted that many sites are vulnerable to flooding and as such mitigation measures in the design are required; the most significant climate change risks associated with the subprojects are 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 WWTPs. However, if effectively managed, the CRVA notes that new facilities will bring about improvements to the living conditions of the population of the project areas.

123. ***Table 15*** shows the impacts from climate change on the subproject as identified by the CRVA. These issues have been managed through design mitigation measures where appropriate.

Figure 21: Rainfall Data for Steung Saen 2015 - 2018



Source: Meteorological Department, MOWRAM, 2018

Table 15: 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.

124. 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°C. This factor is conservative and is recommended as a design factor

5.5. Hydrology, Surface and Ground Water

125. The Stueng Saen River with a length of 520 km is the longest river in Cambodia. The river is a tributary of Tonle Sap and has a catchment of 16,000 km^2. The river has an average annual discharge of 325 m^3/s, but there is a high seasonal and inter-annual variation with monthly averages of 400-700 m^3/s in the rainy season to monthly averages ranging from about 80 m^3/s down to just a few m^3/s during the dry season.

126. The Stueng Saen River is a main water source in Stueng Saen City. The river crosses the city and is about 1 km from the WWTP site, the water quality is not routinely monitored by MoE. ***Table 16*** summarizes the surface water quality of Stueng Saen River, upstream and downstream of the subproject area but both upstream the confluence with the irrigation canal to which the WWTP discharges. The data indicates that the national water quality standards were met at the time of sampling (2019).

Table 16: Surface Water Quality in Stueng Saen River

No.	Parameter	Unit	Standards	Result SWQ1	Result SWQ2
1	pH	mg/l	6.5-8.5	7.23	6.18
2	Total Dissolved Solid (TDS)	mg/l	< 100	28.00	25.00
3	Total Suspended Solid (TSS)	mg/l	25-100	91.00	26.00
4	Dissolved Oxygen (DO)	mg/l	7.5-2.0	6.40	6.60
5	Biochemical Oxygen Demand (BOD_5)	mg/l	1-10	1.40	1.00
6	Chemical Oxygen Demand (COD)	mg/l	< 50	4.70	4.30
7	Oil and Grease	mg/l	< 5.0	5.20	5.20
8	Detergent	mg/l	< 5.0	0.08	0.02
9	Sulphate (SO_4)	mg/l	< 300	21.00	20.00
10	Total Nitrogen (TN)	mg/l	0.1-0.6	0.68	0.65
11	Total Phosphorus (TP)	mg/l	0.005-0.05	0.30	0.24
12	Lead (Pb)	mg/l	< 0.01	0.01	0.008
13	Arsenic (As)	mg/l	< 0.01	0.005	ND
14	Cadmium (Cd)	mg/l	< 0.001	ND	ND
15	Iron (Fe)	mg/l	< 1	8.37	6.20
16	Mercury (Hg)	mg/l	< 0.0005	0.0002	0.0002
17	Total Coliform Bacteria	MPN/100ml	< 5000	$4.3x10^3$	$9.3x10^3$

Source: MoE November 2019

SWQ1: Surface water quality in downstream of Stueng Saen River (X: 488413, Y: 1405335) – 700 m upstream the bridge for National Road No. 6

SWQ2: Surface water quality in downstream of Stueng Saen River (X:487079, Y:1405387) – 800 m downstream the bridge for National Road No. 6

127. The closest surface water body to the subproject site is the Chhum Nick Pond (***Figure 11*** and ***Figure 13***) - a 4 ha pond that farmers pump dry for irrigation of rice fields in the dry season. The pond is connected to the network of irrigation canals in the area, and it is naturally refilled in the rainy season. The water quality in the pond has been analysed and the results are listed in ***Table 17***. The irrigation canals drain into the Stueng Saen River which is therefore considered the natural recipient of the effluents from the WWTP.

128. There are no protected surface water bodies within the area of influence. The Steung Saen River drains into the Tonle Sap Lake about 70 km from Stueng Saen City (***Figure 22***).

Table 17: Surface Water Quality in Chhum Nick Pond at the subproject site

N.	Parameter	Unit	Standards (Lake)	Result
1	pH	mg/l	6.5-8.5	6.28
2	Total Dissolved Solid (TDS)	mg/l	< 100	26.00
3	Total Suspended Solid (TSS)	mg/l	25-100	120.00
4	Dissolved Oxygen (DO)	mg/l	7.5-2.0	2.20
5	Biochemical Oxygen Demand (BOD_5)	mg/l	< 30	2.80
6	Chemical Oxygen Demand (COD)	mg/l	1-8	11.96
7	Oil and Grease	mg/l	< 5.0	11.53
8	Detergent	mg/l	< 5.0	0.22
9	Sulphate (SO_4)	mg/l	< 300	240.00
10	Total Nitrogen (TN)	mg/l	0.1-0.6	5.62
11	Total Phosphorus (TP)	mg/l	0.005-0.05	2.25
12	Lead (Pb)	mg/l	< 0.01	0.02
13	Arsenic (As)	mg/l	< 0.01	ND
14	Cadmium (Cd)	mg/l	< 0.001	ND
15	Iron (Fe)	mg/l	< 1	0.66
16	Mercury (Hg)	mg/l	< 0.0005	0.0004
17	Total Coliform Bacteria	MPN/100ml	< 5000	$7.5x10^3$

Source: MoE November 2019. Surface water quality in Chhum Nick Lake (small lake, X: 484924, Y: 1403246).

129. Groundwater. Based on field visits and discussions with local authorities and people, local people in Stueng Saen Town use water from Provincial Water Supply Authority for household consumption, some of them use water from the river and canals for irrigation. The field observation did not find any groundwater wells located in or near the WWTP site. The soil strata at the WWTP site encountered by the geotechnical investigations[12] consists of 7-8 m of clay followed by silty sand down to the drilling depths of 15 m to 20 m below ground. Groundwater was detected at greater depths during drilling and stabilized a few hours after completion of the drillings at 0.5 m – 0.9 m below ground. This confirms low permeability in the upper clay layer.

5.6. Air Quality

130. Field visits indicate that air quality in the project sites is good, as the project areas are located in rural areas without significant industrial/commercial zones to cause air quality degradation. Typically, in Cambodia, outside Phnom Penh or town centers there are few

[12] 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

industrial pollution sources, and the volume of vehicular traffic is low. However, there are limited of existing data of air quality in the project towns as shown in ***Table 18***.

Table 18: Air Quality, Stueng Saen City

No	Parameter	Unit	National Standards	Result
1	Carbon Monoxide (CO)	mg/m^3	20 (8 hours)	0.25
2	Nitrogen Dioxide (NO_2)	mg/m^3	0.1 (24 hours)	0.008
3	Sulphur Dioxide (SO_2)	mg/m^3	0.3 (24 hours)	0.015
4	O_3	mg/m^3	0.5	0.18
5	Total Suspended Particles (TSP)	mg/m^3	0.33 (24 hours)	0.089
6	(Pb)	mg/m^3	0.005	ND
7	Methane (CH_4)	mg/m^3	-	ND
8	PM 10	mg/m^3	0.05	0.037
9	PM 2.5	mg/m^3	0.025	0.012

Sources: MoE Laboratory December 2019. The air quality is conducted in Stueng Saen Town by MoE laboratory

5.7. Noise

131. Field visits indicate that noise levels in the WWTP location are not significant, due to WWTP area is located in rural area without industrial/commercial noise sources (Table 19). The drainage and sewage network areas are in urban location which are subject to noise primarily from local traffic.

Table 19: Table: Noise Level in subproject site

Period	Survey time	Noise Level dB(A)			Standards
		LAeq	LAmax	LAmin	
Day	6:00 - 7:00	44.3	63.9	34.7	70
	7:00 - 8:00	45.4	72.0	32.7	
	8:00 - 9:00	54.2	72.7	31.4	
	9:00 - 10:00	40.8	58.2	32.1	
	10:00 - 11:00	46.1	63.3	33.8	
	11:00 - 12:00	46.8	67.9	32.0	
	12:00 - 13:00	57.1	90.8	32.1	
	13:00 - 14:00	49.4	62.2	35.3	
	14:00 - 15:00	42.7	56.3	37.0	
	15:00 - 16:00	42.3	49.5	34.9	
	16:00 - 17:00	49.2	75.6	42.3	
	17:00 - 18:00	58.5	69.1	44.4	
Evening	18:00 - 19:00	43.7	69.1	32.0	65
	19:00 - 20:00	49.0	55.5	33.7	
	20:00 - 21:00	49.6	55.6	39.0	
	21:00 - 22:00	52.6	56.0	35.7	
Night	22:00 - 23:00	52.0	55.9	35.6	50
	23:00 - 00:00	52.4	59.0	39.4	
	00:00 - 1:00	47.4	59.7	36.6	
	1:00 - 2:00	49.3	54.8	36.5	
	2:00 - 3:00	53.3	55.6	44.7	
	3:00 - 4:00	53.7	56.8	44.9	
	4:00 - 5:00	53.6	56.3	45.3	
	5:00 - 6:00	45.6	59.5	37.4	

The Average in 24 hours	**49.1**	**62.3**	**36.8**	

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

5.8. Natural Disasters

132. 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.

133. ***Table 20*** presents Natural Disasters occurring between 2012-2014 in provinces of TS-2 Project and shows that the largest impact on the population around the Tonle Sap, in the project area, is flooding. Also, of note is the increase in drought affected households in 2013 and 2014 for the cities of Serei Saophoan and Stueng Saen. In addition, the socio-economic survey undertaken for this project (see Feasibility Study Volume 4) confirmed that 69% of respondents had experienced a flood where they are now living; the main sources of flooding were cited as drainage system (49%), river (27%) and canal (11%).

Table 20: Natural Disasters 2012-2014

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

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

5.9. Physical Cultural Resources

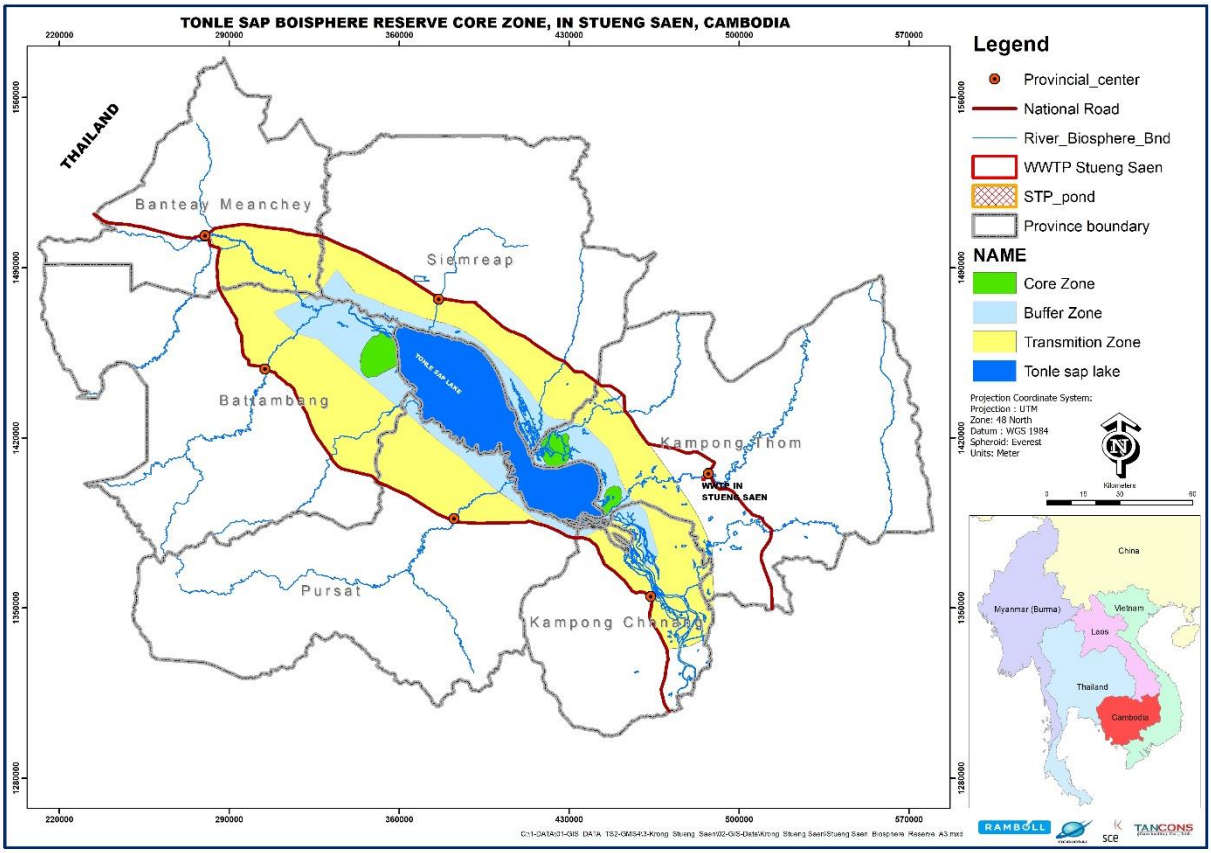
134. The WWTP site is located in rural area surrounded by rice fields. Steung Saen City is located about 4 km from the WWTP. The wastewater and drainage networks and pump stations are located in the urban area of Stueng Saen City, which has places of worship, in particular pagodas, old buildings, and governmental office buildings, however, there are no temples or other sensitive cultural resources located near the subproject areas (***Figure 17***).

5.10. Special or Protected Areas

135. Of the 23 Protected Areas in Cambodia, the closest to the project is the Tonle Sap Biosphere Reserve (TSBR) which is located in Kampong Chhnang, Pursat, Battambang, Siem Reap, Banteay Meanchey, and Kampong Thom provinces. The TSBR is classified as a multiple use zone and covers an area of 316,250 ha. It has three core zones which are strictly controlled for biodiversity and conservation. Note that these are not within the area of influence and will not be impacted by the project; the nearest core zone is called Stueng Saen, approximately 70 km downstream Stueng Saen town.

136. The Tonle Sap Authority was established by the RGC in 2009. It is mandated to coordinate the management, conservation and development of the Tonle Sap Lake region and TSBR. A map showing the TSBR and core zones is shown in ***Figure 22***.

Figure 22: Tonle Sap Biosphere Reserve



5.11. Ecological Resources

137. Flora. Biodiversity screening of the project sites using IBAT was carried out. The project area does not contain any protected areas or habitats of particular biodiversity value. Stueng Saen subproject area 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 includes a number of common species including rattan (Calamus sp), acacia (Acacia Auriculiformis) bamboo (Bambusa Arundinacea), snowy orchid (Bauhinia Acuminata), but no Threatened species have been found. There are no trees in the WWTP site itself.

138. 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. The IESIA team conducted further consultations and investigations on fish resources, which are detailed in ***Annex 5***.

139. 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 29 species of birds observed in their locality, with the majority being seen in Stueng Saen. ***Table 21*** lists the species noted for Stueng Saen. Heliopais Personata is the only endangered species. It is classified as endangered due to degradation of wetland and riverine lowland forest habitats in Asia. The favored habitat is well vegetated wetlands, including swamps and lake edges; however, there are no such habitats within the project area of influence and it is therefore assessed that the project will not cause any impact on that bird species. Apart from the observation by one of the interviewees, the closest most recent sighting of the species around the Tonle Sap was at Boung Chma in 1998 - approximately 65 km from Stueng Saen Town.

Table 21: Locally observed bird species, Stueng Saen Residents

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

No	Khmer Name	English Name	Scientific Name	IUCN Status

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

140. Socio-economic data were obtained from Commune/sangkat discussions during the DED preparation. ***Table 22*** 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. This subproject is located in 03 communes: Damrei Chaonkhla, Kampong Thom, and Kampong Roteas Commune, ***Table 23*** presents the population in subproject areas.

Table 22: Socio-Economic Data

Project City	No. Communes	Total Population	No. Female Headed HH	Khmer Islam Pop.	Vietnamese Pop.	Poor Level 1 HH*	Poor Level 2 HH*	% Poor (1+2)
Stueng Saen	8	57216	2471	121	46	882	1342	17%
Ministry of Interior classification HH= Household								

Source: PPTA Team 2018

Table 23: Population in communes and villages in Subproject areas

No	Commune	Village	Total family	Male	Female	Total population
1	Damrei Chaonkhla	Damrei Chaonkhla	520	1335	605	1940
2	Kampong Thom	Village 1	111	300	252	552
		Village 2	56	117	142	259
		Village 3	44	101	101	202
		Village 4	51	117	120	237
		Village 5	35	70	75	145
		Village 6	61	108	128	236
		Village 7	138	302	313	615
3	Kampong Rotes	Kampong Thom	740	1824	2127	3951
	Total		**1756**	**4274**	**3863**	**8137**

Source: Commune Data Book 2018

141. Socio-Economic Survey of 1478 respondent was undertaken during Project Preparation Technical Assistance (PPTA) of TS-2 Project. A full analysis of the survey results is provided in Volume 4 of the Feasibility Study. However, a few key points relevant to environmental safeguards are summarized here, for all provinces:

- Electricity / Infrastructure. 97% of households are connected to the electricity grid
- Sanitation. 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 waste collection service in their area, the remainder does 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.

142. 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 and three responses stated ‘’canal’’; as a water source. This indicates that there is potential for a small number of community residents to use the canal network as a water source. It is not known what subsequent treatment the resident may then undertake on the water, such as boiling, chemical or UV treatment.

143. **Occupation:** The result for interview with 95 households in subproject area. The main occupation of head family and other occupation in family is shows in ***Table 24*** and in ***Table 25***.

Table 24: Main head family occupation in commune.

No.	Occupation of head family	Kampong Thom	Kampong Roteas	Danrei Chhoan Khla	Total	Percent %
1	Government	11	22	7	40	42
2	Business/Trade	10	7	14	31	33
3	Company/NGO	0	8	3	11	12
4	Hair Cut	3	1	2	6	6
5	Transporting service	1	1	0	2	2
6	Moto Repairing	0	0	2	2	2
7	Construction job	1	0	0	1	1
8	Pharmacy shop	1	0	0	1	1
9	Car-moto washing	0	1	0	1	1
	Total	**27**	**40**	**28**	**95**	**100**

Table 25: The supplementary / other occupation in families by commune

No.	Occupation of head family	Kampong Thom	Kampong Roteas	Danrei Chhoan Khla	Total	Percent %
1	Business/Trade	12	24	15	51	38
2	Company/NGO	16	15	17	48	36
3	Government	5	3	3	11	9
4	Tailor	1	6	0	7	5
5	Transporting service	2	4	0	6	4
6	Hair Cut	1	3	2	6	4
7	Car-moto washing	0	3	0	3	2
8	Pharmacy shop	1	1	0	2	1
9	Moto Repairing	0	1	1	2	1
	Total	**38**	**60**	**38**	**136**	**100**

Source: IESIA report. SBK January 2020.

144. **Migration:** The migration is relative to poverty condition. Some young people migrate to Phnom Penh, and some go to a foreign country for finding jobs (see ***Table 26***).

Table 26: The migration condition in subproject area

No.	Commune	Village	Total family	Inside country		Foreign Country		Poverty Rate	
				Female	Total	Female	Total	# Family	%
1	**Damrei Chhoan Khla**	Damrei Chhoan Khla	520	10	15	5	11	**22**	**5%**
2	**Kampong Thom**	Village-1	111	23	56	0	3	**10**	**9%**
3		Village-2	56	6	16	3	5	**2**	**4%**
4		Village-3	44	3	6	0	0	**0**	
5		Village-4	51	0	0	0	0	**0**	
6		Village-5	35	0	1	3	3	**0**	
7		Village-6	61	23	45	0	0	**3**	**5%**
8		Village-7	138	12	30	4	7	**11**	**8%**
9	**Kampong Roteas**	Kamp. Thom	740	81	149	19	34	**90**	**12%**
			1756						

145. **Land Use.** The land use in the communes of the subproject as registered in Commune Data Book 2018 (SBK, January 2020) is shown in ***Table 27***. The dominant land use is for rice production.

Table 27: Land Use in the subproject area

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

146. **Education.** Based on interviews with 95 households in in the subproject area (3 communes), the number students for each education level is shown in ***Table 28***.

Table 28: Students finished education level

		Commune name			Total	%
No.	Education level	Kampong Thom	Kampong Roteas	Damrei Chhoan Khla		
1	Primary school	0	1	0	1	1
2	Secondary school	6	13	7	26	27
3	High school	16	24	16	56	59
4	University/college	5	2	5	12	13

Source: IESIA report. SBK January 2020

147. **Health and Sanitation.** 95 households in the subproject area were interviewed about their health conditions in 2018. The results of the interviews are summarized in ***Table 29***.

Table 29: The type of diseases and number of cases in the subproject area in 2018

No.	Type of diseases	Number of cases	Percentage (%)
1	Flu	89	21.6
2	Headache	88	21.3
3	Fever	87	21.1
4	Coughing	60	14.5
5	Diarrhea	49	11.9
6	Stomach Disease	11	2.7
7	Respirator Disease	11	2.7
8	Blood Pressure	5	1.2
9	Fiber-Joints Disease	4	1.0
10	Dengue Fever	4	1.0
11	Typhoid Fever	3	0.7
12	Diabetes Disease	2	0.5
	Total	**413**	**100**

Source: IESIA report. SBK January 2020

6. ANTICIPATED IMPACTS AND MITIGATION MEASURES

6.1. Project Environmental Benefits

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

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

150. 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

151. 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).

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

6.3. Impacts Associated with Project Location, Planning and Design

153. 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)[13]; and (b) contracting of international and national Project Management Consultant for Environmental Safeguards (PMC- I/NES) will be carried out. Prior to the start of construction, an environmental capacity building and training program will be delivered by the PMC. The training will focus on ADB's and

[13] 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.

Cambodia's relevant environmental, health and safety laws, regulations and policies; implementation of the EMP, environmental monitoring, requirements for information disclosure, public consultation and the project GRM. Training will be provided to the PIUs, and contractors.

(ii) Grievance Redress Mechanism (GRM). In accordance with the GRM (see EMP), 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 (if required): Mitigation measures defined in this IEE and the associated EMP have been updated based on the final engineering design, the IESIA and Variation Order No 3. This is the responsibility of the PMC with support from PMU. The revised documents will be submitted to ADB for clearance and disclosure on ADB's website.

(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 CEMP.

(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. Proper site selection is critical for the prevention or minimization of impacts on receptors, particularly with respect to a) residential areas, b) surface water including rivers and canals, and c) groundwater. The potential sites were discussed in detail in terms of suitability in the Feasibility Study Report Volume 2 – Engineering Design.

(vii) Environmental Quality. Undertake key baseline surveys to inform detailed design and the domestic IESIA including water analysis of receiving waters for WWTP effluent.

(viii) 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

6.4.1. Impedance of traffic.

154. 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:

a) Provide notices to the public advising of timing and duration of construction work and the effects on traffic routes during construction;
b) Place "safety first" traffic signs and warning signs,
c) Identify and mark detours when necessary;
d) Arrange temporary traffic signals;
e) Liaise regularly with traffic police;
f) Clearly demarcate construction sites; and
g) To the extent practicable, schedule work that blocks roadways to periods of low traffic.
h) Ensure that a speed limit of 20 km/h is enforced at all construction sites.

6.4.2. Air Quality

155. Moderate temporary and localized air quality impacts during the construction stage of the project are anticipated because of fugitive dust generation associated with construction works (breaking of surfaces, loading and unloading), earth works, waste movement and exhaust fumes from vehicles. The receptors for lower air quality are businesses and residents within the local area particularly downwind of the construction activities. Dust will be generated during the installation of pipe networks through excavations in urban areas which are by their nature, densely populated.

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

a) Emissions from construction machinery and equipment, movement of haulage trucks will lead to minor increases in levels of nitrogen oxides (NOx) and sulfur oxides (SOx);
b) Asphalt for road pavement reinstatement will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH);
c) Fugitive dust from borrow pits and all excavations;
d) Fugitive dust from loading, unloading and haulage of construction materials;
e) Fugitive dust and bioaerosols from movement of waste within existing dumpsites and to new sites; and
f) Fugitive dust from concrete batching plants.

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

a) 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.
b) Water will be sprayed for construction sites, material handling areas, borrow pits, construction sites (road section), where fugitive dust is generated.
c) Trucks carrying dry and loose construction materials such as earth or waste will be covered with tarpaulins or other suitable cover.
d) Construction vehicles and machinery will be maintained to a high standard to minimize emissions.
e) Waste pickers and all residential areas within 500m of existing dumpsites will be informed in advance of when waste movements will take place.
f) Areas in which road excavations are required for sewage and drainage pipe works will be notified adequately 1 month in advance of works starting.
g) Ensure that a speed limit of 20 km/h is enforced at all construction sites

6.4.3. **Noise**

158. Noise impacts will be temporary and localized at all construction sites from construction machinery and vehicles generate noise when they operate. Other noise sources include loading and unloading of equipment. As set out in 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.

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

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

b) Restrict construction activities using heavy machinery work between 8 am and 6 pm. In any cases, the constructor shall collaborate with local authorities and affected people to select proper working hours to mitigate the impact of noise (in town, streets or near sensitive sources).

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

d) Ensure noise monitoring is undertaken near sensitive receptors, particularly dwellings when construction machinery is operated;

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

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

g) Ensure that a speed limit of 20 km/h is enforced at all construction sites

6.4.4. Flora and Fauna

160. 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.

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

a) All trees over 3 m high in construction sites or access areas to be protected from construction activities if they are not required to be removed;

b) 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.

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

6.4.5. **Surface Water**

163. Construction will take place in areas which have a network of irrigation canals, used for both household water requirements such as laundry and bathing as well as for fishing. Short term construction impacts may be seen in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals and canals are dredged. Also, some construction activity will be required at the riverbank where outfalls for WWTP effluent or drainage are required.

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

a) Potential impacts on surface water will be mitigated through the following measures:

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

c) Installation of temporary storm drains or ditches for construction sites to manage and control the flow and direction of surface water runoff.

d) Installation or building the dykes or dams around the WWTP site to protect run-off and big flood flows in and out of WWTP.

e) Maintenance of irrigation water supplies during dry season works within or around irrigation canals.

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

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

h) Stockpiles and materials will be stored at least 50 m from surface waters with drainage system to direct away the runoff from the irrigation canals or drainage channels.

i) All construction fluids such as oils, and fuels should be stored and handled on a bunded impermeable surface; a bund will be provided around any above ground fuel storage tanks with a capacity of 110% of the largest single tank or 25 percent of the total storage capacity (whichever is greater).

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

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

j) The use of vehicles can cause risks of soil and water pollution, in the event of leaks and spills of fuel, lubricants, hydraulic fluid or other fluids used for vehicle operation. To reduce risks and limit impacts the contractor will be required to ensure that vehicles are maintained in sound operable condition, free of leaks and that the condition of vehicles and equipment is regularly checked. The contractor will prepare and submit a plan for spill management, including provision of spill kits, training/briefing of workers on procedures on handling spills and allocation of responsibility within the contractor's team for ensuring that spill kits are available and that workers know how to use them.

6.4.6. Groundwater

165. 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.

6.4.7. **Soil and Land**

166. 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. Excavations from pipe trenches and foundations for structures will involve making temporary stockpiles of material that will either be removed or re-used as backfill. 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.

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

a) Site specific spoil and borrow site management plan will be developed and approved by the relevant Municipal authority;
b) Excavated areas are rapidly refilled on completion of works.
c) Stabilize soils once the pipeline is in place.
d) Place silt fences around temporary piles of excavated material.
e) Avoid excavation of trenches in wet weather to the extent practicable.
f) A map of all borrow sites will be developed and maintained with copies held by the Contractor and PIU;
g) Safety measures, if required, will be implemented to prevent access by members of the public and livestock;
h) Measures to rehabilitate the borrow sites include contouring of the slopes within each site and replanting sites with native species;
i) Topsoil at 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;
j) No disposal of spoil material on agriculturally productive land or within 50 m of a water course.
k) Construction working areas will be clearly demarcated and encroachment onto adjacent areas avoided.

6.4.8. Solid Waste Management

168. Impacts may arise from waste generated during construction such as inert wastes e.g. spoil, biodegradable wastes e.g. cleared vegetation, and hazardous wastes e.g. oily wastes. Poor waste management can lead to impacts such as wind-blown litter, contamination of water bodies and soil, and other impacts on public health for example from open burning of waste.

169. Potential impacts linked to waste will be mitigated through the following measures (for management of spoil see also ***Section 6.4.9*** and for septage see ***Section 6.4.10***):

a) The contractor shall develop and implement a solid and liquid waste management plan under the CEMP.
b) The contractor shall aim at reducing waste generation through careful planning of material and equipment use, good maintenance of equipment, and repair.
c) The contractor shall ensure effective management of materials on site through good housekeeping and work planning;

d) The contractor shall make clear arrangements for storage, transportation and disposal of all hazardous and non-hazardous waste to a duly authorised waste management and disposal enterprise (public or private).

e) The contractor shall segregate recyclables (as a minimum: plastic containers, scrap metal and metal cans, glass containers, cardboard and paper) for collection or purchase by duly authorised recyclers.

f) No waste will be stored within 20 m of a water body

g) All solid waste will be stored in containers with lids.

h) All worksites will be equipped with containers for waste collection

i) Littering and indiscriminate disposal of waste will be prohibited and strictly controlled.

j) All open burning of waste will be prohibited.

6.4.9. **Management of Spoil Materials**

170. Disposal of soil and concrete materials from the removal of existing drains will be carried out in accordance with the following measures:

a) The soil excavated for the removal of existing drains will be transported to a dedicated spoil disposal site within the premises if the WWTP but outside the fenced area (see ***Figure 9***). Excavation of the drains will be carried out with great care not to damage the elements and salvageable concrete elements will be handed over to the municipality for reuse in other projects. The remaining concrete drain structures will be separated during excavation and brought to the disposal site where the concrete will be crushed, and rebar will be separated for sale as scrap metal. The crushed concrete will preferably be used for slope stabilization (including stabilization of the soil deposit slopes), or as aggregate in construction works to the extent that the materials have the required properties. Any unused crushed concrete will be deposited together with the soil in the spoil disposal site.

b) The spoil disposal site is a flat area without vegetation and will not cause any loss of sensitive habitats.

c) The site boundaries will be set out to ensure that the surrounding land is not disturbed;

d) All excess spoil materials from the removal of the existing drains will be disposed of within the boundaries of the designated disposal site and no spoil materials will be side tipped along roads or down slopes, dumped on private or public land, or dumped in water bodies.

e) The spoil disposal site will be prepared and made ready prior to start of the drain removal work.

f) Erosion and sediment controls will be constructed as necessary to prevent or minimise excessive discharge of sediment-laden runoff.

g) Only inert waste will be disposed of at the spoil disposal site.

h) Roots and stumps and other vegetation debris will be separated from the spoil materials prior to disposal and either mulched on-site for reuse in landscaping or ground stabilization works, left to decompose naturally, or otherwise safely disposed.

i) Routine inspections, not less frequently than once a week, will be carried out of water pollution, erosion and sediment control measures, and any necessary repair or maintenance work will promptly be implemented to ensure integrity of the design.

j) Inspections will be undertaken within 24 hours of a heavy rainfall event.

k) Any topsoil will be stockpiled for later site rehabilitation.

l) The site will be recontoured, depressions will be filled, and the site will be revegetated to create a final surface that is consistent with the original topography of the area;

m) The final landform and slopes will be designed to prevent surface water ponding, to facilitate revegetation, to convey runoff in a non-erosive manner, and to account for long term settlement.

n) The site will be revegetated to establish a diverse, effective, and long-lasting vegetative cover that is capable of self-regeneration without continued dependence on irrigation, soil amendments or fertilizer, and is at least equal in extent of cover to the natural vegetation of the surrounding area;

o) The site will be revegetated with appropriate native and non-invasive plant species.

6.4.10. Management of Septage from Disconnected Households

171. Septage may contain bacteria, viruses, and parasites that can cause diseases and therefore pose a risk to public health and the environment. The highest risks include the risk that septage comes in contact with groundwater or surface water used for domestic consumption, the risk of contact with crops used for human consumption, and the risk of direct exposure for workers handling the septage, for people accessing sites where septage has been deposited, and the risk of direct exposure or pollution of water bodies due to spills.

172. Septage has a strong nuisance odour which is a concern during handling and after land application, however, a well-managed operation that incorporates lime stabilization, subsurface injection, or burial creates minimal odour emissions.

173. Potential impacts on public health and the environment will be mitigated through the measures[14] stipulated hereunder. The Contractor shall prepare and submit a method statement that to the satisfaction of PMU/PMC demonstrates full compliance with the requirements stipulated hereunder and in the EMP.

a) Prior to execution of any work under Variation Order No. 3 that would require disposal of septage, the PIU together with the Contractor will consult with the affected households and obtain their consent to the proposed septage removal process.

b) The Contractor shall demonstrate that the proposed septage disposal site (see ***Figure 8***) complies with the selection criteria indicated in ***Table 30***. The method statement shall include topographic maps and satellite images in proper scale where the site and receptors are clearly marked. The method statement shall include site layout drawings indicating surface drainage and any trenches or pits to be excavated for disposal of septage.

Table 30: Septage Disposal Site Selection Criteria

Site Selection Criteria	Proposed Site Conditions[15]
Preferably on agricultural land or other non-public land	
At least 75 m from groundwater well	

[14] These measures are adapted from: Guide to Septage Treatment and Disposal, United Stated Environmental Protection Agency, September 1994

[15] This shall be filled in by the Contractor and included in the method statement to be submitted to PMU/PMC for review and approval

Site Selection Criteria	Proposed Site Conditions[15]
At least 500 m from residential area and 150 m from single houses	
No direct drainage to surface lake, river or stream	
Not in ecological sensitive area (e.g. Protected Area or Key Biodiversity Area or on land that hosts Threatened (IUCN Red List) plant or animal species	
Not in wetlands, waterways or in riparian zones	
Not in land with spiritual, cultural, historical or archaeological value	
On flat land with slope not exceeding 2%	
In an area with depth between the bottom of septage trenches or pits and the seasonal high groundwater table would at least be 2 m	
Not in a flood prone area	

c) The Contractor shall provide evidence of agreement with the landowner of the proposed septage disposal site. The agreement shall include the land use restrictions stipulated in this ***Para 173***.

d) The Contractor shall inform households/businesses at least 1 day before pumping their septic tank.

e) The septage shall be disposed by land application method either by burial in trenches or pits that shall immediately be backfilled with soil, or by incorporating the septage into the soil immediately upon application.

f) To reduce odour and pathogen content, the septage shall be pre-treated with lime prior to land application. Lime shall be mixed with the septage to increase the pH of the septage to at least 12.0 for 30 minutes (2.4 to 3.0 kg per 1,000 L CaO or quicklime). The lime may be added as slurry either to the vacuum truck before the septage is pumped, or to the vacuum truck while the septage is being pumped.

g) In the event of a spill of septage, the septage should be immediately cleaned up. Hydrated lime should be sprinkled over the area of the spill, and the spill should be removed for example with a suction wand attached to the end of the vacuum hose. For large spills, a second vacuum truck may be necessary. The Contractor should reach an agreement with another company to assist in emergency spill clean-up.

h) Food crops with harvested parts that touch the septage/soil mixture and are totally aboveground shall not be harvested from the land for 14 months after application of the septage.

i) Animal feed, fibre, and those food crops whose harvested parts do not touch the soil surface shall not be harvested for 30 days after application of the septage.

j) Public access to land shall be restricted for 30 days after application of the septage. Examples of restricted access include remoteness, posting with no trespassing signs, and simple fencing.

k) Animals shall not be allowed to graze on the land for 30 days after application of the septage.

l) During the entire operation until the new wastewater system is installed and in operation, the contractor shall closely monitor and control that domestic wastewater from the affected households/enterprises does not overflow onto land or run into ditches, trenches or other voids.

6.4.11. Community Health and Safety

174. 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.

175. 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:

a) Nomination of 'Contractor focal point' for GRM, complaints register and complaints form.
b) 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.
c) Measures to safeguard vulnerable structures close by due to vibration / differential settlement from deep excavation works.
d) Safety measures, if required, to prevent access by members of the public and livestock to any borrow site excavations
e) 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.
f) Signage and speed controls if public roads are to be affected by construction traffic.
g) Sufficient signage giving community dangers/warnings and information disclosure outside all construction sites, include example warnings.
h) Avoid land application of septage when wind conditions favour transport to residential areas.

6.4.12. Occupational Health and Safety

176. The main occupational health and safety risks include:

a) Working in excavations (trenches 1.5 m – 5 m deep, and excavation pits for wet-wells at pump stations). Work in excavations is well-known to be one of the most hazardous construction works with a history of serious injuries and fatalities. Specific hazards include: Cave-in of the trench/excavation pit, falling objects, slips or falls into the trench/pit, water in the excavation, asphyxiation due to lack of oxygen, exposed utility lines (underground and overhead), moving machinery near the edge of the excavation that could cause a collapse.

b) Working with heavy construction equipment.

c) Handling of septage from households disconnected from the drainage system in connection with removal of the existing drainage system. Septage may contain bacteria, viruses, and parasites that can cause diseases.

d) Handling of lime (hydrated lime or quick lime) for stabilization of septage. Contact with lime powder or slurry can cause irritation of the skin and serious eye damage.

177. **Mitigation of Occupational Health and Safety Risks**. As a general rule, prior to start of any new work, the contractor shall:

a) prepare a health and safety plan (as part of the CEMP) containing site-specific precautions in accordance with relevant occupational health and safety guidelines[16]

b) inspect and check the relevant construction equipment to ensure that it meets the applicable mechanical and safety requirements.

c) Inspect the worksite to ensure that the equipment can be safely mobilized and operated, and that there are no unmitigated risks (typical factors to consider include: proximity and physical condition of nearby structures, soil classification, soft ground, surface and ground water).

d) Conduct training of workers on work practices, health and safety measures, use of personal protective equipment and emergency response.

178. **General occupational health and safety measures include:**

a) Provide fall protection when workers are exposed to unguarded platforms or walkways higher than 2 m.

b) Guard against danger to persons at work from falling objects (earth, rock or other material) by suitable sloping[17], shielding[18] or shoring[19];

c) Ensure there are safe ways to enter and exit the excavation.

d) Trenches will have cave-in protection such as sloping, shielding or shoring.

e) Materials will be kept at least 0.6 m away from the edge of a trench.

f) Adequate ventilation will be secured at all workplaces so as to maintain an atmosphere fit for respiration.

g) Excavations will be kept dry.

h) Provision will be made for safety precautions when using high voltage electric power tools.

i) The health and safety measures at the worksite will be inspected at least once in every day during which persons are at work there, and after any event likely to have affected the strength or stability of the excavation or the shoring.

j) Daily toolbox meetings (safety briefings) will be carried out.

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

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[16] For example, guidelines issued by the US Department of Labour, Occupational Safety and Health Administration, https://www.osha.gov/ or the US National Institute for Occupational Safety and Health, https://www.cdc.gov/niosh/index.htm

[17] Sloping means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins, https://www.osha.gov/

[18] Shield (Shield system) is a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses, https://www.osha.gov/

[19] Shoring means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins, https://www.osha.gov

l) Worker education and awareness events for construction hazards will be given. A construction site safety program will be developed and distributed to workers.

m) The contractor shall appoint an Environment, Health and Safety Officer who is a qualified engineer. The officer will be responsible for ensuring compliance with applicable Cambodian environmental, health and safety legislation and with relevant IFC Environmental, Health and Safety guidelines.

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

o) Training and awareness will be provided to the workers on safety management and HIV-AIDS.

p) The contractor will set out an Emergency Response Plan in accordance with the requirements outlined in the EMP.

q) Handling of lime shall strictly follow the measures in the relevant Safety Data Sheet. Areas where lime slurry is handled shall be kept free of combustible materials. Lime slurry is not flammable or explosive but does react vigorously with acids, releasing sufficient heat to ignite combustible materials.

179. All workers and visitors to the worksites will be provided with and shall wear the relevant Personal Protective Equipment. Standard mandatory PPE include:

a) hard hat

b) high visibility clothing in yellow or orange material with reflective panels

c) safety shoos with metal toe cap

180. Work specific PPE includes:

a) Cut-resistant work gloves

b) Ear protection (earplugs or muffs) wherever it is not feasible to reduce the noise levels or duration of exposures to those specified in internationally recognized guidelines[20]

c) Safety glasses (rock/surface breaking, piling, crushing/grinding, cutting)

d) Welding hoods with clear safety glasses under (welding).

181. PPE for workers handling septage or lime:

a) Gloves,
b) Waterproof safety boots,
c) Full overalls (or clothing that covers all exposed skin)
d) Safety glasses with eye shields.
e) Face mask.

6.4.13. Labour Camp Impacts

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

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

d) 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

[20] Occupational Noise Exposure Revised Criteria 1998, Centers for Disease Control and Prevention, https://www.cdc.gov/niosh/topics/noise/reducenoiseexposure/regsguidance.html

sanitation for male and female workers, relevant training and a plan of how camp areas will be restored to original condition after construction completed.

e) 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.

f) Priority given to use of local labour and retain evidence of how local labor recruitment efforts were undertaken.

184. The risk of transmission of the SARS-CoV-2 virus will be prevented or minimised by implementation of the relevant measures instructed by the Royal Government of Cambodia, General Department of Labour as well as any updated guidelines of the WHO or ADB. The key measures include:

a) Conduct risk communication, training, and education for the contractor and the workers on the relevant infection prevention and control practices.

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

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

d) Regularly clean and disinfect toilet and bathrooms.

e) Promote personal hygiene (including hand and respiratory hygiene), make wash basins and sanitizers available.

f) Screen on entry the temperature of each person entering the work site and record their contact details to facilitate tracking of infected persons should there be a need.

g) Health surveillance and insurance.

h) Review and update preventive and control measures as the situation evolves.

i) Individuals who have been potentially exposed to the virus, or who are exhibiting flu-like symptoms shall immediately to inform their supervisor, stay at home and self-isolate; and contact local health authorities for further direction. Such individuals may not return to work until the proper health authorities have lifted the self-isolation;

j) All areas on site potentially infected by a confirmed or probable case will be barricaded to keep individuals two meters away until the area has been properly disinfected.

6.4.14. Socio-Economic Impacts (accessibility)

185. The installation of sewage pipes will require the excavation of parts of the road network. This is in urban areas where businesses, cultural resources 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, businesses and cultural resources. 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.

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

g) Warning given to residents 4 weeks in advance of any excavations.

h) 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.

i) Adequate and safe pedestrian and vehicular (motorbike) access to enter buildings across any open trenches.

j) Temporary restoring/rebuilding impacted assets or moving shops and stalls

k) 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, are remaining in front of houses and shops.

l) Restoration or compensation of any damage at expense of contractor.

m) Management of potential localized flood impacts.

n) A Chance Find Procedures will be implemented as necessary.

6.5. Environmental Impact and Mitigation Measures during Operation

187. 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 the pumping 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 groundwater quality from WWTP effluent.

188. 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.

189. The EMP for Stueng Saen Wastewater and drainage subproject include capacity building and awareness raising on the management of environmental risks during operations.

190. 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.

6.5.1. Surface Water

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

192. Simple mass balance calculations based on a conservative dry season low flow in the Stueng Saen River of 2 m^3/s and the design treatment capacity of 3,500 m^3/d or approx. 0.04 m^3/s (see also ***Para 125***) indicate that the resulting concentrations of key water quality parameters in Stueng Saen 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 31.*** In addition, during the dry season, it is likely that most of the effluent will be used for irrigation thus further increasing the dilution rate; and in the rainy season with flows in the hundreds of m^3/s in Stueng Saen River, the effect of the effluent discharge on the river water quality will be negligible.

Table 31: Sample Mass Balance Calculation of total suspended solids concentration in Stueng Saen River after mixing with the WWTP effluent

Parameter	Unit	Value
Effluent discharge	m^3/s	0.04
Effluent discharge concentration	g/m^3	40.0
Effluent discharge mass per second	g/s	1.60
Flow in Stueng Saen River	m^3/s	2.00
Upstream concentration in Stueng Saen River[21]	g/m^3	20.00
Upstream load per second in Stueng Saen River	g/s	40.00
Stueng Saen River concentration after complete mixing	g/m^3	20.4
Downstream concentration in Stueng Saen River after complete mixing	mg/L	20.4
Calculated difference in downstream concentration	mg/L	0.4

193. 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 produce 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.

194. The access road level will be raised 0,5 m, (design of WWTP access road elevations is based on 1 in 5-year flood as per national standards) and the WWTP will be raised up to 3 m from ground level. These elevations will not impact on the drainage due to rainwater will flow to irrigation canal network for dispersion. The canal network in the area is such that any banked-up water from the raised road will easily find alternative drainage paths (***Figure 17***). Thus, surface runoff movement will not be impeded nor exacerbate flooding of the area.

195. Mitigation and management measures will include:

(i) Final design ensures that the effluent criteria are met for Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 (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) O&M manual to be developed prior to commissioning provide clear methods and procedures for all aspects of the WWTP, sewer and drainage operation, including the following key issues[22]:

a. Sludge management including treatment, disposal and emergency situations

[21] As indicated in Table 16, there is considerable variation in TSS levels in the river, and a conservative low TSS concentration is assumed in the calculation

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

b. Monitoring/ testing procedures and schedule for treated effluent and sludge, with approval by MOE. Work with MOE and MPWT to establish biosolids reuse quality requirements.
c. Emergency procedures including schedule for testing and upgrading procedures

(iv) Procedures for storing, transporting and disposing of solid waste generated by the operations
(v) Commissioning phase of WWTP to ensure design discharge standards can be met.
(vi) Discharge to be tested prior to release into the environment. Monitoring and reporting on water quality in the recipient of the effluent discharge from the WWTP in line with the EMP. If the treated effluent consistently fails to meet discharge standards, operator to discuss and agree with MPWT and MOE on a way forward to return to compliance.
(vii) Provision of adequate budget for O&M to ensure regular effluent and surface water quality monitoring.
(viii) Meeting required operating standards to ensure effluents are treated effectively prior to discharge;
(ix) Regularly monitor the sewage system structures and provide maintenance or corrective actions.
(x) Ensure the operational and maintenance plan for each facility includes an emergency response plan considering flooding.
(xi) Provision of effluent and receiving water body monitoring data to Provincial Department of Agriculture to enable assessment of effects of treated effluent application on crop yields.

6.5.2. Noise

196. 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 pumping stations are 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.

197. The operation of the WWTP does not involve any activities that would generate significant noise emissions, and due to its location approximately 800 m from the nearest residences, any occasional noisy activities are unlikely to cause any significant impacts.

6.5.3. Community and occupational health and safety (H&S)

198. 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.

199. 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.

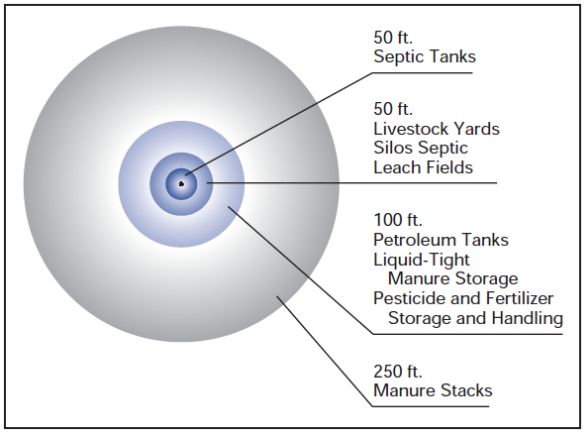
(vi) Provision of appropriate and adequate PPE for workers (including regular training and drills on the use of PPE and other emergency equipment).

6.5.4. **Groundwater**

200. Groundwater infiltration into the sewers or seepage from the sewers into groundwater will be mitigated to the extent possible by using High Density Poly-Ethylene (HDPE) pipes tightly jointed by fusion welded joints[23], and the pumping stations will be constructed with water-tight concrete. At the WWTP, the pond sides and bottoms will be constructed with a stone pitching over well-compacted clay – except for the facultative ponds which will be equipped with a HDPE liner over well-compacted clay. Normally, waste stabilization ponds eventually seal themselves[24] and considering the use of well compacted clay on top of at least 4 m of intact clay (see ***Para 129***) 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[25].

201. The safe distances between water wells and pollution sources recommended by the USEPA[26] are displayed in ***Figure 23***. 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 800 m between the WWTP and the nearest residential area, the risk of polluting groundwater used for drinking water is negligible.

Figure 23: Safe distances between water wells and pollution sources



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

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

[25] 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.

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

6.5.5. Overflow at the pumping stations

202. 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 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.

6.5.6. Odour and Dust, wastewater treatment

203. 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[27], and considering that typical sulphate concentrations in domestic wastewater is less than 100 mg/L nuisance odours from the anaerobic ponds are not likely.

204. 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 208***).

205. Furthermore, the WWTP will be in an open paddy field area with a buffer of about 800 m to the nearest houses ensuring that any release of nuisance odour from the WWTP will not impact the local residents[28].

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

6.5.7. Odour, pumping stations

207. At Pumping Station 1 located at the western outskirts of the town there are no houses within a 20 m radius, but one house within 30 m from the pumping station. At Pumping Station 2 located at the eastern outskirts of the town, there is one house within a 20 m radius, and two houses within 30 m from the pumping station (see ***Figure 18*** and ***Para 114***). However, with proper operation and maintenance and considering that the cycle time of the pumps is less than 15 minutes, septic conditions are not likely to develop at the pumping stations. Nevertheless, the frequency and duration of odorous events will be closely monitored, and the stations will be made ready for installation of odour control measures in the future should this be warranted.

208. Potential mitigation measures of odour will include:

(i) Regular monitoring and maintenance the operation of WWTP, culvert system, and pumping stations.

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[27] 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

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

(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;
(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; and
(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 filters, biofilter) 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

6.5.8. Agricultural Yield

209. As discussed in ***Para 193***, the effluent water quality will meet requirements for use in agriculture, possibly even for unrestricted use for irrigation and aquaculture. The provision of nutrient-holding treated effluents that meets the standards for irrigation will benefit the local farmers, and to control that the standards continue to be met, the effluent water quality will be carefully monitored and the results reported to Provincial Department of Agriculture.

210. 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

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

212. 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

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

214. The FS considered alternative wastewater treatment technologies, to ensure that the most cost-effective treatment process is selected. The treatment process selection process considered:

- Physical Factors;
- Low Cost Technologies;
- Comparative Costs (***Table 35***)

7.2.1. Physical Factors

215. The technology selected should recognize the local constraints and the WWTP technology be adapted to suit the local conditions. Several site options should be examined for consideration to determine their suitability due to factors such as distance from the urban centre, topography, available land suitable for WWTP construction and appropriate technologies that could be applied. The FS considered the proposed WWTP site to be optimal considering the following physical factors:

216. Land Availability: The proposed land area is used solely for agricultural purposes and the land area would be sufficient for all treatment processes and ancillary works. The proposed site location would have minimal damage to the local environment without resettlement although some land compensation would be necessary.

217. Ground Conditions and Topography: The general shape of the land is suitable for the civil works construction. Some reshaping the land and the lining of lagoons would be considered based upon the results of geotechnical investigations, if necessary, to mitigate any pollution of the existing ground water table. Ideally, existing soils conditions such as clay soil favor the use of ponds technologies.

218. Environmental Compatibility: The disposal of treated effluent should be to an existing surface water canal, currently used solely for extraction of irrigation water, ideally with the canal connected to a river. In order to protect the environment quality and to safeguard public health, the level of treatment achieved by the WWTP shall be in accordance with the sensitivity and the use of the WWTP effluent receiving waters. A primary consideration is that pollutant and coliform levels are reduced to a level where the WWTP effluent is suitable for all

agricultural purposes. This criterion is in addition to the obligation to meet any prescribed standards for the quality of the discharged effluent. The WWTP has been designed to fulfil Sub-decree, No. 27 ANRK.BK on Water Pollution Control, MoE, 1999 (public water area and sewer). Therefore, WWTP effluent can be discharged to the canal.

7.2.2. Low-Cost Technologies

219. The proposed treatment technology is for inlet screening, anaerobic, facultative and maturation ponds. The option of constructed wetlands was discussed with each of the cities MPWT; however, the ponds-based technology was agreed as the least capital cost, least O&M cost, lowest energy requirements, greatest ease of operations and shall produce a high-quality effluent with 95% reduction in pollutants. The process description, principal operating parameters, reliability, advantages, disadvantages, capital and O&M costs are discussed in detail in the FS and summarized below.

220. **Wastewater Pre-Treatment by Screening**

Table 32 Automatic Fine Screening – Advantages and Disadvantages

Advantages	Disadvantages
Removes 40% of solids and 100% debris	Requires some power for operation
Least cost wastewater treatment option	Disposal of dried screenings to landfill
Power consumption is very low (minimal)	
Automatic operation has minimal operations	
Reduction in biochemical oxygen demand (BOD) by 25-40%	

221. **Sewerage Secondary Treatment - Biological**

Table 33 Advantages and Disadvantages of Anaerobic Lagoons Technology

Advantages	Disadvantages
More effective for rapid stabilization of strong organic wastes	Vegetation growth on pond embankments and on the pond surface requires periodic attention
Can treat high organic loadings, with a reduction of BOD and SS up to 60% removal	Impermeable ponds bottom with a liner is generally required to prevent seepage
Produce less biomass per unit of organic material processed, equating to savings in sludge handling and disposal costs.	Nuisances from odours may occur if not properly operated
Do not require energy, because they are not aerated, heated, or mixed.	
Least expensive treatment process to construct and operate.	

Table 34 Advantages and Disadvantages of Facultative Lagoons

Advantages	Disadvantages
Produces high quality effluent with a 95% removal of pollutants	Requires more land than other forms of treatment technologies
Lowest capital costs and lowest energy and operating costs	Vegetation growth on pond embankments and on the pond surface requires regular attention
Operations and maintenance is much easier than other technologies	Impermeable ponds bottom with a liner is required to prevent seepage

Advantages	Disadvantages
Complicated controls are not required	Potential nuisance of insects and odours if not properly operated
Good ability to absorb shock loads or hydraulic surges	
Produces less sludge than other wastewater treatment processes	

222. **Maturation Ponds Technology for Disinfection and Polishing**

223. Disinfection treatment is generally applied in situations where the bacteriological quality of the wastewater needs further treatment, due to receiving water requirements or proposed downstream uses of the receiving water effluent. Disinfection treatment is generally considered in two forms UV or chlorination.

224. Maturation ponds are aerobic lagoons that shall be used as UV disinfection for bacteriological pollutant removal and tertiary or “effluent polishing” treatment. The ponds will be shallow at 1-1.5 m depth to facilitate disinfection by UV and produce a high-quality effluent. Since they are aerobic, maturation ponds share the same characteristics of facultative lagoons.

225. Alternative options were considered for the WWTP technology and sludge management.

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

Table 35 Comparison between Technologies for Stueng Saen

STUENG SAEN YEAR 2040	Constructed Wetlands TA	WSP -Tonle Sap 2 TA
Population	23,452	22,978
L/C/D Wastewater	139 l/c/d	150 l/c/d
Q IN design (mc/d)	3,251	3,500 m3/d
BOD5 IN load design (kgBOD5/d)	1,076	1,034 kg/d
Base Land Area (free water / reeds)	2.7 / 2.2	2.1 Ha
Total Land Area	4.4 / 2.9	2.8 Ha
Cost Estimate	2.7 / 3.2 Mil $ equivalent	$2.6 Mil $
Annual O&M Costs	18 / 33,000 $/yr	18,000 $/yr

Notes:
- Population & BOD5/d aspects are nearly equivalent between the two Options;
- Construction costs estimates are reasonably equivalent between WSP and free water system when flood levels and site filling with imported soil and crushed stone are taken into account.

226. **Sludge Stabilization and Dewatering**

227. Sludge will be produced by all the lagoons treatment processes and accumulated sludge will need to be removed after 3-5 years. The primary source and largest quantities of sludge will be from the anaerobic treatment lagoons. The sludge needs to be stabilized and dried before it can be properly disposed.

228. The water content of the sludge is very high, and solids constitute very small part of it. Therefore, before final disposal further treatment of anaerobic sludge from the ponds is required to reduce water content and oxygen demand of the sludge. The sludge needs to be digested by biological oxidation of degradable organic sludge by microbes under anaerobic conditions to stabilize the sludge, to reduce pathogens, eliminate odours, inhibit, reduce, or eliminate the potential for decomposition, and improve dewatering characteristics of the sludge to reduce volume for disposal.

127. Disposal of the sludge presents problems due to (a) the solids present are mostly organic and undergo decomposition, and (b) the volume of the sludge is many times than the solids constituents. Hence, further treatment is required for reducing volume of the sludge, stabilizing organic matter present in the sludge, and improving its filtration ability for easy dewatering. The stabilization of organic matter can be obtained by employing digestion (aerobic or anaerobic), incineration, composting, heat treatment, chlorine oxidation or lime stabilization. Due to the high costs and/or health/safety risks of aerobic digestion, incineration, composting, heat treatment, chlorine oxidation or lime stabilization

229. 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.

230. A sludge stabilization and drying pond is recommended because it provides effective, low-cost treatment and dewatering of sludge. It is similar to 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.

231. The CDIA study looked at the options of composting and disposal to landfill of dried sludge. It was argued that composting requires a fair amount of attentive manual labour in the form of turning the compost, and ensuring it is covered from rain. With no existing market for it in Cambodia and as there are naturally fertile soils in the area, composting of drier treated sludge was not recommended. Instead, it was recommended to use dewatered sludge as cover for the proposed landfill rehabilitation project where landfill material has been compacted in layers it is capped, and treated dewatered sludge is ideal for this purpose.

7.3. Combined versus separate sewer system.

232. 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.

233. 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 sewage system will be developed in the central key areas of the subproject cities.

234. 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

235. 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.

236. 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 36***. 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 36: CDIA Phase Consultations Held

Location	Dates	Stakeholders or Groups Met*	
Stueng Saen	From 16/12/16 To 17/01/2017	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		

237. The Preparation of the IEE. Further consultations were undertaken in two formats during the IEE (May, 2018): (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 concerned people may have and how they may wish to see their concerns mitigated.

238. Household socio-economic surveys were undertaken for this project in January 2018 and included a number of questions relevant to environmental safeguards. The respondents' views are summarized in ***Table 37***. Where appropriate, corresponding mitigation measures are included in the EMP.

Table 37: Socio-Economic Survey Questions

Household Question	Response	EMP Response
Concerns over construction impacts (Dust, Noise, Water Quality, Other suggestions) – Rank two responses	Combining the two scores, 75% of responses included dust as a concern, 41% included noise, 15% included water quality and no other suggestions for concerns were given.	Mitigation measures for noise and dust Control of construction near water bodies
Connection to piped water supply	57% of households are connected to a piped water supply, of which 63% are connected to	-

Household Question	Response	EMP Response
	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 rain water to a water source. The remainder being own drilled well (275) responses, own open well (125 responses), water seller (51 responses), bottled water (66 responses) pond/lake (68 responses), own pond (13responses).	Measures to prevent water pollution in all surface water bodies during operations in particular where the risk to receptors is higher
During Construction, what mitigation measures would you like to see to reduce any potential impacts on you and your environment	The main responses are spray water on the road (to avoid dust) (62%), Ensure the security of road traffic (lighting) (17%) Limit the hours of work during the day (noise) (10%). 8% had no concerns. Alternative responses include concerns over construction safety, traffic safety (10 responses) and concern over impact to land or access (9 responses).	Traffic management to be implemented by contractor via the Community and Occupational Health and Safety and Emergency Response Sub-Plan Noise and dust control measures to be used.
If you are living close to the new landfill site, would you be interested in mitigation measures?	Glass in windows 35% Tree screens 22% Fly screen 26% 'Other' responses include operational requests to bury waste after it is deposited (28 responses) and requests for odor control.	Mitigation measures and budget for house improvements included for houses close to landfill sites.

239. Focus group discussions (FGD). FGDs were conducted by the FS 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.

240. Inclusion of Affected People's Views. The mitigation measures in the EMPs for this project reflect the result of the consultations during IEE preparation. The results of the consultation discussions are summarized in ***Table 38***. Where appropriate, a response to the comment or concern is signposted in the EMP.

Table 38: Consultation FGD Stueng Saen

O Kanthor Commune, Stung Saen Town, KPT Province (WWTP subproject)	
Key Issues/Comments/Suggestions raised by the Stakeholders	**EMP Response**
- The WWTP site is located in Prek Sbov Village, O Kanthor Commune. It is in the lowland area of small lake (Chhum Nik Lake) and some areas are belonging to private. - The rice field is round the site and the irrigated canals are near the proposed site (the farmers pump canal water for wet and dry rice). - There are not sewage drains in this village. 50% of households have solid waste collection service. - The environment in the town is poor, concerning on wastewater management and solid wastes management and also drainage system, especially in rain season. the wastewater mixing with rainwater flooded in our town and streets.	None required
- We think during operation stage there are some impacts on natural and social resources near the project site such as: (i) the odour from WWTP will increase (ii) water quality in this area can be changed by discharged wastewater from WWTP – this will affect rice crops around the subproject. - Bad smell/odor from WWTP operation will affect workers and human health (Prek Sbov Village is near the site). - The project should prepare proper mitigation policies for reducing negative impacts like air pollution, smell, water pollution, land use and public safety.	Training for operators is included in capacity development
During construction, the impacts are small e.g. air and noise from movement of materials/ equipment. The main impact is considered land use during clearing and excavating the site. So the project should negotiate with landowners before the construction starts.	Dust and noise mitigation measures are in EMP Land ownership outside EMP scope.
The WWTP is important for our Town to protect our environment as well as wastewater management.	Not required

8.2. Public Consultations during Project Implementation Pre-Construction

241. PMC were engaged after the DED was completed for this subproject and conducted the following consultations. FS consultations are considered the first consultations:

242. A second consultation was conducted prior to the commencement of the detailed measurement survey (DMS) and socio economic survey (SES) led by the Inter- Ministerial Resettlement Committee working group (IRC-WG) and assisted by Provincial Resettlement Subcommittee working group (PRSC-WG) on 25 April 2019 with 101 participants (50 males and 51 females) and the affected communities at the commune or village level on about the Project and subproject scope, entitlements and compensation for lost assets, GRM, including contact persons, and DMS/SES.

243. Third consultation took place 26-30 December 2019 (four separate consultations) with 333 participants (222 males and 111 females) to conduct re-consultation meeting with affected households (AHs) along the network to consult people of the reduced impact through narrowing of the corridor-of-impact (COI), and to retract all of the DMS yellow papers back for revision. Yellow papers were re-issued to the AHs having remaining impact. GDR, PIU and PMC explained carefully about the reasons to reduce impact and number of AHs, and the role and responsibility of the construction contractor to cover temporary impacts during the construction.

244. Fourth consultation was done in 12-13 February 2020 covering waste pickers in existing dumpsite, WWTP access road to AHs and market vendors to 255 participants, including 67 males and 188 females. The consultation explained to the attendees about the Project and its benefits, the scope of works, resettlement impacts, the ADB and RGC policies on compensation, eligibility, entitlements, contractor responsibility for temporary impact, cut-off date of 12 February 2018 and GRM. It also detailed temporary market relocation, and upcoming DMS/SES and RCS.

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

246. ***Table 39*** summarizes the public consultations undertaken with the participants.

Table 39: Summary of Consultations

No.	Date	Location	Topic and Summary of Discussions	Participants
1	25 April 2020	Ponimith Pagoda, Stung Saen town	Explanation of the project scope and standard procedure on resettlement policies. Consultation explained DMS Questionnaire, DMS process, contract agreement for compensation and compensation payments to affected households.	101 people (Female 51, Male 50)
2	26, 27 and 30 December 2019	Wat Tepnitmit (Pagoda) for Sangkat Kompong Roteh, Sangkat Kampong Thom	Conduct re-consultation meeting with AHs along the network to consult people of the reduced impact through narrowing of the COI. GDR, PIU and PMC explained carefully about the reason to reduce impact and number of AHs, and the role of contractor on temporary impact during the construction. Inform AHs on project scope, design and household connection types, construction schedule, ABD and RGC resettlement policies, entitlements, GRM and RCS. Majority of the participants in the meeting are happy when project try to reduce impact by narrowing down COI and have contractor responsible for restore/rebuild temporary impacts. The participants requested the project to start construction as soon as possible. The	333 people (Female 111, Male 222)

No.	Date	Location	Topic and Summary of Discussions	Participants
			AHs wanted to provide close collaboration with GDR and return DMS yellow papers back for review and revision. Majority of question focus on the household connections to wastewater main pipeline.	
3a	12 February 2020	City Hall meeting room, Kampong Thom (this consultation is for landfill subproject)	Initial consultation with waste pickers to inform AHs on Project description and ADB policy (SPS 2009), Details about Involuntary Resettlement, and project Resettlement Framework and compensation, Details about Income Restoration Program of the project, Details about PRSC and GRM and how to process formal complaint letter, cut-off date, and upcoming DMS/SES.	20 people (female 10, Male 10)
3b	13 February 2020	Oukunthor Commune Office, Kampong Thom	Consultation with AHs along access road to WWTP site on Project description and ADB policy (SPS 2009), Details about Involuntary resettlement and project Resettlement Framework, What/who are the affected assets, people, and vulnerable group in the project, Details of COI, Resettlement Framework for compensation and Entitlement, Cut-off-date, GRM and PRSC, Details about DMS and RCS, Details about narrowing down the impact of the subproject, Details of responsibility of contractor during construction on affected assets, Details about Temporary Impact Agreement Form, Details about affected assets and compensation, and Inform about responsibility of the contractor and GDR during implementation.	18 people (8 female, 10 male)
3c	13 February 2020	Wat Tep Nimit (Pagoda), Kampong Thom	Consultation with market vendors on Project description and ADB policy (SPS 2009), Details about Involuntary resettlement and project Resettlement Framework, What/who are the affected assets, people, and vulnerable group in the project, Details of COI, Resettlement Framework for compensation and Entitlement, Cut-off-date, Grievance Redress Mechanism and PRSC, Details about DMS and RCS, Details about narrowing down the impact of the subproject, Details of responsibility of contractor during construction on affected assets, Details about Temporary Impact Agreement Form, Details about affected assets and compensation, and Inform about responsibility of the contractor and GDR during implementation.	217 people (170 female, 47 male)
4	10 March 2020	City Hall meeting room, Kampong Thom	The consultation included details of GRM, IRP eligibility, vocational training options, current employment opportunities in Stung Saen and special support to vulnerable AHs. All vulnerable AHs participated in the consultation.	22 people (11 female, 11 male)

247. ***Table 40*** summarizes the key discussion points on the questions from the AHs and responses provided at various consultative meetings.

Table 40: Summary of key Discussion Points

No.	Date	Question	Answer / EMP
1	25 April 2020	(1) Commune Chief asked where the construction of the drainage system will take place.	(1) The construction is in the southern part of Stung Saen town and affect Domrey Chon Kla, Kompong Rortes Kompong Thom Communes. The draining system will be constructed within the existing alignment.

No.	Date	Question	Answer / EMP
2	26, 27 and 30 December 2019 on reduction of impact due to narrowing of alignment	(1) AH request compensation rather than restoration by contractor.	(1) Based on the project requirement and BOQ the contractor will restore/rebuild all the other structures least effect size during construction in front of the house to reinstall with the same condition as before construction starts. So, we cannot change this method and no compensation with double responsible by contractor and GDR.
		(2) AH suggests that enough space is provided for the access road in front of her business during construction and speed up the construction.	(2) Base on the contract agreement with the contractor, they will provide enough space and no need to close the road during the construction. But if there is a problem, please let the project know by written complaint to the commune or direct to project.
		(3) AH viewed the project negatively and does not understand the effect of narrowing down, due to expecting a severe impact on his primary structure (note: in fact, his structure is not impacted due to narrowing down COI).	(3) AH was informed again about this meeting objective for narrowing down the impact, and especially complete mitigation of impact on his primary structure. AH was re-assured of the project already realigning outside his house to avoid any impact.
		(4) AH asked to explain to me about the red color on my wall with 2 separate numbers written up during the interview? Which one of the numbers is the affected area that will be compensated for?	(4) GDR has to mark down numbers to your wall, one is ROW and one more is COI. COI will be compensated if your affected asset is private asset. However, the ROW is 10 meters from the centerline and our project requested for COI only 9 meters.
		(5) What is the compensating prices to be used?	(5) For the price for compensation to affected private properties and assets the specific price for compensation has not been determined yet. The project has an independent RCS team to study the affected price of land, structure, tree and so on. For all the compensation prices we will inform later with price table after completion of DMS and RCS, and approval by IRC.
		(6) As an example, if a project sets up a manhole in the front of a house or gateway to a house, can the project move the location of a manhole?	(6) The project can move manhole locations to avoid any impact.
		(7) Does this project have a plan to expand the road width or not?	(7) The project is not going to expand the road width. it will just recover the existing road after construction. Therefore, further expansion of the road will depend on future plans of DPWT and provincial authorities.

No.	Date	Question	Answer / EMP
3b	13 February 2020	(1) How about our land, is it going to be affected? (2) How about our tree along the access road? (3) Is this road going to be expanded or not?	(1) Yes, based on the cadastral measurements and DMS the land is on the legal ROW. Therefore, GDR does not compensate for the land, but compensate for assets such as trees and structures only. (2) All of the trees have been surveyed along the access road and the ones affected by the project will be compensated for. As for the compensation price, we do not yet know as this will be based on replacement cost survey, done by RCS team. We will inform to all of you later. (3) Based on the DED prepared by the consultant which we also checked yesterday, this road is not expanded. The project will prepare road shoulders that will affect with your trees and fences only. The road will remain at the same width of the existing road. This is done in order to avoid any impact households.
3c	13 February 2020	(1) Can we return to same place to continue business after construction is finished? (2) Where do we move into? (3) How many months is it expected for the construction to take?	(1) Yes of course, all the vendors that are required to be moved to the temporary place during construction will be returned to selling at the same place without any condition or problem. Project will record all of your names and places of selling to keep the same conditions and places after construction. (2) All of the vendors need to be moved will be located to Grandpa and Grandma Garden (Suon Yeayta), near the current market area. (3) This depends on the road situation, whether the road is big or small and how difficult or easy the construction will be. But it is estimated to take at least 1 to 2 months for construction. Some place maybe delays to 3 months of working.
4	10 March 2020	(1) I was really excited when I heard that the project is providing vocational training for us. But I would like to inform that, I don't have any member of family who can join the vocational training. So, I suggest that, please provide us with the cash compensation. (2) I am really interested with vocational training because I think that this can be long term income for my household members if they can finish their training with success. Bu, I will need some time to discuss with my family members about this option. I will inform you later.	(1) This discussion is the best time for us to find the best solution to your current requirement or needs from the project. So, is not a problem for everyone to select vocational training as cash compensation is also possible. Please let me know about your ideas about these options you can select from. You can change your selection next one week if you like. (2) We can wait you to respond back in next week. Please call me with the phone number in this name card anytime. Thank you for your interest with the vocational training.

8.3. Public consultation during Construction.

248. The Consolidated IEE for this subproject contains details of the consultation undertaken during preparation and pre-construction of this subproject. In addition, consultation will take place during implementation. 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. It is suggested that the consultations take the form of meetings and site-based discussions and include the following:

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

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

8.4. Public consultation during Operation

250. The mitigation measures for this IEE specify that the wastewater and drainage 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 and make correct actions or responses.

8.5. Information Disclosure

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

(i) The EMP will be translated into Khmer and be available for review PDPWT offices;
(ii) The IEE will be disclosed on ADB's project website (www.adb.org), current available version in ADB project website is IEE May 2018.
(iii) Copies of the IEE are available upon request; and
(iv) Semi-annual or quarterly environmental reports on project's compliance with the EMP and other necessary information will be available at www.adb.org.

252. 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.

253. Public information and disclosure about the subproject will be continued during the implementation in the Project areas. The updated PIB will be distributed after contract award 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 with their concerns.

254. 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 MECHANISH

255. 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.

256. 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).

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

10. ENVIRONMENTAL MANAGEMENT PLAN

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

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

259. The overall responsibility for EMP implementation and compliance with loan assurances lies with the Executing Agency, the MPWT. The Executing Agency has established a Project Steering Committee (PSC) and PMU based in Phnom Penh, responsible for general project implementation. The Implementing Agency for the Subproject is the PDPWT in Stueng Saen Province. The PDPWT has established a PIU comprising relevant provincial government representatives including the PDoE.

260. A summary of the key functions for project implementation and therefore environmental safeguards is presented in ***Table 41***.

Table 41: Key Roles for Project Implementation

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

11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Conclusions

261. 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 as well as separated and improved drainage system will be realized, while risk of environmental pollution could arise if the wastewater and drainage 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.

262. The EMP, if implemented effectively, 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. They will be supported by qualified national and international environmental consultants within the Project Implementation Assistance Consultant Team. The implementation of this EMP will be closely monitored and reported on by the relevant stakeholders in the project.

263. The construction related impacts are temporary and local and associated with the construction of drainage and collection 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 collection and drainage systems and may occur if the facilities are not managed and maintained effectively. If the WWTP is not maintained at sufficient operational level, surface and ground water 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. Inadequate maintenance of the drainage system may result in localized flooding.

264. 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.

265. 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.

266. 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.

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

11.2. Recommendations

268. 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).

269. 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) Surface Water Quality Standard

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

Annex 2 of Sub-decree on Water Pollution Control

Effluent standard for pollution sources discharging wastewater to 'protected public water area' and '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

No	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
19	Tin (Sn)	mg/l	< 2.0	< 8.0
20	Iron (Fe)	mg/l	< 1.0	< 20
21	Boron (B)	mg/l	< 1.0	< 5.0
22	Manganese (Mn)	mg/l	< 1.0	< 5.0
23	Cadmium (Cd)	mg/l	< 0.1	< 0.5
24	Chromium (Cr^{+3})	mg/l	< 0.2	< 1.0
25	Chromium (Cr^{+6})	mg/l	< 0.05	< 0.5
26	Copper (Cu)	mg/l	< 0.2	< 1.0
27	Lead (Pb)	mg/l	< 0.1	< 1.0
28	Mercury (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

Public water areas refer to water areas that are for public use such as: tonle, stung (rivers), stream, gully, lake, pond, well, sea, peam (river mouth) and include canal irrigation system and other waterways that are for public use and ground water;

Source of pollution refers to any type of places such as dwelling house, public administrative building, premise, transport facilities, business areas or service places from which effluent, pollutants or hazardous substances are directly or indirectly discharged into public water areas or public drainage systems;

Wastewater refers to water discharged from any source of pollution into public water areas or public drainage systems either it is treated or untreated;

Sewage refers to a contaminated water discharged from dwellings and public building.

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

Annex 4 of Sub-decree on Water Pollution Control

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

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

a) River

Parameter	Standard	
	Unit	Value
pH	mg/l	6.5 – 8.5
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

Source: - Ground water quality monitoring MoE, 2016.

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

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

No	Parameter	Unit	Standard Value
23	Selenium	µg/l	< 10
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

(4) Groundwater Quality Standard

No	Parameter	Standard	
		Unit	Value (CNDWQS Standard)
1	pH	-	6.5-8.5
2	Turbidity	NTU	5.0
3	Dissolved Oxygen (DO)	mg/l	NV
4	Total Suspended Solid (TSS)	mg/l	NV
5	Chloride (Cl^-)	mg/l	250
6	Nitrate (NO_3)	mg/l	50
7	Phosphate (PO_4)	mg/l	NV
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

Parameter	Standard	
	Unit	Value
Zinc	mg/kg	200
Arsenic	mg/kg	12
Cadmium	mg/kg	1.4
Lead	mg/kg	70
Iron	mg/kg	-
Chromium	mg/kg	64
Mercury	mg/kg	6.6

Annex 2: Site Field notes & Descriptions

Stueng Saen Town, Kampong Thom Province
The proposed site for WWTP is located in Beung Chhumnich Lake, Prek Sbov Village, O Kantor Commune, Stung Sen Town, KPT Province. This site is in a lowland area and is flooded during raining season, so the farmers grow the rice crops (wet-dry rice) is around the site. This proposed WWTP site is located:

- Prek Sbov Village when houses and school are there is about 0.7 km
- Stung sen River is about 1 km
- Stung Sen Town is about 4 km
- National Road 6 is about 2 km (bypass road)
- The irrigation canals are near the WWTP site and the rice file is around this site, so the farmers grow rice crops: wet rice use raining water and dry rice use water from irrigating canals.
- There are no sensitive resources and sensitive ecology located in / near the WWTP site.
- The condition of this site from the town is sloping reach to the lowland area of Tonle Sap Lake.

Pictures



The existing environmental condition in proposed WWTP in Stueng Sen Town



The existing irrigated canals, rice field, and access road are near WWTP of Stueng Sen Town

		
The visiting drainage system in some villages and main drainage flow to WWTP site		

		
Discussion with local people and visiting the existing canal for proposed waste water flow direction from Stung Sen Town to WWTP site		

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, and 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 and Gender Specialist and National Environmental Specialist of the TA 9203-CAM: Second Urban Environmental Management in The Tonle Sap Basin Project undertook FGDs in the proposed subprojects areas for Stueng Sen Town. The key points from the consultation meetings are presented in this IEE.

Consultations for Stueng Sen Town, Kampong Thom Province

- Consultation pictures in Kampong Thom Province



Consultation in Srayov Commune, Stung Sen Town, Kampong Thom



Consultation in O Kanthor Commune, Stung Sen Town, Kampong Thom Province



Consultation in Trapaeng Russey Commune, Kampong Svay District, Kampong Thom Province

- Participants List for Consultations in Kampong Thom Province

1. Consultation in Sra Yov Commune, Stung Sen Town, KPT Province

No	Name	Agency/Village/Commune	Position	Phone
1	Mr. Harm Chheav	Srayov Commune	Group Leader	O88 850 4809
2	Mr. Srey Nhel	Srayov Commune	Village Chief	092 628 046
3	Mr. Seang Yeung	Srayov Commune	Group Leader	
4	Mr. Chean Cheam	Srayov Commune	Villager	
5	Mr. Porn Phit	Srayov Commune	Villager	
6	Ms. Chhun Nath	Srayov Commune	Villager	
7	Mr. Chhup Darith	Srayov Commune	Villager	
8	Mr. Chhup Ron	Srayov Commune	Villager	

9	Mr. Horn Kea	Srayov Commune	Villager	
10	Mr. Chhup Lim	Srayov Commune	Villager	
11	Mr. Sim Lim	Srayov Commune	Villager	
12	Ms. San Sineth	Srayov Commune	Villager	
	Total: 13 persons (female: 02 persons)			

2. Consultation in O Kanthor Commune, Stung Sen Town, KPT Province

No	Name	Agency/Village/Commune	Position	Phone
1	Mr. Chhiv Kim Oun	O Kanthor Commune	Commune Chief	012 214 628
2	Mr. Seng Vankim	O Kanthor Commune	Commune Council	097839 5552
3	Mr. Din Sok	O Kanthor Commune	Deputy Village Chief	
4	Mr. Samreth Ron	O Kanthor Commune	Villager	
5	Ms. Sos Ho	O Kanthor Commune	Villager	
6	Ms. Thou Thouk	O Kanthor Commune	Villager	
7	Ms. Phon Tho	O Kanthor Commune	Villager	
8	Ms. Hing Sin	O Kanthor Commune	Villager	
9	Ms. Nao Sok	O Kanthor Commune	Villager	
10	Ms. Phon Pao	O Kanthor Commune	Villager	
11	Mr. Sim Sophal	O Kanthor Commune	Villager	
12	Mr. Chheum Kreun	O Kanthor Commune	Villager	
13	Mr. Sim Chhun	O Kanthor Commune	Villager	
14	Mr. Douch Samith	O Kanthor Commune	Villager	
15	Mr. Muth Vung	O Kanthor Commune	Villager	
16	Mr. Ou Hay	O Kanthor Commune	Villager	
17	Mr. Mes Chan	O Kanthor Commune	Villager	
18	Mr. Hing Kimtry	O Kanthor Commune	Villager	
19	Mr. Kin Chheun	O Kanthor Commune	Village Chief	
20	Ms. Im La	O Kanthor Commune	Villager	
	Total: 20 persons (female: 07 persons)			

3. Consultation in Trapaeng Russei Commune, Kampong Svay District, KPT Province

No	Name	Agency/Village/Commune	Position	Phone
1	Ms. Seng Pich	Trapaeng Russei Commune	Village Member	
2	Mr. Hong Khoth	Trapaeng Russei Commune	Deputy Village Chief	097 699 8723
3	Ms. Hing Neng	Trapaeng Russei Commune	Villager	
4	Mr. Ving Sandap	Trapaeng Russei Commune	Villager	
5	Ms. Seng Veun	Trapaeng Russei Commune	Villager	
6	Mr. Chhorn Yeun	Trapaeng Russei Commune	Villager	
7	Mr. But Phorn	Trapaeng Russei Commune	Villager	
8	Mr. Rim Rithy	Trapaeng Russei Commune	Villager	
9	Ms. Khe Sokha	Trapaeng Russei Commune	Villager	
10	Ms. Sem Mom	Trapaeng Russei Commune	Villager	
11	Ms. Van Ne	Trapaeng Russei Commune	Villager	
12	Ms. Chheng Ngip	Trapaeng Russei Commune	Villager	
13	Ms. Dem Khan	Trapaeng Russei Commune	Villager	
14	Mr. Nang Nem	Trapaeng Russei Commune	Village Chief	012 162 6981
15	Ms. Pin Kao	Trapaeng Russei Commune	--	
16	Ms. Sem Khom	Trapaeng Russei Commune	--	
17	Ms. Van Vanna	Trapaeng Russei Commune	--	071 708 8357
18	Ms. Ngim Navy	Trapaeng Russei Commune	--	
19	Ms. Kong Vy	Trapaeng Russei Commune	--	
20	Ms. Tea Teang	Trapaeng Russei Commune	--	
	Total: 07 persons (female: 05 persons)			

Annex 4: Environmental Management Plan – Stueng Saen WWTP subproject

See EMP

Annex 5: Fish Resources

Table 42: Table: The fish Species from consultation with local people, at Kompong Rortes Commune, Stueng Sen City. Kompong Thom Province on 2 November 2019

NN	Khmer Latin Name	English Name	ឈ្មោះវិទ្យាសាស្ត្រ	Origins	IUCN Read List ๐5/11/2019
1. 1	Trey Kranh	Climbing perch	*Anabas testudineus*	Anabantidae	DD
2. 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 Chhloon Kro Ngouk	Peacok eel	*Macrognathus siamensis*	Mastacembelidae	LC
13.	Trey Ptoong	Halfbeak	*Zenarchopterus ectuntio*	Hemiramphidae	Unknown
14.	Trey Jangva Toch		*Rasbora amplistriga*	Cyprinidae	LC
15.	Trey Jangva Stueng	Leaping barb	*Chela laubuca*	Cyprinidae	Unknown
16.	Trey Jangva Srae		*Amblypharyngodon chulabhornae*	Cyprinidae	LC
17.	Trey Slaart	Bronze featherback	*Notopterus notopterus*	Notopteridae	LC
18.	Trey Chlang	Asian redtail catfish	*Hemibagrus sp. (cf. nemarus)*	Bagridae	Unknown
19.	Trey Kreum Khda	Croaking gourami	*Trichopsis vittata*	Belontiidae	LC
20.	Trey Kontrung Preng	Durkyfin glassy perchlet	*Parambassis wolffii*	Ambassidae	LC
21.	Trey Srorka Khdarm Krahom	Beardless barb	*Cyclocheilichthys apogon*	Cyprinidae	LC
22.	Trey Tror Ourn		*Omok hypophthalmus*	Siluridae	Unknown
23.	Trey Riel Chnoot		*Lobocheilos rhabdoura*	Cyprinidea	LC
24.	Trey Sleuk Russey		*Paralaubuca barroni*	Cyprinidae	LC
25.	Trey Chror Kaeng		*Puntioplites waandersi*	Cyprinidae	LC
26.	Trey Chhpen Stueng		*Hypsibarbus lagleri*	Cyprinidae	Vu
27.	Trey Kontrub	Catopra	*Pristolepis fasciata*	Pristolepidae	LC

Table 43: The fish species from site investigation with fish-man

No.	Khmer Latin Name	English Name	*Scientific Name*	Origin	IUCN Read List ᴅ5/11/2019
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 Chhloon		*Macrognathus facus*	Mastacembelidae	LC
7.	Trey Chhloon Kro Ngouk	Peacock eel	*Macrognathus siamensis*	Mastacembelidae	LC
8.	Trey Chror Kaeng		*Puntioplites waandersi*	Cyprinidae	LC
9.	Trey Riel Chnoot		*Lobocheilos rhabdoura*	Cyprinidae	LC
10	Trey Srorka Khdarm Krahom	Beardless barb	*Cyclocheilichthys apogon*	Cyprinidae	LC
11	Trey Sleuk Russey		*Paralaubuca barroni*	Cyprinidae	LC
12	Trey Konchhos Bay	White-line catfish	*Mystus albolineatus*	Bagridae	LC
13	Trey Konchhos		*Mystus wolffi*	Bagridae	Unknown
14	Trey Slaart	Bronze featherback	*Notopterus notopterus*	Notopteridae	LC
15	Trey Chlang	Asian redtail catfish	*Hemibagrus sp. (cf. nemarus)*	Bagridae	Unknown
16	Trey Jangva Stueng	Leaping barb	*Chela laubuca*	Cyprinidae	Unknown
17	Trey Jangva Srae		*Amblypharyngodon chulabhornae*	Cyprinidae	LC

Source: IESIA report. SBK January 2020

Annex 6: IESIA

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
លេខ: ...ថែ៧៧.សជណ.ប.ស

សូមគោរពជូន

ឯកឧត្តមទេសរដ្ឋមន្ត្រី រដ្ឋមន្ត្រីក្រសួងសាធារណការ និងដឹកជញ្ជូន

កម្មវត្ថុ ៖ ករណីសំណើសុំពិនិត្យ និងផ្តល់យោបល់លើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ និងទឹកភ្លៀងក្រុងស្ទឹងសែន នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំហានទី២ នៅខេត្តកំពង់ធំ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន

យោង ៖
- ព្រះរាជក្រមលេខ នស/រកម/១២៩៦/៣៦ ចុះថ្ងៃទី២៨ ខែធ្នូ ឆ្នាំ១៩៩៦ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ
- អនុក្រឹត្យលេខ ៧២ អនក្រ.បក ចុះថ្ងៃទី១១ ខែសីហា ឆ្នាំ១៩៩៩ ស្តីពីកិច្ចដំណើរការវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន
- លិខិតលេខ ១១២៤ សក/កបទ២ ចុះថ្ងៃទី២០ ខែមីនា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ២៥៦ សក/កបទ២ ចុះថ្ងៃទី២៣ ខែមករា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ៤៨៨២ សក/កបទ២ ចុះថ្ងៃទី១៥ ខែវិច្ឆិកា ឆ្នាំ២០១៩ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន
- លិខិតលេខ ៣៣៦ សជណ ប.ស ចុះថ្ងៃទី១៧ ខែមីនា ឆ្នាំ២០២០ របស់ក្រសួងបរិស្ថាន
- លិខិតលេខ ១៩៧២ វ.ហ.ប.ស ចុះថ្ងៃទី១៧ ខែធ្នូ ឆ្នាំ២០១៩ របស់នាយកដ្ឋានវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន នៃក្រសួងបរិស្ថាន

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមគោរពជម្រាបជូន **ឯកឧត្តមទេសរដ្ឋមន្ត្រី** មេត្តាជ្រាបថា ក្រសួងបរិស្ថានឯកភាពលើរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ និងទឹកភ្លៀងក្រុងស្ទឹងសែន នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ដំហានទី២ ដែលមានទីតាំងស្ថិតនៅសង្កាត់កំពង់រទេះ សង្កាត់កំពង់ធំ សង្កាត់ជំរៃជាន់ខ្ពស់ និងសង្កាត់អូរគគីរ ក្រុងស្ទឹងសែន ខេត្តកំពង់ធំ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន (ម្ចាស់គម្រោង) ដោយម្ចាស់គម្រោងត្រូវគោរពតាមកិច្ចសន្យាការពារបរិស្ថានលេខ ១៥១៩ សក/កបទ២ ចុះថ្ងៃទី២៤ ខែមេសា ឆ្នាំ២០២០ របស់ក្រសួងសាធារណការ និងដឹកជញ្ជូន។

អាស្រ័យដូចបានគោរពជម្រាបជូនខាងលើ សូម **ឯកឧត្តមទេសរដ្ឋមន្ត្រី** មេត្តាជ្រាប និងចាត់ចែងដោយសេចក្តីអនុគ្រោះ។

សូម ឯកឧត្តមទេសរដ្ឋមន្ត្រី មេត្តាទទួលនូវសេចក្តីគោរពពីខ្ញុំ។

ថ្ងៃព្រហស្បតិ៍ ១រោជ ខែ ពិសាខ ឆ្នាំជូត ទោស័ក ព.ស.២៥៦៤
រាជធានីភ្នំពេញ ថ្ងៃទី ០៧ ខែ ឧសភា ឆ្នាំ២០២០

ជ. រដ្ឋមន្ត្រី
រដ្ឋលេខាធិការ

សៅ_សុភាព

ចម្លងជូន៖
- ទីស្តីការគណៈរដ្ឋមន្ត្រី
- ក្រសួងសេដ្ឋកិច្ច និងហិរញ្ញវត្ថុ
- ក្រសួងរៀបចំដែនដី នគរូបនីយកម្ម និងសំណង់
- ក្រសួងធនធានទឹក និងឧតុនិយម
- រដ្ឋបាលខេត្តកំពង់ធំ
- មន្ទីរបរិស្ថានខេត្តកំពង់ធំ
- ឯកសារ កាលប្បវត្តិ

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និងដឹកជញ្ជូន
លេខ: ...សក/កបទ២

ជម្រាបជូន
ឯកឧត្តមរដ្ឋមន្ត្រីក្រសួងបរិស្ថាន

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

សូមធ្វើកិច្ចសន្យាការពារបរិស្ថាន

ដើម្បីរួមចំណែកធានានូវនិរន្តរភាពបរិស្ថានក្នុងកិច្ចដំណើរការអភិវឌ្ឍន៍ប្រទេសជាតិ ក្រសួងសាធារណការ និងដឹកជញ្ជូន (ម្ចាស់គម្រោង) សូមធ្វើកិច្ចសន្យាការពារបរិស្ថានចំពោះក្រសួងបរិស្ថាន **សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ និងទឹកភ្លៀងក្រុងស្ទឹងសែន នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ជំហានទី២** ដែលមានទីតាំងស្ថិតនៅសង្កាត់កំពង់រទេះ សង្កាត់កំពង់ធំ សង្កាត់ដំរីជាន់ខ្លា និងសង្កាត់អូរគគីរ ក្រុងស្ទឹងសែន ខេត្តកំពង់ធំ ដូចប្រការដូចខាងក្រោម៖

ប្រការ ១..

ធានាទទួលខុសត្រូវ និងអនុវត្តនូវខ្លឹមសារ ដែលបានរៀបរាប់នៅក្នុងរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមដំបូង (IESIA) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ និងទឹកភ្លៀងក្រុងស្ទឹងសែន នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ជំហានទី២ 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) សម្រាប់អនុគម្រោងការគ្រប់គ្រងទឹកកខ្វក់ និងទឹកភ្លៀងក្រុងស្ទឹងសែន នៃគម្រោងកែលម្អការគ្រប់គ្រងបរិស្ថានក្រុងជុំវិញបឹងទន្លេសាប ជំហានទី២ ដែលមិនបានលម្អិតនៅក្នុងរបាយការណ៍ IESIA ដើម្បីដាក់ជូនក្រសួងបរិស្ថានពិនិត្យ និងផ្តល់យោបល់។

ប្រការ ៥..

ក្នុងករណីក្រសួងបរិស្ថានតម្រូវឱ្យម្ចាស់គម្រោងធ្វើការកែប្រែនូវបច្ចេកទេសបរិស្ថានណាមួយ ដើម្បីឱ្យសមស្របទៅតាមគោលការណ៍ណែនាំ និងកម្រិតបទដ្ឋានបរិស្ថាន ម្ចាស់គម្រោងនឹងទទួលអនុវត្តទៅតាមគោលការណ៍ណែនាំនោះទាំងស្រុង។

ប្រការ ៦..

ទៅថ្ងៃអនាគត បើម្ចាស់គម្រោងមានគម្រោងពង្រីកបន្ថែម ឬផ្លាស់ប្តូរ ឬកែសម្រួលរបាយការណ៍សិក្សាសមទិលទ្ធភាព (Feasibility Study Report) ឬផ្ទាកសកម្មភាព ម្ចាស់គម្រោងនឹងរាយការណ៍ជូនក្រសួងបរិស្ថានឱ្យបានមុន ០១ខែ។

ប្រការ ៧..

អនុញ្ញាតឱ្យមន្ត្រីជំនាញពីក្រសួងបរិស្ថាន ឬមន្ទីរបរិស្ថានខេត្តកំពង់ធំ ដែលមានលិខិតបញ្ជាបេសកកម្មត្រឹមត្រូវ ដើម្បីធ្វើការត្រួតពិនិត្យនៅទីតាំងគម្រោង។

ប្រការ ៨..

ក្នុងករណីដែលម្ចាស់គម្រោងពុំបានគោរពតាមប្រការណាមួយ ឬអនុវត្តផ្ទុយពីកិច្ចសន្យានេះ ឬលិខិតបទដ្ឋានគតិយុត្តចូលជាធរមានផ្សេងៗទៀត ម្ចាស់គម្រោងនឹងទទួលខុសត្រូវចំពោះមុខច្បាប់ជាធរមាន។

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

ជ. រដ្ឋមន្ត្រីក្រសួងសាធារណការ និងដឹកជញ្ជូន

ស៊ុយ_សាន

បានឃើញ និងគោរពជូន
ឯកឧត្តមរដ្ឋមន្ត្រីក្រសួងបរិស្ថាន មេត្តាពិនិត្យ និងសម្រេច
លេខ:...ហ.ប.ស្ត
ថ្ងៃ...ខែ...ឆ្នាំជូត ទោស័ក ព.ស...
រាជធានីភ្នំពេញ ថ្ងៃទី...ខែ...ឆ្នាំ២០២០
ប្រធាននាយកដ្ឋានទាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន

ជាញ់_សើរី

បានឃើញ និង ឯកភាព
ថ្ងៃ...ខែ...ឆ្នាំជូត ទោស័ក ព.ស...
រាជធានីភ្នំពេញ ថ្ងៃទី...ខែ...ឆ្នាំ២០២០
ជ. រដ្ឋមន្ត្រីក្រសួងបរិស្ថាន
រដ្ឋលេខាធិការ

សៅ_សុភាព

Annex 7: Wastewater Characterization For Use in Agriculture

FAO Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture together with the Australian guidelines for effluent reuse, and typical dried sludge constituents and reuse guidelines are tabulated in this annex.

Table A2-1 Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture[29]

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

Notes:

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

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

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

In view of the above, it is imperative that some studies be done on the sludge during the startup 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 form as useful reference until better understanding and more data are obtained for the conditions in Battambang.

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*.