

Initial Environmental Examination

March 2019

Cambodia: National Solar Park Project

Prepared by the Electricité du Cambodge, Government of Cambodia for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 4 March 2019)

Currency unit	–	riel (KR)
KR1.00	=	\$0.00025
\$1.00	=	KR3,991

ABBREVIATIONS

ADB	Asian Development Bank
CEMP	Construction Environmental Management Plan
CCOF	Climate Change Operational Framework, ADB
CRVA	Climate Risk and Vulnerability Analysis
EDC	Electricite du Cambodge
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electric and Magnetic Fields
EMP	Environmental Management Plan
EMOP	Environmental Monitoring Plan
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan
GHG	greenhouse gas
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
IBAT	Integrated Biodiversity Assessment Tool
IPP	Independent Power Producer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEE	Initial Environmental Examination
ILO	International Labor Organization
IUCN	International Union for Conservation of Nature
LARP	Land Acquisition and Resettlement Plan
MAFF	Ministry of Agriculture, Forestry and Fisheries
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
PAM	Project Administration Manual
PCR	Physical Cultural Resources
PIC	Project Implementation Consultant
PPA	Power Purchase Agreement
PDoe	Provincial Department of Environment
PMO	Project Management Office
PPE	Personnel Protective Equipment
PV	photovoltaic
REA	Rapid Environmental Assessment
ROW	Right of Way
SEPRO	Social, Environment and Public Relations Office
SCADA	Supervisory Control and Data Acquisition
SPS	Safeguard Policy Statement
STD	Sexually Transmitted Disease
TA	technical assistance

TAS	Transaction Advisory Services
TOR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
UXO	Unexploded ordinance
WHO	World Health Organization

WEIGHTS AND MEASURES

dBa	–	A-weighted decibel
km	–	kilometer
km ²	–	square kilometer
ha	–	Hectare (10,000 square kilometer or 2.47105 Acre)
LAeq	–	Equivalent Continuous Level 'A weighting' - 'A'- weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies
m	–	Meter
°C	–	Degree Celsius
PM10	–	Particulate Matter 10 micrometers or less
PM2.5	–	Particulate Matter 2.5 micrometers or less
µg/m ³	–	Microgram per cubic meter
kV	–	Kilovolt (1,000 volts)
kW	–	Kilowatt (1,000 watt)
MW	–	Megawatt (1000 kilowatt)
GWh	–	Gigawatt-hour
MVA	–	Megavolt Amperes

GLOSSARY

District	–	Sub-divisions of the 24 provinces in Cambodia
Commune	–	Sub-divisions of districts

NOTE

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

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EXECUTIVE SUMMARY

A. Introduction

1. The National Solar Park Project (“Project”) will support Electricité du Cambodge (EDC) in constructing a 100-megawatt (MW) capacity solar park and associated pooling substation in Kampong Chhnang province and a transmission interconnection infrastructure to the Phnom Penh demand center to supply power to the national grid. The project will also assist EDC to design and conduct a competitive tender for procuring the first solar photovoltaic (PV) power plant within the solar park.

2. The project is the first of its kind in Cambodia and builds on lessons learnt from ADB Private Sector Operations Department’s financing of a 10 MW solar power plant at Bavet, Svay Rieng Province in 2016. Building on the Bavet project, this project aims to demonstrate the ability of large-scale solar parks to produce solar energy at a competitive price while also providing technical benefits to the national grid¹ and substitute for planned fossil fuel and hydropower generation in the future. This project will build appreciation for the costs, operational requirements and actual performance of solar PV plants. It will also inform further policy development and give EDC knowledge and experience of structuring a transparent, competitive procurement for private sector-led power projects and negotiating with private developers. These early projects will also build experience among grid operators on management of the variable power produced by solar PV projects.

3. The government’s Rectangular Strategy, Phase IV (2018–2023), highlights increased investment in solar energy to reduce electricity costs and ensure long-term energy security.² The government has also prioritized the development of renewable energy in its National Strategic Development Plan 2014–2018 in order to meet the growing demand for electricity in Phnom Penh and address the country’s electrification target of 100% of villages by 2020.³ In addition, the government’s Industrial Development Policy 2015–2025⁴ identifies the historically high power tariffs in the country as a major impediment to the competitiveness of the country’s manufacturing sector, and calls for alternate sources of energy to be developed. Furthermore, Cambodia’s Nationally Determined Contribution, enshrined in the 2015 Paris Agreement⁵, commits to a 16% reduction in greenhouse gas (GHG) emissions from a business as usual scenario by 2030 from the energy sector.⁶ Ideally, alternate, clean sources of energy would complement installed and planned hydropower-based generation, which is often inadequate during the dry season, as well as help provide ancillary benefits to the grid around the key demand centers.

B. Project Organizational Structure

¹ Technical or ancillary benefits include: (i) voltage support during peak loading periods, (ii) reduction of loading levels on transformers, (iii) and reduction of the amount of power that needs to be generated from distant sources (hydro and coal, in particular) and therefore reduction of losses in the transmission system.

² Government of Cambodia. 2018. *Rectangular Strategy for Growth, Employment, Equity and Efficiency: Building the Foundation Toward Realizing the Cambodia Vision 2050, Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly*. Phnom Penh.

³ Government of Cambodia, Ministry of Planning. 2014. *National Strategic Development Plan, 2014–2018*. Phnom Penh, Government of Cambodia. 2013. *Rectangular Strategy for Growth, Employment, Equity and Efficiency, Phase III of the Royal Government of Cambodia of the Fifth Legislature of the National Assembly*. Phnom Penh.

⁴ Government of Cambodia. 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

⁵ The Paris Agreement entered into force on 4 November 2016.

⁶ Government of Cambodia. 2015. *Cambodia’s Intended Nationally Determined Contribution*. Phnom Penh.

4. EDC will be the executing agency responsible for overall project implementation and compliance with loan and grant assurances and the Project Management Office (PMO) of the EDC will be the Implementing Agency responsible for the day-to-day coordination. The PMO will be supported by the Project Implementation Consultant services (PIC) 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 and ensure consistency of all safeguards documents with government policy, legal and administrative framework.

5. EDC will own, operate and maintain the solar park and all common infrastructure, including the transmission interconnection, installed under the project. EDC will tender the solar PV plants to private sector Independent Power Producers (IPPs) and execute long-term power purchase agreements (PPAs). The project will be implemented in two phases; Phase I will tender a 60 MW solar PV plant while Phase II will procure the remaining capacity. The ownership and the responsibility for operating and managing the solar PV plants will be with the IPPs.

C. Project Location

6. The solar park is located in Tuek Phos district of Kampong Chhnang province. The transmission line will run through Sameakki Mean Chey district in the Kampong Chhnang province and Thpong and Odongk districts in Kampong Speu province. The existing grid substation 6 (GS6) is located in Odongk district in Kampong Speu province (see Figure 1.1)

D. Project Impacts, Outcome and Outputs

7. The project is aligned with the Government's stated impact of lower electricity cost in Cambodia.⁷ The project outcome will be increased private sector investments in solar PV in Cambodia. The project will have the following outputs:

- (i) **Output 1: Solar park and transmission interconnection constructed.** The project will support EDC in constructing a 100 MW solar power park in Kampong Chhnang Province and a transmission interconnection system to grid substation 6 (GS6) near the Phnom Penh demand center to supply power to the national grid. The park will initially consist of 100 hectares (ha) of land; associated construction works (i.e., fencing, roads, and drainage systems); common facilities; and supporting infrastructure to accommodate 60 MW of solar PV plant capacity. The transmission interconnection infrastructure comprises (i) the 100 MW capacity pooling substation at the solar park, with two 50-megavolt-ampere transformers (and room for two additional transformers); switchgear; an ancillary system; and controls; (ii) a supervisory control and data acquisition system compatible with EDC's requirements, advanced forecasting tools, and expanded information and communication technology applications; (iii) a dedicated 40-kilometer 230-kilovolt double circuit overhead transmission line between the solar park substation and GS6; and (iv) two new bays with switchgear at GS6.⁸

⁷ Government of Cambodia. 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

⁸ EDC is considering a 10 MW (2-hour) battery storage system for output smoothing to counterbalance intermittent solar power generation. ADB is applying for grant funds to support this component; if available, they will be processed as additional financing. The transmission line will be rated at 230 kilovolts but will be initially operated at 115 kilovolts.

- (ii) **Output 2: Capacity of Electricite du Cambodge in solar power plant construction and operation, project design and supervision, grid integration and competitive procurement strengthened.** The project will strengthen EDC's capacity to design, construct, and operate solar PV plants and solar parks (including management of environmental and social safeguards issues). The project will also strengthen EDC's capacity to procure competitively bid independent solar PV plants and to adopt energy storage systems and other measures to integrate intermittent renewable energy into the national grid.

Under the ongoing transaction advisory services (TAS) agreement that has been signed between the two institutions, ADB's Office of Public-Private Partnership is assisting EDC to design and conduct a competitive tender for procuring the first power plant to be built by the private sector and located within the park.⁹ As transaction advisor, ADB is performing project due diligence (including legal, technical, financial, environmental and social due diligence), preparing the feasibility study,¹⁰ assisting the development of tender documents and long-term power purchase agreements, and supporting the review and selection process.

E. Project Design

8. **Climate Resilience.** A climate risk and vulnerability analysis (CRVA) has been carried out for the project and the project is classified as being at medium risk from future climate change impacts. The study indicates that the key climate change impacts in the region would be extreme rainfall events causing flooding and precipitation induced landslides. While climate change impacts are not anticipated to be significant over the design life of the solar park (+25 years), the preliminary design integrates flood resilience measures such as ensuring solar park and transmission tower footings are raised above the highest flood level, paving and raising embankment height of access roads, strengthening existing drainage canals and building a storm water retention pond. Regular maintenance of drainage canals, storm water retention pond and access roads will be carried out to ensure their ongoing effective operation. The key climate vulnerable components will be subject to further analysis during the project detailed engineering design. Flood resilience measures that will permanently become part of the solar park and transmission interconnection infrastructure will be included within the main civil work contract costs (indicative estimate of \$1.17 million¹¹). Climate mitigation is attributed to \$25.73 million of the project costs. ADB will finance 25.9% of mitigation costs.

9. **Permanent Land Take.** Phase I of the park will require 100 ha for a 60 MW PV plant, Phase II will require a further 150 ha to accommodate additional PV plants up to 100 MW.¹² The development of the access road to the solar park site will affect three to four km, with a Right of

⁹ The tender will be for a 60 MW solar PV generating plant, to include crystalline-silicon solar arrays and mounting structures, power conversion units (inverters and associated transformers), direct current and alternating current plant cabling, power controls, and SCADA. The development of the plant will be financed by the private sector through private sector equity and commercial debt. Additional power plants supplying the remaining 40 MW are expected to be tendered out to the private sector by EDC in a subsequent phase.

¹⁰ The feasibility study will focus on optimal park site selection and design, and future power plant design.

¹¹ Source: Detailed Cost Estimates by Expenditure Category, Project Administration Manual, February 2019. The total costs are indicative costs and may be subject to revision.

¹² One MW requires 1.5 to 2.5 ha of land; Source: Cambodia Solar Park Feasibility Study, 2018. The land requirements for each phase are not scaled by MW; however, the total requirement for 100 MW will be met with 250 ha.

Way (ROW) width of 5.5 m, the land take for the access road is included in the solar park land requirements. The 230-kV transmission line from the new pooling substation at the solar park to an existing grid substation (GS6) will affect a 40 km Right of Way (width of 30m, 15m either side of the center line), a total of 117 ha. The transmission line tower footings will require permanent acquisition of 3 ha. The total land take for a 100 MW solar park and associated infrastructure is 370 ha, of which 253 ha is permanent.

Infrastructure type	Land requirements
Phase I – 60 MW	100 ha
Phase II – remaining capacity up to 100 MW	150 ha
40 km Transmission line ROW – 30 m (15 m either side of centerline), between new pooling substation at the solar park and existing grid substation GS6	117 ha (temporary disturbance during construction and maintenance)
Transmission line tower footings	3 ha
Access roads to solar park site (approximate ROW – 5.5 m)	3-4 km (included in park land requirements)

F. ADB and Domestic Environmental Requirements

10. The due diligence has confirmed the project environment classification is B requiring an initial environmental examination (IEE) and Environmental Management Plan (EMP). The IEE and EMP cover environmental impacts and risks in the project area of influence¹³ of project outputs, including the solar PV plants, which are associated facilities¹⁴ and the GS6 substation, which is an existing facility¹⁵ as per the definitions in ADB Safeguards Policy Statement (ADB SPS 2009). 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.

¹³ For the purposes of establishing the environmental baseline and assessing the potential environmental impacts, the area of influence for local impacts on transmission line is taken as 200 m distance from the center line, while the area of influence for impacts on solar park land ecology is taken as 7 km radius. Overall, a total area of 500 ha area i.e. larger area than the actual area (250 ha) required for the solar park, common facilities, pooling substation and associated facilities has been screened to ensure capture of all possible outcomes while the proposed transmission line was screened for a length of 33-34 km out of 40 km, starting from existing facility GS6 towards the solar park site, the remaining length will be assessed during detailed engineering design after completion of land purchase for the solar park.

¹⁴ ADB SPS 2009 requires that assessment encompasses *associated facilities* that are not funded as part of the project (funding may be provided separately by the borrower or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

¹⁵ ADB SPS 2009 requires for projects involving *existing facilities* and/or business activities that already exist, 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.

11. The project will also comply with the Government Sub-decree No.72 on Environmental Impact Assessment (EIA) issued on 11 August 1999. Initial EIAs (IEIAs) are required for the solar park common infrastructure, substation and transmission interconnection system (“solar park infrastructure”) and for each of the solar PV plants. The Government Ministry of Environment (MOE) will approve the IEIAs at detailed engineering design stage. An approved consulting company or companies, registered with the MOE, will prepare the IEIAs for the solar park and each solar PV plant on behalf of the project owners (EDC and IPPs, respectively).¹⁶

G. Project Benefits

12. This project is expected to have significant environmental benefits. A transition to clean energy sources (i.e. solar energy generation) will limit import dependence on coal and other fossil fuels, delay or defer construction of new coal-fired plants and reduce reliance on hydropower generation¹⁷. This would contribute to national emission reduction targets¹⁸ and reduce pollution impacts.

13. The operation of a 60 MW solar PV plant (Phase I) will avoid approximately 84,000 tons of carbon dioxide-equivalent (tCO₂e) annually. When the anticipated 100 MW capacity (Phase II) is achieved there will be approximately 140,000 tCO₂e annual emission savings or approximately 2.934 million tCO₂e over a 20-year project lifetime. See Table 1.1.

Table 1.1. Greenhouse Gas Emissions Reductions from Project

Scenario I – Phase I (60 MW) and Phase II (40 MW), Total (100 MW)		
Installed capacity	Average annual avoided emissions (tCO ₂ e)	Lifetime avoided emissions (tCO ₂ e)
Phase I: 60 MW	84,000	1,760,000
Phase II: 40 MW	56,000	1,174,000
Total 100 MW	140,000	2,934,000

H. Anticipated Adverse Environmental Impacts and Mitigation Measures

14. Environmental impacts were assessed for project area of influence across all stages of project implementation, i.e. (i) design and pre-construction stage, (ii) construction stage, and (iii) operation stage. Direct impacts will result from acquisition of land for the solar park and transmission tower footings.

15. **Impacts during Design and Pre-Construction.** The potential adverse environment impacts associated with the project have been avoided or minimized through careful site and route selection of the solar park and the transmission line. During detailed design, further survey will be conducted to finalize the transmission line alignment, which will be adjusted as needed to avoid sensitive natural and human receptors and minimize the cutting of trees for the ROW. A number of environmental measures will be implemented in the design and pre-construction phase to ensure the project’s environment management readiness. Some of these measures will permanently become part of the infrastructure and will be included in the detailed engineering

¹⁶ Alternatively, one EIA may be prepared for a 100 MW solar PV plant.

¹⁷ Cambodia now has a surplus of power generation in some hours in wet periods and at nighttime. Yet the national grid is unable to meet daytime peak demand in high population areas such as Phnom Penh and experiences shortages during the dry season when storage in hydropower reservoirs is limited.

¹⁸ <https://unfccc.int/resource/docs/natc/khmnc2.pdf>

design. Measures include: (i) ensuring final site and route selection avoids sensitive receptors including protected areas, habitats and species of conservation value, hospitals/clinics/schools and physical cultural resources (PCRs) as well as minimizing impacts on human health, households and crops and trees of economic value, (ii) an efficient project implementation and grievances redress mechanism (GRM) set up, (iii) training and capacity building for the PMO, SEPRO and contractors¹⁹; (iv) timely land acquisition and compensation, (v) permits and clearances, (vi) integration of design features for climate risks and effective environmental management, (vii) integration of safeguards requirements in contracts, tenders and bidding documents for IPPs and contractors, (viii) conducting meaningful consultations, environmental baseline and seasonal surveys, and (ix) unexploded ordinances (UXO) clearance prior to civil works.

16. Impacts during Construction Stage: There will be temporary localized impacts during peak construction such as increased noise and dust levels, vibration, traffic congestion, potential interruption to existing utilities (e.g. power outages), waste generation, disrupted access to properties and agricultural land, presence of workers at construction camps and work sites as well as loss of vegetation, trees, plantations, orchards and/or crop damage. A biodiversity assessment was carried out for the project; no habitats of significant conservation value or protected species have been identified within the project area of influence. Further seasonal surveys of migratory birds and bats and impacts on flight routes will be carried out to inform the detailed design of the solar park and the transmission line. A Terms of Reference (TOR) is enclosed in Appendix III. Upgrade works at GS6 will take place within the fenced perimeter of the existing grid substation and the construction impacts will be minor. An environmental audit of GS6 was conducted and corrective actions are identified in the EMP.

17. Impacts during Operation Stage: There will be minor impacts during operation such as due to use of transformer oil at the substation, visual impacts (industrial park in rural setting), risks to occupational and community health and safety (working at height, electrocution), water usage for PV panel cleaning, waste generation and impacts from the site and ROW vegetation management.

18. Mitigation Measures: The identified potential adverse environmental impacts can be managed through effective implementation of the EMP and appropriate compensation agreed in the project Land Acquisition and Resettlement Plan (LARP). However, the main project risks include the low institutional capacity of the PMO and contractors and their failure to implement the EMP effectively during construction and operation stages. These risks will be mitigated by: (i) project output 2 that includes provisions for providing training and capacity building on environmental and social safeguards to the PMO, SEPRO and contractors, (ii) developing and implementing site specific construction EMPs (CEMPs) and Standard Operating Procedures (SOP) manuals, (iii) following appropriate project implementation mitigation, monitoring and reporting arrangements, and (iv) adequate site supervision including audits of contractor's environmental, health and safety (EHS) performance. Monitoring parameters have been identified in the environmental monitoring plan (EMOP) to check the effectiveness of EMP measures and to ensure any unidentified impacts can be readily addressed. The project risks will also be mitigated through inclusion of environmental specifications in contracts, bids and tenders for IPPs such as recycling and/or disposal of component parts of solar PV plants and restoring and maintaining landscape, hedges and field margins at the solar park site.

¹⁹ Contractors imply - solar park and transmission interconnection infrastructure Engineering Procurement, Construction (EPC) contractor and solar PV plant key subcontractor(s) - EPC contractor.

I. Information Disclosure, Consultation and Participation

19. Public participation in the course of preparing this IEE included information disclosure via distribution of project information booklet (PIB) in affected communes during consultations, public meetings at district and village level and focus group discussions (FGDs) with both women and men of the affected communes. The majority of participants supported the project. Main environmental concerns expressed by the participants were related to increases in dust in the dry season, interrupted access to agricultural / grazing land, construction debris dumping and damage to existing roads during construction and safety concerns due to presence of transmission towers during the operation stage. Other general environmental concerns were periodic drought episodes, soil erosion and low water quality in the communes. Measures to address these concerns have been integrated in the design and EMP.

J. Grievance Redress Mechanism

20. EDC will set up a project grievance redress mechanism (GRM) to document and resolve complaints from affected persons. The GRM will be coordinated by the PMO / SEPRO and assisted by PIC. GRM will address concerns and complaints promptly via a transparent process. Complaints and their resolution will be documented and reported in quarterly project progress reports and semi-annual safeguard reports.

K. Key IEE and EMP implementation Responsibilities

21. The key institutions involved in the IEE and EMP implementation will be the PMO and PIC. The PMO will have the responsibility to supervise and oversee compliance with environmental safeguards requirements, coordinate the project GRM and report to ADB. PIC will assist the PMO with the implementation of the project, EMP and oversight of the contractors or third party consultants. The PMO will be assisted by international and national environmental and social development specialists from the PIC for a total of twenty-four (24) months over 30-month period. For upgrade works at existing facility, substation GS6, PIC will collaborate with Cambodia Transmission Limited (CTL).²⁰

22. SEPRO of the EDC will be responsible for the overall supervision and coordination during project implementation; in particular it will ensure consistency of all safeguards documents with government policy, legal and administrative framework across all jurisdictions as well as assist with project GRM and meaningful consultation.

23. The PMO will be responsible for environmental reporting. The PIC will provide the environment input based on site visits, compliance checks and environmental monitoring and prepare the project Quarterly Progress Reports (QPR) for submission to the PMO. The PMO will verify and use the information from the project QPR and prepare an Environmental Monitoring report for submission to ADB semi-annually during construction and annually during operation stage. The environmental monitoring reports will be publicly disclosed on the ADB website (<https://www.adb.org/>). Reporting to ADB will continue until project completion report is prepared, one year after physical completion.

24. The PIC will be responsible for environmental monitoring. The PIC will coordinate and interact with the PMO on compliance to ADB safeguards requirements and with relevant

²⁰ GS6 is operated and managed by the CTL since 2013 in accordance with a 25-year agreement with EDC on Build Operate and Transfer ("BOT") contract.

government agencies and local authorities on permits and clearances and update and finalize the IEE and EMP as needed. The PIC will also be responsible for assisting the PMO, SEPRO and contractors in handling complaints and/or grievances filed through the GRM, if any.

25. The Contractor(s) will submit monthly progress reports to PIC on CEMP/EMP implementation, which will inform the project QPR and semi-annual safeguard monitoring reports.

L. Conclusion

26. This IEE shows potential adverse environmental impacts can be reduced to acceptable levels with effective implementation of mitigation measures. The EMP has specified mitigation measures to address identified impacts, responsible parties, and monitoring during construction and operation. The project is expected to improve electricity supply and increase access to clean and reliable energy that will encourage additional investment and economic growth. A transition to cleaner energy sources will avoid thermal generation and imports as well as the construction of new coal-fired plants. This would have significant environmental benefits, contributing to national emission reduction targets and reduced pollution impacts.

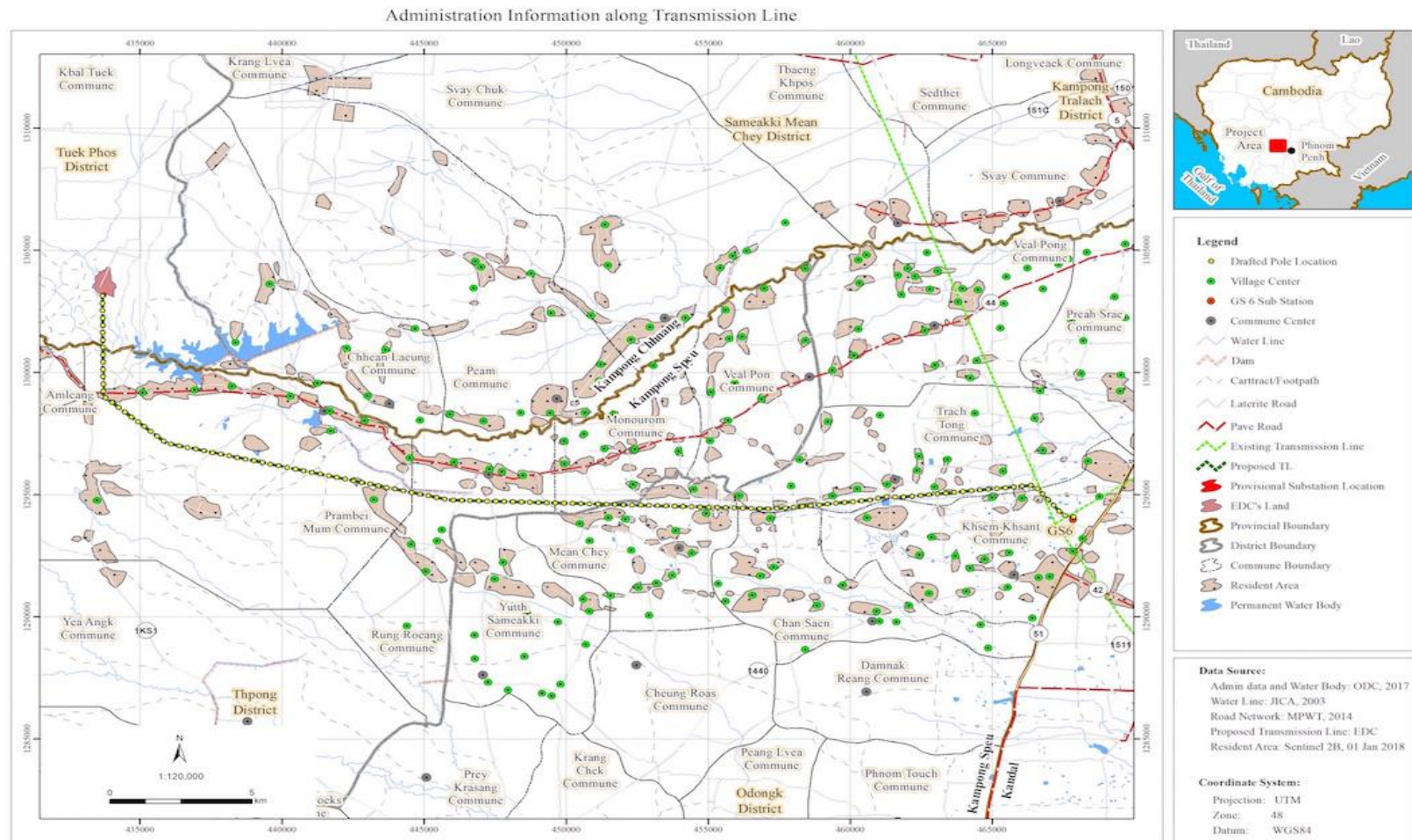


Figure 1.1. Project Location²¹

²¹ The solar park site is referred to as EDC land in Figure 1.1.

1. INTRODUCTION

1.1. Project Scope and Location

1. The National Solar Park Project will support Electricité du Cambodge (EDC) in constructing a 100-megawatt (MW) capacity solar park and a transmission interconnection system to the Phnom Penh demand center to supply power to the national grid.²²
2. The project will also assist EDC to design and conduct a competitive tender for procuring solar photovoltaic (PV) plants within the solar park. The solar PV plants will be tendered to Independent Power Producers (IPPs) in two phases. Phase I will be for a 60 MW capacity solar PV plant and Phase II will procure the remaining capacity.
3. The solar park and the transmission interconnection infrastructure will be located in Kampong Chhnang and Kampong Speu provinces.

1.2. ADB and Domestic Environmental Due Diligence

4. **ADB SPS 2009 and Domestic Requirements.** ADB SPS 2009 sets out the environmental safeguard requirements that apply to all ADB-financed projects. The due diligence carried out during project preparation confirms the project environment classification as Category B requiring an Initial Environmental Examination (IEE) and Environmental Management Plan (EMP). Additionally, as per the requirements of the national Ministry of Environment (MOE), Initial Environmental Impact Assessments (EIAs) are required for the solar park common infrastructure, substation and transmission interconnection system (“solar park infrastructure”) and for each of the solar PV plants. An approved company, registered with the MOE will prepare separate EIAs for the solar park common infrastructure, substation and transmission interconnection system and for each solar PV plant at detailed engineering design stage²³. The environmental requirements as per ADB SPS 2009 and national environmental regulations are set out in detail in Section 2 of this IEE.
5. **Site Visits.** As part of the environmental due diligence, site visits were conducted during preparation of the Pre-Feasibility Study²⁴ in July 2017 and January 2018 prior to the project preparatory technical assistance inception²⁵ in February 2018. A rapid socio-economic and vegetation survey for the proposed transmission line was conducted in April 2018 (results are enclosed as Appendix II); following this a ground survey for biodiversity assessment was conducted in March and July 2018 (Appendix III, Part 1). The objective of the site visits and ground surveys was to collect primary and secondary data relevant to the project location, to establish the environmental baseline conditions, identify potential impacts and to inform the ongoing project Feasibility Study.
6. **Public Consultations and Focus Group Discussions.** Public consultations and Focus Group Discussions (FGDs) with project affected persons and other relevant stakeholders were conducted in May and July 2018. Records of consultations are enclosed as Appendix VII and findings discussed in Section 7 of this IEE. Further consultations will be carried out during detailed design and will continue throughout project implementation.

²² The project is included in ADB. 2017. *Country Operations Business Plan: Cambodia, 2018–2020*. Manila

²³ Alternatively, one EIA may be prepared for a 100 MW solar PV plant.

²⁴ National Solar Park Project for Cambodia: Pre-Feasibility Study, August 2017

²⁵ Project Inception Report, February 2018

1.3. Structure Of This Report

7. This IEE report follows the format prescribed in ADB SPS 2009. For the purposes of this project, this IEE contains the following:

- 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

8. Annexure to this IEE contains the Environmental Management Plan (EMP), the Environmental Monitoring Plan (EMOP) and safeguards tender requirements for IPPs that are designed to aid the contractors and facility operators in management of environmental impacts. The EMP includes:

- Mitigation and monitoring measures
- Institutional arrangements and project responsibilities
- Public consultations and information disclosure
- Project GRM
- Training and capacity building requirements
- EMP budget of environmental safeguards and mitigation measures
- When the final project detailed engineering designs are available, the EMP will be updated to include detailed site location maps to support contractors with preparation of site-specific Construction EMPs (CEMPs) and in environmental monitoring

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1. Environmental Assessment Requirements

2.1.1. Environmental Requirements ADB Safeguard Policy Statement (SPS 2009)

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

10. SPS 2009 environmental assessment requirements specify that:

- At an early stage of project preparation, the borrower/client will identify potential direct, indirect, cumulative, and induced environmental impacts on and risks to physical, biological, socioeconomic and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected persons and concerned non-government organizations (NGOs). If potentially adverse environmental impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle.
- The assessment process will be based on current information, including an accurate project description and appropriate environmental and social baseline data.
- Impacts and risks will be analyzed in the context of the project's area of influence.
- Environmental impacts and risks will be analyzed for all relevant stages of the project cycle, including preconstruction, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration.
- The assessment will identify potential transboundary effects as well as global impacts.
- Assessment encompasses associated facilities that are not funded as part of the project (funding may be provided separately by the borrower or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.
- Assessment encompasses existing facilities and/or business activities that already exist (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.

11. Other requirements of SPS 2009 included in the IEE include:

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

- ▶ Consultation and participation. The borrower/client will carry out meaningful consultation with affected persons and other concerned stakeholders, including civil society and facilitate their informed participation. This IEE includes a Stakeholder Analysis and Communication Strategy and a consultation plan to ensure that the project affected persons, other concerned stakeholders and the civil society can provide meaningful consultations into the project detailed design and implementation.
- ▶ Information disclosure. Environmental information on the project will be translated into Khmer and made available in accessible locations (e.g. project construction field offices, commune councils local government offices, etc.) in accordance with ADB's Public Communications Policy (2011) and SPS (2009). The draft IEE will be disclosed on ADB's project website (www.adb.org) prior to Board approval, the final IEE after detailed engineering design and safeguards monitoring reports during implementation.
- ▶ Grievance redress mechanism. The borrower/client will establish a mechanism to receive and facilitate resolution of project affected persons' concerns, complaints, and grievances about the project's environmental (and social) performance.
- ▶ Monitoring and Reporting. The borrower/client will monitor, measure the progress of implementation of the EMP, EMOP and safeguards tender requirements for IPPs and report as mandated by the SPS 2009.

12. This IEE covers the solar park infrastructure, the solar PV plants, which are associated facilities, and the GS6 substation, which is an existing facility and has been prepared based on the preliminary engineering designs and will be updated where necessary to meet the final project detailed engineering designs.

13. This project was also screened and assessed for climate risks and vulnerability following the ADB Guidelines for Climate Proofing Investments in the Energy Sector, May 2013. The preliminary design integrates flood resilience measures for the solar park infrastructure; these will be further assessed and integrated in the final detailed engineering design. The screening and climate risks and vulnerability analysis (CRVA) are enclosed in Appendix IV.

2.1.2. National Environmental Requirements

14. Environmental assessment in Cambodia is governed by the following laws and guidelines:

- ▶ Sub-decree on Environmental Impact Assessment (EIA) process No. 72 (1999); This law provides the detailed guidelines for implementation of the EIA process and specifically that power plants that generate more than 5 MW require an IEIA or EIA.
- ▶ Declaration on Guideline for Conducting IEIA and EIA Reports No. 376 (2009); This declaration specifies the basic contents of IEIA / EIA Reports, which should include: (i) introduction, (ii) legal framework, (iii) project description, (iv) description of the existing environment, (v) public participation, (vi) assessment of and mitigation measures for significant environmental impacts, (vii) environmental management plan, (viii) cost-benefit analysis, and (ix) conclusion and recommendations.

15. The MOE through its EIA Department regulates and monitors the EIA process. The MOE is responsible for: (i) review and approval of IEIA/EIA reports in collaboration with other relevant ministries and (ii) monitoring the EMP implementation of Project Proponents/Owners throughout the different project stages. The MOE operates at the municipal and provincial levels through its Provincial Departments of Environment (PDOE).

16. The Project Proponents /Owner (public or private) is required to submit the necessary project document (IEIA / EIA Reports) to the MOE for review and approval. After submission of IEIA / EIA report, it will take a maximum of 30 working days for a decision.

17. A meeting held between the MOE, SEPRO and ADB consultant team for the project on May 10, 2018 confirmed the following requirements for the Project:

- ▶ The Project Proponent/Owner (EDC) to prepare one IEIA for the solar park infrastructure (solar park common facilities, substation and transmission interconnection infrastructure (this will be loan-financed);
- ▶ The IPPs to prepare for the solar PV plants - either one EIA covering a 100 MW plant or separate IEIAs for each solar PV plant)
- ▶ IEIA / EIA to be based on detailed engineering design and to incorporate additional baseline environmental surveys (water and soil quality)

18. According to the PRAKAS on Guideline for Conducting EIA (2009), a registered company authorized to complete an IEIA or EIA, is required to submit the prepared report(s) on behalf of the Project Proponent / Owner.

2.2. National Environmental Policy and Legislation

2.2.1. Legal Framework for Environmental Management

19. The hierarchy of legislation in Cambodia is:

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

20. 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.

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

22. The Environment Law has the following objectives:

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

23. Specific regulations and standards for environmental quality are contained in three Sub-decrees:

- ▶ Sub-decree on Solid Waste Management (1999);
- ▶ Sub-decree on Water Pollution Control (2009); and
- ▶ Sub-decree on Air Pollution Control and Noise Disturbance (2000)

24. A summary of legislative and policy instruments relevant to the project is presented in Table 2.1. The key environmental quality standards applicable to the EMP for this IEE are listed in Table 2.2 and details are enclosed in Appendix I; the most stringent limit (national or international) shall apply.

Table 2. 3. Relevant Laws, Regulations and Guidelines

Law/Regulation/Guideline	Year	Summary
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 in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Article 37 stipulates that in case of chance find of a cultural property during construction, work should be stopped and the person who found the property should immediately make a declaration to the local police, who shall, in turn, transmit the property to the Provincial Governor without delay.
Labor Law (1997) Decree No. CS/RKM/0397/01	1997	Governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: Chapter VIII Health and Safety of Worker. The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camp); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace. Article 230: Work places 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 No. 36 ANK/BK),	1999	Article 1: Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity through using appropriate technical approaches.

Law/Regulation/Guideline	Year	Summary
		<p>Article 2: This Sub-decree applies to all activities related to disposal, storage and collection, transport, recycling, dumping of garbage and hazardous waste.</p> <p>Article 4: The Ministry of Environment (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.</p> <p>The authorities of the provinces and cities shall establish the waste management plan in their province and city for short, medium and long-term.</p>
Sub-decree on Control of Air Pollution and Noise Disturbance (Sub-decree No. 42 ANK/BK)	2000	<p>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).</p> <p>Article 3 A. "Source of pollution" is defined and separates mobile sources (including transport) and fixed sources such as factories and construction sites.</p> <p>Article 3 B. "Pollutant" is defined as smoke, dust, ash particle substance, gas, vapor, fog, odor, radio-active substance</p>
Law on Land (NS/RKM/0801/14)	2001	<p>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)</p>
Law on Forestry	2002	<p>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.</p>
Law on Water Resources Management (NS/RKM/0607/016)	2007	<p>Requires 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 to endanger human, animal and plant health.</p>

Law/Regulation/Guideline	Year	Summary
		<p>(Articles 12 & 22)</p> <p>Article 24 stipulates that Ministry of Water Resources and Meteorology (MOWRAM), in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.</p>
<p>Royal Decree on Protected Areas (Royal Decree No. NS/RKM/0208/007)</p>	<p>2008</p>	<p>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.</p> <p>Article 11 divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone and community zone.</p> <p>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.</p> <p>Article 41 provides for the protection of each protected area against destructive/harmful practices such as destroying water quality in all forms, poisoning, using of chemical substances, disposing of solid and liquid wastes into water or on land.</p> <p>Article 44 requires all proposals and investments within or adjacent to protected area boundary an Environmental and Social Impact Assessment.</p> <p>Each protected area shall be divided into four (4) management zoning systems:</p> <ol style="list-style-type: none"> 1. Core zone: management area(s) of high conservation values containing threatened and critically endangered species, and fragile ecosystems. Access to the zone is prohibited except the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the MOE, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defense sectors. 2. Conservation zone: management area(s) of high conservation values containing natural resources, ecosystems, watershed areas and natural landscape located adjacent to the core zone. Access to the zone is allowed only with prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defense

Law/Regulation/Guideline	Year	Summary
		<p>sectors. Small-scale community uses of Non-Timber Forest Products to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone.</p> <p>3. Sustainable use zone: management area(s) of high economic values for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community, and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the MOE.</p> <p>4. Community zone: management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar).</p>
Sub-decree on Water Pollution Control (Sub-decree No. 27 ANRK/BK)	2009	<p>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.</p> <p>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.</p>
Expropriation Law	2010	<p>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.</p>

Table 4.2. Key National and International Environmental Standards

Environmental Parameter	National Standard	International Standard
Ambient air quality	Ambient Air Quality Standard, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	IFC (WBG) EHS Guidelines, Air Emissions and Ambient Air Quality, 2007 ²⁶ WHO Air Quality Guidelines, Global Update 2005 ²⁷
Noise	Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	IFC (WBG) EHS Guidelines, Noise management, 2007 WHO Guidelines for Community Noise, 1999 ²⁸
Ground water quality	Drinking water Quality Standards, 2004	WHO Guidelines for Drinking-water Quality, Fourth Edition, 2011 ²⁹
Surface water quality	Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, Water Quality Standards for Public Waters and Health of Sub-decree on Water Pollution Control, 1999	US EPA National Recommended Water Quality Criteria ³⁰ IFC (WBG) EHS Guidelines, Wastewater and ambient water quality, 2007 MRC Technical Guidelines for the Protection of Aquatic Life ³¹ MRC Technical Guidelines for the Protection of Human Health

EHS = environmental, health and safety; IFC = International Finance Corporation; MRC = Mekong River Commission; US EPA = United States Environment Protection Agency; WBG = World Bank Group; WHO = World Health Organization

2.2.3. Cambodia Electric Power Technical Standards

25. Part 6: General Requirements for High Voltage Transmission facilities (230 / kV).

These requirements issued by the Ministry of Industry, Mines and Energy in accordance with the Electricity Law of the Kingdom of Cambodia (2004, amended 2007)³² will be applicable to the project.³³ The double circuit overhead high voltage transmission line will be designed for 230 kV and operated initially at 115 kV. The minimum safety clearances for the construction and maintenance of 230 kV double circuit over-head high voltage transmission lines are summarized as follows. The typical clearance requirements are illustrated in Figure 2.1.

- General, distance > 4.2m
- With trees, distance > 3.2m
- In urban areas, distance > 7.7m
- Over roads and/or railways, distance > 14.2m
- Over rivers/sea, with no vessels, distance > 6.7m

²⁶ [IFC \(WBG\) EHS Guidelines 2007](#)

²⁷ [WHO Air Quality Guidelines Global Update 2005](#)

²⁸ [WHO Guidelines for Community Noise 1999](#)

²⁹ [WHO Guidelines for Drinking - Water Quality](#)

³⁰ <https://www.epa.gov/wqc/national-recommended-water-quality-criteria>

³¹ <http://www.mrcmekong.org/about-mrc/mandate/procedures-for-water-quality/>

³² http://www.cambodiainvestment.gov.kh/prakas-796-on-the-first-amendment-on-the-prokas-no-470_070809.html (accessed April 2018)

³³ Printed by the Electricity Authority of Cambodia (EAC)

- Over rivers/sea, with vessels, distance > 4.2m

26. There are no specific requirements listed on ROW or Adjacent Land Type in the Technical Standards, however for the purpose of this project and as confirmed by SEPRO of EDC, the ROW is taken as 30 m (15 m either side of centerline). The Cambodia Electric Power Technical Standards for High Voltage Transmission Lines are enclosed as Appendix I.

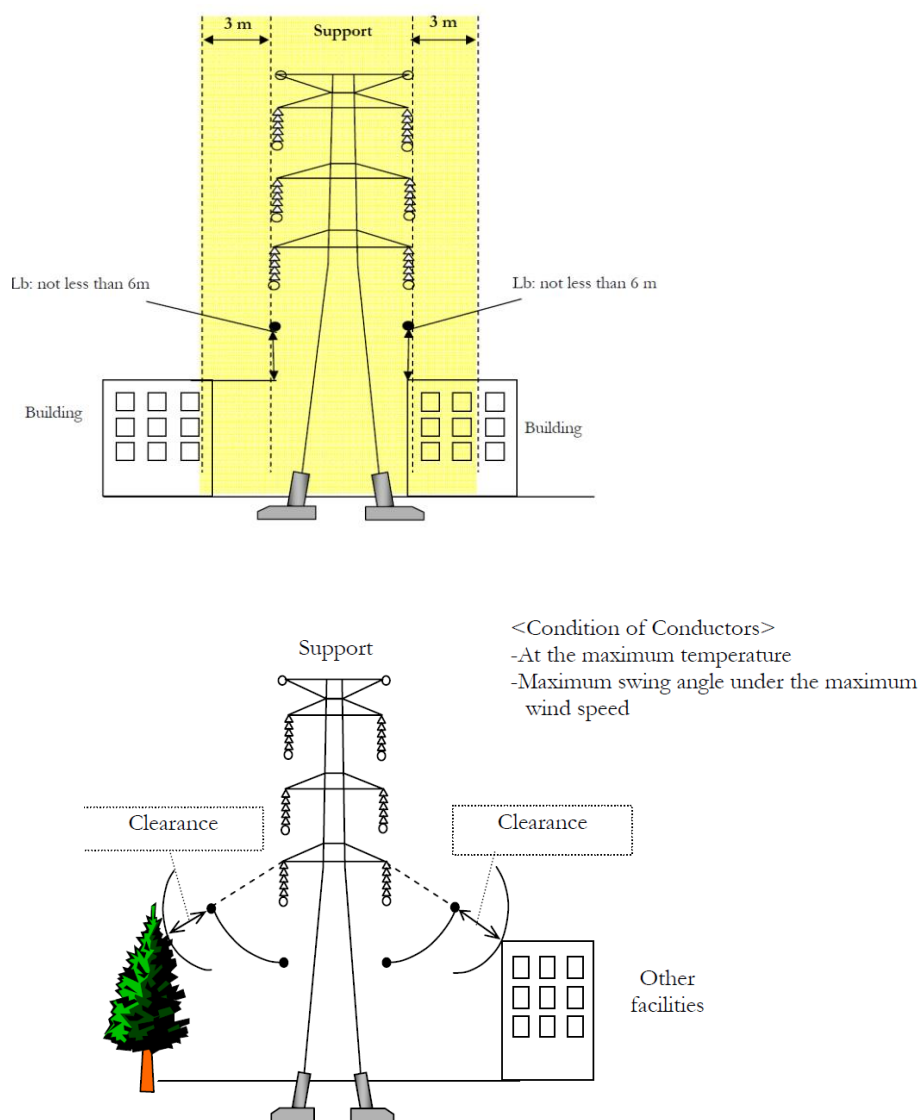


Figure 2.1. Typical Clearance Requirements as per Cambodia Electric Power Technical Standards

2.3. International Agreements, Best Practices and Standards

2.3.1. International Finance Corporation (World Bank Group) Environmental, Health and Safety Guidelines

27. **International Best Practices.** SPS 2009 requires that during the design, construction, and operation of the project, the Borrower/ Client will apply pollution prevention and control technologies and practices consistent with International Best Practice, as reflected in internationally recognized standards of the International Finance Corporation's (World Bank Group) Environmental, Health and Safety Guidelines ("EHS Guidelines") and World Health Organization (WHO). These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the Borrower/ Client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the Borrower/ Client will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in this document. These EHS Guidelines are adopted in the EMP for the project such as IFC (WBG) Industry Sector EHS Guidelines for Electric Power Transmission and Distribution (2007)³⁴; and Environmental Guidelines on Air Emissions and Ambient Air Quality, Noise Management, Wastewater and Ambient Water Quality, Hazardous Material Management and Waste Management as well as Occupational Health and Safety and Community Health and Safety (2007).

28. The ADB is committed to due consideration of Core Labor Standards (CLS) in the design and implementation of investment projects. A CLS handbook has been developed by ADB with cooperation of International Labor Organization (ILO). EDC will also ensure compliance to applicable CLS of ADB-ILO during project implementation including:³⁵

- ▶ Freedom of association and the effective recognition of the right to collective bargaining
- ▶ Elimination of all forms of forced or compulsory labor
- ▶ Effective abolition of child labor
- ▶ Elimination of discrimination in respect of employment and occupation

29. The project will comply with ADB Prohibited Investment Activities List as listed in Appendix I, Part 3 of this IEE.

2.3.2. International and Regional Agreements

30. **International Agreements.** Cambodia is party to the following international environmental agreements in general and as relevant to the Project: (i) United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention, 1991; (ii) Convention on Biodiversity, 1995; (iii) United Nations Framework Convention on Climate Change (UNFCCC), 1995; (iv) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997; (v) UNESCO Network of Biosphere Reserves in 1997; (vi) Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1999; (vii) Basel Convention on the Control of Trans-boundary Movements of the Hazardous Wastes and Their Disposal, 2001; (viii) Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer, 2001, and all Amendments, 2007; (ix)

³⁴ [IFC \(WBG\) Industry Sector Guidelines for Electric Power Transmission and Distribution](#)

³⁵ Asian Development Bank and International Labour Organization. Core Labour Standards, October 2006.

Climate Change Kyoto Protocol, 2002; (x) International Tropical Timber Agreement, 2006; and (xi) Paris Agreement, 2016.

31. **Cambodia Climate Change Commitments.** The First and Second National Communication was submitted to UNFCCC in October 2002³⁶ and November 2015³⁷, respectively. The Second National Communication contained information on the country's major source of GHG emissions and sinks, vulnerability, adaptation options and mitigation measures that Cambodia has implemented or intends to implement to further contribute to global efforts to reduce GHG emissions. Furthermore, Cambodia's Nationally Determined Contribution (NDC) enshrined in the 2016 Paris Agreement³⁸, commits to a 16% reduction in GHG emissions from a business as usual scenario by 2030 from the energy sector.³⁹ The National Strategic Development Plan (2014-2018) states the importance of implementing Cambodia's Climate Change Strategic Plan (2014-2023) and contains indicators to track implementation of climate change actions. In alignment to the Climate Change Strategic Plan of Cambodia, Sectoral Climate Change Strategic Plans and Action Plans have also been developed.

32. **Regional Agreements.** At the regional level, Cambodia has ratified the following Association of Southeast Asian Nations (ASEAN) agreements: (i) on Trans-boundary Haze Pollution in 2006; and (ii) on Disaster Management and Emergency Response, entered into force in 2009.

33. **Sub-Regional Agreements.** At the sub-regional level, Cambodia, along with the Lao People's Democratic Republic, Thailand and Viet Nam, signed the "Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin" (or the Mekong Agreement) in April 1995.

2.3.3. ADB Climate Change Commitments

34. In 2015, ADB committed itself to increasing climate financing from its own resources to \$6 billion yearly by 2020—\$4 billion for mitigation in sectors such as renewable energy, energy efficiency, sustainable transport, and urban development, and \$2 billion for adaptation in areas such as urban resilience and agriculture and land use. The \$6 billion target corresponds to around 30% of ADB's projected corporate pipeline by 2020. In 2017, ADB reached a record high of \$4.5 billion in climate investments, a 21% increase from the \$3.7 billion reached in 2016. From 2011 to 2017, ADB approved more than \$25 billion for climate financing—\$21.7 billion from ADB's own resources while leveraging over \$3.4 billion from external resources.

35. With a view to deliver stronger, better, and faster support to its Developing Member Countries (DMCs), ADB has established its Climate Change Operational Framework, 2017–2030 (CCOF 2030), which positions ADB to facilitate, collaboratively and proactively, a regional shift toward a low GHG emissions and climate-resilient development path. It further provides a framework for supporting DMCs in translating their NDC aspirations into climate change action investment plans and implementing those plans.

³⁶ <https://unfccc.int/resource/docs/natc/khmnc1.pdf> (accessed May 2018)

³⁷ <https://unfccc.int/resource/docs/natc/khmnc2.pdf> (accessed May 2018)

³⁸ The Paris Agreement entered into force on 4 November 2016.

³⁹ Government of Cambodia. 2015. *Cambodia's Intended Nationally Determined Contribution*. Phnom Penh.

3. DESCRIPTION OF THE PROJECT

3.1. Rationale

36. **Country Background.** Cambodia's economy has grown quickly over the past decade, averaging annual growth of 7.0% from 2006 to 2016 and poverty has fallen substantially, from 47.8% in 2007 to 13.5% in 2014.⁴⁰ Nonetheless, gross domestic product (GDP) per capita, estimated at \$1,427 in 2017, remains among the lowest in Asia. An underdeveloped energy sector is a key constraint to the further improvement of Cambodia's economic competitiveness and the welfare of its people. Cambodia's energy sector is faced with several strategic challenges. Access to reliable energy is the most pressing one in the short and medium term while broader and longer-term issues of energy security, affordability and environmental sustainability also need to be addressed. Nearly 5 million Cambodians do not have access to electricity and are reliant on batteries, wood and other traditional fuels for energy. Historically, the high cost of power, dependence on conventional energy sources and limited transmission and distribution networks, coupled with intermittent power supply, have hindered economic competitiveness and discouraged private sector investments. Annual electricity demand growth in Cambodia averaged 16% from 2011 to 2017. In 2017, Cambodia's energy consumption was 8,073 gigawatt-hour (GWh), of which 44% was coal, 34% hydro, 4% diesel, less than 1% renewables and 18% power imports from neighboring countries. The hydropower and coal-fired plants are owned by the private sector and operated under long-term Power Purchase Agreements (PPAs) with take-or-pay arrangements. The current Power Development Plan (PDP), revised in 2015, projects demand growth to average about 7% through 2030.

37. The government's Rectangular Strategy, Phase IV (2018–2023), highlights increased investment in solar energy to reduce electricity costs and ensure long-term energy security.⁴¹ The government also prioritized the development of renewable energy in its National Strategic Development Plan, 2014–2018 to meet growing demand for electricity in Phnom Penh and address the country's electrification target of 100% of villages by 2020.⁴² In addition, the Government's Industrial Development Policy 2015–2025⁴³ identifies the historically high power tariffs in the country as a major impediment to the competitiveness of the country's manufacturing sector and calls for alternate sources of energy to be developed. Furthermore, Cambodia's Nationally Determined Contribution, enshrined in the 2016 Paris Agreement⁴⁴ commits to a 16% reduction in GHG emissions from a business as usual scenario by 2030 from the energy sector.⁴⁵ Ideally, alternate, clean sources of energy would complement installed and planned hydropower-based generation, which is often inadequate during the dry season as well as help provide ancillary benefits to the grid around the key demand centers.

38. **The Project.** This project will support the construction of solar PV plants in Cambodia and address the country's need to: (i) expand low-cost power generation, (ii) diversify the power

⁴⁰ADB. 2016. *Country Economic Indicators 2016*. Manila.

⁴¹ Government of Cambodia. 2018. *Rectangular Strategy for Growth, Employment, Equity and Efficiency: Building the Foundation Toward Realizing the Cambodia Vision 2050, Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly*. Phnom Penh.

⁴² Government of Cambodia, Ministry of Planning. 2014. *National Strategic Development Plan, 2014–2018*. Phnom Penh.

⁴³ Government of Cambodia. 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

⁴⁴ The Paris Agreement entered into force on 4 November 2016.

⁴⁵ Government of Cambodia. 2015. *Cambodia's Intended Nationally Determined Contribution*. Phnom Penh.

generation mix with an increase in the percentage of clean energy in line with the national GHG emissions reductions targets, and (iii) expand the use of competitive tenders and other global best practices in the sector.

39. The project will support EDC in constructing a 100-MW capacity solar park in Kampong Chhnang province and a transmission interconnection system to the Phnom Penh demand center to supply power to the national grid.⁴⁶ The project will also assist EDC to design and conduct a competitive tender for procuring the first solar PV plant within the solar park. The solar PV plants will be tendered to IPPs in two phases: Phase I will be for a 60 MW capacity while Phase II will procure the remaining capacity.

40. The project is the first of its kind in Cambodia and builds on lessons learnt from ADB Private Sector Operations Department's financing of a 10 MW solar PV plant at Bavet, Svay Rieng province in 2016. The project aims to demonstrate the ability of large-scale solar parks to produce solar energy at a competitive price while also providing technical benefits to the national grid⁴⁷ and substitute for planned fossil fuel and hydropower generation in the future. This project will build appreciation for the costs, operational requirements and actual performance of solar PV plants. It will also inform further policy development and give EDC knowledge and experience in structuring a transparent, competitive procurement for private sector-led power projects and negotiating with private developers. These early projects will also build experience among grid operators on management of the variable power produced by solar PV plants. Under the ADB regional Technical Assistance (TA), Demonstration of An Assisted Broker Model for Transfer of Low Carbon Technologies to Asia and the Pacific, a Pre-Feasibility Study of the solar park was prepared. The Feasibility Study was completed in August 2018 under the regional TA - Supporting Regional Project Development for Association of Southeast Asian Nations Connectivity and the Office of Public-Private Partnerships' TAS. To improve project readiness, the TA will also prepare basic engineering designs and assist procurement of the civil works.⁴⁸ Under the TAS, ADB will assist in structuring the tender for the construction of the first solar PV plant.

41. Furthermore, in April 2018 the Global Scaling up Renewable Energy Program (SREP) subcommittee of the Climate Investment Funds approved the Cambodia National Solar Park Project, thereby approving \$3 million in grants and \$11 million in concessional loans for use by EDC.

42. Figure 3.1 presents the Cambodia power transmission map and Figure 3.2 presents the Cambodia solar radiation map with existing and proposed transmission lines.

3.2. Project location

43. The solar park is located in Tuek Phos district of Kampong Chhnang province. The solar PV plants will be constructed within the solar park. The transmission line will run through Sameakki Mean Chey district in the Kampong Chhnang province and Thpong and Odongk districts in Kampong Speu province. The GS6 substation is located in Odongk district in Kampong

⁴⁶ The project is included in ADB. 2017. *Country Operations Business Plan: Cambodia, 2018–2020*. Manila.

⁴⁷ Technical or ancillary benefits include: (i) voltage support during peak loading periods, (ii) reduction of loading levels on transformers, (iii) and reduction of the amount of power that needs to be generated from distant sources (hydro and coal, in particular), and therefore reduction of losses in the transmission system.

⁴⁸ Basic engineering design for bidding purposes will be issued in Q1/2019 (indicative timeline).

Speu province. The solar park is located about 70 km from the capital city of Phnom Penh by road. The indicative project location is provided in Figure 3.3.

3.3. Project Impact, Outcomes and Outputs

44. The project is aligned with the Government's stated impact of lower electricity cost in Cambodia.⁴⁹ The project outcome will be increased private sector investments in solar PV in Cambodia. The project will have the following outputs:

- (i) **Output 1: Solar park and transmission interconnection constructed.** The project will support EDC in constructing a 100 MW solar power park in Kampong Chhnang Province and a transmission interconnection system to grid substation 6 (GS6) near the Phnom Penh demand center to supply power to the national grid. The park will initially consist of 100 hectares (ha) of land; associated construction works (i.e., fencing, roads, and drainage systems); common facilities; and supporting infrastructure to accommodate 60 MW of solar photovoltaic plant capacity. The transmission interconnection infrastructure comprises (i) the 100 MW capacity pooling substation at the solar park, with two 50-megavolt-ampere transformers (and room for two additional transformers); switchgear; an ancillary system; and controls; (ii) a supervisory control and data acquisition system compatible with EDC's requirements, advanced forecasting tools, and expanded information and communication technology applications; (iii) a dedicated 40-kilometer 230-kilovolt double circuit overhead transmission line between the solar park substation and GS6; and (iv) two new bays with switchgear at GS6.⁵⁰
- (ii) **Output 2: Capacity of Electricite du Cambodge in solar power plant construction and operation, project design and supervision, grid integration and competitive procurement strengthened.** The project will strengthen EDC's capacity to design, construct, and operate solar PV plants and solar parks (including management of environmental and social safeguards issues). The project will also strengthen EDC's capacity to procure competitively bid independent solar PV plants and to adopt energy storage systems and other measures to integrate intermittent renewable energy into the national grid.

Under the ongoing TAS agreement that has been signed between the two institutions, ADB's Office of Public-Private Partnership is assisting EDC to design and conduct a competitive tender for procuring the first Solar PV plant to be built by the private sector and located within the park.⁵¹ As transaction advisor, ADB is performing project due diligence (including legal, technical, financial, environmental and social due diligence), preparing the Feasibility Study⁵², assisting the development of tender documents and long-term PPAs and supporting the review and selection process.

⁴⁹ Government of Cambodia. 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

⁵⁰ EDC is considering a 10 MW (2-hour) battery storage system for output smoothing to counterbalance intermittent solar power generation. ADB is applying for grant funds to support this component; if available, they will be processed as additional financing. The transmission line will be rated at 230 kilovolts but will be initially operated at 115 kilovolts.

⁵¹ The tender will be for a 60 MW Solar PV Plant, to include crystalline-silicon solar arrays and mounting structures, power conversion units (inverters and associated transformers), direct current and alternating current plant cabling, power controls, and SCADA. The development of the plant will be financed by the private sector through private sector equity and commercial debt. Additional power plants supplying the remaining 40 MW will be tendered out to the private sector by EDC in a subsequent phase.

⁵² The Feasibility Study will focus on optimal park site selection, design and future solar PV plant design.

3.4. Project Design

3.4.1. Design and Site Selection for Solar Park Infrastructure

45. A more detailed description of project design and site selection is provided in the Feasibility Study and bidding documents. A summary relevant to this IEE is provided below. The overview of the project output 1 (“project at a glance”) is illustrated in Figure 3.4.

46. **Site Selection and Design of Solar Park.** A total of seven sites were assessed for the solar park location in the Pre-feasibility Study out of which three were identified as preferred sites for further assessment during the project preparatory technical assistance phase. All of the sites are located between Kampong Chhnang and Kampong Speu provinces. Out of the three preferred sites, two were dropped from further study mainly due to potential socio-economic impacts and ease and cost of land acquisition. For details refer to Section 6 of this IEE. EDC further determined that the optimal point of connection of the proposed solar park site (initially referred to as site 6) to the national grid is at GS6. GS6 is located close to the major load center of Phnom Penh. Connecting the new substation at the proposed solar park site to GS6 will minimize the need for new infrastructure while enabling the project component to provide voltage support and reduce network losses.⁵³

47. Two natural streams, the only surface water bodies that run across the proposed solar park site, will be conserved in current natural condition by establishing a buffer of at least 400 m on either side of the streams during site design. The proposed solar park site is also situated outside the historical flood zone. Detailed engineering design will integrate measures based on recommendations from the ongoing hydrological study to maximize flood resilience and minimize impacts on local drainage patterns. Details on hydrology and flood risks are provided in Section 4 of this IEE.

48. Common infrastructure will include perimeter fencing with adequate ground clearance (for passage of animals/ wild species), drainage design and/or building storm water retention pond, common facilities over 250 ha and construction of access roads for length approximately 3 – 4 km with road width of 5.5 m (the road width is indicative and will be confirmed during detailed engineering design). There is an existing unpaved approach road up to the start of the solar park site (width 30 m) that has been built by the local Army; this approach road connects Road No. 132 / 136. Access roads to the site (length 3-4 km, width 5.5 m) will be constructed and maintained for transportation of the equipment, materials and machinery and further maintained during operation of the solar park.

3.4.2. Design and Route Selection of The Transmission Interconnection System

49. **Substation:** An air-insulated substation will be designed for power evacuation and will require one ha of land within the solar park. This type of substation uses atmospheric air as the phase to ground insulation for the switchgear of the substation. The single line diagram of the substation and technical specifications is illustrated in Figure 3.5.

50. **Transmission Line Design.** The proposed transmission alignment is 230 kV overhead double circuit high voltage line for 40 km length between the new solar park pooling substation

⁵³ Other factors considered were the quality of terrain, local weather factors, proximity to high voltage transmission lines, proximity to settlements as well as agricultural facilities.

and existing substation GS6. The double circuit overhead high voltage transmission line will be designed for 230 kV will be operated initially at 115 kV. Tower types are steel lattice (approximate 134 towers at a span /interval of 300 m, the exact number of poles will be defined during the detailed design phase). Height of towers will be 30–40 m. An optical ground wire and Aluminum Conductor Steel Reinforced conductors will be used. Design clearances and height for the transmission line will be in accordance with the Cambodia Electric Power Technical Standards. For summary on clearances and height, refer to Section 2 of this IEE and also refer to Appendix I.

51. **Route Selection.** The final transmission line and access road alignment will consider avoidance of and/or adjusted to minimize impacts on agriculturally productive land, orchards, habitats of conservation value, sensitive areas (parks, recreational centers, physical cultural resources such as temples and animist sites) and households, schools and residential areas. The ROW will consider suitable slope and soil type and will be of 30 m width (15 m width on either side of the transmission center-line). The ROW will be adjusted to minimize the cutting of trees. Within the ROW, the height of vegetation and/or trees will be limited to 3 m while 225 m² (15 x15 m²) will be required for each tower base at a span/ interval of 300 m (equivalent to total 3 ha land take for length 40 km).

52. Access roads in and around the proposed transmission line are classified as earth road and laterite road. Access to construction sites for tower footings and stringing of conductors will be via temporary access roads / approach ways that will be restored to pre-construction conditions after completion of civil works.

3.4.3. Upgrade To Grid Substation 6 (Existing Facility)

53. Upgrade works will take place within the fenced perimeter of the grid substation (GS6) in collaboration with Cambodia Transmission Limited (CTL) that has operated and maintained GS6 since 2013 in accordance with a 25-year agreement with EDC on a Build Operate and Transfer (“BOT”) contract.

54. The scope of work for upgrading existing substation GS6 will include the following:

- Two new feeder bays (with Circuit Breakers, Dis-connector, Current Transformer, Voltage Transformer and Surge Arrestors)
- Protection panels (feeder protection with distance protection as main), Over-current backup, Power revers protection on two (2) transformer circuits
- Check on Current Transformer characteristics (for replacements if any)
- Control Scheme and SCADA upgrade
- High Voltage connection

3.4.4. Design of The Solar PV Plants (Associated Facilities)

55. **Solar PV Plants:** The PV plants will be funded and built by private sector partners (IPPs) and are considered associated facilities.⁵⁴ Preferred technology would be crystalline modules⁵⁵,

⁵⁴ One MW requires 1.5 to 2.5 ha of land; Source: Cambodia Solar Park Feasibility Study, 2018

⁵⁵ Crystalline modules are discussed in Section 6 of this IEE.

1-axis tracked system⁵⁶, power conversion units (inverters and associated transformers), direct current and alternating current plant cabling, power controls and SCADA. The PV modules shall follow the accepted standards issued by the International Electro-technical Commission.⁵⁷

3.4.5. Climate Risks Adaptation

56. The project is classified as being at medium risk from future climate change impacts. The project design includes climate change adaptation measures for the solar park infrastructure. Measures include: siting of solar park and transmission tower footings at the highest flood level, site level drainage provisions, constructing a storm water retention pond, road pavement and raising embankment height of access roads to the solar park site. These key climate vulnerable components will be subject to further analysis during the detailed engineering design. Climate adaptation measures that will permanently become part of the solar park infrastructure will be included within the main civil work contract costs (indicative estimate \$1.17 million).

3.4.6. Land Take

58. The solar park infrastructure will affect land as follows:

Table 3.1. Land Affected by the Project

Infrastructure type	Land requirements
Phase I – 60 MW	100 ha
Phase II – remaining capacity up to 100 MW	150 ha
40 km transmission line ROW – 30 m (15 m each side of centerline), between the new solar park pooling substation and existing grid substation GS6	117 ha only temporary disturbance during construction and maintenance.
Transmission line tower footings	3 ha ⁵⁸
Access roads to solar park site (ROW – 5.5 m, approximate)	3-4 km (land requirement included in park)

3.5. Project Implementation

59. **Permanent Land Take.** At the time of preparation of this IEE, EDC has acquired 43 ha of land and is in the process of acquiring the rest of the land for Phase I; EDC is also in the process of acquiring the remainder of the land for the solar park for Phase II. Access roads to the solar park site for length 3-4 km will be common. All transactions related to land purchase for the solar

⁵⁶ Techno– economic optimisation shows that 1-axis tracked system gives lowest tariff, FFM Technical presentation May 9, 2018.

⁵⁷ Utility Scale Solar Power Plants; A Guide for Developers and Investors, Page 28 of 204 (IFC Feb 2012)

⁵⁸ This is an indicative estimate and will be confirmed during detailed walk over survey, to be conducted after the land acquisition for the solar park is completed and EDC has acquired the required land through Negotiated Settlement.

park are through negotiated settlement with the local landowners. In addition, an identified land area of 15x15 m (225 m²) at 300 m span / interval will be permanently acquired at full market value by EDC for each of the 134 transmission tower footings (approximate number); this will affect approximately 3 ha of land. As confirmed by SEPRO, EDC will apply a ROW of 30m (15 m on each side of the transmission center-line) and aim to pay compensation to land owners for 30% of the land value and for affected trees at their full value within the ROW. The total area of the ROW that will be affected will be approximately 120 ha (40 km x 30 m, inclusive of 3 ha that will be permanently acquired). For details on compensation, including impacts to crops and trees, refer to project LARP document.

60. **Temporary Land Take.** Facilities such as construction and erection staging areas, construction camps, spoil disposal sites and access tracks established for the transmission line alignment will take up land temporarily during the construction stage. The temporary land take areas will be estimated during detailed engineering design. There is no temporary land-take associated with the solar park; all civil works will be undertaken within the final solar park acquired area.

61. The project is scheduled for completion within 30 months from the loan effective date.

3.5.3. Project Organizational Structure

62. EDC will be the executing agency responsible for overall project implementation and compliance with loan and grant assurances and the Project Management Office (PMO) of the EDC will be the Implementing Agency responsible for the day-to-day coordination. The PMO will be supported by the PIC services that will be engaged under the project. SEPRO of the EDC will be responsible for the overall supervision and coordination during project implementation and ensure consistency of all safeguards documents with government policy, legal and administrative framework.

63. EDC will own, operate and maintain the solar park including the transmission interconnection infrastructure installed under the project. EDC will tender the solar PV plants to private sector IPPs and execute a long-term PPAs. The project will be implemented in two phases; Phase I will tender a 60 MW solar PV plant while Phase II will procure the remaining capacity. The ownership and the responsibility for operating and managing the solar PV plants will be with the IPPs. The project organization structure is presented in Figure 3.6.

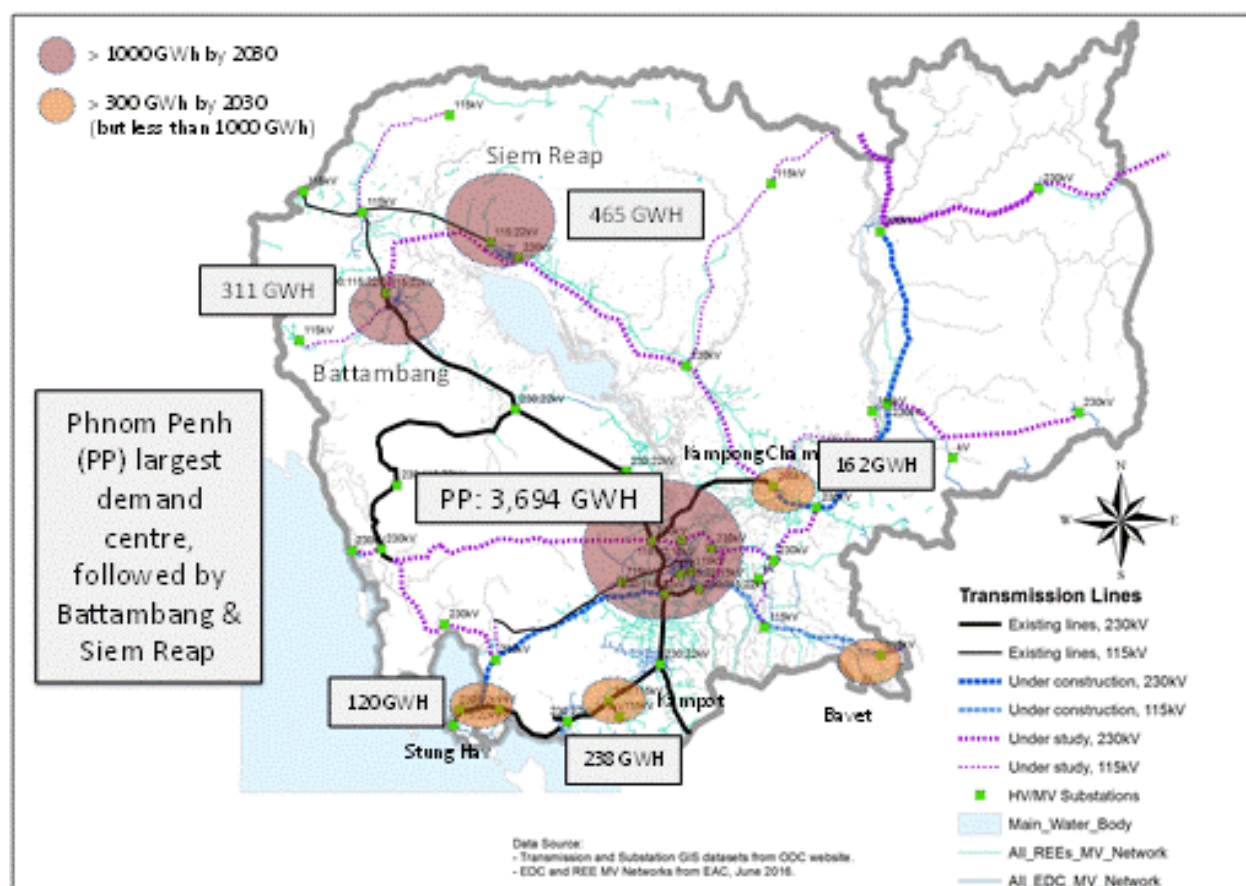


Figure 3.1. Cambodia Power Transmission Map⁵⁹

⁵⁹ Demand Centers (as of 2016) and Existing and Planned Transmission. Map prepared by GIS project specialist

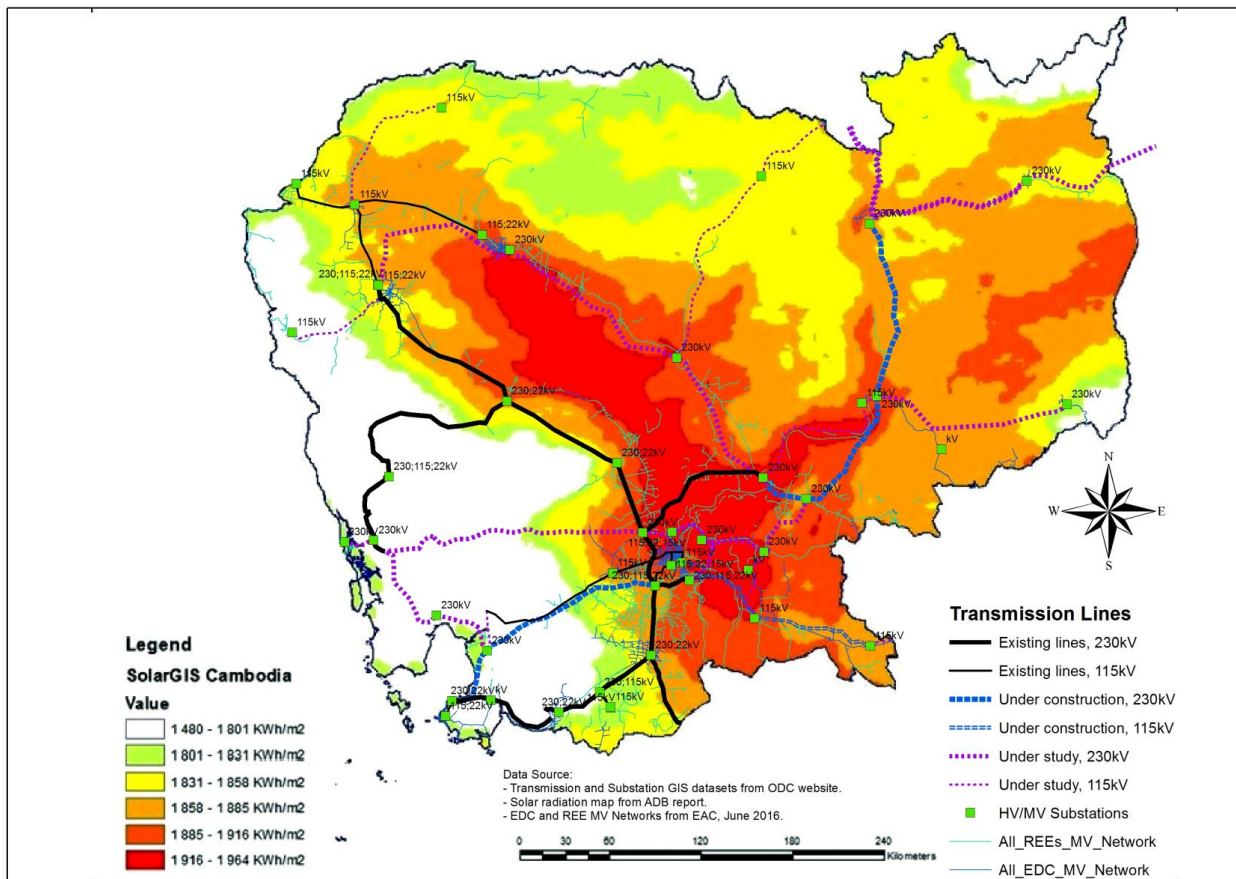


Figure 3.2. Cambodia Solar Radiation Map with Existing and Planned Transmission Network Lines



Figure 3.3. Project Location on Map⁶⁰

⁶⁰ The project site is geographically situated between 11.669518° and 11.804790° north latitudes and 104.334288° and 104.699287° east longitudes in the provinces of Kampong Chhnang and Kampong Speu in Cambodia.

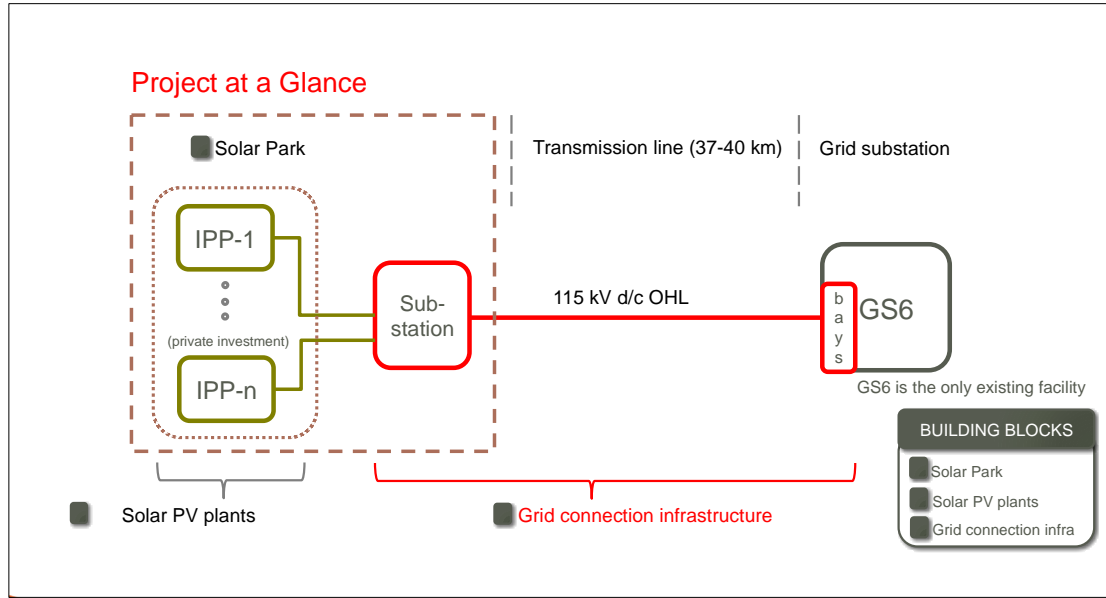


Figure 3.4. Project Output 1

Note: The transmission line will be rated at 230 kilovolts but will be initially operated at 115 kilovolts.

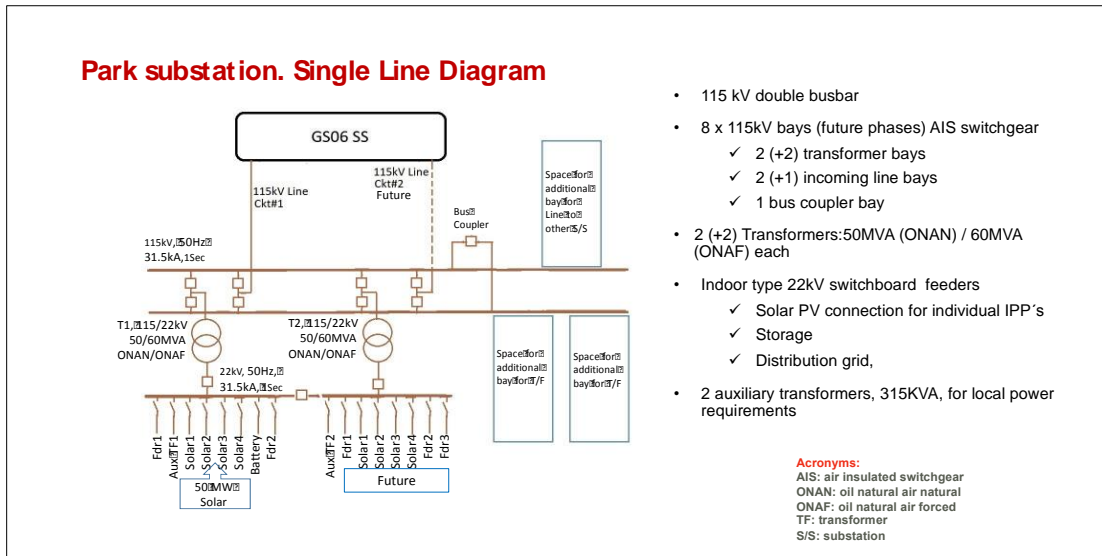


Figure 3.5. Single Line Diagram for the Solar Park Substation – Output 1

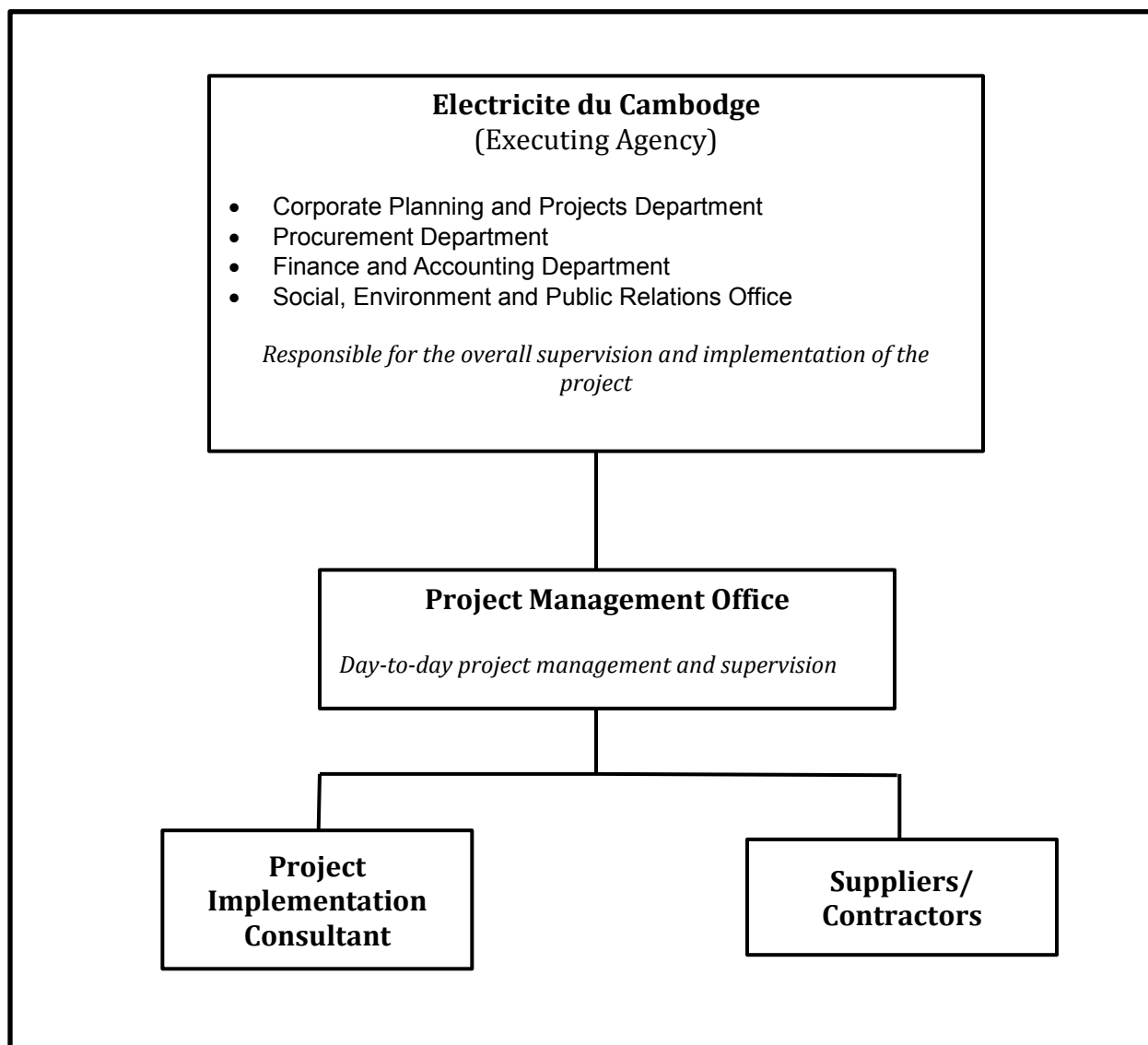


Figure 3.6. Project Organizational Structure

4. DESCRIPTION OF THE BASELINE ENVIRONMENT

4.1. Project Area Of Influence

The project area of influence includes localized impacts arising from noise, vibration and dust and transboundary impacts with wider geographical impacts, such as GHG emissions associated with material transport and PV panel production⁶¹ and disturbance to bird / bats flyways due to the operation of the solar park and the 230-kV double circuit overhead high voltage transmission line.

64. For the purposes of establishing the environmental baseline and assessing the potential environmental impacts, the area of influence for local impacts on transmission line is taken as 200 m distance from the center line, while the area of influence for impacts on solar park land ecology is taken as 7 km radius. A total area of 500 ha area, i.e. larger area than the actual area (250 ha) required for the solar park infrastructure, has been screened to ensure capture of potential impacts; the proposed transmission line was screened for length 33-34 km from existing grid substation GS6 heading towards the new pooling substation at the solar park (see sub-section 4.2 for a discussion). Particular attention was paid to identify:

- ▶ Sensitive natural environmental receptors such as water bodies, biodiversity and wildlife habitats;
- ▶ Sensitive human receptors such as households, schools;
- ▶ Cultural and heritage sites (such as temples and animism sites); and
- ▶ Potential health and safety issues.

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

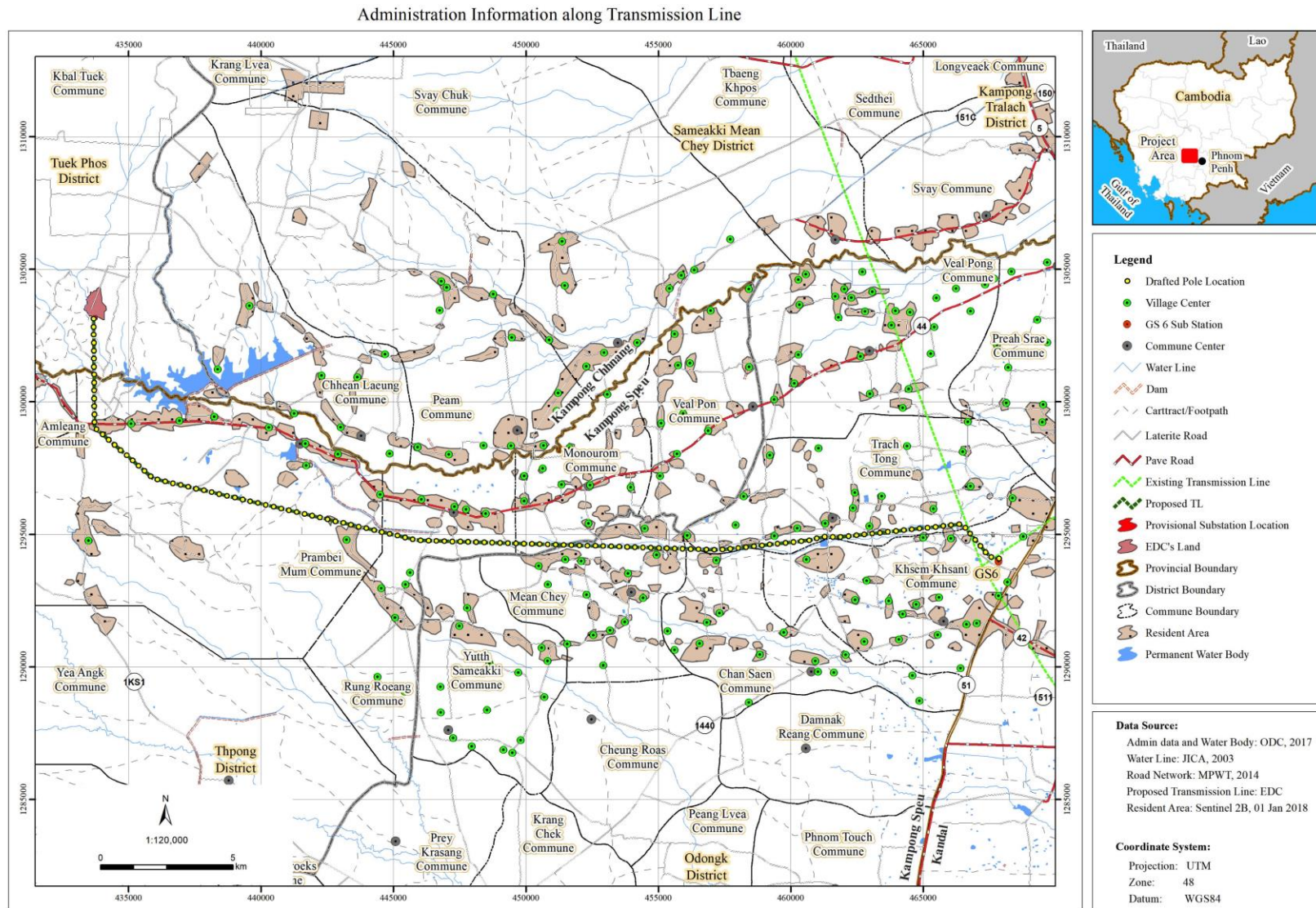
- i. The primary project site(s) and related facilities that the Borrower/ Client develops or controls. The primary project site for this project includes direct construction site for the solar park, drainage canals, fencing, storm water retention pond, access roads, temporary construction camps and permanent common facilities.
- ii. Associated facilities are defined as activities that are not funded as part of the project but whose viability and existence depends exclusively on the project. The solar PV plants are associated facilities for this project.
- iii. Existing facilities are defined as activities that already exist, for which the borrower will undertake an environment audit, including an on-site assessment to identify past or present concerns related to impacts on the environment. GS6 is an existing facility for this project.
- iv. Effects from cumulative impacts from further planned development of the project, other sources of similar impacts. Cumulative impacts in this regard are anticipated as a result of this or similar projects in the area; a discussion is included in Section 5 of this IEE.
- v. Effects from unplanned but predictable developments caused by the project that may occur later or at a different location. As a result of this project, it is anticipated that the development of the solar park will lead to further developments around the sub-project area.

⁶¹ PV panel production is energy intensive and causes depletion of some natural resources, because bulk semiconductor material is needed in high quantities (Tsoutsos et al. 2005)

4.2. Baseline Receptor Summary

66. The following section of the IEE provides the description of the baseline environment for the project components under output 1. Key receptors information was obtained and collated based on-site visits, stakeholder consultations, Rapid Socio-economic Survey, project LARP, Biodiversity assessment, discussions and interviews with Key Consultants Cambodia, consultants mandated with the task of leading the hydrological site study. A summary table for key receptors is provided in Table 4.1 while Figure 4.1 presents the project location with receptor information (the solar park site is referred to as “EDC’s land” in Figure 4.1).

67. At the Feasibility Study stage in June - July 2018, only 33-34 km of the planned transmission line starting from the GS6 could be assessed for key receptors. The remaining part of the proposed alignment closest to the solar park will be assessed after the land acquisition for the solar park is completed. The key receptors identified are in Table 4.1. Receptor information will be updated after completion of the detailed engineering design, after all land has been purchased.



National Solar Park Project (RRP Cam 511)

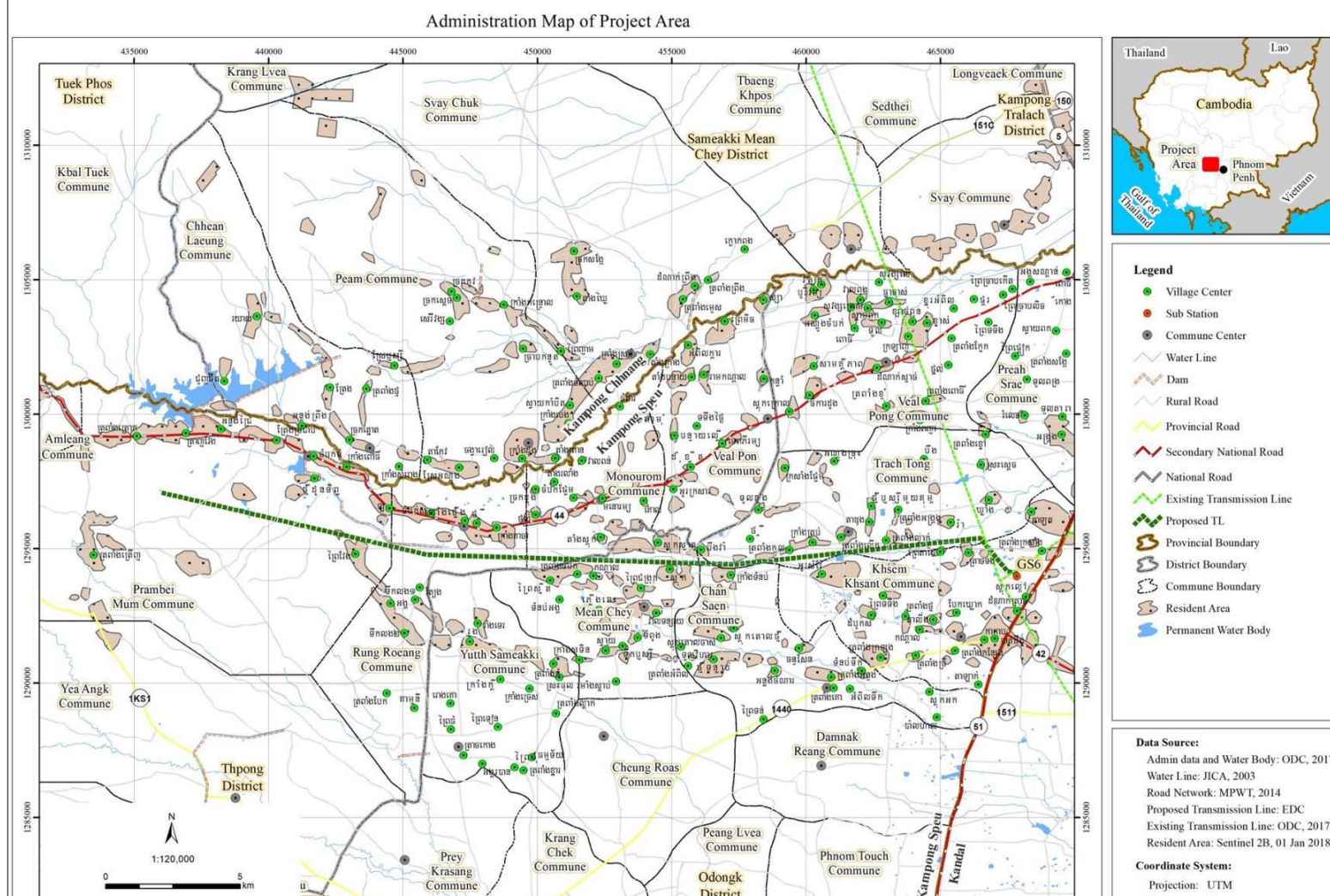


Figure 4.1 (b). 33-34 km Assessed Transmission Line

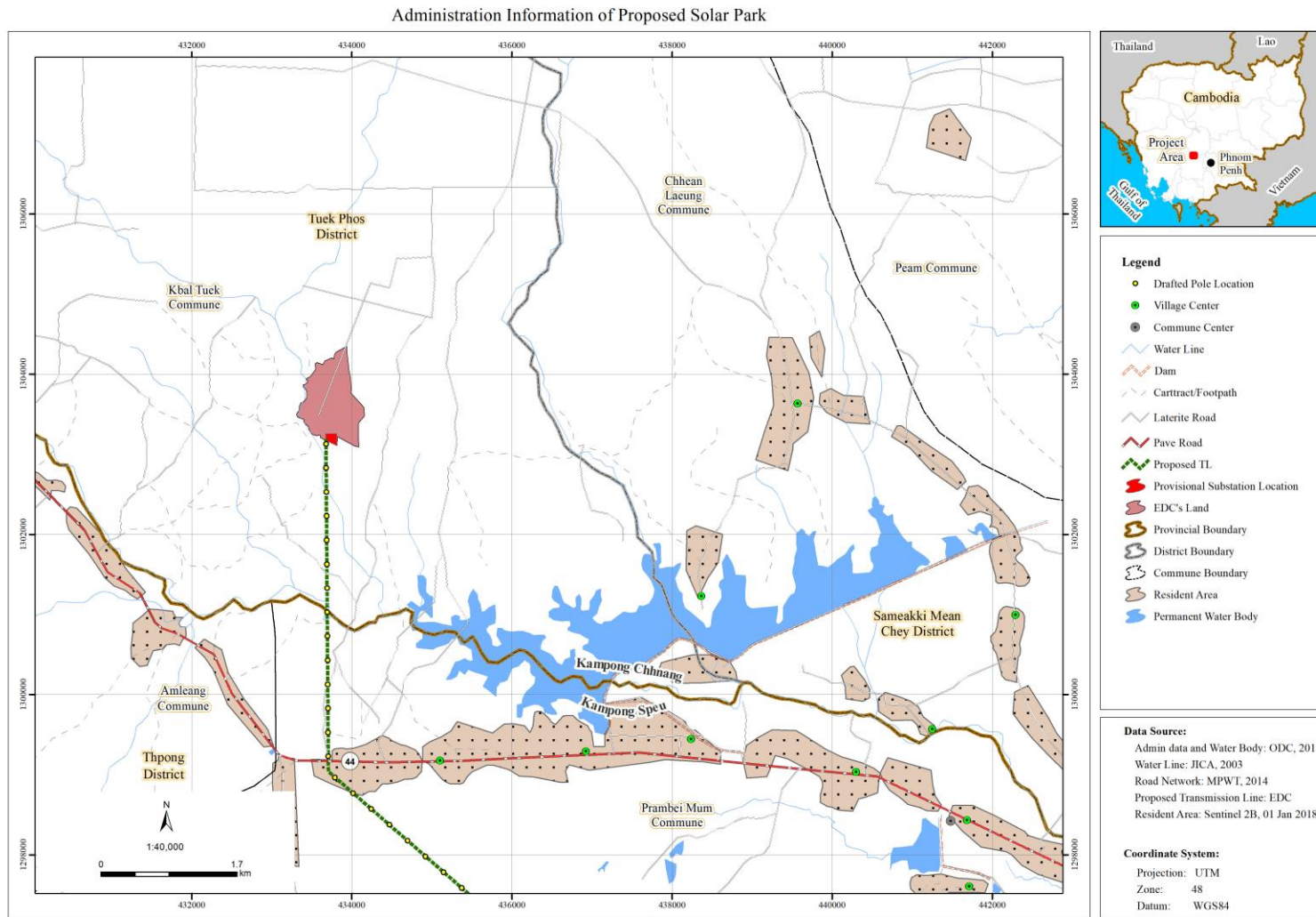


Figure 4.1 (c). Solar Park Site and Partial Transmission Line Alignment to GS6

Table 4.1. Summary of Environmentally Sensitive Receptors for Project Components under Output I

Province / District	Project Component	Communes Affected	Surface Water Receptors	Socio-Economic and Cultural Receptors	Land Cover/ Ecological Receptors	Existing Utilities Affected	Protected Area
Kampong Chhnang Province / Districts: Tuek Phos and Sameakki Mean Chey	Solar Park And Transmission Interconnection System	Total No. 2 Kbal Tuek Chean Laeung	Two natural streams transecting across the length of the proposed solar park site with inflow coming from Upper Catchment Aural and feeding into “An Long Chrey” reservoir located downstream at a distance of approximately 4-5 km; the reservoir may function as a stop off point for migratory birds	No habitations / settlements within the proposed solar park site private ownership with formal land titles or traditional land holding; police owned farmland in close vicinity	Scrubland (293 ha) and paddy fields (116 ha); small plantations such as cassava, mango, cashew, eucalyptus and bamboo are also present	None	None in close proximity to the proposed site; Phnom Aural National Protected Area located within 20 km of site; 300 ha Community forest in Chean Laeung located 5-7 km from proposed solar park in the northeast direction ⁶² .
Kampong Speu Province / Districts: Thpong and Odongk	Transmission Line ROW (approx. length 40 km) ⁶³	Total No. 6 Prambei Mum Rung Roeang	Average distance from the ROW midline: 2 fish ponds at 50 m	Average distance from the ROW midline: 1 pig farm at 35 m	Paddy fields (711 ha), scrubland (213 ha) and degraded land (147); fruit tree orchard (54 ha) and non-fruit tree orchard	2 bridges within the ROW; road crossings in all communes	Community forests located 7 – 8 km from the proposed

⁶² Tbeng Srong community forest⁶³ For the transmission line, key receptors were identified within an estimated 400 m width (or 200 m) on each side of the midline for a 30 m wide ROW for a total length of 33-34 km.

Province / District	Project Component	Communes Affected	Surface Water Receptors	Socio-Economic and Cultural Receptors	Land Cover/ Ecological Receptors	Existing Utilities Affected	Protected Area
		Mean Chey Chan Saen Trach Tong Khsem Khsant	18 natural ponds at 100 m 2 canals between 85-130 m 1 natural stream in Mean Chey at 95 m Water canal crossing in Mean Chey Chan Saen, Trach Tong and Prambei Mum	1 school fence at 20 m in Prambei Mum Commune, 3 schools at 120 m 6 houses between 40 – 90 m No hospitals identified in the vicinity. Some cultural sites within 40 m to 250 m of the proposed transmission line; refer to Table 4.5	(41 ha); vacant grassland (16.3 ha); development land (18 ha) 256 trees estimated to be cut at transmission tower footings (including 100 mango trees) while over 8500 trees to be affected by the ROW. ⁶⁴	and one railway crossing	transmission line: - 70 ha in Rung Roeang Commune and 800 ha in Prambei Mum ⁶⁵
	Grid Substation GS6		None	Village Sdok located at 500 m distance to GS6 1 school at 200 m in Khsem Khsant Commue	Upgrade within existing substation boundary	None	None

⁶⁴ Trees - palm, mango, banana, eucalyptus, bamboo, neem, other trees (Dipterocarpus obtusifolius) Source: LARP, September 2018.

⁶⁵ Chornng K'rark community forest

4.3. Geographical Location

68. The proposed project site is geographically situated between 11.669518° and 11.804790° north latitudes and 104.334288° and 104.699287° east longitudes in the provinces of Kampong Chhnang and Kampong Speu in Cambodia, located northwest and west of capital Phnom Penh, respectively. The north border of Kampong Chhnang lies on the banks of the Tonle Sap Lake. Kampong Chhnang province is connected to the capital by National Road No. 5 at a distance of 91 km while Kampong Speu is connected by National Road No. 4 at a distance of 45 km. Kampong Chhnang province has a population of over 504,234 persons and a population density of 86 persons per square km and Kampong Speu province has a population of over 72,341 persons and a population density of 102 persons per square km. The project will run across a total of four districts – Tuek Phos and Sameakki Mean Chey districts in Kampong Chhnang province and Thpong and Odongk in Kampong Speu province. There are a total of eight project affected communes – two (Kbal Tuek and Chean Laeung) in Kampong Chhnang province and remaining six (Prambei Mum, Rung Roeang, Mean Chey, Chan Saen, Trach Tong and Khsem Khsant) in Kampong Speu province. Table 4.1 lists the districts (total 4) and communes (total 8) affected by the project components under output 1.

4.4. Physical Resources

69. The proposed solar park requires 250 ha of land and the site is on a contiguous piece of land in Kbal Tuek and Chean Laeung Communes, upstream of the An Long Chrey Reservoir.⁶⁶ There are no habitations / settlements within the proposed site and a police owned farmland is located nearby that is used for cassava plantations and as a police training area. The site assessment conducted for 500 ha (inclusive of the above 250 ha) identified the site as mainly scrubland (293 ha) and paddy fields (116 ha); there are also small plantations such as cassava, mango, cashew, eucalyptus and bamboo. There is some farmland with sugar cane along the approach road to the proposed site from Road No. 51. Land classification data⁶⁷ is presented under socio-economic profile section of this section.



Source: Solar park photos from field visit

⁶⁶ The reservoir serves the micro-hydro An Long Chrey project and managed by the Ministry of Water Resources and Meteorology (MoWRAM).

⁶⁷ Rapid Socio-economic survey, April 2018

70. The proposed alignment for the 230-kV double circuit overhead high voltage transmission line will run across paddy fields and scrubland. It will also cross orchards, vacant grasslands, development land (for future residential planning), small water canals in Mean Chey, Trach Tong and Prambei Mum communes, two bridges, one railway crossing and pass between settlements / villages. Some 256 trees may be cut at the tower footing sites while over 8500 trees may be affected due to the proposed ROW.⁶⁸ Houses / structures / schools have been identified at an average distance of 20-120 m from the ROW centerline. The proposed alignment will be adjusted during detailed engineering design and sensitive receptors will be avoided. Traveling / commuting along and/or crossing the proposed alignment will be unavoidable. Health and safety measures and safeguards are included in the EMP.

71. GS6 is an existing facility located 500 m from Sdok village in Khsem Khsant commune of Odongk district in Kampong Speu province. The approach road to GS6 is through the village. The substation land is owned by EDC and is fenced on all sides with one main entrance gate with a security check. The area surrounding the substation site is open land with no households or structures. All upgrade works will take place within the existing fenced perimeter of the substation. An environmental audit conducted for GS6 is enclosed in Appendix VI.

72. Table 4.2 summarizes the land use in 500 ha area (that is inclusive of the solar park and substation); Table 4.3 summarizes the identified vegetation type 20 m on either side of the ROW centerline of the proposed alignment (surveyed length 33-34 km); and Table 4.4 summarizes the identified vegetation type at the proposed tower footing base (total land affected 3 ha). Figure 4.2 presents the land use in and around the proposed project site (delineated by a red boundary).

⁶⁸ Source: LARP, September 2018

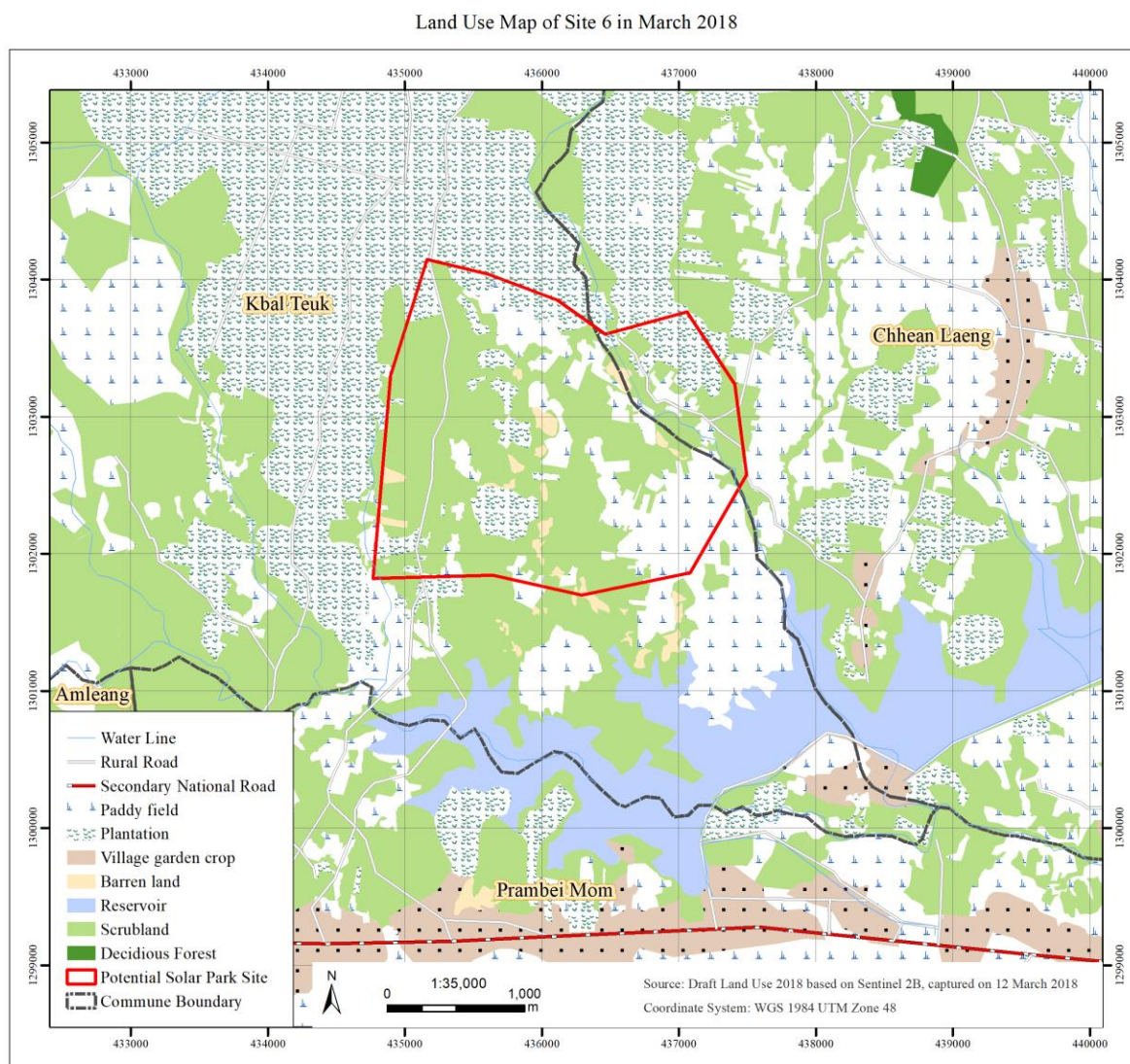


Figure 4.2 Land Use in and around the Project Site

Table 4.2. Land Use Identification for 500 ha Area, the Solar Park and Pooling Substation

Land type	Total area ha	% Of the total area
Paddy Field	115.89	23
Plantation (mango, cassava, cashew)	81.39	16
Scrubland	307.04	61
TOTAL	504.32	100

ha = hectare

Table 4.3. Land area (m²) per vegetation type identified within 30m ROW in each commune, 33-34 km (110 power tower poles area)

Commune	Paddy field	Integrated fruit tree orchard*	Non-fruit tree plantation**	Scrubland	Residential/ development land	Degraded forest / bush by stream	Water body	Palm tree	Vacant grassland	Total
Khsem Khsant	29,220	-	10,220	5,660	5,000	-	-	3,900	-	54,000
Trach Tong	197,966	7,500	12,300	46,034	-	2,000	5,200	2,500	8,500	282,000
Chan Saen	11,500	-	-	500	-	-	-	-	-	12,000
Mean Chey	120,050	-	-	9,900	-	500	1,500	50	-	132,000
Rung Roeang	148,992	-	-	1,008	-	-	-	-	-	150,000
Prambei Mum	120,460	44,280	-	83,310	9,200	56,000	-	9,550	12,450	335,250
Kbal Tuek										
Total m²	628,188	51,780	22,520	146,412	14,200	58,500	6,700	16,000	20,950	965,250
Total ha	62.8	5.18	2.25	14.64	1.42	5.85	0.67	1.6	2.10	96.5

ha = hectare; m = meter; m² = square meter; ROW = right of way

* Mango and other fruit trees; **eucalyptus and acacia

Table 4.4. Impact on Land (m²), Tower Footing Base

Commune	No. of AHs ⁶⁹	Residential land	Paddy land	Other annual crops land	Mango orchard	Eucalyptus plantation	Bamboo forest	Degraded forest	Scrub-land	Other*	Total
Khsem Khsant	10	450	1,350			225	225		450		2,700
Trach Tong	27		4,950					225	675		5,850
Chan Saen	7		900								900
Mean Chey	39		4,500								4,500
Rung Roeang	22		4,050						225		4,275
Prambei Mum	33		1,473	225	1,013	225			2,800	790	6,525
Total	138	450	17,223	225	1,013	450	225	225	4,150	790	24,750
Total ha			1.722		0.1				0.4		2.475

AHs = affected households; ha = hectare; m² = square meter

*Grassland, banana trees

⁶⁹ AH = Affected households

73. There are no PCRs (places of worship and animist sites) in the proposed solar park site; one PCR is located at a distance of approximately 1 km east of the site in Cean Laeung commune while remaining PCRs are located approximately 5 to 8 km away. For the surveyed length of the proposed transmission line alignment, PCRs are located 150 to 500 m from the alignment. Remaining length leading up to the new solar park pooling substation is yet to be surveyed and distances to PCRs ascertained. The final alignment will be planned and adjusted to avoid all PCRs. The PCRs for solar park and proposed alignment surveyed for length of 33 - 34 km are presented in Table 4.5.

Table 4.5. Physical Cultural Resources in the Project Area of Influence

Commune	Cultural and worship sites in the village	Distance to the proposed Transmission line ROW (approximate)
Solar Park		
Kbal Tuek	Chuonh Chit Village <ul style="list-style-type: none"> ▪ Neak Ta Thmor Kombour Prey Chhrao Village Thmor ROUNG KLA	This place is approximately 5 km in the south-east the proposed solar park area. Approximately 8 km from the Solar Park at the Northeast.
Cean Laeung	Royeas Village <ul style="list-style-type: none"> ▪ Trapeang K'chao pagoda Neak Ta Doun Roath and Neak Ta Chrook Nghor	6 km from the study site 1 km at the East the proposed area
Transmission Line		
Rung Roeang	Village Krang Ta Char <ul style="list-style-type: none"> ▪ Cultural site called Neak Ta Ta Koul located at a nearby natural canal 	200 – 250 m
Prambei Mum	Village Tranh Veaeng and Trapeang Troak Village Prey Veang and Trapeang Traeunh	No sacred site or place of workshop
Chan Saen	Village Krang Tumnob <ul style="list-style-type: none"> ▪ Sacred place north of the village 	200 m
Mean Chey	Village Sdok <ul style="list-style-type: none"> ▪ Place of worship called Tea Houch Village Trapeang Cambak <ul style="list-style-type: none"> ▪ Place of workshop called Oung Vaeen ▪ Animist hut called Lok Ta Pouk 	Tea Houch: 200 m Oung Vaeen: 250 m Lok Ta Pouk: 500 m
Trach Tong	Village Trapeang Kdol <ul style="list-style-type: none"> ▪ Worship site called Neakta Lpeak. Village Trapeang Lpeak <ul style="list-style-type: none"> ▪ Animist site called Neak Ta Svay Thom, Neak Ta Boeung Klou, and Neakta Oung. 	Neakta Lpeak located 200 m South of the proposed transmission line. 150 - 200 m
Khsem Khsant	Village Trach Tong <ul style="list-style-type: none"> ▪ Animist site and Trach Tong (Buddhist) temple are close to each other. Village Prey Ta Chey	Animist site and Trach Tong (Buddhist) temple located 500 m to the South of the proposed transmission line.

Commune	Cultural and worship sites in the village	Distance to the proposed Transmission line ROW (approximate)
	<ul style="list-style-type: none"> Animist site to the north of the TL, there is also an animist workshop site too in Prey Tachey village. 	Animist site located 300 m to the North the proposed transmission line.

km = kilometer; m = meter; ROW = right of way

4.4.1 Topography, Geology and Soils

74. The topography of the area ranges from $\pm 80\text{m}$ to $\pm 100\text{m}$ above mean sea level.⁷⁰ The site is mainly Devono-Carboniferous sandstone and shale and portion of it was formed by old alluvium. Figure 4.3 presents the site geology.

75. The MOE does not routinely monitor soil quality and data is not available for the project provinces. The soil quality testing for the solar park and the final transmission line alignment will be conducted as part of the engineering scope and will inform the detailed design.

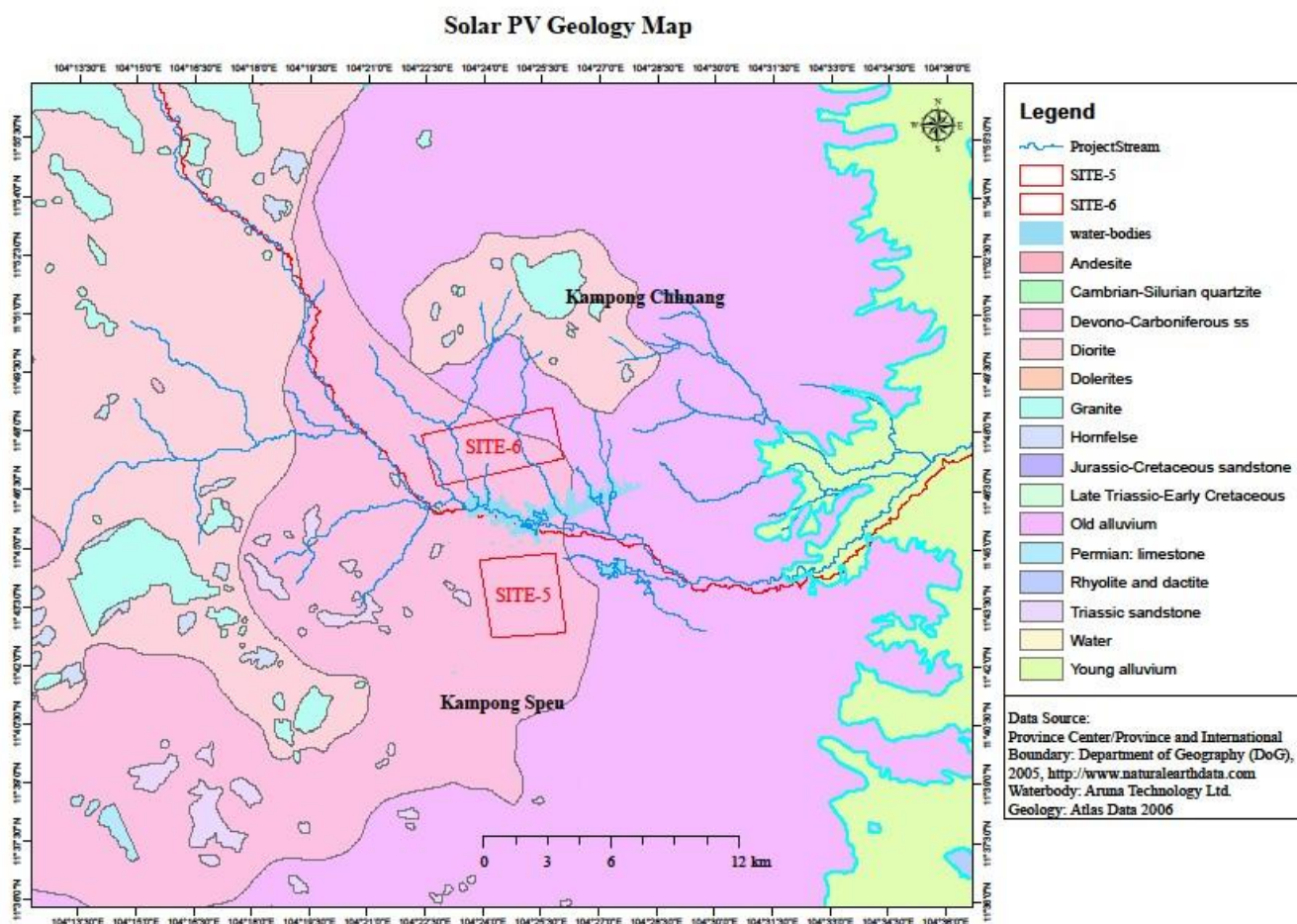


Figure 4.3. Site Geology in the Area of Influence (marked as Site 6)⁷¹

⁷⁰ Source: Google Earth (April 08, 2018)

⁷¹Source: Save Cambodia's Wildlife. *Atlas of Cambodia: maps on socio-economic development and environment*. Second ed. Phnom Penh, 2014.

4.4.2 Meteorology and Climate

76. Cambodia is situated in a tropical zone between 10 and 14 degrees latitude north of the equator. The climate is dominated by the monsoon cycle with a distinct dry season and wet season. The northeast monsoon brings in the dry season from November to April. The dry season is cooler from November to January when cool air from Siberia flows in and is dry and hot from February to April. The wet season is from May to October, as southwest monsoon brings in moisture and rains from the Indian Ocean. Most Provinces experience an average wind speed of less than 3 m/s. The maximum wind speed in the rainy season is over 20 m/s while it is lower during the dry season.

77. Average temperature has minimal variations regionally and seasonally. The average temperature in Kampong Chhnang Province is 29.8 °C. The lowest average monthly temperature occurs in December and January (from 25.6 to 25.7 °C), and the highest average monthly temperatures occur in March and April (from 29.3 to 29.8 °C). The average temperature in Kampong Speu Province is 27°C. The lowest average monthly temperature occurs in December and January (from 26 to 27°C), and the highest average monthly temperatures occur in March and April (from 29 to 30°C).

78. Both Kampong Chhnang and Kampong Speu provinces have relatively low rainfall with an average annual rainfall of approximately 1,000 millimeter.

4.4.3 Air Quality and Noise

79. Field visits indicate that air quality in the project site is good as the project areas are located in rural areas without significant industrial/commercial zones to cause air quality degradation or high noise levels. This was also observed at the existing facility GS6 site. Typically, in Cambodia, outside Phnom Penh or town centers there are few industrial pollution sources and the volume of vehicular traffic is low. There was no available air quality data or noise level measurements for the project provinces. Air quality and noise monitoring will take place to inform the environmental baseline. These will be undertaken at the proposed solar park site and at sensitive receptor sites (e.g. households) along the final transmission line alignment during detailed design and incorporated into an updated IEE and EMP.⁷²

4.4.4 Hydrology, Surface And Groundwater

80. **Hydrology.** An ongoing hydrological study will assess the entire catchment area of the final selected site for the solar park and the transmission interconnection infrastructure. Assessment will take account of peak rainfall season (September and October) and anticipated increases in frequent and /or intense extreme weather events. Preliminary assessment shows the proposed project site is outside the flood boundary (also see Appendix V). Figure 4.4 presents the site contour generated by Google Earth and ArcGIS while Figure 4.5 shows stream inflow at

⁷² Air quality monitoring will be conducted bi-monthly during the civil works and once after completion of the civil works (location: solar park site and at sensitive receptor sites along the final transmission line alignment). Measurements of noise levels will be conducted bi-monthly during civil works (location: solar park site and at sensitive receptor sites along the final transmission line alignment) and once after completion of the civil works (location: solar park site / upon commissioning of the substation).

the proposed project site. The data from the hydrological study will be integrated into the IEE during detailed design.

81. **Surface Water.** The proposed solar park is located upstream of a reservoir that serves a 170 kW micro-hydro An Long Chrey project. The reservoir gathers the interflow from three main streams (source - upper catchment Aural) with major inflow from Stung Chreav stream. Two of these streams transect the project site while Stung Chreav stream bypasses the proposed project site by a distance of 1.6 km. These two streams are the only surface water bodies within the proposed solar park site and will be conserved in its current natural condition by establishing a buffer of at least 400 m on either side of the streams.⁷³ Preliminary findings from the ongoing hydrological study suggests that the An Long Chrey reservoir experiences overflow during operation on recurring basis; in February 2012 the overflow extended up to 1.5 km from the proposed site. The reservoir is located a distance of approximately 4 to 5 km from the proposed solar park site, therefore overflow will not be an issue. As seen in Table 4.1 there are no protected surface water bodies within the project area of influence. There are, however man-made drainage canals that are used for irrigation at the solar park site and irrigation dykes along the proposed transmission alignment.

82. **Groundwater.** The depth to groundwater will need to be clarified as well as usage at the proposed solar park site as the detailed engineering design phase progresses and the relevant hydrological assessments are undertaken for the entire site. The existing facility (GS6) utilizes groundwater for in-house use such as sanitation / kitchen via a 1000 liters capacity tank; water is pumped to the tank once per day. The substation also pumps groundwater for fire fighting and stores it in three tanks of 2000 liters capacity each. At the time of the audit, copy of permissions for groundwater abstraction was not available and site engineers were unaware of the permit requirements.

83. **Water Quality.** The MOE does not routinely monitor water quality. Water quality analysis will take place to inform the environmental baseline. This will be undertaken for both surface water and ground water at the proposed solar park site and downstream reservoir once before the start of civil works, These data will be incorporated into an updated IEE and EMP during detailed design phase.⁷⁴ At existing facility (GS6) water quality testing is conducted on a semi-annual basis. The drain water is collected at the final discharge point for sampling and sent to a MOE registered laboratory for tests. There has not been detection of water contamination at the site since start of operation in 2013.

84. **Water Usage and Sources.** Information on water usage and source by households in the project-affected communes are included under the Socio-Economic Profile of this section. Public consultations confirmed that the water usage is mainly for household use, feeding animals and irrigation. Water is sourced from local ponds, streams, and river or groundwater wells.

⁷³ The important habitat within the proposed solar park are the natural streams and it is necessary to conserve these streams in its natural state and establish a buffer of 400 m on both sides, Source: Project Biodiversity Assessment, July 2018.

⁷⁴ Water quality analysis will also be conducted once prior to civil works and once after completion of civil works as stipulated in the EMP.

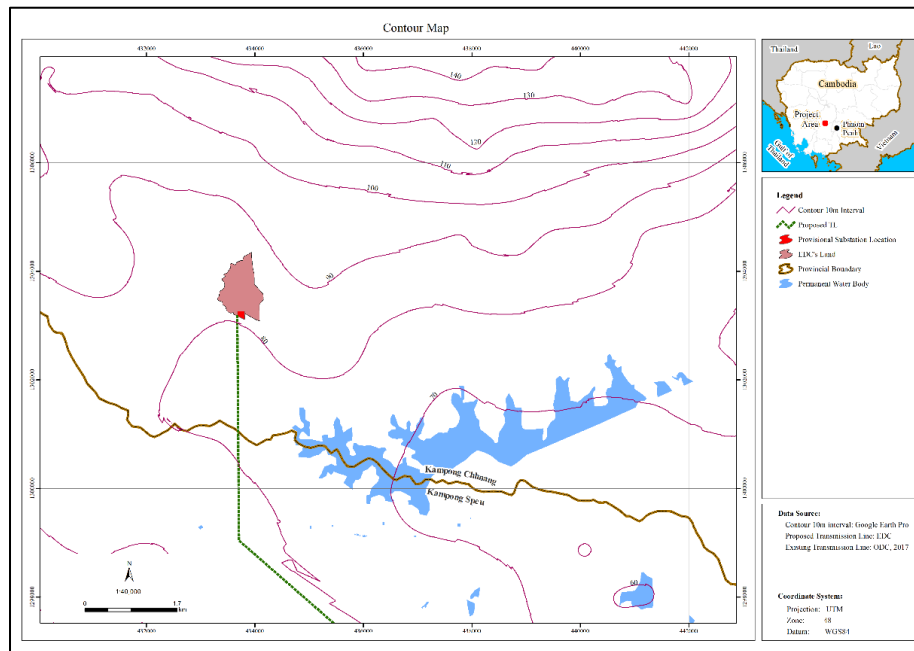


Figure 4.4 Site Contour in the Area of Influence

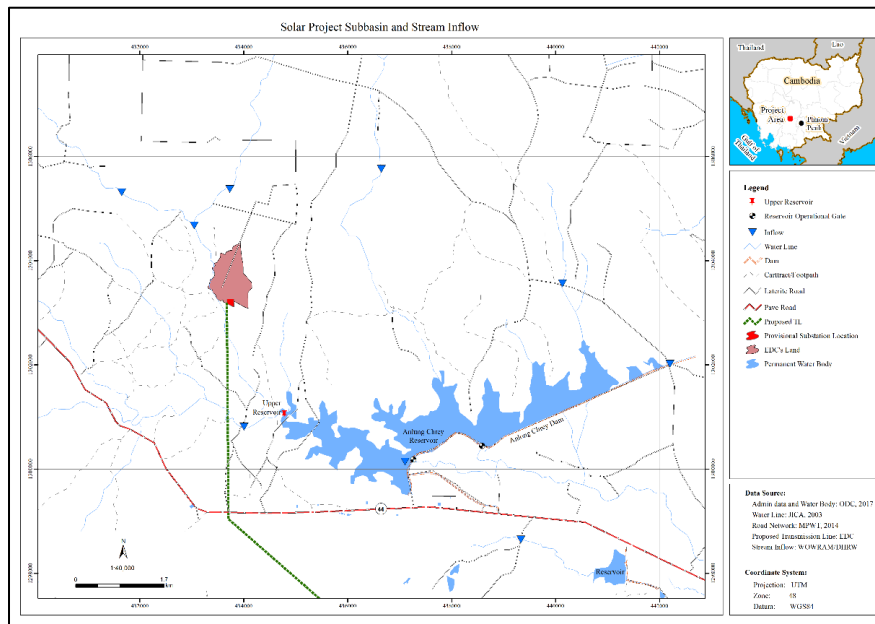


Figure 4.5 Stream Inflow in the Area of Influence⁷⁵

⁷⁵ Hydrological Study CAM NSPP March 2018 (draft, work in progress)

4.4.5 Natural Hazards

85. **Climate Risks.** The project has been screened for climate risks using the AWARE climate risk-screening tool⁷⁶ and the overall risk level is Medium. The screening noted that the proposed project site is located in a region that may be potentially at a High-Level Risk from recurring major flood events and precipitation induced landslides and as such mitigation measures in the design are required. The screening also noted that the proposed project site is at a Medium Level Risk for increase in temperature and precipitation, change in water availability and solar radiation. Following the screening results, a Climate Risks and Vulnerability Analysis (CRVA) has been undertaken for the project. Project components sensitive to climate change were identified as listed in Table 4.6. These potential impacts are managed through design mitigation measures, where appropriate in accordance with the Guidelines for Climate Proofing Investments in the Energy Sector (ADB, 2013). Detailed CRVA is enclosed as Appendix IV.

Table 4.6 Climate Change Impact on Solar Park Infrastructure⁷⁷

Climate Change Factor	Risk Level	Potential Impacts
<ul style="list-style-type: none"> • More Frequent and/or Intense Extreme Weather Events <ul style="list-style-type: none"> ○ Recurring flood events ○ Precipitation induced landslides 	High	<ul style="list-style-type: none"> • Increased risk of direct flood damage to solar photovoltaic (PV) plants, substation, drainage canals, access roads and transmission line tower structures • Increased risk of accelerated surface run-off, soil erosion and sedimentation load at site affecting land and drainage • Access / approach roads could be damaged or washed out or segments could be eroded. • Affected life span of solar park infrastructure
<ul style="list-style-type: none"> • Increase in temperature • Increase in precipitation • Change in solar radiation • Change in water availability 	Medium	<ul style="list-style-type: none"> • Increased operating challenges to solar PV plants such as lower cell efficiency and energy output • Heat waves stress on roads, buildings and other infrastructure • Reduced electricity carrying capacity of transmission lines • Increased losses within the substation and transformers • Increased risk of corrosion of steel infrastructure (lattice towers) with a corresponding increase in humidity

⁷⁶The screening is based on the AwareTM geographic data set, compiled from the latest scientific information on current geological, climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to hazard variables, returning information on the current and potential future risks that could influence its design and planning.

⁷⁷ Data sources utilized: (i) GMS CEP SEA START RC Climate Change Adaptation Platform, web-link - <http://climatechangeadaptation.gms-eoc.org/home/country>; (ii) World Bank's Climate Change Knowledge Portal; (iii) Preliminary findings of the project Hydrological Study; (iv) Think Hazard, web-link: <http://thinkhazard.org/en/report/44-cambodia/LS>; (v) EM-DAT | The international disasters database, web-link: <https://www.emdat.be/>; (vi) Guidelines for Climate Proofing Investments in the Energy Sector (ADB, 2013).

Climate Change Factor	Risk Level	Potential Impacts
		<ul style="list-style-type: none"> Increased risk of drought episodes and dust damage to solar PV plants Less water availability for PV panel cleaning and maintenance of vegetation within the solar park

86. **Extreme Weather Events.** Storms and typhoons are not considered a major problem in Cambodia as surrounding mountain ranges protect the country. However, some storms do occasionally affect the country with most storm-related damage caused by localized floods associated with heavy rain. Tropical storms can also affect the level of Mekong River flooding and cause flash floods⁷⁸ as well as increase the risk of precipitation-induced landslides. Figure 4.6 presents the precipitation-induced landslides in the region (highlighted in yellow). As seen the proposed project site is outside the landslide impact zone.

87. Some parts of Kampong Speu and Kampong Chhnang were affected by flash floods in the recent past. The maximum flood extent in 2000⁷⁹ by the Mekong River flood and the maximum flash flood extent in 2011 and 2013 are presented in Figure 4.7. As seen in the figure, the proposed project site was out of the flood boundary during these events. The project area communes report heavy precipitation and corresponding floods that affected large areas of rice paddy fields in 2015. Kampong Chhnang and Kampong Speu provinces were affected by drought in January 2002 considered as the worst in two decades by the National Committee of Disaster Management and lasted until the onset of rains in mid-August. The project area communes report droughts as recurring phenomena during the dry season.

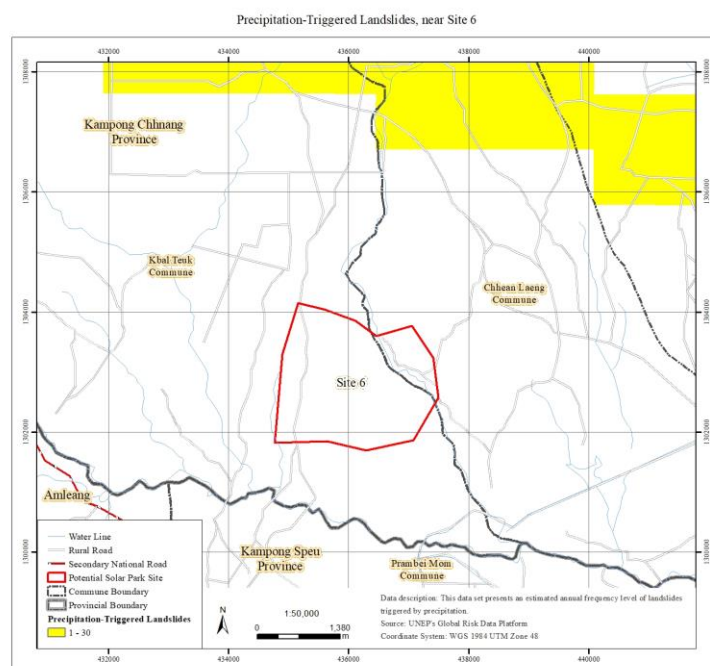


Figure 4.6 Precipitation Induced Landslides

⁷⁸ The Mekong river floods are a result of the cumulative rainfall in the upper catchment of the Mekong throughout the rainy season. Mekong river floods are common in the provinces of Stung Treng, Kratie, Kampong Cham, Prey Veng, Svay Rieng, Kandal, and Takeo. Flash floods are a result of repeated heavy rainfall in mountainous areas that flow to streams and tributaries of the Mekong River. Flash floods are swift, last only a few days but often cause severe damage to crops and infrastructure especially in tributaries around the Tonle Sap Lake.

⁷⁹ The year 2000 is considered as the worst flood in the recent history of Cambodia

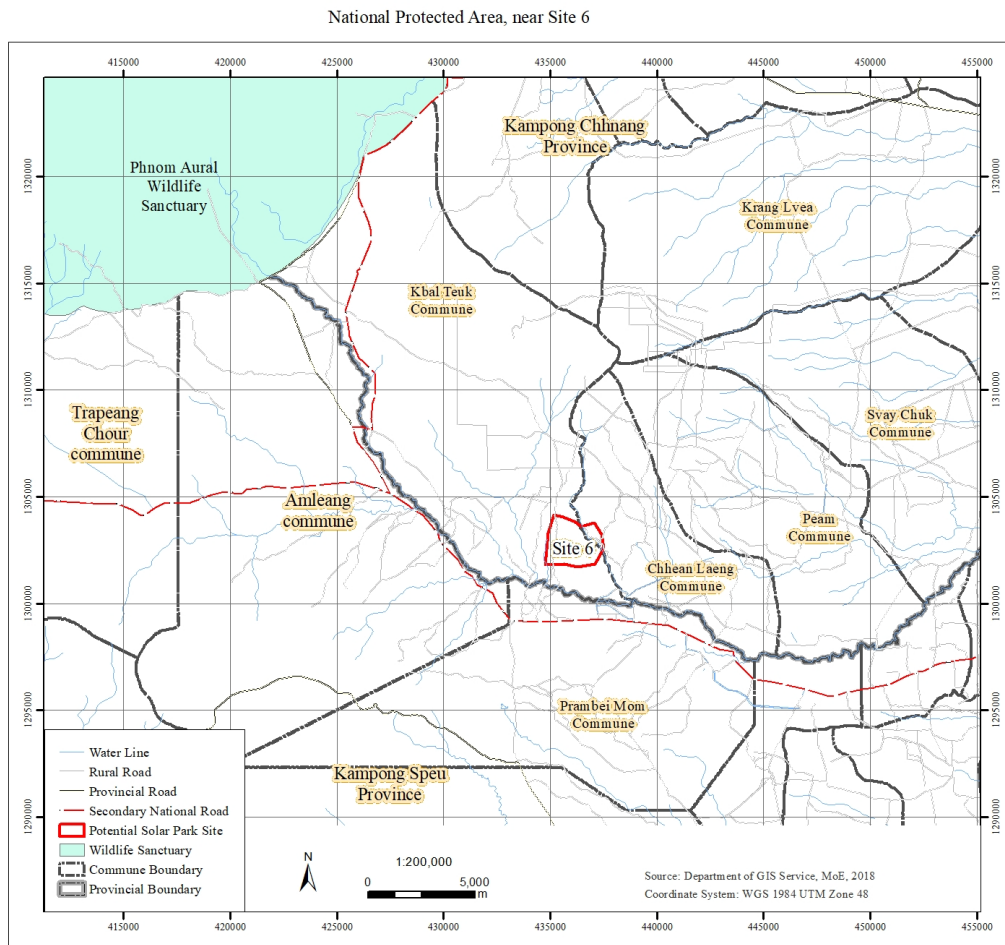


Figure 4.8 National Protected Area - Phnom Aural and Proposed project site (initially referred to as “Site 6”)

4.6. Ecological Resources

4.6.2. Flora

90. There are no protected areas or habitats of particular biodiversity value within the project area of influence. The proposed solar park site is located in modified environment (disturbed by human activity) dominated by scrubland with scattered trees and paddy fields (see Table 4.2 through 4.4), however it contains two natural streams that transect across the site and these are important for conservation since these serve the local habitat (also refer to discussion in Physical Resources). A forest habitat located approximately 200 m east of the transmission line alignment close to the proposed solar park site⁸¹ covering roughly 10 hectares contains habitat type “dipterocarpaceae” which may support wildlife. However, this is private land owned by multiple persons.

91. Community forests. The Tbeng Srong protected community forest (located approximately 5-7 km away from the proposed solar park site) has a mix of diverse tree species that are grown and /or regenerated. The habitats located within this community forest can be considered as new regenerating natural habitat and a good ecosystem for wildlife. This community forest will not be affected by this project. There are two community forests in the project-affected communes for the proposed transmission line, one situated in Rong Rueung commune and the other in Prambei Mom commune. These two community forests are located away from the transmission line ROW by 6 to 8 km and will not be affected by the proposed project.

4.6.3. Fauna

92. There were no endemic, rare, threatened or globally endangered species or species of particular conservation value observed during the site visit or identified from consultations and historic records at the proposed solar park site, transmission line alignment and An Long Chrey reservoir. All bird species recorded or tallied during the ground surveys that were conducted in dry season and wet season⁸² are classified by IUCN as being of Least Concern category, these include regional migratory, local migratory and ground birds. Further seasonal surveys of migratory species (birds and bats) and potential impacts on flyways will be carried out; this will inform the detailed design (see Appendix III). The initial survey findings are summarized below:

93. **An Long Chrey reservoir.** The reservoir is located downstream of the solar park site at a distance of about 4-5 km. Based on its ecological condition coupled with frequent increases in elevation of stored water especially during rainy season, this site can attract some migrant bird species such as Lesser Whistling Duck, Cotton Pygmy Goose, Barn Swallow, Asian Palm Swift, House Swift, etc as winter visitors (all IUCN Least Concern classification). These migrants have their own specific flyway that is included in East Asian – Australasian Flyway of migratory water birds.

94. **Solar Park Site.** When considering the habitats within the proposed solar park site and the wider surrounding area comprising of scrubland, agricultural farms, streams as well as the

⁸¹ See Appendix III – Biodiversity Assessment, Figure 3 (TL2 point)

⁸² Dry season survey was conducted in March 2018 and covered the proposed solar park site, alternative site and transmission line ROW. Wet season survey was conducted in July 2018 and covered the proposed solar park site, transmission line ROW (close to the solar park site), An Long Chrey Reservoir⁸² and Tbeng Srong community forest (300 ha) located northeast of proposed solar park in Chean Leung commune at a distance of approximately 4-5 km.

downstream reservoir, these are modified habitats. Within the solar park itself, the presence of two natural streams may support bird species as well as wild pig, muntjac, Burmese hare and other rabbit species (all Least Concern IUCN classification).

95. **Transmission Line ROW.** Due to mix of habitats along the proposed transmission line comprising of agricultural fields, grassland, scrubland and dipterocarpaceae forest, these habitats can be a stop off for migratory bird species such as Black Drongo, Common Myna, Common Snipe, etc (all Least Concern IUCN classification).

96. **Comparison between Survey Results conducted during dry and wet season.** Dry season and wet season surveys tallied and recorded a total of 78 and 24 bird species, respectively at the proposed solar park site. All bird species were of “Least Concern” category as per IUCN. Only 16 bird species were common between dry and wet season surveys. The difference in number of species recorded during the two surveys may be attributed to seasonal migration. The dry season survey was conducted in March, which is a prime time for bird migration at global, regional and local level while the wet season survey was conducted in July, which is when most of the bird species move away to their breeding or to other foraging grounds. The wet season survey indicates that there is an ecological connection between stream habitats, reservoir, dipterocarpaceae forest and scrubland. The natural streams within the proposed solar park site serve as the feeding ground for Green Peafowl (Least Concern IUCN classification) while the Dipterocarpaceae forest in Tbeng Srong community forest serves as its breeding ground. Other bird species may migrate to other nearby areas for feeding and breeding including the Phnom Aural Wildlife NPA, the Tonle Sap Biosphere Reserve of the reservoir, for instance, the migration of egret and heron species from the natural stream to the reservoir. In addition, the habitat of Dipterocarpaceae forest and scrubland is also favorable for local migratory species such as the eagle.

97. **Community Forests.** Tbeng Srong community forest containing the Dipterocarpaceae forest (300 ha) is suitable for wildlife such as Green Peafowl, Red jungle fowl, Wild pig, etc. Most of red jungle fowl can breed within this habitat. This forest, located approximately 5-7 km northeast of the proposed solar park site, will not be affected by the proposed project. The local interviews at Royeas village in Chaen Laeung commune suggested possible presence of endangered and vulnerable mammals and reptiles within Tbeng Srong community forest as seen or heard within the last five years. Species included Dhole, Fishing Cat (both classified as IUCN Endangered), Asiatic Jackal, and Burmese Python (both classified as IUCN Vulnerable). However, these species and/or suitable habitats for these species were not identified in the field survey. The interviews also confirmed that bird species found are typical of forested areas, wetlands and rural areas.

4.7. Socio-Economic Profile

98. A commune level baseline population and socioeconomic assessment was undertaken in eight communes in the project area in January and March 2018. Following this, a Census and Inventory of Loss (IOL) survey of the affected households along the proposed transmission line was conducted in June 2018; details are presented in a separate Land Acquisition and Resettlement Plan (LARP) report.

99. **Population and Poverty in the Project Affected Communes.** The average household size in the project area is 4-5 persons. The portion of female-headed households varies between 12-24% across the communes. Household poverty rate is high with 19-27% of households under the national poverty line and in almost all communes the household poverty rate is higher than the national rural poverty rate of 20% (2012)⁸³. Almost all inhabitants in the project area communes are ethnic Khmer with one to four Cham households in some communes. Majority of the households are Buddhist; only in Rung Roeang commune there are six Christian and three Muslim households, one Christian household each in Mean Chey and Chan Saen communes and 66 Christian households in Khsem Khsant commune. Table 4.7 presents the survey findings on population and poverty in the project area communes.

Table 4.7. Population and poverty situation in the project area communes

Commune	Population			Total HHs	% Female-headed HHs	HH Poverty rate %*
	Total	Male %	Female %			
Chean Laeung	5,205	46	54	1,237	ND	22
Kbal Tuek	5,893	48	52	1,463	24	22
Prambei Mum	11,860	50	50	2,745	12	23
Rung Roeang	9,873	47	53	2,116	14	27
Mean Chey	6,726	49	51	1,377	15	23
Chan Saen	7,612	45	55	1,682	12	19
Trach Tong	8,268	47	53	1,705	ND	25
Khsem Khsant	11,126	47	53	2,213	13	21
	72,591			15,752		

HH = household

Source: Ministry of Planning Sub national Poverty Rate Report 2015. ND – Not Determined

100. **Livelihoods and Income.** Majority of the households in the project area communes practice farming while some households run small businesses. Some household members also earn their livelihood working in nearby factories / industries, at construction sites and/or hold government staff positions. Livelihood generation vis. employment on plantations was reported as temporary and seasonal. Household average monthly income varies from \$80 to \$200; the low income was attributed to poor land productivity, lack of cultivable land, lack of family labor force and unemployment, disease or death in family (leading to non-working days) and unfavorable climate conditions. In Chean Laeung commune, four persons are employed at the small-scale hydropower plant I.E. An Long Chrey while two persons are employed at a cassava plantation. In Kbal Tuek commune, 450 Workers are employed at the local sugarcane plantation while in Prambei Mum commune 650 workers are employed at two local sugarcane plantations. In Chan Saen commune, 230 workers are employed at a drinking water plant. In Khsem Khsant commune,

⁸³Ministry of Planning, 2014.

200 workers are employed at Sakura Food industry while a total of 430 workers are employed at rice milling industries in two villages of the Commune. Workers in these industries / plantations may come from different communes so not all workers are local or Commune specific. Table 4.8 presents the survey findings of household livelihoods and average monthly income in the project area communes.

Table 4.8. Household livelihoods/main income sources in the project area communes

Commune	Total HHs	Agricultural HHs	Small business and handicraft HHs	Non-agricultural worker No. of people	Government staff No. of persons	HH average monthly income in USD
Chean Laeung	1,237	1,211	1	74	42	110
Kbal Tuek	1,463	ND	19	169	10	80
Prambei Mum	2,745	2,610	1	67	80	120
Rung Roeang	2,116	1,798	106	212 HHs	81	100
Mean Chey	1,377	1,377	17	911 HHs* 30 HHs**	30	200
Chan Saen	1,682	1,682	40	1,672***	55	200
Trach Tong	1,705	1,364	17	324 HHs	19	100
Khsem Khsant	2,213	1,440	331	442 HHs	105	150

HH = household; No. = number; USD = United States Dollar

* work in garment factory; ** work in construction; ***persons, garment factory workers and construction workers.

101. **Electricity.** Table 4.9 presents electricity access information at households in the project area communes. Kbal Tuek commune has no grid connection while Khsem Khsant commune has 100% grid connection. All communes with exception of Khsem Khsant commune also utilize batteries for electricity.

Table 4.9. Electricity access in the project area communes

Commune	Total No. of villages	Villages with grid connection	% HHs with grid electricity	% HHs using batteries for electricity	% HHs with solar panels for electricity
Chean Laeung	8	-	-	70	ND
Kbal Tuek	10	ND	ND	61	ND
Prambei Mum	ND	ND	18	82	ND
Rung Roeang	10	6	59	27	14
Mean Chey	14	9	65	16	15
Chan Saen	ND	ND	86	14	-
Trach Tong	17	9	55	38	-
Khsem Khsant	19	19	100	-	-

HH = household; ND – Not Determined; No. = Number

102. **Source of energy for cooking.** Firewood is the most common energy source for cooking followed by electricity and liquid petroleum gas. Table 4.10 presents the energy source for cooking at households in the project area communes.

Table 4.10. Energy source for cooking, percentage of households

Commune	Firewood	Gas (LPG)	Grid Electricity
Chean Laeung	ND	ND	ND
Kbal Tuek	ND	ND	ND
Prime Mum	ND	ND	ND
Rung Rueing	90	2	8
Mean Chewy	35	0	65
Chan Sean	54	18	28
Trash Tong	79	21	0
Khsem Khsant	65	20	15

ND – Not Determined; LPG – Liquid Petroleum Gas

103. **Water sources for household use.** In the project area, only two communes have more than 75% households with access to improved source of drinking water (“improved” source of drinking water implies piped water supply in dwellings or premises, public taps, tubed/piped well or borehole, protected dug well or rainwater collection). Households in other six communes access drinking water from unimproved sources (“unimproved” source of drinking water implies unprotected dug well, pond, river or stream, vendor-provided water or water tanker). Sanitation conditions vary between households. Approximately half the families have improved toilets (i.e. flush connected to sewerage or septic tank, or pit latrine with slab). In three communes, 50% households practice open defecation. Table 4.11 presents survey findings of drinking water sources and sanitation in the project area communes.

Table 4.11. Water and sanitation in the project area communes

Commune	Source of HH drinking water % HHs		Toilet facilities % HHs		
	Improved	Unimproved	Improved	Unimproved	Open defecation
Chean Laeung	90	10	70	ND	ND
Kbal Tuek	77	23	6	ND	ND
Prambei Mum	18	62	ND	ND	ND
Rung Roeang	0	100	49	51	-
Mean Chey	26	74	51	-	49
Chan Saen	ND	ND	47	-	53
Trach Tong	6	94	41	-	59
Khsem Khsant	32	68	80	20	-

HH = household; ND = not determined

104. **Education and Health.** Each Commune has several primary schools and one lower secondary school while upper secondary schools are located in only Khsem Khsant and Prambei Mum communes. The health facilities in the project area Commune are presented in Table 4.12.

Table 4.12. Number of Public and Private Health Facilities in the Project Area

Commune	Health Facility
Chean Laeung	1 public
Kbal Tuek	0
Prambei Mum	0
Rung Roeang	1 public and 1 private facility
Mean Chey	0
Chan Saen	1 public and 1 private facility
Trach Tong	1 private facility
Khsem Khsant	1 public and 4 private

105. **Land Classification.** Land classification data and productive land use in the project area communes are compiled in Table 4.13 and 4.14. There are no reported social and economic land concessions in these communes with the exception of Prambei Mum commune that has 1 ha of economic land concession area. There are 70 ha of land classified as protected area (community forest) in Rung Roeang commune and 800 ha in Prambei Mum commune; the proposed project does not impact the protected area in these communes. These have been discussed under Ecology Resources. Approximately half the households have less than 1 ha of rice land while paddy production per ha varied between project area communes from 1.2 to 3 tons per ha. Households reported some land conflicts. In Kbal Tuek Commune there were 17 cases of land-related conflicts between family groups in 2014 while in Mean Chey Commune there one land conflict issue between Commune Chief and Commune Clerk that involved selling commune's land to private owners, the conflict lasted from 2003 to 2008.

Table 4.13. Land Classification in the Project Area Communes (ha.)

Commune	Total area	State land	Private land	Collective property land	Social land concessions	Economic land concessions	Wildlife sanctuary/protected area ⁸⁴
Chean Chean Laeung	4,210	ND	ND	ND	ND	ND	ND
Kbal Tuek	23,560	ND	ND	ND	0	0	0

⁸⁴ These areas are not within the project area of influence.

Commune	Total area	State land	Private land	Collective property land	Social land concessions	Economic land concessions	Wildlife sanctuary/protected area ⁸⁴
Prambei Mum	14,045	ND	847	ND	0	1	800
Rung Roeang	4,000	0	2,179	0	0	0	70
Mean Chey	2,562	ND	ND	ND	0	0	0
Chan Saen	4,237	ND	ND	ND	0	0	0
Trach Tong	4,017	ND	ND	ND	0	0	0
Khsem Khsat	4,050	10	0	0	0	0	0

ha – hectare; ND = not determined

Table 4.14. Productive Land Use in the Project Area Communes (ha.)

Commune	Rice paddy	Subsidiary and industrial crops	Irrigated area	Paddy productivity tons /ha	HHs with less than 1ha of paddy land		Forestry area
					No.	%	
Chean Laeung	1,080	ND	160	1.2	662	54	-
Kbal Tuek	3,300	1,500	ND	2.5	460	31	-
Prambei Mum	1,900	3,520	35	2.7	932	34	7,528
Rung Roeang	1,850	250	71	2.5	436	21	26
Mean Chey	2,060	47	9	3.0	0	-	360
Chan Saen	2,195	216	45	2.5	930	56	26
Trach Tong	1,160	1,668	0	ND	682	40	1,500
Khsem Khsant	1,500	750			1,549	70	1,450

ha – hectare; HH = household; ND = not determined; No. = number

5. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1. Project Environmental Benefits

106. This project is expected to have significant environmental benefits. A transition to clean solar energy generation will limit import dependence on coal and other fossil fuels, delay or defer construction of new coal-fired plants and reduce reliance on hydropower generation⁸⁵. This would contribute to national emission reduction targets⁸⁶ and reduced pollution impacts. The project will construct a 100 MW capacity solar park in phases. Phase I will be 60 MW while Phase II will be the remaining capacity. However, two scenarios are considered for calculating GHGs reductions presented as follows:

- Scenario I – A 30 MW project (Phase I) will avoid approximately 42,000 tons of carbon dioxide-equivalent (tCO₂e) annually. When the anticipated 100 MW capacity (Phase II) is achieved there will be approximately 140,000 tCO₂e annual emission savings or approximately 2.934 million tCO₂e over a 20-year project lifetime.
- Scenario II – A 60 MW project (Phase I) will avoid approximately 84,000 tons of carbon dioxide-equivalent (tCO₂e) annually. When the anticipated 100 MW capacity (Phase II) is achieved there will be approximately 140,000 tCO₂e annual emission savings or approximately 2.934 million tCO₂e over a 20-year project lifetime.

5.2. Environmental Impact Screening

107. This section discusses potential environmental in the context of the following factors:

- i. “Receptor”: the resource (human / natural environment / economic / social) that 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 may support aquatic ecosystems or the local biodiversity or livelihoods through fishing and/or tourism.
- iii. “Magnitude”: the size of the potential impact. Impacts may be short term and considered low magnitude (e.g. noise, dust or vibration) or high magnitude and long term (e.g. global and regional flyways of migratory birds).

108. 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.

109. Environmental impacts were assessed across all stages of project implementation i.e. (i) design and pre-construction stage, (ii) construction stage, and (iii) operation stage. Direct impacts

⁸⁵ Cambodia now has a surplus of power generation in some hours in wet periods and at nighttime. Yet the national grid is unable to meet daytime peak demand in high population areas such as Phnom Penh and experiences shortages during the dry season when storage in hydropower reservoirs is limited.

⁸⁶ <https://unfccc.int/resource/docs/natc/khmnc2.pdf>

will result from acquisition of land for the solar park and transmission tower footings. Potential cumulative and induced impacts from further planned development of the project and other sources of similar impacts were also considered.

5.3. Design And Pre-Construction Stage

110. The potential adverse environmental impacts associated with the project will be avoided or minimized by: (i) careful site selection and route alignment; (ii) integrating key measures that will permanently become part of the infrastructure and will be included in the project detailed engineering design; (iii) implementation of environmental mitigation measures for identified impacts; and (iv) ensuring project environment management readiness.⁸⁷ These are as follows:

Key Measures During Site and Route Selection

111. Site and Route Selection.

- i. A critical issue for the management of impacts on identified receptors, particularly: a) households areas / structures, b) surface water sources, c) groundwater wells, d) road and railway crossings, e) global and regional flyways of migratory birds, f) protected areas, habitats and species of conservation value, and g) PCRs
- ii. EDC and ADB undertook a Pre-Feasibility Study⁸⁸ to assess site and route options for the project (see Section 6 of the IEE).
- iii. The preferred site and route were selected to avoid sensitive receptors such as protected areas, habitats and species of conservation value, hospitals/clinics/schools, PCRs as well as to minimize impacts on human health, households, crops and trees of economic value.
- iv. Detailed walk over survey will be conducted for the final transmission line and access road alignment once confirmed to inform the detailed design; the alignment will be adjusted as needed to avoid impacts to sensitive natural and human receptors and to minimize the cutting of trees for the ROW.
- v. Figure 4.1 presents the project location with receptor information.

112. Land Requirements.

- i. Permanent land-take. The proposed project will involve permanent land take for the solar park and transmission tower footings. Negotiated settlements with landowners for the solar park site will be completed prior to any civil works. The PMO will undertake appropriate and timely compensation for land take and affected ROW for the final transmission alignment as described in the LARP developed in accordance with ADB requirements and EDC Compensation Schedule. This will result in direct and irreversible impact.
- ii. Temporary land-take. Facilities such as construction and erection staging areas, construction camps, spoil disposal sites and access tracks established for the transmission line alignment will take up land temporarily during the construction stage. The temporary land take areas will be estimated during detailed engineering design and will avoid sensitive receptors such as farmland, irrigation canals / dykes and households / structures. All the temporary sites will be vacated and restored or

⁸⁷ Project design is discussed in detail in the project Feasibility Study while Climate Risks and Vulnerability Analysis is enclosed as Appendix IV.

⁸⁸ National Solar Park Project for Cambodia: Pre-Feasibility Study, August 2017

vegetated upon completion of civil works. No irreversible impact is anticipated. There is no temporary land-take associated with the solar park; all civil works will be undertaken within the final solar park acquired area.

Key Measures during Detailed Design

113. Site Design.

- i. Integrate measures for potential climate risk impacts in project detailed design as follows:
 - a) Recommendations from the project Feasibility Study to maximize flood resilience and minimize impacts on local drainage patterns
 - b) Consider highest flood level and suitable slope in detailed engineering design – site preparation and civil works for the solar park, substation and placement of tower footings for the transmission line; and type of road surface and embankment height for access road construction
 - c) Design improved flood protection measures for all equipment mounted at ground level
 - d) Strengthen existing drainage canals at the solar park site
 - e) Design storm-water retention pond for controlled inflow and overflow and use for operation and maintenance (e.g. landscaping, washing of PV panels, etc.)
- ii. Integrate measures in site design to conserve the two natural streams transecting through the solar park site in its current natural condition and establish a buffer of at least 400 m on either side of the streams.

114. Substation.

- i. Select Air Insulated Substation to avoid fugitive emissions of Sulfur Hexafluoride (SF₆), a potent GHG.
- ii. Design the substation location to minimize shading by the transmission line on the solar PV plants.
- iii. Design and maintain a permanent ('bundled') impermeable surface and dykes capable of carrying 110% volume of materials for accidental spills or leakage.

115. Transmission Line

- i. Consider a resilient high capacity overhead transmission line for extreme weather conditions.
- ii. Detailed walk over survey for final route selection to avoid agriculturally productive land, orchards with fruit bearing trees, habitats of conservation value, sensitive areas (e.g. schools, hospitals, parks), residential areas (households, other structures) and PCRs.
- iii. The ROW to be adjusted to minimize the cutting of trees.
- iv. The ROW to consider suitable slope and soil type.
- v. Avoid construction of transmission tower footings near irrigation canals / dykes.
- vi. Avoid placement of tower footings in water bodies.

116. Environmental Baseline Surveys.

- i. Undertake key baseline surveys to inform detailed engineering design and the domestic IEIA as follows:
 - a) Surface and ground water quality analysis once before the start of civil works, location: water sources within the solar park site and downstream An Chrey Long reservoir.⁸⁹
 - b) Air quality monitoring once before start of the civil works, location: solar park site and at sensitive receptor sites (e.g. households) along the final transmission line alignment.⁹⁰
 - c) Noise level measurements once before start of the civil works (location: solar park site and at sensitive receptor sites along the final transmission line alignment).⁹¹

117. Seasonal Birds Surveys.

- i. Undertake seasonal survey to assess impacts of the solar park and transmission line alignment on migratory birds and bats flyways to inform the detailed design.
- ii. Terms of Reference (TOR) detailing the area of influence, survey methodology and person-months required for task completion is enclosed as Appendix III.

Key Measures during Pre-Construction

118. Project Implementation Set up. Contracting of PIC services⁹², to include International and National Environmental and Social Development Specialists,⁹³ will be carried out for effective project implementation. For upgrade works, PIC and associated specialists will collaborate with Cambodia Transmission Limited (CTL).⁹⁴

119. Training and Capacity Building⁹⁵. The capacity of PMO, SEPRO and contractors⁹⁶ responsible for EMP implementation, GRM and supervision will be strengthened. The project will address the lack of capacity and expertise in environmental and social management through project output 2 consisting of the following steps:

⁸⁹ Surface and ground water quality analysis will also be conducted once prior to civil works and once after completion of the civil works for the aforementioned locations. Discussion is included under the Construction Stage of this section.

⁹⁰ Air quality monitoring will also be conducted bi-monthly during the civil works and once after completion of the civil works for the aforementioned locations. Discussion is included under the Construction Stage of this section.

⁹¹ Noise level measurements will be also be conducted bi-monthly during civil works for the same locations and once after completion of civil works / upon commissioning of the substation for the solar park site only (see discussion under Construction Stage impacts).

⁹² The project implementation consultant (PIC) will be engaged to assist EDC with the implementation of the project and, in particular, to: (a) update, as necessary, the Initial Environmental Examination (IEE), Environmental Management Plan (EMP), and Land Acquisition and Resettlement Plan (LARP), and, after obtaining ADB's approval, oversee their implementation; and (b) supervise the design, supply, installation, and commissioning of the solar park infrastructure works by the EPC contractor. The PIC will be responsible for building EDC's capacity in financial management, contract administration, and social and environmental monitoring and reporting. The PIC will recruit and manage a local registered firm, who will work with EDC to prepare and submit an Initial Environmental Impact Assessment (IEIA) or full EIA for the solar park infrastructure to the Ministry of Environment (MOE) for clearance and approval, as required, prior to any civil works contract awards.

⁹³ PIC will include 2 international specialists (each 3 person-months for 30 months) and 2 national specialists (each 8 person-months for 30 months). Source: Project Administration Manual (PAM) for CM NSPP, November 2018

⁹⁴ GS6 is operated and managed by the CTL since 2013 in accordance with a 25-year agreement with EDC on Build Operate and Transfer ("BOT") contract.

⁹⁵ Also see Section 9, Environmental Management Plan.

⁹⁶ Contractors imply - solar park and transmission interconnection infrastructure Engineering Procurement, Construction (EPC) contractors and solar PV plant key subcontractor(s) - EPC contractor.

- The capacities of PMO, SEPRO and contractors to coordinate environmental management will be strengthened through a set of measures:
 - i. Appointment of at least one environment focal person within the PMO staff (“PMO EHS” officer) to be in charge of EMP coordination, implementation and site inspections including project GRM
 - ii. Appointment of at least one environment, health and safety officer (“C-EHS”) within the contractor staff to be in charge of EMP coordination, implementation, site inspections and information disclosure and consultations
 - iii. Appointment of at least one GRM focal person (“C-GRM”) within the contractor staff to be in charge of project GRM coordination, handling complaints, dispute resolution, site visits and information disclosure and consultations
- PMO, SEPRO and contractors will receive training in EMP implementation, supervision, monitoring and reporting, project GRM, conducting meaningful consultations and relevant environmental rules and regulation. Training will be facilitated by the PIC. In addition, orientation and briefing of project staff, all contractors / sub-contractors, hired workers will be conducted prior to mobilization on site during construction and operation stages.

120. Updating the IEE and EMP (if required). Mitigation measures defined in this IEE and EMP will be updated based on final detailed engineering design. This will be the responsibility of the PIC with support from PMO. The revised documents will be submitted to ADB and PMO for approval and disclosure on ADB’s website when updated. PIC will develop site-specific checklists for use in monitoring environmental compliance during construction and operation.

121. Safeguard Measures in Bidding Documents, Contracts and Tenders.

- Updated EMP will be included in the tender, bidding and contract documents (“documents”) to provide basis for the contractors to develop specific CEMPs for construction of the solar park infrastructure including associated facilities and existing facility.
- Documents will include a provision for imposition of penalties in case non-compliances to safeguards are encountered repeatedly.
- Documents will include a provision to compensate for any temporary or permanent damage and loss or inconvenience as a result of the project during construction.
- Documents will include a provision for each contractor to appoint an Environment Health and Safety Officer (“C-EHS”) and GRM focal point person (“C-GRM”) within its staff.
- The PPA agreements will include a tender requirement for IPPs to comply with Cambodia environmental requirements⁹⁷
- These Safeguards Requirements for IPPs are presented in Table 5.2.

122. Grievance Redress Mechanism. The PMO will set up a project GRM and Grievance Redress Committee (GRC) as soon as the project commences. GRC will function from

⁹⁷ The project will comply with the Government Sub-decree No.72 on EIA issued on 11 August 1999. IEIAs are required for each of the solar PV plants. The MOE will approve the IEIAs at detailed engineering design stage. An approved company, registered with the MOE will prepare separate IEIAs for the each solar PV plant on behalf of the plant owner.

construction to operation stage. Project GRM will assist affected persons and other stakeholders in resolving queries, conflicts and complaints, if any, in a timely manner. The PMO will assume overall responsibility for coordinating and reporting on GRM while PIC will support the day to day monitoring of GRM in a manner consistent with the provisions detailed in the IEE and LARP and with assistance of the contractor appointed “C-GRM”. Project information booklet/ frequently asked questions leaflet (PIB / FAQ) in Khmer will be made available for the affected communities in public consultation meetings, project construction field offices and at commune councils. This will include the contact information including EDC website address, PMO/PIC address and telephone number for local entry points e.g. C-EHS and C-GRM, village chiefs, communes councils.

123. Information Disclosure, Consultation and Participation. Information disclosure, meaningful consultation and participation activities will be continued with affected persons and other relevant stakeholders on topics including but not limited to the project design, project implementation schedule, key religious periods, key construction activities (in particular those that result in disturbance or nuisance and potential community health and safety issues), project GRM, status of compensation as per LARP and safety trainings for communities residing close to the proposed high voltage overhead transmission line. A Stakeholder Analysis and Communication Plan has been developed for the project and the EMP will set out ongoing consultation requirements during project implementation. Similar to above, a project information booklet/ frequently asked questions leaflet in Khmer will be made available for the affected communities in public consultation meetings, project construction field offices and at commune councils. This will include the contact information including EDC website address, PMO/PIC address and telephone number for local entry points e.g. C-EHS and C-GRM, village chiefs, commune councils.

124. Permits and Environmental Clearances. Obtain all necessary permits and environmental clearances from the relevant national authorities prior to the commencement of civil works.

125. Physical Cultural Resources (PCRs). There are no PCRs within the proposed solar park site. PCRs along the proposed transmission line will be avoided by adjusting the final transmission line alignment to keep a distance of at least 100 m from the 20 m ROW. In addition, site preparation and civil works during the construction phase have the potential to disturb these existing PCRs and as yet unknown PCRs. The following measures will be implemented:

- iii. Consultations will be carried out to ensure sensitive religious periods are taken into consideration prior to start of civil works.
- iv. Chance Find Procedures will be established and activated if any chance finds of PCRs are encountered during civil works as follows:
 - a) Civil works will be immediately suspended if any PCRs are encountered;
 - b) Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited;
 - c) The provincial or main office of Ministry of Culture and Fine Arts will be promptly informed and consulted; and
 - d) Civil works will resume only after thorough investigation and with the permission of the provincial or main office of the Ministry of Culture and Fine Arts.

126. Unexploded Ordinances Clearance. The PIC will coordinate with the Cambodia Mine Action Centre to undertake UXO clearance in the project area of influence prior to civil works, as deemed necessary. UXO clearance will include surveys and explosive detection, removal, transport and destruction in accordance with the national regulations. During this process warning

signs will be erected to warn households and communities. The UXO clearance certificate will be provided to ADB prior to construction.

Table 5.2 Safeguards Tender Requirements for IPPs

EDC and PMO will ensure that the IPPs and their major subcontractors will construct, operate and maintain the solar PV plants in accordance with the following requirements, number 1 through 7.

Contractors imply IPP EPC contractors.

1. Construction Environmental Management Plan. The IPP and their major subcontractors will develop and implement CEMPs in line with the IEE and EMP during construction and develop and implement SOPs in line with the IEE and EMP during operation and maintenance.

2. Hazardous and Polluting Materials Management.

- Handling and disposal of hazardous waste and materials will be in accordance with Sub-Decree No. 36 Solid Waste Management Guidelines issued 1999, Chapter 3 – Hazardous Waste Management; MOE Declaration of Standard Level on Pollutants or Hazardous Substance permitted for disposal issued 2015 and International Best Practices as per IFC (WBG) EHS Hazardous Material Management Guidelines.
- PV Modules: In case of modules containing hazardous materials, IPP and their major subcontractors shall develop and implement plans for environmentally safe disposal in line with applicable laws and ADB SPS 2009.
- The purchase agreement / contract between IPP and supplier(s) shall contain a contractual provision that obligate the supplier to take back unused / replaced modules.
- Energy Storage Batteries: In case energy storage batteries are used, IPP and their contractors will develop and implement plans for environmentally safe disposal in line with applicable law and ADB SPS 2009.
- The purchase agreement / contractor between IPP and supplier(s) shall contain a contractual provision that obligate the supplier to take back unused / faulty / used batteries.
- All equipment installed and used by the IPP will be certified as Polychlorinated Biphenyls (PCBs) free
- Use of herbicides / pesticides for vegetation clearing will be prohibited

3. Health and Safety.

- The IPP and their major subcontractors shall comply with applicable law and IFC EHS Guidelines on Occupational Health and Safety and Community Health and Safety requirements.

4. Biodiversity.

- The IPP and their contractors shall develop and implement Standard Operating Procedures (SOP) relating to searching for and assessing, monitoring and record keeping of animal / bird carcass searches within the solar park and maintain a log of findings; The IPPs will ensure that there is a trained staff to conduct carcass searches.

5. Training and Awareness.

- The IPP and their major subcontractors shall have qualified staff responsible for environmental, health and safety (EHS).
- The IPP shall ensure adequate training to their contractors on use of Personal Protective Equipment (PPE), relevant Health and Safety laws and regulations, Information Disclosure to communities, project GRM, records management, monitoring and reporting. Monitoring shall also relate to incidents and non-compliance with ADB SPS 2009 and Cambodian applicable laws.
- The IPP shall ensure that their contractors receive awareness and training programs or information materials with respect to sexually transmitted diseases such as HIV/AIDS and child labor, bonded labor or forced labor.

6. Access to Site, Landscape and Visual Impacts.

- Damage to existing access roads to site (if any) will be repaired by the IPP and their contractors.
- The IPP will establish and maintain a secure perimeter fence at the solar PV plants to control trespassing. Fencing will have adequate ground clearance for passage of animals/ wild species to prevent habitat fragmentation.
- Landscaping will be established and maintained along the perimeter fence and within the site to reduce visual and dust impacts such as maintenance of hedges and field margins, re-seeding with native species.
- Access to adjacent properties/ lands will be maintained.
- All civil works will be confined within clear demarcated work sites, no encroachment outside the demarcated zone

7. Water Requirements.

- Groundwater extraction shall be prohibited.
- The IPP shall include in the Construction Schedule estimates of anticipated annual water usage for construction. The IPP and their contractors will review, as applicable, the availability and sources of water for usage for the construction and consult with relevant governmental stakeholders and affected communities on water availability, usage and estimated usage for future periods. Within 60 days of each Contract Year after the commercial operations date, the IPP shall provide to EDC reasonable estimates of water usage for purposes of operating and maintaining the Solar PV Plants for the applicable Contract Year.

5.4. Construction Stage

5.4.1. Workforce Organization And Orientation

Orientation for Project Staff, Contractors, Workers

127. Prior to mobilizing on site, the PIC will conduct briefing and orientation for all project staff, workers, contractors / sub-contractors, contractor appointed EHS officers and GRM focal point persons on:

- EMP, GRM, Information disclosure and meaningful consultation, environmental monitoring and reporting requirements
- ADB and Cambodia labor standards
- Responsibilities of the contractors in developing and implementing the site-specific CEMPs, SOPs and monitoring environmental compliance with the EMP ⁹⁸/CEMP;
- Responsibility of the contractors in engaging with affected persons for project GRM
- Create awareness of sexually-transmitted diseases (HIV/AIDs), child labor, bonded labor or forced labor
- Record and maintain briefing and orientation events log with duration and list of attendees

128. Under the supervision of the PIC and prior to mobilizing on site, contractors will conduct training and drills for workers on:

- CEMP sub-plans implementation (see Table 5.3)
- Environmental, health and safety and hygiene at work sites as well as sexually transmitted disease such as HIV/AIDS to prevent potential incidences
- Record and maintain briefing and orientation events log with duration and list of attendees

Hiring Of Project Staff and Workers

129. Project implementation will bring opportunities for local employment. While this is beneficial, it may also be a cause of conflict over transparency of hiring particularly if migrant workers are recruited over local people. The contractors will be required to use local labor for manual work and eligible local workforce for technical and administrative jobs. The PIC will monitor the compliance to priority of local hiring.

Presence of Workers at Construction Sites

130. The presence of workers and staff at the project sites may increase demand for services such as food and beverages. The localized demand of services may result in an opportunity for local communities to set up temporary small-scale business in providing food and beverages outside the solar park or along the transmission line alignment. This will be a beneficial impact to local economy.

Preparation of Construction Environmental Management Plans / Standard Operating Procedures

⁹⁸ PIC will develop checklists for use in monitoring environmental compliance during construction stage.

131. The CEMP will help to avoid unplanned activities of contractors and will guide the smooth implementation of all project activities. Prior to mobilizing on site, the contractors will develop site-specific CEMP for the key activities; appropriate maps showing where activities will take place and corresponding implementation schedule. PIC will also guide contractors to prepare Standard Operating Procedures (SOPs) in line with the environmental component likely to be affected.⁹⁹ The site-specific CEMPs will include the sub-plans listed in Table 5.3 and will be submitted to PMO for approval.

Table 5.3 List of Construction Environmental Management Plans (CEMP Sub-plans)

Environmental Component Likely to be Affected	CEMPs
Land and Vegetation	Spoils Disposal Plan Hazardous Material Control Plan Site Rehabilitation and Clean up Plan
Air	Noise and Dust Control Plan
Water	Drainage and Storm-water Management Plan
Waste	Materials Management Plan (including warehouse / storage) Waste Management Plan
Humans (Communities / Workers)	Community Health and Safety Plan Occupational Health and Safety Plan (including worker's facilities and work areas) Emergency Response Plan (ERP) Traffic and Road Management Plan
Physical Cultural Resources	Chance Find Procedures

5.4.2. Site Preparation And Civil Works

132. Site preparation and civil works will integrate key measures during detailed engineering design (see design and pre-construction sub-section). Construction activities will be scheduled in the dry season, avoid sensitive periods for religious activities, breeding periods of birds, farming and/or harvesting season, as possible. If unavoidable, standing crops on affected land will be harvested prior to start of civil works by informing affected persons at least six months in advance of the schedule for handing the required land (e.g. along the transmission line alignment).

Impacts on Topography (Land and Vegetation)

133. Impacts on land and vegetation will result from mobilization of workers, construction equipment and materials; setting up temporary construction camps; site preparation (vegetation clearance, land leveling and grading for laying foundation¹⁰⁰) and civil works over 100 ha during Phase I and remaining 150 ha during Phase II as well as construction and permanent paving of 3-4 km access road (width 5.5 m) to the solar park site from the main road (No. R132 or R136).

⁹⁹ SOPs / O&M manuals will be developed taking reference from the CEMP sub-plans except for Spoils Disposal Plan which will not be required during the Operation Stage.

¹⁰⁰ For the solar park, the leveling of the site will ensure direct irradiance from the sun.

134. Land leveling and grading works may alter drainage patterns at the solar park site that may result in surface erosion, generation of spoil and localized flooding. Impacts will also result from operating cranes for unloading and installation of equipment, installation of cable routes (above ground and/or underground) and commissioning of new equipment. These impacts will be temporary and localized at the construction sites within the solar park. The potential impacts on land and vegetation will be mitigated through the following measures as set out in the EMP:

- Clear demarcation of work sites, no encroachment outside the demarcated zone
- Access to adjacent properties and agricultural land will be maintained, as necessary
- Construction camp set up at least 400 m from natural streams or any other water source at site including drainage /irrigation canals and dykes
- Vegetation clearances will be strictly restricted to the works site and for permanent access roads, hedges and field margins will be retained
- Use of herbicides / pesticides will be prohibited for vegetation clearing to prevent soil contamination
- Implement engineering and biological measures to prevent surface erosion such as provision of silt traps or sowing soil-binding grass, as needed.
- Restore loose soil from foundations through ramming, if required
- Implement the following CEMP sub-plans
 - Spoils Disposal plan¹⁰¹
 - Drainage and Storm-water Management Plan
 - Site Rehabilitation and Clean up Plan after completion of civil works to restore works site to pre-construction conditions including landscaping along the fenced perimeter, maintain hedges and field margins to reduce visual and dust impact, re-seeding most or all of the site with native plant species (soil binding grass) to stabilize the soil and restore habitat

135. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS staff.

136. Impact on land and vegetation for the transmission line will result from temporary land take for setting up temporary construction camps, waste/ recycling sorting area, mobilization of construction equipment, materials (these will be restricted to the construction camps and not along the transmission line alignment except prior to installation) and workers; setting up temporary access tracks to the transmission line ROW; site preparation and vegetation clearance along the 30 m ROW for length of 40 km. There will also be minimal earthworks, leveling and grading for laying foundations; placement of towers sequentially along the verge of the transmission alignment prior to hole auguring and tower erection; and stringing of conductors. Approximately 3 ha of land within the transmission line alignment will be permanently impacted due to tower footings, 256 trees will be permanently felled (including 100 mango trees) and over 8500 trees will be affected (lopping / pruning for ground clearance and maintenance of minimum sag).

137. Land leveling and grading works at work sites (tower footings) may alter drainage patterns that may result in surface erosion, generation of spoil and localized flooding. These impacts will be temporary and localized. While there are no major river crossings, the transmission line will

¹⁰¹ Excess spoil will be backfilled onsite or temporary / permanently disposed as per the clearly identified disposal sites on site specific map, with corresponding distance and number of trips made will be maintained (this will help avoid disposal of spoil on farm land or within 400 m of any water source).

cross small water canals/ streams / bridges and this will not require any footings in the water bodies. The transmission line will also cross roads (see discussion under Impact on Human Environment) and railway crossings.

138. The potential impacts on land and vegetation will be mitigated through the following measures as set out in the EMP:

- Clear demarcation of work sites, no encroachment outside the demarcated zone
- For the transmission line, stockpiling of materials to be at the construction camp and not along the transmission line except prior to installation
- Construction camps to be set up at least 400 m from any water source, drainage / irrigation canals or dykes
- Access to adjacent properties and agricultural land will be maintained, as necessary
- Vegetation clearances will be strictly restricted to work sites (tower footings, transmission line ROW and temporary access tracks, if required)
- Use of herbicides / pesticides will be prohibited for vegetation clearing to prevent soil contamination
- Trees below 3 m will not be cut along the ROW; only tree looping / pruning will be done for ground clearance and to maintain minimum sag
- Record of crops and trees loss along the transmission line alignment will be maintained in accordance with project LARP
- Any damage to areas outside the ROW as defined in project LARP will be restored to pre-construction conditions and /or compensated in line with the entitlement matrix
- Restore loose soil from tower foundations through ramming, if required
- Excess spoil will be backfilled onsite or spread out in a manner that causes no disturbance to existing drainage / irrigation canals, dykes or local drainage pattern
- Implement the following CEMP sub-plans
 - Spoils Disposal plan¹⁰²
 - Drainage and Storm-water Management Plan
 - Site Rehabilitation and Clean up Plan after completion of civil works to restore temporary land take along the transmission line will be restored to pre-construction conditions including vegetation planting along transmission line ROW to stabilize soil where it does not compromise the intended transmission function.

139. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS staff.

140. GS6 Substation Upgrade. The upgrade works will be planned and executed within the fenced perimeter of the substation and there is no new land acquisition or site clearing envisaged while minimal construction /civil works will be involved. There are no anticipated impacts on the nearby village / communities. The upgrade of GS6 will result in temporary and localized impacts and these will be mitigated and managed via EMP prepared for the project such as:

- Any debris / dismantled structures / equipment will be taken to EDC depot and/or disposed in a designated landfill
- Usable scrap materials from dismantling will be used for resale / auction

¹⁰² Excess spoil will be backfilled onsite or temporary / permanently disposed as per the clearly identified disposal sites on site specific map, with corresponding distance and number of trips made will be maintained (this will help avoid disposal of spoil on farm land or within 400 m of any water source).

141. Based on the audit of GS6, the following corrective measures will be undertaken:

- Consult with the nearby village / communities in line with requirements for information, disclosure and participation as set out in the IEE and EMP translated in the local language (Khmer).
- Translate the Safety Manual in the local language and make relevant sections available to the nearby village / communities
- Conduct Emergency Response Plan (ERP) drills with the nearby village / communities on a regular basis
- Obtain a permit for groundwater abstraction from the relevant ministry in case there is none.

142. All upgrade activities will be supervised by PMO's EHS officer / PIC in collaboration with CTL and monitored by the EPC contractor and C-EHS staff.

143. **Waste Generation.** Impacts due to waste generation during construction stage have been assessed for all infrastructure types under project output 1 and discussed as follows.

144. Impacts on resource use and impacts associated with disposal will arise from waste generated during site preparation and civil works. This includes generation of inert wastes e.g. spoil, biodegradable wastes e.g. cleared vegetation, construction debris, packaging waste, metal scrap, domestic waste. Impacts of disposal and wind-blown litter will be seen at the construction areas whereas the impacts of resource use are national and global. The potential impacts will be mitigated through the following measures as set out in the EMP:

- Compliance with Sub-decree No. 36 ANRK.BK on Solid Waste Management, MOE, 1999
- Establish a covered onsite sorting and recycling area away from existing water sources, drainage /irrigation canals or water sources
- Transport of recyclables, scrap, discarded equipment to EDC depots, dedicated storage yards for resale or auction to authorized dealers
- For other type of wastes, licensed companies will be hired to collect, transport and dispose of wastes at licensed dump facilities
- Biodegradable waste such as cleared vegetation may be provided to local communities for use
- Provide multiple waste containers at construction camps
- Waste burning will be prohibited
- No final waste disposal on site
- Implement the following CEMP sub-plans that will apply the waste hierarchy to ensure efficient use and management of resources with priority to prevent waste at source as much as possible, reduce impact to human receptors and prevent contamination to land and water sources.
 - Materials Management Plan
 - Waste Management Plan
 - Map with clearly identified waste disposal sites with corresponding distance and number of trips made will be maintained (this will help avoid disposal of construction debris on farm land or within 50 m of any water source)
- Contractor(s) will be responsible for proper removal and disposal of any significant residual materials and wastes that remain on work sites after completion of civil works

145. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

146. **Hazardous and Polluting Materials.** Impacts due to hazardous and polluting materials during construction stage have been assessed across all infrastructure types under project output 1 and discussed as follows.

147. Inappropriate transportation, storage, usage, hazardous and polluting materials waste disposal, leakage and spills may result in adverse environmental impacts. A temporary secured hazardous materials handling and waste storage area will be provided across all work sites. As part of a design feature, a permanent secured ('bunded') impermeable surface and dykes capable of carrying 110% volume of materials for accidental spills or leakage will be constructed and maintained at the solar park. GS6 is adequately equipped to handle hazardous and polluting materials, therefore adverse impacts are not anticipated. The potential impacts will be mitigated through the following measures as set out in the EMP:

- Compliance with Sub-decree No.36 ANRK.BK on Solid Waste Management, Chapter 3 – Hazardous Waste Management, MOE, 1999; and Declaration of Standard Level on Pollutants or Hazardous Substance permitted for disposal, MOE, 2015
- Temporary secured area set up for handling hazardous and polluting materials
 - Secured areas to be sited away from direct sunlight and 400 m from existing drainage /irrigation canals and /or any water sources
- Delivery and acceptance of all hazardous materials / equipment will be accompanied by a Materials Safety Data Sheets (MSDS) and/or be certified that it is polychlorinated biphenyl-free (PCB) free
- Licensed vendors/ companies to collect transport and dispose used / unused hazardous materials / wastes
- Asphalt making process for access roads (for solar park site) will be located at least 500 m downwind from the nearest dwellings
- Vehicle / equipment maintenance and refueling to be done offsite or within designated service area on impermeable surfaces and away from water sources
- Implement CEMP sub-plan
 - Hazardous Materials Control Plan including spill control and clean up
- The following records will be maintained:
 - Record of equipment and corresponding PCB free certificates
 - Record of MSDS
 - List of licensed vendors/ companies that collect, transport and dispose used / unused hazardous materials / wastes
 - Record of incidents, spills / accidents / near-miss / fatalities

148. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

Impacts on Human Environment

149. Impacts on human environment during construction stage have been assessed for all infrastructure types under project output 1 and discussed as follows.

150. **Construction Camps.** The work sites will be provided with facilities such as structures to house workers and sanitary facilities i.e. construction camps. The contractors will ensure that sanitary facilities are in good condition, wash areas are clean, safe drinking water is available, garbage bins provided in designated locations and good housekeeping is observed at all times. Construction camps will be set up at least 400 m away from any drainage /irrigation canals, dykes or water bodies. Construction camp is not required for GS6 since there is space within the substation perimeter to carry out all upgrade activities and it has in-house facilities for toilets and drinking water, these were deemed adequate during the audit. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

151. **Information Disclosure and Consultation.** Information and consultation with local residents (community awareness program) and authorities will be conducted one month prior to commencement of civil works and intermittently during civil works. These activities will be conducted in and around the villages situated close to the solar park site, transmission line alignment and existing facility GS6.¹⁰³ The following measures will be undertaken as set out in the EMP.

- Distribute PIB/FAQ and make it publicly available during consultations, at project construction field offices and commune councils
- Record of consultations will be maintained in accordance with Stakeholder Analysis and Communication Plan
- Record of incidents /accidents / near-miss/ fatalities associated with the project will be maintained
- Records of issues raised will be maintained in accordance with project GRM

152. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

153. **Physical Cultural Resources (PCRs).** There are no known PCRs within the solar park site and existing facility GS6 is within an existing fenced perimeter. The final transmission alignment will be planned and adjusted to avoid PCRs by at least 100 m. During the construction stage, there may be moderate temporary air quality impacts due to fugitive dust generation and noise to these existing PCRs. These will be mitigated as per the steps detailed under Impacts on Air Quality, Noise and Vibration and by conducting consultations to avoid sensitive religious and spiritual functions / periods. In addition site preparation and civil works during the construction stage have the potential to disturb as yet unknown PCRs. A Chance Find Procedures will be implemented as necessary. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff.

154. **Interruption to Existing Utilities.** To reduce impacts on existing utilities (such as power outages), transmission line works and upgrade works will be scheduled in a phased manner such that existing power interruptions are no more than 12 hours in duration, and if possible these will be scheduled during low use times in the 24-hour cycle. Advance approval from the relevant authority will be obtained prior to power cuts. A 24-hour advance notice shall be provided to the

¹⁰³ GS6 will be required to undertake the following corrective action - Consult with the nearby village / communities in line with requirements for information, disclosure and participation as set out in the IEE and EMP translated in the local language (Khmer); Translate the Safety Manual in the local language and make relevant sections available to the nearby village / communities; Conduct ERP drills with the nearby village / communities on a regular basis.

affected communities for interference to existing utilities (e.g. power outages during interconnection of substation and transmission line). There are no anticipated interruptions to existing utilities within the solar park site. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

155. Use of Existing Access Roads. Delivery of equipment, materials and machinery to work sites at the solar park, transmission alignment construction camp and GS6 may lead to increase in traffic and road congestion. In particular for the transmission line works, it may cause interference with road crossings during stringing of conductors. Movement of transport vehicles will also result in moderate air quality impacts (dust and increase in vehicular emissions) as well as an increase in noise (due to operation of transport vehicles) during peak construction period (these are discussed under Impact on Air Quality, Noise and Vibration). The potential impacts due to increase in traffic and road congestion will be mitigated through the following measures as set out in the EMP:

- Implement Traffic and Road Management Plan
- Follow planned transportation routes and delivery schedule
- Any traffic detours to have danger and clearly visible warning signs as well as flag persons
- Compliance with local speed limits vehicle load carrying capacity and other road regulations
- Any damage to roads to be borne by Contractor(s)
- Record of incidents / accidents/ near-miss/fatalities / road damage will be maintained
- When stringing and stretching conductors across road, the following practices will be followed:
 - Workers / Communities will be briefed in advance to plan activities
 - Advance approval from Ministry of Public Works and Transport will be sought
 - Traffic will be diverted as appropriate to ensure safety
 - Scaffolding will be used to support conductors and minimize traffic disruptions

156. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

157. Occupational Health and Safety. Contractors will comply with the relevant safety measures required by law and as per International Best Practices. The potential impacts to workers will be mitigated through the following measures as set out in the EMP:

- Implement CEMP sub-plan on Occupational Health and Safety (OHS) Plan
- Establish and implement ERPs as required
- Compliance with Cambodia Occupational Safety and Health laws and regulations, Department of Safety and Health, Ministry of Labour and Vocational Training (MLVT), 2011¹⁰⁴
- Provide sanitary facilities and wash areas, safe drinking water and garbage bins
- Provide health assessments (health and fitness to workers once every two months)
- Periodic training will be provided to workers in all aspects of the ERP and OHS
- Coordinate with nearest hospital for arrangements in case of accidents
- provide first aid treatment for construction sites and camp

¹⁰⁴ MLVT- Ministry of Labor and Vocational Training

- Assess safety risks and safety protocols (such as for electrical works, working at heights, etc.), and implement
- Workers will be equipped with PPE including proper safety clothes and protection gear/equipment to avoid accidents
- Provide communication devices to designated site officers / engineers
- Specifically for works on transmission lines
 - Electrical safety risks will be assessed and safety protocols will be developed and implemented such as for electrical works, working at heights, etc.
 - All works at height will be prohibited during night time, periods off fog and strong wind on the Beaufort Wind Scale¹⁰⁵
 - All workers climbing towers will have a Safety Certificate of Class 3¹⁰⁶ or above
 - All towers, steel structures and equipment will be properly earthed and equipped with lightening protection
 - When testing electrical equipment, all unrelated works in the flagged zone – marked as danger zone- will be stopped and unrelated workers will leave the zone
- Records of health assessments / incidents / accidents/near-miss/fatalities will be maintained

158. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

159. **Community Health and Safety.** Site preparation and civil works, numerous terminating gantries for incoming and outgoing lines, erection of towers, stringing of conductors, movement of vehicles bringing equipment, materials, supplies and machinery may interfere with road crossings, flow of traffic and may cause an increase in traffic congestion. These activities may pose safety risks to the communities residing in close proximity to the work sites and general public. In addition, construction camps and an influx of workers may cause social conflict or even lead to the spread of disease. Transmission line footings are not anticipated close to existing roadways, however this will be confirmed during detailed walk over survey. Since this is an overhead transmission line, crossings over road / railway lines will result in temporary disruption to movement of traffic, public or trains schedule. Contractors will obtain permissions from relevant authorities before commencement of activities. The potential impacts to communities and public will be mitigated by the following measures as set out in the EMP:

- Adhere to strict schedule for completion of civil works and avoid prolonged construction and disturbance
- Implement CEMP Sub-plans
 - Community Health and Safety Plan
 - Traffic and Road Management Plan
- Provide perimeter fencing to mitigate trespassing (fencing will be constructed with

¹⁰⁵The Beaufort Wind Scale is an empirical measure with 12 wind speed classes. Winds above Class V are higher than 10.8 m/sec

¹⁰⁶Electric Safety Classification is regulated in Circular 31/2014/TT-BCT (2014). The Circular stipulates five Safety Classifications (1 to 5), with 5 being the highest. A Class 3 Safety Certificate designates a worker capable of working in the field, and is given to workers/technicians who: 1) pass 80% of the training; 2) have knowledge of the proper use of PPE; 3) master the method to extract an electrocuted victim from the power source; 4) can provide first aid to an electrocuted victim; 5) is able to determine unsafe practices; and 6) is able to supervise electric workers working at height and near electric equipment.

adequate ground clearance for passing of wild animals / other species at the solar park site)

- Provide barricade to temporarily enclose open excavated tower foundations
- Provide sufficient lights, clear warning signs and danger signals
- Assign security personnel to prevent accidents, trespassing and pilferage
- Warning signs and cones will be installed in and around the transmission tower site and along roads, with clearly marked danger zones
- Safety flags and flag persons will be used, as needed
- Record of incidents /accidents / near-miss/ fatalities associated with the project will be maintained
- Records of issues raised will be maintained in accordance with GRMs
- Outreach to local communities to disseminate knowledge about safety and ERPs at or near solar park, transmission line alignment and GS6 will be provided via information disclosure and consultation activities, project information booklet (PIB) / frequently asked questions (FAQ) flyers.

160. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

Impacts on Air Quality, Noise and Vibration

161. Impacts on air quality during construction stage are assessed for all infrastructure types under project output 1 and discussed as follows.

162. **Air Quality.** Moderate temporary air quality impacts during peak construction phase of the project are anticipated because of construction activities scheduled in the dry season and due to fugitive dust generation associated with construction works and transport (of materials, equipment and machinery), loading, unloading and haulage of materials and corresponding increase in vehicular emissions. This will impact the workers at works sites and communities / households in the local area and downwind of the transmission line alignment. Use of construction machinery and equipment and movement of transport vehicles may also levels of nitrogen oxides (NO_x) and sulfur oxides (SO_x), affecting air quality. Building access roads to project site (asphalt road pavement) will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH). The contractors will conduct air quality monitoring at the solar park site and at sensitive receptor sites along the final transmission line alignment once before start of the civil works to establish the baseline, bi-monthly during the civil works and once after completion of the civil works to monitor and mitigate exceedances (if any) with respect to the Ambient Air Quality Standards (see Annexure I EMP, Part 2).

163. The potential impacts on air quality will be mitigated by following measures as set out in the EMP as follows:

- Air monitoring will be conducted utilizing hand held air monitoring devices at select locations identified on site map
- Open and exposed land areas at the solar park site, along the new access roads and transmission line will be sprayed with water to suppress dust levels particularly during the dry season.
- Use of chemical dust suppressants will be prohibited.

- Aside from this, works sites will be temporarily barricaded to enclose to control dust levels (solar park and open excavated tower foundations).
- Asphalt making process will be located at least 500 meters downwind from the nearest dwellings in order to reduce the impact of fumes on humans.
- Storage areas /warehouse for materials required for construction and civil works will be provided onsite (construction camps at the solar park site and transmission line) to reduce construction vehicle trips of transporting materials and minimize stockpiling
- Vehicles transporting materials that generate dusts will be covered with tarps. Construction vehicles and machinery will be maintained to a high standard to minimize vehicular emissions and noise.
- Log of monitoring / incidences of non-compliance and rectification will be recorded and maintained.

164. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

165. **Noise and Vibration.** Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise as they operate. Other noise sources include loading, unloading and haulage of equipment and materials. Significant noise impacts will be experienced by construction site workers / operators; construction machinery may produce noise levels up to 90 A-weighted decibels (dBA). For the solar park site and GS6, only construction workers will be this close to the machinery for extended periods of time. Households / communities residing within 250 m of work sites along the transmission line alignment are likely to be subject to intermittent noise impacts above the WHO limit of One Hour Equivalent Continuous Level 'A weighting' (LAeq)¹⁰⁷ 55 dBA. Measurement of noise levels at the solar park site and at sensitive receptor sites along the transmission line alignment will be conducted by the contractors once prior to start of the civil works to establish the baseline, bi-monthly during the civil works and once after completion of the civil works (the latter will be conducted at the solar park site only / upon commissioning of the substation) to monitor and mitigate exceedances (if any), with respect to the Ambient Noise Standards (see Annexure I EMP, Part 2). The potential impacts due to noise and vibration will be mitigated by the following measures as set out in the EMP.

- Noise monitoring will be conducted utilizing hand held noise monitors at select locations identified on site map
- Log of monitoring / incidences of non-compliance and rectification will be recorded and maintained
- Drivers will be required to observe low speed wherever necessary and no blowing of horns.
- Construction activities utilizing heavy machinery work will be restricted between 8 AM – 6 PM.
- Advance warning to communities will be provided with respect to the timing of noisy activities.
- Construction vehicles and machinery will be maintained to a high standard to minimize emissions and noise.
- All construction workers / operators will use appropriate PPE including ear defenders when operating machinery.

¹⁰⁷ 'A'-weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies

- Implement CEMP Sub-plans:
 - The Noise and Dust Control Plan
 - Traffic and Road Management Plan

166. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

Impacts on Water Quality and Resources

167. Impacts on water quality and resources during construction stage are assessed for all infrastructure types under project output 1 and discussed as follows.

168. At the solar park site, construction will take place in an area that has a network of drainage canals used for irrigation purposes and two natural streams that flow through the site. This may result in short-term impacts in terms of increased turbidity, run-off of construction related wastewater and sewage discharge and contamination due to improper handling of hazardous and polluting materials. The two natural streams will be conserved in natural condition and a buffer of at least 400 m on either side of the streams will be established.

169. The solar park site design will integrate flood resilience measures and construct a permanent secured ('bunded') area on impermeable surfaces and dykes capable of carrying 110% volume of materials for accidental spills or leakage, the secured areas will be sited away from direct sunlight and 400 m from existing water sources. The transmission line alignment design avoids placement of tower footings in water bodies. GS6 utilizes groundwater for its current operation and it was not clear during the audit if a permit for groundwater abstraction has been obtained, a further check on this is included in the corrective actions. Furthermore, surface and ground water quality testing will be conducted at the solar park site and the downstream An Long Chrey reservoir by a Cambodia MOE recognized local laboratory once prior to start of the civil works to establish the baseline, once during the civil works and once after completion of civil works to ascertain if any changes have occurred with respect to Surface and Ground Water Quality Standards (see Annexure I EMP, Part 2).

170. The potential impacts on water quality and resources during construction stage will be mitigated by the following measures as set out in the EMP.

- Compliance with Sub-decree No. 27 ANRK.BK on Water Pollution Control, MOE, 1999
- Construction camps to be established at least 400 m from any water source
- No washing or repair of equipment / machinery will take within 400 meters of any water source
- Provision for adequate short-term drainage, storm drains or ditches will be made to prevent contaminated construction run-off entering water bodies, if required
- Provision for a temporary secured hazardous materials handling and waste storage area will be provided across all work sites
- Provide temporary sanitary facilities (e.g. pit latrines / portable toilets) to workers and safe drinking water
- Groundwater abstraction will be avoided
- Contractors to include in the construction schedule estimates of anticipated annual water usage and sources of water for construction
- Implement CEMP Sub-plan

- Drainage and Storm-water Management Plan

171. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. Upgrade activities will be supervised and monitored in collaboration with CTL.

Impact on Ecological Resources

172. A biodiversity assessment has been carried out for the project; the flora and fauna recorded during the data search, ground surveys and consultations did not reveal the presence of species or habitats of particular conservation value within the project area of influence. Further seasonal surveys of migratory birds and bats and impacts on flight routes will be carried out to inform the transmission line alignment and mitigation measures identified in relation to any specific impacts. The TOR is in Appendix III.

173. There are no protected areas or community forests in or around the solar park site. The Phnom Aural NPA is located within 20 km of the solar park site and 300 ha Tbeng Srong community forest in Chean Laeung commune is located approximately 5-7 km from the solar park site in the northeast direction. Local interviews with villagers in the Chaen Laeung commune, which borders the Tbeng Srong community forest have suggested the possible presence of endangered and vulnerable species of mammals and reptiles in the forest such as Dhole, Fishing Cat, Asiatic Jackal, and Burmese Python. The interviewed locals also suggested possible presence of rich bird species diversity (species found typically in forested areas, wetlands and rural areas).¹⁰⁸ While there may be avifauna migration from one habitat to another habitat over close distances, for instance, the migration of egret and heron species from the natural stream within the solar park to the downstream reservoir, such coverage is not anticipated for ground mammals or reptiles due to existing habitat fragmentation and sustained human activity. No direct or indirect adverse impacts are anticipated on the NPA or the community forest as a result of construction activities at the solar park site. Construction impacts on terrestrial flora and fauna within the solar park site will be negligible because the site is located in areas of modified habitat consisting of paddy fields and scrubland¹⁰⁹ disturbed by human activity.

174. There are no community forests along the transmission line alignment; the nearest community forests are located 7-8 km from the proposed alignment.¹¹⁰ No direct or indirect adverse impacts are anticipated on these community forests due to construction activities along the alignment. The transmission line ROW will run across paddy fields, scrubland and degraded land, fruit and non-fruit orchards, vacant grasslands, development land and settlements / households.¹¹¹ The project LARP estimates that approximately 256 trees (including 100 mango trees) may be cut for preparation and excavation works on the transmission tower foundations and more than 8500 trees will be affected along the transmission line ROW (i.e. height maintenance under 3 m for minimum sag); all trees are privately owned and will be compensated through the LARP. The final transmission line will be assessed further during the detailed engineering design including adjustments to the ROW to minimize the cutting of trees.

¹⁰⁸ The interviewee said the observations were in the last five years and there has been a decline in sightings due to change in land use and hunting.

¹⁰⁹ Solar park site is mainly scrubland (293 ha) and paddy fields (116 ha); small plantations such as cassava, mango, cashew, eucalyptus and bamboo.

¹¹⁰ Community forests - 70 ha in Rung Roeang Commune; 800 ha in Prambei Mum; 300 ha in Chean Lerng Commune

¹¹¹ Transmission line alignment is mainly paddy fields (711 ha), scrubland (213 ha) and degraded land (147); fruit tree orchard (54 ha) and non-fruit tree orchard (41 ha); vacant grassland (16.3 ha); development land (18 ha)

175. Upgrade works at GS6 will not result in any direct or indirect impacts on ecological resources

176. The potential impacts on ecological resources will be mitigated by the following measures as set out in the EMP:

- Minimise vegetation clearing confined to the footprint of the solar park area
- No use of chemicals (pesticides / herbicides)
- Maintain hedges and field margins along the solar park perimeter
- After completion of civil works, implement Site Rehabilitation and Clean Up Plan including landscaping along the fenced perimeter of the solar park, re-seeding most or all of the site with native species of plants
- Provision for adequate ground clearance under fencing for allowing passage of animals / wild species to prevent habitat fragmentation
- Restoring temporarily disturbed areas to pre-construction conditions
- Minimum vegetation clearing confined to the footprint of the transmission line ROW
- Minimise tree felling along the transmission line alignment
- Trees below 3 m will not be cut or felled, minimum lopping and pruning will be undertaken as necessary
- Any identified bat roosting sites will not be disturbed
- Vegetation planting along the transmission line ROW to stabilize soil where it does not compromise the intended transmission line function
- Restoring temporary land use (used for material storage) to pre-construction conditions
- Economic loss due to loss of crops, trees and agricultural land along the transmission line alignment will be mitigated by appropriate and timely compensation as described in project LARP.
- Any damage to areas outside the ROW as defined in project LARP will be restored to pre-construction condition and /or compensated in line with the entitlement matrix

177. All activities will be supervised by PMO's EHS officer / PIC and monitored by the EPC contractor and C-EHS and C-GRM staff. TOR activities will be supervised by PMO and PIC.

5.5. Operation Stage

5.5.1. Workforce Organization And Orientation

Orientation for Project Staff, Contractors, Workers

178. The PIC will conduct briefing and orientation for all project staff, workers, and contractors / sub-contractors (facility operators), contractor appointed EHS officers (C-EHS) and GRM focal point persons (C-GRM) on:

- EMP, GRM, Information disclosure and meaningful consultation, environmental monitoring and reporting requirements
- ADB and Cambodia labor standards

- Responsibilities of the contractors in implementing SOPs and monitoring environmental compliance with environmental performance indicators and EMP ¹¹²
- Responsibility of the contractors in engaging with affected persons for project GRM
- Create awareness of sexually-transmitted diseases (HIV/AIDs), child labor, bonded labor or forced labor
- Searching for an assessing, monitoring and recording keeping of carcass searches (birds / bats)
- Record and maintain briefing and orientation events log with duration and list of attendees

Impact on Topography (Land and Vegetation)

179. Operation stage impacts on land and vegetation are assessed for all infrastructure types under project output 1 and discussed as follows.

180. **Vegetation Management.** Periodic vegetation maintenance will be undertaken at the solar park site and transmission line ROW. The existing facility GS6 will not require vegetation management within its existing fenced perimeter because the site surface is mainly gravel or asphalt. The potential impacts during operation will be mitigated through the following measures as set out in the EMP:

- Maintain landscaping along the fenced perimeter of the solar park
- Maintain hedges and trees at field margins
- Employ manual vegetation maintenance methods such as grazing by local cattle or manual trimming of grasses and plants within the solar park site and employ local labor
- Maintain the re-seeded site
- Maintenance of vegetation along permanent access roads to the solar park site
- No chemicals (herbicides / pesticides) will be used
- Restore and maintain landscaping (with native vegetation species) under 3 m along the transmission line ROW
- To avoid buildups of trimmed vegetation and branches, these will be allowed for collection by local people for firewood or facility operator will contact the relevant local authorities for collection, transport and disposal.

181. All activities will be supervised by PMO's EHS officer / PIC and monitored by C-EHS staff.

182. **Waste Generation.** While it is not expected that solar PV panels at associated facilities within the solar park will require replacement since their life span is 25+ years; however some may fail due to rain, humidity or heat. Inverters at the substation will likely be rebuilt as opposed to replaced. Small amounts of domestic solid waste will also be generated at the solar park site during operation. Lack of proper handling, storage and disposal of domestic waste and /or broken PV panels may result in adverse impacts. Waste generation will not be an issue due to operation of the transmission line. Waste generation activities at GS6 will continue to comply with its IEIA requirements and the following requirements listed below. The potential impacts due to waste generation will be mitigated by following the measures as set out in the EMP:

- Compliance with Sub-decree No. 36 Solid Waste Management, MOE 1999
- Utilize licensed vendors / suppliers for collection, transportation and disposal of broken / unused PV panels

¹¹² PIC will develop checklists for use in monitoring environmental compliance during construction stage.

- Implement SOP for
 - Materials Management
 - Waste Management

183. All activities will be supervised by PMO's EHS officer / PIC and monitored by C-EHS staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

184. **Hazardous and Polluting Materials.** Hazardous and polluting materials will not be an issue along the transmission line ROW during operation stage. Operation of transformers at the substation within the solar park and GS6 may result in accidental spillage or leakage of mineral oil that may contaminate land and water. GS6 will continue to comply with its EIA requirements and the following requirements listed below. Erection processes and operation will follow manufacturers' specifications and contractors will adhere to the following measures as set out in the EMP:

- Compliance with Sub-decree No.36 on Solid Waste Management, Chapter 3 – Hazardous Waste Management, MOE, 1999; and Declaration of Standard Level on Pollutants or Hazardous Substance permitted for disposal, MOE, 2015
- Maintain Material Safety Data Sheets (MSDS) and Poly Chlorinated Biphenyl (PCB) free certification for equipment
- Maintain controlled area set up for hazardous and polluting materials
- Maintain a register of activities involving hazardous materials.
- Utilize licensed vendors / companies for collection, transportation and disposal of used/ unused hazardous materials / wastes
- Record of incidents, spills / accidents / near-miss / fatalities will be maintained
- Implement SOP for Hazardous Materials Control

185. All activities will be supervised by PMO's EHS officer / PIC and monitored by C-EHS staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

Impacts on Human Environment

186. Operation stage impacts on human environment are assessed for all infrastructure types under project output 1 and discussed as follows.

187. **Occupational Health and Safety.** Contractors will comply with the relevant safety measures required by law and as per International Best Practices. The potential impacts to workers will be mitigated through the following measures as set out in the EMP:

- Implement SOP for Occupational Health and Safety
- Compliance to Cambodia Occupational Safety and Health laws and regulations, MLVT, 2011
- Compliance to relevant national electrical safety standards
- Provide and maintain signage as per Institute of Electrical and Electronics Engineers standards at dangerous places for warning of electrical hazards
- Provide and maintain health assessment by a competent medical practitioner for all workers
- Provide periodic training to all workers with access to electrical and hazardous conditions and workers will be certified to work on site
- Provide and maintain workers appropriate PPE
- Equipment and tools will be inspected before use to ensure proper and safe operation

- Appropriate grounding and deactivation of live power equipment during maintenance work or if working in close proximity to the equipment; provision of lightning arrestors as appropriate
- Record of health assessments, incidents, accidents, near-miss, fatalities will be maintained
- EMF levels expected to be below the limits set by International Commission on Non-Ionizing Radiation Protection which is 4.17 kV/m for electric field and 833 miliGauss for magnetic field; periodic EMF monitoring using hand held devices as required

188. All activities will be supervised by PMO's EHS officer / PIC and monitored by the O&M contractor and C-EHS staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

189. **Community Health and Safety.** The presence of a substation at the solar park and the transmission line may pose potential hazards such as electrocution, lightning strike due to accidental failure of power transmission and exposure to EMF. Information and consultation with local residents (community awareness program) and authorities will be conducted intermittently during operation stage. These activities will be conducted in and around the villages situated close to the solar park site, GS6¹¹³ and along the transmission line alignment.

190. The potential impacts will be mitigated by the following measures as set out in the EMP:

- Distribute PIB/FAQ and make it publicly available during consultations
- Communicate with communities on potential health and safety risks and mitigation measures including ERPs
- Record of consultations will be maintained in accordance with Stakeholder Analysis and Communication Plan
- Security and inspection personnel will be deployed to avoid vandalism of equipment and pilferage of lines/cables that may cause accident and/or electrocution
- Periodic monitoring of EMF using hand held devices at select locations along the transmission line alignment
- Record of incidents, accidents, near-miss, fatalities associated with the project will be maintained
- Records of issues raised will be maintained in accordance with project GRM

191. All activities will be supervised by PMO's EHS officer / PIC and monitored by C-EHS and C-GRM staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

192. **Visual Impact.** The solar park will create a visual impact and may result in induced access to the area. The site is not surrounded by habitation or permanent structures. Steps to reduce visual impacts e.g. maintenance of hedges and field margins around the fenced perimeter will be incorporated after completion of civil works and during the start of operation. This project will showcase green development of the power sector in Cambodia as well as preserve the local biodiversity. Solar panel glare issues are not anticipated for solar PV plants¹¹⁴. Visual impact due to the transmission line will be localized to the tower footing sites; vegetation in and around the

¹¹³ GS6 will be required to undertake the following corrective action - consult with the nearby village / communities in line with requirements for information, disclosure and participation as set out in the IEE and EMP translated in the local language (Khmer); Translate the Safety Manual in the local language and make relevant sections available to the nearby village / communities; Conduct ERP drills with the nearby village / communities on a regular basis.

¹¹⁴ Current glint / glare studies for solar systems at airports have proved that these are not an issue. Source: FS CAM NSPP Technical Team.

tower footing will be restored and maintained as long as it does not cause interference to its intended function. Since GS6 is an existing facility, no additional visual impacts are anticipated during operation.

Impacts on Air Quality, Noise and Vibration

193. Operation stage impacts on air quality, noise and vibration are assessed for all infrastructure types under project output 1 and discussed as follows.

194. **Air Quality.** Operation of the solar park, substation, solar PV plants and the transmission line will not impact the air quality except for some fugitive dust generation due to movement of transport vehicles. Noise-generating equipment (such as inverters / transformers) at pooling substation and GS6 will be enclosed and periodic maintenance of equipment will be conducted to minimize disturbance.

195. All activities will be supervised by PMO's EHS officer / PIC and monitored by the O&M contractor and C-EHS staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

Impact on Water Quality and Resources

196. Operation stage impacts on water quality and resources are assessed for all infrastructure types under project output 1 and discussed as follows.

197. Operation impacts on water quality and resources at the solar park and associated facilities may result due to excess usage, potential contamination to water sources due to accidental spills and leakage as well as due to accidental discharge of wastewater. No impacts are anticipated during the operation of the transmission line. Contractors within 60 days of each contract year after the commercial operations date, will be required to provide to the PMO reasonable estimates of water usage for purposes of operating and maintaining the solar PV plants for the applicable contract year. GS6 will utilize groundwater for its current operation in line with permit for ground water abstraction from the relevant ministry and its current IEIA.

198. The potential impacts on water quality and resources will be mitigated by the following measures as set out in the EMP.

- Maintain storm water retention pond for use for PV cleaning
- Periodic cleaning of storm water retention pond to remove debris
- No use of chemicals / detergents for cleaning purposes
- Groundwater abstraction will continue to be prohibited
- Provide and maintain permanent sanitary facilities to workers and safe drinking water
- Provide and maintain a septic system for wastewater collection and disposal; tank system will be located at least 400 m from any water sources, to avoid contamination.
- Maintain permanent secured ('bunded') areas on impermeable surfaces and dykes capable of carrying 110% volume of materials for accidental spills or leakage

199. All activities will be supervised by PMO's EHS officer / PIC and monitored by the O&M contractor and C-EHS staff. Supervision and monitoring at GS6 will be in collaboration with CTL.

Impacts on Ecological Resources

200. The large area of PV panels in the solar park may create a 'lake effect' which could attract birds that mistake the solar panels for a water body and the hot panels could kill or seriously injure birds, which attempt to land on them especially the young inexperienced ones. Bird collisions can also happen with the transmission lines. Visual deterrents and flight diverters will be provided at the solar park, particularly close to the storm water retention pond and along the transmission line. Further surveys are proposed to determine if specific bird and bat mitigation measures are needed in respect of the transmission line. The safeguards tender requirements for IPPs and SOPs will integrate season specific risks (based on the results of the seasonal bird and bat survey) and monitoring and record keeping of carcass searches.

Decommissioning Phase

201. The solar park facility lifespan is expected to be >25 years, at which point it might be decommissioned. 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. Associated impacts include erosion, noise, dust and vehicle exhaust, and the need to properly manage large amounts of debris, solar panels, wire and cabling, electronics, etc. Solar park substation and transmission line may have a much longer lifespan than the solar PV plants (order of 45 to 60 years), which may be further extended through maintenance and periodic equipment replacement. Therefore decommissioning of substation and transmission line is not further evaluated.

202. The EMP plan provides a preliminary assessment of potential mitigation measures / safeguards that may be implemented at a minimum of six months prior to plant closure at that time. This will be followed by a detailed decommissioning and site reclamation plan to be developed at that time. The preliminary assessment will include measures for avoiding and / or minimizing surface erosion, impact to air and water quality, noise and vibration, flow alteration, waste generation, impact to flora and fauna, traffic related issues as well as health and safety of workers and communities.

5.5.3. Cumulative and Induced Impacts

203. In 2016, ADB conducted a preliminary grid-integration study on solar PV prospects for Cambodia.¹¹⁵ The study report, issued in February 2017, demonstrates the technical feasibility of rapid uptake of solar power to boost generation capacity, diversify the country's energy mix, increase energy security, improve system stability and avoid GHGs. The grid integration study lays out three scenarios of PV penetration (low, medium and high), the corresponding levels of electricity generation and emissions as well as impacts on the grid and recommended mitigation measures. The study suggests that with currently available technologies, up to 150 MW of solar can be added to the grid by 2020 with no major impact on the grid and no additional transmission investment.¹¹⁶ The study also suggests a staged solar PV capacity development plan to 2030 that would allow new systems to be added as demand grows and transmission capacity expands in Cambodia.

¹¹⁵ ADB. (14 February 2017) Towards a National Solar Program in Cambodia: Pre-feasibility Study Findings. Confidential Draft. Manila.

¹¹⁶ The report studies the addition of 100 MW added to the Phnom Penh region and 50 MW elsewhere throughout Cambodia.

204. Given the above scenario, cumulative impacts could arise from other similar solar PV projects in the vicinity that are being constructed concurrently with the construction stage of this project. There are no existing commercial solar PV plants in operation in close proximity to the proposed project. The 10 MW Bavet solar park project in Svay Rieng province is approximately 200 km from the proposed site. In addition, at this time no information is available on current or potential construction works on other transmission line projects that could overlap with this project. Given the constraints in availability of information, it is only possible to qualitatively assess cumulative impacts.

205. Topography and land-use. Field visits suggest that 500 ha in and around the solar park site are heavily disturbed by human activities; impacts resulting from land use change and future solar PV plants at the site are expected to be medium. However, all solar PV power plants will have negative impact on land use.

206. Soils, Surface and Groundwater. When preparing sites for PV panels, some developers clear the entire site of vegetation, often leveling and grading the whole extent of the site. This may result in soil compaction, soil disturbance and erosion and increase the sedimentation of canals and/or any water bodies in the area. As solar PV plants occupy large areas, potential cumulative impacts could be significant if not managed properly especially if more solar PV plants were to be constructed and operated in the future in the surrounding wider area. During operation, PV panels require water for panel cleaning. Some facility operators may undertake groundwater extraction that may affect the groundwater table, excess usage and shortage in water availability for other users in the area. With stipulated mitigation measures to avoid disturbance to the soils as well as surface and groundwater usage, the cumulative impacts associated with future solar PV plants in this regard are expected to be minor.

207. Air, Noise and Vibration: Most solar PV plants will have negative impacts on air, noise and vibration during peak construction stage, which are temporary and localized in nature, the cumulative impacts in this regard are expected to be minor. There will be no air quality issues during operation except for fugitive dust emissions arising from movement of transport vehicles on access roads. There will be some noise generation due to movement of vehicles and operation of substation. However, cumulative impacts during operation in this regard are expected to be minor.

208. Ecology. The biodiversity assessment confirmed that the proposed site does not support any species or habitat of conservation value. However, given the considerable space requirements of commercially viable solar PV plants (>50-100 ha) and corresponding site / vegetation clearances and transmission lines, the effect on ecology could be significant and should be informed by detailed ecological assessment of the area under consideration.

209. Human Environment. Resettlement and rehabilitation of affected persons may have higher relevance for solar PV plants in cases of land acquisition of paddy fields (that also serve as a livelihood source for most rural communities) and associated power evacuation. However, with implementation of safeguard measures such as careful site selection that avoids agriculturally productive lands and appropriate and timely compensation, the cumulative impacts associated with solar PV plants in this regard are expected to be minor.

210. Waste. All solar PV plant development will need to effectively manage their wastes such as biodegradable waste (vegetation clearances), construction debris, presence of workers and hazardous materials, leaks and spills. In case solar PV plants utilize lithium ion batteries for energy storage, then certified vendors will need to be identified for collection and disposal of

batteries at the end of its life span. The cumulative impacts associated with solar PV plants in this regard are expected to be minor if managed effectively.

211. Visual and Aesthetics. Within the wider surrounding area, there are no sensitive human receptors, no sites of particular importance, visual or scenic features, environmental reserves or parks that will be affected by the current or future development. The nearest community forest is approximately 5-7 km away. Another issue is the potential for glare caused by sunlight reflected off the PV panels from the future developments in the wider project area. PV panels work on the concept of absorbing sunlight rather than reflecting it. While minimal reflections from the panels are inevitable, this is not anticipated as a major issue. Thus, impacts in this regard are expected to be minor.

212. Induced impacts would include more frequent use of major roads and access roads for the transportation of workers, equipment and machinery to the solar park site. This will result in traffic nuisance to nearby communes and increase in dust due to movement of vehicles and increase in vehicular emissions affecting air quality. However, with mitigation measures, the impacts are expected to be minor.

6. ANALYSIS OF ALTERNATIVES

6.1. Site Selection

213. Preliminary site evaluation was based on assessment of seven individual sites identified by EDC¹¹⁷, and followed by field visits in May and July 2017 (see Figure 6.1 and 6.2). Site 6 was identified as the preferred site for the solar park.

214. Some sites were excluded due to potential socio-economic impacts and ease and cost of land acquisition followed by other criteria such as unsuitable terrain and vulnerability to flooding (a key concern in Cambodia given the seasonal flood pattern). For example:

- Site 1 is close to a cemetery and urban areas. Land acquisition costs will be high and the potential social impacts more significant than at other sites. The site is also small, limiting scope for future potential expansion of the initial park (the initial 100 MW solar park requires a land area of 150-250 hectares, assuming 1.5-2 hectares per 1 MW of installed capacity). Therefore, it was dropped from further evaluation.
- Site 2 is located about 10km from GS6 where the land price is also very expensive. In addition, EDC noted that it would make little sense to build a new substation and transmission line from the site to GS-6 for such a short distance and that, if a site close to GS6 is to be used, it would be more economic to select Site 1 which is adjacent to GS6 and would avoid these infrastructure investment costs. Therefore, it was dropped from further evaluation.
- Site 3 is opposite a primary school and next to a reservoir. It is located along national road 44, about 35-40km from GS6 (straight line distance) where the land price is considered medium to high. The site size of 205 hectares may also be too small and constrain possible future expansion of the solar park. The land may be suitable for an agro-plantation and land preparation appears to already have taken place on parts of an Economic Land Concession (ELC) within the site, which will further raise the cost and complexity of land acquisition. Therefore, it was dropped from further evaluation.
- Sites 4, 5 and 7 are mostly occupied by scrubland with scattered grown trees and palm trees. Land values are assessed as being much lower than for Sites 1, 2 and 3. The number of landowners with land-based livelihoods is also expected to be low, minimizing social impacts. However, EDC recommended dropping site 4 while further preliminary technical and socio-economic assessment¹¹⁸ resulted in dropping site 7 from evaluation and keeping site 5 as back up.

6.2. Route Selection

215. From the outputs of preliminary evaluation, the direct route to site 6 (30 to 35 km, marked as yellow line in Figure 6.2) was dropped from further evaluation since the ROW would transverse undulating terrain and it would affect settlements. An indirect route via site 5 was selected for further evaluation, ROW (length 40 km) marked as blue line in Figure 6.2.

¹¹⁷National Solar Park Project for Cambodia: Pre-Feasibility Study, August 2017

¹¹⁸Inception Report, February 2018

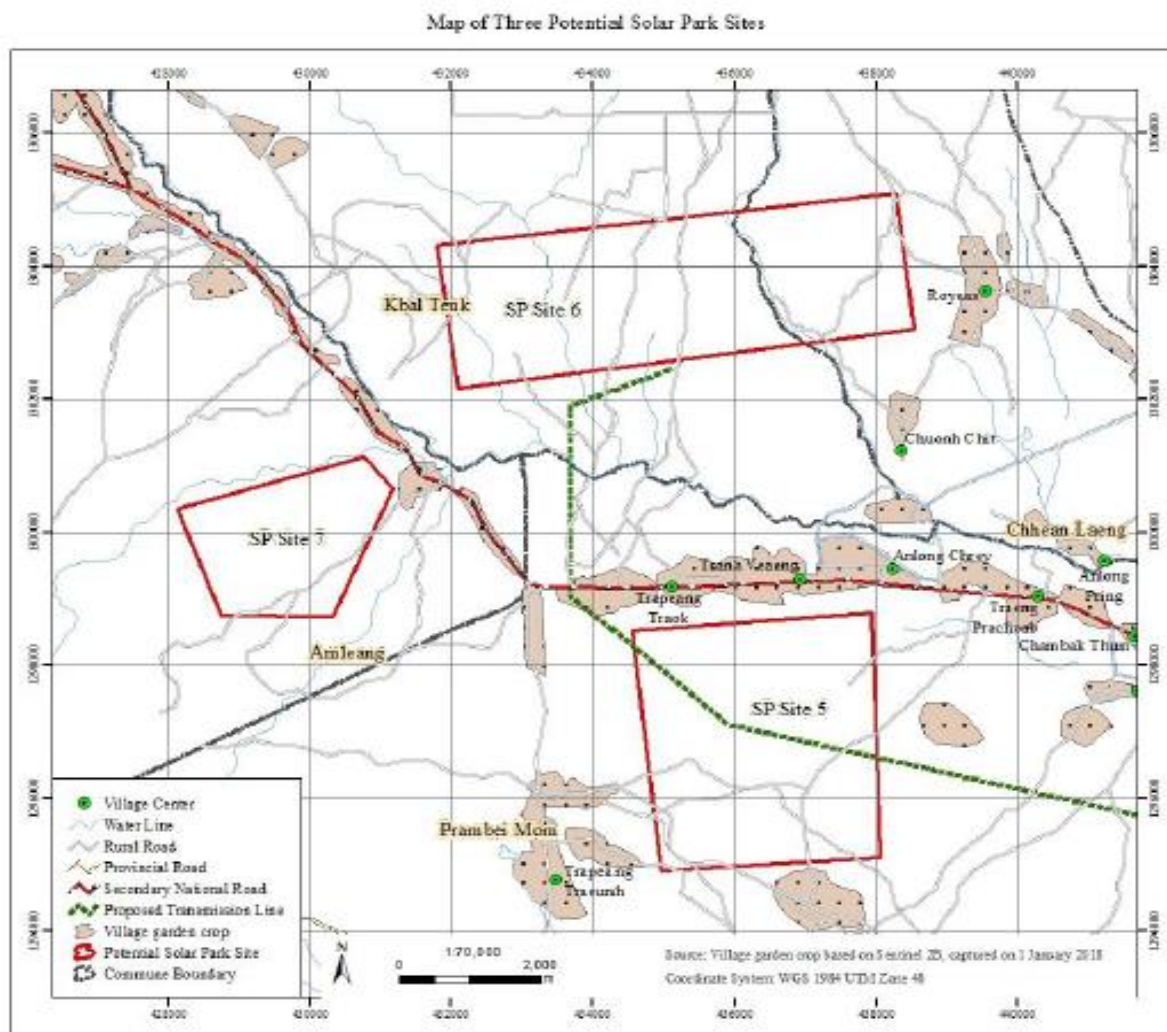


Figure 6.1 Solar Park Sites 5, 6 and 7



Figure 6.2 Transmission Line Route Options

6.3. Technology Selection

PV Module Technologies

216. A number of PV module technologies were assessed for use in the project, and selection was based on minimum environmental impacts and disposal method and procedures as follows:

217. Crystalline Modules: Most manufacturers of crystalline modules have a performance guarantee of 25 years however; these panels can have a longer lifetime if maintained properly. Crystalline modules pose little to no risk to the environment in terms of toxicity since most of the module is made of common construction materials such as tempered glass and aluminum. Furthermore, the PV cell is made from silicon, which is a common earth element. Some panels contain a small amount of lead however; it is sealed in a panel to reduce the risk of environmental release¹¹⁹. Even though these modules do not pose a significant environmental risk, they should be recycled. PV Cycle is an organization of PV module manufacturers that collects and recycles PV modules within the EU with the costs of these services included in the selling price of the modules¹²⁰. In 2016, PV Cycle extended its collection and recycling service to include Japan¹²¹. The waste management solution is also offered to other countries outside of the EU however; an additional fee may be required for services. Recycle Solar is another option for PV recycling. The company recycles damaged or defect PV modules of all types in the UK and Ireland¹²².

218. For the purpose of this project, crystalline modules (mono) will be utilized in the solar PV plants. For end of life / failure or at decommissioning, provision in tender agreements with suppliers / vendors will ensure proper and safe collection, recycling and /or disposal, as needed.

¹¹⁹ NC Clean Energy Technology Center (n.d.). Health and Safety Impacts of Solar Photo-Voltaics

¹²⁰ <http://www.pvcycle.org/services/european-union/>

¹²¹ <http://www.pvcycle.org/press/pv-cycle-launches-take-back-and-recycling-service-in-japan/>

¹²² <https://recyclesolar.co.uk/>

219. **CdTe Thin Film Modules:** CdTe modules also have a warranty of 25 years.¹²³ The modules contain small amounts of cadmium, which is a toxic heavy metal. Tests have shown that in the event that these panels are damaged, only a negligible amount will be leached from the panel. Also, in the event of a catastrophic event such as a fire, the release of cadmium is below human health evaluation levels.¹²⁴ Recycling of CdTe modules is the best option after decommissioning due to the potential release of cadmium into the environment. First Solar, a leading CdTe module manufacturer, has a take-back policy to pay for collecting and recycling modules at the end of their life cycle.¹²⁵

220. **CIGS Thin Film Modules:** CIGS modules typically have a shorter lifetime than other PV module technologies. These cells consist of copper, indium, gallium and selenium, which are all not considered to be very toxic elements. However, the potential formation of hydrogen selenide from selenium is a concern because it is a carcinogen. Also, some cells contain a thin layer of cadmium, which is toxic to the environment. The release of these compounds into the environment is not a significant risk when the panels are in normal use however; special disposal is required at the end of the product life. For recycling, CIGS modules can be collected through programs such as PV Cycle.

Energy Storage

221. If battery storage is considered for this project, then lithium ion will be deployed since this chemistry constitutes the standard for power grid applications and has been installed and operated successfully in very variegate conditions worldwide. Additionally, lithium ion batteries present higher power and energy density than lead-acid batteries and therefore occupy less space. Currently a standard battery recycling commercial proposition does not exist. Therefore, in case of battery usage for the project, for the end of life of battery or at decommissioning, provision in tender agreements with battery suppliers / vendors will be made to ensure safe battery collection, recycling and/or disposal, as needed.¹²⁶

222. Lead-acid batteries account for as much as 50 percent of all battery use worldwide, primarily in the form of car batteries. While lead-acid batteries benefit from their low cost and reasonable safety characteristics, they contain toxic materials and have low energy densities. Lead-acid batteries were utilized in many of the early demonstration projects for grid-scale battery storage. Though lead-acid batteries have been somewhat overshadowed by the more energy-dense lithium-ion batteries in the transportation and consumer spheres, they continue to shine in grid applications because of their low cost, safety profile and established (and highly effective) recycling and reuse infrastructure, all areas in which lithium-ion batteries are (currently at least) less able to compete. Given the wide variety of lead acid models and the higher degree of customizability of chemistry and dimensioning according to the desired operations, is more complicated to give a precise estimate of a large lead acid battery system. As a rule of thumb, the ex-works price can be from 50% to 66% less per MW than the price of a lithium ion battery, while

¹²³ <http://www.firstsolar.com/Modules/Our-Technology>

¹²⁴ Centre for Renewable and Sustainable Energy Studies (2015). First Solar's CdTe Module Technology – Performance, Life Cycle, Health and Safety Impact Assessment.

¹²⁵ Environment Canada (2012). Assessment of the Environmental Performance of Solar Photovoltaic Technologies

¹²⁶ *Battery Storage for PV Support in Cambodia, April 2018.* TESLA has been able to work alongside UMICORE to enable a closed loop recycling system for Li-ion batteries. UMICORE's factory plants are able to recycle TESLA batteries into completely reusable materials and substantially reduce the carbon footprint of manufacturing Lithium Ion batteries. UMICORE's battery recycling technology can extract from the exhaust battery Cobalt and Nickel in the form of alloys usable in the industry. The by-product of this process is an environment-friendly slag where the lithium ends up and could be valorised in different applications, one being construction material.

shipping costs will be significantly higher due to the larger dimension. Lead acid batteries have lifetime usually ranging from 1500 to 2500 cycles before reaching end of life, and have quite inexpensive O&M. Some technologies require some water re-filling every 3-6 months. Lead acid batteries have limited depth of discharge (50%) and are usually highly over dimensioned to avoid frequent fast and deep charge/discharge operations. The silver lining of this is that lead acid batteries have an intrinsic long duration (4 hours or more).

223. The comparison of the two energy storage technologies is presented below.

System	Lead-Acid	Li-ion
Energy Density	35–40 Wh/kg (1) 80–90 Wh/l	150–180 Wh/kg 300–350 Wh/l
Power Density	250 W/kg (1) 500 W/l	800 W/kg 800 W/l
High Temperature Performance	to 40 °C	to 50 °C
Low Temperature Performance	to –30 °C	to –20 °C
Charge Acceptance	Good	Better
Cycle Life	1500–5000	1000–5000
Overall Service Life	15 years	10–15 years

6.4. With And Without Project Scenario

224. Table 6.1 presents a comparison of a “with project” and a “without project” scenario.

Table 6.1 “With” and “Without” Project Scenario

No.	Parameter	With Project Scenario	Without Project Scenario
1	Electricity	Major effect, improve the electricity supply and stability of the national grid, diversity the power generation mix, increase the percentage of clean energy supply	Negative Effect, increase in greenhouse gas (GHG) emissions due to continued reliance on fossil fuel based energy generation
Environment			
2	Effect on protected, sensitive, or forest areas	No effect, avoids National Protected Areas, environmentally sensitive and forest areas	No effect
3	Effect on endangered species	No effect identified to date, further seasonal surveys to be carried out for transmission line. Solar park avoids valuable habitats, forest areas	No effect

No.	Parameter	With Project Scenario	Without Project Scenario
4	Tree cutting, looping and trimming	Minor effect, shall comply with the Environmental Mangement Plan (EMP), environmental safeguards provision of the ADB Safeguard Policy Statement (SPS) 2009 and relevant national regulatory standards	No effect
5	Air emissions	Minor effect during construction: Increase in air emissions because of construction activities / trenching, dust generation; temporary impact Major effect during operation: Decrease in GHG emission	Negative effect, Increase in GHG emissions due to continued reliance on fossil fuel based energy generation
9	Water supply	Minor effect during operation: Increase in groundwater withdrawal compared to without project, shall comply with EMP and withdrawal limits as prescribed in permits and clearances obtained from	No effect
Social			
10	Disturbances of people/ communities	During construction phase; temporary impact	No issue
11	Effect of business	Construction activities may employ local populace generating economic and livelihood generation opportunities.	No issue
12	Status of living	Improve access to electricity, reduce domestic load for persons such as women involved in cooking activities, accessing water supplies	No change
Economic			
13	Economic development	Greater rate of economic development expected	Slow development

7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7.1. Consultation and Participation

225. Initial consultations with relevant stakeholders potentially affected by the project were conducted in May and July 2018 before the commencement of any project activity to inform them of the proposed project, potential temporary impacts and project benefits. First set of consultations were conducted for the transmission interconnection system from May 25 to 31, 2018 at the district and village level followed by FGDs at the village level; and b) second set of consultations were conducted for the solar park from July 4 to 8, 2018 and involved FGDs at the village level.

226. Appendix VII of this IEE includes:

- The agenda for the public consultation meetings along the proposed transmission line
- The Guide Questionnaires for FGDs with women and with men
- The PIB in Khmer that was distributed to participants in the meetings
- Photo documentation of the consultations
- Attendance sheets with signatures
- Stakeholder Analysis and Communication Strategy

7.2. Consultations - Transmission Line

227. The first set of consultations covered participants from a total of two districts, six communes and 26 villages in the Kampong Speu province¹²⁷.

228. District level public consultations were organized in Thpong district and in Odongk district. Consultations were attended by village chiefs, commune councils, district councils, district sectoral offices such as cadastral office, planning office, environmental office, agricultural office, rural development office, district electricity authority, NGOs working on social and environmental issues, women's organization, and district police office. Total of 57 persons (5 female) participated in these meetings.

229. Seven village level public consultation meetings were arranged in the six communes of Khsem Khsant, Trach Tong, Chan Saen, Mean Chey, Rung Roeang and Prambei Mum. The invited participants were village chiefs and people from the villages along the planned transmission line. Total of 169 participants (70 female) attended these public consultations.

230. After each village level public consultation meeting, two gender separated FGDs were organized. Total of 152 persons (86 female) participated in the FGD.

231. Concerns of the public / villagers were common and they include: (i) request for commencement of civil works in the dry season and advance notice prior to start of civil works; (ii) project impacts affecting households /structures, crop production, livelihood, access to agricultural land and general day to day affairs; (iii) dust generation and improper disposal of construction debris during and after completion of civil works; and (iv) safety concerns due to presence of transmission towers and inadequate knowledge of project impacts. Compensation to persons (landowners) affected during construction of and erection of the transmission towers and

¹²⁷ Consultations for the transmission line were held as follows – 2 at district level, 7 at village level, and 14 FGDs.

/or stringing of the conductors was not a concern and there was an agreement over the proposed project Grievance Redress Mechanism (GRM). Overall, the public / villagers were supportive due to expected benefits, i.e. potential employment opportunities. No major environmental issues were raised during the consultation process and no species of particular conservation value were identified in the local areas.

7.3. Consultations – Solar Park

232. The second set of consultations covered participants (villagers) from a total of 4 villages in 3 communes in the vicinity of the proposed solar park¹²⁸ in Kampong Chhnang province. Total of 27 persons (12 female) participated in the FGDs at the village level.

233. The villagers stated that: (i) Air quality is good in their local environment expect for dust generation caused by vehicles transecting through the villages on unpaved roads; (ii) The proposed solar park site and the surrounding area is often utilized by the villagers for cattle grazing (e.g. Trapeang Troak, Chuonh Chit, and Royea villages) and access to nearby lands should be maintained; (iii) Villagers rely mainly on water tankers to bring in water for household usage and for their animals while some groundwater extraction is also done; the water tanker brings in pumped water from the An Long Chrey reservoir situated approximately 4-5 km northwest of the proposed site. Villagers expressed concern about possible water contamination due to excessive use of chemical fertilizers at cassava and sugarcane plantations in the upstream areas; (iv) There are no significant issues related to soil erosion in the area particularly after heavy rainfalls mainly due to flat topography of the area, however all villages have experienced short episodes of drought at least one to two months every year for past ten years; (v) A community forest named Tbeng Srong in Royeas village in Chean Laeung commune is located approximately 5-7 km northeast of the proposed solar park site.

234. Table 7.1 summarizes the concerns raised by the stakeholders and general findings of the consultations and how these are assessed in the IEE.

Table 7.1 Consultations – Odongk-Thpong Transmission Line and Solar Park

Concerns / Findings	Mitigation and Safeguards Measures in the IEE
<p>Construction schedule and timeline</p> <ul style="list-style-type: none"> Request for commencement of construction activities in the dry season, after harvest (January – May) Request for advance notice / information of construction schedule (commencement to completion) 	<ul style="list-style-type: none"> In line with the IEE project planning EMP provision for continuous stakeholder engagement through project implementation and information disclosure on schedule and timeline Disseminate information viz. FAQs / PIB in easy to understand and local language

¹²⁸ Consultations for the solar park were held as follows – 4 at village level. Out of 4 villages, only one village called Trapeang Troak was covered twice for consultations (i.e. for transmission line and solar park).

Concerns / Findings	Mitigation and Safeguards Measures in the IEE
<p>Potential Project Impacts</p> <ul style="list-style-type: none"> • Request for detailed information on physical, biological and social impacts • Concern about construction debris removal from site / dumping on adjacent agricultural land after completion of civil works • Concern about impact of tower footings on water bodies (Khsem Khsant Commune) and water quality • Concern about air quality / increase in dust during the dry season • Request to maintain access to lands under transmission Right of Way (ROW) and areas in and around the solar park for cattle grazing, livestock, etc. • Concern about damage to existing utilities such as access roads, drainage lines, canals and pumps • Concern about lack of continuous monitoring during construction and operation 	<ul style="list-style-type: none"> • Stakeholder engagement and information disclosure on impacts viz. FAQs / PIB in easy to understand and local language • Work sites will be clearly demarcated for construction, with no encroachment outside the demarcated zone • No tower footings will be placed in water bodies • Dust suppression methods to be employed during civil works and transportation of material and equipment to works site (water spraying) • Access to adjacent properties and agricultural land will be maintained, as necessary • Any damage to existing utilities will be repaired and cost borne by the contractors
<p>Concern about soil erosion and localized flooding</p> <ul style="list-style-type: none"> • Almost all villages in the 6 Communes that will be affected by the transmission line experience soil erosion after heavy rains e. g. tower failure/ fall in Kh'laing village (from another project) • No villages in the 3 Communes that will be affected by the solar park experience soil erosion • Most villages across all 8 Communes experience recurrent droughts, some village in Rung Roeang, Mean Chey and Khsem Khsant Communes experience flood events 	<ul style="list-style-type: none"> • EMP provision for considering highest flood level for placement of tower footings • EMP provision that prohibits groundwater abstraction, minimal water usage for temporary sanitation for workers during civil works and usage estimates to be provided by contractors
<p>Concern about safety</p> <ul style="list-style-type: none"> • Fear of electrocution, safety of children climbing towers • Request for fencing around the transmission tower footing • Siting of transmission towers near schools 	<ul style="list-style-type: none"> • Disseminate information viz. FAQs / PIB in easy to understand and local language • EMP provisions for community awareness programs throughout project implementation with specific community health and safety training and ERPs • Signage meeting the Institute of Electrical and Electronics Engineers

Concerns / Findings	Mitigation and Safeguards Measures in the IEE
	<p>standards will be placed on all transmission towers to warn the communities / public of electrical hazards</p> <ul style="list-style-type: none"> • Transmission alignment to be placed away from sensitive receptors such as households, schools and PCRs
<ul style="list-style-type: none"> • Project should provide appropriate compensation for the land to be lost and cover all the costs related to transfer of land ownership • Local employment opportunities during project implementation 	<ul style="list-style-type: none"> • Compensation to be conducted in a timely manner in line project LARP; EDC will engage an Independent External Party to document land acquisition, negotiated settlement in line with ADB SPS 20009. • Local hiring will be given preference as appropriate

EDC = Electricite du Cambodge; EMP = environmental management plan; ERP = Emergency Response Plan; FAQ = frequently asked questions; IEE = Initial Environmental Examination; LARP = Land Acquisition and Resettlement Plan; PCR = physical cultural resource; PIB = project information booklet; SPS = Safeguard Policy Statement

7.4. Information Disclosure

235. Stakeholder Analysis and Communication Strategy has been prepared to serve as a guide in conducting meaningful information sharing, consultations and active participation of concerned stakeholders. The intention of the strategy is to prevent misconceptions on project impacts, project implementation process and doubts or misconceptions on the project that may cause delays in project implementation.

236. Stakeholder Analysis and Communication Strategy identifies various groups of potential project stakeholders and their different roles and interests in the project. It also provides a guideline for the consultation and participation mechanisms to be used during different stages of the project cycle.

237. The Communication Strategy Matrix will be used to tailor the consultations during the detail design phase when updating the draft IEE. Based on the Communication Strategy, a detailed Consultation Plan will be prepared with the affected persons in the project area with schedule, location, invited participants, information to be disseminated and methods of consultation. PIC will assist PMO in preparing the Consultation Plan. An overview activity outline for a Consultation Plan is presented in Table 7.2.

238. Consultations with the affected persons will include information on the project environmental impacts (positive and negative), safeguards measures including community health and safety, training in emergency response, project implementation schedule and process, results from environmental baseline surveys, and acquisition and compensation process, affected households, affected persons' right to complain and Project GRM. Consultations with affected persons will provide a two-way information sharing channel, ensuring that the concerns, questions and ideas of the affected persons will be discussed and responded to in an appropriate and gender inclusive way.

239. The PMO/PIC will record all information dissemination and consultation activities and the results from consultations with the affected persons, including how concerns raised and recommendations made are addressed in the updated IEE and EMP.

240. Consultations with concerned stakeholders will continue throughout project implementation and will be open and gender inclusive.

241. The updated IEE will be disclosed on ADB website (www.adb.org) as required by the ADB SPS 2009 and Public Communication Policy 2011. An updated PIB/FAQ in Khmer will be made available for the affected communities in public consultation meetings, project construction field offices and commune offices.

Table 7.2 Activity Outline for Consultation Plan¹²⁹

Project Implementation Schedule	Activity	Stakeholders
Detail design phase: Detailed Survey	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 Households Villages, Village leaders, Commune councils
Civil works construction	Informal meetings for information updates on project schedule and activities through Village leaders and commune councils Public information meetings as needed Community Awareness Program once during civil works PIB / FAQ made available at consultations, project construction field offices and commune councils	
Operation and Maintenance	PIB / FAQs distributed to communities	

FAQ = frequently asked question; PIB = project information booklet

¹²⁹ All consultations and information disclosure material will be made available in the local language (Khmer).

8. GRIEVANCE REDRESS MECHANISM

8.1. Awareness Of Stakeholders

242. Initial consultations with relevant stakeholders potentially affected by the project were conducted in May and July 2018 before the commencement of any project activity to inform them of the proposed project, potential temporary impacts and project benefits.

243. PIB containing preliminary information on GRM was made available at the time of the initial consultations. This booklet will be updated with GRM details and be made available at the project construction field offices and commune councils. The GRM information will pertain to procedures for making complaints and key contact information e.g. PMO, PIC, SEPRO and C-GRM.

8.2. Need For Grievance Redress Mechanism

244. Since this project will be funded by ADB, SPS 2009 requires PMO of EDC to establish a project specific GRM to provide an accessible platform for receiving and facilitating resolution of complaints from affected persons on project implementation. GRM will cover issues that may be raised on environmental issues such as temporary increase in dust, noise or traffic causing inconvenience to local people, access to adjacent properties / agricultural land or other relevant issues.

8.3. Current Scenario

245. The PMO and SEPRO are aware of the procedures of handling complaints/grievance attributed to social or environmental issues due to previous projects with ADB¹³⁰. With assistance of PIC, the PMO and SEPRO will proactively engage with affected persons and other relevant stakeholders via a project community awareness program prior to start of civil works. The program will cover the scope of the project, schedule of construction activities, identified impacts and mitigation measures, health and safety issues and GRM. There will be ongoing public consultation during project implementation as described in the EMP.

8.4. Project GRM

246. Composition. EDC will set up a Grievance Redress Committee (GRC) as soon as the project commences. GRC will function from construction to operation phase. As practiced, the GRC will include the relevant local commune and/or village chiefs. It will be headed by the PMO and assisted by SEPRO and PIC through the duration of its contract. Other members may include Provincial Officer or their nominee, District Officer from the Cadastral office or their nominee, Contractor and a witness of the affected person; at least one person in the GRC will be female.

247. **Responsibilities.** The GRC is expected to: (i) resolve issues on land acquisition (if any), compensation to temporary damages to crops, orchards, trees and other use of land such as temporary / permanent areas for transmission towers / ROW; (ii) resolve issues on dust, noise, vibration, construction related nuisances to public, etc.; (iii) convene once a month to review complaints lodged (if any); (iv) record the grievances and resolve the issues within 30 days from

¹³⁰ Loan 2979 - Cambodia: medium-voltage sub-transmission expansion sector project.

the date the grievance was filed with the PMO; and (v) report to the complainant(s)/affected persons the status of grievance resolution and the decisions made or action taken.

248. **Area of Jurisdiction.** GRC will be established at provincial level (“Provincial GRC”) with representation from commune councils across the project area of influence where the project components will be implemented.

249. **Procedures.** The key contacts for the GRC will be posted at construction sites, construction camps and public notice boards in affected communes in Khmer language. The GRM will consist of the following steps of conflict resolution:

Step 1

250. Any complaints by an affected person / complainant can be presented to the Contractor, commune council via village or commune chief, either verbally in person or in writing.¹³¹ The Contractor, village or commune chief will be obliged to provide immediate written receipt of the complaint and take it forward in a written format and shared with the PMO.¹³² The contractor will resolve the issue within one week through negotiation. All contractors will maintain records of complaint received and/or resolutions and submit it to PIC and PMO as part of their monthly progress reports.

Step 2

251. If or when the affected person/ complainant is not satisfied with the action or decision of the contractor, an affected person/ complainant will take the issue to PMO / SEPRO via the commune council. In all cases, the grievances will be recorded in writing and then forwarded to the PMO/SEPRO. SEPRO will have 15 days to resolve the complaint through negotiation. If the issue is not handled within 15 days, or if the complainant is not satisfied with the result, he/she can bring the issue to the District office.

Step 3

252. The District office has 15 days to negotiate the complaint and bring it into a resolution. If the complaint cannot be resolved in a way that is satisfactory to all parties, the District office will bring the issue to the provincial GRC.

Step 4

253. The Provincial GRC will meet the affected person/ complainant and try to resolve the issue. Within 30 days of the submission of the complaint to the GRC, it has to take a decision and inform in written both the affected person/ complainant and PMO / SEPRO of the decision.

¹³¹ If affected persons do not have sufficient writing skills or are unable to express their grievances verbally, it is a common practice that they are allowed to seek assistance from any recognized local NGO or other family members, village heads or community chiefs to have their complaints or grievances written for them. affected persons will be allowed to have access to the Detail measurement survey or contract document to ensure that all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned affected persons are provided with copies of complaints and decisions or resolutions reached.

¹³² Each contractor will designate a contractor GRM focal person (C-GRM)

Step 5

254. If the affected person / complainant gets no response from the Provincial GRC or is not satisfied with the result, he/she can bring the case to the Provincial Court. The Court will make a written decision and submit copies to the executing and implementing agencies. If any party is still unsatisfied with the Provincial Court judgment, he/she can bring the case to a higher-level court.

Step 6

255. If efforts to resolve disputes using the grievance procedures remain unresolved or unsatisfactory, affected persons have the right to directly discuss their concerns or problems with the ADB's Energy Division, Southeast Asia Department or through the ADB Cambodia Resident Mission (CARM). If affected persons are still not satisfied with the responses of the Division and/or CARM, they can directly contact the ADB Office of the Special Project Facilitator through the accountability mechanism¹³³.

256. **Recordkeeping and Reporting.** PMO will keep a record of all the grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were affected, and final outcome. Documentation of the grievances filed and resolved will be summarized and reported in quarterly project progress reports and semi-annual safeguard reports.

257. **Disclosure of Information.** Under the direction of the PMO, the PIC will inform the affected persons / complainants on grievance redress procedure, who to contact and when, where and how to file a grievance, time likely to be taken for redressal of minor and major grievances, etc. Grievances received and responses provided will be documented and provided to the affected persons during the process. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the project field offices and Commune council offices and Provisional Office (if required).

258. **Review of the Process.** The PMO will periodically review the implementation of the GRM and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address grievances.

259. **Cost of Implementation.** Costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by EDC.

¹³³ <https://www.adb.org/site/accountability-mechanism/main>

9. ENVIRONMENTAL MANAGEMENT PLAN

260. The project Environmental Management Plan (EMP), see Annexure 1, identifies the potential project environmental impacts and defines mitigation measures and monitoring requirements for the design and pre-construction, construction, and operation stages of the project. It also defines the institutional arrangements, roles and responsibilities of institutions involved and cost estimates for implementation of the EMP. The EMP will ensure environmental protection activities during all stages in order to prevent, reduce, or mitigate adverse environmental impacts and risks. The EMP draws on the findings of the project IEE report and discussions and agreements with EDC and the ADB.

261. The EMP is based on inputs from the Feasibility Study team for the project as of June–July 2018. Detailed engineering designs are yet to be finalized and may require subsequent revisions to this EMP. The EDC will provide the detailed designs to ADB for review to determine if the EMP requires revision. The draft and final EMP will be disclosed on the ADB public website (www.adb.org) and included in the project administration manual (PAM). The final EMP will be included as a separate annexure in all bidding, tender and contract documents. The contractors¹³⁴ will be informed of their obligations to implement the EMP and to include EMP implementation costs in their bids for project works.

9.1. Mitigation And Monitoring Plan

262. This EMP covers the project area of influence and consists of three components: (i) project readiness checks for effective environmental management during design and pre-construction stage and environmental mitigation measures during construction and operation stage; (ii) environmental monitoring measures during all stages of project implementation; and (iii) the last section of this EMP contains the safeguards tender requirements for Independent Power Producers (IPPs) i.e. a list of environmental contract clauses for inclusion into all bidding documents and works contracts in the project for environmental management. These are enclosed as Annexure I – Environmental Management Plan.

9.2. Institutional Arrangements And Implementation Responsibilities

263. **Executing Agency.** The EDC will be the executing agency responsible for overall supervision and monitoring of project implementation and compliance with loan / grant assurances and the EMP. EDC shall ensure that the design, construction, operation and maintenance of the project components to be financed under output 1 are carried out in accordance with ADB SPS 2009, the applicable laws and regulations of the Government of Cambodia, IEE and EMP.

264. **Project Management Office.** EDC has established the project management office (PMO) and this will be the Implementing Agency. The PMO is assigned responsibility on behalf of EDC, for the day-to-day management of the project. The PMO will have the responsibility to supervise and oversee compliance with (i) loan and grant covenants, (ii) environmental safeguards requirements, (iii) coordinate the project GRM, (iv) coordinate with line ministries to ensure smooth implementation of the project, (v) engage PIC services, (vi) supervise the procurement process and (v) report to ADB. The PMO will appoint at least one environment focal person on staff.

¹³⁴ Contractors imply - solar park and transmission interconnection infrastructure Engineering Procurement, Construction (EPC) contractor and solar PV plant key subcontractor(s) - EPC contractor.

265. **Project Implementation Consultant.** PIC services will be engaged to assist EDC / PMO with the implementation of the project, EMP and oversight of the EPC contractor for the solar park infrastructure during construction and operation. At the end of PIC services contract, PMO / SEPRO will be responsible for ensuring compliance with safeguards.

266. The PIC will: (a) update, as necessary, the Initial Environmental Examination (IEE), Environmental Management Plan (EMP), and Land Acquisition and Resettlement Plan (LARP), and, after obtaining ADB's approval, oversee their implementation; and (b) supervise the design, supply, installation, and commissioning of the solar park infrastructure works by the EPC contractor.

267. The PIC will be responsible for building EDC's capacity in financial management, contract administration, and social and environmental monitoring and reporting.

268. The PIC will recruit and manage a local registered firm, who will work with EDC to prepare and submit an Initial Environmental Impact Assessment (IEIA) or full EIA for the solar park infrastructure to the Ministry of Environment (MOE) for clearance and approval, as required, prior to any civil works contract awards. For the upgrade works, PIC will collaborate with the CTL¹³⁵.

269. International and national environmental and social safeguards specialists will support PMO for a total of twenty-two (22) months over a 30 month period.

Positions	Number	Person-Months
International		
Environmental Specialist	1	3
Resettlement / Social Development Specialist	1	3
Sub-total		6
National		
Environmental Specialist	1	8
Resettlement / Social Development Specialist	1	8
Sub-total		16
Total		22

270. **Contractors.** All contractors or third-party consultants will be responsible for implementing the mitigation measures during construction and operation under the supervision of the PIC and PMO. To ensure that the contractors comply with the EMP provisions, the PMO will ensure that the safeguards requirements are included in all bids, contracts and tender documents. All Contractors will be required to prepare a site-specific Construction Environmental Management Plan (CEMP) and Standard Operating Procedures (SOPs) for operation stage, appoint an Environment, Health and Safety Officer ("C-EHS Officer") and submit monthly progress reports on the implementation of the CEMP/EMP. Contractors will also be the key local entry point for the Grievance Redress Mechanism (GRM) viz. appointment of a Contractor GRM focal person ("C-GRM") within its staff and will be required to regularly co-ordinate with affected persons), village chiefs and commune councils to provide up to date information on project activities and to address any issues that arise during project implementation.

271. **Social, Environment and Public Relations Office.** The Social, Environment and Public Relations Office (SEPRO) of EDC in coordination with PMO and PIC will be responsible for overall supervision and coordination during project implementation; in particular it will ensure consistency of safeguards documents with government policy, legal and administrative framework across all jurisdictions – national, state and local level as well as assist with project GRM and meaningful consultations.

9.3. Reporting And Monitoring

272. The PMO will be responsible for environmental reporting. The PIC will provide the environment input based on site visits, compliance checks and environmental monitoring and prepare the project Quarterly Progress Reports (QPR) for submission to the PMO till the project completion report is issued. The PMO will verify and use the information from the project QPR and prepare an Environmental Monitoring report for submission to ADB semi-annually during construction and annually during operation phase. The environmental monitoring reports will be publicly disclosed on the ADB website. Reporting to ADB will continue until project completion report is prepared, one year after physical completion.

273. The PIC will be responsible for environmental monitoring. Three types of project monitoring will be conducted under the EMP.

- Project readiness monitoring. To be conducted by the PIC and PMO (see Project Readiness Checklist)
- Environmental monitoring. To be conducted across all stages of project implementation as described in the EMOP and assessing compliance with applicable Cambodia environmental quality standards (refer to Appendix I of this IEE)
- Compliance monitoring. To be conducted by the PIC to verify EMP and EMOP compliance during project implementation

274. ADB will oversee project compliance on the basis of the annual environmental monitoring reports provided by PMO and site visits (generally one to two times per year).

275. In addition, PIC will coordinate and interact with the PMO on compliance to ADB safeguards requirements and with relevant government agencies and local authorities on permits and clearances, national regulatory requirements, update and finalize the draft IEE as needed. The PIC will also be responsible for assisting the PMO/ SEPRO and contractors in handling complaints and/or grievances filed through the Grievance Redress Mechanism (GRM), if any.

276. The Contractor(s) will submit monthly progress reports to PIC on CEMP/EMP implementation, which will inform the project QPR and semi-annual safeguard monitoring reports.

9.4. Training and Capacity Building

277. The capacity of PMO, SEPRO and contractors staff responsible for EMP implementation, GRM and supervision will be strengthened. All parties involved in implementing and supervising the EMP must have an understanding of the goals, methods, and practices of project environmental management. The project will address the lack of capacity and expertise in environmental and social management through project output 2 consisting of the following steps:

- The capacities of PMO, SEPRO and contractors to coordinate environmental management will be strengthened through a set of measures:
 - i. Appointment of at least one environment focal person within the PMO staff (“PMO EHS”) to be in charge of EMP coordination, implementation and site inspections including project GRM
 - ii. Appointment of at least one environment, health and safety officer within the contractor staff (“C-EHS”) to be in charge of EMP coordination, implementation, site inspections and information disclosure and consultations
 - iii. Appointment of at least one GRM focal person within the contractor staff (“C-GRM”) to be in charge of project GRM coordination, handling complaints, dispute resolution, site visits and information disclosure and consultations
- PMO, SEPRO and contractors will receive training in EMP implementation, supervision, monitoring and reporting, project GRM, conducting meaningful consultations, and relevant environmental rules and regulation. Training will be facilitated by the PIC. In addition, orientation and briefing of project staff, all contractors / sub-contractors, hired workers will be conducted prior to mobilization on site during construction and operation stages.

9.5. Cost Estimates

278. There are three types of mitigation measures and corresponding costs:

- i. Measures that will permanently become part of the infrastructure such as landscaping, re-seeding of sites, hedge planting, maintenance of field margins, perimeter fencing with adequate ground clearance for passage of wild species/animals, road signage, permanent access roads to solar park site, detailed engineering measures for preventing soil erosion and localized flooding (storm water retention pond, strengthening of drainage canals), will be included within the main civil work contract costs and not double-counted as part of the EMP costs, estimated as \$1.17 million or 4.3% of the total base cost.¹³⁶
- ii. Measures such as conducting environmental baseline surveys for surface water and groundwater and seasonal surveys can be counted as part of the EMP costs. Cost estimates related to environmental and social impact mitigation are estimated as \$0.20 million or 0.74% of total project base cost.
- iii. Measures during the construction stage (e.g. dust suppression by watering, use of hand held portable air and noise monitoring devices, EMF measuring devices, quiet / low noise machinery and equipment, PPE, etc.) as well as measures to mitigate unforeseen impacts due to construction activities will need to be included in the tender documents to ensure that all contractors budget these items in their bids. Contractors will also bear all environmental monitoring costs during the operational stage.
- iv. Information disclosure, GRM related costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the EDC.
- v. Human resources for EMP support are part of the PIC services and estimated as \$1.5

¹³⁶ Source: Project Administration Manual, February 2019. The total project base cost is USD 26.90 million; subject to change.

m or 5.6% of total project base cost.

10. CONCLUSION

279. The project is confirmed as environment category B as per ADB SPS 2009; a draft IEE and EMP have been prepared. The project will comply with the Government Sub-decree No.72 on Environmental Impact Assessment (EIA) issued on 11 August 1999, in accordance with these requirements, IEIAs are required for the solar park common infrastructure and for each of the solar PV plants. The MOE will approve the IEIAs at detailed engineering design stage.

280. This project is expected to have significant environmental benefits. A transition to clean energy sources (i.e. solar energy generation) will limit import dependence on coal and other fossil fuels, delay or defer construction of new coal-fired plants and reduce reliance on hydropower generation. This would contribute to national emission reduction targets and reduced pollution impacts.

281. The total land conversion for a 100 MW solar park and associated infrastructure is 370 ha, of which 253 ha is permanent. Vegetation along the final ROW will be maintained for safety reasons and proper operation of the transmission line but will not be permanently acquired, the transmission line tower footings will require permanent acquisition of 3 ha.

282. The potential adverse environment impacts associated with the project have been avoided or minimized through careful site selection of the solar park and preliminary route selection of the transmission line. More detailed assessment is proposed to inform the transmission line alignment and detailed design to minimise 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. A biodiversity assessment conducted for the project confirms that there are no habitats or species of conservation value in the project area of influence. Further seasonal surveys of birds and bats will be conducted to inform the project detail design in relation to the potential impacts on flyways. The TOR for this study is enclosed in Appendix III.

283. While climate change impacts are not anticipated to be significant over the design life of the solar park (+25 years), the preliminary design integrates flood resilience measures such as elevating solar park and transmission tower footings above the highest flood level, paving and raising embankment height of access roads, strengthening existing drainage canals and building a storm water retention pond. Regular maintenance of drainage canals, storm water retention pond and access roads will be carried out to ensure their ongoing effective operation. The key climate vulnerable components will be subject to further analysis during the detailed engineering design.

284. The project output 1 is not expected to cause significant adverse impacts, the identified impacts can be managed through effective implementation of the mitigation measures specified in the EMP, appropriate compensation agreed in the project LARP and through inclusion of safeguards specification in tenders for IPPs and operation and maintenance SOPs. Monitoring parameters have been identified to check the effectiveness of EMP measures and to ensure any unidentified impacts can be readily addressed. Project risks such as low institutional capacity of the PMO and contractors and their failure to implement the EMP effectively during construction and operation stages, will be mitigated by project output 2 that includes provisions for providing training and capacity building on environmental and social safeguards.

285. The PMO will set up a GRM and GRC as soon as the project commences to deal with environmental and social issues that may be raised by affected persons and other relevant

stakeholders during project implementation. The GRM will be coordinated by the PMO and assisted by PIC and contractor C-GRM. GRM will address concerns and complaints promptly via transparent process.

286. Public consultations and FGDs with project affected persons and other relevant stakeholders were conducted in May and July 2018. Measures to address concerns raised during the consultations have been integrated in the design and EMP. Overall, all stakeholders were made aware of the proposed project and were supportive due to expected benefits such as local employment. Consultations with project-affected stakeholders will continue during detailed design and project implementation.