Initial Environmental Examination (Draft)

September 2020

Cambodia: Grid Reinforcement Project

Prepared by Electricité du Cambodge for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 22 September 2020)

Currency unit	–	Riel (KR)
KR1.00	=	$0.00025
$1.00	=	KR4,089

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	affected person
BESS	–	Battery Energy Storage System
CEMP	–	Construction Environmental Management Plan
EA	–	executing agency
EDC	–	Electricité du Cambodge
EHS	–	environment, health and safety
EIA	–	environmental impact assessment
EMP	–	environmental management plan
EPC	–	engineering, procurement, and construction
FI	–	financial intermediary
GDP	–	gross domestic product
GRM	–	Grievance Redress Mechanism
IA	–	implementing agency
IEE	–	initial environmental examination
IEIA	–	initial environmental impact assessment
LARP	–	land acquisition and resettlement plan
MIME	–	Ministry of Mines and Energy
MOE	–	Ministry of Environment
OHL	–	overhead line
PCR	–	physical cultural resource
PDOE	–	Provincial Department of Environment
PMU	–	Project Management Unit
PIC	–	project implementation consultant
SEPRO	–	Social, Environmental and Public Relations Office, EDC
SPS	–	Safeguard Policy Statement
UGC	–	underground cable

WEIGHTS AND MEASURES

kV	–	kilovolt
m^2	–	square meter
km	–	kilometer
mg/l	–	milligram per liter
m	–	meter
MW	–	megawatt
MVA	–	megavolt-ampere

NOTE

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

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EXECUTIVE SUMMARY

1. The Grid Reinforcement Project (the project) will support Electricite du Cambodge (EDC), the state-owned power utility, to improve transmission network capacity and stability. The project will (i) expand and reinforce the electricity transmission infrastructure by constructing 115 kilovolt (kV) and 230 kV transmission lines and associated substations in Phnom Penh, Kampong Chhnang, Kampong Cham, and Takeo provinces; and (ii) introduce as a pilot the first utility-scale battery energy storage system to understand the performance of the technology and assess different business models for (a) renewable capacity firming, (b) ancillary services, and (c) transmission congestion relief and investment deferral as a combined set of services.

2. The project aligns well with government aspirations to attain middle-income status by 2030 and recognizes the importance of developing the energy sector to increase competitiveness, ensure sustained economic growth and thereby continue to reduce poverty. Constructing transmission lines and substations to enhance adequate and reliable supply of power is one of the key energy policy objectives of the government and EDC.

3. The Project is confirmed as environment category B based on the Asian Development Bank (ADB) Safeguard Policy Statement (SPS) (2009). A draft Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) and Climate Change Assessment have been prepared based on site and due-diligence activities, public consultations and field studies. The EMP and Initial Environmental and Social Impact Assessment (IESIA) documents will be submitted by EDC to the Ministry of Environment (MOE) for approval prior to contract award.

4. EDC will be the executing agency responsible for overall project implementation and compliance with ADB loan and grant assurances while the Project Management Unit (PMU) of the EDC will be responsible for day-to-day coordination. The PMU will be supported by the project implementation consultant (PIC) services that will be engaged under the project. The Social, Environment and Public Relations Office (SEPRO) of the EDC will be responsible for the overall supervision and coordination during project implementation with regards to ensuring consistency and compliance with all safeguards commitments to ADB and the government policy and legal requirements.

5. Environmental benefits of the project include increasing people's access to a more stable energy supply, which is likely to reduce reliance on alternative energy sources such as batteries for energy or wood for cooking. The BESS pilot project will build capacity for deploying and operating energy storage technology which will support Cambodia to scale-up energy storage as part of power system development in the future. Additionally, the battery system will improve grid stabilization and provide increased power reliability. Improving the stability and reliability of renewable energy may encourage supplementary investment into renewable energy solutions.

6. This IEE study reveals that the project is not likely to have significant negative environmental impacts. The anticipated adverse environmental impacts at subproject sites are considered temporary, localized and can be mitigated. The majority of potential impacts identified during the assessment are associated with the construction phase and can be avoided through good design and construction planning, or mitigated through effective implementation of EMP.

7. Potential community health and safety impacts during construction and operation will be effectively mitigated through community awareness and future consultations.

8. This IEE and the EMP will be updated based on detailed engineering design to take account of any changes in alignment, design or scope. The updated IEE/EMP should be cleared by ADB prior to issue of no objection for civil works to proceed.

I. INTRODUCTION

A. Overview

1. The project will strengthen adequate supply of electricity in the greater Phnom Penh and the provinces of Kampong Chhnang, Kampong Cham and Takeo through expanding four 230 kilovolt (kV) and 115 kV electricity transmission infrastructure, installing ten substations and providing an energy storage and smart sensor system to strengthen grid stability. The first standalone battery energy storage system (BESS) in Cambodia will be installed in Kampong Chhnang to enhance storage capacity (16 megawatt-hours) and grid stabilization.

B. Scope and Objective of the Initial Environmental Examination

2. This initial environmental examination (IEE) assesses the environmental impacts associated with the construction and operation of the substations and transmission lines and the BESS as listed in Table 3. For assessment and reporting purposes, the IEE generally discusses subproject components by geographical location.

3. Project screening and categorization has been undertaken to (i) determine the significance of potential environmental impacts and risks with respect to the environment, involuntary resettlement, and Indigenous Peoples; (ii) identify the level of assessment and resources required to address safeguard issues; and (iii) determine the information disclosure and consultation requirements. The Project is classified as Category 'B' for environment based on the due diligence findings.

4. An IEE is required for the project since the impacts are few, generally site-specific, largely reversible, and readily addressed through implementation of mitigation measures.[1]

5. The objectives of the IEE are to:

i) Assess existing environmental conditions in subproject locations, including the identification of environmentally sensitive areas;
ii) Assess the proposed location, design, construction and operation activities to identify and evaluate their potential impacts, and determine their significance; and
iii) Propose appropriate mitigation and monitoring measures that can be incorporated into an Environmental Management Plan (EMP) that will avoid or minimize adverse impacts so that residual impacts are reduced to acceptable levels.

6. This IEE is based on primary and secondary sources of information, field inspections, surveys, discussions with Electricite du Cambodge (EDC) staff, previous IEE documents, public consultations and input from national and international consultants. Impacts and risks will be analyzed in the context of the area of influence across each subproject location.

7. Site visits as part of environmental due diligence were conducted during preparation of the Pre-Feasibility Study in November and December 2020. Public consultations with project affected persons and other relevant stakeholders were conducted in January and February 2020. Records of consultations are discussed in Section 7 of this IEE. Bird and drone surveys were conducted in January 2020 and bat surveys in February 2020.

[1] ADB. 2009. *Safeguard Policy Statement*. Manila.

8. Further consultations will be carried out during detailed design and will continue throughout project implementation.

9. The IEE and EMP have been prepared based on the preliminary engineering designs and will be updated where necessary to meet the final detailed engineering designs.

10. This IEE report aligns with the format prescribed in ADB SPS 2009:

Section 1 - Introduction
Section 2 - Policy, Legal and Administrative Framework
Section 3 - Description of the Project
Section 4 - Description of the Baseline Environment
Section 5 - Anticipated Environmental Impacts and Mitigation Measures
Section 6 - Analysis of Alternatives
Section 7 - Information Disclosure, Consultation and Participation
Section 8 - Grievance Redress Mechanism
Section 9 - Environmental Management Plan
Section 10 - Conclusions and Recommendations

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK POLICY

11. This chapter provides an overview of the policy framework and national legislation that applies to the proposed Project. The Project is expected to comply with all national legislations and ADB Guidelines relating to environmental and social issues. The required regulatory clearances will be obtained from MOE.

A. Asian Development Bank Environmental Safeguard Policies

12. Safeguard requirements for all projects funded by ADB are defined in the SPS 2009 and Operations Manual Bank Policies (2013). Safeguard procedures establish 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. The policy also promotes adoption of international good practices as reflected in the IFC's (World Bank Group) Environmental, Health and Safety (EHS) Guidelines.

13. This IEE and EMP are intended to meet SPS 2009 requirements. The guidelines specify that environmental assessment apply the following:

i) Assessment is conducted an early stage of project preparation to identify potential direct, indirect, cumulative, and induced environmental impacts and risks to physical, biological, socioeconomic and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected persons and concerned nongovernment organizations;
ii) The assessment process will be based on current information, including an accurate project description and appropriate environmental and social baseline data;
iii) Impacts and risks will be analyzed in the context of the project's area of influence;

iv) Environmental impacts and risks will be analyzed for all relevant stages of the project cycle, including preconstruction, construction, operation, decommissioning, and post-closure activities such as rehabilitation or restoration works;
v) The assessment will identify potential transboundary effects as well as global impacts; and
vi) Assessment encompasses existing facilities and/or business activities that already exists (for which) the borrower 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 assessment and indigenous peoples. The objective of the audit is to determine if actions were in accordance with SPS and to identify and address outstanding compliance issues.

14. Project based screening and categorization will be carried out by ADB at the earliest stage of project preparation when sufficient information is available. Screening and categorization are conducted to (i) reflect the significance of potential impacts or risks that a project might present; (ii) identify the level of assessment and institutional resources required. ADB will conduct safeguard reviews, including reviews of the borrower's/client's safeguard documents, as part of its overall due diligence.

15. ADB uses a classification system to reflect the significance of a project's potential environmental impacts relating to the: (i) sensitivity and vulnerability of environmental resources in project area and (ii) potential for the project to cause significant adverse environmental impacts. Projects are categorized to one of the following four categories:

i) **Category A:** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.
ii) **Category B:** Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An IEE is required to determine whether or not significant environmental impacts warranting an EIA are likely.
iii) **Category C**: Projects unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.
iv) **Category FI:** Projects are classified as category FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all subprojects will result in insignificant impacts.

B. World Bank Guidelines

16. EHS Guidelines for Electric Power Transmission and Distribution (2007) are designed to provide guidance to users on common EHS issues and mitigation measures applicable to electric power transmission and distribution project. The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

17. The EHS Guidelines identify construction-related impacts as well as operational impacts of power lines. Workers may be exposed to occupational hazards from contact with live power

lines during construction, maintenance, and operation activities. Recommended prevention and control measures associated with live power lines include:

i) Only allowing trained and certified workers to install, maintain, or repair electrical equipment;
ii) Deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines;
iii) Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following:
    a) Distinguish live parts from other parts of the electrical system
    b) Determine the voltage of live parts
    c) Understand the minimum approach distances outline for specific live line voltages
    b) Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system
iv) Workers should not approach an exposed energized or conductive part even if properly trained unless:
    a) The worker is properly insulated from the energized part with gloves or other approved insulation; or,
    b) The energized part is properly insulated from the worker and any other conductive object; or,
    c) The worker is properly isolated and insulated from any other conductive object (live-line work).
v) Where maintenance and operation are required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan.

C. Legal and Institutional Framework on Environmental Management in Cambodia

18. The hierarchy of legislation in Cambodia is shown below:

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

19. 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.

20. 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 (Environment Law), which was adopted in 1996.

21. The Environment Law has the following objectives:

i) Protect and upgrade environmental quality and reduce pollution;
ii) Assess the impacts of proposed projects before approval;

iii) Ensure rational and sustainable use of the Kingdom's resources;
iv) Encourage public participation in environmental protection and natural resource management; and
v) Reduce activities that impact negatively on the environment.

22. A summary of legislative and policy instruments relevant to the proposed Project is described below:

Table 1: Summary of national level policy, laws and regulations related to the Project

Title	Description
Royal Decree on the Protection of Natural Areas, 1993	Classifies 23 protected areas in Cambodia into four categories: (i) natural parks; (ii) wildlife sanctuaries; (iii) protected landscapes; and (iv) multiple-use areas.
Law on the Protection of Cultural Heritage (NS/RKM/0196/26), 1996	Regulates the protection of national cultural heritage and cultural property against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Under Article 6, protected sites containing archaeological reserves or other sites of archaeological, anthropological or historic interest may be established.
Sub-decree No 72 on Environmental Impact Assessment Process (1999)	Sub-decree N° 72 on Environmental Impact Assessment Process (1999) aims to: (1) Determine the type and size of the proposed project(s) and activities, including existing and ongoing activities in both private and public prior to undertaking the process of EIA; (2) Determine the requirements for an EIA upon every private and public project or activity. The EIA is to be reviewed by the MOE, prior to the submission for a decision from the Royal Government; (3) Encourage public participation in the implementation of EIA process and take into account the public's inputs and suggestions in the implementation of any project. According to Article 2 of this Sub-decree, every proposed project and activities and existing and in-process, private, joint-venture and public projects, that are listed in the Annex of the Sub-decree, except projects declared as necessary under state of emergency and approved by the Government, shall prepare an EIA and comply with this Sub-decree. The list of projects, which requires conduct of an EIA or IESIA, is described in the Annex of sub-decree N° 72 ANRK.BK. Construction of sub-station(s) and/or transmission lines project are not mentioned in the Annex of this Sub-decree[2]. Those not included in the list are required to conduct a pre-feasibility study based on Article 7 and may be required to prepare EMP. The MOE shall: (i) evaluate and review the IESIA/EIA report in collaboration with other Governmental Institutions and (ii) take appropriate administrative action, conduct appropriate surveillance and monitoring to ensure that the EMP during project construction, operation, and closure, based on Article 3 of the sub-decree.
Prakas N° 021 on Classification of Environmental Impact Assessment for Development Projects	Provides an update to Sub-Decree N° 72 to classify investment projects that are subject to full environmental impact assessment ("Full EIA") or to initial environmental impact assessment ("IEIA"); based on the nature and/or scale of the project. This new regulation also identifies a third category of projects that are required to prepare an environmental management plan and to agree an environmental protection contract ("EPC"). Under Prakas N° 021 substation construction is subject to IEIA and for transmission lines, <115 kV lines are subject to EPC, 115 kV-230 kV to IEIA and >230 kV subject to EIA.

[2] New Prakas under development. Once codified, all substation and transmission line project will require some form of environmental assessment: i) Environmental Contract ii) Initial or Full ESIA

Title	Description
Labor Law (1997) Decree N° CS/RKM/0397/01	Governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. Key sections relevant to this project include: • Chapter VIII (Health and Safety of Worker) prescribes the key provisions related to the quality of the premises; cleaning and hygiene; lodging of personnel (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; and lighting and noise levels in the workplace. • Article 230 (Workplaces) must guarantee the safety of workers. • Chapter IX Work-Related Accidents Article 248: All occupational illness, as defined by law, shall be considered a work-related accident. The law sets out how accidents should be managed in terms of compensation.
Sub-decree on Solid Waste Management (Sub-decree N° 36 ANK/BK)	Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity through appropriate technical approaches. Article 2 specifies that the Sub-decree applies to all activities related to disposal, storage and collection, transport, recycling, dumping of garbage and hazardous waste. Article 4 prescribes that the MOE 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.
Sub-decree on Control of Air Pollution and Noise Disturbance (Sub-decree N° 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 of the Sub-decree) and (ii) maximum allowable noise level in public and residential areas (Annex 6 of the Sub-decree). 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, vapor, fog, odor, 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)
Law on Forestry, 2002	Provides general jurisdiction and enforcement activities for all forest related offences that occur within the Protected Areas; supervised by the Ministry of Agriculture, Forestry, and Fisheries in coordination with the MOE.
Law on Water Resources Management (NS/RKM/0607/016), 2007	The general purpose of this law is to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and ensure the welfare of the people. This Law determines the: • rights and obligations of water users, • fundamental principles of water resources management, and • participation of users and their associations in the sustainable development of water resources. Projects require a license/permit/written authorization for the: (i) abstraction and 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 and gravel from the beds and banks of water courses, lakes, canals and reservoirs; (iii) filling of river, tributary, stream, natural lakes, canal and reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and endanger human, animal and plant health. (Articles 12 & 22).

<table>
<tr><th>Title</th><th>Description</th></tr>
<tr><td>Royal Decree on Protected Areas (Royal Decree N° NS/RKM/0208/007), 2008:</td><td>Defines the framework of management, conservation and development of protected areas to ensure the conservation of biodiversity and sustainable use of natural resources in protected areas.
Article 11 divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone and community zone.
Article 36 strictly prohibits all types of public infrastructure in the core zone and conservation zone; allows development of public infrastructures in the sustainable use zone and 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, use of chemical substances, disposal of solid and liquid wastes into water or on land. Each protected area shall be divided into four (4) management zoning systems:
Core zone: management area(s) of high conservation values containing threatened and critically endangered species, and fragile ecosystems.
Conservation zone: management area(s) of high conservation values containing natural resources, ecosystems, watershed areas and natural landscapes located adjacent to the core zone.
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.
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) land.</td></tr>
<tr><td>Sub-decree on Water Pollution Control (Sub-decree N° 27 ANRK/BK), 2009</td><td>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. Annexes 2, 4 and 5 provide the industrial effluent standards, including effluent from wastewater stabilization ponds, water quality standards for public waters for the purpose of biodiversity conservation, and water quality standards for public waters and health, respectively.
In addition, water quality standards and associated parameters for public water areas, specifically water quality for lakes and reservoirs, is illustrated in table below.
<table><tr><th>No</th><th>Parameter</th><th>Unit</th><th>Standard Value</th></tr><tr><td>1</td><td>pH</td><td>mg/l</td><td>6.5 – 8.5</td></tr><tr><td>2</td><td>COD</td><td>mg/l</td><td>1.0 – 8.0</td></tr><tr><td>3</td><td>Suspended Solid</td><td>mg/l</td><td>1.0 – 15</td></tr><tr><td>4</td><td>Dissolved Oxygen</td><td>mg/l</td><td>2.0 - 7.5</td></tr><tr><td>5</td><td>Coliform</td><td>MPN/100ml</td><td>< 1000</td></tr><tr><td>6</td><td>Total Nitrogen</td><td>mg/l</td><td>1.0 – 0.6</td></tr><tr><td>7</td><td>Total Phosphorus</td><td>mg/l</td><td>0.005 – 0.05</td></tr></table></td></tr>
<tr><td>Expropriation Law, 2010</td><td>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.</td></tr>
<tr><td>National Environmental Standards including Ambient Air Quality Standard, of Sub-</td><td>Sub-decree N° 42 ANK/BK Disturbance and Air Pollution Control (2000) aims to protect the quality of the environment and public health from air pollutants and noise disturbance through monitoring, reduction and mitigating activities.
Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000, Drinking water Quality Standards, 2004 (groundwater), Water Quality Standards for Public</td></tr>
</table>

<table>
<tr><th>Title</th><th>Description</th></tr>
<tr><td>decree on Control of Air Pollution and Noise Disturbance, 2000</td><td>
Waters for the Purpose of Biodiversity Conservation, Water Quality Standards for Public Waters and Health of Sub-decree on Water Pollution Control, 1999 (surface water quality)
In accordance with Article 4, air quality standards are highlighted in the table below.
<table>
<tr><th>No</th><th>Parameter</th><th>1 Hour Average mg/m³</th><th>8 Hours Average mg/m³</th><th>24 Hours Average mg/m³</th><th>1 Year Average mg/m³</th></tr>
<tr><td>1</td><td>Carbon Monoxide (CO)</td><td>40</td><td>20</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>Nitrogen Dioxide (NO_2)</td><td>0.3</td><td>-</td><td>0.1</td><td>-</td></tr>
<tr><td>3</td><td>Sulfur dioxide (SO_2)</td><td>0.5</td><td>-</td><td>0.3</td><td>0.1</td></tr>
<tr><td>4</td><td>O Zone (O_3)</td><td>0.2</td><td>-</td><td></td><td>-</td></tr>
<tr><td>5</td><td>Lead (Pb)</td><td>-</td><td>-</td><td>0.005</td><td>-</td></tr>
<tr><td>6</td><td>Total Suspended particulate (TSP)</td><td>-</td><td>-</td><td>0.33</td><td>0.1</td></tr>
</table>
Based on Article 5, emissions from movable sources shall not exceed the levels highlighted in in the table below.
<table>
<tr><th rowspan="2">No</th><th rowspan="2">Kind of Vehicle</th><th rowspan="2">Kind of Fuel</th><th colspan="4">Level of Emission</th></tr>
<tr><th colspan="2">CO (%)</th><th colspan="2">HC (ppm)</th><th>Dark Fume %</th></tr>
<tr><td></td><td></td><td></td><td>A</td><td>B</td><td>A</td><td>B</td><td></td></tr>
<tr><td>1</td><td>Motorcycle contain 2 stroke combustion</td><td>Petrol</td><td>4,5</td><td>4</td><td>10,000</td><td>3,000</td><td>-</td></tr>
<tr><td>2</td><td>Motorcycle contain 4 stroke combustion</td><td>Petrol</td><td>4,5</td><td>4</td><td>10,000</td><td>2,400</td><td>-</td></tr>
<tr><td>3</td><td>All kinds of vehicles</td><td>Petrol</td><td>4,5</td><td>4</td><td>1,200</td><td>800</td><td>-</td></tr>
<tr><td>4</td><td>All kinds of vehicles</td><td>Diesel</td><td>-</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
</table>
Remark: This Standard applied to control of gases emission of mobile sources into atmosphere.
A) Refer to all kinds of vehicles used over 5 years counting from year of production.
B) Refer to all kinds of vehicles that are newly imported in the first 5 years counting from year of production.
According to Article 7, noise emission standards from various sources are specified in the table below. The standards and accepted noise levels are categorized into: quiet, residential, commercial and small industrial areas.
<table>
<tr><th rowspan="2">No</th><th rowspan="2">Area</th><th colspan="3">Period of Time</th></tr>
<tr><th>From 6 am to 18 pm</th><th>From 18 pm to 22 pm</th><th>From 22 pm to 6 am</th></tr>
<tr><td>1</td><td>Quiet Areas
- Hospital
- Library
- School
- Kindergarten</td><td>45</td><td>40</td><td>35</td></tr>
<tr><td>2</td><td>Residential Areas
- Hotel
- Administrative office
- House</td><td>60</td><td>50</td><td>45</td></tr>
<tr><td>3</td><td>Commercial and service areas and area of multiple businesses</td><td>70</td><td>65</td><td>50</td></tr>
<tr><td>4</td><td>Small industrial factories mingling in residential area</td><td>75</td><td>70</td><td>50</td></tr>
</table>
<table>
<tr><th>Noise Level (dB (A))</th><th>Maximum Period of Time</th><th>Level</th></tr>
<tr><td>75</td><td>32</td><td rowspan="9">Ear protection equipment shall be provided to worker who works at a location with noise level over 80dB(A)</td></tr>
<tr><td>80</td><td>16</td></tr>
<tr><td>85</td><td>8</td></tr>
<tr><td>90</td><td>4</td></tr>
<tr><td>95</td><td>2</td></tr>
<tr><td>100</td><td>1</td></tr>
<tr><td>105</td><td>0.5</td></tr>
<tr><td>110</td><td>0.25</td></tr>
<tr><td>115</td><td>0.125</td></tr>
</table>
</td></tr>
</table>

D. Cambodia Electric Power Technical Standards

23. Requirements issued by the Ministry of Mines and Energy (MME) in accordance with the Electric Power Technical Standard of the Kingdom of Cambodia (2004, amended 2007) will be applicable to the project. Table 2 presents the applicable safety clearances and standards for transmission lines based on the requirements of the Electric Power Technical Standard of the Kingdom of Cambodia (2007).

Table 2: Clearance and Safety Standards for Transmission Lines

Name	Description
General Requirements for High Voltage Transmission facilities, Electric Power Technical Standard (2007)	Article 2 – The Technical Standards aim to prescribe the basic requirements necessary to regulate the existing and the planned transmission and distribution facilities in the Kingdom of Cambodia. Article 13 - Environmental Protection Compliance with Environmental Standards by preventing environmental pollution, the electric power facilities shall be constructed in accordance with the environmental laws and regulations of the Kingdom of Cambodia. According to Article 35: The minimum safety clearances for the construction and maintenance of 115 kV and 230 kV over-head transmission lines are summarized as follows: <u>115 kV</u> - General clearance height > 3.5 m - Tree clearance height > 2.5 m - Height in urban areas > 7 m - Height over roads and/or railways > 13.5 <u>230 kV</u> - General clearance height > 4.2 m - Trees clearance height > 3.2m - Height in urban areas > 7.7 m - Height over roads and/or railways > 14.2 m

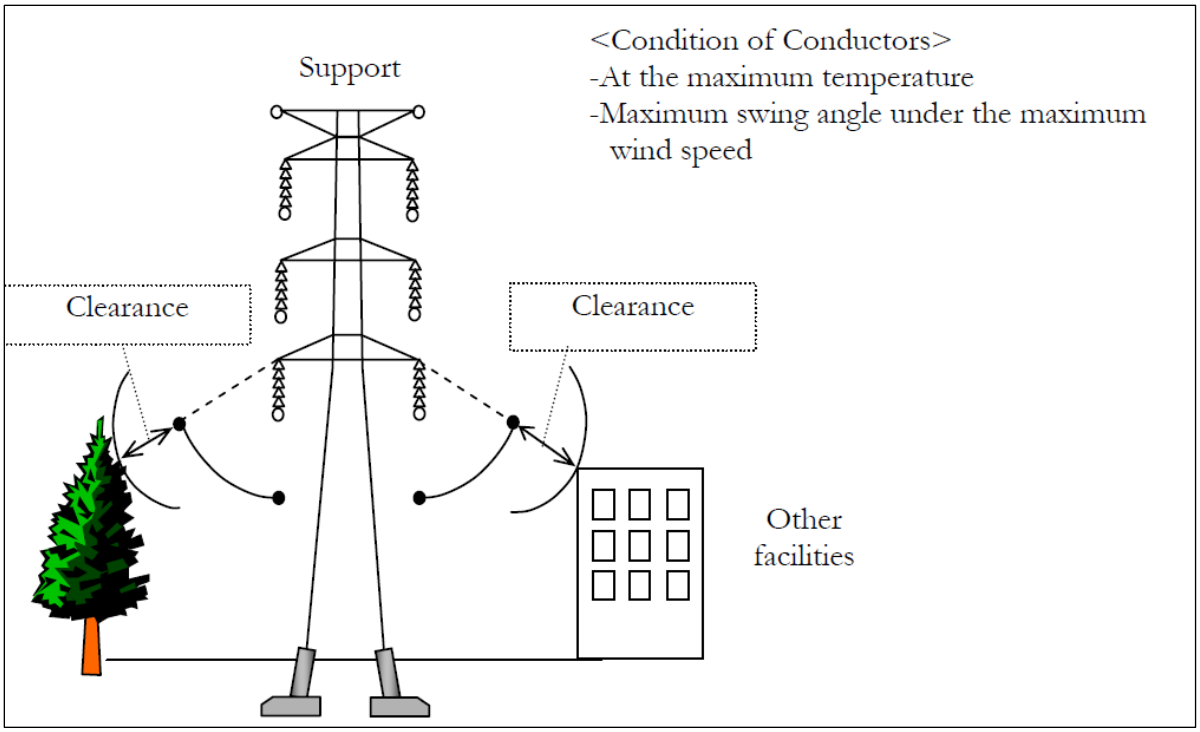

Figure 1: General transmission line clearance diagram for trees and buildings[3]

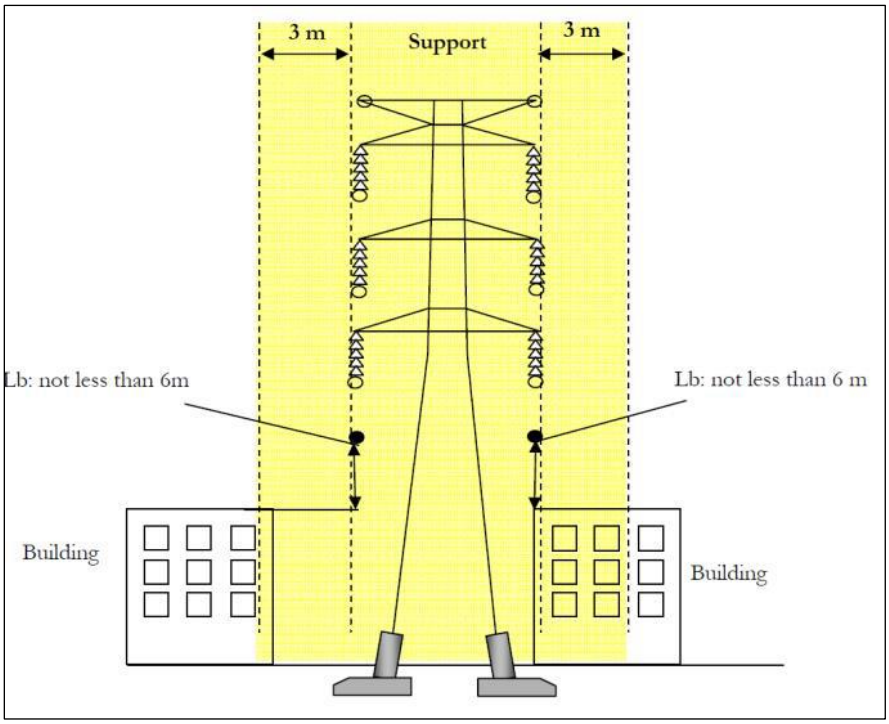

Figure 2: General safety clearances in urban areas[4]

[3] Ministry of Industry, Mines and Energy. 2006. *Electric Power Standards*. Phnom Penh.
[4] Ministry of Industry, Mines and Energy. 2006. *Electric Power Standards*. Phnom Penh.

E. International Conventions and Agreements

24. There are a number of international environmental conventions, treaties and protocols related to environmental management and protection that the Royal Government of Cambodia has signed and ratified such as:

i) United Nations Framework Convention on Climate Change (UNFCC), 1992, entered into force on 21 March 1994 (Cambodia ratified on 18 December 1995)
ii) Kyoto Protocol 1997, entered into force on 16 February 2005 (Cambodia accessed on 4 July 2002)
iii) Vienna Convention for the Protection of the Ozone Layer, entered into force on 22 September 1988 (Cambodia accessed on 27 June 2001)
iv) Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, entered into force on 1 January 1989 (Cambodia accessed on 27 June 2001).

III. DESCRIPTION OF THE PROJECT

A. Project Rationale

25. **Socioeconomic context.** Cambodia underwent significant development in recent years reaching lower middle-income status in 2015. The country continues to demonstrate strong economic growth, mainly driven by urban-based industries such as garment exports, tourism, and more recently construction and real estate. Per capita gross national income grew on average 7.3% per annum from $950 in 2013 to $1,230 in 2018.[5]

26. **Country background.** Cambodia's population is about 15.3 million and continues to annually increase by 1.3%.[6] The country is at an early stage of urbanization with 23% of people living in major cities of Phnom Penh and Siem Reap. At an average annual urbanization growth rate of 3.3%, it is expected that 28% of the population will live in urban areas by 2030 and 40% by 2050.[7] The bulk of urbanization is taking place in Phnom Penh which serves as a regional economic center, strategically located along the Greater Mekong Subregion Southern Economic Development Corridor and regional industrial developments.[8]

27. Phnom Penh, the capital, where presently 2 million people live, and government, business and industry are concentrated, currently accounts for 57% of electricity consumed. About 23% of total electricity consumption is used in the other urban areas including Preah Sihanouk, Siem Reap, Kampong Cham, Takeo, and Battambang. Households and businesses face frequent unpredictable power shortages and voltage fluctuations. It severely constraints quality of life and undermines the country's effort to diversify into a manufacturing destination.

28. **Government strategy.** The government aspires to attain middle-income status by 2030. In its Socio-Economic Policy Agenda, 2018–2023,[9] the government recognizes the importance of developing the energy sector to increase competitiveness, ensure sustained economic growth and thereby continue to reduce poverty. Constructing transmission lines and substations to

[5] ADB. 2015. *Basic Statistics 2015*. Manila; and ADB. 2019. *Basic Statistics 2019*. Manila.
[6] Royal Government of Cambodia. 2019. *General Population Census of the Kingdom of Cambodia.* Phnom Penh.
[7] World Bank Data. https://data.worldbank.org/indicator/SP.URB.GROW. Accessed 12 July 2019.
[8] Baker, Judy L.; Kikutake, Natsuko; Lin, Sarah Xinyuan; Johnson, Erik Caldwell; Yin, Soriya; Ou, Narya. 2017. Urban development in Phnom Penh (English). Washington, D.C.: World Bank Group.
[9] Royal Government of Cambodia. 2018. *Rectangular Strategy for Employment, Equity and Efficiency, Phase IV: Building the Foundation toward Realizing the Cambodia Vision 2050.* Phnom Penh.

enhance adequate and reliable supply of power is one of the key energy policy objectives of the government and EDC. Cambodia's electricity consumption grew to 9,307 gigawatt-hours in 2018 and is forecast to rise to 28,542 gigawatt-hours by 2025, a greater than threefold increase relative to consumption in 2018. To meet growing demand for electricity with environmentally and socially sustainable supply, it is planned to increase solar power generation capacity from 10 MW to 41 MW and to develop 80 MW of generation capacity from wind energy by 2022.

29. A key constraint to improvement of Cambodia's economic competitiveness and social welfare is an underdeveloped energy sector. Nearly 5 million Cambodians do not have access to electricity and are reliant on batteries, wood and other traditional fuels for energy.[10] Cambodia's energy sector is faced with several strategic challenges, such as energy access, security, affordability and environmental sustainability.

B. Project Outputs

30. The Grid Reinforcement Project (the project) will support EDC, the state-owned power utility, in improving transmission network capacity and stability. The project will consist of the following outputs:

31. **Output 1: 115 kilovolt and 230 kilovolt grid infrastructure expanded and reinforced.** The proposed project will support the expansion of 115 kV and 230 kV overhead and underground transmission lines and associated substations in Phnom Penh, Kampong Chhnang, Kampong Cham and Takeo provinces. It will add 13 circuit-kilometer (cct-km) of 230 kV transmission lines, 36.7 cct-km of 115 kV transmission lines, 1,475 megavolt-ampere (MVA) of 230/115/22 kV substation transformer capacity and 275 MVA of 115/22 kV substation transformer capacity.

32. **Output 2: First utility-scale energy storage system provided.** The project will support the EDC in installing the first stand-alone BESS in Cambodia. The BESS will be capable of storing 16 megawatt-hour of power and will provide the following services: (i) smoothing of fluctuating power supplied from a 60 MW solar park; (ii) providing at least 0.5 hour of curtailment reserve to address power shortages; (iii) providing primary frequency control; (iv) deferring upgrades in transformer capacity at GS6 substation; and (v) shifting lower cost electricity supply to high cost peak demand to achieve savings. Validation tests will be conducted to understand the effectiveness of the storage system at stabilizing the grid. It will help to build the capacity for deploying and operating energy storage technology thus, creating the foundation for EDC to scale-up energy storage as part of power system development in the near future.

33. The project will support EDC in implementing the project components with a focus on procurement and contract management, construction supervision, testing and commissioning, implementation, updating and monitoring of social and environmental safeguards, implementation of gender and social equality dimensions, project performance monitoring and evaluation. PIC will complement existing staff of EDC, thus ensuring a high degree of project implementation efficiency.

C. Project Components

34. The proposed scope of work includes fourteen subprojects and the BESS. The 14 subprojects include (i) one 230 kV and two 115 kV transmission lines, plus five associated new 230 kV and 115 kV substations in Phnom Penh; and (ii) one 115 kV transmission line and five

[10] Cambodia: Energy Sector Assessments, Strategy and Roadmap (2018) ADB

new 230 kV and 115 kV substations in Kampong Chhnang, Kampong Cham and Takeo provinces. Table 3 outlines the subproject components and locations.

Table 3: Overview of subproject components and locations

N°	Subproject Name	Subproject Scope	Administrative District	GPS Coordinates
Transmission Lines and Substations in Phnom Penh				
TPP1	New 6.52 km 230 kV transmission line from existing GS5 to proposed Sen Sok substation	230 kV double circuit line; ~ 5 km overhead on monopoles and 1.5 km underground cable	Khan Sen Sok, Phnom Penh	GS5 SS: 11°35'18.81"N, 104°50'30.93"E SPP2 Sen Sok SS: 11°36'21.54"N, 104°53'14.58"E
TPP2	New 2.44 km 115 kV transmission line between proposed Sen Sok and Russei Keo substations	115 kV double circuit line; ~ 1.5 km overhead on monopoles and 1.0 km underground cable	Khan Sen Sok / Khan Russei Keo, Phnom Penh	SPP2 Sen Sok SS: 11°36'21.54"N, 104°53'14.58"E SPP5 Russei Keo SS: 11°36'37.87"N, 104°54'18.27"E
TPP3	New 4.4 km 115 kV transmission line from proposed Boeung Tompon substation to new Olympic substation	115 kV double circuit line; ~2.4 km overhead on monopoles and 2.0 km underground cable; plus 0.8 km underground cable to connect SPP3	Khan Mean Chhey and Khan Chamka Mon, Khan Boeung Keng Kang, Phnom Penh	SPP4 Boeung Tompon SS: 11°31'31.26"N, 104°54'17.44"E Olympic SS: 11°33'22.70"N, 104°54'47.39"E
SPP1	New 230/115/22 kV Dangkor substation	2×240 MVA 230/115/22 kV transformers; outdoor switchyard; 2 x 230 kV circuits; 4 x 115 kV circuits	Sangkat Prateah Lang, Khan Kambol, Phnom Penh	SPP1 Dangkor SS: 11°28'12.59"N, 104°47'8.70"E
SPP2	New 230/115/22 kV Sen Sok substation	1×360 MVA 230/115/22 kV transformer; GIS indoor switchgear; 2 x 230 kV circuits; 2 x 115 kV circuits	Khan Sen Sok, Phnom Penh	SPP2 Sen Sok SS: 11°36'21.54"N, 104°53'14.58"E
SPP3	New 115/22 kV RUPP substation	1×75 MVA 115/22 kV transformers; GIS indoor switchgear; 4 x 115 kV circuits	Khan Sen Sok, Phnom Penh	SPP3 RUPP SS: 11°34'13.20"N, 104°53'12.22"E
SPP4	New 115/22 kV Boeung Tompon substation	1×75 MVA 115/22 kV transformer; GIS indoor switchgear; 6 x 115 kV circuits	Khan Mean Chhey, Phnom Penh	SPP4 Boeung Tompon SS: 11°31'31.26"N, 104°54'17.44"E
SPP5	New 115/22 kV Russei Keo substation	1x75 MVA 115/22 kV transformer; GIS indoor switchgear; 4x115 kV circuits	Khan Russei Keo, Phnom Penh	SPP5 Russei Keo SS: 11°36'37.87"N, 104°54'18.27"E

N°	Subproject Name	Subproject Scope	Administrative District	GPS Coordinates
Transmission Lines and Substations in Kampong Chhnang (KCN), Kampong Cham (KPC), and Takeo (TKO)				
TKCN1	New 11.1 km 115 kV transmission line from proposed Samaki Meanchey to proposed Kampong Tralach substations	115 kV double circuit line; overhead on monopoles or steel towers	Tbaeng Kpos, Thlok Vein, Sedthei communes, Samaki Meanchey District and Peani commune, Kampong Tralach district, Kampong Chhnang province	SKCN1 Samaki Meanchey SS: 11°53'37.11"N, 104°36'58.07"E SKCN2 Kampong Tralach SS: 11°55'54.72"N, 104°42'25.91"E
SKCN1	New 230/115/22 kV Samaki Meanchey substation	1×160 MVA 230/115/22 kV transformer; outdoor switchyard; 4 x 230 kV circuits; 2 x 115 kV circuits	Tbaeng Khpos commune, Samaki Meanchey district, Kampong Chhnang province	SKCN1 Samaki Meanchey SS: 11°53'37.11"N, 104°36'58.07"E
SKCN2	New 115/22 kV Kampong Tralach substation	1×50 MVA 115/22 kV transformer; outdoor switchyard; 2 x 115 kV circuits	Peani commune, Kampong Tralach district, Kampong Chhnang province	SKCN2 Kampong Tralach SS: 11°55'54.72"N, 104°42'25.91"E
SKPC1	New 230/115/22 kV Thnal Keng substation	1×160 MVA 230/115/22 kV transformer; outdoor switchyard; 4 x 230 kV circuits; 2 x 115 kV circuits	Sambour commune, Batheay district, Kampong Cham province	SKPC1 Thnal Keng SS: 11°52'50.58"N, 104°54'7.38"E
SKPC2	New 230/22 kV Skun substation	1×75 MVA 230/22 kV transformer; outdoor switchyard; 4 x 230 kV circuits	Soutip commune, Chheuong Prey district, Kampong Cham province	SKPC2 Skun SS: 12°02'41.48"N, 105°04'24.53"E
STKO1	New 230/115/22 kV Samroang Yoang substation	1x240 MVA 230/115/22 kV transformer; outdoor switchyard; 4 x 230 kV circuits; 2 x 115 kV circuits	Trapang Sap commune, Tonle Bati district, Takeo province	STKO1 Samroang Yoang SS: 11°53'37.11"N, 104°36'58.07"E
BSS1	Pilot battery energy storage system (BESS)	Approx. 16 containers	National Solar Park, Kampong Chhnang province	

Source: Transmission Lines and Substations Technical Overview, TA-9600-REG. September 2020.

35. Figures 3 to 5 present the locations of the transmission lines and substations.

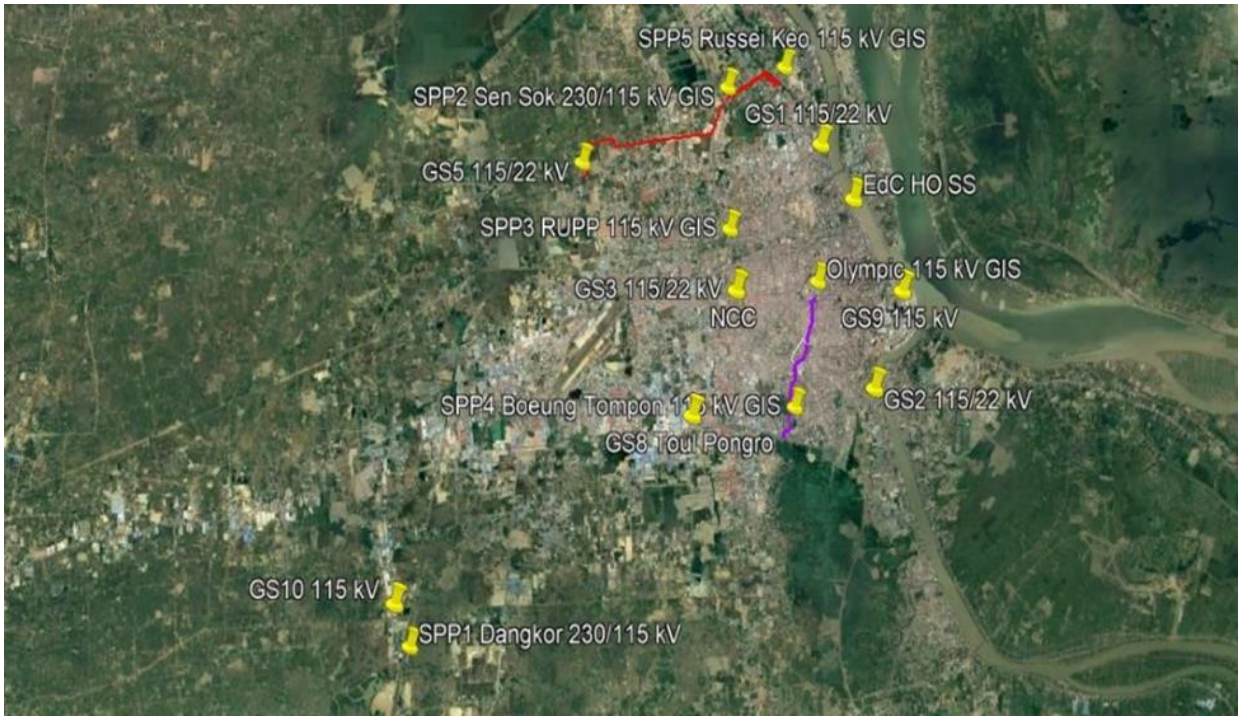

Figure 3: Transmission lines and substations in Phnom Penh

Figure 4: Transmission lines and substations in Kampong Chhnang and Kampong Cham

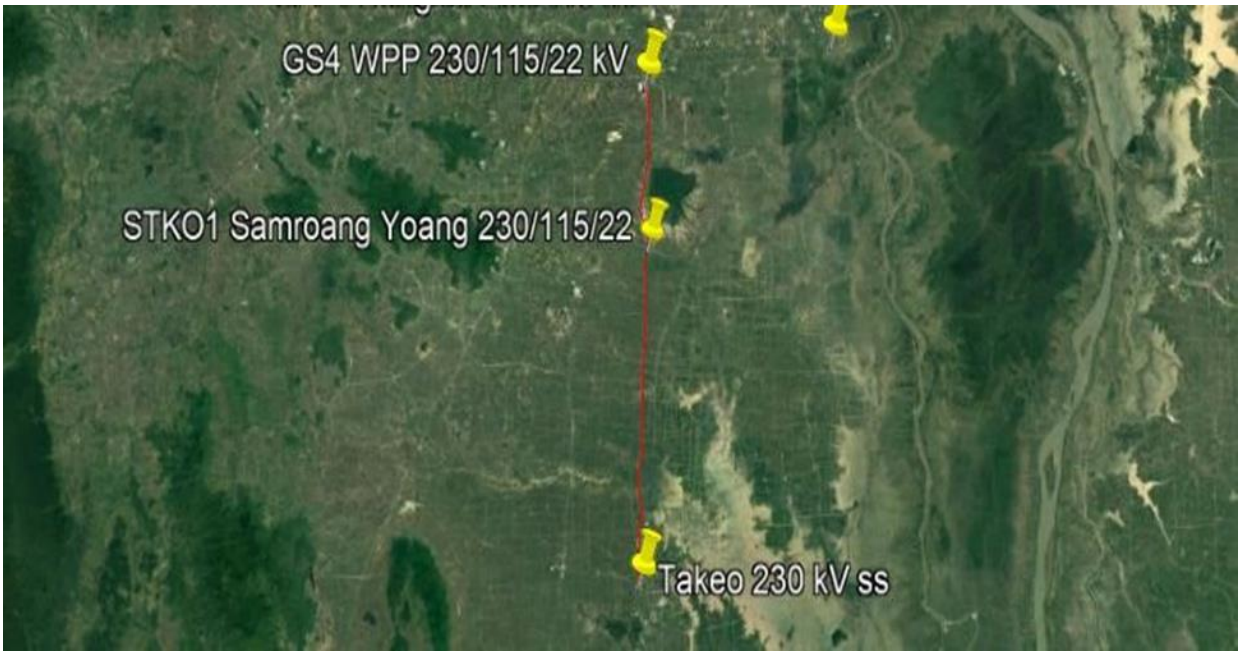

Figure 5: Transmission Lines and Substations in Takeo Province

36. Described in the succeeding sections are the details of each subproject.

1) TPP1: New 6.52 km 230 kV transmission line from existing GS5 substation to proposed Sen Sok substation (SPP2)

37. **Objective.** The objective of the subproject is to provide high voltage power to the Sen Sok and Russei Keo substations in order to meet the growing demand in the area.

38. **Scope of work.** The subproject includes the construction of new 6.52 km double circuit 230 kV transmission line consisting of approximately 1.5 km of underground cable (UGC) and about 5 km of overhead line (OHL)[11] between the existing 230 kV busbars at GS5 substation and the proposed 230/115 kV Sen Sok substation (SPP2).

39. The OHL of TPP1 will be on 30 m high steel monopoles with in-situ cast reinforced concrete foundations. Insulators will be polymer post type installed directly on the poles without crossarms, in order to minimize the width of the ROW. Average spans will be 250 m, with section poles located on large angles. The OHL design provides for Bittern ACSR 645 mm^2 twin conductors per phase, with nominal rated capacity of 115 MVA per circuit plus one top mounted ground wire (OPGW cable 50 mm2 plus 48 optic fibers) for lightning shielding, protection and communications.

40. The UGC design provides for six single-core 1,200 mm^2 230 kV aluminum XLPE-insulated cables, plus a separate 48 core fiber optic cable, to be installed underground in seven sets of 100 mm Φ PVC pipes. Jointing pits will be installed at approximately 300 to 500 m intervals, depending on the maximum available lengths of cable. The implementation of this subproject, excluding detailed design, will take approximately 36 months from start of construction.

[11] The exact lengths of overhead and underground lines will be determined during the detailed design. There is possibility that the entire length can be installed as overhead. (Source: Technical Report. March 2020)

41. **Location.** The 230 kV transmission line alignment is situated to the north of the city and traverses through peri-urban and urban environments that consist of residential, industrial and manufacturing areas and also some rice paddy and grazing fields. The line follows the road alignment and is all on public land without need for land acquisition. The landscape is considered heavily modified which is evidenced by major developments in the area, including Aeon Mall 2 and numerous garment factories and gated communities. Connecting to GS5 substation at Krang Thong, the alignment initially runs north along a storm drain for 900 m before running east (unnamed road) and then following Street 92 south before heading north along 1003. The end of the line at Sen Sok substation is approximately 250 m north of Aeon Mall 2.

Figure 6: TPP1 230 kV and TPP2 115 kV transmission line alignment

Existing GS5 substation which is the start of TPP1

General condition along the alignment of TPP1

Photo 1: Site of TPP1 – 230 kV transmission line from GS5 substation to proposed Sen Sok substation

2) TPP2: New 2.44 km 115 kV transmission line between proposed Sen Sok (SPP2) and Russei Keo substations (SPP5)

42. **Objective.** The proposed new 115 kV transmission line aims to provide high voltage power to the new Russei Keo substation (SPP5) in order to meet the growing demand in the area.

43. **Scope of work.** The subproject includes the construction of a new 2.44 km double circuit 115 kV transmission line between the proposed Sen Sok substation and the proposed Russei Keo substation. The alignment will be a combination of OHL (~1.5 km) and UGC (1.0 km).

44. The OHL will be on 30 m high steel monopole towers with in-situ cast reinforced concrete foundations. Insulators will be polymer post type installed directly on the poles without crossarms, in order to minimize the width of the ROW. Average spans will be 250 m, with section poles located on large angles. The OHL design provides for Bittern ACSR 645 mm^2 twin conductors per phase, with nominal rated capacity of 30 MVA per circuit plus one top mounted ground wire (OPGW cable 50 mm^2 plus 48 optic fibers) for lightning shielding, protection and communications.

45. The UGC design provides for two three-core 800 mm^2 115 kV aluminum XLPE-insulated cables, plus a separate 48 core fiber optic cable to be installed underground in three sets of 100 mm Φ PVC pipes. Jointing pits will be installed at approximately 300 to 500 m intervals, depending on the maximum available lengths of cable. The implementation of this subproject, excluding detailed design, will take approximately 36 months from start of construction.

46. **Location.** The proposed 115 kV transmission line is situated to the north of Phnom Penh. The line follows the road alignment and is all on public land without need for land acquisition. The alignment initially runs north-east along Road 1003, south along Road 1800 and then turns northeast along an unnamed laterite road. The transmission line alignment continues until it crosses the Russei Keo River and then connects to the proposed Russei Keo substation. Broadly, the surrounding area is heavily modified and supports residential housing, schools, light industry and small agricultural plots.

3) TPP3: New 2.44 km 115 kV transmission line between proposed Boeung Tompon (SPP4) to Olympic substations

47. **Objective.** The subproject aims to provide high voltage power to the new Boeung Tompon substation in order to meet the growing demand in the area and to provide a link between the existing 115 kV lines south of Boeung Tompon substation (which connects to GS4 and GS2) and the Olympic 115 kV GIS substation.

48. **Scope of work.** The proposed TPP2 subproject consists of: (i) new 4.4 km double-circuit 115 kV transmission line (~2.4 km overhead on monopoles and 2.0 km underground cable) between the proposed Boeung Tompon 230/115 kV substation and Olympic 115 kV substation[12] and (ii) new 0.5 km four-circuit 115 kV overhead transmission line between Boeung Tompon 230/115 kV substation and the existing double circuit 115 kV overhead line in Tomnop Thmey (Street 371). The subproject also includes 0.8 km (four-circuit x 0.2 km) 115 kV cables to connect from the new Royal University of Phnom Penh (RUPP) 115 kV GIS substation (SPP3) to the existing double circuit 115 kV cables at Street N° 598.

49. At SPP4, four 115 kV circuits will interconnect to the existing double circuit 115 kV overhead line in Tomnop Thmey (Street 371). Two circuits from SPP4 will connect to GS2, one circuit to GS3 and one to GS8, under the proposed arrangement. Figure 7 presents the alignment of TPP3.

[12] The Olympic 115 kV GIS substation, with 2 x 115/22 kV 75 MVA transformers, is currently under construction under JICA funding. Provision is being made in the Olympic 115 kV substation for two GIS line bays for the TPP3 line.

50. The overhead towers will be 30m steel monopoles with average spans of 250 m and section poles located in large angles. Insulators will be polymer post type installed directly on the poles without crossarms, in order to minimize the width of the ROW. The OHL design provides for Bittern ACSR 645 mm^2 twin conductors per phase, with nominal rated capacity of 28 MVA per circuit plus one top mounted ground wire (OPGW cable 50 mm^2 plus 48 optic fibers) for lightning shielding, protection and communications.

51. The UGC design provides for two three-core 800 mm^2 115 kV aluminum XLPE-insulated cables, plus a separate 48 core fiber optic cable to be installed underground in three sets of 100 mm Φ PVC pipes. The jointing pits will be installed at approximately 300 to 500 m intervals, depending on the maximum available lengths of cable. The implementation of this subproject, excluding detailed design, will take approximately 36 months from start of construction.

52. **Location.** The alignment traverses from near the Boeung Tompon pumping station, accessed through Street 371, to the Olympic 115 kV substation located at the Olympic Stadium. The area is predominantly characterized as residential with some light-industries. OHL installation will be located in proximity to the storm canal that functions to channel urban run-off, wastewater and sewerage to Boeung Tompon wetland system to the south of the city. Trees and shrubs feature along some sections of the storm canal banks. The section further south is accessed by through Street 2BT and an unnamed gravel track. The Boeung Trabek lake is located to the west of the storm canal and is considered an inundated area that is cultivated with aquatic crops.

53. The UGC section will commence at Street 7BT with the alignment continuing north-east along Street 173. The UGC continues north, crossing several major roads, until it reaches Sihanouk Boulevard and briefly turns east before connecting into the Olympic substation which is under construction.

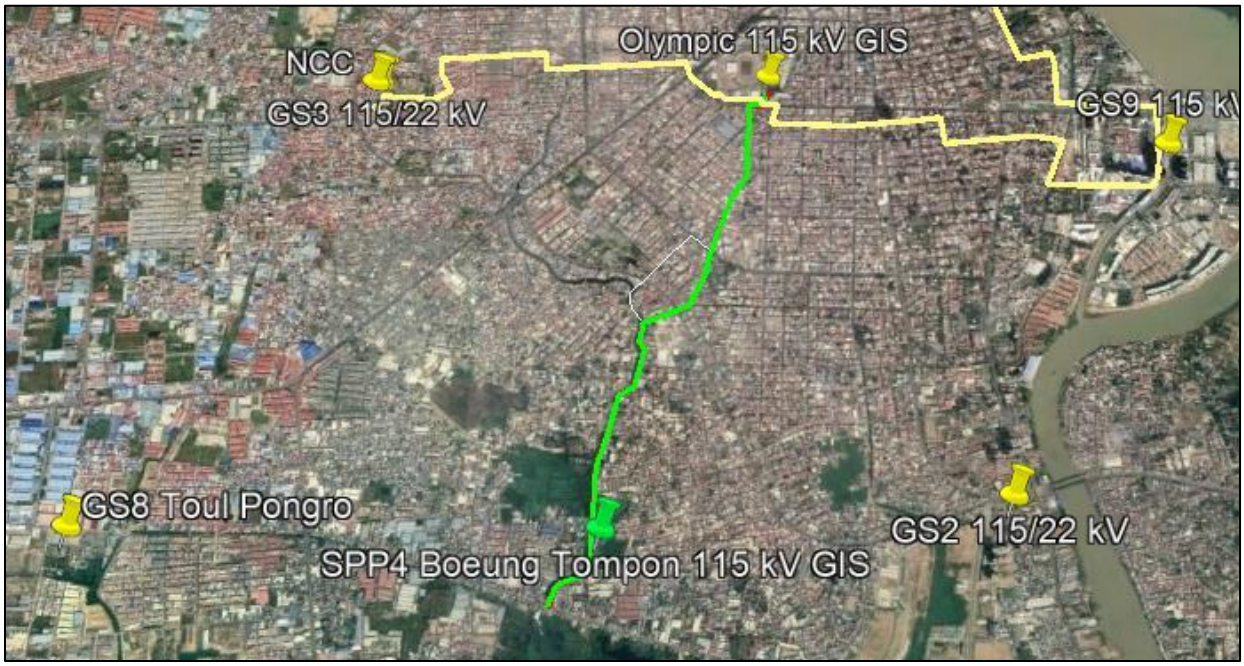

Figure 7: TPP3 transmission line alignment

Start of TPP3

Proposed alignment of TPP3

Storm canal adjacent to TPP3 alignment

Ongoing construction of Olympic Stadium substation

Photo 2: Location of the proposed TPP3 – 230 kV transmission line between Boeung Tompon and Olympic substations

4) SPP1: New 230/115/22 kV Dangkor Substation

54. **Objective.** The subproject aims to (i) ensure improved power supply at 115 kV to the adjacent industrial zone area; (ii) provide a more reliable 115 kV supply to neighboring GS10 115 kV substation; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

55. **Scope of work.** The proposed SPP1 includes the installation of new greenfield 2 x 240 MVA 230/115 kV Dangkor substation including outdoor switchyard with initially five bays (two-line feeders, two transformer bays, and one bus interconnector bay). There is provision for future six 230 kV line feeders. The 115 kV outdoor switchyard design is also double busbar, with initially seven bays (four line feeders, two transformer bays, one bus interconnector bay). There is provision for future 115 kV line feeder bays. The 22 kV indoor switchboard is 21 panels (two transformer incomers, 16 line feeders, one bus sectionaliser, two VTs and two auxiliary MV/LV 400 kVA station transformers). The design provides for SCADA system and connection to EDC's National Control Center.

56. The subproject requires the adjacent 230 kV double circuit line to be cut and terminated onto two terminal towers, for connecting to the 230 kV switchyard. This component is included in the subproject TKCN1. This subproject also includes two new 230 kV line bays at GS5 which is needed for subproject TPP1. The implementation of this subproject, excluding detailed design, will take approximately 36 months from start of construction.

57. **Location.** The new 230/115 kV Dangkor substation is located on private land in Khan Po Senchey with an area of about 4.0 hectares (160 m x 250 m). The site is adjacent on the east to the Phnom Penh Special Economic Zone (PPSEZ) and the Phnom Penh to SihanoukVille railway line. The site is pending land acquisition by EDC.

Figure 8: Proposed location of Dangkor substation

The proposed site of Dangkor substation

Phnom Penh Special Economic Zone and the Phnom Penh-SihanoukVille railway line further to the east of the site

Photo 3: View of the proposed location of Dangkor substation and vicinity

58. The proposed location consists of rice paddy and cattle grazing areas, whilst existing 230 kV (operating at 115 kV) transmission lines are visible to the south-west of the proposed site and also traverse near the proposed subproject location. To the south of the site in Sangkat Prateah Lang Kahn and along National Road 3 are residential houses and small businesses. There is currently no available direct road access to the site.

5) SPP2: New 230/115/22 kV Sen Sok substation

59. **Objective.** The subproject aims to (i) provide reliable power supply to the north Phnom Penh area; (ii) reduce load on existing nearby GS1 and GS5 grid substations; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

60. **Scope of work.** The SPP2 subproject includes the installation of a new greenfield 115/35/22 kV GIS Sen Sok substation, with provision to connect (i) subproject TPP1 incoming double circuit 230 kV lines; and (ii) subproject TPP2 outgoing double circuit 115 kV lines to proposed SPP5 Russei Keo substation. The scope includes (i) one 360 MVA 230/115/22 kV transformer; and (ii) 22 kV indoor panel to supply the adjacent 22 kV distribution network.

61. The substation design provides for a capacity of 360 MVA at 230/115/22 kV. The 230 kV indoor GIS switchgear design is double busbar, with four bays (two outgoing line switches, one transformer switch, and one bus interconnector bay). The 115 kV indoor GIS switchgear design is also double busbar, with four bays (two outgoing line switches, one transformer switch, one bus interconnector bay).

62. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, 8 line feeders, 1 VT, MV capacitor bank and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's National Control Center (NCC). The implementation of this subproject, excluding detailed design, will take approximately 36 months from start of construction.

63. **Location.** The proposed 230/115/22 kV Sen Sok substation will be located near Aeon Mall 2 at Sen Sok City and the Australian International School Phnom Penh. The site is accessed through Angkor Boulevard or Street 1003. The proposed substation will be located on public land covering an area of 30 m x 60 m. The site is vegetated with shrubs and is beside a drainage ditch to the road. The surrounding area consists of shops, gated communities, and industrial facilities.

Photo 4: Site of the proposed 230/115/22 kV Sen Sok Substation

Figure 9: Proposed Sen Sok substation location

6) SPP3: New 115/22 kV Royal University of Phnom Penh (RUPP) substation

64. **Objective.** The proposed subproject aims to (i) ensure power supply for Phnom Penh; (ii) reduce load on existing GS3 and GS5 115 kV substations; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

65. **Scope of work.** The subproject includes the installation of new greenfield 1 x 75 MVA 115/22 kV GIS substation that will connect at 115 kV between the NCC and GS1. It will require four 115 kV cables to connect to the existing 115 kV cables at Street N° 598, which is about 200 m away. The 115/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer, two transformer switches (includes provision for second transformer), and one bus interconnector bay.

66. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, 8 line feeders, 1 VT, MV capacitor bank and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC. The implementation of the subproject, excluding detailed design, will take about 36 months from start of construction.

67. **Location.** The site of the proposed RUPP substation is public land which is located approximately 500 m to the north-west of the RUPP campus and adjacent to the airport railway line. The land area is about 30 m x 60 m. The site is beside a canal. The immediate vicinity is a mixture of shrubland, agricultural plots and local resident housing.

Figure 10: Location of proposed SPP3 - RUPP 115 kV substation

Photo 5: Proposed site of SPP3 - RUPP 115 kV substation

7) SPP4: New 115/22 kV Boeung Tompon Substation

68. **Objective.** The subproject aims to (i) ensure power supply for south Phnom Penh; (ii) reduce load on existing GS2 and GS8 115 kV substations; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

69. **Scope of work.** The subproject includes the installation of new greenfield 1 x 75 MVA 115/22 kV Boeung Tompon GIS substation that will interface at 115 kV to subproject TPP3 between the Olympic substation and the existing double circuit 115 kV overhead line in Tomnop Thmey (Street 371).

70. The 115/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer. The 115 kV indoor GIS switchgear design is double busbar, with nine bays (six outgoing line switches, two transformer switches, including provision for second transformer, and one bus interconnector bay).

71. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, 8 line feeders, 1 VT, MV capacitor bank, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC. The implementation of the subproject, excluding detailed design, will take approximately 36 months from start of construction.

72. **Location.** The new 230/115 kV substation will be located on public land that is currently used as waste dumping site. The land for the proposed substation measures 20 m x 40 m (0.8 ha). The exact location and use of the site by EDC is subject to finalization of ownership with the Phnom Penh City Hall.

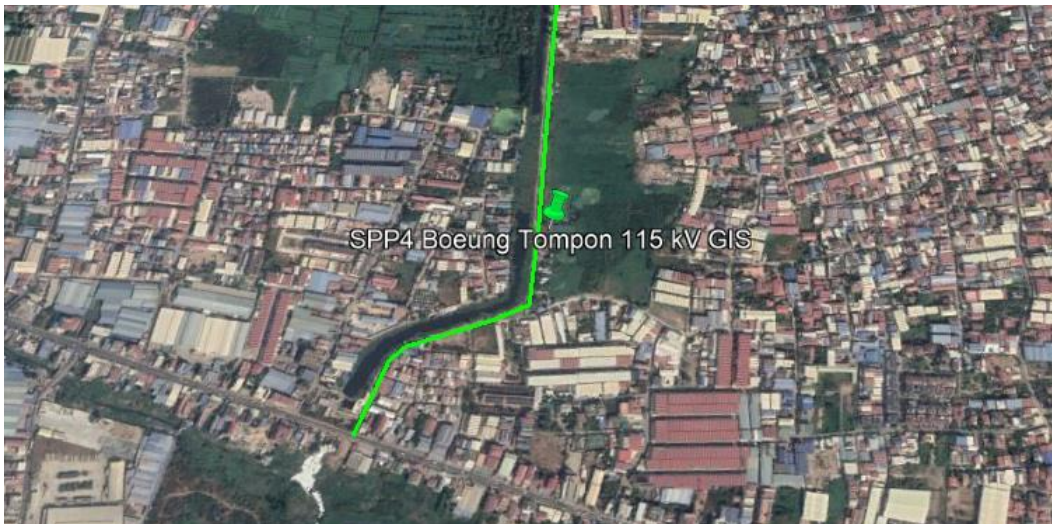

Figure 11: Proposed location of Boeung Tompon substation

Photo 6: Site of the proposed Boeung Tompon 115 kV substation

73. The site is located to the east of Boeung Trabak storm canal. Informal discussions with local residents suggested that the proposed location has been utilized as a waste dumping ground for a number of years, with much of the waste now overgrown by shrubland vegetation. The proposed site can be accessed along a gravel track that connects to Street 2BT.

8) SPP5: New 115/22 kV Russei Keo Substation

74. **Objective.** The subproject aims to (i) ensure power supply for north Phnom Penh; (ii) reduce load on existing GS1 115 kV substation; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

75. **Scope of work.** The SPP5 subproject includes the installation of new greenfield 1 x 75 MVA 115/22 kV Russei Keo GIS substation which will connect at 115 kV to Sen Sok 115 kV substation and provide for future two 115 kV circuits to GS1 substation.

76. The 115/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer. The 115 kV indoor GIS switchgear design is double busbar, with six bays (four outgoing line switches, two transformer switches, including provision for second transformer, and one bus interconnector bay).

77. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, 8 line feeders, 1 VT, MV capacitor bank, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC. The implementation of the subproject, excluding detailed design, will take approximately 36 months from start of construction.

78. **Location.** The new Russei Keo substation site will be constructed in proximity to the Russei Keo River and Toul Os Lok Pagoda. The proposed substation location is beside a canal on public land in urban northern Phnom Penh. Because of limited land availability, an indoor GIS design will be used with an area of 20 m x 40 m area (0.8 Ha). The exact location and use of the site is pending confirmation by EDC.

Figure 12: Location of SPP5 - Russei Keo 115 kV substation

Photo 7: Site of the proposed SPP5 - Russei Keo 115 kV substation

79. A new link road is being constructed on the northern bank of the river. The wider area is characterized by light industry, garment factories, residential areas paddy fields. Access to the site is along Street 200R.

9) TKCN1: 115 kV Transmission Line between proposed Samaki Meanchey to Kampong Tralach Substations

80. **Objective.** The subproject aims to provide high voltage power to the new SKC2 115 kV Kampong Tralach substation in order to meet the growing demand in the area.

81. **Scope of work.** The subproject includes the construction of new 11.1 km double circuit overhead 115 kV transmission line between the proposed SKC1 230/115 kV Samaki Meanchey to the proposed SKC2 115 kV Kampong Tralach substations. The scope also includes the supply and installation of eight terminal towers (two at each substation) to break the existing transmission lines and divert them into new substations SPP1, SKCN1, SKPC1, and SKPC2.

82. The overhead line design provides for Bittern ACSR 645 mm^2 conductor per phase, with a nominal rated capacity of 30 MVA per circuit, plus two top mounted ground wire (OPGW cable mm^2 plus 48 optic fibers) for lightning shielding, protection and communications.

83. The towers will be constructed from standard galvanized steel lattice towers, with in situ cast reinforced concrete foundations. Average spans will be 250 m, with section poles located on large angles. Insulators are polymer type.

84. The implementation of the subproject, excluding detailed design, will take about 36 months from start of construction.

85. **Location.** The new 11.1 km 115 kV double circuit transmission line spans six communes. TKCN1 alignment traverses through a predominantly rural location broadly described as

agricultural with landscape features that includes rice paddy, scattered shrubland and secondary forest growth.

86. Along the laterite roads, that provide access to parts of the proposed alignments, a mixture of residential houses and local shops exist intermittently. Consideration of additional access roads required to support construction will be decided during detailed design stage.

Figure 13: Location of the Samaki Meanchey to Kampong Tralach transmission line

10) SKCN1: New 230/115/22 kV Samaki Meanchey Substation

87. **Objective**. The objectives of the subproject are to: (i) ensure the increase in power supply for Kampong Chhnang province; (ii) provide secure high voltage n-1 supply to the new Kampong Tralech substation; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

88. **Scope of work**. The subproject includes the installation of a new greenfield 230/115/22 kV Samaki Meanchey substation located adjacent or under the existing 230 kV double circuit transmission line connecting GS6 to Kampong Chhnang substations. It will provide 115 kV power to subprojects TKCN1 transmission line and the proposed SKCN2 substation. The scope includes (i) one 160 MVA 230/115/22 kV transformer and (ii) 22 kV indoor panel to supply the adjacent 22 kV distribution network.

89. The 230/115/22 kV substation design provides for an initial capacity of 160 MVA, with provision for a future second 160 MVA transformer. The 230 kV outdoor switchyard design is double busbar, with initially six bays (four line feeders, one transformer bay and one bus interconnector bay). The 115 kV outdoor switchyard design is double busbar, with initially four bays (two line feeders, one transformer bay, one bus interconnector bay). There is provision for future 230 kV and 115 kV bays.

90. The 22 kV indoor switchboard is single busbar, with initially eleven panels (one transformer incomer, 8 line feeders, 1 VT, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC.

91. **Location**. The new 230/115/22 kV Samaki Meanchey substation site is located on private land to the south of Kdouch Pagoda in Kampong Chhnang province, northeast of Phnom Penh. The site is 200 m x 160 m (3,.2 ha), situated approximately 50 m from the road on flat land and currently used for crops. The vicinity is composed of shrubland, cattle grazing areas, rice paddy and palms intermittingly scattered along field edges. Some plots of land located near to the site are being prepared for development. To the south-west of the site is a eucalyptus plantation. Road access to the proposed site could be challenging during the wet season.

Figure 14: Samaki Meanchey substation location

Photo 8: Proposed site of Samaki Meanchey 115 kV substation

11) SKCN2: New 115/22 kV Kampong Tralach Substation

92. **Objective.** The objectives of the subproject are to (i) ensure the increase in power supply for Kampong Chhnang province and (ii) improve the reliability and safe operation of the MV/LV system and reduce losses.

93. **Scope of work.** The subproject includes the installation of a new greenfield 1 x 75 MVA 115/22 kV Kampong Tralach substation to be supplied by subproject TKCN1 double circuit 115 kV transmission line. The scope includes a 22 kV indoor panel to supply the adjacent 22 kV distribution network.

94. The 115/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer. The 115 kV outdoor switchyard design is double busbar, with initially five bays (two line feeders, one transformer bay, one bus interconnector bay, and one transfer bus interconnector bay). There is provision for future three 115 kV bays (two-line feeders and one transformer bay).

95. The 22 kV indoor switchboard is single busbar, with initially seven panels (one transformer incomer, 4-line feeders, 1 VT, and 1 auxiliary MV/LV 100 kVA station transformer). MV lines for 22 KV will be constructed. Both panels have facility for a second switchboard in the future. The design provides for SCADA system and connection to EDC's NCC. The implementation of the subproject, excluding detailed design, will take approximately 36 months from start of construction.

96. **Location.** The new 115/22 kV Kampong Tralach substation site is located on private land measuring approximately 100 m x 150 m (1.5 ha) in Kampong Chhnang province. The site is approximately 50 m from the road on flat land which is currently used for rice growing and with palm trees located along field edges. Adjacent to the proposed site across the laterite road is a residential property. The proposed location is approximately 500m west of National Road 5. The proposed Kampong Tralach substation is the located at western end of the Samaki Meanchay to Kampong Trachach transmission line.

Figure 15: Location of proposed SKC2 – Kampong Tralach 115 kV substation

Photo 9: Site of the proposed SKCN2 – Kampong Tralach 115 kV substation

12) SKPC1: New 230/115/22 kV Thnal Keng Substation

97. **Objective.** The objectives of the subproject are to: (i) ensure power supply for Kampong Cham province; (ii) reduce load on existing GS6 substation; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

98. **Scope of Work.** The subproject includes the installation of a new greenfield 1 x 160 MVA 230/115/22 kV Thnal Keng substation, adjacent to the existing double circuit 230 kV transmission line between GS6 and Kampong Cham. The subproject requires the adjacent 230 kV double circuit line to be cut and terminated onto two terminal towers, for connecting to the 230 kV switchyard which forms part of subproject TKCN1. Thnal Keng substation will connect the existing 230 kV line that traverses between GS6 substation to Kampong Cham substation.

99. The 230/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer. The 230 kV outdoor switchyard design is double busbar, with initially eight bays (six line feeders, one transformer bay, and one bus interconnector bay). There is provision for future 230 kV bays. Two-line bays are included for new circuits to the south of the substation.

100. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, eight line feeders, 1 bus section, 1 VT, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC.

101. **Location.** The new 230/22 kV substation is located on private land at Thnal Keng, in Kampong Cham province. The proposed site measures about 200 m x 160 m (3.2 ha). The proposed site is geographically located at 11^{O}52'50.58"N and 104^{O}54'7.38"E. It is approximately 1km south-west of Chong Village, Sambour commune, Batheay district and about 800m south of Road 61. The proposed substation site and surrounding areas is predominantly rice paddy with scattered palm trees. Other agricultural activities in the area includes animal husbandry and the cultivation of fruit trees and lotus flowers (*Nelumbo nucifera).* There is no existing road access to the proposed site location.

Figure 16: Proposed location of SKPC1 – 230 kV Thnal Keng substation

Photo 10: Site of the proposed SKPC1 – 230 kV Thnal Keng Substation

13) SKPC2: New 230/22 kV Skun Substation

102. **Objective**. The objectives of the subproject are to: (i) ensure power supply for Kampong Cham province; (ii) reduce load on existing GS6 and Kampong Cham substations; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

103. **Scope of work**. The subproject includes the installation of new greenfield 1 x 75 MVA 230/22 kV Skun substation, adjacent to the existing double circuit 230 kV transmission line between GS6 and Kampong Cham. The subproject required the adjacent 230 kV double circuit line to be cut and terminated onto two terminal towers, for connecting to the 230 kV switchyard. This component is included in subproject TKCN1.

104. The 230/22 kV substation design provides for an initial capacity of 75 MVA, with provision for a future second 75 MVA transformer. The 230 kV outdoor switchyard design is double busbar, with initially six bays (four line feeders, one transformer bay, and one bus interconnector bay). There is provision for future 230 kV bays.

105. The 22 kV indoor switchboard is single busbar, with initially twelve panels (one transformer incomer, eight line feeders, 1 bus section, 1 VT, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC. Implementation of the subproject, excluding detailed design, will take approximately 36 months from start of construction.

106. **Location**. The new 230/22 kV substation site will be located on private land near to Skun commune in Kampong Cham province. The site measures approximately 200 m x 160 m (3.2 ha). It can be accessed by National Road 6 and then a connecting laterite road that runs south past Skun market. The site is located approximately 1.2 km south of Skun commune center.

107. The proposed site is typical of a rural setting with rice paddy and palms the predominant landscape features. Irrigation ditches run parallel to paddy field boundaries and the sites are locally accessed by unpaved laterite roads. The laterite roads are intermittently lined with residential houses and shops.

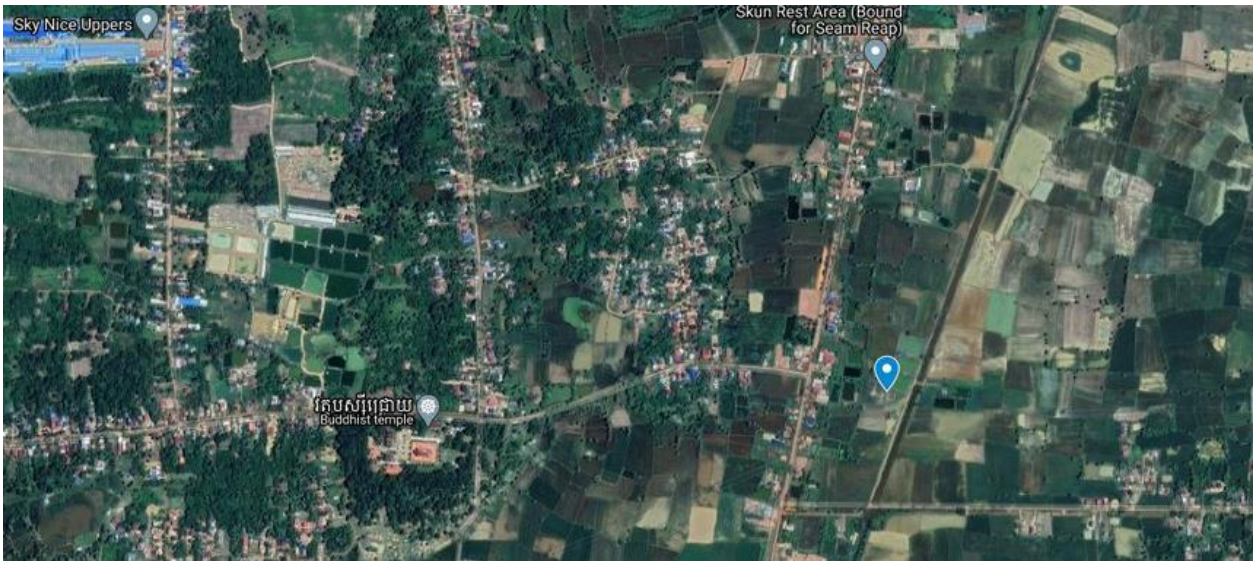

Figure 17: Location of proposed SKCN2 – 115 kV Skun Substation

Photo 11: Site of the proposed SKCN2 – 115 kV Skun Substation

14) STKO1: New 230/115/22 kV Samroang Yoang Substation

108. The 230/11/22 kV Samroang Yoang substation is the only subproject in Takeo province.

109. **Objective.** The objectives of the subproject are to: (i) ensure increase in power supply for Takeo province; (ii) reduce loan on adjacent GS4 grid substation; and (iii) improve the reliability and safe operation of the MV/LV system and reduce losses.

110. **Scope of work.** The subproject includes the installation of a new greenfield 230/115/22 kV Samroang Yoang substation, located adjacent or under the existing 230 kV double circuit transmission line connecting GS4 substation to Takeo substation. It will provide a new 115 kV supply to the province. The scope includes (i) one 240 MVA 230/115/22 kV multi-winding transformer and (ii) 22 kV indoor panel to supply the adjacent 22 kV distribution network.

111. The subproject requires the adjacent 230 kV double circuit line to be cut and terminated onto two terminal towers, for connecting to the 230 kV switchyard. This component is included in subproject TKCN1.

112. The 230/11/22 kV substation design provides for an initial capacity of 240 MVA, with provision for a future second 240 MVA transformer. The 230 kV outdoor switchyard design is double busbar, with initially six bays (four line feeders, one transformer bay, and one bus interconnector bay). The 115 kV outdoor switchyard design is double busbar, with initial four bays (two line feeders, one transformer bay, one bus interconnector bay). There is provision for future 230 kV and 115 kV bays.

113. The 22 kV indoor switchboard is single busbar, with initially eleven panels (one transformer incomer, 8 line feeders, 1 VT, and 1 auxiliary MV/LV 100 kVA station transformer). The design provides for SCADA system and connection to EDC's NCC.

114. **Location.** The new 230/22 kV substation will be developed on private land at Achleng village, Trapang Sap commune in Takeo province. The proposed site measures approximately 200 m x 160 m (3.2 ha). The site can be accessed from National Road 3 and connects to Road 106.

115. An access road connecting Road 106 to the site location will need to be developed to access the proposed substation site. To the east of the proposed site runs the Phnom Penh to SihanoukVille railway line that traverses in a north/south alignment and to the east National Road 2. Near to the railway line is an artificial irrigation pond that supports community rice production.

116. The proposed location is atypical of a rural landscape with rice paddy and cattle grazing as the dominant landscape feature. Much of the dried rice straw in the surrounding fields had been burned as part of local agricultural practices.

15) Battery Energy Storage System

117. The BESS will be located at the 250-ha site of the ADB National Solar Park (GS5) in Tuek Phos district of Kampong Chhnang province, located northwest of Phnom Penh. The BESS will be contained within a building at the ADB solar park. The BESS will be located at the ADB solar park site which will be constructed in 2020. The ADB solar photovoltaic plant will be connected to

the 230/115/22 kV grid substation (GS6).[13] The connection is locally at 22 kV and will be transformer to 115 kV for connection and transmission to the GS6 substation. The BESS allows energy to be stored at a given time for later use. The BESS shall absorb the short-term power variations in the solar power plant output power by fast charging or discharging the lithium-ion batteries to generate smoother generation curve that can be absorbed in the grid.

118. The BESS will be equipped with anti-islanding protection as per IEC 62116 or equivalent international standard and will implement passive fire protection methods (e.g. fire protection walls). The BESS will comprise of battery system (battery ells/modules/stacks, battery management system), power conversion system, control system, lightning arrestor, protective relays, surge protection devices, transformers, data communication units, auxiliary systems and ventilation systems, fire detection and protection system and safety equipment. Validation tests are required to understand the effectiveness of potential stabilization abilities.

119. There are no habitations / settlements within the proposed site although there is farmland located nearby which is used for cassava plantation and as a police training area. Site surveys[14] identified the site to be a mixture of: scrubland (293 ha), paddy fields (116 ha) and small plantations (i.e. cassava, mango, cashew, eucalyptus and bamboo).

D. Civil Works to be Undertaken and Impact Footprints

1. Transmission Lines

120. In Phnom Penh, the proposed transmission lines will operate a combination of underground cables and monopole double circuit overhead lines, generally following existing road ROW to minimize the need for land acquisition. In provincial locations, transmission line design will consist galvanized steel lattice with in-situ cast reinforced concrete foundations. Transmission Line route selection and access road alignment will consider avoidance of and/or adjusted to minimize impacts on agriculturally productive land, habitats of conservation value, sensitive areas i.e. parks, cultural heritage sites such as temples, pagodas, and churches and households, schools, hospitals, and residential areas

121. **Overhead lines.** The Electric Power Technical Standard issued by MME sets safety clearances for the construction of overhead 115 kV and 230 kV transmission lines but does not prescribe a fixed right-of-way (ROW). Based on the discussion with EDC and in line with the clearance standards, in rural areas, the ROW for a 115 kV transmission line is in general 15m with (7.5m from central line) and for a 230 kV transmission line 30m width (15m from central line) In urban areas the ROW is usually narrower. The ROW will be adjusted to minimize the cutting of trees, although, trimming of select trees and vegetation may be required to ensure appropriate safety clearances for the power lines to meet the applicable clearance standards presented in Chapter II.

122. During the construction period, activities are likely to involve the construction of some access roads, transporting poles and materials, erection of poles, stringing of conductors, trenching, excavating footings and pouring footings. Poles will be sequentially placed and will require a 0.5 m diameter at ground level and therefore a 2 metre diameter excavation will be required for the footings, depending on the geological conditions. Standard area of land to be acquired permanently for the foundation of each monopole: is 6.4 m x 6.4 m or 40.96 sqm (see

[13] GS6 is an interconnection point between two transmission voltages (115 kV and 230 kV) and is located between two solar parks (60 MWp ADB and 80 MWp KPS). The KPS solar park is already under operation.
[14] Initial Environmental Examination (IEE) Cambodia: National Solar Park (2019)

Figure 18) and construction area for the foundation of each monopole to be temporarily acquired inclusive of the area that will be acquired permanently is 8 m x 8 m or 64 sqm.

123. Clearance between each conductor of overhead high-voltage lines and other facilities shall be not less than 3.5m for the 115 kV TL and 4.2m for the 230 kV TL. For the clearance to trees, the safety distance shall be not less than 2.5m for the 115 kV TL and 3.2m for the 230 kV TL according to Cambodian Electric Power Technical Standards by MIME.

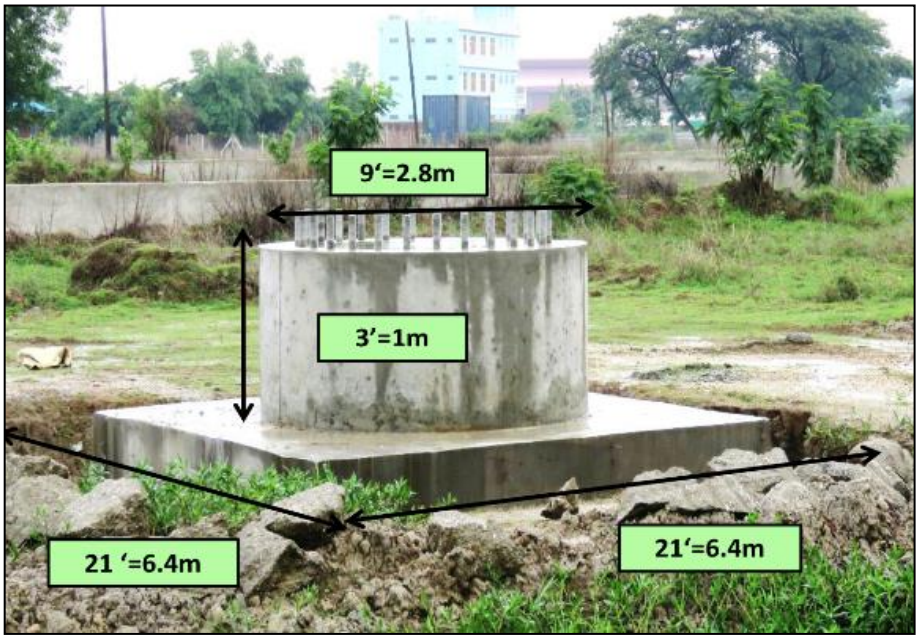

Figure 18. Typical dimension of monopole foundation

124. **Underground cables.** Undergrounding cabling will require open-cut trenching that will connect jointing bays at approximately 200-500m intervals, depending on the maximum available lengths of cable. The cables are insulated and inserted in 100 mm Φ PVC pipes.

125. Night works will be conducted for all underground cable works. The construction process will involve three teams. The first team cuts and excavates the trenches to the required width and depth of about 1.0 m x 0.5 m. The second team lays and welds the ducts that will encase the cables. Finally, the third team replaces the material in the excavated trench and then apply a layer of asphalt. The night works are anticipated to avoid disruption of daytime activities. The jointing bays which are at 200–500 m intervals will require about 2–3 weeks of construction and will require barricading.

126. Operational maintenance will be undertaken by provincial EDC technical staff and will likely involve one or two people for short time periods of time. Under normal operating conditions such activities will not require the use of powered mechanical equipment other than a transport vehicle to the site.

2. Substations

127. Substations are electric power facilities where voltage of electrical power is transformed. Substation facilities require various components, *inter alia* including: transformers, lightning arresters, circuit breakers, disconnecting switches, voltage transformers, current transformers,

bus bars, protective relay systems, Remote Terminal Unit (RTU) for Supervisory, Control and Data Acquisition (SCADA) system, and telecommunication facilities. Common infrastructure will include grounding, control house, perimeter fencing, staff facilities, drainage (including a septic tank at some sites) and monopoles and connection lines.

128. There are two types of electrical substation design that are used depending on availability of land and the characteristics of the project location. Air Insulated Switchgear (AIS) has equipment erected outdoors where land is available, whereas Gas Insulated Switchgear (GIS) is applied to sites that are spatially limited and applies a combination of indoor and outdoor equipment depending on site requirements.

129. Except for Dangkor substation, the substations in Sen Sok, RUPP, Boeung Tompon and Russei Keo in Phnom Penh will have GIS to minimize substations' spatial requirements. The substations in Kampong Chhnang, Kampong Cham, and Takeo will have AIS. No buffer area is required outside a substation perimeter as equipment is positioned using specified safety clearances.

130. Construction and installation work for substations will commonly involve the following activities:

i) Topographic survey
ii) Soil investigation
iii) Site preparation including cutting and clearing of vegetation, leveling and removal of cut soil
iv) Foundation works
v) Procurement of equipment
vi) Erection of substation equipment
vii) Wiring to connect to control building
viii) Testing and commissioning of 115/230 kV substation(s)

3. Battery Energy Storage System

131. The BESS building requires approximately 31 m^2 per MWh including 10 m safety distance to all sides. For the 16 MWh BESS, the building will require a total space of about 489 m^2 within the ADB solar park. The building will include a battery room, inverter room, transformer room, HVAC room, and spare parts room. The BESS site at the ADB solar park does not have any restrictions regarding the required space and will be constructed together with the substation of the solar park.

132. An option that is being considered instead of the BESS building is the containerized BESS which is factory-made and assembled. The fully equipped enclosure consists of the HVAC external units, battery modules, battery switchgears, and MV/LV transformers. The container integrated BESS requires approximately 61 m^2 per MWh including 2 m safety distance to all sides of each container. For all containers, a 40 ft ISO standard container is considered for the following:

i) Battery racks container (4 units) – 25 m^2 per MWh (including HVAC)
ii) Inverter container (2 units) – 13 m^2 per MWh
iii) Transformer container (2 units) – 13 m^2 per MWh (including SCADA)
iv) Spare parts container (2 units) – 10 m^2 per MWh (1 container per 10 MWh).

133. The 16 MWh BESS integrated in several containers will occupy a total area of 1,018 m^2.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Project Area of Influence

134. The project area of influence is described with information collated from field trips, survey work, secondary data, previous IEE reports, and discussions with local and national government officials, local stakeholders and community members.

135. Relevant conditions for assessing potential environmental impacts include: physical, biological, and socio-economic aspects. The assessment has paid particular attention to:

i) Sensitive human receptors (i.e. schools, hospitals,)
ii) Sensitive natural/ecological receptors (i.e. water bodies, wildlife)
iii) Cultural heritage sites (i.e. temple, pagodas, and historical sites)

136. According to ADB 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, access roads, and borrow pits.
ii) Associated facilities that are not funded as part of the project whose viability and existence depends on the project. Associated facilities are listed in Table 5.
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. No additional developments are thought to occur as a result of the project.

B. Baseline Receptor Summary

137. Table 4 below provides a summary of site-specific receptors. Distances given between subproject locations and receptors are approximate and based on a center point for each proposed site. The receptor information will be updated after completion of the detailed engineering design.

Table 4: Summary of subproject receptors

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
Phnom Penh								
TPP1	GS5 substation: 11°35'18.81"N, 104°50'30.93"E SPP2 Sen Sok substation 11°36'21.54"N, 104°53'14.58"E	New 6.52 km 230 kV transmission line from existing GS5 to proposed Sen Sok substation	ROW along Khan Sen Sok, Phnom Penh	Heading east, the area is open scrubland for approx. 1000m. within 250m from the line. At >250m, the alignment is open scrubland and non-dense residential areas.	None	From GS5, the TL is propose d along the canal for about 900m.	- Church 1000m Southeast of GS5 sub-station - Panna Vihara pagoda 320m North of TL (near to GS5) - Khos Peal Thik Vong pagoda 600m South of TL (near Aeon 2 Mall)	None in close proximity to the site
TPP2	SPP2 Sen Sok substation 11°36'21.54"N, 104°53'14.58"E SPP5 Russei Keo substation 11°36'37.87"N, 104°54'18.27"E	New 2.44 km 115 kV transmission line between proposed Sen Sok and Russei Keo substations	ROW along Khan Sen Sok / Khan Russei Keo, Phnom Penh Borey Nice Sovan Borey Villa Tuol Songke in Phnom Penh Crown Football Stadium 500m South	Public land (road ROW)	Russei Keo River (storm canal)	None	None	None in close proximity to the site
TPP3	SPP4 Boeung Tompon substation 11°31'31.26"N, 104°54'17.44"E Olympic substation	New 4.4 km 115 kV transmission line from proposed Boeung Tompon substation to new Olympic substation	ROW along Khan Mean Chhey, Khan Chamka Mon, and Khan Boeung Keng Kang in Phnom Penh	Public land (beside canal on the southern section and road ROW on the northern section)	None	Storm canal directly East of propose d TL until Street 371	- Mohar Montrei pagoda 50m East of TL (Boeung Kengkan khan), - Methodist church 250m at East of TL	None in close proximity to the site

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
	11°33'22.70"N, 104°54'47.39"E					-Sewage pumping station	(Mean Chhey Khan), there and 400m at West is - National church 400m West of TL - New Hope Baptist church 200m North of TL (Mean Chhey Khan) - Toul Tumpum pagoda 800m East of TL (Cham Karmon Khan)	
SPP1	11°28'12.59"N, 104°47'8.70"E	New 230/115/22 kV Dangkor substation	-Residential area 100m South-East - Railway 50m East - Phnom Penh Special Economic Zone 150m at North-West	Annual cropland – 33,000 m^2	- Prek Thnaot stream 900m South-West - Unnamed pond 500m South	- Irrigation channel 40m East - Irrigation Canal 130m South-West	- Boeung Thum primary school 1000m West - Prateah Lang primary school 900m East - Sovan Ampea Svaymeas pagoda 1000m South-East	None in close proximity to the site
SPP2	11°36'21.54"N, 104°53'14.58"E	New 230/115/22 kV Sen Sok substation	-Australian International School Phnom Penh 100m at South-East - Aeon Mall 2 500m South	- Scrubland North to West and South is open area (land is not developed yet)	None	None	None	None in close proximity to the site

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
			- Borey Angkor Phnom Penh residential area 400m North-West - Non-dense residential area North-East					
SPP3	11°34'13.20"N, 104°53'12.22"E	New 115/22 kV RUPP substation	Dense residential and commercial area surrounds the site. - Royal University of Phnom Penh 250m South-East - Pannasastra University is 230m at East - Bordering the proposed site to the South is airport railway link - Indradevi High School 1000m North-East	Vacant land	-	-The propose d site is adjacent to the storm canal (Tralok Bek)	- Protestant church 650m North - Bethany Independent Bapist church 860m South-West	None in close proximity to the site
SPP4	11°31'31.26"N, 104°54'17.44"E	New 115/22 kV Boeung Tompon substation	- Located in central- south Phnom Penh, the site is surrounded by residential areas and light industry.	Area is used as an open dumping site	- The proposed site is adjacent to Boeung Tompon lake (wetland)	- Stormwa ter canal West -Tnaot Chrum Ti Bey,	- Phnom Penh Joy Church 150m South - Elim Community Church 200m East	None in close proximity to the site

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
			- a residential area surrounds the Boeung Tompon lake -700m at East is Talk-School of English - Best Way International school 900m West		- Choeung Ek lake (wetland) 420m South	Street 371	- Mercy Village church 200m South-East - Sansam Kosal pagoda 1000m at Northeast is -1000m at North is Child Jesus Catholic church - Child Jesus Catholic church 1000m at North - Dombok Khpous pagoda 1000m South-East - Sansam Kosal pagoda 1000m Northeast - Angk Portinhean pagoda 1000m West	
SPP5	11°36'37.87"N, 104°54'18.27"E	New 115/22 kV Russei Keo substation	- surrounded by residential areas and light industry - National Defense University 900m East	Vacant land	- Russei Keo River (storm water channel) runs directly North of	Bridge and Street 200R on the north	- Toul Sonte Wan pagoda 150m East - Bible Baptist church 800m North	None in close proximity to the site

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
			- Russei Keo High School 950m North-East - American University of Phnom Penh 1000m Northeast		site in an East-West direction			
Kampong Chhnang								
TKCN1	Samaki Meanchey: 11°53'37.11"N, 104°36'58.07"E Kampong Tralach: 11°55'54.72"N, 104°42'25.91"E	New 11.1km 115 kV transmission line from proposed Samaki Meanchey to proposed Kampong Tralach substations	Thoko Vein, Sedthei, Peani communes, Samaki Mean Chey, Kampong Tralach district, Kampong Chhnang province - Borrow pit (400m x 100m) for National Road 5 is located within the TL alignment	-100m from alignment centerline is rice field, farmland, open scrubland	Seasonal pond at 100m from the alignment center	Wells	Kdouch pagoda 500m North-West	None in close proximity to the site
SKCN1	11°53'37.11"N, 104°36'58.07"E.	New 230/115/22 kV Samaki Meanchey substation		Eucalyptus Plantation 100m to South Annual cropland – 32,500 m^2	None	None	Kdouch pagoda 500m North-West	None in close proximity to the site
SKCN2	11°55'54.72"N, 104°42'25.91"E	New 115/22 kV Kampong Tralach substation	-Residential property 50m East Of laterite road connecting to NR5 - Hun Sen Kompong Tralach high school 700m East	Annual cropland – 15,500 m^2	None	- National Road N° 5 500m East	- Kol Voin pagoda 1.2 km South	None in close proximity to the site

N°	GPS Coordinates	Project Component	Human Receptors/ Community facilities	Land Cover	Surface Water Receptors	Existing Utilities Affected	Cultural Receptors	Protected Area
SKPC1	11°52'50.58"N, 104°54'7.38"E	New 230/22 kV Thnal Keng substation	Chong Village 1km North-East	-Surrounding area is rice paddy -Annual cropland- 32,000m^2 - Eucalyptus Plantation 280m South	- Pond 500m south	None	None	None in close proximity to the site
SKPC2	12° 2'41.48"N, 105° 4'24.53"E	New 230/22 kV Skun substation	Residential area 400m West Cham province	Annual cropland- 31,000m^2	Bordering site to the South is an irrigation ditch	None	- Russei Chhroy pagoda 1km West	None in close proximity to the site
BSS1		Pilot battery energy storage system (BESS)	No habitations/ settlements within the solar park site.	Scrubland	None	None	None	None in close proximity to the site
Takeo								
STK01	11°53'37.11"N, 104°36'58.07"E.	New 230/115/22 kV Samroang Yoang substation	Residential area 400m North and East	The proposed site is on rice field in Ar Chhaeng village; Annual cropland- 22,000m^2	- Seasonal stream 300m South	- Railway line 200m West	- Serei Chouttwoan pagoda 850m East	None in close proximity to the site

C. Description of Associated Facilities

138. As per ADB 2009 SPS and A Planning and Implementation Good Practice Sourcebook 2012 (para. 21), projects not funded by ADB, critical to the design or implementation of ADB projects, must be identified.

139. Seven subprojects shown in Table 5 have been identified as associated facilities and a due diligence report prepared.

Table 5: Summary of associated facilities

N°	Subproject Component	Associated Facility
TPP1	230 kV TL from existing GS5 to proposed Sen Sok substation	230 kV GS5 substation
TPP3	115 kV TL from proposed Sen Sok to proposed Russei Keo substations	115 kV Olympic substation (under construction)
SPP1	New 230/115 kV Dangkor substation	115 kV from GS4 – Toul Pongo TL / 115 kV GS4 – GS 10 TL
SPP3	New 115/22 kV RUPP substation	230 kV UGC from NCC to Toul Kork and Beung Kok
SKPC2	230/22 kV Skun substation	230 kV OT from GS6 to GS Kampong Cham TL

D. Topography, Geology and Soils

140. Broadly, Cambodia is composed of an undulating plateau in the east, a continuous flat plain (the Lake Tonle Sap lowland) interrupted only by isolated hills (*phnoms*), the Mekong River and to the southwest the Cardamon mountains.[15] The central plain area is formed of low-lying river basins of the Mekong and Tonle-Sap Rivers and consists of thick deposits of sand, clay, and gravel of the Pleistocene and Holocene epochs.

141. **Phnom Penh**. A significant proportion of the capital is flatland, gently inclined from north to south and from west to east, with the entire cities topographical variance altering approximately 10m.[16] Phnom Penh was developed on alluvial floodplains on the banks of the junction of Tonle Sap and Mekong Rivers. The center of the capital is surrounded by natural levees and dikes, and its suburbs form low wetlands. Soils in Phnom Penh are mostly Alluvial Lithosols and Red-Yellow Podzols.[17]

142. **Kampong Chhnang / Kampong Cham / Takeo**. Rural subproject areas are located on flat plains with some 'phnoms' (hills) visible. Kampong Chhnang generally consists of Plio-Pleistocene sediments, alluvial clay, alluvial sand and basalt soils. [18] Kampong Cham and Takeo is similar in that is it composed of alluvial sands and Basalt widely distributed in the area.[19]

[15] Cambodia Aquastat (2011). FAO
[16] Study of Drainage and Sewerage Improvement Project in Phnom Penh Metropolitans Area (2016) JICA/CTI.

[17] Open Development Cambodia (accessed 9/12/2019) https://opendevelopmentcambodia.net/layers/soils/
[18] Geological Map of Cambodia (2002). JICA.

[19] The Study of Groundwater Development in Central Cambodia (2002) JICA.

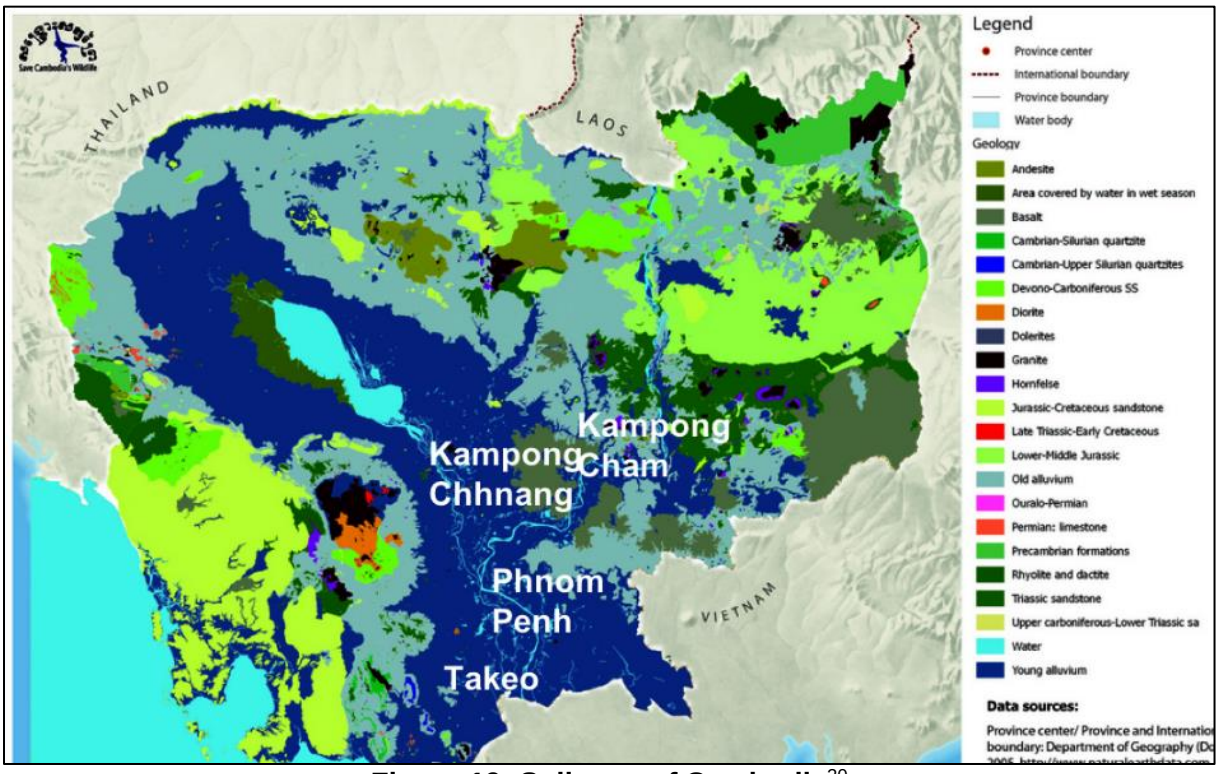

Figure 19: Soil map of Cambodia[20]

E. Climate

143. Cambodia has a tropical climate with characteristically high temperatures and two distinct seasons recognized as: (i) wet season from May to October, with the southwest winds ushering in clouds and moisture that accounts for between 80 – 90% of the country's annual precipitation; and (ii) dry season from November to April with the northeast winds bringing drier and cooler air. Mean monthly rainfall in some provinces during the wet season can exceed 5000mm. Average temperatures during the dry season are relatively uniform across the country (25 to 27^{o}C) and are highest (26-40^{o}C) in the early summer months before the start of the wet season. Yearly variations in climate result from the El Niño Southern Oscillation episodes that influence the nature of the monsoons in the region and generally bring warmer and drier than average winter conditions across Southeast Asia while La Niña episodes bring cooler than average conditions.[21]

144. Annual rainfall in the country is between 1,000 to 1,600mm in the lowland areas around Tonle Sap River and Mekong River. The average annual rainfall in the central lowland's region, where the Project sites are located, is 1400 mm.

145. **Phnom Penh.** Total annual rainfall in Phnom Penh (Porchentong Station) between 2014-2018[22] was 1407 mm per year or 117.3 mm per month. Phnom Penh experiences heaviest rainfall between September to October. On average there are 121 days per year with more than 0.1 mm of rainfall or 10.1 days with a quantity of rain per month. The wettest weather in October receives an average of 257 mm of rainfall.

[20] Open Development Cambodia (accessed 9/12/2019) https://opendevelopmentcambodia.net/layers/soils/
[21] World Bank's Climate Change Knowledge Portal.
[22] Data purchased from the Department of Meteorology of Ministry of Water Resources and Meteorology (December 2019)

146. Climate data analysis using the Berkeley Earth dataset suggests Phnom Penh has experienced around 1°C of warming over the 20th century, based on the change between 1900-1917 and 2000-2017. Most of this warming took place in the latter half of the century, with 0.8°C reported between 1960 and 2003.[23]

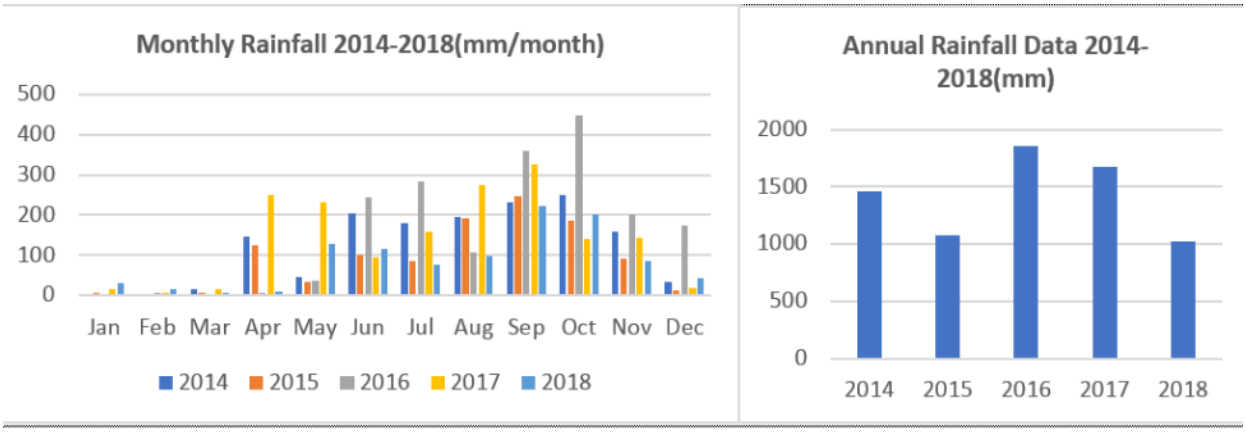

Figure 20: Phnom Penh rainfall data

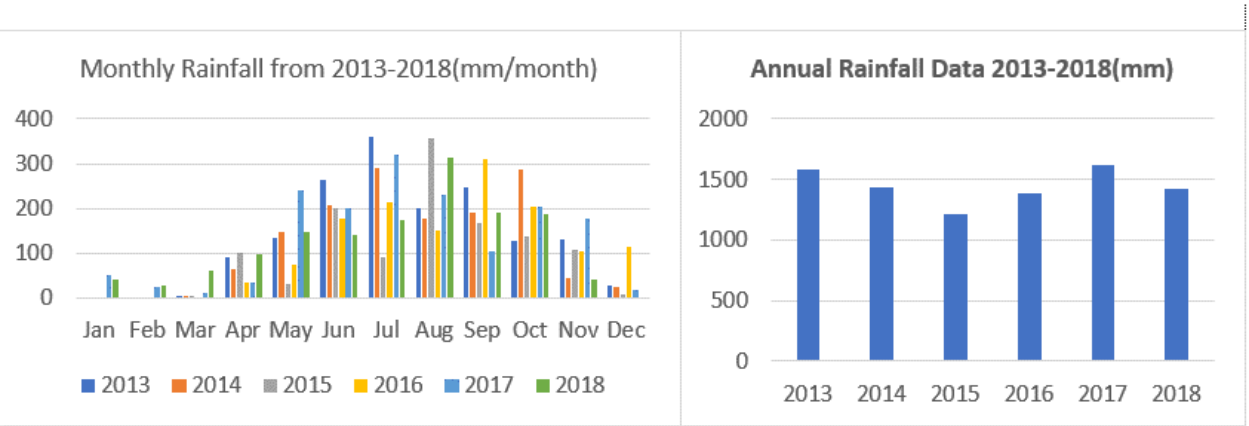

Figure 21: Kampong Chhnang rainfall data

147. **Kampong Chhnang**. Between 2013-2018[24] Kampong Chhnang province experienced its heaviest rainfall between July and September (288.6-359.1mm/month) with the highest average rainfall occurring in 2017 during the last 5 years.

148. **Kampong Cham.** Between 2014 and 2018 Kampong Cham province experienced its heaviest rainfall in between July to October (185.5-335.5mm/month).[25] The year 2017 has the highest average rainfall.

[23] UNDP (2006) UNDP Climate Change Country Profiles: Cambodia. United Nations Development Programme
[24] Ministry of Water Resources and Meteorology. Purchased data (2013-2018)
[25] Ministry of Water Resources and Meteorology. Purchased data (2014-2018)

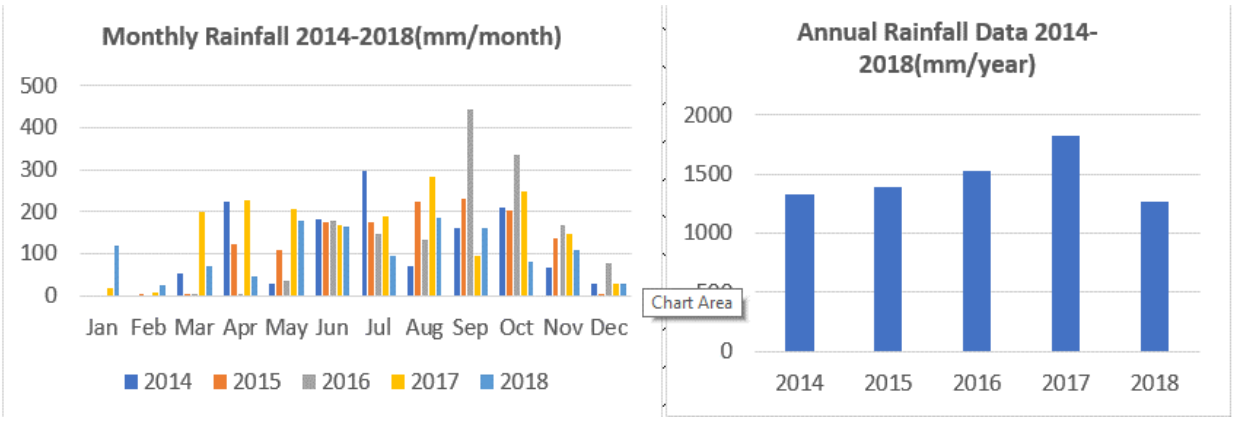

Figure 22: Kampong Cham rainfall data

149. Temperatures in the central lowland's region can exceed 40ºC in April and drop to lows of 17ºC in December or January. The average annual temperature approximately 28ºC. Humidity levels vary depending on different seasons, with approximately 60% humidity between January and March increasing to an average of 90% humidity between September and October. [26]

150. Windspeeds average 14-16 (m/s) in Cambodia although a large variation in speed is evidenced depending on the time of year and from year to year. [27]

151. **Takeo.** The driest month in Takeo province is February, with an average of 8 mm of precipitation. Most of the precipitation falls in October, averaging 252 mm. With an average of 28.9ºC, April is the warmest month. January is the coldest month, with temperatures averaging 26.1ºC.

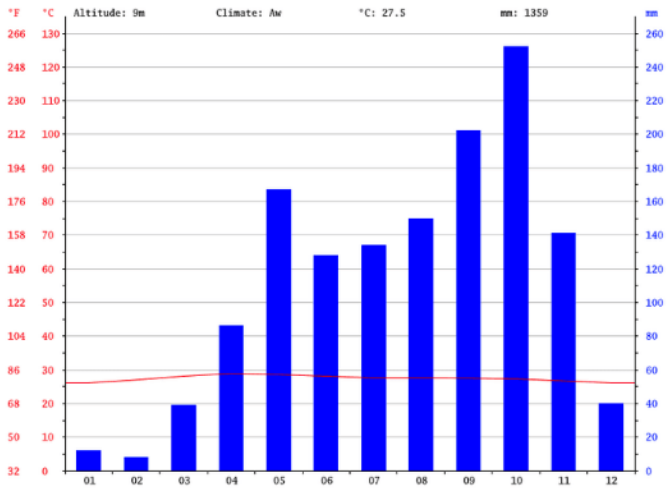

Figure 23: Climate in Takeo Province[28]

[26] Ministry of Water Resources and Meteorology. Purchased data (2014-2018)
[27] Ministry of Water Resources and Meteorology. Purchased data (2014-2018)
[28] Takeo Climate. https://en.climate-data.org/asia/cambodia/takeo/takeo-32243/ (accessed March 28, 2020)

F. Natural Hazards

152. **Climate risk.** The locations of each subproject were screened for climate risks using AWARE climate-risk screening tool. The climate risk assessment noted that subproject sites are located in areas potentially exposed to 'High-level Risk' from recurring flood events, due to increased precipitation, and increases in wind strength that could result in storm damage. Recommendations to adapt to anticipated climate change risks include adequate engineering design of the subprojects, such as transmission line and substation footings to be built above the highest recorded flood levels and high design standard transmission lines to withstand increases in wind and storm intensity.

153. There are two flood types in Cambodia: Mekong River flood and flash floods. All subproject regions are considered as being at 'high-risk' of future flood events[29]. However, localised flood data [30] suggested that rural subproject sites in Kampong Chhnang, Kampong Cham, and Takeo provinces were not historically impacted by flood events during the period researched.

154. Although the initial screening identified that project locations were considered at being at 'High-Risk' of landslides, no mountainous or areas of significant elevation are located in proximity to subprojects and not therefore considered a risk.

155. **Geological hazard risk.** Project risks associated with earthquakes, seismic landslides, tsunamis or volcanoes are all considered 'Low Risk'.

G. Air Quality

156. Primary air quality (AQ) data was not recorded or available during this assessment period, although mandatory AQ baseline measurements will be taken at subproject locations during detailed design and the future IESIA study.

157. **Phnom Penh.** As rapid development in the city has catalyzed industry, manufacturing and significant increases in traffic, average annual air quality levels exceed WHO air quality standards.[31]

158. **Kampong Chhnang / Kampong Cham / Takeo.** Agriculture acts as the dominant economic activity in the subprojects' rural locations and is considered as the main source of air pollution that generates fugitive dust and exhaust fumes from roads and traffic.

159. Field visits and discussion with local government officials and commune chiefs confirmed that the recent operation of factories near the subproject locations has not significantly impacted the air quality levels of local communities.

H. Water Resources

160. **Phnom Penh.** Proposed siting of TPP3, SPP2, SPP3, and SPP5 are near to or on surface water bodies or drainage areas in order to minimize private land acquisition in the capital. Boeung Trabek lake is a wetland area located to the south of Phnom Penh and is predominantly utilized

[29] GFDRR (2019) Available at: http://thinkhazard.org/en/report/806-cambodia-phnom-penh [accessed 19/02/19]
[30] Source: http://surface-water-servir.adpc.net/ (funded by USAID, NASA and adpc)
[31] Health Effects Institute. 2018. *State of Global Air 2018*. Special Report. Boston, MA: Health Effects Institute. https://www.stateofglobalair.org/report (accessed December 2019)

for aquatic agriculture. The lake is rain fed and acts a drainage area for urban runoff. One of three major storm canals, that run in a north/south alignment, intersects the wetland / lake to channel water to Boeung Tompon wetland /lake system to the south. The water quality in the storm canal appears to be very polluted because of urban runoff and wastes, although this will be confirmed during water sampling in the IESIA.

161. Russei Keo substation site will be located near to Russei Keo River, which functions as a part of the wider storm canal system that receives urban runoff and waste water from the surrounding areas. During the dry season, the channel is vegetated and has barely any baseflow.

162. Preliminary assessment shows that proposed sites in rural locations are situated outside the flood extent of the Mekong River and Tonle Sap River.[32]

163. Water quality data for subproject provinces is not routinely monitored by MOE. Ground and surface water quality sampling and analysis will be conducted at each subproject site during the IESIA.

164. Information relating to groundwater will need to be clarified in detailed design stage as well as usage for proposed sites during construction or operational phases.

I. Biodiversity

165. **Phnom Penh.** The capital is considered a heavily modified environment, characterized by widespread development, and does not represent a site of special ecological value. In general, Land uses at the project sites and immediate vicinity are characterized by a mixture of drainage canals, urban settlements, industry and rice paddy.

166. The Integrated Biodiversity Assessment Tool (IBAT) screening study indicated the presence of Boeung Veal Samnap important bird area (IBA).[33] Located >10 km to the north-east of the city, the IBA supports a number of large water-birds during the wet season, including small numbers of Spot-billed Pelican (*Pelecanus philippensis*). However, in discussion with experts from Wildlife Conservation Society (WCS), it was considered unlikely that proposed Project transmission lines and the modified nature of habitats in project areas in the city were unlikely to be important for bird species.

1. Bat Surveys

167. In consultation with a regional bat expert,[34] it was suggested that the Project area of influence could support foraging, breeding and/or roosting grounds of bat species including a flying fox (*Pteropus lylei*) species classified as 'Vulnerable' by the International Union for Conservation of Nature (IUCN).

168. A baseline survey was undertaken in February 2020 (dry season) along the Sensok to Russei Keo and Boeung Tompon to Olympic Stadium transmission line alignments in Phnom Penh to assess if project activities are likely to impact key bat habitat, roosts or foraging grounds.

[32] Servir Mekong (accessed on 3/5/20) http://surface-water-servir.adpc.net/
[33] IBAT report (generated by ADB) 2019
[34] Dr. Neil Furey

169. During the field assessment eight distinct bat taxa were registered within the area of influence of the proposed transmission line alignments and are shown in Table 6.

Table 6: Bat species documented in Kandal and Phnom Penh Municipality

#	Family / Species	KAN	PPM	Record Sources
I	**Pteropodidae**			
1	*Pteropus lylei*	X	X	Ravon et al. 2014; Choden et al. 2019; CBC 2020.
2	*Pteropus vampyrus*	X		CBC 2020.
3	*Cynopterus sphinx*		X	Kock 2000; Reynes et al. 2004; CBC 2020.
4	*Cynopterus horsfieldii*		X	Chheang et al. 2013.
II	**Megadermatidae**			
5	*Megaderma spasma*		X	Kock 2000.
III	**Emballonuridae**			
6	*Saccolaimus*		X	Ith et al. 2011.
7	*Taphozous melanopogon*		X	Reynes et al. 2004.
8	*Taphozous longimanus*		X	Kock 2000; Matveev 2005.
9	*Taphozous theobaldi*		X	Reynes et al. 2004.
IV	**Vespertilionidae**			
10	*Scotophilus heathii*	X		Furey, unpubl. data.
11	*Scotophilus kuhlii*	X	X	Kock 2000; CBC 2020.
12	*Myotis hasseltii*		X	Kock 2000; CBC 2020.
13	*Myotis muricola*		X	Matveev 2005.
14	*Myotis rosseti*		X	Kock 2000.
15	*Kerivoula picta*	X		Ith et al. 2011.
V	**Molossidae**			
16	*Chaerephon plicatus*	X	X	Kock 2000; Reynes et al. 2004; Furey et al. 2018.
TOTAL		**6**	**13**	

170. With the exception of one species (*Pteropus lylei*: Vulnerable), all other bats recorded during the survey are regarded as Least Concern by the IUCN (2020). Survey results show the proposed routes for the power transmission lines do not qualify for bats under criterion 1 (Habitat of Critically Endangered +/or Endangered species), criterion 2 (Habitat of significant importance to endemic and/or restricted-range species) or criterion 3 (Habitat supporting globally significant concentrations of migratory species and/or congregatory species) of IFC Performance Standard 6.[35]

171. **Sensok to Russei Keo Transmission Line**: Interviews and visual assessments along the section did not reveal any significant (e.g. >100 individuals) bat roosts. Eight phonically distinct bat taxa were detected during the acoustic sampling that was extracted from 8,120 bat passes. As the landscape along this alignment is heavily modified, the loss of existing habitat is unlikely.

172. **Boeung Tompon to Olympic Stadium Transmission Line**: No evidence of significant bat roosts (e.g., >100 individuals) were discovered along the latter portion of the proposed line and as such loss of bat roosting and foraging habitats is unlikely to present a major risk in this area. In contrast, the southern portion of the route (Boeung Tompon Canal) evidently provides important foraging habitat for insectivorous bats which likely roost in the riparian vegetation and adjacent structures such as culverts. Construction works for the power transmission line should seek to avoid loss and/or disturbance of such features to the greatest extent possible.

[35] IFC (2012a) Performance standard 6: Biodiversity conservation and sustainable management of living resources. International Finance Corporation, World Bank Group, Washington DC, USA; and IFC (2012b, updated 27 June 2019) Guidance note 6: Biodiversity conservation and sustainable management of living resources. International Finance Corporation, World Bank Group, Washington DC, USA.

173. The report concludes that collision risks are unlikely to be major for echolocating bats along either route, whereas any risk posed to non-echolocating species (fruit bats & flying foxes) could potentially be reduced by marking structures and power lines with flight deflectors.

174. It is recommended to conduct a walk-over study prior to works to check for the presence of bat roosts, for example flying foxes or other important avifauna, that may be affected by transmission line construction activities.

175. **Kampong Chhnang / Kampong Cham / Takeo Province** As generated by the IBAT screening, Phnom Aural Wildlife Sanctuary is located approximately 55 km to the west of to the proposed transmission line alignment in Kampong Chhnang Province. The Phnom Tamoa Zoological Park and Wildlife Centre is set within a protected regenerated forest and is located approximately 10 km north-east of the proposed Takeo substation site.

176. Public consultation meetings attended by each local authority (i.e. commune chief) confirmed no protected forests or community protected areas are located within the area of influence to the proposed subproject sites. Secondary data revealed no flora or fauna of conservation significance is considered under threat from subproject activities in each provincial location as rural locations are heavily modified by human activity. Vegetation cover generally consists of a mixture of agricultural (i.e. lowland rice cropping is the dominant agricultural activity) shrubs, grasses and sparse trees (i.e. palm / *Borrasssus flabbellifer*).

2. Bird Surveys

177. Following a bird survey conducted along the proposed Samaki Meanchey to Tralach transmission line and discussion with key stakeholders[36] it was decided that the area surrounding the transmission line could be suitable habitat to support a range of resident and migratory birds, including Near Threatened species such as Oriental Darter and Painted Stork.

178. Surveys were designed such that they clarified the likely distribution, including timing, and status of bird species in the project area of influence and surrounding areas.

179. The survey captured a total of 2,526 birds and identified 76 species. All 76 species identified are classified as ‘Least Concern’ on the ICUN Red List. No Near Threatened or Globally Threatened birds were identified during the survey.

[36] Meeting with Wildlife Conservation Society December 3rd 2019.

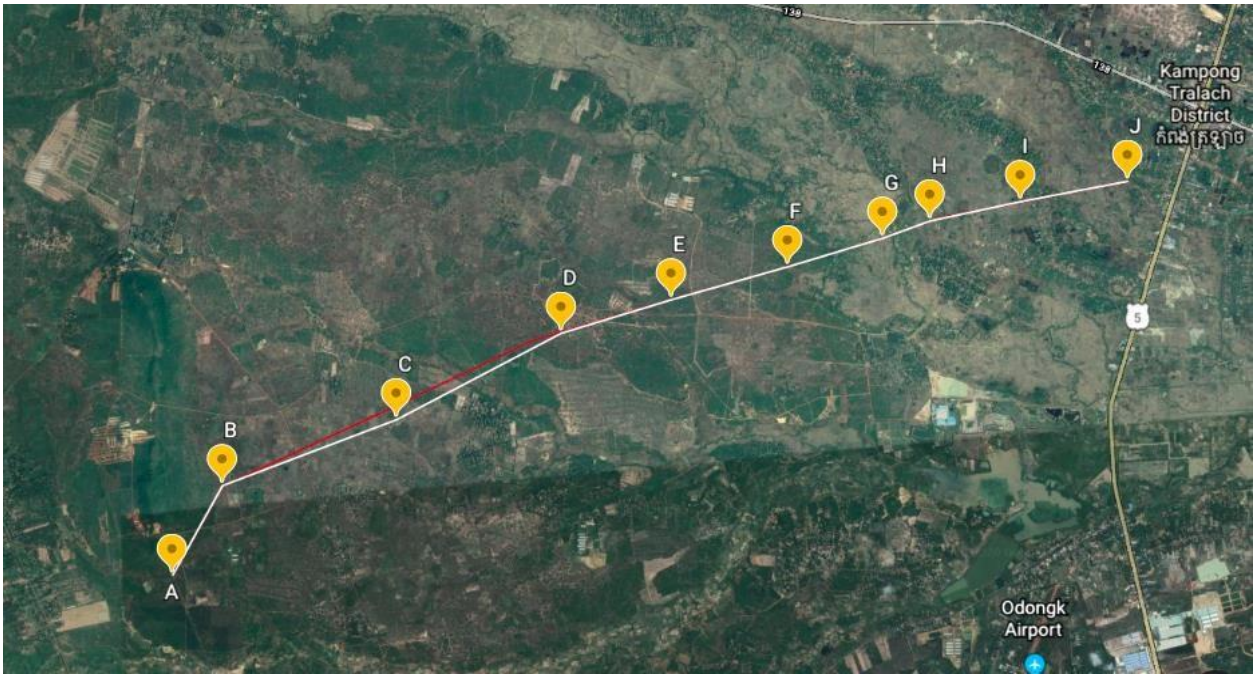

Figure 24: Map of proposed transmission line with survey vantage points labelled A to J

Table 7: Bird species list

	Species	Scientific Name	IUCN Red List Classification	Total seen in bird survey
Grouse, Quail, and Allies	Chinese Francolin	*Francolinus pintadeanus*	LC	54
Heron, Ibis, and Allies	Great Egret	*Ardea alba*	LC	10
	Little Egret	*Egretta garzetta*	LC	84
	Cattle Egret	*Bubulcus ibis*	LC	6
	Chinese Pondheron	*Ardeola bacchus*	LC	59
Vultures, Hawks, and Allies	Black Baza	*Aviceda leuphotes*	LC	40
	Rufous-winged Buzzard	*Butastur liventer*	LC	3
	Shikra	*Accipiter badius*	LC	1
Shorebirds	Small Buttonquail	*Turnix sylvaticus*	LC	8
Pigeons and Doves	Rock Dove	*Columba livia*	LC	59
	Red-collared Dove	*Streptopelia tranquebarica*	LC	33
	Spotted Dove	*Spilopelia chinensis*	LC	4
	Zebra Dove	*Geopelia striata*	LC	34
Cuckoos	Plaintive Cuckoo	*Cacomantis merulinus*	LC	4
	Asian Koel	*Eudynamys scolopaceus*	LC	207
	Green-billed Malkoha	*Phaenicophaeus tristis*	LC	8
	Greater Coucal	*Centropus sinensis*	LC	83
Owls	Spotted Owlet	*Athene brama*	LC	28

	Species	Scientific Name	IUCN Red List Classification	Total seen in bird survey
Swifts	Germain's Swiftlet	*Aerodramus germani*	LC	19
	Asian Palm-swift	*Cypsiurus balasiensis*	LC	179
Hoopoes	Eurasian	*Upupa epops*	LC	50

180. A repeat bird survey is proposed to study if migratory species may be present in the area of influence during the wet season that were absent during the dry season. Transmission line deflectors are considered a suitable mitigation measure to reduce or prevent bird collision and electrocution along the TKCN1 power line.

J. Socio Economic

181. Baseline data was collected for commune and khan subproject locations in January and February 2020.

182. **Population and poverty**. Table 8 shows the results of the commune data for all subproject locations. The data shows that rural locations have a higher poverty rate compared to urban locations.

Table 8: Population and poverty in each subproject location

Commune / Khan	Population [37]			Total number of households	Poverty Rate %
	Total	Male	Female		
Peani Commune	9,598	4,650	4,948	2,460	15.27%
Sedthei Commune	9,022	4,392	4,630	2,115	27.77%
Tbeng Kpos Commune	10,965	5,303	5,662	2,724	21.51%
Thlok Vien Commune	7,163	3,496	3,667	1,788	25.73%
Sambour Commune	14,552	7057	7495	3126	11%
Soutip Commune	14922	7519	7403	3812	8.96%
Sangkat Boeung Tompon I	27,117	14,856	12,261	5075	0.75%
Sangkat Tuol Tompon II, Khan Chamkar Mon	7158	3533	3625	1238	1.27%
Sangkat Tuol Svay Prey I, Khan Boeung Keng Kang	8551	4106	4445	1650	1.79%
Sangkat Olympic, Khan Boeung Keng Kang	5411	2686	2725	916	4.73%
Sangkat Phnom Penh Thmei, Khan Sen Sok	25,275	12513	12762	5642	2.41%
Sangkat Kilomet Lek Prammouy, Khan Russei Keo	17443	8428	9015	3653	7.37%
Sangkat Russei Keo, Khan Russei Keo	32414	15637	16777	6916	2.95%
Sangkat Prateah Lang, Khan Kambol	5725	2811	2914	1314	6.5%
Trapeang Sap Commune, Bati District	21007	10086	10921	4778	14.51%

[37] Social Economic Profile 2019

Electricity in the project area

183. Table 9 represents electricity access at households at commune / khan level across all project sites.

Table 9: Electricity access at subproject locations

Commune / Khan	Number of villages	Villages with grid connection	% of HHs with grid power	% HHs using batteries for electricity
Peani Commune	9	9	97.3%	1%
Sedthei Commune	10	9	76.1%	5.9%
Tbeng Kpos Commune	9	9	81.6%	2.7%
Thlok Vien Commune	7	7	84.1%	6.9%
Sambour Commune	7	7	93.7%	5.1%
Soutip Commune	8	8	96.1%	0.5%
Sangkat Boeung Tompon I, Khan Mean Chey	11	11	100%	0%
Sangkat Tuol Tompon II, Khan Chamkar Mon	4	4	100%	0%
Sangkat Tuol Svay Prey I, Khan Boeung Keng Kang	7	7	100%	0%
Sangkat Olympic, Khan Boeung Keng Kang	5	5	100%	0%
Sangkat Phnom Penh Thmei, Khan Sen Sok	6	6	93.2%	0%
Sangkat Kilomet Lek Prammouy, Khan Russei Keo	3	3	100%	0%
Sangkat Russei Keo, Khan Russei Keo	4	4	100%	0%
Sangkat Prateah Lang, Khan Kambol	6	6	100%	0%
Trapeang Sap Commune, Bati District	15	15	93.3%	0%

K. Physical Cultural Resources

184. A combination of site visits, public consultations and secondary resources confirmed that there are places of worship (temples, pagodas and churches) in the vicinity of the proposed subproject locations. Table 8 shows approximate distances of temples and churches from Project components and infrastructure.

185. Final alignment of transmission lines and required access roads will be adjusted to avoid all physical cultural resources (PCRs) during detailed design stage.

V. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

186. The process of impact prediction is at the core of the IEE process. Anticipating impacts enables mitigation recommendations to be developed for each project phase: detailed design, construction, operation and decommissioning.

187. This section discusses the location and scale of the potential environmental impacts of the proposed Project and identifies mitigation measures to prevent or minimize the impacts at each phase in line with recommendations and guidelines set out in ADB SPS (2009).

188. ADB SPS (2009) states an environmental impact is considered as any change (positive and negative) that activities associated with a project may cause in the environment, including the impact of any such change on health and socio-economic conditions, on physical or cultural heritage, on the current use of lands and resources for traditional purposes by Indigenous Peoples.

A. Methodology

189. The type and intensity of impacts of the project were assessed in consideration of environmental settings and the nature and extent of the proposed subproject activities The check list supported characterization of anticipated impacts with respect to their severity, in addition to determining whether the potential impact can be avoided through better project design and planning, or mitigated with the help of appropriate measures to be taken during the project execution.

B. Environmental Impact Screening

190. Impact screening was developed on the basis of the following:

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.

191. Site visits to each subproject site were conducted by national and international experts in order to:

i) Ground-truth secondary information to further understand the context of each subproject environment and socio-economic situation; and
ii) Meet local government officials to substantiate secondary information.

192. 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 water for human consumption) and a receptor must be present to receive the impact, such as humans, flora or fauna.

C. Positive Impacts and Benefits

193. Benefits of the project are wide-ranging and include meeting growing energy demand and to ensure sustainability of the future development of the grid. The proposed substations and

transmission line projects are expected to reduce power losses, improve efficiency and flexibility for network operation, increase system reliability and ensure power supply security.

194. Environmental benefits of the project include increasing people's access to a more stable energy supply, which is likely to reduce reliance on alternative energy sources such as batteries for energy or wood for cooking. The BESS pilot project will build capacity for deploying and operating energy storage technology which will support Cambodia scale-up energy storage as part of power system development in the future. Additionally, the battery system will improve grid stabilization and provide increased power reliability. Improving the stability and reliability of renewable energy may encourage supplementary investment into renewable energy solutions.

D. Negative Impacts and Mitigation

195. This IEE study reveals that the project is not likely to have any significant negative environmental impacts. The anticipated adverse environmental impacts at subproject sites are considered temporary, localized and can be mitigated. The majority of potential impacts identified during the assessment are associated with the construction phase and can be avoided through good design and construction planning, or mitigated through effective implementation of EMP.

196. Potential community and occupational health and safety impacts during construction and operation will be effectively mitigated through community awareness and future consultations.

197. This IEE and the EMP will be updated based on detailed engineering design to take account of any changes in alignment, design or scope. The updated IEE/EMP should be cleared by ADB prior to issue of no objection for civil works to proceed.

1. Design and Pre-Construction Phase

a. Site Design and Route Alignment

198. A critical issue for the management of impacts on receptors is the location and siting of subproject infrastructure. Detailed design will consider the following:

i) Identification and avoidance of key receptors during siting of substations and transmission line alignments (and associated road access) and adjustment of subproject components and infrastructure will be applied to avoid sensitive receptors. A drone survey conducted along the SKCN1 (11.1 km) transmission alignment will support avoidance of receptors during detailed design stage.
ii) Walk over studies will be completed at subproject locations during detailed design to support final adjustment to avoid receptors.
iii) All designs to consider future climate change risks and hazards associated with increased precipitation, wind strength and localized flood incidence.
iv) Project infrastructure to be sited on public/state land where possible to avoid impacts to communities and livelihoods.
v) Subproject sites utilizing drainage areas should consider results from flood assessments, as necessary, to prevent localized flooding incidence.

b. Climate Change Adaptation

199. Subproject locations are classified as being at 'high-risk' from future climate change impacts such as increased in temperature, precipitation, wind, and extreme events such as floods.

Measures to combat potential climate change-based impacts are considered in detail in the Climate Change Assessment. Key climate vulnerable components will also be subject to further analysis during the detailed engineering design. Climate adaptation measures that will permanently become part of project infrastructure and will be included within the main civil work contract costs. These measures include:

i) Specifications for transmission lines provide for a maximum ambient air temperature of 40.5^{o}C to anticipated projected increase in temperature over longer periods;
ii) Designs of OHL allow for maximum line sagging due to increase temperatures, to maintain ground clearances;
iii) Ensure components are resilient to higher temperatures and humidity;
iv) UGC engineering and design to consider drought conditions / soil moisture reduction;
v) Conductors to be designed to combat extended periods of drought that can cause dust to amass on conductors;
vi) Design, operational and maintenance standards to consider heavy precipitation events;
vii) Reduce vulnerability of exposed assets (e.g. outdoor substation switchgear, power transformers);
viii) Flood risk management measures to be considered in project siting, design and construction including protection of drainage; and
ix) Transmission towers and substation footings and battery room enclosure to be built above the highest recorded flood levels.

c. Land Acquisition and Resettlement

200. Identification of affected people (AP) has been included in the social assessment. The impacts are categorized into (i) permanent impacts caused by the use of land for the substations and tower (footings), and (ii) temporary impacts caused due to construction or stringing of line along the transmission line ROW. A land acquisition and resettlement plan has been prepared in separate reports covering compensation for APs. All temporary acquisition and monetary compensation are discussed in the land acquisition and resettlement plans (LARPs).

201. **Phnom Penh.** Seven transmission lines and substation subprojects in Phnom Penh, namely, TPP1, TPP2, TPP3, SPP2, SPP3, SPP4 and SPP5 are expected to be constructed on public land. A total of 152,402 m^2 land will be affected by the 7 subprojects in which 7,016.64 m^2 will be permanently acquired for the construction of 4 substations (including access roads to the substations) and 59 monopoles. 132,583.36 m^2 of land will be restricted due to the ROW and 21,802 m^2 will be temporarily affected by the construction of UGC and 59 monopoles.

202. The construction of the UGC will temporarily affect 250 shops along the road N° 371 although impacts will be site-specific and short-term. Proposed mitigation of impacts to business include nighttime construction to avoid disruption to traffic and business.

203. The BESS will be constructed within the National Solar Park financed by ADB[38] although the exact location of the system within the solar park will not be confirmed until detailed design stage.

[38] ADB.2019. *Proposed Loan and Administration of Loan, Grant and Technical Assistance Grant Kingdom of Cambodia: National Solar Park Project. Report and Recommendation of the President to the Board of Directors.* Manila

204. **Kampong Chhnang / Kampong Cham / Takeo Province.** EDC will acquire land for six substations (SPP1, SKC1, SKC2, SKC3, SKC4, and STKO1) through negotiated settlement. For the six substations, it is estimated that an aggregate of 166,000 m^2 covering 80 land plots of 58 households will be acquired permanently for the construction of the substations and associated access roads, in which, 162,000 m^2 of land for substation area and 4,000 m^2 for roads. It is envisaged that about 180,000 m^2 will be temporarily affected during the construction duration for material transportation and storage areas. No houses or auxiliary structures belonging to individual households will be affected by the subprojects, although the six subprojects will affect 133,500 m^2 of rice and 25 palm trees.

205. The transmission line from Samaki Meanchey to Kampong Tralach will require 6,150 m^2 of land on a permanent basis for the lattice towers along the 11.1 km 115 kV transmission line. Adversely affected by permanent land acquisition totals 28 households. Of the 6,150 m^2 permanently acquired landholdings, all are planted with rice. A total of 158,350 m^2 of landholdings within the 15 m ROW will be affected by the transmission line. This land will not be acquired by the subproject but their continued use following construction of the transmission line will be restricted for safety reasons as mandated by Cambodia's Electrical Power Technical Standards by MME (2007). Two main structures of two households in Peani commune will be acquired by the subproject. A total of 85 trees of various species will be removed and compensated.

206. Original conditions of access roads and irrigation canals will be recorded by contractor(s) prior to construction. All damage caused by construction activities will be repaired, restored or compensated by the contractor. PIC will monitor and report on the respective cases of reinstatement of infrastructure and/or compensation of damage, and report through semi-annual safeguard monitoring report with evidence/photos annexed to the report.

207. **Impacts of associated facilities**. As shown in Table 10 there are three associated facilities in Phnom Penh, namely: GS5 SS, Olympic SS and the UGC that are critical to the design and implementation of TPP1, TPP3, and SPP3 subprojects. According to EDC, compensation has been fully implemented and there are no pending issues related to the existing projects.

Table 10: Associated facility subprojects' impacts in Phnom Penh

Associated Facility	Permanently acquired land area (m^2)	Temporarily affected land area (m^2)	Trees	Crops
GS5	80,000	0	0	80,000
New Olympic	1,560	0	0	0
230 kV UGC	0	15,000	0	0
Total	81,560	15,000	0	80,000

208. The total acquired land area is 68,893 m^2 for construction of tower foundations and 2,001,107 m^2 land under the ROW. Of this amount, approximately 2,070,000 m^2 is rice. Other land acquisition impacts during the construction of the associated facilities included impacts to tree, rice and structures.

Table 11. Associated Facility Subprojects impacts in Kampong Cham

Subproject	Permanently acquired land (m^2)	Land within the RoW	Total
115 kV GS4 - Grongpor	8,333	291,667	300,000

Subproject	Permanently acquired land (m^2)	Land within the RoW	Total
115 GS4 – GS 10	3,360	116,640	120,000
230 kV BOT line	57,200	1,592,800	1,650,000
Total	**68,893**	**2,001,107**	**2,070,000**

209. The identified associated facilities have been subject to IESIA based on the requirements of MOE. The ADB Solar Park is an associated facility of the BESS in Kampong Chhnang. An environmental assessment of the entire park has been undertaken during the processing of the ADB loan and is also subject to IESIA in accordance with requirements of MOE.

210. For site installation or other areas needed for subproject activities, the Engineer, Procurement, Construction (EPC) Contractor will have to propose a site installation and access plan and obtain approval from the EDC. Where possible, public land will be used for temporary land use.

211. The EPC Contractor shall lease the private space with an agreed rental fee. Both private and public land shall be returned to the same condition or better. Through a transparent and contractual approach, EDC will provide the EPC Contractor with the project's land acquisition and compensation principles to ensure that (i) official compensation rates are applied, (ii) re-instatement of affected assets contractually defined, (iii) consultation takes place, (iv) the grievance mechanism is followed, (v) the Environmental Management Plan (EMP) is applied, and (vi) other items specified are complied with.

d. Institutional Strengthening and Capacity Building

212. The successful evaluation of environmental conditions of subproject sites during construction and operation phases is crucial to minimizing impacts through the correct application of predetermined mitigation options. Training will be undertaken by PMU and SEPRO representatives to ensure the effective implementation of EMP and GRM, supervision, monitoring and reporting, conducting meaningful consultations and following of relevant environmental rules and regulation. Training will be completed before commencement of the construction phase. Additional training may be required during construction to support PMU/SEPRO with specific project requirements (i.e. construction environmental management plan [CEMP] preparation).

e. Mines and Unexploded Ordinance Clearance

213. In some areas of Cambodia, there is a significant risk of encountering land mines and UXO. Locating landmines and UXO will be completed by an accredited mine/UXO organization. All required clearance works will be completed, with appropriate documentation submitted to the EPC Contractor from the selected organization, prior to the commencement of any works across all sites.

f. Physical Cultural Resources

214. Baseline information collected during the development of this IEE showed that there are temples, pagodas and churches within the project area of influence. However, none of these structures will be directly impacted by the subproject infrastructure.

215. To avoid the potential disturbance of existing or unknown PCRs, a Chance Find Procedure will be activated for the construction phase. Detailed information relating to the Chance Find Procedure is outlined in the EMP.

g. Waste Assessment and Disposal

216. The EPC Contractor, together with the PIC, will conduct an assessment of all sites for the disposal of wastes and debris in coordination with Phnom Penh Municipality, MOE and the municipal waste collection organization (CINTRI). A Waste Management Plan will be formulated once the assessment is complete. The plan will need to include clear arrangements for the safe extraction, transportation and disposal of hazardous and non-hazardous waste to be completed prior to commencement of any works at subproject sites.

h. Information and Disclosure

217. A consultation schedule (Table 16) will be designed and implemented to continue information disclosure with APs to disclose key construction activities and impacts and GRM entry points.

218. Information will be disclosed one month prior to works commencement and intermittently during the construction phase to all subproject locations. Project information booklet (PIB) will be distributed and made publicly available during consultations, at project construction field offices, and commune offices.

i. Preparation of Environmental Management Plans

219. The EPC Contractor will update the EMP based on detailed engineering design and will develop a CEMP to provide framework for implementation of project activities and associated mitigation and monitoring measures. Prior to starting physical works, the EPC contractors will develop site-specific CEMP for the key activities, appropriate maps showing where activities will take place, and corresponding implementation schedule. In coordination with PIC, the CEMP will include the specific plans listed in Table 12 and will be submitted to PMU for approval.

Table 12: List of Plans to be included in Construction Environmental Management Plan

Environmental and Social Component Likely to be Affected	**Construction Environmental Management Plans**
Soil and Vegetation	Spoil and Borrow Management Plan
Air	Noise and Dust Control Plan
Surface Water	Site Management Plan
Waste	Solid Waste Management Plan Hazardous Waste Plan
Communities / Workers	Community Health and Safety Plan Traffic Management Plan Occupational Health and Safety Management Plan
Physical Cultural Resources	Chance Find Procedure

2. Construction Phase

a. Air Quality

220. Moderate temporary air quality impacts during construction phase are anticipated from construction activities, civil works and waste removal.

221. Air quality impacts are likely to arise from the following sources**:**

i) Fugitive dust generation is likely to be associated with excavation, construction works and transport (of materials, equipment and machinery), loading, unloading and haulage of materials;
ii) Emissions from construction machinery and haulage will lead to minor increases in levels of nitrogen oxides (NOx) and Sulphur oxides (SOx); and
iii) Fugitive dust from concrete production (batching works).

222. Mitigation measures to protect receptors from air quality issues are as follows:

i) Minimize dust by regularly applying water suppression techniques;
ii) Trucks should use tarpaulins is carrying waste or earth to and from site;
iii) Vehicles and machinery should be regularly maintained; and
iv) Monitoring of air quality levels will be conducted by an MOE-recognized monitoring company at proposed substation sites which are located in close proximity to residential areas and sensitive receptors such as the substations in Dangkor, RUPP, Boeung Tompon, Russei Keo, Kampong Tralach, and Skun. The monitoring stations and frequency of monitoring will be finalized during detailed design.

b. Noise

223. Noise impacts from operation of construction machinery and vehicles will be temporary and localized at construction sites. Activities such as piling and excavation are likely to cause short term noise impacts at subproject locations. Other noise sources include loading, unloading and haulage of equipment and materials. Receptors, such as residential houses or pagodas, within 250 m of construction sites are likely to be subject to intermittent noise impacts. Receptors located near to site access roads may experience short-term increase in noise from necessary project transport traffic.

224. Potential impacts will be mitigated through the following measures:

i) Equipment and machinery to be regularly maintained;
ii) Construction activities to be limited between 8 am and 6 pm;
iii) Appropriate PPE (i.e. ear defenders) will be used by workers; and
iv) In densely populated areas, noise barriers and fences should be used during works.

c. Impacts on Flora and Fauna

225. Baseline environment information and bat and bird surveys have shown that subproject locations are in environments that are highly modified or disturbed, such as urban areas and rice paddies and as such impacts on flora and fauna is considered insignificant.

226. Trees located along transmission line alignments may have to be cut or trimmed to ensure EDC safety standard clearances are achieved, as it is essential to maintain suitable conductor clearance (see section 2). Trees within the ROW at a height of >3m are considered a striking risk to the lowest conductor will be safely removed. However, where possible, the contractor will work to avoid tree cutting or trimming by, for example, altering pole positioning.

227. Bird and bat surveys, (see section 3 Description of the Environment), conducted along the Samaki Meanchey to Kampong Tralach (Kampong Chhnang) and Sen Sok to Russei Keo (Phnom Penh) transmission line found no significant species of note during the time of surveys. However, construction works for the power transmission line should seek to avoid loss and/or disturbance of features of value to bats and birds, such as mature trees.

228. Along TKCN1 transmission line, deflectors will be applied as a mitigation to prevent electrocution or collisions of birds. It has also been advised that a repeat bird survey should be conducted during the wet season as the surrounding landscape may be suitable seasonal habitat for migratory bird species. As no other surveys have been previously conducted in the project area, it has been advised that a wet season survey should be performed to confirm the project site does not support Near Threatened or Globally Threatened species.

d. Surface Water

229. Construction will take place in proximity of irrigation channels and storm canals in rural and urban settings. Construction impacts may include increased sedimentation or turbidity from excavation, piling or construction of footings.

230. Subproject sites located in proximity of waterways and storm canals (i.e. TPP1, TPP2, TPP3, SPP1, SPP3, SPP4, SPP5, TKCN1, SKPC1, and SKPC2) are likely to require a geo-tech assessment to establish the sites load-bearing potential and ground conditions to determine the number, depth and type of foundations. Sheet piling may also be required in these areas.

231. Mitigation of surface water impacts will consider the following measures:

i) Provision of adequate short-term drainage solutions to allow continued channel functionality;
ii) Install temporary storm drains or ditches to prevent surface run-off from impacting water quality;
iii) All construction fluids (i.e. oils and fluids for refueling) to be stored and handled at least 50m from surface waters;
iv) Storage or laydown areas set at least 50m from channels or ditches to prevent bank erosion or collapse;
v) No washing of equipment or machinery to occur within 50m of surface water; and
vi) Contractors will monitor water quality of adjacent waterways of Russei Keo River, Prek Thnaot stream, and Boeung Tompon lake, in line with laboratory standards outline by MOE. The water quality monitoring reports are to be submitted bi-monthly.

e. Soil

232. Subproject locations are situated on flat topography but soil erosion impacts are anticipated during the wet season. During rain events, open excavation and earthworks may lead to soil erosion and siltation of water courses, lakes and reservoirs.

233. During the construction period, it is likely that backfill will be required to support substation slab elevation. Where feasible, excavated material (spoil) will be effectively used from other subproject sites to minimize the requirements of borrow pits. A cut and fill assessment can support efficient resource use at detailed design stage.

234. Soil at rural locations will be protected as many subproject sites are located in agriculturally productive areas.

235. Mitigation will be included in a Spoil and Borrow Management Plan and include the following measures:

i) As part of the CEMP, a map will be developed highlighting the location of all spoil piles and borrow sites for each subproject location, as required;
ii) Excavated top soil to be retained, stored and reinstated during site rehabilitation;
iii) Soil replacement around transmission footings should be compressed to prevent erosion;
iv) Identify areas susceptible to water erosion, provide silt traps, retain vegetation (where possible) and revegetate disturbed areas once work is complete; and
v) Avoid earthworks during the wet season.

f. Waste Generation

236. Impacts associated with waste generated during site preparation and civil works are likely to include the generation of inert wastes (i.e. spoil, cleared vegetation, construction debris, packaging waste, metal scrap, domestic waste) and potentially hazardous wastes (i.e. waste removal from dumping grounds).

237. Impacts will be mitigated through the implementation of a Waste Management Plan designed by the EPC Contractor and will include the following mitigation measures:

i) Efficient use and management of resources;
ii) Application of the waste hierarchy to demonstrate how waste at affected sites will be recycled;
iii) Prohibit burning of waste;
iv) All site-related waste (i.e. concrete, wood, metal) to be properly disposed of using licensed companies to transport to a predetermined licensed waste facility (shown on map);
v) Excavated materials, excess materials and contaminated materials to be disposed of. Some waste material may be re-used at project sites; and
vi) Contractor(s) will be responsible for proper removal and disposal of any residual wastes after works completion.

g. Occupational Health and Safety

238. Occupational health and safety impacts include exposure to hazardous materials, dust and noise, falling objects and electrical hazards.

239. Prior to site mobilization, the PIC will conduct briefing and orientation for all project staff, workers, EPC contractors to ensure awareness of expectations and requirements at each subproject site.

240. To support ongoing awareness at each subproject site, all EPC Contractor team members will attend toolbox talks and awareness training sessions A trained health and safety officer will be present as a part of each construction team at each subproject site and all incidents and accidents will be recorded.

241. EPC Contractors will ensure compliance with applicable national laws[39] and IFC EHS Guidelines on Occupational Health and Safety.

242. Potential impacts will be mitigated through the following measures:

i) Loan covenants and contract specifications will exclude the use of asbestos-containing materials and Operations and Maintenance Manual will include safe handling, management and disposal requirements for any hazardous chemicals that cannot be avoided.
ii) PIC to provide orientation prior to works commencement, including: EMP, GRM, environmental monitoring, and Community Health and Safety Plan;
iii) Only allow trained and experienced workers onto subproject sites;
iv) Implement SOP for Occupational Health and Safety as detailed in EMP (will be converted into CEMP plan by EPC Contractor);
v) Provide sanitary facilities and wash areas, safe drinking water and garbage bins at construction camps;
vi) Establish and implement emergency contingency plan (including coordination with nearest hospital);
vii) Provide periodic training covering OHS, emergency contingency plan activation and tool box talks;
viii) Provide suitable PPE, first aid kits and routine health checks to all workers;
ix) Coordinate with nearest hospital for arrangements in case of accidents; and
x) Record all accidents, incidents, deaths and near misses.

h. Community Health and Safety

243. The construction of subproject facilities and infrastructure poses moderate risk to the health and safety of community members. At least one month prior to commencement of civil works and intermittently during civil works, local residents and authorities will be advised and consulted about the construction activities. These activities will be conduction in and around the villages situated close to the substation sites, transmission line alignment, and the BESS.

244. To protect community members from incident or injury, the EPC Contractor will prepare and implement a Community Health and Safety Plan covering potential issues that may arise at each project location. The plan will ensure the application of international standards, has

[39] Cambodia Occupational Safety and Health laws and regulations, MLVT, 2011

contingency plans for emergency situations (i.e. fire, spills, accidents) that are location specific. A communication channel between the EPC Contractor and communities will be active through the GRM.

245. To mitigate potential health and safety risks, the EPC Contractor will be required to submit a Community Health and Safety Management Plan and will include the following mitigation:

i) Suitable security measures (i.e. signs, lights, perimeter fences, barriers) will be enforced at all subproject sites and access areas to protect public;
ii) Barricade open excavated tower foundations;
iii) Provide sufficient lights, clear warning signs and danger signals;
iv) Assign security personnel to prevent accidents, trespassing and pilferage;
v) Safety flags and flag persons will be assigned for works adjacent to roads;
vi) Roads to be cleaned, repaired or rehabilitated after completion of works as necessary;
vii) Provide appropriate signs (in Khmer) placed at each subproject location to highlight relevant site dangers;
viii) Perimeter fences and barriers to be erected around all subproject sites;
ix) Record all incidents, accidents, deaths and near misses; and
x) Outreach to local communities and the distribution of the project information booklet (in Khmer).

i. Interruption to Power Supply

246. The installation of the transmission lines and substations may result to temporary power outages, particularly during interconnection with the existing grid. Advance notification will be provided to affected communities on schedule of power interruption at least 24-hours prior to the outage.

j. Traffic Impacts

247. Critical works required to construct OHL, UGC and substations will increase project reacted traffic that may cause increased congestion, especially within urban locations around Phnom Penh.

248. A Traffic Management Plan will be developed by the EPC Contractor for each project site, to manage and mitigate potential adverse traffic impacts and road closures (if required). In Phnom Penh, it will be important to coordinate with appropriate authorities that will include the National Road Safety Committee that is headed by a combination of the Ministry of Interior (MoI) and the Ministry of Public Works and Transport (MPWT).

249. Across project settings, information will be disclosed during public consultations to detail construction scheduling information and reduce or prevent disruption to community members and their livelihoods. Other mitigation measures will include the following:

i) Adequate traffic management to provide advance warning or works;
ii) Installing appropriate road signs (i.e. to highlight diversions);
iii) Enforcing speed limit restrictions;
iv) Avoiding vehicle movement during peak traffic times (7am- 9am / 5pm - 7pm);
v) Rehabilitating roads to pre-construction conditions; and

vi) UGC works to be conducted at nighttime to reduce impacts to business and communities in urban locations. Disruption would be mitigated as the trenching would be backfilled each night and therefore limit road closures during the day.

3. Operation Phase

a. Occupational Health and Safety

250. Contractors will comply with Cambodia safety regulations under by law and international best practice. EPC Contractor will create an operation and maintenance standard operating procedure (SOP) that will be submitted to EDC at project hand-over. The operation and maintenance manual will be developed having utilized information set out in manufacturer's instructions for specific equipment and components. Procedures will be detailed in the manual relative to equipment operational instructions, calibration, monitoring, maintenance of health and safety in the workplace, and management of used and damaged equipment. The EPC Contractor will conduct training for EDC on the implementation of the O&M SOP.

251. Potential impacts associated with workers during operation are set out in the following mitigation measures:

i) EPC to implement SOP for Occupational Health and Safety;
ii) Compliance with relevant national level electrical safety standards and occupational health and safety[40];
iii) Provision of PPE for workers (i.e. helmet, MV gloves, anti-UV goggles, spark-resistant clothing with long sleeves), safety guidelines, personal safety devices, and other precautions as required by each subproject site;
iv) Provide routine health checks to all workers;
v) Only allow trained and qualified workers to access work and provide periodic training to all workers accessing to on site electrical and hazardous conditions;
vi) Restrict access to electrical equipment by workers only trained and certified to work on electrical equipment;
vii) Ensure emergency contingency plans are in place at each subproject site prior to maintenance;
viii) Ensure proper grounding and deactivation of live power lines during maintenance work or if working in close proximity to the lines;
ix) Maintain adequate clearance of conductors to prevent flash over;
x) Workers will be required to observe guidelines to minimum approach distances for excavations, tools, vehicles, pruning, and other activities when working around power lines;
xi) Erect appropriate warning signs erected on all facilities;
xii) Only trained workers using licensed operators, transport companies and authorized waste sites will handle hazardous equipment or material (i.e. Mineral oils [non- polychlorinated biphenyl] used as an insulant in transformers and some HV switchgear; SF_6; battery electrolytes, refrigeration gas in air conditioners); and
xiii) Record all incidents, accidents, near-misses and fatalities.

[40] Overview of Occupational Health and Safety, Cambodia. (2011). Ministry of Labour and Vocational Training.

b. Community Health and Safety

252. Subproject infrastructure may expose community members to electrocution hazards from direct contact with live conductors, flashover from the conductor to a pole or conductor breakage (i.e. if the vertical clearance is compromised), and exposure to EMF. Information and consultation with local residents (community awareness program) and authorities will be conducted intermittently during operation stage by PMU. EPC Contractor will obtain permission from relevant authorities before commencement of activities.

253. Potential impacts will be mitigated by the following measures:

i) PMU to communicate with communities regarding potential health and safety risks including disclosure of project information booklet highlighting operational risks and hazards;
ii) Appropriate measures to prevent third persons from entering compounds or scaling transmission lines[41];
iii) For UGC, all cables are insulated and encased in PVC pipes to ensure integrity and safety and avoid risk of electrocution if area is affected by flooding;
iv) Record incidents, near misses, accidents and fatalities associated with the project;
v) Issues raised through GRM with be recorded and rectified.

254. Whilst there is no empirical data that demonstrates the health effects from exposure to electric and magnetic fields from power lines and equipment, public and scientific concern over such effects remains such that the potential impact should be addressed. As such, Project infrastructure will comply with minimum safety clearances.

4. Decommissioning Phase

255. A detailed decommissioning and site reclamation plan will be developed between 6-12 months prior to subproject site closure.

256. Sub-project facilities and components have an expected lifespan of >50 years, at which point may be decommissioned.

257. Typical activities during the decommissioning and site reclamation phase include facility removal, breaking up of concrete pads and foundations, removal of access roads that are not maintained for other uses, re-contouring the surface (if required), and land re-vegetation and replantation of trees. Potential impacts include erosion, noise, dust and vehicle exhaust, and the need to properly manage large amounts of debris, poles, cabling, electronics, steel etc.

258. Table 13 shows estimated replacement periods for BESS components.

Table 13: Estimated replacement period for BESS components

Component	Estimated replacement period (years)
BESS Battery Racks (including modules and switchgear):	10
DC/AC Inverter:	10-15
Transformer 1 kV - 22 kV:	25-40
Other Power Electronics	10
Battery Building	60 years or if it will be containerised then ~20 years with maintenance

[41] Electric Power Technical Standards. Specific Requirements for Transmission and Distribution Facilities (2006). MIME

259. Potential environmental impacts are considered *insignificant* due to the limited nature and scale of proposed infrastructure, the lack of sensitive receptors within the project areas of influence and available mitigation opportunities:

i) Construction activities will occur in areas considered modified and where power distribution infrastructure is generally already present;
ii) Impacts to environmental aspects and receptors will be mitigated through the EMP and CEMP;
iii) No protected areas or significant natural habitats will be impacted;
iv) Occupational and community risks will be mitigation through the development and implementation of management plans;
v) Detailed design will ensure alignments avoid sensitive receptors; and
vi) Road access exists to many subproject sites.

a. Generation of Used Batteries

260. The operation of the BESS will use lithium-ion batteries for storing energy which has a service life of around 10 years. Owing to the composition of the batteries, there are still valuable components that has potential for recycling. Currently, there is no battery recycling company in the country that could take the used batteries at end of life or at decommissioning. To properly manage batteries at end of life, a temporary storage area for used batteries will be designated at the BESS site. Tender agreements with battery suppliers / vendors will be made for a “buy back” option of the used batteries. The process of storage, transport and disposal shall be reported to MOE by EDC in accordance with the Standards for Hazardous Waste Management under Sub-Decree 36.

VI. ALTERNATIVES

261. Alternative options associated with the proposed Project include siting, technology, design, and operation, and a ‘no project option’.

262. **Site selection** Preliminary site assessments were conducted in November and December on subproject sites identified by EDC.

263. The location of BESS was changed to the ADB National Solar Park as EDC requested utilization of space available at this site. EDC voiced concerns that the original GS6 site currently supports many different energy sources that could cause technical issues with power distribution. The location is also beneficial as it can enhance the photovoltaic smoothing service and therefore enable more efficient interconnection to the transmission.

264. Where feasible, state or public land was preferred to reduce potential land acquisition and socio-economic issues.

265. **Route selection** A drone survey along the proposed transmission line spanning from Samaki Meanchey to Kampong Tralach was undertaken to determine presence of sensitive receptors. The drone survey highlighted presence of sand mining operations, settlements, water bodies and agricultural land. During the detailed design stage, any sensitive receptor such as schools, hospitals, community areas, temples, pagodas, churches and community areas will be avoided.

266. **Energy storage.** The BESS component of the Project will use lithium ion batteries, a preferred alternative to lead-acid batteries. Lithium ion batteries have successfully been operated in various climates and conditions worldwide. Lithium ion batteries provide higher power and energy density than lead-acid batteries and therefore occupy less space.

267. Currently a standard battery recycling commercial proposition does not exist in country and therefore at end of life of the battery, or at decommissioning phase, provision in tender agreements with battery suppliers / vendors will be made to ensure safe battery collection, recycling and/or disposal, as needed. Compliance with the requirements of MOE with regards to safe storage of used batteries prior to collection by the supplier/vendor will be implemented by EDC.

268. **No-project option.** This assessment highlights that insignificant, short term and minor impacts may occur during construction, many of which will be mitigated through the correct administration of the EMP. As such, the no-project option is not considered an adequate solution as it is determined that proceeding with grid reinforcement in Cambodia is necessary to promote economic development (including economic-diversification away from the main economic hub in the capital), poverty reduction and reduce power outages.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

269. On 18 and 19 November 2019, EDC conducted preliminary consultations with government stakeholders to introduce the proposed project and to solicit their views and suggestions. During the consultation, the participants suggested that the project should be aligned with the Energy Development Master Plan of Cambodia.

270. A series of public consultation meetings were held between 23rdJanuary and 4th February 2020 at 13 locations shown in Table 14. A total of 219 persons, representing the communes where the transmission lines and substations are located, attended the public consultation meetings. Public consultations were also held at the proposed location of BESS. Public consultations were designed to provide an opportunity to outline project intentions, activities and to provide a platform with which local community members and local stakeholders could voice any project related queries or concerns.

271. Each consultation was attended by representatives from EDC and ADB who disclosed information relating to technical, social and environmental aspects of each subproject.

272. The following environmental aspects were discussed:

i) What is an environmental impact?
ii) ADB Safeguard Policies (SPS 2009)
iii) ADB project impact categories
iv) Objectives of IEE
v) Environmental assessment methods
vi) Potential subproject impacts and mitigation measures
vii) Environmental Management Plan (EMP).

Table 14: Summary of public consultation schedule and attendees

N°	Commune / District / Province	Subproject	Venue	Dates and Time	Number of Participants		
					Total	M	F
1.	Chong village, Sambour commune, Batheay district, Kampong Cham province	New 230/22 kV Thnal Keng substation	Pagoda (Chhong village)	17th January 8 AM – 11 AM	32	29	3
2.	Soutip commune, Chheuong Prey district Kampong Cham	New 230/22 kV Skun substation	Health Center	17th January 1:30PM – 04:30 AM	25	24	1
3.	Tbeng Khpos commune, Samaki Meanchey district, Kampong Chhnang province	New 230/115/22 kV Samaki Meanchey substation	Kduoch Pagoda	20thJanuary 8 AM – 11 AM	22	8	14
4.	Sedthei commune, Samaki Meanchhey district, Kampong Chhnang province	115 kV transmission line from proposed Samaki Meanchey sub-station to proposed Kampong Tralach substations	Sedthei commune hall	20th January 2020 1.30 PM – 4.30 PM	44	34	10
5.	Thlork Vien commune Samaki Mean Chey district, Kampong Chhnang province		Thlork Vien commune hall	21st January 8 AM – 11 AM	31	25	6
6.	Soben village, Peani commune, Kampong Tralach district, Kampong Chhnang province	New 115/22 kV Kampong Tralach substation	Peani commune hall	21st January 2020 1.30 PM – 4.30 PM	67	43	24
7.	Khan Meanchey, Phnom Penh	New 115/22 kV Boeung Tompon substation	Khan hall	23rd January 2020 1.30pm-4.30pm	18	17	1
8.	Sangkat Tuol Tompon II, Khan Chamkamon, Phnom Penh	115 kV transmission line from proposed Boeung Tompon sub-station to Olympic substation	Sangkat office	28th January 2020 8 AM-11 AM	24	19	5
9.	Khan Boeung Keng Kang, Phnom Penh		Boeung Keng Kang hall	29th January 2020 8 AM-11 AM			
10.	Khan Russei Keo, Phnom Penh	115 kV transmission line from proposed Sen Sok sub-station to Russei Keo substation	Khan hall	23rd January 2020 8AM-11AM	38	32	6
11.	Khan Sen Sok, Phnom Penh	New 230/115/22 kV Sen Sok sub-station	Khan hall	28th January 2020 1.30pm-4.30pm	64	56	8
		230 kV transmission line					

N°	Commune / District / Province	Subproject	Venue	Dates and Time	Number of Participants		
					Total	M	F
		from GS5 sub-station to proposed Sen Sok sub-station					
		New 115/22 kV RUPP substation					
12.	Sangkat Prateah Lang, Khan Kambol, Phnom Penh	New 230/115 kV Kambol substation	Sangkat Prateah Lang office	4th February 2020 8AM-11AM	48	26	12
13	Trapeang Sab, Kandal Province	New 230/115/22 kV transmission line	Village hall	23rd February 2020	69	38	31
Total					152	57	0

273. **Public consultations feedback.** Those in attendance were encouraged to provide their views and opinions of, *inter alia*, project design, potentially sensitive areas, impacts and mitigation. Table 15 summarizes comments made by participants during each public consultation.

Table 15: Highlights of feedback from participants during public consultations

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
SKC3	New 230/22 kV Thnal Keng substation	Previous power project grid affected their land and tree and compensation was not applied	This substation only requires 2ha of paddy land and compensation will reflect market price.	Compensation to be conducted in a timely manner in line with LARP
		Can we get electricity directly from proposed transmission line?	No, this not possible. Power will be distributed to homes using the high-voltage TLs and substations and then through the distribution lines.	EMP provisions for community awareness programs throughout project implementation with specific community health and safety training and leaflet distribution
		Under transmission lines, can we create fishponds, grow rice or build structures?	Yes- Land owners can cultivate rice and build ponds. Buildings or any structures are not permitted to be constructed.	Signage installed (in Khmer) reflecting EDC standards and to highlight electrical hazards
		How high will the TLs be strung?	TLs will be strung 4.5 m above the ground	Design standards
		Approximately 70% of participants use smart phones	Acknowledged	GRM
		No protected forest, community areas or water bodies are located in the AOI protected area or natural lake in this commune?	Acknowledged	None required
SKC4	New 230/22 kV Skun substation	This project is very important as the current price of power is very high.	If the government issues new pricing system, the private enterprise needs to comply. If non-compliance occurs, EDC will become the operator.	None Required
		When the proposed substation is operating will power/electricity be more stable?	BESS system will be piloted to improve grid stability	GRM
		After substation construction, will the local electricity supplier be changed?	EDC is also enterprise but belong to government while private enterprise has license approval with operating period.	None required
		During previous construction another contractor damaged a public road. Will the new contractor repair the road to its previous condition?	If there is damage to the public infrastructure, such as roads, the contractor has to repair or rehabilitate to original condition (before operation) in line with ADB SPS 2009.	Rehabilitation will be outlined in the EMP and reflected in contractor contracts

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
		What are differences between hydropower and grid substation?	Hydropower is power source where electricity/power is generated from flowing water, and a substation is a facility that can decrease or increase voltage.	None required
		Will ADB approve the loan?	After consulting teams submit required documents, the ADB board will make decision on loan approval.	None required
		There is no natural forest or protected area in this commune.	Acknowledged	None required
		There are several natural lakes in the commune such as Chhroy lake, Khloy lake, Chhreung lake and Prek lake and they are 6-7 km away from the proposed site.	Outside of AOI	None required
		Approximately 70% of participants use smart phone	None required	GRM
SKC1	New 230/115/22 kV Samaki Meanchey substation and transmission line	Fruit trees were previously cut without compensation during the construction of a low voltage transmission line along the road.	ADB-funded project requires project owner compensating on types and scale of impacts based on market price.	Compensation to be conducted in a timely manner in line with LARP
		There are no sensitive environmental or cultural receptors in the commune.	Acknowledged	None required
		Approximately 60% of participants use smart phone	None required	GRM
TKC1	Sethei Commune New 11.1 km 115 kV transmission line	Where will the TL be aligned and what compensation is available?	The compensation will be partial and full payment based on market price. Land price will be depending on location, proximity to road.	Compensation to be conducted in a timely manner in line with LARP
		There is no natural forest or protected area in this commune.	Acknowledged	None required
		Approximately 80% of participants use smart phone	None required	GRM
TKC1	Thlok Vien Commune New 11.1 km 115 kV	Villagers have complained to local authorities regarding private electricity companies who operate that have affected trees	EDC provided a complaint mechanism.	GRM will be activated and compensation process will be conducted in a timely manner in line project LARP

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
	transmission line	and houses without compensation or consultant		
		When the project is implemented, will local electricity supplier be replaced?	Power will remain as long as they are granted a license.	None required
		There is no forest or protected area in the commune. There are some natural lakes and they are about 7km from the transmission line	Acknowledged	None required
		The major environmental issue is plastic waste.	Acknowledged	None required
		Approximately 80% of participants use smart phone	None required	GRM
SKC2	Peani Commune New 115/22 kV Kampong Tralach substation	There is no natural forest or community protected areas in the commune.	Acknowledged	None required
		What activities can be conducted under the TL?	Rice farming or growing vegetable is permitted under transmission lines, but constructing building or growing tress is not permitted under transmission line.	Signage installed (in Khmer) reflecting EDC standards and to highlight electrical hazards
		How far from the foundation of the transmission pole that is allowed for rice farming?	Dimensions of 15 m x15 m are likely to be required for foundations, vegetables or rice can be grown nearby.	Signage installed (in Khmer) reflecting EDC standards and to highlight electrical hazards
		Commune Chief requested future consultation to discuss project impacts with affected households	Future consultations will be scheduled and disclosed	Future consultation schedule to be organized with commune. Compensation to be conducted in a timely manner in line with project LARP
		Can the TL be adjusted to avoid houses?	Transmission alignment to be designed to avoid sensitive receptors (i.e. households, schools, hospitals, and PCRs) wherever possible	

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
		Approximately 90% of participants use smart phone	None required	GRM
TPP2	New 2.44 km 115 kV transmission line to Russei Keo substation	Is transmission line installed through overhead or underground?	There will be overhead transmission line and underground transmission line. Overhead transmission lines will be installed along storm canal in the public ROW. Underground transmission lines will be installed in more densely populated areas.	Information disclosure
		What impacts are likely from UGC?	Temporary noise, traffic and dust are anticipated	Dust and noise mitigation to be outlined in EMP. Night works will be scheduled to reduce traffic impacts
		The proposed project should be assessed for short- and long-term impacts to ensure sustainability and to prevent community impacts.	Acknowledged	Impacts will be outlined in EMP along with appropriates mitigation methods.
		Underground transmission line should be installed at the middle of the road, not on the right of way or roadside.	Acknowledged	Detailed design stage
		The major environmental issue in Khan Russei Keo is solid waste. Waste collection does not function well and local people do not pack waste and dump waste properly.	Acknowledged	None required
		Approximately 90% of participants use smart phone	None required	GRM
SPP4	Khan Meanchey New 230/115 kV Boeung Tompon substation & transmission line	Consider adjustment of transmission line to traverse across other government land	Forward request to engineering and design team. All will comply with national standards.	Detailed design stage
		Will there be any negative impacts on households along the transmission line?	OHL will be installed on state land. Minimum clearance standards will be applied in line with EDC standards	None required

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
		Has EDC got any local EIA consulting firm to conduct assessment on the proposed project yet?	The EIA consulting will be hired once the loan is approved. EDC has studied installing underground.	EIA company will be selected after detailed design
		Has EDC conducted any study on underground transmission lines? Any impacts?	Any further studies required will be conducted during the IESIA	None required
		Does existing transmission lines near the Mean Chhey Hall have any impacts to local people who are living nearby?	Transmission will be constructed along channel to minimize impacts.	None required
		Traffic issues are already apparent in the area	Acknowledged	Traffic management plan will be developed by the contractor
		Project should work closely with local authorities to resolve all issues collectively.	Future consultation will be scheduled	Future information disclosure consultations will be scheduled and shared
		Approximately 90% of participants use smart phone	None required	GRM
TPP3	Sangkat Toul Tompon 2, New 4.4 km 115 kV transmission line to Boeung Tompon substation	Which side of Street 173 will the TL be constructed?	This will be finalized during detailed design stage although it is likely that UGC will be utilized.	None required
		Which type of transmission line will be installed?	This will be finalized during detailed design stage	None required
		Contractor should strictly adhere to EMP and monitoring should be applied	Acknowledged	GRM
		Approximately 90% of participants use smart phone	None required	GRM
SPP2	New 230/115/22 kV Sen Sok substation	Is there any impact from the transmission line?	Along open space or channel, overhead transmission line will be installed as building is now allowed to construct within 7.5m from the transmission line. Underground transmission line will be constructed at crowded area where safety is the most priority as well as landscape in the centre of city.	Impacts will be mitigated at detailed design stage

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
		Who will responsible for compensation on the social impacts (resettlement, livelihood and so on)?	There is a policy of the ADB to require project owner (EDC) or country member (Royal Government of Cambodia) responsible for compensation based on fairness, transparency and market value.	LARP
		Project owner should consider and address comments or suggestion from local authorities	Acknowledged	GRM and information disclosure
		Suggest installing underground transmission line as much as possible to minimize the impact, especially in Kouk Khlang commune.	Acknowledged	None required
		No major environmental issues in the area	None required	None required
		Approximately 90% of participants use smart phone	None required	GRM
TPP3	Khan Boeung Keng Kong New 4.4 km 115 kV transmission line to new Olympic substation	Suggest to EDC to inform us about exact construction plan in advance before actual construction taking place.	Acknowledged	GRM and information disclosure
		Is transmission line installed through overhead or underground? If transmission line is installed underground, is there any impacts to local people?	There will be overhead transmission line and underground transmission line; overhead transmission line will be installed along channel or on the ROW away from to residence houses. Underground transmission line will be installed at crowded area to ensure safety. The underground transmission line costs two to three times more than overhead transmission line.	GRM and information disclosure
		Will the contractor repair to original conditions?	The ADB-funded project requires project owner to look carefully on contractor's performance and rehabilitation/restoration of disturbed area after construction.	GRM and information disclosure

Area	Location	Participants Concerns	Feedback from EDC and Safeguard Experts	EMP Response
		How long the construction will take place? The underground line will fall which side of the road? How big is the underground installation?	Since it is an initial phase of assessment, the construction period for each location has not been planned yet.	GRM and information disclosure after detailed design stage and contractor award
		How will emerging issues be resolved during construction? Will there be contact numbers available?	GRM will be activated and contact numbers will be made available.	GRM and information disclosure
		Benefits of Project?	Ensure stability of electricity supply in the area, so economic activities will be increased as well.	None required
GRM and information disclosure SPP1	New 230/115 kV Kambol substation	Clarify where is location propose substation?	The current project will require 4ha of land and located in paddy land.	GRM and LARP
STK01	New 230/115/22 kV Samroang Yoang SS	If so, is there any impact? If we grow rice near the sub-station, is there any impact? .	People can grow rice on their land near the sub-station safely as long as people do not get inside the sub-station.	GRM and information disclosure
		Which specific location of substation?	EDC Consultant presented the location of proposed two options, i.e. (i) in Prech village and (ii) in Ar. Cheang village.	None required
		Is there any wastewater discharge/flow from the sub-station?	None	None required
		No protected areas	Acknowledged	None required
		Localised flooding occurs in wet season	Acknowledged	Mitigation will be applied during detailed design stage

274. **Initial environmental examination disclosure.** This IEE report will be disclosed on the ADB website (www.adb.org). A Khmer summary will also be posted on the EDC website (www.edc.com.kh), along with a link to the full report on the ADB website. A Khmer translation of the report and the EMP will be made available as hard copy at the EDC Provincial Offices. The updated IEE report with EMP based on detailed design will also be disclosed at ADB website.

275. **Preparation of bid documents.** The EMP and specific environmental conditions of contract will be included in the bidding documents and are shown in Table 16.

Table 16: Activity Outline for Consultation Plan

Project Implementation Schedule	Activity	Stakeholders
Design Phase	Public information meetings Informal meetings for information updates on project schedule and activities through village leaders and commune councils Update of PIB / FAQ Community Awareness Program one month prior to civil works	Affected people, communities, commune and district leaders
Construction Phase	Informal meetings for information updates on project schedule and activities through Village leaders and commune councils Monthly consultations to validate presence of complaints and community disturbance and concerns. Public information meetings as needed Community Awareness Program once during civil works PIB / FAQ made available at consultations, project construction field offices and commune	
Operation and Maintenance	Project information booklet distributed to all subproject communities	

VIII. GRIEVANCE REDRESS MECHANISM

276. Grievance Redress Mechanism (GRM) is a systematic process for receiving, evaluating and addressing an AP's project-related complaints. The grievance redress procedure will comply with the requirements of ADB SPS (2009) in addressing people's concerns and complaints promptly and in a transparent manner.

277. The objective of GRM is to resolve any disagreements and conflicts as early and quickly as possible and at the local level through a reconciliation process, and if that is not possible, to provide clear and transparent procedures for appeal. If the affected people filing complaints will not be satisfied with the outcome of the GRM, they may also resolve the issue through the Cambodian legal system (see Step 4 below).

278. EDC will ensure through public consultation meetings in the project areas and through a project Information Booklet distributed to project locations to ensure APs are fully aware of their rights to complain and about the grievance redress mechanism. Any party who is affected by impacts related to the project construction and operation, is eligible to file a complaint.

279. Access points to the GRM are a critical pathway to ensure APs can access the GRM mechanism. Access points for this project will consist of:

i) EDC's Feedback Office
ii) EPC Contractor
iii) District and Commune Offices
iv) PIC/PMU
v) Provincial Department.

280. The existing complaint management mechanism that is in place at EDC will be adopted wherein a complaint may either be relayed to the Feedback Office of EDC or directly to the PMU or EPC Contractor. Complaints about project implementation can also be received through the district and commune offices and provincial department. Full details of the GRM, its access points and responsible parties can be found in the EMP.

281. During public consultations participants were asked for their preferred grievance mechanisms. Information obtained during consultations suggested that between 70-80% of community members had access to a smart phone and therefore online messaging through the EDC Facebook page can easily enable the GRM. The EDC Feedback Office, which is composed of 26 staff members, of whom 8 are female staff, can then immediately forward the complaint to the responsible unit at EDC, i.e. PMU so that the complaint can be acted upon immediately.

282. In accordance with the GRM (see Environmental Management Plan), the PMU and SEPRO will be responsible for the day-to-day coordination and monitoring of the GRM across subproject locations to ensure the public are correctly informed of project activities and are aware of GRM focal points to raise any concerns/issues. PMU and SEPRO will be report on GRM in periodic monitoring reports to be submitted to ADB.

A. Environmental Management Plan

283. The Project EMP identifies potential environmental impacts arising from the project along with corresponding mitigation measures and institutional arrangements for implementing the EMP and monitoring to ensure its effectiveness.

284. The EMP is designed to ensure potential impacts are reduced to insignificant levels and that international best practice are applied at each Project stage. Key project based EMP considerations include mitigation of potential adverse impacts to the level of "no significant harm to third parties", the polluter pays principle, the precautionary approach, and adaptive management (footnote 1).[42]

285. Detailed engineering designs are yet to be finalized and therefore the EMP may require subsequent revision.

[42] Environment, Health and Safety Guidelines for Electric Power Transmission and Distribution (2007) IFC

286. The EMP will be made available in Khmer to potentially affected communities and stakeholders on request. Implementation of the EMP will be monitored and periodically reported.

287. The draft and final EMP will be disclosed on the ADB website (www.adb.org). The final EMP will be included as a separate annexure in all bidding, tender and contract documents. Contractors will be informed of their obligations to implement conditions set out in the EMP and are required to include EMP implementation costs within the EPC contract. The EPC will prepare detailed engineering designs and implement civil works, although any revision of EPC contracts due to updated IEE/EMP from PIC will need to be cleared by ADB prior to no objection to civil works.

1. Institutional Arrangements and Implementation Responsibilities

288. **Executing agency.** The EDC will be the executing agency responsible for overall supervision, coordination, monitoring, and reporting of various project activities and implementation. EDC will be responsible for the following: (i) provide PMU with sufficient staff and appropriate qualification; (ii) ensure safeguards planning document is compliant with the loan and grant covenants; (iii) provide counterpart staff, operational support and budget for project activities.

289. **Project management unit.** PMU will be responsible for the day-to-day project management and supervision of the project and will include the following responsibilities: (i) responsible for implementing project in accordance with the legal agreements, (ii) for coordinating with line ministries to ensure efficient implementation of the project, (iii) procurement of goods, works and services, (iv) secure technical and safeguard approvals for all civil works prior to contract award, (v) ensure compliance with all loan and grant covenants (vi) prepare and submit reports, including submission of summary of financial and project accounts and annual financial statements to the Ministry of Economy and Finance.

290. **SEPRO.** Collectively PMU and SEPRO will ensure compliance with ADB safeguard requirements and consistency of safeguards documents with the government policy, legal and administrative framework across all jurisdictions--national, state and local. PMU and SEPRO will be responsible for: (i) coordinating with EDC province/district offices to assign a focal person for safeguards and grievance redress committees/focal persons at all levels, (ii) management of national initial environmental impact assessment (IEIA) approval process including engagement of MOE registered firm, (iii) obtaining Environmental Protection Contract prior to contract award, (iv) coordinating with EDC province/district offices safeguard focal to disclose and disseminate information, conduct ongoing public consultation, manage grievance redress mechanism at all levels, (v) establishing and functionality of the project-specific grievance redress mechanism, (vi) implement safeguards requirements detailed in the safeguard documents, (vii) engaging with independent external third-party to document the negotiation and settlement processes, in case of negotiated land acquisition (third-party verified due diligence reports [DDRs]), (viii) implementing LARP before commencement of civil works, and for ensuring any civil works start strictly on land free from encumbrances upon ADB's no-objection, (ix) updating the draft RDDRs based on the detailed engineering design and submitting RDDRs and DDRs for ADB concurrence and disclosure before commencement of civil works; and (x) timely submission of semi-annual safeguard monitoring reports to ADB.

291. **Project implementation consultants**. In coordination with the PMU of EDC, the PIC will be responsible for: (i) procurement process/implementation and contract management, (ii) supervision of construction, final testing and commissioning, (iii) supporting EDC (SEPRO) in

managing IEIA approval process, (iv) supporting EDC (SEPRO) in updating RDDRs and submitting to ADB for concurrence and disclosure before commencement of civil works, (v) supporting EDC (SEPRO) in implementing final LARP and submitting implementation compliance report to ADB before commencement of civil works, (vi) ensuring compliance with safeguards requirements through effective implementation and monitoring of social and environmental safeguards, and (vii) Project performance monitoring and evaluation, including preparation of progress reports, semi-annual safeguard monitoring reports, and report completion.

2. Reporting and Monitoring

292. The key institutions involved in the environmental management and monitoring of the project will be SEPRO, PMU and the PIC.

293. EDC/SEPRO, with support of PIC, will be responsible for environmental monitoring and reporting. An environmental monitoring report will be submitted to ADB semi-annually during the project implementation period. The environmental monitoring reports will be publicly disclosed on ADB website.

294. PC Contractor will be required to prepare and implement site specific CEMP in accordance with the EMP. EPC Contractors will submit monthly progress reports to EDC on EMP implementation, which will inform summary of safeguards and GRM implementation to be included in quarterly project progress reports submitted to ADB. The environmental management report will identify the work undertaken over the reporting period and document the environmental protection measures that have been carried out, problems encountered (if any), and follow-up actions that were taken (or will be taken) to correct any problems.

295. The PIC will be responsible for environmental monitoring. The PIC will coordinate and interact with the PMU on compliance to ADB safeguards requirements and with relevant government agencies and local authorities on permits and clearances as needed, update and finalize the draft IEE as needed. The PIC will also be responsible in handling complaints and/or grievances filed through the Grievance Redress Mechanism (GRM), if any.

296. The PMU and PIC will ensure that Contractors will be informed of their responsibility of complying with the EMP and the ADB safeguards requirements. The PIC will monitor each Contractors work plan relevant to EMP implementation and be responsible for the overall compliance supervision.

297. During the operational phase, SEPRO will be responsible for undertaking routine monitoring, reporting and resolution of environmental health and safety issues. All monitoring and reporting activities will be sustained by EDC to ensure that mitigation measures are effectively implemented.

3. Training and Capacity Building

298. SEPRO representatives have extensive experience of power and energy projects varying in scale and complexity. This experience has come from working alongside multiple development partners (i.e. ADB, World Bank, and JICA). Such project interactions necessitated SEPRO staff to attend various trainings that previously covered environmental and social project requirements, namely: public consultation, information disclosure, GRM, and technical, safety and regulatory procedures and standards.

299. SEPRO has a total of 19 staff members. Within the team, there are dedicated members that focus on the environment (4) and social (5) aspects of projects. Internal EDC policies continue to encourage staff to learn multiple skills and to attend training and courses to enable individuals to be competent across various project activities.

300. Training will be provided by PIC to PMU, SEPRO, and EPC contractors, and facility operators on EMP implementation and monitoring prior to start of construction. The training will focus on ADB's and Cambodia's relevant environmental, health and safety laws, regulations and policies; implementation of the EMP, environmental monitoring, requirements for information disclosure, public consultation and the project GRM. The PIC will also prepare the checklist for monitoring parameters and responsibilities and conduct consultations with affected people / households and communities together with the EPC contractors on ongoing basis during project implementation. Table 17 presents the capacity building and training program.

Table 17: Capacity Building and Training Program

Subject Matter	Participants	Trainer	Frequency	Duration (days)	N° of Participants	Estimated Cost (US$) / Source of Fund
Orientation training on safeguards focusing on Cambodia's EHS laws, ADB SPS, and EMP (defining the mitigation measures, roles and responsibilities for monitoring, supervision and reporting)	PMU, SEPRO, EPC Contractor	PIC (MOE to be invited)	Once prior to construction	2	40	US$2,160 / PIC
GRM implementation and disclosure	PMU, SEPRO, EPC Contractor	PIC	Once prior to construction / site mobilization	1	20	US$540 / PIC
Environmental monitoring and reporting	PMU, SEPRO, EPC Contractor	PIC	Once prior to construction	1	40	US$1,080 / PIC
SOP Manual implementation with hands-on training	PMU, SEPRO, Facility Operators	EPC Contractor	Once prior to commissioning	2	40	US$2,160 EPC Contractor
Refresher course on SOP Manual	PMU SEPRO, Facility Operators	EPC Contractor	One year after commissioning	1	40	US$1,080 / EPC Contractor

IX. CONCLUSIONS

301. The project is confirmed as environment category B as per ADB SPS 2009 and a draft IEE and EMP have been prepared. The project will comply with the Government Sub-decree N°72 on EIA issued on 11 August 1999. In accordance with these requirements, three IEIAs are required for subproject components and infrastructures grouped according to province. The IEIAs based on detailed engineering design will be submitted and reviewed by the Provincial Department of Environment (PDOE). Approval of the IEIAs by PDOE prior to commencement of works will be necessary.

302. Environmental benefits of the project include increasing people's access to a more stable energy supply, which is likely to reduce reliance on alternative energy sources such as batteries for energy or wood for cooking. The BESS pilot project will build capacity for deploying and operating energy storage technology whilst improving grid stabilization and power reliability. As such, the successful integration of BESS technology into Cambodia's energy portfolio will likely encourage supplementary investment into renewable energy solutions.

303. Potential adverse environment impacts associated with the project will be avoided or minimized through careful site selection of subproject infrastructure and transmission line alignment. More detailed assessment is proposed to inform the transmission line alignment and detailed design to minimize impacts on sensitive natural and human receptors, e.g. cutting trees of economic value (such as fruit bearing trees), water bodies, households, schools, and PCRs.

304. A combination of secondary information and drone, bat and bird surveys confirmed that there are no habitats or species of conservation value in the project area of influence. Further seasonal surveys of birds will be conducted to inform detailed design stage in relation to potential impacts on flyways.

305. Climate change impacts are not anticipated to be significant over the design life of project (>50) if detailed design integrates measures such as flood resilience (i.e. elevating transmission tower footings). The key climate vulnerable components will be subject to further analysis during the detailed engineering design.

306. Public consultations with project affected persons and other relevant stakeholders were conducted between November 2019 and February 2020. Measures to address concerns raised during the consultations will be integrated into the detailed design and EMP. Public consultations made stakeholders aware of the proposed project and were supportive due to expected benefits of an increase in reliable and stable power distribution. Consultations with project-affected stakeholders will continue during detailed design and project implementation.

307. Mitigation measures defined in this IEE and associated EMP will be updated based on final technical design and will be the responsibility of the PMU. The EMP will be incorporated into bid documents to EPC Contractor to include provisions for design, construction and operational environmental mitigation and monitoring measures. Revised documents will be submitted to ADB for approval and disclosed on ADB website.

Land uses along 11.1 km 115 kV Transmission Line from Samaki Meanchey to Kampong Tralach substations

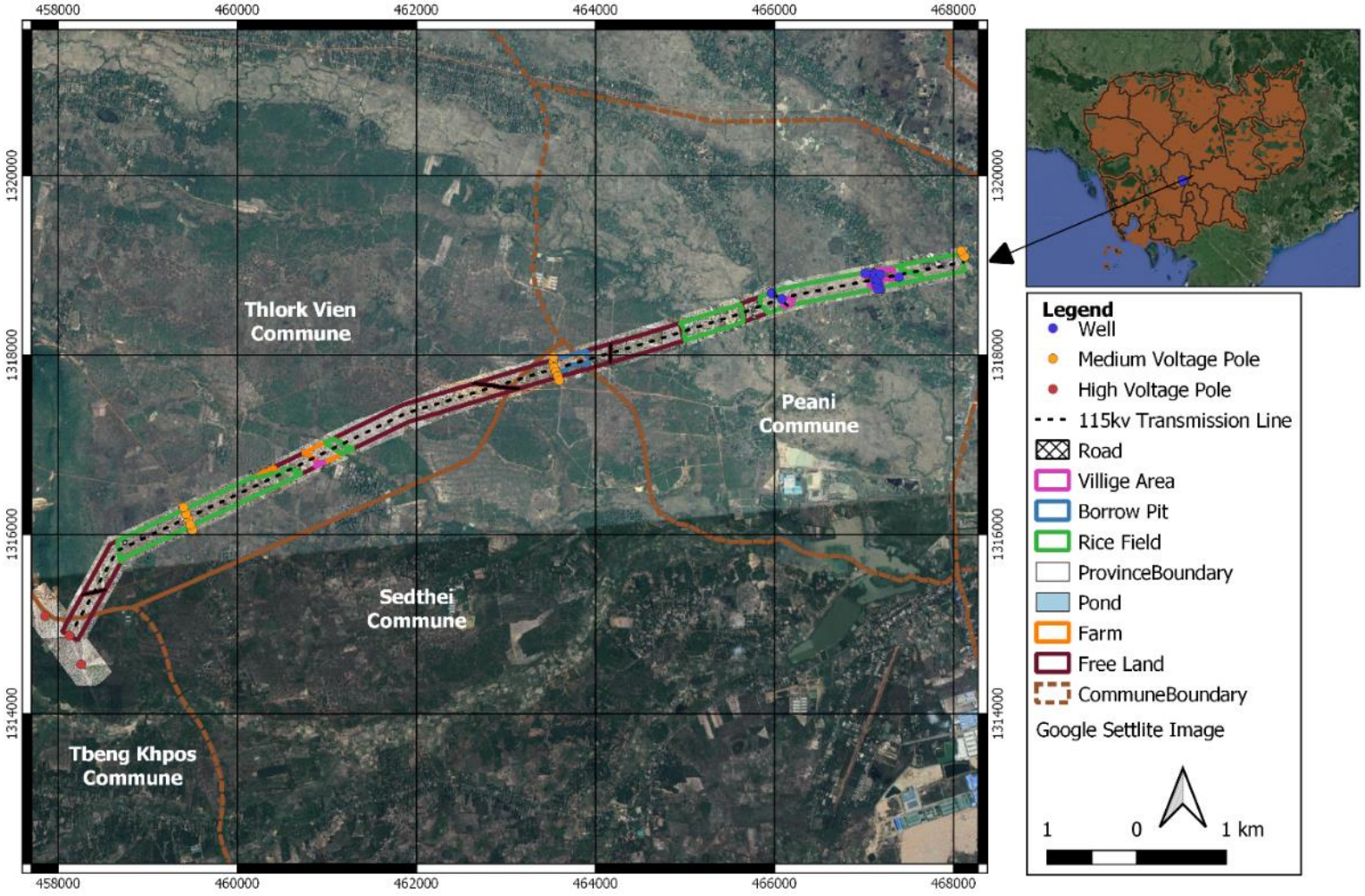

Figure 25: Land use within proposed ROW for transmission line

Drone image of sand mining operation along 115/22 kV transmission line

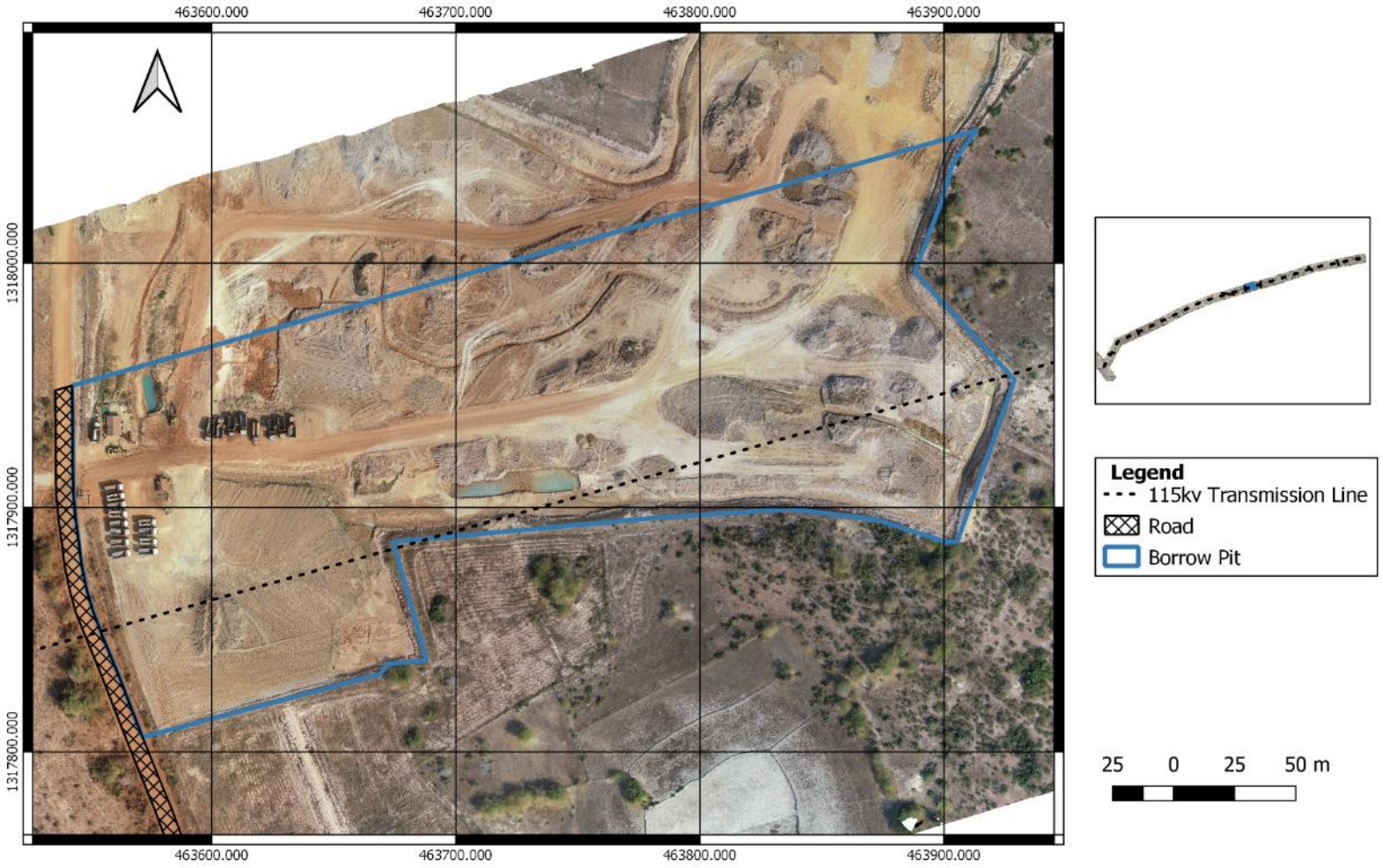

Figure 26: Drone image of sand mining / borrow pit operation. Extracted material was to widen National Road 5.

Documentation of Public Consultations
Date : 21 Jan 2020

Location : Peani Commune Office, Kampong Tralach, Kampong Chhnang

លរ No	ឈ្មោះ Name	ភេទ Sex	តួនាទី /មុខរបរ Position/Occupation	ស្ថាប័ន Organization	លេខទូរស័ព្ទ Phone Number	ហត្ថលេខា Signature
1					012483921	
2						
3						
4					097446446	
5					097457914	
6					092354809	
7					097954446	
8					097444925	
9					097212686	
10						
11						097656914
12						
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Stakeholder Consultations January 2020

Public Consultation Samaki Meanchey

Stakeholder meeting Soutip Commune

Public stakeholder meeting Russei Keo

Public stakeholder meeting Russei Keo

Public stakeholder meeting Kampong Tralach

Public consultation Chong Village

Photo Log

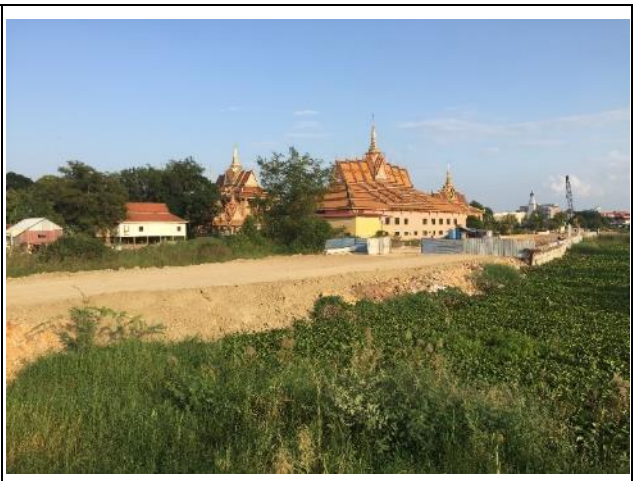
Phnom Penh – December 2020

Proposed alignment site for TTP3

Storm canal adjacent to TPP3 alignment

Proposed SPP4 substation site utlized as a waste dumping ground.

Proposed start of TTP3



Russei Keo River and link road construction

Phnom Penh Special Economic Zone

Proposed Dangkor substation location

Olympic Stadium substation site

Footing for substation at Olympic Stadium site

Kampong Chhnang / Kampong Cham – December 2019

Road access to proposed Samaki Meanchey substation site

Land for sale in proximity to TCCN1 transmission line

Propsoed Kampong Tralach (SKCN2 substation site

Surrounding area near Skun substation site

Propsoed substation site at Skun (SKPC2)

Surrounding landscpe of Thnal Kang substation site

Image illustrating asssociated facility (disatance) that SKPC1 will connect

Takeo Province - February 2020

Train line west of proposed Takeo substation site

Proposed Takeo substation site