

# Initial Environmental Examination

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**PUBLIC**

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## **India: Assam Solar Project**

Outputs 1 and 2, 750 MW Solar Photovoltaic Plant

Volume 1

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## Exchange Rates

(as of 14 July 2024)

Currency Unit	–	Indian rupee (Rs)
Rs1.00	=	\$ 0.0120
\$1.00	=	INR 83.55

\$ refers in this report to United States Dollars

## Acronyms and Abbreviations

ADB	Asian Development Bank
AH	affected household
APDCL	Assam Power Distribution Company Limited
BOD	biochemical oxygen demand
COD	chemical oxygen demand
CSEMP	construction specific environmental management plan
dB	decibel
EA	executing agency
EHS	environmental, health, and safety
EIA	environmental impact assessment
EM	environmental manager
EMP	environmental management plan
EMS	environmental management system
EN	endangered
ERP	emergency response plan
ESO	environmental and social officer
ESZ	eco-sensitive zone
FGD	focused group discussion
GDP	gross domestic product
GHG	greenhouse gas
GoI	Government of India
GRC	grievance redressal committee
GRM	grievance redress mechanism
HH	household
HSO	health and safety officer
IBAT	Integrated Biodiversity Assessment Tool
IES	international environmental specialist
IFC	International Finance Corporation
IFI	international financial institutions
IUCN	International Union for Conservation of Nature
KBA	key biodiversity area
LC	least concern
MOEF&CC	Ministry of Environment, Forests and Climate Change
NDA	non degraded airshed
NES	national environmental specialist
NGO	non-governmental organization
NO <sub>2</sub>	nitrogen dioxide
NT	near threatened
O&M	operation and maintenance
PCB	polychlorinated biphenyl
PCR	physical cultural resource
PGA	peak ground acceleration
PMC	project management consultant
PIU	project implementation unit
PM	particulate matter
PPE	personal protective equipment
RIPP	resettlement and indigenous peoples plan

SCADA	supervisory control and data acquisition
SEAA	state level environmental impact assessment authority
SEMPs	specific environmental management plans
SF6	sulphur hexafluoride
SO2	sulphur dioxide
SPCB	state level pollution control board
SPP	solar power plant
SPPI	solar power plant infrastructure
SPS	Safeguard Policy Statement
TL	transmission line
UG	underground
UNEP	United Nations Environment Program
VOC	volatile organic compounds
VU	vulnerable
WHO	World Health Organization
WLS	wildlife sanctuary

## Units of Measurement

dB(A)	A-weighted Decibel
HZ	hertz
in/sec	inch per second (25.4mm/sec)
km	kilometer
km/h	kilometers per hour
km <sup>2</sup>	square kilometer
kV	kilovolt
L <sub>eq</sub>	equivalent continuous level
masl	meters above sea level
mg/m <sup>3</sup>	milligram per cubic meter
mg/kg	milligram per kilogram
m <sup>3</sup> /s	cubic meters per second
m <sup>3</sup> /h	cubic meters per hour
m <sup>3</sup> /d	cubic meter per day
m	meter
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
m <sup>3</sup> /s	cubic meter per second
MtCO <sub>2e</sub>	million tons of CO <sub>2</sub> equivalent
MW	megawatt
PPM	parts per million
°C	degrees celsius
µg/m <sup>3</sup>	micrograms per cubic meter

## Executive Summary

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### Overview

1. The Assam Solar Project will support the Assam Power Distribution Company Limited (APDCL) of Government of Assam (GoA) with financing from the Asian Development Bank (ADB) and will address the need to rapidly scale-up Assam's installed solar photovoltaic (PV) capacity to meet the targets set by central and state governments. The proposed solar PV solution has been designed to meet the GoA's desire to retain ownership of some solar PV capacity while introducing private sector participation in construction, operation and maintenance, and investment.
2. The project will be implemented over seven years starting October 2024 with a completion date by September 2031. It will be financed through a project loan and have the following outcome: access to clean and reliable electricity in Assam improved. The project will finance the following electricity generation, storage, and distribution investments in Assam:

**Output 1: Sovereign capacity to generate, manage, and operate solar photovoltaic electricity increased.** The project will finance the construction of 500 MW<sub>AC</sub> of solar PV electricity generation capacity and related infrastructure at a site in Karbi Anglong district.

**Output 2: Private sector investment in solar photovoltaic capacity enabled.** Transactional advisory support will be provided by ADB for development of 250 MW<sub>AC</sub> capacity on the same site through PPP modality using the common solar park facilities built under Output 1.

**Output 3: Renewable energy-powered battery storage system piloted.** This output will support the equity contribution of APDCL to set up a joint venture to develop a pilot grid-connected battery storage installation (BESS) of at least 25 MW at the Kukurmara Mirza transmission substation.

**Output 4: Electricity distribution system in project areas enhanced.** The electricity distribution system in the surrounding areas of the proposed solar site in Karbi Anglong district and in the rural parts of the neighboring district of Dima Hasao will be strengthened.

3. This Initial Environmental Examination (IEE) study has been prepared for the project outputs 1 and 2 mentioned above while a separate IEE study has been prepared for outputs 3 and 4. It is part of the process of compliance by APDCL with the ADB's Safeguard Policy Statement (2009) also considering the environment, health and safety requirements of Government of India and GoA. As per ADB's Safeguard Policy Statement (2009), the project is categorized as B for environmental safeguards and therefore an IEE was required.
4. APDCL will serve as the implementing agency with Power (Electricity) Department of GoA as the executing agency. APDCL will set up a project management unit (PMU) headed by a project director reporting to the chief general manager and a project implementation unit (PIU) for the solar power plant, headed by a project manager, supported by project management consultants (PMC).

### Environmental Safeguards Category of Outputs 1 and 2

5. Safeguard requirements for all projects funded by ADB are defined under ADB's Safeguard Policy Statement (2009) which establishes an environmental screening,

assessment and management process. All ADB projects must comply with its environmental safeguard requirements and Operational Manual (OM) F1, 2013 as well as national laws and regulations to ensure the environmental soundness and sustainability and to support the integration of environmental considerations into the project decision-making process.

6. The project outputs 1 and 2 fall under ADB's environment Category B as the solar power plant's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases, mitigation measures can be readily designed. This is due to the following facts:
- (i) though a large volume of vegetation needs clearance including cutting of 2,395 trees, outputs 1 and 2 are mostly located within modified habitat. Much of this has been subject to *jhum* (slash and burn) cultivation in the past. The avoidance of 94 ha of natural habitat in the site means significant conversion and degradation of natural habitat is avoided.
  - (ii) no protected areas, internationally or nationally recognized sites supporting high biodiversity values including key biodiversity areas, important bird areas, Elephant Reserves, Reserve Forests and elephant corridors will be affected by the works under outputs 1 and 2.
  - (iii) though the works are within the default 10 km eco-sensitive zone of a wildlife sanctuary in the adjacent state of Nagaland, consultation with the principal chief conservator of forests, Nagaland identified that he has no concerns regarding ecological impacts; and
  - (iv) impacts to air quality, noise levels and water quality as well as disruption and disturbance and health and safety risks to workers and communities can be readily mitigated during the construction phase and are not anticipated to be significant during the operational phase.

As a result, significant adverse irreversible, diverse, or unprecedented environmental impacts are unlikely to arise. For a Category B project, an IEE study, including an Environmental Management Plan (EMP) is required to be prepared by the borrower, APDCL.

7. In accordance with ADB's environmental assessment requirements, the IEE study provides a road map to the environmental measures needed to avoid, minimize, and/or mitigate the adverse environmental impacts and risks associated with outputs 1 and 2 on physical, biological, social, and physical-cultural resources in the solar power plant's area of influence during its construction, operation and maintenance (O&M), and decommissioning phases. More specifically, the IEE study:
- Describes the design, construction activities and operational parameters of the solar power plant;
  - Describes the existing socio-environmental conditions within the solar power plant's area of influence;
  - Describes the extent, duration and severity of potential direct, indirect, cumulative, and induced environmental impacts and risks;
  - Analyzes the significance of the environmental impacts and risks; and
  - Formulates the mitigation and monitoring actions to address the potential impacts and risks and presents them in the form of an EMP for implementation by APDCL and the private sector.

## Solar Power Plant Location and Components

8. The solar power plant (SPP) to be installed by APDCL and the private sector under outputs 1 and 2 is located in Karbi Anglong district, on the eastern side of the state of Assam. The district is encircled with Golaghat district on the east, Nagaon and Hojai on the West and Dima Hasao on the southern part. The state of Nagaland covers a significant portion of the eastern side of the district. Diphu is the administrative headquarters of the Karbi Anglong district.
9. The proposed SPP comprises 750MW<sub>ac</sub> of SPP divided into six blocks, with power evacuation to the national grid to be via a grid substation (GSS) and two loop-in, loop-out (LILO) 400kV lines (SPP Transmission Line (TL)) connecting to an existing 400kV TL approximately 5.3km west of the SPP. Several sub-components are included within each component, as follows:

**Component 1:** Works funded by the Project under Output 1 include:

- Sub-component 1a: Package 1 – 250MW<sub>ac</sub> SPP in two lots (125MW<sub>ac</sub> each) Blocks 4 and 5
- Sub-component 1b: Package 2 – 250MW<sub>ac</sub> SPP in two lots (125MW<sub>ac</sub> each) – Blocks 1 and 3
- Sub-component 1c: Package 3 – Pooling Substation (PSS)
- Sub-component 1d: Package 4 – SPP Infrastructure (SPPI)

Works associated with this output that are not funded by the project will include the:

- Sub-component 1e: GSS
- Sub-component 1f: 400kV LILO TL

These works will be funded by APDCL and constructed by a contractor appointed by the Central Transmission Unit (CTU) who manage the national grid. Since they are recognized as associated facilities (AF) of the SPP so their due diligence is considered within the scope of this IEE study.

**Component 2:** Works under this output include transactional advisory support for development of 250 MW<sub>AC</sub> capacity by the private sector through PPP modality using the common solar park facilities:

- Sub-component 2a – Blocks 2 and 6

## Summary of Key Impacts and Mitigation Measures

10. Key impacts identified and mitigation measures to address them are summarized as follows:

### ***Air Quality and Climate Change Emissions***

11. The SPP is in a rural area with generally good air quality although particulate matter may exceed the WHO guidelines during the driest periods. It covers an area of 1,755 ha and there are scattered individual properties and villages within 250m of its boundary all of which could be impacted by a change in ambient air quality during construction and

decommissioning because of fugitive dust from soil being disturbed during earthworks and foundation excavation, and to a lesser extent by combustion emissions from vehicular movements and construction plant including diesel power generators, batching plant and hot mix. However, these properties are only likely to be affected when works occur within 250m of their location, i.e., work sites close to the boundary or along the off-site access roads. Impacts are expected to be localized and of short-term nature with respect to each block. Associated facilities will also involve earthworks and foundation excavation but except for a couple of towers there are few sensitive receptors immediately adjacent. Minimal dust and combustion emission generation is expected to occur during the O&M phase caused by maintenance vehicles passing along the off-site access roads, which will be infrequent. The unmitigated impacts on ambient air quality will be of medium significance. Adoption of the mitigation measures in the EMP should ensure any residual impacts are of low significance with the most impact on those adjacent to the off-site access roads.

12. During the pre-construction phase SPP contractors including the private sector will be responsible for the preparation and implementation of a Dust Management Plan and a Pollution Prevention Plan covering emissions to air management. Off the national and state highway only bitumen surfaced village roads of adequate width to allow vehicles to traverse without damage to the adjacent properties will be used for access to the construction site to minimize dust impact. This will require the off-site access roads to be surfaced at the start of works. A boundary wall will also be constructed around the entire SPP which will help reduce dust dispersion. Contractors shall also install solid temporary fencing at all work sites where residential receptors can be found within 500m. During the decommissioning phase APDCL and contractors will follow all the measures outlined for the construction phase, noting that in 25 years' time new technologies are likely to be available to limit air quality impacts, e.g., electric construction vehicles, improved methods for dust suppression, etc., and where available, they should be used rather than any out-of-date measures proposed in this IEE.
13. Greenhouse gas emissions will result from the clearing of vegetation and the subsequent decomposition of vegetation matter. A major leak of sulphur hexafluoride (SF<sub>6</sub> a potent greenhouse gas) from installed equipment at the PSS and GSS is the worst-case scenario but could occur during operation if equipment is not well-maintained during O&M, or at end of life if the equipment is not appropriately disposed. Although unlikely given that new equipment will be installed, leaks of SF<sub>6</sub> could occur and therefore it is considered prudent to manage it according to good international industry practice, e.g., leak detectors and alarms will be provided.

### ***Climate Change Risk***

14. The main climate impacts on the SPP are likely to be due to temperature increases, increased cloud cover and higher wind speeds. Temperature increases can affect the performance of solar PV modules reducing their output between 0.25% and 0.5% for each temperature rise of 1°C. For large solar power plants, such as this one, a rapid fluctuation in cloud cover can cause localized voltage and power quality concerns. Higher wind speeds can increase dust particle deposits, which decrease solar photovoltaic cell output, but higher winds can also cool the modules, increasing efficiency and output. Very high wind speeds, including cyclones, can cause significant damage to infrastructure. Based on the conclusions of a separate climate change assessment, a range of adaptation measures will be adopted, including constructing the foundations and racking system to withstand cyclones and ensuring passive airflow beneath solar PV modules to reduce module temperature. This should help ensure that any residual impacts are of low significance.

## **Soils**

15. Soil compaction and erosion will be a specific issue across the SPP when construction vehicles traverse and vegetation is removed from the site and earthworks are undertaken to create a construction platform where topography is undulating. The earthworks envisaged for SPP site development will alter drainage lines, which will further increase the risk of soil erosion which in turn will increase the dust impact. Impacts can be long term and of high magnitude if left unmitigated. Adoption of the mitigation measures in the EMP should ensure any residual impacts will be medium to low.
16. Once earthworks are completed all disturbed areas are to be revegetated using native grass species sourced from the site and bioengineering methods can be considered for slope protection. The contractors design teams shall also identify presence of any unstable land/steep slopes over 10 degrees and avoid these in the layout. A Site Preparation and Vegetation Management Plan will also be prepared. The plan shall map the SPP and identify areas where the removal of existing vegetation shall be minimized. The vegetation will only be removed where essential for construction. Beneath all solar PV modules vegetation cover shall be retained or reestablished at a minimum height of 400 millimeters. The plan shall also outline a sequenced construction method, for revegetating areas immediately construction activities are completed in one area rather than undertaking earthworks on all parts of the site at the same time to minimize the area of bare ground exposed.
17. Leaks and spills of hazardous liquids such as fuel, oil and chemicals can occur during all phases. The use of hazardous liquids will be primarily associated with the use of construction vehicles and plant and diesel generators during the construction and decommissioning phases and from oil filled transformers and oil storage at the PSS and GSS during the O&M phase. Impacts will be localized throughout the construction/decommissioning phase and are unlikely to have significant impacts beyond work zones. To manage leaks from oil containing equipment substation detailed designs will include at minimum 110% impermeable bunds to transformers and storage areas used for oils etc.

## **Hydrology, Water Resources and Water Quality**

18. Changes in slopes within the SPP and the presence of impermeable surfaces will affect the natural recharge of the site to groundwater due to a reduction in greenfield area, although as the solar PV modules will be elevated and mass concrete foundations are to be avoided, land beneath them will still be available for groundwater recharge. Impacts will be long term, localized and of medium intensity and significance. Estimates provided as part of the Detailed Project Report (DPR) prepared for the SPP indicate that there is sufficient water availability to supply the required volumes for solar PV module cleaning – however, the type of solar PV module cleaning requires further consideration during detailed design with semi- or fully automated and dry methods encouraged. To complement groundwater supplies, the DPR suggests a system of rainwater harvesting ponds across the site to collect and store water during the monsoon season. They will be constructed of sufficient size to ensure groundwater levels are fully recharged prior to the dry season so that abstraction for cleaning will avoid a water stress situation and conflict with local community water users. Rainwater harvesting ponds shall be designed so as not to limit the flow of water to downstream off-site water users, and so as not to create a breeding ground for mosquitoes resulting in increased vector borne disease etc. Other water requirements for substations and accommodation blocks are not anticipated to be significant and can be supplied via drilling new groundwater boreholes subject to obtaining licenses from the groundwater authority.

19. Detailed design for all blocks, the PSS and accommodation block will include a hydrological assessment and water balance that clearly shows groundwater availability on site and how the proposed water extraction rates could impact upon local aquifers and neighboring groundwater users. If the water balance indicates that there is potential for extraction rates to become unsustainable, the designs must include for semi- or fully automated and dry cleaning methods to be adopted in combination with the rainwater harvesting ponds to limit groundwater extraction. A groundwater extraction plan will be developed by the contractors to include details of abstraction requirements throughout the year, recharge rates of the rainwater harvesting ponds, methods to monitor groundwater abstraction and aquifer recharge rates and a program to monitor local groundwater supplies around the SPP to ensure no overextraction of groundwater. The plan shall also include a specific requirement to prioritize water abstraction from the rainwater harvesting ponds over groundwater. Should monitoring results identify impacts to community groundwater resources the contractors will be responsible for reducing groundwater extraction for solar PV module cleaning and adopting alternative methods. Residual impacts should be low if the proposed mitigation in the EMP is adequately implemented.
20. There are few surface water features within the SPP or close to the SPP TL that could be significantly affected by construction activities. However, on commencement of construction, the SPP will be fenced and closed to the community except for selected access routes. Several community water resources (ponds and borewells) have been identified across the site and these will no longer be available to access. This will only affect the community living around the SPP that rely on the on-site resources. Alternative water sources will be required to mitigate this long-term impact. During detailed design the contractors will identify all surface water features in the SPP boundary and reconfirm if any are used for drinking water or other purposes by the existing local communities who will remain in the adjacent area following land acquisition. If additional water resources to those in the IEE and Resettlement and Indigenous Peoples Plan (RIPP) are identified, consultations shall be undertaken with the local community to determine what measures are to be taken with respect to ensuring continued access to a supply of water. To ensure these households continue to have access to water the Jal Jeevan Mission program (envisioned to provide safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India) will need to become functional prior to any restrictions being imposed on villagers' access to the water source within the SPP. If the Jal Jeevan Mission program will not become functional prior, APDCL shall ensure the households access to water through other alternatives in a sustainable way e.g., borewell outside the site boundaries.
21. Wastewater from construction camps will be connected to a septic tank with soak away so no untreated wastewater will be disposed of to surface water or ground during construction, septic tank/soakaway effluent to meet national general wastewater standards. Wastewater from the substation and administration block will be connected to a package wastewater treatment plant with treated water used for landscaping water or washing of solar PV modules.
22. Drainage will include the provision of attenuation on-site (retention ponds) to ensure that surface runoff from the SPP site is no more than the greenfield runoff rate so as not to exacerbate waterlogging of adjacent land.

### **Natural Hazards**

23. The SPP area is highly seismic. Seismic activity could damage the SPP or TL infrastructure leading to secondary impacts such as power outages. An assessment of floods completed as part of the DPR indicates that flooding will not have significant



impacts on the SPP infrastructure. Forest fires could occur around the site potentially damaging infrastructure close to the site boundary. Much of the dense vegetation on the SPP itself will be removed, with low growing vegetation beneath the solar PV modules maintained, thereby limiting the potential for forest fires on the site itself. Any that did occur could be on the site due to electrical fault or similar and could affect neighboring land. Forest fires may also be started by workers during the construction phase, prior to vegetation clearance. All designs will need to incorporate measures, as required by national standards, to mitigate the risk of damage from seismic events, and other natural hazards. A 10-meter buffer clear of dense vegetation will be maintained around electrical infrastructure to act as a fire break. Residual impacts should be of low significance.

### **Noise and Vibration**

24. The SPP is in a rural area with low background noise levels. Elevated noise levels will be generated throughout construction and decommissioning phases but especially through the earthworks on the SPP site, the presence of construction workers and the movement of materials and equipment to the site via off-site access roads between the national and state highway and site. Properties are only likely to be affected when works occur within 500m of their location, i.e., work sites close to the boundary or along the off-site access roads. No significant noise impacts are anticipated around the PSS and GSS due to the absence of human receptors. Short term noise impacts will be generated around tower sites along the SPP TL alignment during installation although except for a couple of towers there are few sensitive receptors immediately adjacent. No deep piling or blasting works are envisaged, but shallow piling for installation of solar PV module foundations and TL towers may be required. Any requirements for rock breaking shall be undertaken using hydraulic hammer. To manage potential noise impacts during construction a range of good international industry practice measures will be applied. These measures will be particularly important in all areas within 500m of residential properties. A boundary wall will be constructed around the entire SPP which will help attenuate noise. Contractors shall also install temporary noise barriers where residential receptors can be found within 500m of works sites. Residual impacts should be of medium significance if the proposed mitigation in the EMP is adequately implemented.
25. There is a risk that construction vehicles and vibratory rollers for road works could cause structural and cosmetic damage to neighboring properties adjacent to the off-site access roads. Any properties within 5m of the works could be at risk, beyond that distance impacts are less likely based on experience of similar situations. Accordingly, no impacts to properties outside of the SPP boundary are considered likely to be impacted by vibration from works within it. However, there is a risk that works and movements along off-site access roads could impact properties within 5m of the roadside; therefore, structural survey is to be undertaken before the start of works in case of any claim for damages which will be borne by the contractors. Where properties are within 5m of the off-site access roads to be upgraded, compactors with a higher vibration frequency (above 40 Hz) and a lower drum weight will be used for road works. Making multiple passes at a low vibration levels is much less likely to produce damage than a smaller number of passes at a high vibration level.
26. In relation to operational impacts, a SPP is an inherently quiet installation and there will be only intermittent vehicle movements required for O&M. However, sources of noise on site will include inverter fans necessary to keep them cool, emergency diesel generators and transformer hum. Furthermore, there are several sensitive receptors living in proximity to the SPP TL that could potentially be affected by corona noise. Although no significant O&M noise impacts have been identified, contractors will ensure that the design enables operation to always comply with the noise standards set in this IEE e.g., 45 dBA at the site boundary at nighttime. This shall be achieved by ensuring the

maximum sound power level of equipment at 1 m is 70 dBA through use of sound attenuation, set back from adjacent properties etc. The quietest available equipment with manufacturer-supplied noise mitigation will be installed. This requirement shall be extended to all SPP equipment, including inverters. APDCL shall also coordinate with CTU to ensure that the SPP TL is designed to reduce the impacts of corona noise through conductor design, corona rings, etc.

### ***Internationally Recognized Sites and Nationally Protected Areas***

27. Neither the SPP or the SPP TL are located within, or adjacent to internationally or nationally designated or recognized sites, including Reserve Forest, in Assam state. However, several of the SPP village roads to be rehabilitated and a small portion of the SPP are located within 10 km of the Rangapahar wildlife sanctuary in Nagaland state; this is the default ESZ where none is gazetted. SPP works are permitted within ESZs. Initial consultations have indicated that no further assessment of the SPP access roads within the ESZ is required. However, consultation with Nagaland officials is on-going to confirm this status and no access road works will commence until it is confirmed no permission from them is needed. Temporary facilities such as construction camps, batching plants, and, hot mix will mostly be set up within the SPP boundaries; but if such facilities are off site they will be located on modified habitat outside of all sites of ecological importance. Only licensed off-site material sources will be used for gravel, sand etc. Off-site haul routes to import materials are permitted through reserve forests if the roads are existing paved roads. These measures will ensure low significance of residual impacts to designated sites of ecological importance.

### ***Habitat***

28. The main area of the SPP (1,661 ha) has been classified as primarily modified habitat. A small portion of the site i.e. 94 hectares mostly in Block 6 is classified as primarily natural habitat. The boundary wall will pass through a portion of this natural habitat, along the edge of an existing TL RoW in which vegetation is maintained for safety purposes. Further one internal road will pass through a small portion of the natural habitat. The boundary wall construction will clear only a small corridor through the natural habitat, approximately 540 meters long. The cleared area will be approximately 5 meters wide, meaning a total of just over 0.25 hectares of natural habitat will be lost. The internal road is an existing track and will not be widened and no tree cutting is required in this area. Approximately 15-30% of the currently proposed SPP TL route is located within an area of degraded natural habitat which will need to be cleared, approximately 12 ha. In total, post-mitigation, natural habitat loss will occur across less than 1% of the site and be of medium significance, even without modifications to the SP TL route. Habitat surveys and tree inventories will be completed by the contractors' ecologist and botanist to confirm the findings of the IEE. Design and construction will be undertaken such that works (including all approach roads, internal and peripheral roads, temporary construction roads, boundary walls, material and waste storage areas, workshops, offices, other related facilities, and any labor camps) will not encroach on the 94 ha area mapped as natural habitat with the only exception being the boundary wall and main approach road which follows an existing road alignment. Internal road construction will be restricted to the current track within this part of the SPP, no widening of this track will be permitted, and no vegetation clearance permitted either side of it. Toolbox training will be provided to workers in blocks supporting natural habitat and for the SPPI informing them on a regular basis about restrictions to enter this part of the SPP. These contractors and APDCL will make routine inspections of this area of natural habitat to ensure that no encroachment into the area has occurred upon taking on the site. Other areas of natural habitat (as confirmed through ecological survey) will also be avoided. Further, contractors shall select efficient solar PV panels to minimize the land take

required for the works and to maximize the retention of existing vegetation cover that does not need to be cleared for construction or affect solar PV module efficiency through shading. APDCL shall coordinate with CTU to adjust the SPP TL alignments to avoid or minimize impacts on natural habitat, based on the routing recommendations made in this IEE. Provided the EMP measures are followed residual impacts to natural and modified habitat should be of medium significance.

29. A Critical Habitat Assessment (CHA) prepared for the project concluded that the SPP TL area of analysis (AoA) and SPP freshwater AoA qualify as ADB Critical Habitat as they both overlap a Key Biodiversity Area (KBA) - Dhansiri Reserve Forest. The SPP terrestrial AoA potentially qualifies as Critical Habitat because it overlaps two Reserved Forests. As noted above, the SPP and SPP TL do not extend into any KBA or Reserved Forests and conditions have been added to the EMP to ensure that no works occur in these areas. The CHA notes that the SPP is unlikely to hold significant populations of Black Softshell Turtle or Assam Roofed Turtle. However, there is one permanent stream bisecting the SPP TL and it is possible that turtles are present in this area. The SPP TL AoA potentially also supports Critical Habitat for Bengal Florican, a migratory, critically endangered bird species. Since it moves 15-80 km from its breeding sites to areas characterized by dry unmanaged grasslands and low-intensity agriculture in floodplains with low human population outside of protected areas and Reserve Forests it is possible it could be found within the area of the SPP TL. None of these species have been identified during site surveys undertaken to date. But further studies by Bengal Florican experts would be needed to rule out its presence in the TL alignment. Based on the above, it is considered unlikely that the SPP works will have significant direct impacts on critical habitat species. But as the risk of impacts from the SPP TL cannot be entirely ruled out, mitigation is included in the EMP with the provision of bird diverters recommended to reduce the potential risk of Bengal Florican collisions with the SPP TL. Toolbox training will also be provided to SPP contractors staff regarding identification and management of the Black Softshell Turtle and Assam Roofed Turtle. APDCL shall coordinate with CTU to ensure the significance of impacts on critical habitat species is reduced compared to the pre-mitigation scenario; to achieve this SPP TL designs should include bird diverters along the entire length of the earth wire of both lines unless absence of this species along the SPP TL route can be confirmed by Bengal Florican experts. Residual impact significance on this species is medium since implementation of mitigation measures is primarily the responsibility of CTU, over which the APDCL has reduced leverage without the support of GoI.

### ***Flora and Fauna***

30. During the construction phase, the key potential impacts on flora and fauna relate to vegetation clearance within the 1,755 ha SPP (and potentially adjacent to village roads), vehicle movements, the siting of temporary facilities including construction camps and the presence of workers. 2,395 trees will be cut within the SPP and ground vegetation will need to be cleared where it is essential for construction. Cutting of trees and vegetation clearance will also be required along the SPP TL alignment. Details regarding the exact number trees to be cut for the SPP TL will not be known until the alignment is confirmed. Public trees to be cut will be compensated by compensatory afforestation as per forest department requirements and the requisite forest department approvals for any tree cutting will be sought pre-construction. APDCL will provide funds to the forest department based on the number of public trees counted by the contractors to be cut and monitor the progress of the compensatory plantation process that it has funded to ensure that planting takes place to help ensure no net loss of biodiversity is obtained.

31. During the O&M phase there is potential for impacts to birds via electrocution and collisions with the SPP TL. Of specific concern is the potential presence of the Bengal Florican in the terrestrial AoA as discussed above. Additionally, the construction of permanent wall around the SPP and internal fences to the blocks can act as a barrier to the movement of reptiles and mammals across the site. Of specific interest is the movement of stray elephants which are known to periodically enter the SPP area, since these could cause a lot of damage to the SPP infrastructure. The creation of a “lake effect” due to the scale of the solar plant is considered to be a negligible risk to birdlife.
32. The boundary wall and internal fences will be appropriately designed to allow for the movement of small turtles and mammals. Internal fences shall include 300mm gaps at the base to allow the continued movement of turtles and mammals across the blocks. The external boundary wall will also be provided with 300mm gaps at the base in the vicinity of natural drainage channels, near waterlogged areas, rainwater harvesting ponds, adjacent to retained natural habitat, or created habitat areas, or crossing over an area acting as a wildlife corridor to allow for the continued movement between habitats of turtles, mammals etc. In all other locations 1500m wide 300mm high gaps will be placed in the base every 250m. The external boundary wall and block fences to be screened by a native species vegetation buffer of sufficient width to minimize visual impact of the fence line and SPP infrastructure on adjacent local communities. To protect the SPP boundary wall against stray elephants a hanging solar electric fence will be included in the design immediately in front of it to protect against occasional elephants roaming into the SPP site and damaging it. APDCL shall coordinate with CTU and their contractor to ensure that SPP TL tower designs ensure that adequate clearances are provided between live wires and grounded surfaces as per good international industry practice for bird sensitive TL design. To reduce the risk of impacts to the Bengal Florican, and birds in general, bird divertors should be installed along the entire alignment of the earth wire of both lines. Residual impacts to flora and fauna will be of medium to low significance if all the above measures are implemented. However, residual impacts from bird collisions will remain unless CTU implement the recommended mitigation measures.

### ***Employment and Livelihoods, Land Use***

33. Impacts from land acquisition will be compensated for in accordance with the RIPP for the SPP and national regulations for the associated GSS and TL. The resettlement site must be selected on modified habitat, and not require tree cutting. Since the site is not yet identified, the IEE will need to be updated before any works on it commence to ensure impacts on the environment and social receptors at the selected site(s) are identified and managed.

### ***Access, Social Infrastructure and Utilities***

34. Two access roads for continued access across the site by the local community have been included within the site layout. Both routes have been agreed upon by the community and APDCL. Since these will permit some public access to the site each block will be fenced to prevent access to the electrical infrastructure. However, discussions with the community surrounding the SPP have indicated that there are at least three other access routes through the SPP blocks they would like to be retained. Removal of these access routes, without adequate consultation with the community, may result in complaints when construction commences and the boundary wall is installed or blocks fenced. As part of detailed design, APDCL and contractors will consult with the local community to determine if any additional access routes are required through the blocks before the boundary wall and internal fences are installed. This should be completed as part of facilitated access workshops where all members of the community

living within 500m of the SPP are invited to attend and put forward suggestions for access across the site, or within specific blocks. Residual impacts will remain of high significance until consultations are completed with the community to incorporate all their needs relating to access around and through the SPP.

### **Visual Impact**

35. The solar power plant will be an incongruous feature in the rural landscape at the site being an industrial installation and visual impacts are unavoidable. There may be night-time intrusion from artificial lighting of the SPP in otherwise dark skies. The site itself slopes from west to east and visual impacts from the SPP are more likely to be observed to the east of the SPP, although in general the villages around the SPP are small and the number of people affected will be relatively low. This specific area is not known to be an important, or culturally significant landscape and is not an area for tourism. A facilitated workshop will be held between APDCL and contractors to agree visual design standards so there is visual cohesion between all blocks and the common (administrative area) during the O&M. Contractors will consult with local communities within 500m of the site boundaries to get their views and input into the site layout. Outdoor lighting shall be minimized along with the height of security fencing. The SPP site boundary shall be planted with a vegetation buffer to screen against the boundary wall. Residual impacts may remain of high significance although the numbers of receptors affected will be relatively low.

### **Physical Cultural Resources (PCR)**

36. Several PCR sites have been identified within the SPP, two churches and one prayer home have been confirmed. The church in Block 4 will be relocated to a resettlement site located outside of the SPP, as agreed upon by the community currently living in the SPP area who will be resettled. Consultations with the community of the church in Block 6 and a Prayer Home close to the church found they were not aware of any proposed measures to relocate their facilities. A temple was also identified close to the SPP boundary, anticipated to be outside but its location is still to be confirmed, although consultations with the community did not indicate that it was of any significance to them. It is also possible that a graveyard could be present within the boundary of the SPP. However, consultations with the community were inconclusive regarding its exact location although it was suggested it was not within the SPP site itself. Some trees under which prayer/rituals are performed are reported by consultations to be inside the SPP and it will be difficult if access to them is blocked and they are not allowed to perform in those sites as they are using them since generations. However, the social safeguards survey team has not identified any to date. Other churches have been identified in the area around the SPP and SPP TL. Hatokajan Seventh Day Adventist Church is the closest to the SPP boundary, approximately 500m away. This site will not be significantly impacted. During the construction phase a 'chance find' procedure will need to be implemented during the excavation works given Karbi Anglong has good potential for archaeological finds.
37. As part of the detailed design phase contractors shall conduct an inventory of above ground physical cultural resources checking against the findings of the IEE. The inventory is to be compiled by a qualified physical cultural resources expert who is appointed by the contractor following a site walkover and local community consultation in conjunction with the RIPP consultants. Of particular importance is to identify the presence of any graveyard or the temple on the site and to re-confirm the temple's specific cultural importance to the community and if it can be removed from the site. Additional consultations shall also be completed with the community regarding Jericho Baptist Church and Immanuel Prayer Home to discuss preferred relocation sites.

Resettlement of the Block 4 church will be completed per the requests of the community and per the RIPP. Removal or blocking of access to trees where prayers/rituals are performed will be an issue; such trees are to be retained with access arrangements made for continued use if the community requires it and no alternative arrangement can be agreed with them. Once vegetation has been cleared a second archaeological site walkover will be undertaken by a qualified physical cultural resources expert (archaeologist) appointed by the contractor to identify any previously unknown resources and review the potential for archaeological features to be encountered underground. Demarcation of physical cultural resources to be avoided and retained. The residual significance of impacts of the SPP and SPP TL on physical cultural resources should be low.

### **Waste Management**

38. Generated waste can be appropriately managed through the adoption of international good industry practice measures around the work site and at control rooms and in the administration blocks during operational phase. Solid and hazardous waste management facilities exist in India, if not Assam. However, solid and hazardous waste such as waste oil can contaminate soils and groundwater if it is not stored, handled, and disposed of correctly. During the O&M phase contractors, APDCL and the private sector will be responsible for ensuring waste management and disposal in line with national waste management regulations. During the O&M phase faulty and any broken electrical and electronic equipment will need to be removed from site, this could include PV modules which may contain heavy metals. In sufficient quantity these heavy metals can cause significant pollution events. During decommissioning all the modules and electrical and electronic equipment will need to be removed from site. Further, all equipment from the PSS will be removed, unless it is retained for alternative use (e.g., the SPP may be upgraded in the future with more efficient modules which would still require PSS, GSS and LILO). It is possible that items such as the accommodation block and internal roads may be retained for other purposes, but other infrastructure such as fences, gates, security buildings, etc. will be removed.
39. Contractors will prepare and implement a Waste Management Plan dealing with all solid and hazardous waste as well as wastewater generated in an environmentally sound and safe manner. It will ensure waste generation is reduced, all surplus materials will be reused or recycled, and disposal will be the last resort. Of specific importance is the management of vegetation waste and e-waste. The latter will include solar PV panels and equipment containing SF<sub>6</sub>, oil and lead acid batteries. The Waste Management Plan will include specific sections relating to the management of these waste types. Detailed designs shall ensure that cut material is balanced with fill across the SPP to minimize the creation of inert waste. For vegetation waste the contractor will seek to avoid cutting of trees and clearing of dense vegetation where it is not required for construction and there is no shading of solar PV modules or interference with other equipment and cables. Where tree cutting and vegetation clearance is required the contractor will follow the step-wise approach below:
- a) Handover trees to government as per the legal requirements
  - b) Offer any residual trees and bamboo to the local community as construction material or fuel wood.
  - c) Use any residual trees and bamboo for construction works, e.g., construction of temporary shaded rest areas for workers, etc.
  - d) Establish a composting area for remaining organic waste to be reused on site as topsoil.
  - e) Any organic waste that cannot be re-used or composted, e.g., large tree stumps that cannot be easily grounded, should be collected by an authorized waste

management company, or supplied to a company for use as biomass, wood chips, etc.

40. Environmentally safe solar PV panels and electrical equipment will be selected by the contractors from a manufacturer who offers a facility for return of faulty/broken/end-of-life equipment with a take back guarantee for end-of-life provided. Solar PV modules must not contain hazardous materials e.g., cadmium, lead, or selenium. Equipment purchased is to be accompanied by letter from the manufacturer stating its composition and the leaching potential of any heavy metal content to determine if it is acceptable and how it is to be disposed on at end-of-life. Any e-waste created will be returned to the manufacturer or, if not possible, disposed of at a suitable licensed hazardous waste facility within India. During the decommissioning phase the e-waste will be returned or disposed of in accordance with the prevailing laws and good international industry practice at that time.
41. APDCL and the private sector shall outline the procedure for dismantling and handling equipment as part of their decommissioning-EMP. All solid and hazardous wastes shall be removed from site and either be recycled, returned to vendor for e-waste (if suppliers are still in business or the guarantee is honored at end-of-life) or disposed of in accordance with the prevailing laws and good international industry practice at that time. This will include any equipment containing SF6 and any lead acid batteries. Residual impacts from all phases will be of medium significance.

### ***Occupational and Community Health and Safety***

42. The population surrounding the immediate boundary of the SPP and along the SPP TL is generally low and the risk of impacts to these communities are relatively low, but still need to be managed. The population found along off-site access roads is, as expected, higher and impacts, including vehicle or pedestrian accidents, along these routes could be more significant to the communities. No significant Electromagnetic Field (EMF) impacts are anticipated from the SPP or SPP TL if good international industry guidelines for exposure are followed. During the design phase it is important that all infrastructure is designed with the safety of the community in mind. The design requirements will be different for the various activities; however, the general theme of the detailed design phase is that all infrastructure will be constructed in accordance with national safety codes and safety clearances. Designs will ensure that there can be no illegal access to substations. The PSS is included within the main SPP boundary wall thereby preventing illegal access to the site. The SPP will be secured with the boundary wall, internal block fences and CCTV. This should prevent access to the electrical infrastructure on the site. Contractors will be responsible for the preparation and implementation of a Community Health and Safety Plan outlining all the relevant measures in this EMP relating to it. Additionally, a Traffic Management Plan will be prepared considering both the safety of pedestrians and vehicles and need to avoid traffic congestion on the off-site access roads. Residual impacts should be of low to very low significance.
43. The SPP is expected create at least 500 direct employment opportunities per block and around 50 for the PSS and SPPI during the peak of the construction period. Most workers will be engaged by the contractors and will consist of an unskilled, semi-skilled to skilled workforce. During the O&M phase maintenance works will be undertaken by the O&M contractors, APDCL and/or private sector. The expected impacts on worker rights and H&S because of construction activities and operation are as follows; 1) risk to workers H&S due to hazardous construction activities and inadequate living conditions; and 2) violation of workers' rights. Contractors will be responsible for the preparation and implementation of an Occupational Health and Safety Plan outlining all the relevant

measures in this EMP relating to it. Residual OHS impacts should be of medium to low significance.

### ***Cumulative and Induced Impacts***

44. Key cumulative impacts identified in this IEE study are all associated with the ongoing highway construction works on NH-29. Cumulative impacts will include potential for increased noise and dust around the portions of the off-site access roads connecting to NH-29 and the increased risk of accidents involving members of the community due to the large amount of construction vehicle movements to and from the SPP during the peak periods of construction. In the areas close to NH-29 it is important that contractors responsible for off-site access road works in these areas pay extra attention to these issues. Specifically, more regular watering of off-site access roads in this area is recommended, along with close supervision of vehicle movements ensuring they respect speed limits.
45. Key induced impacts are all related to future expansion of the solar PV plant which will be facilitated by the presence of the PSS and ability to evacuate power through the associated facilities.

### **Consultations and Grievance Redress**

46. Stakeholder engagement has been undertaken throughout the development of this IEE study, with the view to determining and responding to the views of interested stakeholders and persons potentially affected by this SPP component, and to ensure open and transparent, two-way communication between APDCL and their stakeholders. To date, a range of consultation sessions with 878 people (453 male, 426 female) have been undertaken for environmental and social safeguards during 2023 and 2024. Of these, 294 consultees were contacted in relation to the IEE study (173 male, 121 female) while the rest were consulted for social safeguards, which also included cross-cutting themes such as energy access and water supply. Key issues raised during the consultation sessions relate to:
  - Creation of job opportunities, especially for women.
  - Protection of water resources.
  - Conflict resolution during construction.
  - Requirements for road safety through the movement of heavy trucks to the site.
  - Electrical safety around infrastructure.
  - Minimum tree cutting and damage to the environment.
  - Movement of elephants.
  - Continued access across the SPP site.
  - Relocation of churches.
47. These concerns raised by stakeholders have been incorporated into the mitigation included as part of the EMP for the solar PV plant. To address project specific issues from affected persons, a Grievance Redress Mechanism (GRM) will be established by



APDCL starting at site level with the contractors and private sector, the details of which will be disseminated to local communities.

## Conclusions and Recommendations

48. This IEE study has established that in general there are no significant environmental issues that cannot be either totally prevented or adequately mitigated to levels acceptable to the national standards and international good practice guidelines. Mitigation and monitoring measures have been included in the EMP for this solar power plant component, which will ensure that most residual impacts are of medium to low significance. APDCL will implement the EMP measures by ensuring adequate budget and human resources are allocated. However, several residual impacts of high significance have been identified that do require further attention during implementation, including relating to the SPP TL, e.g., impacts to natural habitat. In addition, issues relating to access across the site have been raised by the community and it is important that this issue and PCR impacts are further assessed in close collaboration with the community during the detailed design phase by APDCL, contractors and the private sector.
49. The EMP for the solar PV plant, its mitigation and monitoring programs, will be included within the bidding documents for works and requests for proposals from the private sector by APDCL. The bid documents/request for proposals will state that contractors or the private sector will be responsible for the implementation of the requirements of the EMP allocated to them (including detailed design, O&M and decommissioning phase actions) and preparing their own Construction Specific EMP (C-SEMP), O&M Specific EMP (O-SEMP) and Decommissioning Specific EMP (D-SEMP), which will adopt all the conditions of the EMP and add in site specific elements that are not currently known, such as storage and construction camp locations. This will ensure that all potential bidders are aware of the environmental requirements of this solar power plant and factor in environment, health and safety staff and other costs. The EMP and all its requirements will be added to the contractor or private sector's contract, thereby making implementation of the EMP a legal requirement according to the contract. The contractors and private sector will then prepare their detailed designs and SEMP's which will be approved by APDCL with their works supervised and monitored by them. APDCL will also supervise and monitor CTU associated facility activities. Should APDCL note any non-conformance with the EMP (and SEMP's) the contractors or private sector can be held liable for breach of the contractual obligations. To ensure compliance contractors and the private sector are required to employ a team of environment, health and safety experts to monitor and report their activities throughout the phases they are responsible for. Project Management Consultants will also include environment, health and safety experts to support APDCL with supervision and monitoring of EMP implementation and to build the capacity of APDCL.
50. This IEE including EMP are considered sufficient to meet the environmental assessment requirements of ADB for the solar power plant at project approval stage. However, before the detailed designs and resettlement site(s) are approved by APDCL and works commence on site, and in case of change in scope or other unanticipated impact, the need for the IEE study to be updated to reflect the final detailed designs and resettlement sites selected will be determined in consultation with ADB, and any update (or addendum) reviewed, and cleared by ADB for disclosure on the ADB website and locally.
51. Lastly, it is important to note that there are several important issues raised in this report relating to the SPP TL which will be the responsibility of CTU and their contractor to implement. This IEE study has made recommendations that should be adopted by CTU, including the requirement for bird diverters, consideration of alignment changes, etc.

However, the SPP TL is an associated facility and is not funded by ADB or the project. Associated facilities should achieve an outcome consistent with the project (e.g. environmental, health and safety management, meaningful consultation and informed participation, information disclosure, grievance redress, no significant conversion or degradation of natural habitat, no reduction in the population of critically endangered or endangered species, no net loss of biodiversity, and no significant damage to PCR etc.) but the decision to adopt the mitigation measures can only be taken by CTU in coordination with APDCL.

## I. INTRODUCTION

### 1.1. Background

52. Assam is the second largest state (by area) in India's northeast region. It also has the largest population and the biggest economy amongst India's northeast states, contributing around 60% of the region's economy activity.<sup>1</sup> Assam's proximity to neighboring countries gives it strategic importance. Unlocking Assam's full economic potential requires addressing its energy security. Assam state's electricity supply mix is dominated by coal and gas, which accounted for about 70% in the state's electricity in 2022. This results in significant volatility in the supply cost with variability in fossil fuel prices. Domestic gas prices have more than doubled since early 2021, resulting in an increase in Assam Power Distribution Company Limited's (APDCL) average electricity purchase price of around 15%.
53. Based on the current and projected rate of electricity demand growth of 5.3% and on renewables purchase obligations imposed on the state by central government,<sup>2</sup> Assam needs to develop or contract for the equivalent of around 3,000 megawatts (MW) of solar capacity by 2030.<sup>3</sup> In principle, this capacity could either be developed within the state or could be purchased from other states. However, the transmission connection from the rest of India to the northeastern regional grid (of which Assam is the largest state) through the Siliguri Corridor is heavily constrained and has no spare capacity to cater for load growth in Assam and other northeast states. This constraint will be exacerbated by tightening gas supplies (and higher gas prices) in the northeast, limiting opportunities for new gas-fired electricity generation.
54. The scale of investment required to meet Assam's renewable energy obligations through to 2030 is well beyond the capacity of the public sector; private investment will need to be mobilized. India-wide, approximately 50% of installed generation capacity is owned by the private sector compared to only about 7% in Assam. This lack of private sector investment in Assam's electricity sector reflects various impediments including lack of road map for the generation subsector and the absence of investment incentives and limited investment opportunities suitably packaged for private investment. The limited experience and capacity within the government to execute PPPs is also a factor. The need to increase the involvement of the private sector in the state's renewable energy development is imperative. In this context, the Assam government's renewable energy policy (released in 2022) outlined the government's intention for mobilizing public and private resources for the state's 2027 solar capacity target of 2,000 MW through various private and public-private mechanisms.<sup>4</sup>
55. The Assam Solar Project will support APDCL of Government of Assam (GoA) with financing from the Asian Development Bank (ADB) for increasing its solar energy capacity through public and private financing to meet growing demand and reduce dependency on thermal energy. The main focus of the project is to provide sovereign support for the construction of a 500 MW grid-connected solar PV facility in Assam's Karbi Anglong district and transaction advisory support for development of additional 250 MW capacity through Public-Private Partnership (PPP) modality on the adjacent site

<sup>1</sup> Reserve Bank of India. 2022. Handbook of Statistics on Indian States. New Delhi.

<sup>2</sup> The Gazette of India. 2023. Notification Regarding Renewable Purchase Obligation. 20 October 2023

<sup>3</sup> Under the renewables purchase obligation (RPO) scheme, electricity distributors and open access electricity customers are required to procure a certain proportion of their electricity needs from renewable sources, and a certain proportion of that from solar. The states' 2022-23 target for the solar RPO was 23.44% (of total electricity consumed), compared to a total renewable energy obligation of 17% for 2021-22 (a target that Assam missed by almost 50%). The solar RPO target will increase to 33.57% by 2029-30, and the total renewable energy target will increase to 43.33%.

<sup>4</sup> The Assam Gazette. 2023. [Assam Renewable Energy Policy, 2022](#). 4 November 2022.

using the common solar park facilities. The project will also support development of a 25MW pilot grid-connected battery storage installation at the Kukurmara Mirza transmission substation to support integration of the solar PV facilities and to provide frequency regulation to improve grid stability. Electricity distribution infrastructure in Karbi Anglong district and in the rural parts of the neighboring district of Dima Hasao will be upgraded by the project. The project will also strengthen the institutional capacity and knowledge of executing and implementing agencies.

## 1.2. Project Overview

56. The project will be implemented over seven years starting October 2024 with a completion date by September 2031. It will be financed through a project loan and have the following outcome: access to clean and reliable electricity in Assam improved. The project will finance the following electricity generation, storage, and distribution investments in Assam:

**Output 1: Sovereign capacity to generate, manage, and operate solar photovoltaic electricity increased.** The project will finance the construction of 500 MW<sub>AC</sub> of solar PV electricity generation capacity and related infrastructure in Karbi Anglong district. This will address Assam's need to enhance its energy security by significantly increasing in-state generation capacity. Training to APDCL staff (including 30% women) on solar and other new technologies will be undertaken. APDCL will also target an all-women maintenance workforce for the solar facility.

**Output 2: Private sector investment in solar photovoltaic capacity enabled.** Transactional advisory support will be provided for development of 250 MW<sub>AC</sub> capacity through PPP modality using the common solar park facilities built under Output 1. In addition to providing the land by the state government and common facilities under Output 1, options will be examined to reduce the offtake tariff. ADB will also assist the GoA in clarifying and strengthening the PPP framework in the state, building the government's capacity in developing renewable energy PPP projects, and monitoring and managing the PPP projects.

**Output 3: Renewable energy-powered battery storage system piloted.** This output will support the equity contribution of APDCL to set up a joint venture with Oil and Natural Gas Corporation Tripura Power Company to develop a pilot grid-connected battery storage installation (BESS) of at least 25 MW at the Kukurmara Mirza transmission substation. This storage facility will improve APDCL's ability to meet peak demand and will provide frequency regulation to improve grid stability. 10% of staff of the joint venture company will be recruited from women and other vulnerable groups.

**Output 4: Electricity distribution in project areas enhanced.** The electricity distribution system in the surrounding areas of the proposed solar site in Karbi Anglong district and in the rural parts of the neighboring district of Dima Hasao will be strengthened. The project will finance conversion of overhead lines to covered conductor (or aerial bundled cable), installation of new distribution transformers for capacity enhancement and voltage improvement. Training and awareness programs on safe and efficient use of electricity will be delivered to local communities (including at least 100 women and/or disadvantaged people).

**This IEE study has been prepared for Outputs 1 and 2 while a separate IEE study has been prepared for Outputs 3 and 4.**

### 1.3. Implementing Agency

57. As mandated by the cabinet of Government of Assam, APDCL will serve as the implementing agency with Power (Electricity) Department of GoA as the executing agency. APDCL will set up a project management unit (PMU) headed by a project director reporting to the chief general manager and a project implementation unit (PIU) for the solar power plant, headed by a project manager, supported by project management consultants (PMC).

### 1.4. Project Goals

58. The project is aligned with the following impact: Energy security and renewable energy obligations achieved in Assam. The project will have the following goals:

- Solar energy capacity connected to the Assam state grid increased to 1,000 MW;
- Annual electricity supply from renewable energy sources in Assam increased to 22% of total supply;
- Aggregate technical and commercial network losses on upgraded distribution feeders in Karbi Anglong and Dimahasao districts reduced to 20%; and
- At least 0.68 million tons of CO<sub>2</sub> emissions avoided per year.

### 1.5. Purpose of the IEE Report

59. Safeguard requirements for all projects funded by ADB are defined under ADB's Safeguard Policy Statement (SPS), 2009 which establishes an environmental screening, assessment and management process. All ADB projects must comply with its requirements and Operational Manual F1, 2013 to ensure environmental soundness and sustainability and to support the integration of environmental considerations into the project decision-making process. In accordance with ADB's environmental assessment requirements, the IEE study provides a road map to the environmental measures needed to avoid, minimize, and/or mitigate the adverse environmental impacts and risks on physical, biological, social, and physical-cultural resources during the construction, O&M and decommissioning phases. More specifically, the IEE study:

- Describes the design, construction activities and operational parameters of the solar power plant;
- Describes the existing socio-environmental conditions within the solar power plant's area of influence;
- Describes the extent, duration and severity of potential direct, indirect, cumulative, and induced environmental impacts and risks;
- Analyzes the significance of the environmental impacts and risks; and
- Formulates the mitigation and monitoring actions to address the potential impacts and risks and presents it all in the form of an Environmental Management Plan (EMP) for implementation by APDCL and the private sector.

### 1.6. Categorization

60. For each ADB project, screening and categorization is conducted at the earliest stage of project preparation when sufficient information is available and is undertaken to (i) reflect the significance of potential impacts or risks that a project might present; (ii) identify the

level of assessment and institutional resources required for the safeguard measures; and (iii) determine disclosure requirements. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts.

61. Based on the ADB SPS, 2009, the Output 1 and 2 project components falls under ADB's environment Category B as their potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be readily designed. This is due to the following facts:
- (i) though a large volume of vegetation needs clearance including cutting of 2,395 trees, outputs 1 and 2 are mostly located within modified habitat. Much of this has been subject to *jhum* (slash and burn) cultivation in the past. The avoidance of 94 ha of natural habitat in the site means significant conversion and degradation of natural habitat is avoided.
  - (ii) no protected areas, internationally or nationally recognized sites supporting high biodiversity values including key biodiversity areas, important bird areas, Elephant Reserves, Reserve Forests and elephant corridors will be affected by the works under outputs 1 and 2.
  - (iii) though the works are within the default 10 km eco-sensitive zone of a wildlife sanctuary in the adjacent state of Nagaland, consultation with the principal chief conservator of forests, Nagaland identified that he has no concerns regarding ecological impacts; and
  - (iv) impacts to air quality, noise levels and water quality as well as disruption and disturbance and health and safety risks to workers and communities can be readily mitigated during the construction phase and are not anticipated to be significant during the operational phase.

As a result, significant adverse irreversible, diverse, or unprecedented environmental impacts are unlikely to arise. For a Category B project, an IEE study, including an EMP, is required by the borrower.

## 1.7. Report Preparation

62. This IEE study has been prepared on behalf of APDCL by a team of ADB funded TA consultants (Nick Skinner, International Environment Expert, Dibyendu Banerjee, National Expert – Environment Audit), known forthwith as the IEE team. It has also been supported by national consultants (GreenCIndia) hired by APDCL, who undertook ecological surveys and consultations and produced an initial assessment report on which this IEE builds. The assessment of critical habitat has been prepared by Biodiversity Specialist, John Pilgrim. Other contributions have been made by Biodiversity Specialist, Rick Harness relating to bird safe electricity infrastructure.

## 1.8. Report Structure

63. Section 1: Introduction – The section in hand provides introductory information.
64. Section 2: Policy, Legal, and Administrative Framework – This section presents an overview of the policy/legislative/administrative framework as well as the environmental assessment guidelines of India that are applicable.

65. Section 3: Description of the Activity – Section 3 describes the need for this solar PV plant and its environmental setting. A scope of works is also provided indicating the type of construction works required and operational aspects.
66. Section 4: Analysis of Alternatives – This section presents a summary analysis of the ‘no project’ alternative as well as any alternative alignment and technical design options that were considered.
67. Section 5: IEE Approach – Section 5 outlines the methodology used to complete the assessment.
68. Section 6: Description of the Environment – This section of the report discusses the local environmental baseline conditions. This section is divided into subsections relating to the physical, biological, and social environment.
69. Section 7: Environmental Impacts and Mitigation Measures – Outlines the potential environmental impacts and risks and proposes mitigation measures to manage the impacts. The residual impacts of works under the Output 1 and 2 components are also presented.
70. Section 8: Stakeholder Engagement, Information Disclosure and Grievance Mechanism – Section 8 provides a summary of all the stakeholder consultation activities undertaken and includes the project component’s grievance redress mechanism.
71. Section 9: Environmental Management Plan – This section of the IEE comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan, as well as the institutional arrangements for environmental management.
72. Section 10: Conclusions and Recommendations – The final section of the IEE study provides the conclusions and recommendations, including a summary of residual impacts.

## II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

73. This chapter is about the applicability of national and state laws and regulations, international agreements, and ADB safeguards requirements. The chapter also lays out the various permissions required from national and state authorities. It considers the environmental, health and safety (EHS) policies and procedures that are presently available with APDCL as well as their existing environment safeguards capacity with respect to EMP implementation.

### 2.1 Administrative Framework and Main Regulatory Bodies

74. The main regulatory bodies responsible for administration of the environmental policy and legislation pertinent to the solar power plant component are:

**75. Ministry of Environment and Forests, Forest, and Climate Change (MOEF&CC).**

Responsible for the administration and implementation of Government of India's policy with respect to environmental conservation, management, and pollution control. It formulates and regulates all country level legislations and enforces the regulations in conjunction with various autonomous organizations under MoEF&CC and the states. The environmental management and pollution control framework at Government of India level defines the roles and responsibility of various ministries and government departments at central level and state level with the MoEF&CC at central level as the apex body and state boards/departments working under their guidance and overall coordination. Both central and state governments can enact environmental legislation. The ministry also reviews and issues prior environmental clearances through an Expert Appraisal Committee for category A projects as per Government of India's legislation besides according to wildlife and forest diversion clearances.

**76. National Green Tribunal (NGT).** The NGT based out of New Delhi was established in 2010 under the National Green Tribunal Act, 2010. This tribunal is headed by a chairman and has both judicial and expert members (having multidisciplinary expertise). It is responsible for effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources. It is also responsible for enforcement of any legal right relating to the environment and giving relief and compensation for damages.

**77. Ministry of New and Renewable Energy (MNRE).** The Ministry of New and Renewable Energy (MNRE) serves as the primary ministry within the Indian government responsible for overseeing all aspects concerning new and renewable energy. The overarching objective of the ministry is to promote the growth and utilization of new and renewable energy sources to enhance the nation's energy capacity. The ministry actively supports research, design, development, manufacturing, and implementation efforts for new and renewable energy systems and devices. These initiatives encompass a wide range of applications, including transportation, portable devices, and stationary installations across rural, urban, industrial, and commercial domains.

**78. Central Pollution Control Board (CPCB).** Statutory authority under the MoEF&CC with headquarters in New Delhi and several regional offices. Responsibilities include planning and implementing air and water pollution control programs, setting air and water standards; and coordination with the state level pollution control boards (SPCB). The project components shall be required to adhere to the various standards set by CPCB.



79. **Central Ground Water Board (CGWB) and Central Ground Water Authority (CGWA).** Separate to the MoEF&CC, CGWB is a multi-disciplinary scientific organization under the Ministry of Jal Sakti, providing scientific inputs for the management, exploration, monitoring, assessment, augmentation, and regulation of ground water resources. Besides advising states on planning and management of ground water resources, it provides technical know-how for scientific ground water exploration, development, and management. CGWA is a sister concern of CGWB engaged in various activities related to regulation of ground water development to ensure its long-term sustainability. A no objection certificate (NOC) is required to be obtained from the CGWA for withdrawal of ground water through bore wells before they are drilled, or if existing borewells are used for construction that were installed for some other purposes as it would augment the use of groundwater.
80. **Archaeological Survey of India (ASI).** Sitting under the Ministry of Culture, ASI is responsible for maintenance of ancient monuments and archaeological sites and remains of national importance. It is also responsible for regulating all archaeological activities in the country as per the provisions of the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Antiquities and Art Treasure Act, 1972. The Guwahati Circle of the ASI is responsible for maintenance of monuments in Assam.

## 2.2 National Environmental Framework

81. The legal framework of the country consists of several acts, notifications, rules, and regulations to protect the environment and wildlife. In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. The legal framework is broadly divided under following categories:
- Environmental Protection
  - Forests Conservation
  - Wildlife Protection
82. The umbrella legislation under each of the above categories is as follows:
83. The Environment (Protection) Act, 1986 was enacted with the objective of providing for the protection and improvement of the environment. It empowers central government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. Various rules are framed under this act for grant of environmental clearance for any development project, resources conservation and waste management. In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment.
84. The most notable legislation with respect to environmental assessment is the Environmental Impact Assessment (EIA) Notification, 2006 and its subsequent amendments. This identifies projects and activities that require Prior Environmental Clearance (and lays the procedure for obtaining the same).
85. Projects are categorized as Category A or B as per the EIA Notification, 2006 and these require environment clearance. Category A projects are required to conduct EIA and public consultations and obtain EC from the Expert Appraisal Committee of Ministry of Environment, Forests and Climate Change (MoEF&CC). Category B projects are required to obtain environment clearance from the State Environmental Impact Assessment

Authority (SEIAA). Category B is further sub-divided into Category B1 projects (require an EIA and public consultation) and Category B2 projects (do not require an EIA or public consultation). However, per Schedule 1 which list out the activities that require prior environmental clearance, solar power projects are exempted. Unless large scale building and construction is involved, more than 20,000 square meters in footprint and 150,000 square meters of built-up area, which is not currently anticipated in relation to any of the blocks or the infrastructure component, Output 1 and 2 components do not need a prior environment clearance.

86. The Forest Conservation Act, 1980 as amended was enacted to help conserve the country's forests. It strictly restricts and regulates the de-reservation of forests or use of forest land for non-forest purposes without the prior approval of central government. To this end the act lays down the pre-requisites for the diversion of forest land for non-forest purposes. It provides guidance on the right of way (ROW) and tree cutting beneath power lines in forest land. Where routing of power lines through the forest areas cannot be avoided, these should be aligned in such a way that it involves the least number of trees being cut. Felling/pollarding/pruning of trees will be done with the permission of the local forest officer whenever necessary to maintain the electrical clearance. Cutting of trees on non-forest land requires a tree cutting permit from the local forest department. All trees that are cut must be compensated by compensatory plantation as required by the Environment and Forest Department of Assam.
87. Wildlife (Protection) Act, 1972 as amended was enacted with the objective of effectively protecting the wildlife of the country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. It defines rules for the protection of wildlife and ecologically important protected areas.
88. Table 1 expands on the above and outlines all national environmental, health and safety policies, laws and regulations and their applicability to the project outputs 1 and 2.

**Table 1: Relevant Environmental, Health and Safety and Social Legislation**

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
1	National Environment Policy (NEP), 2006	Applicable as both construction and operation must adhere to the NEP principles of conservation of environmental resources and abatement of pollution. The IEE process and implementation of the EMP will enable this.	Responsible Authorities: MoEF&CC
2	National Water Policy, 2012	Applicable as there is a need to conserve and manage ground water as it is a community resources held by the state. Recognizes that water is required during construction activities including curing of concrete foundations and the utilization should be optimized and an awareness of water as a scarce resource should be fostered.	Responsible Authorities: Ministry of Jal Shakti
3	National Forest Policy, 1988	Policy deals with increasing forest cover and its management by involving local communities in the	Responsible Authorities: MoEF&CC, Environment and Forest Department, Assam, DFO, and District Autonomous

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
		management of forests. No Reserved Forests are impacted by Outputs 1 and 2 of the project but tree cutting and vegetation clearance is required.	Council for Tree trimming/lopping, permission etc.
4	National Conservation Strategy and Policy Statement on Environment and Development, 1992	It provides the measures to be taken for prevention and control of pollution and energy efficient devices	Responsible Authorities: MoEF&CC
5	National Resettlement and Rehabilitation Policy, 2007	Applicable as Output 1 and 2 components require private land.	Responsible Authorities: Ministry of Rural Development
7	The Environmental (Protection) Act, 1986. The Environmental (Protection) Rules, 1987 and its amendments	Both construction and operation of the solar power plant must comply with the legislation issued under this act and rules. The IEE process and implementation of the EMP will enable this.	Umbrella act under which environmental notifications, rules, schedules, and standards are issued. Responsible Authorities: MoEF&CC, Environment and Forest Department of Assam, CPCB and PCB Assam.
8	The EIA Notification, 2006 as amended to 2016	Not applicable for SPP as the EIA notification exempts these from obtaining prior environmental clearance. Prior EC is applicable for direct sourcing of sand and stone during construction when mineral extraction exceeds the area specified in Schedule 1. However, no new borrow pits or quarries will be opened, instead materials will be sourced by the contractor from existing approved sources. The contractor will need to confirm existing sources used by third party vendors already obtained the requisite EC.	Identifies projects and activities that require Prior environmental clearance and lays the procedure for obtaining the same. Responsible Authorities: MoEF&CC and SEIAA
9	The Right to Information Act, 2005 and its amendment of 2019	In relation to information disclosure during all stages of implementation, wherein any citizen of India may request information after paying a fee from a APDCL which is a government body and which APDCL is required to respond within thirty days.	Responsible Authorities: Central Public Information Officers of Central Electricity Authority (CEA) and State Public Information Officer, Assam
10	The National Environmental Appellate Authority Act, 1997 National Green Tribunal Act, 2010	APDCL will need to comply with any NGT rulings in case of application against it.	NGT has dedicated jurisdiction in environmental matters to provide environmental justice and help reduce the burden of litigation in the higher courts. It is mandated to endeavor for disposal of applications or appeals within 6 months of them being filled. Responsible Authorities: NGT

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
11	Central Ground Water Authority (CGWA) Notification no. 21-4/Guidelines/CGWA/2009-832 dated 14 October 2009	Applicable as proposed SPP interventions intend to extract ground water through new borewells; if such ground water extraction is planned, then prior to construction permission to abstract will be required from CGWA in accordance with this notification.	Responsible Authorities: CGWA
12	Comprehensive Environmental Pollution Index (CEPI) 2018	Not applicable as the project components do not fall under any of the industrial clusters nor under the Critically Polluted Areas (CPAs) as per the CEPI.	Industrial clusters are categorized under the CEPI as Polluted Industrial Areas giving weight to various pollutants, ambient pollutant concentrations, receptors (that is, the number of people affected) and additional high-risk elements; they are to be remediated seeking compensation from polluting industries, and any expansion or development of new sites in these areas will be rejected. Responsible Authorities: CPCB, SPCB, enforced by NGT
13	The Water (Prevention and Control of Pollution) Act, 1974 The Water (Prevention and Control of Pollution) Rules, 1975 The Water (Prevention and Control of Pollution) Cess Act, 1977 & amendment in 2003	Applicable as CTE and CTO are required from PCB Assam for major construction plant for SPP, to protect against pollution of surface and ground water. Need to adhere to the water quality standards as per Section 2.10.2 of this IEE study.	Empowers central and state pollution control boards to establish and enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction and operation of certain facilities. Responsible Authority: PCB Assam
14	The Air (Prevention and Control of Pollution) Act, 1981 The Air (Prevention and Control of Pollution) Rules, 1982	Applicable as CTE and CTO are required for major construction plants to protect against pollution of air. Need to adhere to the air quality standards per 2.10.1 of this IEE study.	Empowers state pollution control boards to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission. Responsible Authority: PCB Assam
15	Noise Pollution (Regulation and Control) Act, 2000 and 2010 as amended	Applicable during both construction and operation, solar power plant components must adhere to the ambient noise emission standards (section 2.10.3 of this IEE study); any diesel generator sets used by the contractors or APDCL must also be compliant.	Standards for noise emission for various land uses and equipment have been issued. Responsible Authority: PCB Assam
16	The Motor Vehicle Act. 1988 and its subsequent amendments	Applicable and all vehicles utilized during construction and operation mandatorily require obtaining of a "Pollution Under	Empowers the State Transport Authority to enforce standards for vehicular pollution and issuance of PUC certificates.

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
		Control Certificate" (PUC) for the duration of their use to manage the vehicular emissions.	Responsible Authority: Motor Vehicles Division under the State Transport Department
17	Indian Forest Act, 1927 Forest (Conservation) Act, 1980 as amended. Forest (Conservation) Rules, 2003 and its amendments	Permission is required for tree felling required under the rules.	The act defines the various forest areas and lays down the procedure for diversion of forest land for non-forest activities. Responsible Authorities: MoEF&CC, District Autonomous Council and Environment and Forest Department of Assam
18	Biological Diversity Act, 1992 Biological Diversity Rules, 2004 Wildlife Protection Act, 1972 as amended	The SPP is not situated within any UNESCO biodiversity core and buffer zone or protected areas (e.g., national park or wildlife sanctuary) or reserved forest. The SPP site is located within 10km of a non-notified (default) eco-sensitive zone (ESZ) of the Rangapahar WLS. In general, SPP works are permitted within the 10km ESZ. Felling of trees and widening of roads are regulated. Electrical cables are also regulated, there is a promotion of underground cables. No batching plant or hot mix (or other construction activity that causes pollution) or discharge of effluents or solid waste to water or ground is permitted in the ESZ. MoEF&CC guidelines, plus the criteria and requirements of any Draft ESZ notification in terms of Prohibited and Regulated activities are to be complied with by APDCL for the SPP components with intimation to Nagaland. Also applicable in the event workers encounter any scheduled plants and animals since the sale, trade, or commerce of them is prohibited.	Provides for protection of Protected Areas from non-conservation activities. It also lists (schedules) plants and animals of which sale, trade, or commerce is prohibited. Responsible Authorities: National Board of Wildlife (NBWL), State Board of Wildlife (SBWL) and Chief Wildlife Warden of Assam.
19	Wetlands (Conservation and Management) Rules, 2017	Not applicable. Permission is required if any wetland notified by the central Government, State Government falls within project site	Responsible Authorities: Wetland Authority; MoEF&CC
20	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006	Applicable as solar park and associated transmission line is planned in Tribal areas (Autonomous Council District	Provides rights related to title, usage, relief, development, and forest management including traditional and customary rights

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules 2007	(ADC) of Karbi Anglong) in Karbi Anglong.	of forest-dwelling scheduled tribes. Responsible Authorities: Karbi Anglong Autonomous District Council (KAAC), Department of Tribal Affairs, GoA.
21	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	Applicable as there is land acquisition involved.	Provides directions related to fair compensation of any land acquired for public works purpose. Responsible Authorities: Revenue Department and District Administration and District Autonomous Council
22	MoP guidelines on Transmission ROW vide notification No.3/7/2015-Trans dated 15th October 2015	Applicable as the project component involves 200kV LILO.	Provides directions related to for payment of compensation toward damages in regard to transmission RoW Responsible Authorities: Government of Assam and District Administration and District Autonomous Council
23	The Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996	Applicable as there is land acquisition involved in panchayat and tribal areas	Provides directions related to fair compensation of any land acquired for public works purpose. Responsible Authorities: Karbi Anglong Autonomous District Council (KAAC), Gaon Bura - Gram Village Head and District Administration
24	Indian Treasure Trove Act 1878 (as modified up to September 1949) The Antiquities and Art Treasures Act, 1972	It shall be applicable only if there are any chance finds of physical cultural resources during excavation.	Deals with treasures and other artifacts which are of antique value and origin. Responsible Authority: Archaeological Survey of India (ASI) and Directorate of Archaeology, GoA
25	Ancient Monuments Preservation Act 1904 Ancient Monuments and Archaeological Sites and Remains Act 1958 and its amendments. Ancient Monuments and Archaeological Sites and Remains (Framing of Heritage Bye laws and Other Functions of Competent Authority) Rules, 2011 National Monument Authority Rules, 2011 Heritage Conservation and Preservation Act, 2010	No components are situated within 300m of an ASI notified monument.	Deals with activities that may be permitted and prohibited near the protected monuments. Construction works are prohibited within 100m of a protected monument (prohibited area) and another 200m from the prohibited area (so 300m total distance) is demarcated as the regulated area in which construction is regulated by the competent authority. In event of any chance finds being made they must be notified / surrendered to the competent authority. Responsible Authorities: ASI (Guwahati Circle) and Directorate of Archaeology, GoA

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
24	The Petroleum Rules 2002	Applicable for the supply and storage of diesel for generator sets and for transformer oils etc.	Deals with the import, transport and storage of petroleum and petroleum products Responsible Authorities: Ministry of Petroleum and Natural Gas, Chief Controller of Explosives
25	Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989	Applicable as there shall be storage of hazardous chemicals including petroleum products (oils etc.) at the substations.	Responsible Authorities: PCB Assam
26	Regulation of Polychlorinated Biphenyls (PCBs) Order, 2016	Applicable. New transformers provided for the substations must be PCB free	Provides guidance on the usage of PCBs and prohibits the usage of PCBs in any form by 31 December 2025. Responsible Authority: PCB Assam
27	Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendments	Prohibition on usage of ozone depleting substances during construction and operation period e.g., for servicing of fire extinguishers.	Provide direction on the regulation of ozone depleting substances. Responsible Authorities: PCB Assam
28	Construction and Demolition Waste Management Rules, 2016	Construction and demolition waste will be generated and will need to be managed and disposed of in accordance with these rules during construction.	Deals with safe disposal of construction wastes generated due to construction and demolition activities. Responsible Authorities: PCB Assam
29	Solid Waste Management Rules 2016	Solid waste will be generated and will need to be managed and disposed of in accordance with these rules during construction and operation.	Deals with safe disposal of municipal solid wastes generated due to construction and operation Responsible Authorities: PCB Assam, Municipalities and Panchayats
30	The Plastic Waste Management Rules, 2016 and Plastic Waste Management Amendment Rules, 2021	Plastic will be generated for disposal of waste from packaging materials during both construction and operation periods.	The rules apply to "every waste generator, local body, Gram Panchayat, manufacturer, Importers and producer". Wastes to be segregated and disposed as per Solid Waste Management Rules, 2016. The 2021 amendment prohibits identified single use plastic items by 2022. Thickness of plastic carry bags increased from 50 to 75 microns from 30 <sup>th</sup> September 2021 and to 120 microns with effect from the 31 <sup>st</sup> of December 2022. Responsible Authorities: PCB Assam, and Village Panchayats/Gaon Bura
31	Hazardous and Other Wastes (Management, & Trans-boundary	Applicable in relation to the management and disposal of hazardous wastes (used transformer oils, batteries,	Provides protection to the public against improper handling and disposal of hazardous wastes.

#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
	Movement) Rules, 2016 as amended in 2019	solvent-soaked rags etc.) that are used during construction and operation. All solar PV modules and other electrical equipment from the plant after their 'end of life' (when they become defective/non-operational/ non-repairable) are to be disposed in accordance with the "e-waste (Management and Handling) Rules, 2016" notified by the Government of India and as revised and amended from time to time	Responsible Authority: PCB Assam
32	Batteries (Management and Handling) Rules, 2001	Applicable as use and presence of batteries. Used batteries must be properly disposed to PCB Assam authorized and registered recyclers. The Battery Waste Management Rules 2022" introduces the concept of Extended Producer Responsibility (EPR) compelling Indian manufacturers and importers of batteries to take on additional responsibility for efficiently managing batteries throughout their lifecycle and is to be complied with.	The rules apply "to every manufacturer, importer, re-conditioner, assembler, dealer, recycler, auctioneer, consumer, and bulk consumer involved in manufacture, processing, sale, purchase and use of batteries or components thereof". Half-yearly returns using the required forms are to be filed and submitted to PCB Assam Responsible Authorities: SSPCB
33	E-Waste (Management) Rules, 2016 as amended in 2018 and 2022	Applicable during construction and operation used e-waste (including solar modules) must be properly disposed to PCB Assam authorized and registered recyclers. All solar PV modules and other electrical equipment from the plant after their 'end of life' (when they become defective/non-operational/ non-repairable) are to be disposed in accordance with the "e-waste (Management and Handling) Rules, 2016" notified by the Government of India and as revised and amended from time to time	Responsible Authorities: PCB Assam
34	The Indian Electricity Act, 1910 and its amendments The Indian Telegraph Act, 1885	Applicable as 400kV overhead transmission lines will be constructed (as an associated facility). A Right of Way (RoW) is required for laying new overhead lines. The RoW is 46m from the transmission line centerline.	Safety measures to be taken in laying of electrical lines and connections. Responsible Authorities: Central Electricity Authority (CEA)



#	Name of Policy / Law / Regulation	Applicability to Outputs 1 and 2	Remarks
35	Electricity Act, 2003 and its amendments	Applicable as electric works will be carried out so the act must be complied with. Also, the provisions stipulated in section 67–68 of the Electricity Act, 2003 read with section 10 and 16 of the Indian Telegraph Act, 1885 deals with compensation due for any damages due to the construction of any transmission lines.	Guiding act related to electricity in India. Sections 53, 67, 73, 161 and 177 deal with safety related to electricity including power to make regulations. Responsible Authorities: CEA
36	CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022	Applicable as these pertain to the design of substations, etc. Includes requirement for soak pit and oil collecting pit beneath transformers.	Responsible Authorities: CEA

### 2.3 National EIA Classification

89. MoEF&CC in its Office Memorandum No. J-11013/41/2006-IA.II (I) dated 13th May, 2011 stated that the Solar Photovoltaic Power Projects are not covered under the ambit of EIA Notification, 2006 and hence, no environmental clearance is required. Hence, the solar PV plant components do not require preparation of EIA report and pursuing environmental clearance from central Government or State level EIA Authority.

### 2.4 Government of Assam Environmental Framework

90. The environment safeguards framework in Assam consists of several acts, notifications, rules, and regulations to protect the environment detailed in Table 2. The key policies and environmental authorities are discussed below.

### 2.5 Assam Renewable Energy Policy

91. In order to promote solar power projects and meeting the energy requirements of Assam and India, the Government of Assam have developed the Assam Renewable Energy Policy, 2022. The policy aims to promote clean, accessible, affordable, and widespread usage of solar power and to meet the following objectives, such as:

- Create an enabling environment for business and developers to participate and invest in the process of targeted RE power capacity expansion of 1200MW by 2027 in the state of Assam.
- Encourage residential, commercial, industrial and government consumers for adaptation of modern solar power technology with on-grid and off-grid installations.
- Encourage setting up of solar parks with the necessary utility infrastructure facilities in the state on vacant government land.
- Incorporate provisions for solar energy in the municipal byelaws for promotion of rooftop solar panels.
- Ensure irrigation facilities for farmers by promoting solar pumps.

- Encourage other forms of RE power generation
92. **State Environmental Impact Assessment Authority (SEIAA).** An authority constituted by central government under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 for every state and union territory. The composition of the SEIAA is published through separate gazette notifications and normally has a term of three years. It issues Prior environmental clearances to Category B projects. If the SPP installation required an EC due to its building sizes (in excess of 20,000 square meter), it would be prior applied with Assam SEIAA. However, based on the currently anticipated building sizes, this is not required.
  93. **Pollution Control Board, Assam.** State Pollution Control Board, Assam is an autonomous statutory organization constituted on 2nd June 1975 under the provision of section 4 of the Water (Prevention & Control of Pollution) Act 1974 with a view to protecting the environment and preventing and controlling the pollution of water and air in the State of Assam. Responsible for pollution control activities at the state level for Assam, including planning and executing state level air and water quality initiatives, establishing standards for air and water quality based on national minimum standards, and enforcing and monitoring of all the activities within the state under air and water related legislation. SSPCB shall be issuing Consent to Establish (CTE) and Consent to Operate (CTO) for establishing and operating of any construction plant required such as batching plant, hot mix etc.
  94. **Environment and Forest Department of Assam.** The Mission of the Department of Environment and Forests, Assam is to protect and improve the environment, to safeguard the forests and wildlife of the State, to preserve and add new dimensions to the rich heritage of our composite culture, to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures. It also encompasses opening up the forestry sector for income and employment generation among our people while conserving the priceless biodiversity of the state.
  95. The Principal Chief Conservator of Forests (PCCF) and Head of the Forest Force (HoFF) is the senior most forest officer and is from Indian Forest Service (IFS) cadre. The department is empowered to declare protected and reserved forests. It has also been given the authority to acquire land for extension and preservation of forests. The next level is the Conservator of Forest (CF), followed by the District Forest Officers (DFO). Recommendations for forest diversion accorded by the department are forwarded to MoEF&CC. Karbi Anglong Autonomous council committee also has a PCCF and DFOs for the ADC area.
  96. The PCCF (Wildlife) is the head of the wildlife division, reporting to the PCCF (HoFF) and is responsible for the protection and conservation of all protected areas in the state besides dealing with all wildlife issues. The PCCF (Wildlife) is also a member of the State Board of Wildlife which recommends projects sited within notified ecologically sensitive zones (ESZ) and protected areas and forwards the same to the semi-autonomous National Board of Wildlife (NBWL) under MoEF&CC. Outputs 1 and 2 require permissions from the Environment and Forest Department for any felling of timber and non-timber tree and transit of felled trees. No forest clearance or wildlife clearance are anticipated to be required, this shall be reconfirmed once the associated transmission line route is finalized. Outputs 1 and 2 will require permissions from the Environment and Forest Department for any felling of timber (except Mango, Jackfruit) and non-timber trees (except Bamboo) and transit of felled trees. The Environment and Forest Department and APDCL to ensure that no residential or labour camp shall be constructed over forest land.

97. **Assam State Biodiversity Board.** In exercise of powers conferred under sub-section (1) of Section 22 of the Biological Diversity Act, 2002 (Act 18 of 2003), the Government of Assam constituted the “Assam Biodiversity Board” on 29th September 2010 to promote biodiversity conservation in the State of Assam, sustainable use of its components and equitable sharing of benefits arising out of the use of biological resources of the state and traditional knowledge associated with these resources and matters incidental thereto or connected therewith. The headquarter of the Board is located at Guwahati.

98. **Directorate of Archaeology.** The Directorate of Archaeology, under the Department of Cultural Affairs, Guwahati is responsible for maintenance of state protected monuments in Assam. Set up in 1961 as the Directorate of Archaeology and Museums the Directorate of Archaeology has been functioning under Education (CTM) Department as an independent Directorate since 1983. The department is entrusted for the protection and preservation of ancient archaeological sites, monuments, remains of historical and archaeological importance, which are not less than one hundred years old and developing these into centers of tourists attraction in Assam; archaeological exploration of hitherto unknown sites, remains and their preliminary survey; archaeological excavation of the explored sites; documentation of antiquities found at archaeological sites as well as at excavated archaeological sites in Assam; conservation and restoration of protected Archaeological sites and monuments in the State; publication of archaeological reports of exploration, excavation, conservation of archaeological sites; and publication of annual reports, journals, brochures, leaflets, pamphlets, on archaeology and antiquities and protection, preservation and development of various Sattras (consisting of a large prayer hall facing a simple shrine, surrounded by dormitories and bathing tanks for monk) of Assam.

99. **Autonomous Councils of Assam.** The Government of Assam have been taking various steps to accelerate development process for the welfare of Scheduled Tribe (ST) communities in the State through democratic decentralization of power and empowering the Scheduled Tribe (ST) communities to participate in the planning, monitoring and implementation of Tribal Sub Plan (TSP) schemes in grass root level by constituting Territorial Councils, Autonomous Councils and Development Councils for different Scheduled Tribe (ST) communities in the State. The various Autonomous Councils constituted by the Government are under the following heads:

- Territorial Councils under Sixth Schedule of Constitution of India
- Statutory Autonomous Councils constituted under State Act

100. The Autonomous Councils are given varying degrees of autonomy within the State Legislature. In Assam there are 3 Autonomous Councils under Sixth Schedule of the Indian Constitution. The 3 Autonomous Councils are:

- Bodoland Territorial Council
- Dima Hasao Autonomous District Council
- Karbi Anglong Autonomous District Council (East and West Karbi Anglong)

**Table 2: Applicable State Environmental Requirements**

#	Name of Policy / Law / Regulation	Applicability	Remarks
1	Assam Forest Policy, 2004	Applicable as the SPP TL and SPP affect forest habitat, although not government forest land. Maintenance	To conserve natural heritage of the state by preserving the natural forests and wetlands

#	Name of Policy / Law / Regulation	Applicability	Remarks
		of environmental stability through preservation and where necessary, restoration of ecological balance that has been adversely disturbed by serious depletion of forests in the State.	with vast variety of flora and fauna which represent the unique biodiversity and genetic resources of the State. Responsible Authorities: Environment and Forest Department of Assam and District Autonomous Councils.
2	Draft Assam Bamboo And Rattan Policy-2003	Applicable as the TL and SPP pass through bamboo areas. Regulation for the protection and conservation of biodiversity associated with bamboo forest and Rattan brakes and re-growth areas and their future development.	This regulation considering the ecological significance and vast economic potential of Bamboo and Rattans in the State, aims and objectives of the Bamboo and Rattan Policy shall be as under. Protection and preservation of mountain ecology, protecting the mountain slopes by affording protection to bamboo forests and bamboo re-growth areas for sustained productivity and environmental security for the people. Responsible Authorities: Environment and Forest Department of Assam and District Autonomous Councils.
3	Assam (Control of Felling & Removal of trees from Non-forest Land) Rules, 2002	The rule regulates felling permission and transit of timber derived from non-forest areas. The Rule mandates permission for felling of various species of trees from Department of Environment and Forest.	Responsible Authorities: Environment and Forest Department of Assam and District Autonomous Councils.
4	Assam Forest Regulation 1891 (7 Of 1891) 1.Amended By The Assam Forest Regulation (Amendment) Act 2005 (Act No 2 Of 2008), Published In Ap Eog No 13 Vol Xv Dtd 03.03.2008 [Wef 04/09/2008 Vide Ap Eog No 88 Vil Xv Dtd 18/09/2008]	Applicable as the SPP and SPP TL is passing and located in vegetated areas. A regulation to amend the law relating to forests, forest produce and the duty leviable on timber in Assam.	Responsible Authorities: Environment and Forest Department of Assam, and District Autonomous Councils
5	Assam Biodiversity Rules, 2010	These rules are established in the exercise of the powers conferred by Section 63 of the Biological Diversity Act, 2002 the Government of Assam. As per the act Indian entities or non-	Responsible Authorities: Assam State Biodiversity Board

#	Name of Policy / Law / Regulation	Applicability	Remarks
		Section 3(2) (as prescribed under Biological Diversity Act, 2002) entities, prior intimation to the Assam Biodiversity Board is required for activities pertaining to commercial utilization, or bio-survey and bio-utilization for commercial utilization.	
6	Assam Rhinoceros Preservation Act 1954	This Act aims at protection of the Indian Rhinoceros, Assam's state animal; and enables legal action against killing, injury and capture of the animal.	Responsible Authorities: Environment and Forest Department of Assam, and District Autonomous Councils
7	State Water Policy of Assam, 2007	Applicable as water is required during construction. The State Water Policy of Assam adopts integrated water resource management as a core strategy, based on the principles of water as a finite resource, need to use a participatory approach, the crucial role of men and women, ensuring clean water for human health and looking at water both as an economic and social good.	Responsible Authorities: Water Resource Department, Government of Assam
8	Assam And Meghalaya Autonomous districts (Constitution Of District Councils) Rules, 1951 (Parts I, li & lii) And District Autonomous Council By An Act Of Parliament By Incorporating Into The Sixth Schedule In The Constitution (Amendment) Act, 1995 (42 Of 1995)	Applicable as solar park and associated transmission line is in ADC. Karbi Anglong is District Autonomous Councils. The Statutory Autonomous Councils are constituted for Social, Economic, Educational, Ethnic and Cultural advancement of the Scheduled Tribe (ST) communities living in Core Areas as well as in Satellite Areas covering many districts of Assam. Permissions from Autonomous Council are required for SPP and SPP TL works.	Responsible Authorities: Chief Executive Member of KAAC District Autonomous Council
9	Assam Land and Revenue Regulation (Amendment) Act, 1947 as amended Assam Land (Requisition and Acquisition) Act. 1964	This Act of 1947 was to amend Assam Land and Revenue Regulation 1886, and insert Chapter X, which is aimed at protecting land-ownership rights of indigenous tribal people of Assam. An Act to amend and consolidate the law for requisition and speedy acquisition of premises and land for certain public purposes such as accommodation, transport, communication, irrigation, flood control and anti-erosion measures.	Responsible Authorities: KAAC Chief Executive Member of District Autonomous Council
10	The Assam Ancient Monument and	No components are situated within 500m of a state notified monument.	Act for future preservation and maintenance of the sites/monuments by the

#	Name of Policy / Law / Regulation	Applicability	Remarks
	Records Act, 1959” and “The Assam Ancient Monument and Records Rules 1964”	The acts will only become applicable if there are any chance finds of physical cultural resources during excavation for construction.	Directorate. In event of any chance finds being made they must be notified / surrendered to the competent authority. Responsible Authorities: Deputy Commissioner, Directorate of Archeology, Guwahati

Source: IEE Team

## 2.6 National Health, Safety and Labour Framework

101. The health and safety framework in India consists of several acts, notifications, rules, and regulations to protect the environment and wildlife as detailed in Table 3. The key national authorities are discussed below:

102. **Ministry of Labor and Employment.** The labor, health and safety framework of Government of India level defines the roles and responsibility of various ministries and government departments at central and state level. They are responsible for protecting and safeguarding the interests of workers with due regard to creating a healthy work environment along with the promotion of welfare and providing social security to the labor forces in both the organized and unorganized sectors. This is achieved through enactment and implementation of various labor laws (presently 44 statutes dealing with minimum wages, accidental and social security benefits, occupational safety and health, conditions of employment, disciplinary action, formation of trade unions, industrial relations, etc.) which regulate the terms and conditions of service and employment of workers. Both central and state governments can enact legislation. Numerous labor statutes regulate the terms and conditions of service and employment of workers and are enforced and monitored through the State Labor Commissioner.

103. **Central Electrical Authority (CEA).** Electrical health and safety is under the CEA which is a statutory organization constituted under the Electricity Supply Act 1948, superseded by the Electricity Act of 2003. The authority advises the central government, state governments and regulatory commissions on all policy and technical matters relating to generation, transmission and distribution of electricity and formulates plans for the development of electricity systems. The CEA is also responsible for prescribing the technical standards related to construction of electrical plants, electric lines and connectivity to the grid, installation and operation of meters and safety and grid standards etc. Output 1 and 2 activities are required to adhere to the safety regulations and standards as prescribed by the CEA.

104. **Central Transmission Utility (CTU).** CTU came into existence through “The Electricity Regulatory Commission Act, 1998” enacted by the Parliament on 11th August 1998 in which Indian Electricity Act, 1910 and Electricity (Supply) Act, 1948 were amended. CTU has been assigned the responsibility of undertaking transmission of electricity through Inter State Transmission System (ISTS) and discharge all functions of planning and coordination under section 38 of Electricity Act, 2003. Planning studies are undertaken for identification of new ISTS for evacuation of power from generation pockets to the load centers, augmentation/reconfiguration of existing system etc. in coordination with concerned agencies based on load & generation capacity addition program, connectivity / open access application, feedback from the grid operators, National Electricity Plan by CEA etc.

**Table 3: Applicable National Health, and Safety Requirements**

#	Name of Policy / Law / Regulation	Applicability	Remarks
1	National Policy on Safety, Health and Environment at Workplace, 2009	Applicable, seeks to strive for the objective of improving safety, health, and environment in the workplace during both the construction and operation	Responsible Authorities: Ministry of Labor and Employment
2	National Policy on HIV / AIDS and the World of Work	Applicable as influx of laborers for the construction works may lead to transmission of HIV/AIDS. Policy aims to prevent transmission amongst workers and protect the rights of the infected	Responsible Authorities: Ministry of Labor and Employment
3	Drinking Water Standard (IS 10500:2012)	Applicable as provides the standards of drinking water in India. The drinking water provided in construction must adhere to the standards. The standard is given in Section 2.10.2 of this IEE.	Responsible Authorities: Bureau of Indian Standards, CPCB, SSPCB
4	The Occupational Safety, Health and Working Conditions Code, 2020 (Gazette notification dated 29 <sup>th</sup> September 2020)	This is applicable as all project components will involve labour and workers. This Act consolidates and amends the laws regulating the occupational safety, health and working conditions of the persons employed in an establishment and for matters connected therewith or incidental thereto. The code applies in case of contract labour employed through a contractor in the offices of the Central Government or in the offices of the State Government, where the Central Government or, as the case may be, the State Government is the principal employer, as in the case of APDCL.	Responsible Authorities: Ministry of Labor and Justice, and District Magistrate as Inspector for the district
5	The Bonded Labour (Abolition) Act 1976	Applicable as it prevents use of bonded labor during construction phase	Responsible Authorities: District Magistrate as Inspector for the district or any officer delegated by him
6	The Child Labour (Prohibition and Regulation) Act, 1986 and its amendment	Applicable and it prohibits the employment of children under the age of 14 by the contractors or APDCL.	Prohibits employment of children under the age of 14 in the building and construction industry. Responsible Authority: Labor Inspector
7	The Trade Union Act, 1926	Applicable as it allows the formation of Trade Unions for the purpose of regulating the relations between workers and APDCL.	Responsible Authorities: Registrar of Trade Unions and District Autonomous Councils.
8	The Code on Wages, 2019	Payment of minimum stipulated wages, avoiding inequality in payment of wages etc. to be ensured during the construction and operation phases	The code repealed and replaced Payment of Wages Act, 1936, the Minimum Wages Act, 1948, the Payment of Bonus Act, 1965, and the Equal Remuneration Act, 1976. The Code has consolidated all the provisions of these four labor laws that have been repealed regarding wage and bonus payments and makes it mandatory for payment of minimum wages

#	Name of Policy / Law / Regulation	Applicability	Remarks
			and timely payment of wages for all workers in India. Responsible Authority: Labor Commissioner
9	The Code on Social Security, 2020	Applicable during construction and operation, comply with code in relation to provident funds, gratuities, compensation, employee insurance etc. which are to be paid to the workers employed by the labor contractors, employees of contractors and APDCL.	The code repeals and consolidated the Employee's Compensation Act, 1923, The Employees' Provident Funds and Miscellaneous Provisions Act, 1952, The Payment of Gratuity Act, 1972, The Employees' State Insurance Act, 1948 and five other acts. The act brings generation, transmission and distribution of power works under the ambit of the act. Workmen Compensation Insurance, regular Provident Fund (PF), gratuity and other insurances have to be obtained by contractors. Responsible Authorities: Labor Commissioner, PF Commissioner
10	Employers' Liability Act no. 24 of 1938	Deals with injuries to workers and the responsibility of the employer to maintain machinery and work site in good and safe conditions	Responsible Authorities: Ministry of Labor and Employment
11	<u>Contract Labour (Regulation &amp; Abolition) Act, 1970</u>	Relates to the contracting of labour.	Responsible Authorities: Ministry of Labor and Employment
12	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Emergency response planning must involve the responsible authorities in case during construction and operation a chemical accident that could impact the public occurs while handling any hazardous chemicals (flammable, toxic and explosive).	Protection of the public against chemical accident while handling any hazardous chemicals (flammable, toxic and explosive) Responsible Authorities: District and Local Crisis Group headed by the District Magistrate and Sub Divisional Magistrate
13	The Explosives Act 1884 and its subsequent amendments. The Explosives Rules 1983	Applicable if explosives need to be used, they must also be followed if petroleum products are stored beyond the permissible capacities.	Sets out the regulations as regards to the usage and storage of explosives including explosive fuel (diesel or petrol) at the project site and precautionary measures to be taken. Responsible Authority: Chief Controller of Explosives
14	Public Liability and Insurance Act, 1991	The act is applicable to protect the public from any fortuitous accidents during construction or in the operation phases of the project's components. Liability Insurances are to be obtained by the contractor and APDCL for construction and operation.	The act provides for protection to the public from accidents caused from hazardous materials resulting in continuous or intermittent or repeated exposure to death of,



#	Name of Policy / Law / Regulation	Applicability	Remarks
			or injury to, any person or damage to any property. Responsible Authorities: Labor Commissioner and District Magistrate
15	Central Electricity Authority (Measures Relating to Safety and Electricity Supply) Regulations, 2010 CEA (Measures Relating to Safety and Electricity Supply) Regulations, 2018 CEA (Measures relating to Safety and Electric Supply) Amendment Regulations 2015 CEA (Measures Relating to Safety and Electric Supply) Regulations, 2019	Applicable as the acts deals with distribution and transmission companies and mandates the provision for safety requirements including mandatory appointment of an Electrical Safety Officer and their qualifications	Responsible Authorities: CEA and AERC
16	CEA (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2010	Applicable as these pertain to the safety requirements for construction, operation, and maintenance procedures of electrical lines SPP interconnection with the grid shall abide by Central Electricity Regulatory Commission (CERC) Regulations/Procedure and RE connectivity procedure and the various CEA Regulations including the Grid Code, technical standards as issued by CEA in this regard, Grid Connectivity Regulations, Regulations on Communication System for transmission of electricity etc.	Responsible Authorities: CEA

Source: IEE Team

## 2.7 State Health, Safety and Labour Framework

105. Since labor is a subject in the concurrent list under the Constitution of India, the state governments are also competent to enact legislations. These labor statutes are enforced and monitored through the Labor Commissioners. The health and safety framework in Assam consists of several acts, notifications, rules, and regulations to protect the population as detailed in Table 4.

106. **Labour Welfare Department, Government of Assam.** Labour Department was a part of the former Judicial Department of the Government of Assam till 1951, when it was constituted into an independent department. The Labour Department was renamed as Labour and Employment Department with effect from 10-07-1981 and a Research Cell was created in 1977 as part and parcel of the Department at the Secretariat level. The Labour and Employment Department has bifurcated into two departments, i.e., Labour

Welfare Department and Skill Development and Entrepreneurship Department on 26-03-2016.

107. The two autonomous bodies namely the Assam Tea Employees Provident Fund Organization and the Assam Tea Employee's Welfare Board are running under the administrative control of the Labour Welfare Department. The Labour Welfare Department looks after the health, safety, social security and welfare of labours by implementing labour laws through Commissionerate/ Inspectorate of Labour/Factories/ Boilers/ ESI Scheme and Assam Tea Employees Provident Fund Organization. The Labour Welfare Department is solely responsible for administration of all labour enactments (both Central and State) along with the Rules on number of subjects related to the welfare of labours. The primary objectives encompass:

- Ensuring the provision of welfare facilities and adherence to labour legislations across all segments of the workforce, whether organized or unorganized, by effectively enforcing various labour statutes.
- Eradicating child labour across the state through the identification, rescue, and prosecution of employers involved in employing children in prohibited sectors.

108. Labour Welfare Department is also responsible for discharging the judicial and semi-judicial functions pertaining to industrial disputes arising out of different labour problems through its conciliatory machineries and Industrial Tribunals and Labour Courts created under Section 7-A and Section-7 of the Industrial Disputes Act, 1947.

109. **Assam Electricity Regulatory Commission (AERC).** The Commission is vested under Section 86 of the Electricity Act, 2003 with the responsibility of discharging the following functions: to determine the tariff for generation, supply, transmission and wheeling of electricity, wholesale, bulk or retail, as the case may be, within the State: providing that where open access has been permitted to a category of consumers under section 42, the State Commission shall determine only the wheeling charges and surcharge thereon, if any, for the said category of consumers, regulate electricity purchase and procurement process of distribution licensees including the price at which electricity shall be procured from the generating companies or licensees or from other sources through agreements for purchase of power for distribution and supply within the State, facilitate intra-state transmission and wheeling of electricity, issue licenses to persons seeking to act as transmission licensees, distribution licensees and electricity traders with respect to their operations within the State and promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution license.

**Table 4: Applicable State Health, and Safety Requirements**

#	Name of Policy / Law / Regulation	Applicability	Remarks
1	The Assam Factories Rules, 1950.	It is applicable to construction and operation as laborers will be hired for the various components	The Factories Act is a social legislation that has been enacted for occupational safety, health, and welfare of workers at work place. The State of Assam has formulated its rules as envisaged under the Act.

#	Name of Policy / Law / Regulation	Applicability	Remarks
			Responsible Authorities: Labour Welfare Department, Government of Assam
2	The Assam Payment of Wages Rules, 1937; The Assam Payment of Wages (Procedure) Rules, 1981; The Assam Minimum Wages Rules, 1952; to be amended by the Draft of Code on Wages (Assam) Rules, 2021	It is applicable to construction and operation as laborers will be hired for the various components	An Act to regulate the employment and conditions of services of employed workers/labours Responsible Authorities: Labour Welfare Department, Government of Assam and ADC
3	Notification issued vide GLR (RC) 100/2012/238, dated 18 October, 2016	Applicable as activities will employ women workers and staff. It is applicable to construction and operation as laborers will be hired for the various components. As per State Government notification no. GLR(RC)100/2012/238 dated 18th Oct 2016 referring to the Honourable Madras High court hearing NOA604-061999 and in other matters, it has been declared that, Section 66 (1b) of the act allows employment of women in factory women at night shift between 7 PM To 6 AM with certain conditions in respect of their security and safety of women employees.	Provision permitting women workers in the night shift with adequate safety provision. Responsible Authorities: Labour Welfare Department, Government of Assam and ADC
4	Assam Government Circular No-LE.52/2015/11384 dated 18.10.2016	It is applicable to construction and operation as laborers will be hired for the various components	Provision to ease the mechanism for filling of complaints and grievances by the citizens to ensure speedy disposal, transparency, accountability in the Public Grievance Redressal under various Labour Laws. Responsible Authorities: Labour Welfare Department, Government of Assam and ADC
5	Assam Third Party Audit Scheme, vide Circular No-LE.52/2015 dated 01.11.2016	It is applicable to construction and operation as laborers will be hired for the various components	Regulation to promote the compliance of the labour laws, at the same time, intends to ease the regulatory business environment in the State, by bringing in more transparency and responsibility. Responsible Authorities: Labour Welfare Department, Government of Assam
6	Assam Social Security Rule – Draft, October 2021	It is applicable to construction and operation as laborers will be hired for the various components	Important provision include on gratuity payment, also to nominees and legal heirs, maternity benefit provisions, employee compensation provisions, and social security

#	Name of Policy / Law / Regulation	Applicability	Remarks
			and cess for building construction workers. Responsible Authorities: Labour Welfare Department, Government of Assam and ADC
7	Assam Rule 1971 for labour license	It is applicable to construction and operation as laborers will be hired for the various components	Responsible Authorities: Labour Welfare Department, Government of Assam and ADC
11	The Assam Public Health Act, 2010	Liability Insurances are to be obtained by the contractor and APDCL for construction and operation	Act to provide for protection and fulfillment of rights in relation to health and wellbeing, health equity and justice. Responsible Authorities: Health and Family Welfare Department, Government of Assam

## 2.8 International Agreements and Conventions

110. International agreements pertinent to the project components include multilateral environmental agreements (MEA) and conventions of the International Labor Organization (ILO) related to worker safety and welfare. India is a party and signatory to several international and regional environmental treaties, agreements, and conventions, to which the MoEF&CC is the national focal point. Table 5 provides the key international agreements that India is a signatory with potential applicability. Of note, in relation to the occupational health and safety of labour, India is not a signatory to Occupational Health and Safety Convention of the ILO and several other ILO conventions related to the health and safety of workers.<sup>5</sup>

**Table 5: List of Relevant International Agreements**

#	Name	Date of Ratification	Applicability	Remarks
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971	1 February 1982	One Ramsar site is present in Assam. Not applicable to Output 1 and 2 given distance.	Deals with conservation and sustainable use of wetlands
2	Convention for the Protection of the World Cultural and Natural Heritage, 1972	14 December 1977	The protected area of Assam includes 5 National Parks and 17 Wildlife Sanctuaries as well as 3 proposed Wildlife Sanctuaries, 4 Tiger Reserves, 5 Elephant Reserves, 2 Biosphere Reserves and 2 World Natural Heritage Sites. No project components are situated within any UNESCO	Addresses nature conservation and preservation of cultural properties

<sup>5</sup> [https://www.ilo.org/dyn/normlex/en/f?p=1000:11210:0::NO:11210:P11210\\_COUNTRY\\_ID:102691](https://www.ilo.org/dyn/normlex/en/f?p=1000:11210:0::NO:11210:P11210_COUNTRY_ID:102691)

#	Name	Date of Ratification	Applicability	Remarks
			site or any Biosphere Reserves.	
3	Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	20 July 1976	Risk of illegal wildlife activities by workers outside of working hours.	Deals with protection of endangered species from illegal trade
4	Convention on the Conservation of Migratory Species of Wild Animals, 1979	1 November 1983	Elephant corridors are present inside Assam. Some are found within East Karbi Anglong District. Assam lies along the western part of the East Asian-Australasian flyway as well as in the Central Asian flyway and supports a Ramsar wetland. Impacts to migratory wildlife including birds, elephants and other species. The risk of hunting or poaching of migratory species by the workers to be addressed.	Aims to conserve migratory species in their range
5	Basel Convention on The Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989	24 June 1992	Not applicable as the treaty regulates the movement of hazardous waste between countries	There are 9 units in Assam to whom authorization for collection/transportation/disposal of hazardous waste is issued by UKPCB
6	Convention For the Protection of the Ozone Layer, 1985	18 March 1991	Servicing and refilling of fire extinguishers and air conditioning during construction and operation, ensure that use of ozone depleting substances is prohibited	Lists the various ozone depleting substances and steps for reducing their production
7	Montreal Protocol on Substances That Deplete the Ozone Layer, 1987	19 June 1992		
8	Rio de Janeiro Convention on Biological Diversity, 1992	18 February 1994	Applicable as loss of natural flora due to tree felling is envisaged	Deals with biodiversity conservation, sustainable usage of natural resources and habitat preservation.
9	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998	24 May 2005	Transformers and other equipment procured must be PCB free. Usage of PCBs in transformers and other equipment procured will be prohibited as per the Regulation of Polychlorinated Biphenyls Order, 2016	Promotes the sharing of responsibilities related to import of hazardous chemicals including PCBs.
10	United Nations Framework Convention on Climate Change, 1992	1 November 1993	It can be applicable if new equipment for pooling stations, solar park, etc. uses circuit breakers that may contain sulfur hexafluoride (SF6),	Deals with reductions of greenhouse gases (GHG) to achieve 1.5°C target.

#	Name	Date of Ratification	Applicability	Remarks
11	Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997	19 August 2002	although solid dielectric (Hydrophobic Cycloaliphatic Epoxy (HCEP)) can be used in place of SF6 gas as an insulating medium.	
12	Paris Agreement under the United Nations Framework Convention on Climate Change, 2015	2 October 2016		
13	Stockholm Convention on Persistent Organic Pollutants, 2001	13 January 2006	Transformers and other equipment procured must be PCB free.	Lists PCBs as one of the pollutants. Implemented in India in part by the Regulation of PCBs Order, 2016.
14	International Labor Organization (ILO) Fundamental Conventions: <sup>6</sup> Forced Labor, Equal Remuneration, Abolition of Forced Labor, Minimum Age, Worst Forms of Child Labor	30 November 1954 25 September 1958 18 May 2000 13 June 2017	Construction and operation will involve workers whose fundamental rights per the ILO need to be protected.	Labor laws of India are compliant to the ILO conventions that India is a signatory of.

GHG = greenhouse gas, ILO = International Labor Organization, PCB = polychlorinated biphenyls

## 2.9 Clearances and Permissions Required

111. Clearances, Permissions and NOCs to be obtained by both the borrower (APDCL) and contractors are given in Table 6. Clearances will need to be applied for early on as they can take more than one year to secure. If clearances are not legally required, then the contractor must secure written permission for the works from Department of Environment and Forests and/or ASI.

<sup>6</sup> [https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200\\_COUNTRY\\_ID:102691](https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102691)

**Table 6: List of Environmental Consents and Work Permits Required**

#	Clearances / Permissions / NOC	Authority	Responsible Party	Status as of October 2023
1	Certificate of Registration of Principal Employer	Labor Commissioner, Ministry of Labor and Employment	APDCL (CTU or private sector)	To be obtained prior to construction
2	Intimation and confirmation no further permission required for works as site is in within 10km ESZ of WLS.	ESZ authority (including Rangapahar, Nagaland PCCF)		To be obtained prior to construction
3	Tree felling/trimming permissions	Environment and Forest Department of Assam		To be obtained prior to construction
4	NOC for installing bore wells for construction or operational purpose required for the solar plant	CGWA		To be obtained prior to extraction of water
5	NOC for change of land use for establishing temporary construction camps (if outside APDCL land area)	Revenue Department and District Administration and District Autonomous Council	Contractor	To be obtained prior to construction
6	Consent to Establish (CTE) construction plant	State Pollution Control Board		To be obtained prior to construction
7	Consent to Operate (CTO) construction plant	State Pollution Control Board		To be obtained prior to construction
8	Labor License (labor insurance is also required)	Chief Labor Commissioner, Assam		To be obtained prior to construction
9	Pollution Under Control Certificates for construction vehicles	District Transport Office		To be obtained prior to construction
10	Consent for works in Autonomous Council /IP areas	Department of Tribal Affairs, Directorate of Welfare of Plain Tribes and Backward Classes, Assam and Karbi Anglong Autonomous District Council (KAAC)		To be obtained prior to construction

APDCL = Assam Power Distribution Company Limited, CGWA = Central Ground Water Authority, CTE = Consent to Establish, CTO = Consent to Operate, NOC = No Objection Certificate.

Source: IEE Team

## 2.10 Environmental Standards and Guidelines

112. India has a large set of specific standards that refer to emissions to air, effluent discharge, and noise standards, as well as standard to handle and dispose specific wastes ranging from sewage to hazardous wastes. The following section summarizes these laws and standards along with other good international industry practice (GIIP) guidelines.

### 2.10.1 Air Quality and Emissions

113. National Standards – Under the authority of the Air (Prevention and Control of Pollution) Act of 1981, India's Central Pollution Control Board sets national ambient air quality standards and is responsible for both testing air quality and assisting governments in planning to meet such standards. State Pollution Control Boards are permitted to set stricter standards than those in effect nationally.

**Table 7: National Air Quality Standards <sup>7</sup>**

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)
SO <sub>2</sub> , µg/m <sup>3</sup>	Annual*	50	20
	24 hours**	80	80
NO <sub>2</sub> , µg/m <sup>3</sup>	Annual*	40	30
	24 hours**	80	80
PM <sub>10</sub> , µg/m <sup>3</sup>	Annual*	60	60
	24 hours**	100	100
PM <sub>2.5</sub> , µg/m <sup>3</sup>	Annual*	40	40
	24 hours**	60	60
O <sub>3</sub> , µg/m <sup>3</sup>	8 hours**	100	100
	1 hour**	180	180
Lead (Pb), µg/m <sup>3</sup>	Annual*	0.50	0.50
	24 hours**	1	1
CO, mg/m <sup>3</sup>	8 hours**	2	2
	1 hour**	4	4

\* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.  
\*\* 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

114. International Guidelines – The following table provides WHO recommended air quality guidelines (2021).

**Table 8: World Health Organization 2021 Ambient Air Quality Guidelines**

Parameter	Averaging Period	Guideline Value (micrograms/m <sup>3</sup> )
Sulphur Dioxide (SO <sub>2</sub> )	24 Hour	40
Nitrogen Dioxide (NO <sub>2</sub> )	24 Hour	25
	1 Year	10
Particulate Matter PM <sub>10</sub>	24 Hour	45
	1 Year	15
Particulate Matter PM <sub>2.5</sub>	24 Hour	15
	1 Year	5

### Project Air Quality Standards

115. Any air quality monitoring during the construction phase will be undertaken against national standards, particularly given impacts are short term, although comparison will also be made to the more stringent WHO 2021 guidelines. This is based on the criteria adopted by the WBG Guidelines which state that:

*'Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines.'*<sup>8</sup>

116. As noted above, India has their own national legislated standards and as such they will be applied to the activities under Output 1 and 2, though impact monitoring will also be conducted against the WHO guidelines to ensure the protection of human health given the non-degraded status of the airshed.

<sup>7</sup> [https://cpcb.nic.in/uploads/National\\_Ambient\\_Air\\_Quality\\_Standards.pdf](https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf)

<sup>8</sup> Environmental, Health and Safety Guidelines. Air Emissions and Ambient Air Quality. WBG. 2007



## 2.10.2 Water quality standards

117. Water quality monitoring from surface and groundwater will be assessed against national standards set by the Central Pollution Control Board for surface water.<sup>9</sup> Drinking water will be monitored against Drinking Water Specifications: IS 10500:2012 largely comparable to the WHO drinking water guideline.

**Table 9: Surface Water Quality Standard**

#	Designated Best Use	Class Of Water	Criteria
1	Drinking Water Source (With Conventional Treatment)	A	<ul style="list-style-type: none"> <li>Total Coliform MPN/100 ml Shall Be 50 Or Less</li> <li>pH Between 6.5 To 8.5</li> <li>Dissolved Oxygen 6 mg / l Or More</li> <li>Biochemical Oxygen Demand (BOD) 5 Days 20°C 2 mg/l Or Less</li> </ul>
2	Outdoor Bathing (Organised)	B	<ul style="list-style-type: none"> <li>Total Coliform MPN/100 ml Shall Be 500 Or Less</li> <li>pH Between 6.5 To 8.5</li> <li>Dissolved Oxygen 5 mg / l Or More</li> <li>Biochemical Oxygen Demand (Bod) 5 Days 20°C 3 mg/l Or Less</li> </ul>
3	Drinking Water Source (Without Conventional Treatment)	C	<ul style="list-style-type: none"> <li>Total Coliform MPN/100 ml Shall Be 5000 Or Less</li> <li>pH Between 6 To 9</li> <li>Dissolved Oxygen 4 mg / l Or More</li> <li>Biochemical Oxygen Demand (BOD) 5 Days 20°C 3 mg/l Or Less</li> </ul>
4	Propagation Of Wildlife	D	<ul style="list-style-type: none"> <li>pH Between 6.5 To 8.5 For Fisheries</li> <li>Dissolved Oxygen 4 mg / l Or More</li> <li>Free Ammonia (As N) 1.2 mg/l Or Less</li> </ul>
5	Irrigation, Industrial Cooling, Controlled Waste	E	<ul style="list-style-type: none"> <li>pH Between 6.0 To 8.5</li> <li>Electrical Conductivity At 25°C µmhos/cm Max. 2250</li> <li>Sodium Absorption Ratio Max. 26</li> <li>Boron, Max. 2 mg/l</li> </ul>

Source: CPCB (1999). Bio Mapping Of Rivers, Parivesh New Letter, 5 (Iv), Central Pollution Control Board, Delhi, Pp.20.

<sup>9</sup> <https://cpcb.nic.in/wqstandards/>

**Table 10: Drinking Water Specifications: IS 10500:2012**

#	Substance / Characteristics	Requirement (Acceptable Limit)	Undesirable Effect Outside The Desirable Limit	Permissible Limit In The Absence Of Alternate Source	Methods Of Test (Ref. To IS)	Remarks
<b>ESSENTIAL CHARACTERISTICS</b>						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	15	IS 3025 (Part 4)	Extended to 15 only if toxic substances, in absence of alternate sources.
2	Odour	Agreeable	-	Agreeable	IS 3025 (Part 5)	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	Agreeable	IS 3025 (Part 7 & 8)	Test to be conducted only after safety has been established
4	Turbidity Ntu, Max.	1	Above 5, consumer acceptance decreases	5	3025 (Part 10): 1984	
5	Ph Value	6.5 To 8.5	Beyond this range the water will not affect the mucous membrane and /or water supply system	No Relaxation	IS 3025 (Part 11)	
6	Total Hardness (As CaCO <sub>3</sub> ) mg/l, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	IS 3025 (Part 21)	
7	Iron (As Fe) mg/l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	No Relaxation	IS 3025 (Part 53)	Total concentration of manganese (as mn) and iron (as Fe) shall not exceed 0.3 mg/l
8	Chlorides (As Ci) mg/l Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	IS 3025 (Part 32)	
9	Residual, Free Chloride, mg/l Min.	0.2		1	IS 3025 (Part 26)	To Be Applicable Only When Water is Chlorinated. Tested At Consumer End. When Protection Against Viral Infection is Required, It Should Be Min. 0.5 mg/l
Desirable characteristics						

#	Substance / Characteristics	Requirement (Acceptable Limit)	Undesirable Effect Outside The Desirable Limit	Permissible Limit In The Absence Of Alternate Source	Methods Of Test (Ref. To IS)	Remarks
1	Dissolved Solids mg/l Max.	500	Beyond the palatability decreases and may cause gastrointestinal irritation	2000	IS 3025 (Part 16)	
2	Calcium (As Ca) mg/l Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	IS 3025 (Part 40)	
3	Magnesium (As Mg) mg/l, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	100	IS 3025 (Part 46)	
4	Copper (As Cu) mg/l Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	
5	Manganese (As Mn) mg/l, Max.	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	IS 3025 (Part 59)	
6	Sulphate (As $SO_4$ ), mg/l, Max.	200	Beyond this causes gastrointestinal irritation when magnesium or sodium are present	400	IS 3025 (Part 24)	May be extended up to 400 provided (as mg) does not exceed 30
7	Nitrate (As $NO_3$ ) mg/l, Max.	45	Beyond this methaemoglobinemia take place	No Relaxation	IS 3025 (Part 34)	To Be Tested When Pollution is Suspected
8	Fluoride (As F) mg/l, Max.	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	IS 3025 (Part 60)	To Be Tested When Pollution is Suspected
9	Phenolic Compounds (As $C_6H_5OH$ ) mg/l, Max.	0.001	Beyond this it may cause objectionable taste and odor	0.002	IS 3025 (Part 43)	To Be Tested When Pollution is Suspected
10	Mercury (As Hg) mg/l, Max.	0.001	Beyond this the water becomes toxic	No Relaxation	IS 3025 (Part 48)	To Be Tested When Pollution is Suspected
11	Cadmium (As Cd), mg/l, Max.	0.003	Beyond this the water becomes toxic	No Relaxation	IS 3025 (Part 41)	To Be Tested When Pollution is Suspected
12	Selenium, (As Se). mg/l, Max.	0.01	Beyond this the water becomes toxic	No Relaxation	IS 3025 (Part 56)	To Be Tested When Pollution is Suspected
13	Arsenic (As) mg/l, Max.	0.01	Beyond this the water becomes toxic	0.05	IS 3025 (Part 37)	To Be Tested When Pollution is Suspected

#	Substance / Characteristics	Requirement (Acceptable Limit)	Undesirable Effect Outside The Desirable Limit	Permissible Limit In The Absence Of Alternate Source	Methods Of Test (Ref. To IS)	Remarks
14	Cyanide (As Cn) mg/l, Max.	0.05	Beyond this the water becomes toxic	No Relaxation	IS 3025 (Part 27)	To Be Tested When Pollution is Suspected
15	Lead (As Pb), mg/l, Max.	0.01	Beyond this the water becomes toxic	No Relaxation	IS 3025 (Part 47)	To Be Tested When Pollution is Suspected
16	Zinc (As Zn) mg/l, Max.	5	Beyond this limit it can cause astringent taste and an opalescence taste and an opalescence in water	15	IS 3025 (Part 49)	To Be Tested When Pollution is Suspected
17	Anionic Detergents (As Mbas) mg/l, Max.	0.2	Beyond this it can cause a light froth in water	1	Annex K Of IS 13428	To Be Tested When Pollution is Suspected
18	Chromium (As Cr6+) mg/l, Max.	0.05	May be carcinogenic above this limit	No Relaxation	IS 3025 (Part 52)	To Be Tested When Pollution is Suspected
19	Poly Nuclear Aromatic Hydra Carbons (As PAH) mg/l, Max.	0.0001	May be carcinogenic above this limit	No Relaxation	Apha 6440	-
20	Mineral Oil mg/l, Max.	0.5	Beyond this limit undesirable taste and odor after chlorination take place.	0.03	IS 3025 (Part 39)	-
21	Pesticides mg/l, Max.	-	Toxic	-	-	-
22	Radioactive Material	-	-	-	IS 14194	-
23	Alpha Emitters Bq/1, Max.	0.1	-	No Relaxation	-	-
24	Beta Emitter Pci/1, Max.	1.0	-	No Relaxation	-	-
25	Total Alkalinity (As CaCO <sub>3</sub> ), mg/l, Max	200	Beyond this limit taste becomes unpleasant	600	IS 3025 (Part 23)	-
26	Aluminium (As Al) mg/l, Max.	0.03	Cumulate effect is reported to cause dementia	0.2	IS 3025 (Part 55)	-
27	Boron mg/l, Max.	0.5	-	1.0	IS 3025 (Part 57)	-

Source: Indian Standard Drinking Water Specification – IS 10500:2012

118. Water quality monitoring will be assessed against national standards set by the Central Pollution Control Board.<sup>10</sup>

### **Project Water Discharge Standards**

119. Wastewater discharge from construction sites and camps as well as operational buildings will be of limited volume so shall be assessed against national standards (for any treated sanitary sewage discharge) based on the WBG EHS guidelines which state, “*treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values*” which are included in the last column of Table 11. Comparison of effluent discharges will still be made to the more stringent WBG EHS Guidelines.

**Table 11: General Standards For Discharge Of Environmental Pollutants: Effluents<sup>11</sup>**

#	Parameter	Inland Surface Water	Public Sewers	Land For Irrigation	Marine/Coastal Areas	WBG EHS Guidelines for Public Sewer
1	Colour And Odour	All Efforts Should Be Made To Remove Colour And Unpleasant Odour As Far As Practicable		All Efforts Should Be Made To Remove Colour And Unpleasant Odour As Far As Practicable	All Efforts Should Be Made To Remove Colour And Unpleasant Odour As Far As Practicable	-
2	Suspended Solids mg/l, Max.	100	600	200	(A) For Process Wastewater (B) For Cooling Water Effluent 10 Per Cent Above Total Suspended Matter Of Influent.	50
3	Particle Size Of Suspended Solids	Shall Pass 850 Micron Is Sieve	-	-	(A) Floatable Solids, Solids Max. 3 Mm (B) Settleable Solids, Max 856 Microns	-
4	pH Value	5.5 To 9.0	5.5 To 9.0	5.5 To 9.0	5.5 To 9.0	6-9
5	Temperature	Shall Not Exceed 5°C Above The Receiving Water Temperature	-	-	Shall Not Exceed 5°C Above The Receiving Water Temperature	-
6	Oil And Grease, mg/l Max,	10	20	10	20	10
7	Total Residual Chlorine, mg/l Max	1.0	-	-	1.0	-

<sup>10</sup> <https://cpcb.nic.in/wqstandards/>

<sup>11</sup> These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified in Schedule of the Environment Protection Rules, 1989

#	Parameter	Inland Surface Water	Public Sewers	Land For Irrigation	Marine/Coastal Areas	WBG EHS Guidelines for Public Sewer
8	Ammoniacal Nitrogen (As N),mg/l, Max.	50	50	-	50	10
9	Total Kjeldahl Nitrogen (As N) ; mg/l, Max.	100	-	-	100	-
10	Free Ammonia (As NH <sub>3</sub> ), mg/l, Max.	5.0	-	-	5.0	-
11	Biochemical Oxygen Demand (3 Days At 27°C), mg/l, Max.	30	350	100	100	30
12	Chemical Oxygen Demand, mg/l, Max.	250	-	-	250	125
13	Arsenic (As As) mg/l, Max.	0.2	0.2	0.2	0.2	-
14	Mercury (As Hg), mg/l, Max.	0.01	0.01	-	0.01	-
15	Lead (As Pb) mg/l, Max	0.1	1.0	-	2.0	-
16	Cadmium (As Cd) mg/l, Max	2.0	1.0	-	2.0	-
17	Hexavalent Chromium (As Cr + 6), mg/l, Max.	0.1	2.0	-	1.0	-
18	Total Chromium (As Cr) mg/l, Max.	2.0	2.0	-	2.0	-
19	Copper (As Cu) mg/l, Max.	3.0	3.0	-	3.0	-
20	Zinc (As Zn) mg/l, Max.	5.0	15	-	15	-
21	Selenium (As Se) mg/l, Max.	0.05	0.05	-	0.05	-
22	Nickel (As Ni) mg/l, Max.	3.0	3.0	-	5.0	-

#	Parameter	Inland Surface Water	Public Sewers	Land For Irrigation	Marine/Coastal Areas	WBG EHS Guidelines for Public Sewer
23	Cyanide (As Cn) mg/l, Max.	0.2	2.0	0.2	0.2	-
24	Fluoride (As F) mg/l, Max.	2.0	15	-	15	-
25	Dissolved Phosphates (As P), mg/l, Max.	5.0	-	-	-	2
26	Sulfide (As S) mg/l, Max.	2.0	-	-	5.0	-
27	Phenolic Compounds (As C <sub>6</sub> H <sub>5</sub> OH) mg/l, Max.	1.0	5.0	-	5.0	-
28	Radioactive Materials: (A) Alpha Emitters Micro Curie mg/l, Max. (B) Beta Emitters Micro Curie mg/l	10 <sup>-7</sup> 10 <sup>-6</sup>	10 <sup>-7</sup> 10 <sup>-6</sup>	10 <sup>-8</sup> 10 <sup>-7</sup>	10 <sup>-7</sup> 10 <sup>-6</sup>	-
29	Bio-Assay Test	90% Survival Of Fish After 96 Hours In 100% Effluent	90% Survival Of Fish After 96 Hours In 100% Effluent	90% Survival Of Fish After 96 Hours In 100% Effluent	90% Survival Of Fish After 96 Hours In 100% Effluent	-
30	Manganese mg/l, Max.	2	2	-	2	-
31	Iron (As Fe) mg/l, Max.	3	3	-	3	-
32	Vanadium (As V) mg/l, Max.	0.2	0.2	-	0.2	-
33	Nitrate Nitrogen mg/l, Max.	10	-	-	20	-
34	Coliform MPN/100ml	-	-	-	-	400

Notes:

MPN = most probable number

Annexure 1: The State Boards Shall Follow The Following Guidelines In Enforcing The Standards Specified Under Schedule Iv:

1. The Wastewater And Gases Are To Be Treated With The Best Available Technology (Bat) In Order To Achieve The Prescribed Standards.
2. The Industries Need To Be Encouraged For Recycling And Reuse Of Waste Materials As Far As Practicable In Order To Minimize The Discharge Of Wastes Into The Environment.

3. The Industries Are To Be Encouraged For Recovery Of Biogas, Energy And Reusable Materials.
4. While Permitting The Discharge Of Effluents And Emissions Into The Environment, State Boards Have To Take Into Account The Assimilative Capacities Of The Receiving Bodies, Especially Water Bodies So That Quality Of The Intended Use Of The Receiving Waters Is Not Affected. Where Such Quality Is Likely To Be Affected, Discharges Should Not Be Allowed Into Water Bodies.
5. The Central And State Boards Shall Put Emphasis On The Implementation Of Clean Technologies By The Industries In Order To Increase Fuel Efficiency And Reduce The Generation Of Environmental Pollutants.
6. All Efforts Should Be Made To Remove Color And Unpleasant Odour As Far As Practicable.
7. The Standards Mentioned In This Schedule Shall Also Apply To All Other Effluents Discharged Such As Mining, And Mineral Processing Activities And Sewage.
8. The Limit Given For The Total Concentration Of Mercury In The Final Effluent Of Caustic Soda Industry, Is For The Combined Effluent From (A) Cell House; (B) Brine Plant; (C) Chlorine Handling; (D) Hydrogen Handling; And (E) Hydrochloric Acid Plant.
9. All Effluents Discharged Including From The Industries Such As Cotton Textile, Composite Woolen Mills, Synthetic Rubber, Small Pulp & Paper, Natural Rubber, Petrochemicals, Tanneries, Paint, Dyes, Slaughterhouses, Food & Fruit Processing And Dairy Industries Into Surface Waters Shall Conform To The BOD Limit Specified Above, Namely, 30 mg/l. For Discharge Of An Effluent Having A BOD More Than 30 mg/l, The Standards Shall Conform To Those Given Above For Other Receiving Bodies, Namely, Sewers, Coastal Waters And Land For Irrigation.
10. Bioassay Shall Be Made Compulsory For All The Industries, Where Toxic And Nonbiodegradable Chemicals Are Involved.
11. In Case Of Fertilizer Industry, The Limits In Respect Of Chromium And Fluoride Shall Be Complied With At The Outlet Of Chromium And Fluoride Removal Units Respectively.
12. In Case Of Pesticides.
  - A. The Limits Should Be Complied With At The End Of The Treatment Plant Before Dilution.
  - B. Bio-Assay Test Should Be Carried Out With The Available Species Of Fish In The Receiving Water, The Cod Limits To Be Specified In The Consent Conditions Should Be Correlated With The Bod Limits.
  - C. In Case Metabolites And Isomers Of The Pesticides In The Given List Are Found In Significant Concentrations, Standards Should Be Prescribed For These Also In The Same Concentration As The Individual Pesticides.
  - D. Industries Are Required To Analyze Pesticides In Wastewater By Advanced Analytical Methods Such As GLC/HPLC
13. The Chemical Oxygen Demand (COD) Concentration In A Treated Effluent, If Observed To Be Persistently Greater Than 250 Mg/L Before Disposal To Any Receiving Body (Public Sewer, Land For Irrigation, Inland Surface Water And Marine Coastal Areas), Such Industrial Units Are Required To Identify Chemicals Causing The Same. In Case These Are Found To Be Toxic As Defined In The Schedule-I Of The Hazardous Rules, 1989, The State Boards In Such Cases Shall Direct The Industries To Install Tertiary Treatment Stipulating Time Limit.
14. Standards Specified In Part A Of Schedule Vi For Discharge Of Effluents Into The Public Sewer Shall Be Applicable Only If Such Sewer Leads To A Secondary Treatment Including Biological Treatment System Otherwise The Discharge Into Sewers Shall Be Treated As Discharge Into Inland Surface Waters.

Source: Gsr 801 (E), Epa, 1986, Dated 31 December 1993 and <https://www.ifo.org/wps/wcm/connect/3d9a54ae-c44c-488d-9851-afeb368cb9f9/1-3%2BWastewater%2Band%2BAmbient%2BWater%2BQuality.pdf?MOD=AJPERES&CVID=Is4Xbfn>

### 2.10.3 Noise

120. National Standards – The Noise Pollution (Regulation and Controls) Rules, 2000 provide the noise standards for India. They are shown in Table 12. It is to be noted these standards are on an area/zonal basis and not for individual receptors.

**Table 12: Noise Standards**

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time (6am to 10pm)	Nighttime (10pm to 6pm)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note: Silence zone is defined as an area comprising not less than 100 meters around hospitals, educational institutions and courts. The silence zones are zones, which are declared as such by the competent authority.

121. International Guidelines – To meet WBG EHS Guideline requirements noise impacts should not exceed the levels presented in
122. Table 13 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off site. These levels are applicable at individual receptors, based on type.



**Table 13: WHO Noise Level Guidelines**

Receptor	One-hour $L_{aeq}$ (dBA)	
	Daytime 07.00-22.00	Night-time 22.00 – 07.00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Source: WBG EHS Guidelines, 2007

123. Control room noise should follow best practice guidelines as set out in the WBG EHS Guidelines on Occupational Health and Safety (Table 2.3.1) where the average noise level within the control room shall not exceed 45-50 dB(A) during the length of the 8-hour working day.

### Project Noise Standards

124. National standards will be followed as they are generally more comprehensive than WBG guidelines. The exception being at residential properties found in commercial/industrial areas where the receptor-based guideline not the area-based standard will apply, and daytime noise in industrial areas where international guidelines will be followed. WBG EHS Guidelines shall be followed for control room noise; they will also be followed in relation to lighting and ventilation.

### **2.10.4 Vibration**

125. International Guidelines – some of the most recognizable standards for structural vibration measurements are ISO 4866, British BS 7385-2, and German DIN 4150-3. The German DIN 4150-3 – Vibration in Buildings – Part 3: Effects on structures Standard provides short term and long-term limits<sup>12</sup> for vibration at the foundation for various structures. It is useful as it provides short term values corresponding to construction impacts. Since the international standard focuses more on measurement of vibration this is considered as the GIIP to be followed by the Project, it has been used in various other recent ADB environmental assessments.<sup>13</sup>

**Table 14: Guideline Values for Vibration Velocity to be Used When Evaluating the Effects of Short-term and Long-term Vibration on Structures**

Group	Type of structure	Guideline Values for Velocity (mm/s)				
		Short-term			Uppermost Floor	Long-term
		At foundation				
		Less than 10 Hz	10 Hz to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	10
2	Residential dwellings and buildings of similar design and/or use	5 (105 dB)	5 to 15	15 to 20	15	5 (105 dB)

<sup>12</sup> short-term vibrations are defined as those that do not occur often enough to cause structural fatigue and do not produce resonance in the structure being evaluated and long-term vibrations are all the other types of vibration.

<sup>13</sup> For example, <https://www.adb.org/projects/documents/geo-51257-001-eia-0>

Group	Type of structure	Guideline Values for Velocity (mm/s)				
		Short-term			Long-term	
		At foundation			Uppermost Floor	Uppermost Floor
		Less than 10 Hz	10 Hz to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3 (100.5 dB)	2 to 8	8 to 10	8	2.5 (99.0 dB)

Source: DIN 4150-3, Structural Vibration, Part 3: Effect of vibration on structures

126. DIN 4150-3 notes that “experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Exceeding the value in the table does not necessarily lead to damage”.

### Project Vibration Standards

127. German Standard DIN 4150-3 will be followed during the construction phase.

### **2.10.5 Electromagnetic Field (EMF) Guidelines**

128. Minimum ground clearance for conductors shall be maintained as per requirement of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations 2010. However, requirement of maintaining electrostatic and electromagnetic interference, radio interference voltage, audible noise etc. within acceptable limits becomes ruling condition specifically for power lines of 400 kV and above voltage class.

129. WBG EHS guidelines for Electric Power Transmission and Distribution refer to International Commission on Non-Ionizing Radiation Protection (ICNIRP), which establish reference and exposure levels for the public. They set exposure to electric field at 50 hertz as 5 kV/m and for magnetic fields 100  $\mu$ T.<sup>14</sup>

130. Typical ground level field levels from overhead HV power lines in the United Kingdom are illustrated in Table 15 and show that at 25 meters EMF levels for 275-400kV lines are well below ICNIRP exposure levels for both magnetic and electric fields but within 25 m (under the line) electric field levels may be exceeded. The detailed design of the SPP TL will need to ensure the EMF levels can be complied with at the nearest regularly occupied properties.

**Table 15: Typical Ground-level Electric Field Levels from Overhead Power Lines (132 and 275-400kV)**

Location	Magnetic Field (microteslas)		Electric Field (kV/m)	
	132kV	275-400kV	132kV	275-400kV
Maximum Field (under line)	40	100	4	11
Typical Field (under line)	0.5 – 2	5-10	1-2	3-5

<sup>14</sup> ICNIRP per WBG EHS Guidelines. ICNIRP has more recent 2010 and 2020 guidelines for limiting exposure to electromagnetic fields for low frequencies and up to 300 GHz respectively.

Location	Magnetic Field (microteslas)		Electric Field (kV/m)	
	132kV	275-400kV	132kV	275-400kV
Typical Field (25 meters to side)	0.05 – 0.2	1-2	0.1-0.2	0.2 – 0.5
Typical Field (100 meters to side)	0.01 – 0.04	0.05 – 0.1	0.002 – 0.02	0.01 – 0.04

Source: National Grid, 2012 (<https://www.nationalgrid.com/sites/default/files/documents/13791-Electric%20and%20Magnetic%20Fields%20-%20The%20facts.pdf>)

131. Corresponding ICNIRP limits for general occupational exposure to electric and magnetic fields are significantly higher at 10 kV/m and 500 $\mu$ T, respectively, for 50 hertz. For trained employees, the minimum working clear hot stick distance for 2.1-15 kV is 0.6m, for 15.1 to 35 kV is 0.71m, and so on based on the WBG EHS guidelines.

## 2.11 Other Relevant Standards and Guidelines

### 2.11.1 General Safety Clearances<sup>15</sup>

132. WBG EHS Guidelines for Electric Power Transmission and Distribution note that installation of power lines or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g., schools or offices), should be avoided.

133. In addition, the following national general safety clearance requirements for the SPP TL and any other overhead lines (it is anticipated SPP cables are underground) shall be applied.

### 2.11.2 Clearance above Ground of the Lowest Conductor of Overhead Lines

- For lines exceeding 33kV the clearance above ground shall not be less than 5.2m plus 0.3 meters for every 33,000 volts

### 2.11.3 Horizontal and Vertical Clearances above Buildings

134. Where a low or medium voltage, overhead line passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed:

- For any flat roof, open balcony, veranda roof and lean-to-roof-
  - When the line passes above the building a vertical clearance of 2.5 meters from the highest point, and
  - When the line passes adjacent to the building a horizontal clearance of 1.2 meters from the nearest point, and
- For pitched roof-

<sup>15</sup> Key Extracts from:

- The Draft Standard Technical Specification for Steel Pole Structure. GoI. Ministry of Power. Central Electricity Authority. April 2021
- Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010
- Indian Electricity Rules, 1956. <https://www.dgms.net/IErules1956.pdf>

- i. When the line passes above the building a vertical clearance of 2.5 meters immediately under the lines, and
  - ii. When the line passes adjacent to the building a horizontal clearance of 1.2 meters.
135. Where a high or extra-high voltage overhead line passes above or adjacent to any building or part of a building it shall have on the basis of maximum sag a vertical clearance above the highest part of the building immediately under such line, of not less than:
- a. For high voltage lines up to and including 33,000 volts - 3.7 meters
  - b. For extra-high voltage lines - 3.7 meters plus 0.30 meter for every additional 33,000 volts or part thereof.
136. The horizontal clearance between the nearest conductor and any part of such building shall, on the basis of maximum deflection due to wind pressure, be not less than:
- a. For high voltage lines above 11,000 volts and up to and including 33,000 volts - 2.0m
  - b. For extra-high voltage lines - 2.0 meters plus 0.3 meter for every additional 33,000 volts for part thereof.

#### 2.11.4 Spans

137. The route of HV power lines (66kV and above voltage level) shall be clearly identified as normal section without constraint and section through forest area or urban areas / populated area / approach section near substations. The applicable design span in these sections for various voltage levels of HV power lines as indicated in Table 5 shall be adopted.

**Table 16: Span Criteria – HV Power Lines**

AC Voltage (kV)	Normal Design Span (m)		
	Normal route without constraint	Forest Area	Urban area / populated areas / near SS
400-765	200m -250m		
220-230	300	250	200

#### 2.11.5 Other General Safety Requirements

138. All activities shall follow the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations 2010. The following key points from the regulation are of specific relevance to the IEE.
- The owner of every installation of voltage exceeding 650V shall affix permanently a danger notice in Hindi and English and local language of the district, with a sign of skull and bones of a design per IS-2551 (including all overhead lines).
  - Firefighting equipment shall be kept in all substations and switching stations.
  - Fire extinguishers shall be tested at least once per year.

- First aid boxes and cupboards, labeled and equipped as the state government may specify shall be provided at every substation, switching station and any vehicles used for the maintenance of lines.
- Instructions in English, or Hindi and the local language of the district for the resuscitation of persons suffering from electric shock shall be provided in substations.
- In every substation an artificial respirator shall be provided and kept in good condition.
- Where a substation has more than 2000 liters of oil installed the following measures shall be taken:
  - a. Baffle walls of four hours fire rating shall be provided between equipment
  - b. Provisions shall be made for a suitable oil soak pit. Where more than 9000 liters is stored a system to drain the oil away from the area will be provided along with provisions to extinguish any fire that occurs.
  - c. Spare oil shall not be stored in the vicinity of any oil-filled equipment.
- Outdoor substations, unless the equipment is completely enclosed in metal covering connected with earth, shall be protected by fencing not less than 1.8m in height and earthed.

139. In addition, the requirements of the Central Electricity Authority (Measures Related to Safety and Power Supply) Regulations 2010, Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Power Plants and Power Lines) Regulations and relevant Indian Standards will be followed during erection and stringing along with the CEA Minimum Safety Guidelines.

## **2.12 APDCL Administration, Guidelines and Procedures**

140. APDCL has no environment social management unit for full time staff and capacity to implement the national policy and legislative requirements applicable to the project and ADB SPS is limited. One person (consultant) is deputed for the project, who is also involved with other funded projects. Capacity development is needed (reflected in EMP section of this IEE). Based on discussion with APDCL, their existing environment, health and safety staffing arrangement, staff qualifications and experience, a PMC is planned to be hired with adequate staff including Environmental Specialist, Ecologist, Health & Safety Specialists and Labour specialist to ensure compliance with national requirements and ADB safeguards.

141. APDCL has a Corporate Social Responsibility (CSR) Policy<sup>16</sup>. The CSR Policy has following objectives:

- To create sensitivity within the Company and society toward social development and to consider CSR as one of the Company's responsibilities and to encourage cooperation with the wider stakeholder community.
- To promote high standard of authenticity, responsibility and accountability toward all stakeholders including employees, community, consumers, Government, etc.
- To promote socio-economic development through community development initiatives/programs.

<sup>16</sup> <https://www.apdcl.org/website/docs/documents/Approved%20CSR%20Policy%20-APDCL.pdf>

- To bring about attitudinal change in APDCL employees and other stakeholders about the idea/perception of CSR. This Policy will create a framework, procedure for assessment, implementation and monitoring of any activity under CSR.
- Among the scope of CSR activities, the key environmental and social policies include:
  - Protection of national heritage, art and culture, including restoration of buildings and sites of historical importance and works of art, setting up public libraries, promotion and development of traditional arts and handicrafts.
  - Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centres, and such other facilities for senior citizens, and measures for reducing inequalities faced by socially and economically backward groups; and
  - Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agro forestry, conservation of natural resources and maintaining quality of soil, air and water.
  - The CSR policy also provided basic procedures for project identification, monitoring and documentation.

142. APDCL also has Safety Manual (2019)<sup>17</sup> and a Disaster Management Plan (2015)<sup>18</sup>

### 2.13 Good International Industry Practice

143. WBG EHS General Guidelines (30 April 2007) will be applicable for the Project, especially Section 4 on Construction and Decommissioning. In addition, the WBG EHS Guidelines for Electric Power Transmission and Distribution (30 April 2007) also need to be considered while designing the substations and power lines. It requires consideration of terrestrial and aquatic habitat alteration, electric and magnetic fields, hazardous materials, occupational health and safety and community health and safety. The ILO Safety and Health in Construction, 2022 and worker accommodation guidelines are also relevant. The project is required to comply with these guidelines regarding assessment of potential impacts and management measures, performance indicators and monitoring guidelines. APDCL shall follow the WBG EHS Guidelines and ILO guidelines for this project and shall also ensure that all appointed contractors and their subcontractors follow them.

144. The applicable international good practice standards and guidelines from the above-mentioned guidelines are set out in this chapter and Appendix I. Where international good practice standards or guidelines are more stringent than national, it is the most stringent that applies unless otherwise justified by APDCL in this IEE report.

### 2.14 Asian Development Bank Safeguard Policy Statement 2009

145. ADB has three safeguard principles and requirements (environment, involuntary resettlement, and indigenous peoples) under its Safeguard Policy Statement 2009 that seek to avoid, minimize, or mitigate adverse impacts of projects on the environment and affected people. The Project requires the application of environment, involuntary resettlement and indigenous peoples safeguard requirements. The latter are dealt with in the separate resettlement and indigenous peoples plan (RIPP) prepared for the project.

146. ADB's prohibited investment activities list will also apply. Thus, any use of CFCs, PCBs, and asbestos containing materials will be prohibited. In relation to child labor,

<sup>17</sup> [https://www.apdcl.org/website/docs/safety/Safety\\_Manual\\_2019\\_English.pdf](https://www.apdcl.org/website/docs/safety/Safety_Manual_2019_English.pdf)

<sup>18</sup> [https://www.apdcl.org/website/docs/documents/disaster\\_management\\_plan.pdf](https://www.apdcl.org/website/docs/documents/disaster_management_plan.pdf)

considering capacity for supervision, no under 18s will be permitted to work on the construction site or operational areas due to the hazardous nature of work involved.

### **Safeguard Requirements 1: Environment**

147. The objectives are to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the project decision-making process. Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. Eleven 'Policy Principles' have been adopted as part of the ADBs Safeguard Policy Statement (SPS 2009). These are as follows with a note on the gap analysis compared to national requirements:
148. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks. SPP are not listed under the schedule of the EIA Notification as environmental sensitive projects. (Though there is no requirement to screen the project under national requirements, the Project was screened by the ADB and classified as a Category B project.)
149. Conduct an environmental assessment for the proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate. (Though there is no requirement to assess the project under national requirements, the IEE herewith provides the environmental assessment for the SPP in accordance with ADB's Safeguard Policy Statement 2009 and having cognizance of national environment, health and safety laws and regulations. Transboundary impacts are not applicable with the exception of climate change impacts due to clearance of vegetation and SF6 use).
150. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative. (Though there is no requirement to consider alternatives under national requirements, alternatives have been considered in this IEE, including the 'no project' alternative).
151. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. (Though there is no requirement to prepare an EMP under national requirements, an EMP has been prepared for the Output 1 and 2 components in accordance with ADB's Safeguard Policy Statement 2009 and having cognizance of national environment, health and safety laws and regulations).
152. Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the

project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance. (Though there is no requirement to conduct consultation or establish a GRM under national requirements, meaningful consultations were held to discuss environmental issues. The findings of the consultations (and a description of the grievance redress mechanism) are presented in this IEE).

153. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders. (Though there is no requirement to disclose the environmental assessment under national requirements, this IEE and its EMP will be disclosed on the ADB website, they will also be locally disclosed by APDCL on their website and at the construction site offices).
154. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports. (There is no requirement to monitor the EMP or disclose monitoring reports under national requirements. Therefore, the IEE and its EMP outline a plan to monitor the implementation of the EMP and the institutional responsibilities for monitoring and reporting throughout the SPP lifecycle).
155. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources. (Biodiversity and, in some cases, critical habitat areas are found outside the legally protected area system of India wherein some endangered or critically endangered species may be present. Indian regulations have no provisions for protecting biodiversity from power line and SPP projects in this event as such projects do not fall under the EIA Notification 2006. However, the IEE includes a biodiversity assessment including consideration of natural and critical habitats and legally protected areas to ensure that this principle is complied with).
156. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides. (Limiting



value of some pollutants specified in the Indian regulatory standards are different than those specified in WBG EHS guidelines and hence those that are applicable to the project need to be established. Indian regulations have no provisions for ensuring pollution control is considered at project planning stage unless projects fall under the EIA Notification or require a CTE/CTO from SPCB. However, the IEE includes an assessment of pollution impacts and risks, and the mitigation plan of the EMP includes the measures to be followed to comply with this principle).

157. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. (Both the Safeguard Policy Statement 2009 and Indian regulations require safe work areas, the use of safety equipment and personal protective equipment etc. However, the enforcement of national requirements can be weak. The IEE and its EMP outline the requirement for specific occupational and community health and safety plans, monitoring and supervision).
158. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of “chance find” procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation. (Indian regulations have no provisions for protecting physical cultural resources that are not nationally or state protected from power line and SPP at planning stage in the event projects do not fall under the EIA Notification 2006. However, the IEE includes a PCR assessment to ensure that this principle is complied with. A chance find procedure is provided in this IEE).

### **Safeguard Requirements 2: Involuntary Resettlement.**

159. The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. The safeguard requirements underscore the requirements for undertaking the social impact assessment and resettlement planning process, preparing social impact assessment reports and resettlement planning documents, exploring negotiated land acquisition, disclosing information and engaging in consultations, establishing a grievance mechanism, and resettlement monitoring and reporting.
160. The involuntary resettlement requirements apply to full or partial, permanent or temporary physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. Resettlement is considered involuntary when displaced individuals or communities do not have the right to refuse land acquisition that results in displacement. (A Resettlement and Indigenous Peoples Plan (RIPP) has been prepared for the Project according to the requirements of ADB).

### **Safeguard Requirements 3: Indigenous Peoples.**

161. The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples’ identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive

culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them.

162. To achieve the desired results, safeguard requirements are built into the process which needs to be realized during the processing and implementation of the projects that ADB shall finance. (A Resettlement and Indigenous Peoples Plan (RIPP) has been prepared for the Project according to the requirements of ADB).

163. Table 17 presents a comparison and gap analysis of ADB's SPS 2009 and Indian Requirements.

**Table 17: ADB SPS 2009 and Government of India Environmental Requirements Gap Analysis**

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
Screening and Categorization	<ul style="list-style-type: none"> <li>• EIA Notification of 2006 and its amendments list the types of projects to be screened and categorized and sets criteria to classify such new and expansion projects based on potential environmental impacts as either category A, B1 and / or B2.</li> <li>• The category of the project shall determine the level of environmental assessment.</li> <li>• EIA is mandatory for project activities that satisfy the defined threshold limits for category A</li> <li>• EIA is also mandatory for certain category B project activities that are within 10km of (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries</li> <li>• Category B projects will be screened and categorized by SEIAA as either B1 or B2 by Government of India, those categorized B1 require EIA before the granting of prior environment clearance whereas those categorized as B2 will not require EIA.</li> <li>• For building and construction projects, if more than 20,000 square meters in footprint area and more than 150,000 square meters of built-up (floor) area these are classified under Category B and Prior Environmental Clearance is required from SEIAA.</li> </ul>	<ul style="list-style-type: none"> <li>• As per ADB's Safeguard Policy Statement (2009) screening and categorization is required for all projects</li> <li>• Assigns categories based on potential impacts into either: <ul style="list-style-type: none"> <li>i. Category A - EIA required (significant irreversible, diverse, or unprecedented adverse environmental impacts)</li> <li>ii. Category B – IEE required</li> <li>iii. Category C – no environmental assessment required but a review of environmental implications</li> <li>iv. Category FI – Environmental and Social Management System required</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Power line and SPP projects are not listed under the schedule of the EIA Notification as environmental sensitive projects. Therefore, screening and categorization are not required by Government of India except for when building and construction components of a certain size are involved.</li> <li>• Based on the size of buildings proposed at the SPP none trigger the building criterion and require prior environment clearance.</li> <li>• Under ADB's Safeguard Policy Statement (2009) the project including all the outputs is categorized as B as the project components are unlikely to have significant irreversible, diverse, or unprecedented adverse environmental impacts this IEE has been prepared to address their potential impacts/risks and mitigation measures required.</li> </ul>

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
Environmental Assessment	<ul style="list-style-type: none"> <li>No assessment required for power line or substation projects or small-scale building and construction</li> </ul>	<ul style="list-style-type: none"> <li>Identify potential impacts on physical, biological, physical cultural resources and socioeconomic aspects in the context of project's area of influence (i.e., primary site and related facilities, associated facilities etc.)</li> <li>Assess potential transboundary and global impacts, including climate change.</li> </ul>	<ul style="list-style-type: none"> <li>Major gap since as per Indian regulations power line and SPP projects are not listed as environmental sensitive projects, building sizes are also below the threshold to require prior environment clearance, and hence no environmental assessment is required.</li> <li>However, to comply with ADB's Safeguard Policy Statement (2009) an IEE has been prepared.</li> </ul>
Analysis of Alternatives	<ul style="list-style-type: none"> <li>No analysis of alternatives required for power line or substation projects or small-scale building and construction</li> </ul>	<ul style="list-style-type: none"> <li>Category A (projects with significant impacts) are required to carry out alternative analysis.</li> <li>Alternatives to the project's location, design, and technology are to be examined and rationale for selecting the project location, design, and technology to be documented.</li> <li>Also "no project" alternative must be assessed.</li> </ul>	<ul style="list-style-type: none"> <li>No gap as project components are unlikely to have significant irreversible, diverse, or unprecedented adverse environmental impacts but consideration has been given to alternatives as part of the IEE.</li> </ul>
Environmental Planning and Management	<ul style="list-style-type: none"> <li>No environmental planning and management required for power line and substation projects or small-scale building and construction</li> </ul>	<ul style="list-style-type: none"> <li>Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts</li> <li>Key considerations include mitigation of potential adverse impacts to the level of "no significant harm to third parties", the polluter pays principle, the precautionary approach, and adaptive management.</li> <li>Prepare EMP addressing the potential impacts and risks identified by the environmental assessment which should include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related</li> </ul>	<ul style="list-style-type: none"> <li>Major gap but this IEE including an EMP has been prepared to meet ADB's Safeguard Policy Statement (2009) requirements</li> </ul>

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
		institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.	
Meaningful Consultation	<ul style="list-style-type: none"> <li>No formal public consultations / public hearing is required for power line or substation projects or small-scale building and construction</li> </ul>	<ul style="list-style-type: none"> <li>Meaningful consultation starts early and continues during implementation phase. It is undertaken in a conducive atmosphere and is inclusive of gender, vulnerable and indigenous groups such that the project incorporates all relevant views and concerns of affected persons and other stakeholders.</li> </ul>	<ul style="list-style-type: none"> <li>Major gap but meaningful consultations have been undertaken as part of the IEE</li> </ul>
Information Disclosure	<ul style="list-style-type: none"> <li>Power line or substation projects or small-scale building and construction projects do not require any information disclosure</li> </ul>	<ul style="list-style-type: none"> <li>ADB will post in its website the following:               <ol style="list-style-type: none"> <li>Draft IEE prior to appraisal</li> <li>Final or updated IEE upon receipt</li> <li>Environmental monitoring report submitted by borrowers upon receipt</li> </ol> </li> <li>Local disclosure is also required</li> </ul>	<ul style="list-style-type: none"> <li>Major gap but environment safeguard documents prepared under the project shall comply with the requirements of ADB's Safeguard Policy Statement (2009) and shall be disclosed on the ADB website and locally</li> </ul>
Grievance Redress Mechanism (GRM)	<ul style="list-style-type: none"> <li>GRM is not required</li> </ul>	<ul style="list-style-type: none"> <li>Establish GRM to facilitate resolution of grievances or complaints received in the project</li> </ul>	<ul style="list-style-type: none"> <li>Major gap exists but GRM to be established as per the requirements of ADB's Safeguard Policy Statement (2009)</li> </ul>
Monitoring and Reporting	<ul style="list-style-type: none"> <li>No monitoring and reporting are required for power line and substation projects or small-scale building and construction</li> </ul>	<ul style="list-style-type: none"> <li>Borrowers are required to prepare and regularly submit periodic monitoring reports on the progress of EMP implementation to ADB for review and disclosure</li> <li>Prepare and implement corrective action plan if non-compliance is identified</li> </ul>	<ul style="list-style-type: none"> <li>Major gap exists but monitoring measures in accordance with ADB's Safeguard Policy Statement (2009) are proposed</li> </ul>
Biodiversity	<ul style="list-style-type: none"> <li>Wildlife Protection Act, 1972 and amendments provides the procedures and guidelines for siting of projects within protected areas and their ESZ. Projects within protected areas involve lengthy</li> </ul>	<ul style="list-style-type: none"> <li>ADB's Safeguard Policy Statement 2009 requires that the borrower assess the significance of project impacts and risks on biodiversity and natural</li> </ul>	<ul style="list-style-type: none"> <li>Biodiversity and, in some cases, critical habitat areas are found outside the legally protected area system of India wherein some</li> </ul>

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
	<p>permission procedures. Projects obtaining permissions are mainly linear projects of national importance and are permitted with mitigation measures.</p> <ul style="list-style-type: none"> <li>Indian Forest Act, 1927 and the Forest (Conservation) Act, 1980 and its subsequent amendments set procedures for diversion of forest land for non-forest activities. The procedure is also time consuming especially for cases involving diversion &gt;5 ha. Any diversion of forest land involves compensation of land and plants that shall be felled. For central government projects there are some relaxations related to compensation of land.</li> <li>Most, but not all, critical habitat or areas inhabited by endangered species (under schedules of the Wildlife Protection Act, 1972 and amendments) are protected under either the Wildlife Protection Act or the Forest Act</li> </ul>	<p>resources as an integral part of the environmental assessment process.</p> <ul style="list-style-type: none"> <li>It also requires that the assessment focus on the major threats to biodiversity including destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner</li> <li>Borrowers are required to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of biodiversity.</li> <li>ADB's Safeguard Policy Statement 2009 also lays down procedures for implementing projects in natural habitats, critical habitats, and Legally Protected Areas</li> </ul>	<p>endangered or critically endangered species may be present.</p> <ul style="list-style-type: none"> <li>Indian regulations have no provisions for protecting biodiversity in this event at project planning stage unless projects fall under the EIA Notification 2006.</li> <li>Gaps persist especially as prior EC is not required for power line or SPP or small-scale building and construction projects; there is no mechanism for this type of project outside of protected areas or forest areas to assess impacts on biodiversity and natural resources.</li> <li>However, to comply with ADB's Safeguard Policy Statement (2009) an IEE has been prepared considering biological impacts.</li> </ul>
Pollution	<ul style="list-style-type: none"> <li>The Environment (Protection) Rules, 1986 and various legislations address aspects such as air, noise, water pollution, hazardous substance management etc.</li> <li>National Ambient Air Quality Standards have been specified as per MoEF&amp;CC notification General Statutory Rules (GSR) 826(E) dated 16.11.2009 in compliance with the Air (Prevention and Control of Pollution) Act, 1981(Amended 1987) and Air (Prevention and Control of Pollution) Rules 1982</li> <li>Noise Standards has been specified as per the Noise Pollution (Control and Regulation) Rules, 2000 (Amended 2002).</li> </ul>	<ul style="list-style-type: none"> <li>Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phaseouts.</li> <li>Refers to WBG EHS Guidelines for international good practice standards and measures for pollution control and prevention. If national regulations differ, more stringent will usually be followed.</li> </ul>	<ul style="list-style-type: none"> <li>Limiting value of some pollutants specified in the Indian regulatory standards are different than those specified in World Bank Group (WBG) EHS guidelines and hence those that are applicable to the distribution components need to be established.</li> <li>The guideline values of the five WHO air pollutants referred to by the WBG EHS guidelines in the absence of national standards are more stringent than the Indian standards. National Ambient Air Quality Standards (NAAQS) list 12 pollutants along with their</li> </ul>

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
	<ul style="list-style-type: none"> <li>• Water quality standards have been specified as per MoEF&amp;CC notification No. GSR 742(E), Dt: 25.09.2000 and in compliance with the Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Water (Prevention and Control of Pollution) Rules 1974.</li> <li>• Standards applicable to the project components are provided in this chapter of the IEE.</li> </ul>	<p>If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification.</p>	<p>permissible concentrations. The major pollutant that is listed in the Indian standard but not by the WHO to which the WBG EHS guidelines refer is Carbon Monoxide (CO) although the WHO introduced one in their latest 2021 update of the guidelines. Also, the NAAQS are for two types of land uses – (a) industrial, residential, rural and others and (b) ecologically sensitive areas notified by Government of India whereas WHO make no distinction on land use.</p> <ul style="list-style-type: none"> <li>• Ambient noise limits for industrial receptors are lower as per the WHO community noise guidelines to which the WBG EHS guidelines refer than the Government of India standard, whilst at residential receptors they are similar, but differ for silent and commercial zones. The Government of India introduces an additional receptor type not considered by the WBG EHS guidelines (WHO) namely silence zone (hospitals, educational institutions, courts, religious places and 'any other area which is declared as such by the competent authority')</li> <li>• National ambient surface water quality standards exist as well as drinking water standards (ISO 10500)</li> <li>• The guideline values for treated sanitary wastewater discharges referred to by the WBG EHS</li> </ul>



Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
			<p>guidelines in the absence of national standards are the same or more stringent than the general effluent quality standards as set under the Environmental Protection Rules 1986. Sector specific Indian CPCB standards for effluent quality exist, although not for power lines and SPP.</p> <ul style="list-style-type: none"> <li>Indian regulations have no provisions for ensuring pollution control is considered at project planning stage unless projects fall under the EIA Notification or will require a CTE/CTO from SPCB.</li> <li>However, to comply with ADB's Safeguard Policy Statement (2009) an IEE has been prepared considering impacts related to pollution risk.</li> </ul>
Health and Safety	<ul style="list-style-type: none"> <li>Occupational health and safety standards included in various Indian labour laws and codes</li> <li>Community health and safety of distribution projects is covered by CEA regulations including requirement to maintain vertical and horizontal safety clearances</li> </ul>	<ul style="list-style-type: none"> <li>Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease.</li> <li>Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.</li> <li>Refers to WBG EHS Guidelines for the occupational health and safety guidelines to be followed</li> </ul>	<ul style="list-style-type: none"> <li>No major gaps with respect to occupational health and safety as both the WBG EHS guidelines and Indian regulations require safe work areas, the use of safety equipment and personal protective equipment (PPE)</li> <li>Some gaps with respect to community health and safety as there are no standards for EMF</li> </ul>
Physical Cultural Resources	<ul style="list-style-type: none"> <li>The procedures for obtaining permissions for siting of projects in the vicinity of a protected monument are laid in the various acts related to ancient monuments</li> <li>National legislation prohibits projects that are within 100m of protected monuments.</li> </ul>	<ul style="list-style-type: none"> <li>ADB's Safeguard Policy Statement (2009) states that the borrower is responsible for siting and designing the project to avoid significant damage to physical cultural resources. It requires that such resources that may have</li> </ul>	<ul style="list-style-type: none"> <li>Some gaps persist for locally important physical cultural resources especially where prior environmental clearance is not required under the EIA notification</li> </ul>

Project Stage	Indian Requirements	ADB's SPS (2009)	Gap Analysis
	<p>For projects within 300m, permissions are first to be obtained from the competent authorities.</p> <ul style="list-style-type: none"> <li>• Chance finds as per Indian regulations are to be handed over to the authorities who shall inspect / assess the chance finds.</li> <li>• Only rarely are protected physical cultural resources removed unless a project is of national importance and the resources are of minor importance and, in such cases, it is handled by the specialist from the Archaeological department. In most cases of conflicts, the project proponent is advised to relocate their project site.</li> </ul>	<p>direct, indirect, cumulative, and induced impacts are identified and assessed by qualified and experienced experts using field-based surveys. If such resources are impacted consultations with affected communities shall take place to identify the importance and to incorporate the views of the affected communities besides consultations with relevant national or local regulatory agencies. Appropriate mitigation measures ranging from avoidance to full site protection to selective mitigation, including salvage and documentation be provided in case of impacts.</p> <ul style="list-style-type: none"> <li>• For projects that are located where physical cultural resources are expected to be found as per the environmental assessment, procedures for chance finds shall be included in the EMP and such finds shall not be disturbed until assessed by a competent specialist</li> <li>• Movement of physical cultural resources shall be done only when no alternatives exist, overall benefits of the project substantially outweigh the anticipated cultural heritage loss and the removal is in accordance with relevant national and international laws and uses the best available techniques</li> </ul>	<p>and impacts are not required to be assessed.</p> <ul style="list-style-type: none"> <li>• However, to comply with ADB's Safeguard Policy Statement (2009) an IEE has been prepared considering impacts on all physical cultural resources.</li> </ul>

### III. DESCRIPTION OF THE OUTPUT 1 AND 2 COMPONENTS

#### 3.1 Location and Description

164. The site is in the Karbi Anglong district, on the eastern side of the state of Assam (see Figure 1: Site Location). The district is encircled with Golaghat district on the east, Nagaon and Hojai on the West and Dima Hasao on the southern part. The state of Nagaland borders a significant portion of the eastern side of the district. Diphu is the administrative headquarters of the district.

165. This proposed solar PV component of the project comprises 750MWac of SPP with power evacuation to the national grid via two loop-in, loop-out (LILO) 400kV lines (SPP TL) connecting to an existing 400kV line approximately 5.3km west of the SPP.

#### 3.2 Components

166. This IEE study provides the assessment of Outputs 1 and 2 of the proposed project. Several sub-components are included within each component, as follows:

##### Component 1:

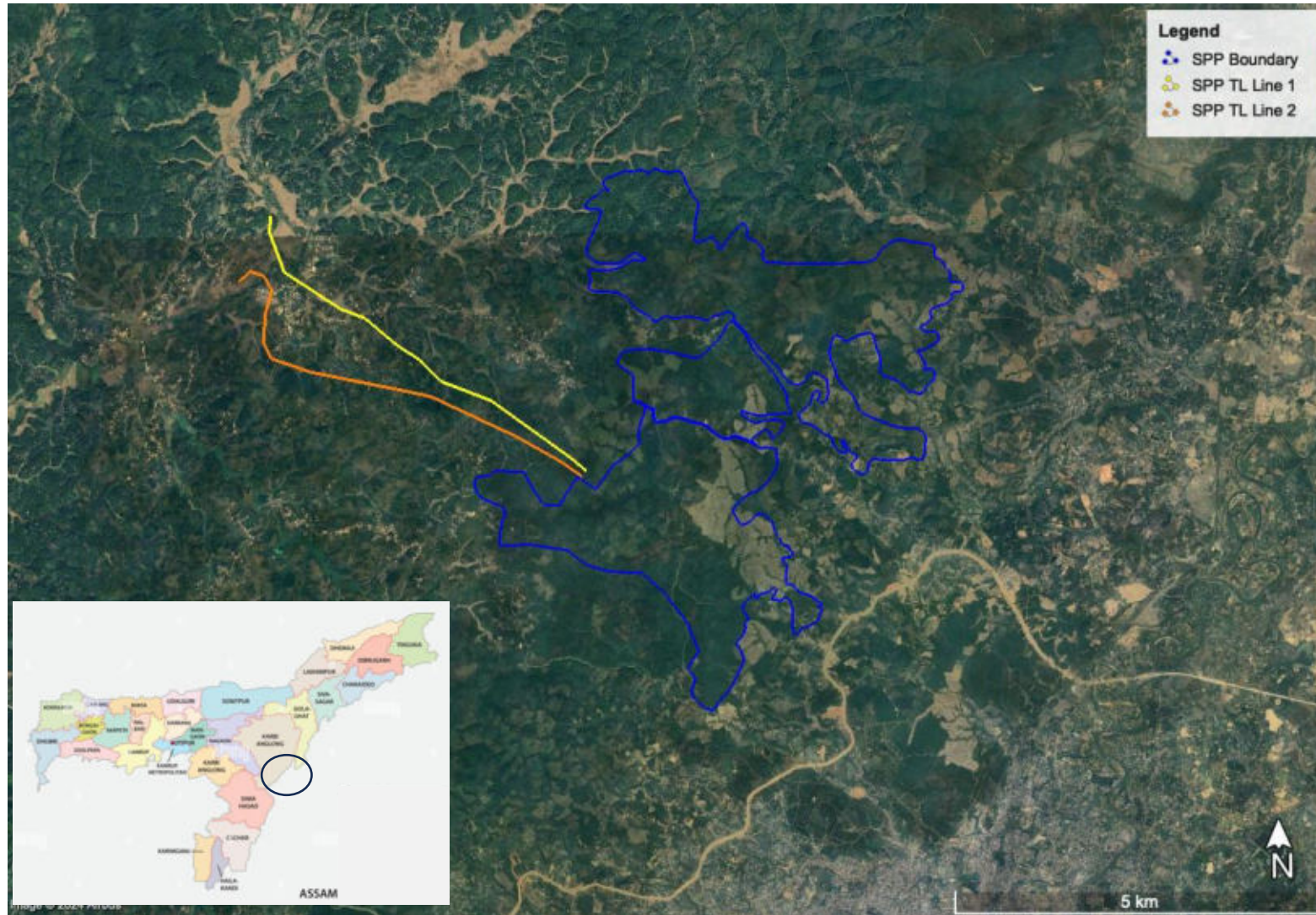
167. Works funded by ADB include:

- Sub-component 1a: Package 1 – 250MWac SPP in two lots (125MWac each) Block 4 and 5
- Sub-component 1b: Package 2 – 250MWac SPP in two lots (125MWac each) – Block 1 and 3
- Sub-component 1c: Package 3 – Pooling Substation
- Sub-component 1d: Package 4 – SPP Infrastructure (SPPI)

168. Works under this output that are not funded by ADB, but are recognized as associated facilities (AF) will also include:

- Sub-component 1e: Grid Substation
- Sub-component 1f: 400kV LILO Transmission Line (SPP TL)

Figure 1: Site Location



Source IEE Team/APDCL

Note: SPP TL routes are indicative and will be finalized by CTU

## Component 2:

169. Works under this output include transactional advisory support for development of 250 MW<sub>AC</sub> capacity (Blocks 2 and 6) through PPP modality using the common solar park facilities – Sub-component 2a.

**Table 18: Outputs 1 and 2 Overview**

Details	Location details	District	Total Land Area (hectares) <sup>19</sup>	International or National Biodiversity Sites
Solar PV Plant (SPP)	Assam Province	Karbi Anglong (East)	1,755	Nearest Nationally Protected Area– 6km Nearest Key Biodiversity Area – 6km Nearest Elephant Reserve – 4.5km Nearest Reserve Forest - 2km

170. An extension plant to the south of the solar power plant is proposed by APDCL to be developed in the future and will eventually connect to the Package 3 pooling substation. APDCL is seeking to acquire land for this at the same time as the project. However, the dates for development of this site are unknown, it is not funded by the project, and no works relating to it (e.g., boundary wall installation) will be undertaken by the project. As such, assessment of this plant is not included within this IEE study except in respect of cumulative and induced impact.

### 3.3 Contracting Arrangement

171. **Sub-Component 1a / 1b / 1c** - Contractors will be selected through an international competitive bidding process. The contractors will undertake the detailed design, carry out civil works, supply and install the solar power plant/pooling substation and operate and maintain the SPP and pooling substation for at least three years, after which the contractor will hand over O&M activities to APDCL, or continue to perform O&M for additional contractual periods as negotiated between them and APDCL.

172. **Sub-component 1d** – A contractor will be selected through an international competitive bidding process. The contractor will undertake the detailed design, carry out civil works, supply and install the SPP infrastructure.

173. **Sub-component 1e / 1f** – Central Transmission Utility of India (CTU) will engage a transmission service provider who in turn may employ a contractor to undertake the detailed design, carry out civil works, supply and install the LILO transmission line and the grid substation as associated facilities of the solar power plant. The LILO and grid substation will be operated and maintained by CTU.

174. **Sub-component 2a** – The PPP modalities for this sub-component are not yet defined. However, it is likely that it will be a build, own, operate (BOO) arrangement. Private sector investors will be selected through a request for proposal. It is assumed a contractor will be engaged by the private sector investors to design and build the relevant blocks, but the operator status needs to be confirmed. The conditions of this IEE study will apply to all

<sup>19</sup> Main plant including six SPP blocks, common (administration) area and pooling substation.

aspects of the design, construction, O&M and decommissioning phases of this sub-component through the request for proposal.

175. Table 19 summarizes the contract packages and their status in terms of bid and tender dates.

**Table 19: Contracting Arrangements**

Sub-component / Package	General Description	Tender Status	Notes
<b>Component 1</b>			
1a/P-1	Design, Supply, Installation and O&M of 250 MWac SPP on turnkey basis - 2 lots: <ul style="list-style-type: none"> <li>Lot 1 of 125 MWac</li> <li>Lot 2 of 125 MWac</li> </ul>	Tendered	EMP included in bid documents. Final updated EMP will need to be included before contract award and followed by contractor.
1b/P-2	Design, Supply, Installation and O&M of 250 MWac SPP on turnkey basis - 2 lots: <ul style="list-style-type: none"> <li>Lot 1 of 125 MWac</li> <li>Lot 2 of 125 MWac</li> </ul>	Not yet tendered	EMP to be included in bid and contract documents.
1c/P-3	Design, supply, installation and commissioning of pooling substation switchyard 3X315MVA (with one additional power transformer bay and switchgear for 750MW) on turnkey basis – 1 lot	Not yet tendered	EMP to be included in bid and contract documents.
1d/P-4	Design and Construction of solar park infrastructure comprising (i) boundary wall (ii) internal roads (iii) office and control room buildings (iv) canteen etc. – 1 lot	Tendered	EMP included in bid documents. Final updated EMP will need to be included before contract award and followed by contractor.
1e and 1f (CTU)	Design and construction of 400kV transmission line Design and construction of HV grid substation	Tendered	Tendering by CTU for transmission service provider – APDCL need to coordinate with CTU to ensure EMP requirements are addressed by the selected transmission service provider and their contractor
<b>Component 2</b>			
2a (private sector)	Design, Supply, Installation and O&M of 250 MWac SPP on turnkey basis - 2 lots: <ul style="list-style-type: none"> <li>Lot 1 of 125 MWac</li> <li>Lot 2 of 125 MWac</li> </ul>	Not yet tendered	IEE and EMP to be included in request for proposal

Source: ADB Procurement Plan

### 3.4 Solar Power Plant (Sub-components 1a, 1b and 2a)

176. The design and construction activities for the SPP are the same for all lots (except for the block layouts) and as such will be described under one section below.

#### 3.4.1 General

177. Each lot will comprise:

- Development of 125 MWac solar power within the corresponding block (includes all related works for supply and installation of PV modules, inverters or power conditioning units, transformers, electrical switch gears, back up batteries, SCADA system, control rooms, underground cable works, etc.) up to termination at the 33kV switchgear of the 400/33kV pooling substation.
- Labor accommodation and site offices including water and sanitation, security cabin, fabrication yard and workshops, maintenance buildings, stores, etc.
- Power, safety and security systems with fire detection and protection, lighting and CCTV cameras for the corresponding block.
- Storm water drainage and rainwater harvesting ponds for the corresponding block.
- Strengthening of existing village roads for access to the corresponding block (Block 4 2.8km, Block 5 4.6km, for other blocks these works will be undertaken by the SIIP contractor).
- Construction of approach roads with drainage within the SPP site from the public highway (village roads) for access to the corresponding block (Block 4 7km, Block 5 2.7km, for other blocks these works will be undertaken by the SIIP contractor).
- Construction of internal roads with drainage within the corresponding block for use during O&M of the SPP (routing determined by contractor).
- Construction of security fence and peripheral road with drainage around the boundary of the corresponding block.

### 3.4.2 Footprint

178. The “footprint” is the total estimated physical area of land required by the SPP main plant. The total proposed footprint for each lot (also known as a ‘block’) is shown in the following table.

**Table 20: Block Footprints**

Component	Package	Lot	Block	Area (hectares)
1a	1	1	4	274
1a	1	2	5	275
1b	2	1	1	278
1b	2	2	3	274
2a	PPP Mode	1	6	271
2a	PPP Mode	2	2	278
Total				1,650

Source: APDCL

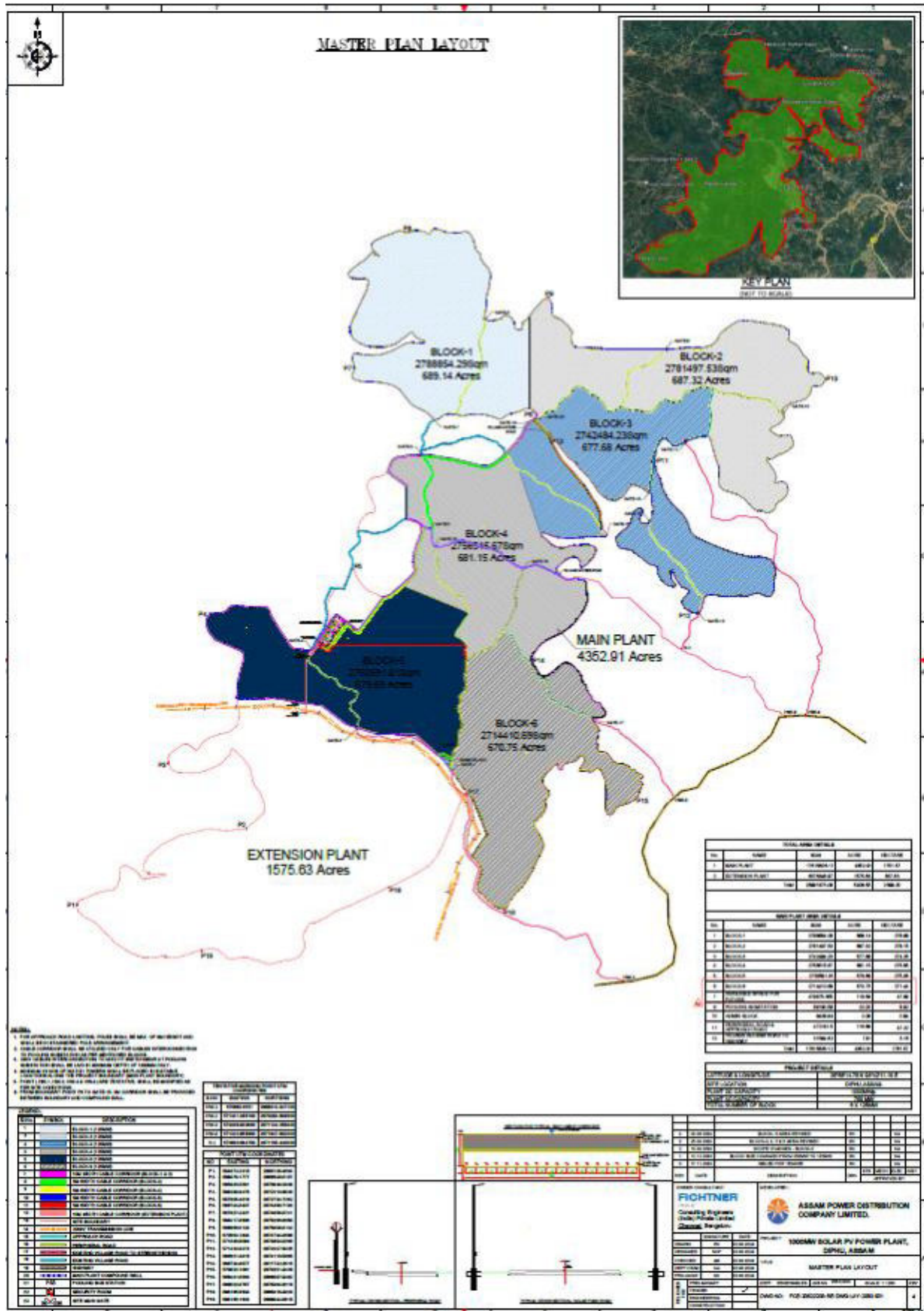
179. The individual layout of the six blocks is shown in Figure 3 to

180.

181.

182. **Figure 8.**

### Figure 2: SPP Block Layout

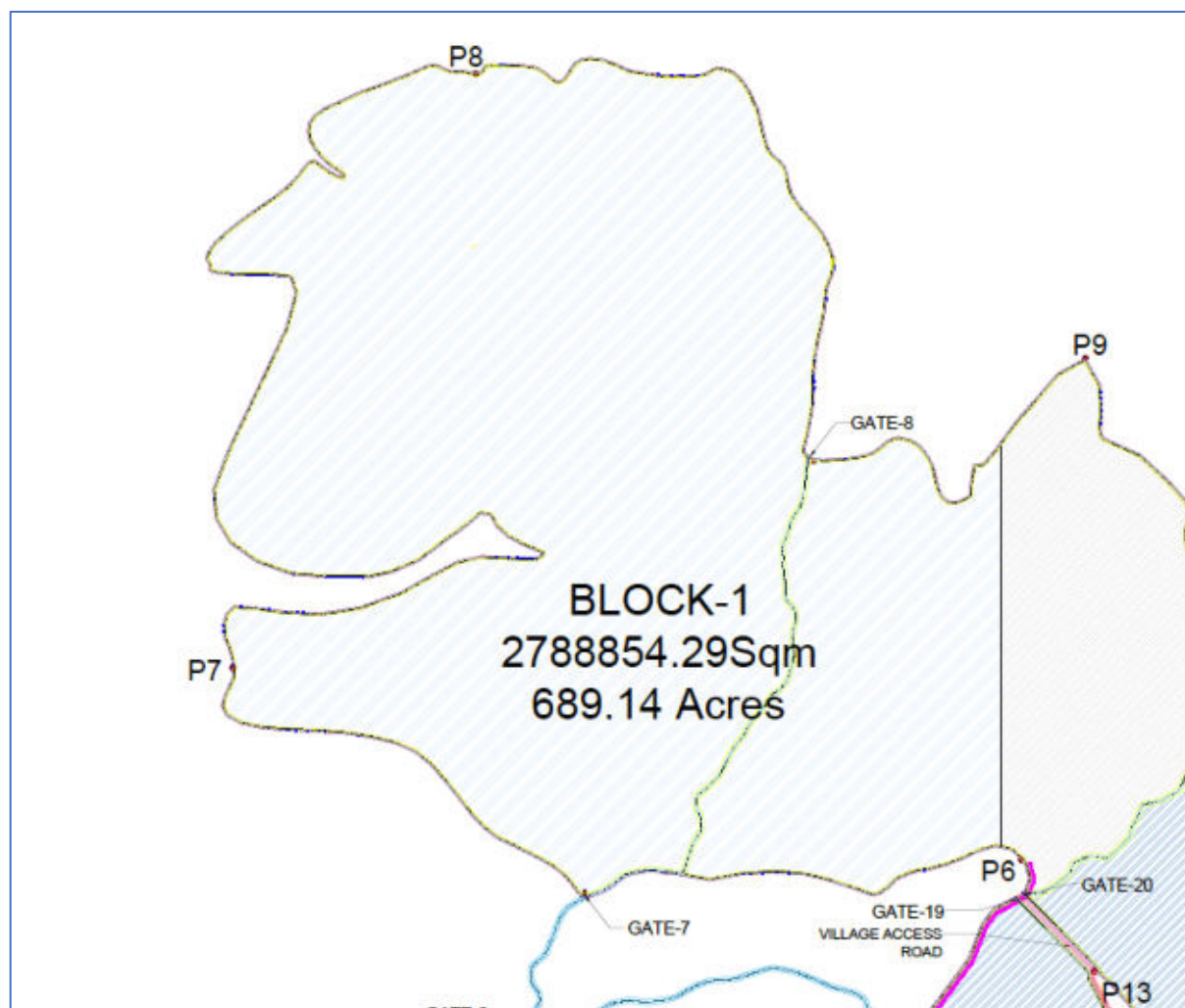


Source: APDCL

Note: the site boundary will run along the edge of the RoW of an existing TL for 540m so it falls outside the site and maintenance issues will not arise. The extension plant shown is a future proposal and not part of the project.



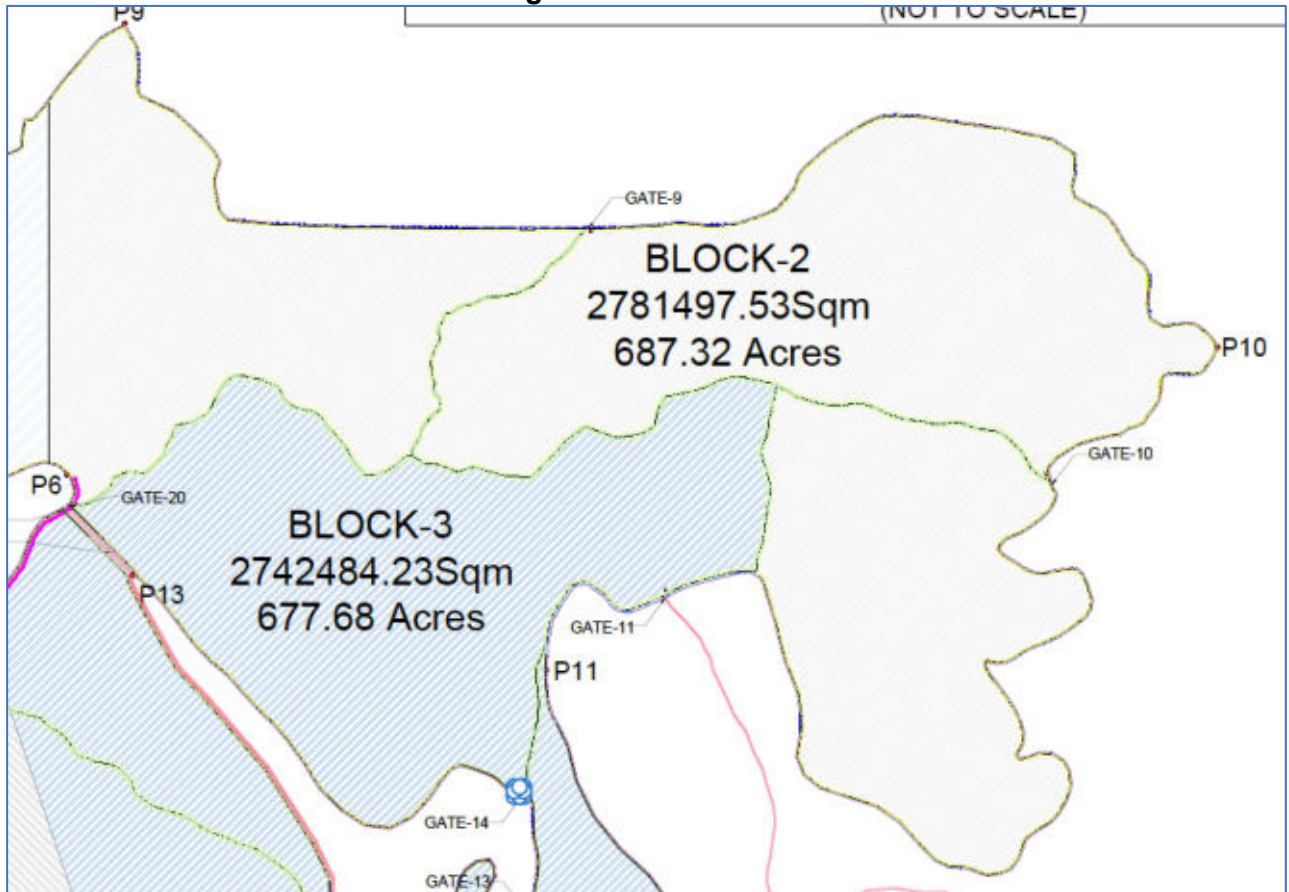
Figure 3: Block 1



Sl.No.	SYMBOL	DESCRIPTION
1		BLOCK-1 (125MW)
2		BLOCK-2 (125MW)
3		BLOCK-3 (125MW)
4		BLOCK-4 (125MW)
5		BLOCK-5 (125MW)
6		BLOCK-6 (125MW)
7		10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8		5M WIDTH CABLE CORRIDOR (BLOCK-3)
9		5M WIDTH CABLE CORRIDOR (BLOCK-4)
10		5M WIDTH CABLE CORRIDOR (BLOCK-5)
11		5M WIDTH CABLE CORRIDOR (BLOCK-6)
12		10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13		SITE BOUNDARY
14		220KV TRANSMISSION LINE
15		APPROACH ROAD
16		PERIPHERAL ROAD
17		SITE OUTER ROAD-1
18		SITE OUTER ROAD-2
19		HIGHWAY
20		EXTENSION PLANT WITH BOUNDARY WALL
21		MAIN PLANT WITH BOUNDARY WALL
22		STU SUB STATION
23		POOLING SUB STATION
24		CTUIL SWITCHING SUB STATION
25		SECURITY ROOM
26		SITE MAIN GATE

Source: APDCL

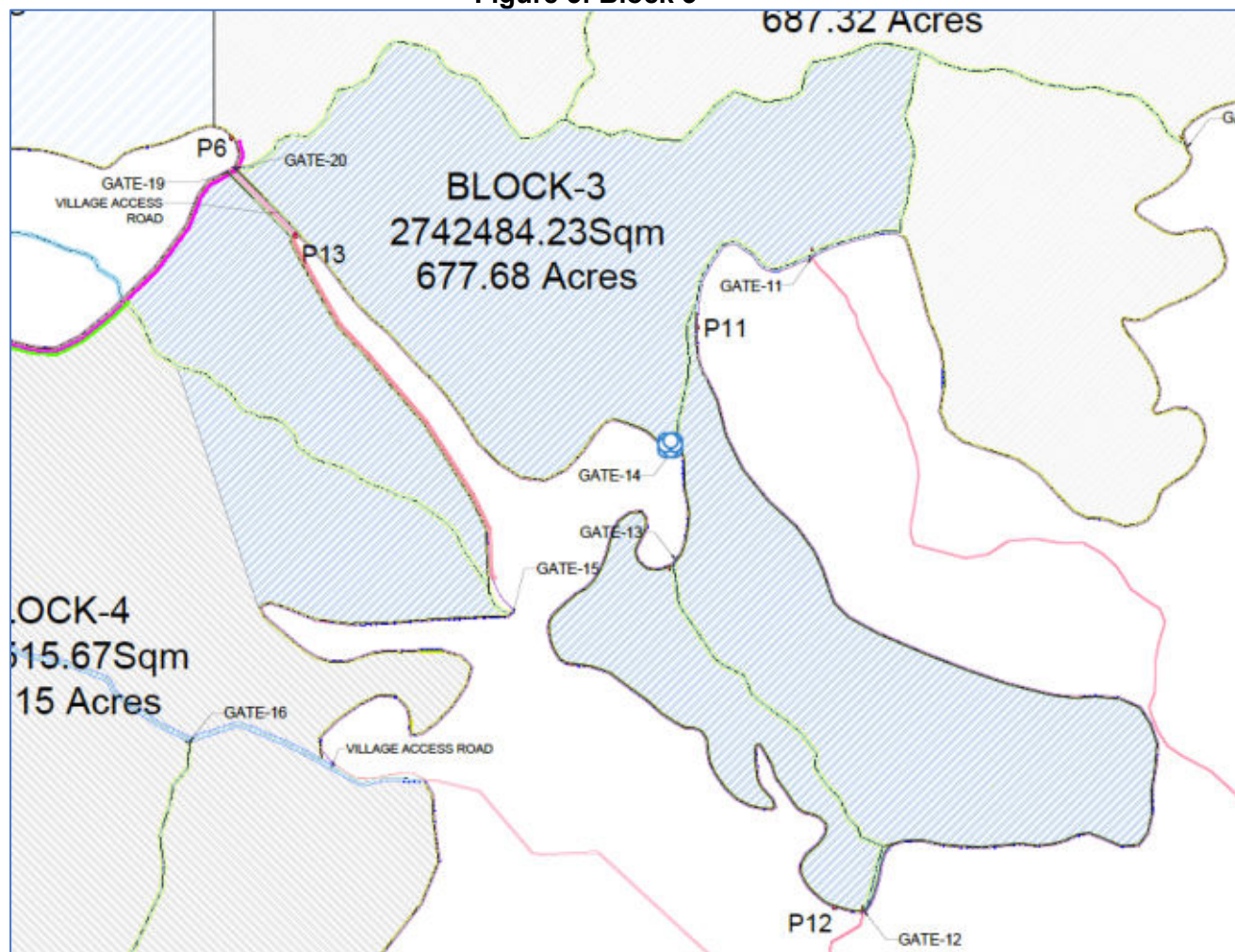
Figure 4: Block 2



Sl.No.	SYMBOL	DESCRIPTION
1	[Light Blue Box]	BLOCK-1 (125MW)
2	[Light Grey Box]	BLOCK-2 (125MW)
3	[Blue Hatched Box]	BLOCK-3 (125MW)
4	[Light Blue Box]	BLOCK-4 (125MW)
5	[Light Blue Box]	BLOCK-5 (125MW)
6	[Light Blue Box]	BLOCK-6 (125MW)
7	[Pink Line]	10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8	[Green Line]	5M WIDTH CABLE CORRIDOR (BLOCK-3)
9	[Yellow Line]	5M WIDTH CABLE CORRIDOR (BLOCK-4)
10	[Blue Line]	5M WIDTH CABLE CORRIDOR (BLOCK-5)
11	[Red Line]	5M WIDTH CABLE CORRIDOR (BLOCK-6)
12	[Red Line]	10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13	[Red Line]	SITE BOUNDARY
14	[Orange Line]	220KV TRANSMISSION LINE
15	[Blue Dashed Line]	APPROACH ROAD
16	[Green Dashed Line]	PERIPHERAL ROAD
17	[Red Dashed Line]	SITE OUTER ROAD-1
18	[Blue Dashed Line]	SITE OUTER ROAD-2
19	[Brown Dashed Line]	HIGHWAY
20	[Blue Line]	EXTENSION PLANT WITH BOUNDARY WALL
21	[Blue Line]	MAIN PLANT WITH BOUNDARY WALL
22	[Blue Circle]	STU SUB STATION
23	[Blue Circle]	POOLING SUB STATION
24	[Blue Circle]	CTUIL SWITCHING SUB STATION
25	[Red Circle]	SECURITY ROOM
26	[Red Circle]	SITE MAIN GATE

Source: APDCL

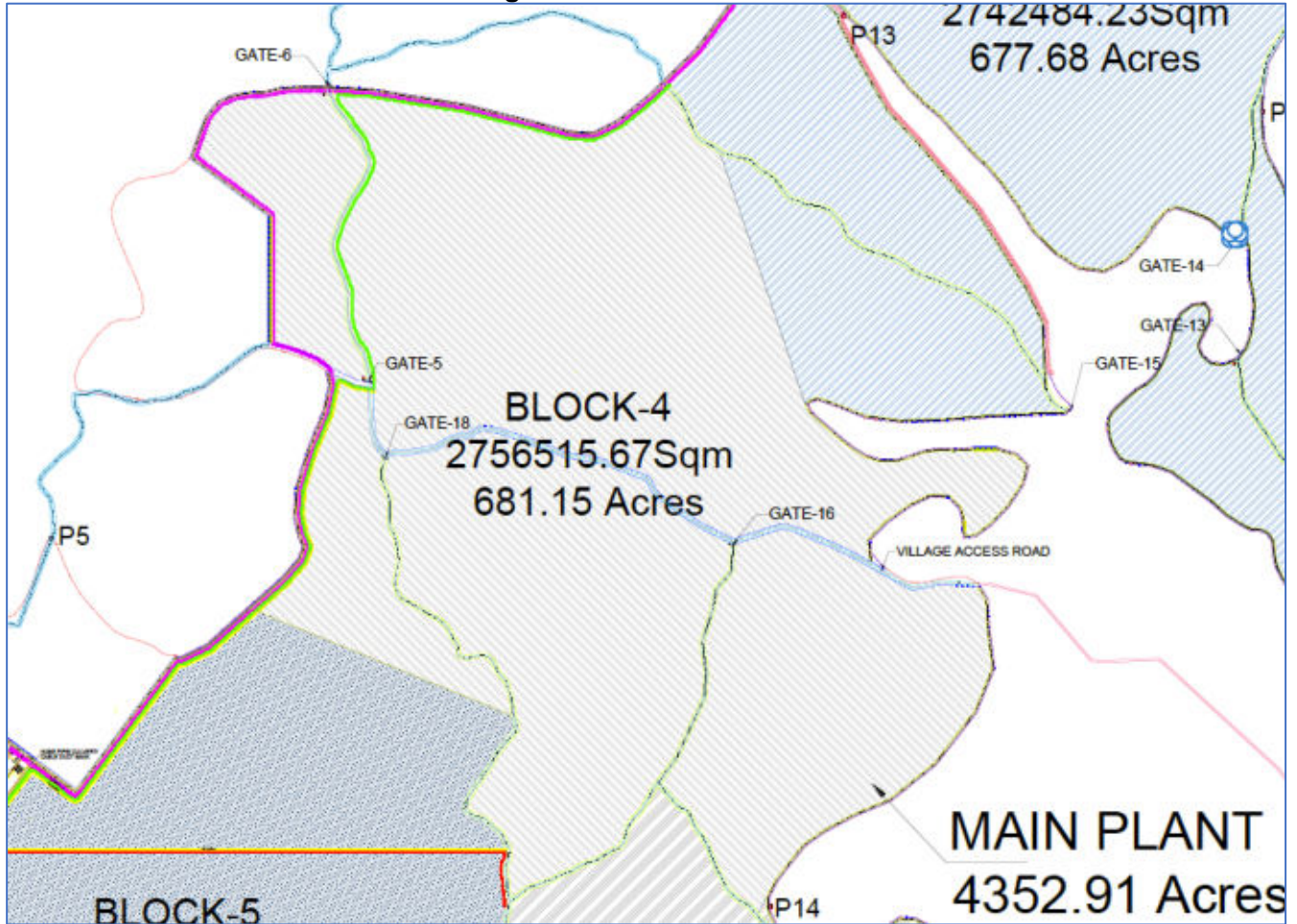
Figure 5: Block 3



Sl.No.	SYMBOL	DESCRIPTION
1		BLOCK-1 (125MW)
2		BLOCK-2 (125MW)
3		BLOCK-3 (125MW)
4		BLOCK-4 (125MW)
5		BLOCK-5 (125MW)
6		BLOCK-6 (125MW)
7		10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8		5M WIDTH CABLE CORRIDOR (BLOCK-3)
9		5M WIDTH CABLE CORRIDOR (BLOCK-4)
10		5M WIDTH CABLE CORRIDOR (BLOCK-5)
11		5M WIDTH CABLE CORRIDOR (BLOCK-6)
12		10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13		SITE BOUNDARY
14		220KV TRANSMISSION LINE
15		APPROACH ROAD
16		PERIPHERAL ROAD
17		SITE OUTER ROAD-1
18		SITE OUTER ROAD-2
19		HIGHWAY
20		EXTENSION PLANT WITH BOUNDARY WALL
21		MAIN PLANT WITH BOUNDARY WALL
22		STU SUB STATION
23		POOLING SUB STATION
24		CTUIL SWITCHING SUB STATION
25		SECURITY ROOM
26		SITE MAIN GATE

Source: APDCL

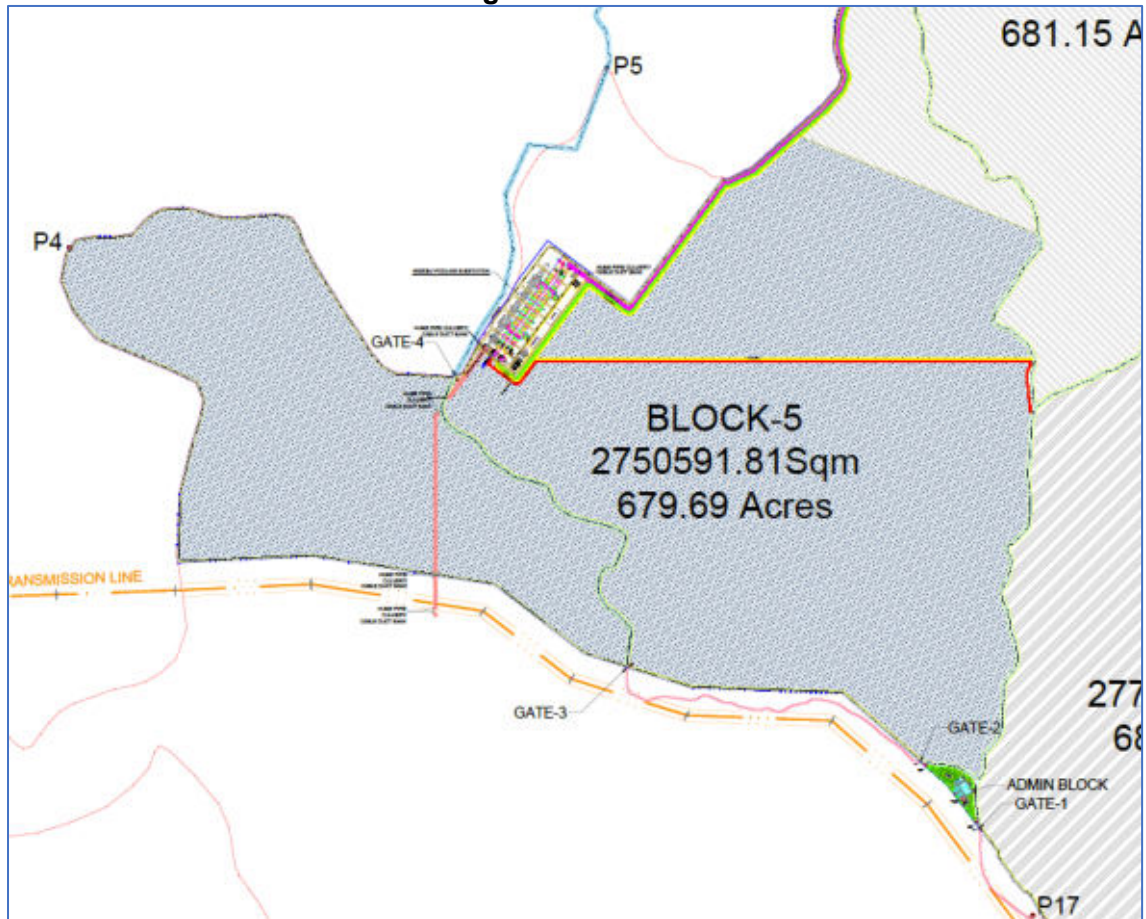
Figure 6: Block 4



Sl.No.	SYMBOL	DESCRIPTION
1	[Light Blue Box]	BLOCK-1 (125MW)
2	[Light Green Box]	BLOCK-2 (125MW)
3	[Light Yellow Box]	BLOCK-3 (125MW)
4	[Light Purple Box]	BLOCK-4 (125MW)
5	[Light Orange Box]	BLOCK-5 (125MW)
6	[Light Red Box]	BLOCK-6 (125MW)
7	[Pink Line]	10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8	[Light Green Line]	5M WIDTH CABLE CORRIDOR (BLOCK-3)
9	[Light Yellow Line]	5M WIDTH CABLE CORRIDOR (BLOCK-4)
10	[Light Purple Line]	5M WIDTH CABLE CORRIDOR (BLOCK-5)
11	[Light Orange Line]	5M WIDTH CABLE CORRIDOR (BLOCK-6)
12	[Light Red Line]	10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13	[Red Line]	SITE BOUNDARY
14	[Orange Line]	220KV TRANSMISSION LINE
15	[Blue Line]	APPROACH ROAD
16	[Green Line]	PERIPHERAL ROAD
17	[Red Line]	SITE OUTER ROAD-1
18	[Purple Line]	SITE OUTER ROAD-2
19	[Orange Line]	HIGHWAY
20	[Blue Line]	EXTENSION PLANT WITH BOUNDARY WALL
21	[Red Line]	MAIN PLANT WITH BOUNDARY WALL
22	[Blue Circle]	STU SS STU SUB STATION
23	[Red Circle]	PSS POOLING SUB STATION
24	[Purple Circle]	CTUIL SS CTUIL SWITCHING SUB STATION
25	[Red Square]	SECURITY ROOM
26	[Blue Circle]	SITE MAIN GATE

Source: APDCL

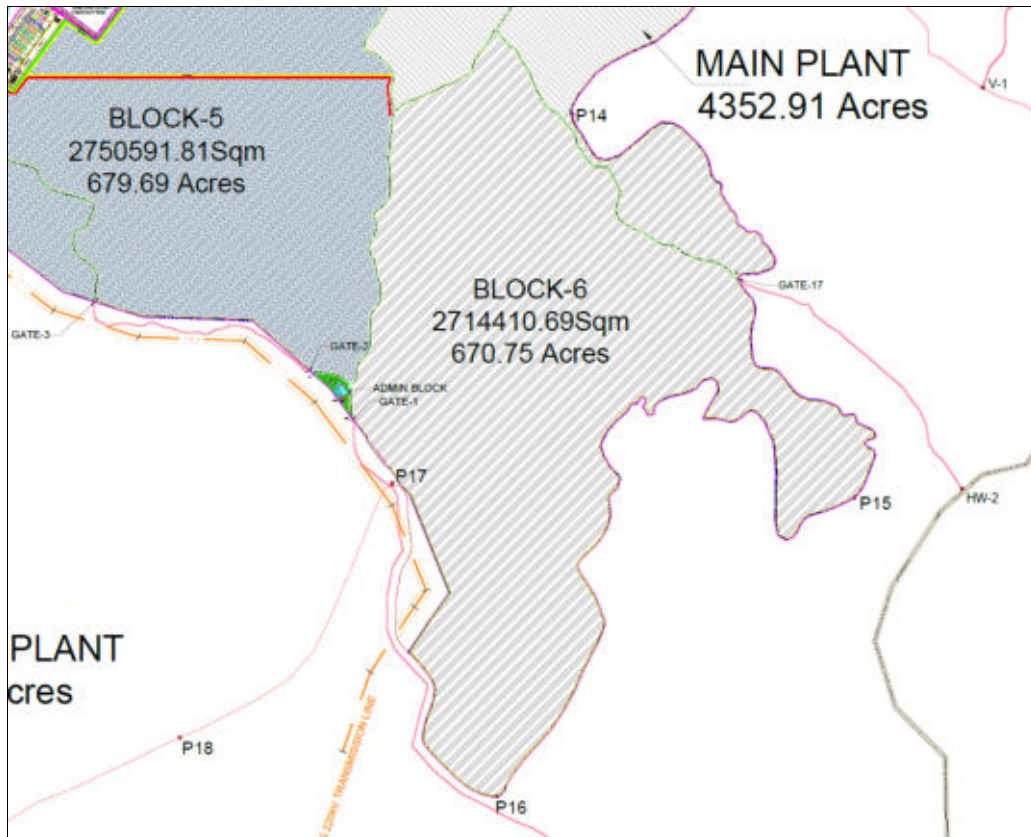
Figure 7: Block 5



Sl.No.	SYMBOL	DESCRIPTION
1	[Blue hatched box]	BLOCK-1 (125MW)
2	[Light blue hatched box]	BLOCK-2 (125MW)
3	[Dark blue hatched box]	BLOCK-3 (125MW)
4	[Light blue hatched box]	BLOCK-4 (125MW)
5	[Dark blue hatched box]	BLOCK-5 (125MW)
6	[Light blue hatched box]	BLOCK-6 (125MW)
7	[Pink hatched box]	10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8	[Light green hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-3)
9	[Light yellow hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-4)
10	[Light blue hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-5)
11	[Light red hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-6)
12	[Light red hatched box]	10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13	[Red line]	SITE BOUNDARY
14	[Orange dashed line]	220KV TRANSMISSION LINE
15	[Green dashed line]	APPROACH ROAD
16	[Yellow dashed line]	PERIPHERAL ROAD
17	[Red dashed line]	SITE OUTER ROAD-1
18	[Blue dashed line]	SITE OUTER ROAD-2
19	[Brown dashed line]	HIGHWAY
20	[Blue solid line]	EXTENSION PLANT WITH BOUNDARY WALL
21	[Blue solid line]	MAIN PLANT WITH BOUNDARY WALL
22	[Blue circle]	STU SUB STATION
23	[Blue circle]	POOLING SUB STATION
24	[Blue circle]	CTUIL SWITCHING SUB STATION
25	[Red shield]	SECURITY ROOM
26	[Red gate icon]	SITE MAIN GATE

Source: APDCL

Figure 8: Block 6



Sl.No.	SYMBOL	DESCRIPTION
1	[Blue hatched box]	BLOCK-1 (125MW)
2	[Light blue hatched box]	BLOCK-2 (125MW)
3	[Blue hatched box]	BLOCK-3 (125MW)
4	[Grey hatched box]	BLOCK-4 (125MW)
5	[Dark blue hatched box]	BLOCK-5 (125MW)
6	[Diagonal hatched box]	BLOCK-6 (125MW)
7	[Pink hatched box]	10M WIDTH CABLE CORRIDOR (BLOCK-1 & 2)
8	[Light green hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-3)
9	[Yellow hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-4)
10	[Blue hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-5)
11	[Red hatched box]	5M WIDTH CABLE CORRIDOR (BLOCK-6)
12	[Pink hatched box]	10M WIDTH CABLE CORRIDOR (EXTENSION PLANT)
13	[Red line]	SITE BOUNDARY
14	[Orange dashed line]	220kV TRANSMISSION LINE
15	[Green dashed line]	APPROACH ROAD
16	[Yellow dashed line]	PERIPHERAL ROAD
17	[Red dashed line]	SITE OUTER ROAD-1
18	[Blue dashed line]	SITE OUTER ROAD-2
19	[Grey dashed line]	HIGHWAY
20	[Blue solid line]	EXTENSION PLANT WITH BOUNDARY WALL
21	[Blue solid line]	MAIN PLANT WITH BOUNDARY WALL
22	[Blue circle]	STU SUB STATION
23	[Blue circle]	POOLING SUB STATION
24	[Blue circle]	CTUIL SWITCHING SUB STATION
25	[Shield icon]	SECURITY ROOM
26	[Gate icon]	SITE MAIN GATE

Source: APDCL

Note: the site boundary will run along the edge of the RoW of the existing TL for 540m so it falls outside the site and maintenance issues will not arise.

### 3.4.3 SPP Design

183. In general terms, solar PV technology converts the sun's energy into electricity using a series of solar panels, inverters, and transformers to connect to the electricity grid. The performance of a PV module will decrease over time due to degradation. Degradation rate depends on the environmental conditions in the local area and the technology of the module. Modules are either mounted on fixed-angle frames or on sun-tracking frames. Fixed frames are simpler to install, cheaper and require less maintenance. However, tracking systems can increase yield by up to 20%. Tracking, particularly for areas with a high direct/diffuse irradiation ratio, also enables a smoother power output.
184. The energy generated by the PV modules is then converted from direct current (DC) into alternating current (AC) electricity, conforming to the local grid requirements, by solar inverters. Inverters are arranged either in string or central configurations. String inverters enable individual string Maximum Power Point Tracking (MPPT) and require less specialized maintenance skills. String configurations also offer more design flexibility. Central configuration inverters are more suitable for multi-MW plants.
185. PV modules and inverters are all subject to certification, predominantly by the International Electrotechnical Commission (IEC). The performance ratio (PR) of a well-designed PV power plant will typically be in the region of 77% to 86% (with an annual average PR of 82%), degrading over the lifetime of the plant. In general, good quality PV modules may be expected to have a useful life of 25 to 30 years. The main components of the Assam SPP are discussed below.
186. **Solar PV Modules:** solar PV cells utilize the photoelectric effect to directly convert solar irradiation into electricity through a clean and noiseless process. The resulting electricity is in the form of direct current (DC). These cells are interconnected in series and parallel, enclosed within a protective casing to create a PV module. Various types of PV modules are available, categorized based on the PV cell technology they employ. Some common examples include monocrystalline and polycrystalline silicon, as well as cadmium telluride (CdTe) thin film technology. In India, Monofacial PERC Crystalline and Bi-facial Crystalline technologies are at the forefront for PV modules. For the proposed site, APDCL considered both Monofacial PERC Crystalline and Bi-facial PERC Crystalline technologies for a techno-economic analysis. Bi-facial modules demonstrate superior efficiency and a greater capacity to perform well under higher operating temperatures compared to Monofacial Modules. The ground albedo value plays a pivotal role in the decision-making process regarding the use of Bi-facial modules. Given the site's frequent rainfall, the soil tends to remain dark for most days, making Bi-facial modules an unsuitable choice. Conversely, Monofacial Monocrystalline PERC Modules are more cost-effective than their Bi-facial counterparts. Therefore, Monofacial Monocrystalline PERC Modules have been recommended by the DPR for the project.
187. **Mounting Structures / Racks:** these structures are used to install the PV modules at the desired angle. The PV modules installed on the mounting structure are referred to as arrays. The structural supports for the PV modules will commonly be made from anodized aluminum or hot-dip galvanized steel, along with bolts and screws. In cases where piles are required, they will be constructed using either steel or concrete. If steel is chosen, the piles will be manufactured to endure higher expected levels of corrosion by utilizing hot-dip galvanized steel. A good quality mounting system may be expected to:
- Have undergone thorough testing to ensure that their designs not only meet but also surpass the load conditions experienced at the site.

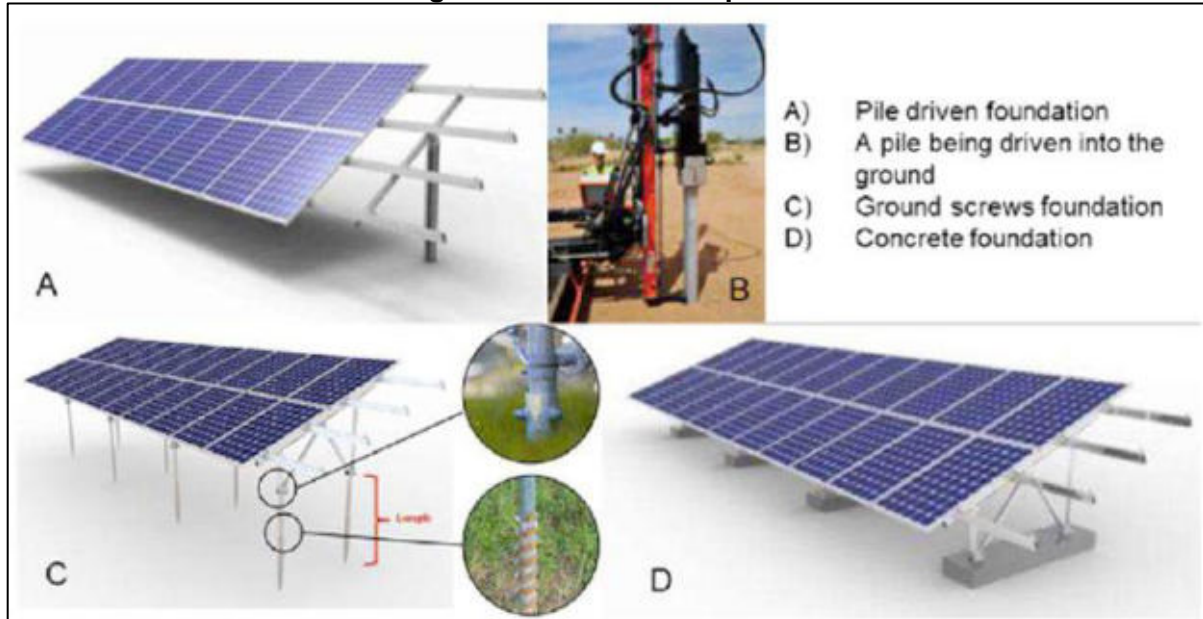
- Provide a precise tilt angle with a minimal margin of uncertainty
  - Field adjustments are possible, which can reduce installation time and account for any inaccuracies in the placement of foundations.
  - Installation process is designed to minimize the need for specialized tools and expertise.
  - Installation strictly adheres to the guidelines outlined in the module manufacturer's installation manual.
  - To accommodate thermal expansion, the structures incorporate expansion joints in long sections, preventing modules from experiencing thermal stresses.
188. The mounting system plays a vital role in maximizing energy capture and aligning the modules toward the sun. This is essential because the highest energy yields are achieved when the modules are positioned to capture the maximum available direct solar radiation.
189. The Detailed Project Report (DPR)<sup>20</sup> has recommended the most appropriate module mounting structure for this project is a Fixed Tilt Module Mounting Structure. Due to the uneven terrain of the site, the length of the tracker tables needs to be reduced from their standard size. This adjustment results in an increase in the total number of tracker units required. While this increase in quantity can enhance energy production, it also leads to higher maintenance costs. Therefore, despite the potential for improved yield with Single Axis Trackers, the additional cost incurred does not justify their use at this site.
190. **Foundations:** foundation design can be categorized into three main groups: galvanized driven piles, ground screw piles, or concrete foundations. These designs are illustrated in Figure 9. Piles are typically installed to the depth of 2.5 m to 3 m below ground, whereas concrete foundation slabs are placed directly onto the ground. The choice of foundation is determined based on the substrate characteristics of a site (whether the ground is too soft, too rocky or accessible by the drilling machines) and the expected wind loads in the area. The final choice of mounting structure and foundations may depend on the outcome of further geotechnical surveys by the contractor and may comprise a combination of the foundation types.

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<sup>20</sup> Fichtner, 2023



**Figure 9: Foundation Options**



Source: ILF Consulting Engineers, 2019

191. **Inverters:** the primary function of a solar inverter is to convert the direct current (DC) produced by the PV modules into an alternating current (AC) for supply to the grid. An inverter may be located in a decentralized fashion to service small arrays of PV modules (string inverter) or in a centralized fashion to service large arrays of PV modules (central inverter); nevertheless, the functionality of the inverters is the same. A central inverter has a footprint of approximately 1-2 m by 2-3 m and is typically up to 3 m tall and has a noise emission rating in the order of 68 decibels (dB(A)) (SMA Solar Technology AG). String inverters are smaller, approximately 1 m by 0.6 m and up to 1 m tall (Sungrow, 2019), and are generally quieter than central inverters. According to the DPR the SPP will likely use string inverters. It is estimated that 2,076 string inverters will be required for the SPP.
192. The technical lifespan of inverters is expected to be less than 25 years. It is assumed that, in the future, inverters may have a longer technical lifespan than currently, but even so, it is anticipated that 100% of the inverters will require replacement between the 12th and 25th years of operation.
193. **Cable Trenches:** cable trenches will be constructed across all blocks connecting to the pooling substation. Typical trenches are 700mm deep and 600mm wide. No overhead lines will be constructed within the SPP.
194. **Lightning Protection System:** the SPP shall be provided with Lightning Protection System (LPS) to protect solar PV fields from lightning and the lightning protection system shall cover solar PV array (DC) side and AC side (up to interconnection point).
195. **Roads:** NH-129 and NH-29 will be the main off-site access road to the SPP boundary. Construction/strengthening of off-site access along village roads from the national/state highway to the main gates, internal approach roads leading to SPP blocks and the Pooling Substation, internal roads within solar blocks, and the peripheral patrol road of the solar park is to be undertaken. The off-site access roads will be surfaced to avoid dust. The peripheral patrol road will be designated as a single lane. The internal approach roads are to be configured with double lanes. These approach roads shall be 7.5 m wide with 2.0 m wide shoulder on both sides. The design (including route) and construction of

internal roads within individual solar blocks will be the responsibility of the respective contractors.

196. Village Roads (External or Off-Site Roads): Strengthening of village roads will be the responsibility of block 4, 5 and SPPI contractors as follows:

**Table 21: Strengthening of Village Roads**

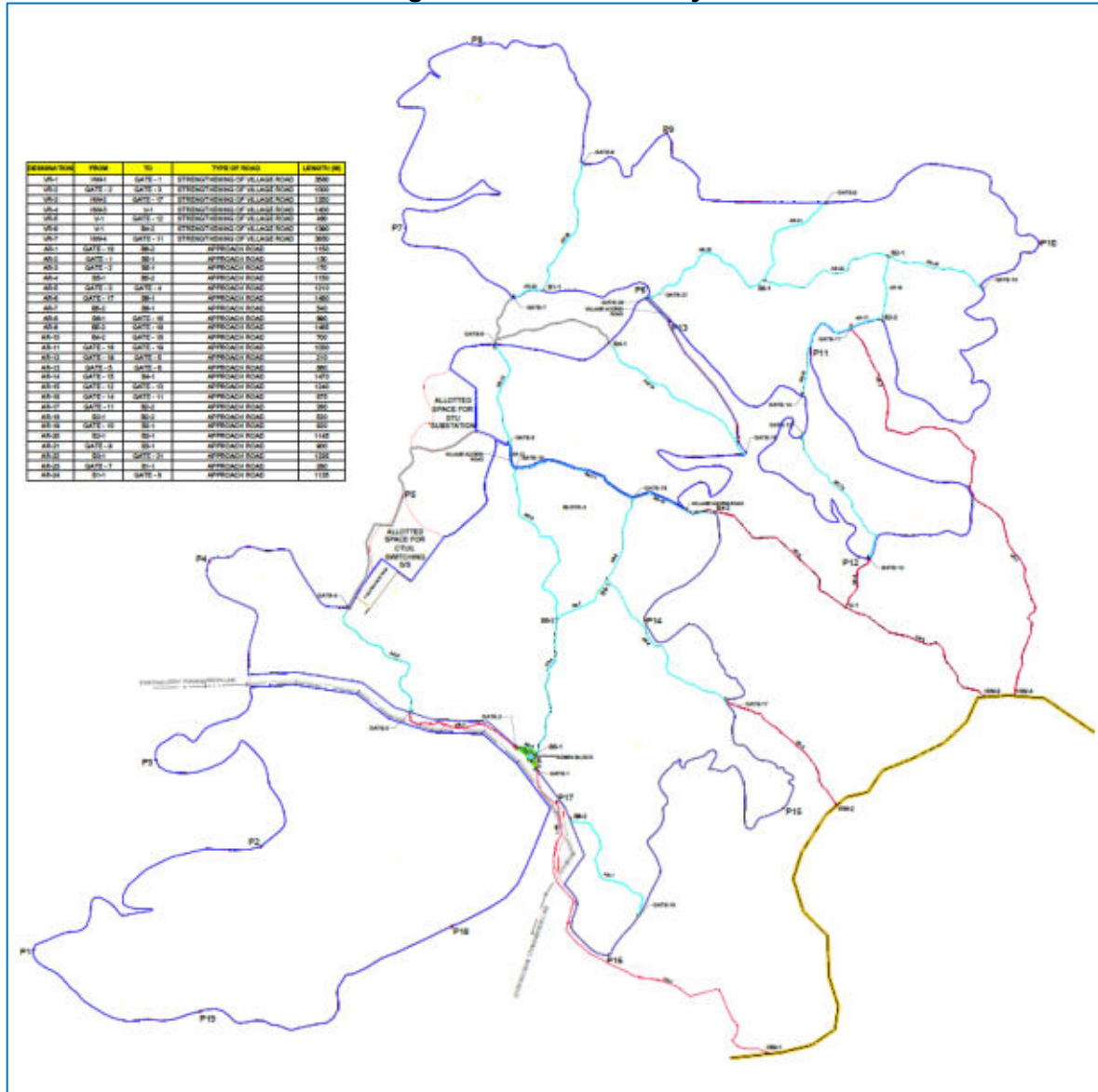
#	Designation	From	to	Length (m)	Responsibility (Contractor)
1	VR-1	HW-1	Gate 1	3560	5
2	VR-2	Gate 2	Gate 3	1000	5
3	VR-3	HW-2	Gate 17	1250	SPPI
4	VR-4	HW-3	V-1	1400	4
5	VR-5	V-1	Gate 12	460	SPPI
6	VR-6	V-1	B4-2	1390	4
7	VR-7	HW-4	Gate 11	3850	SPPI

197. Internal Roads: Internal approach roads will be the responsibility of block 4, 5 and SPPI contractors as follows:

**Table 22: Construction of Internal Approach Roads**

#	Designation	From	to	Length (m)	Block
1	AR-1	Gate 18	B6-2	1150	SPPI
2	AR-2	Gate 1	B5-1	130	5
3	AR-3	Gate 2	B5-1	170	5
4	AR-4	B5-1	B5-2	1150	5
5	AR-5	Gate 3	Gate 4	1210	5
6	AR-6	Gate 17	B6-1	1480	SPPI
7	AR-7	B5-2	B6-1	540	4
8	AR-8	B6-1	Gate 16	690	4
9	AR-9	B5-2	Gate 19	1485	4
10	AR-10	B4-2	Gate 16	700	4
11	AR-11	Gate 16	Gate 19	1030	4
12	AR-12	Gate 19	Gate 5	210	4
13	AR-13	Gate 5	Gate 6	860	4
14	AR-14	Gate 15	B4-1	1470	4
15	AR-15	Gate 12	Gate 13	1240	SPPI
16	AR-16	Gate 14	Gate 11	875	SPPI
17	AR-17	Gate 11	B2-2	260	SPPI
18	AR-18	B2-1	N2-2	520	SPPI
19	AR-19	Gate 10	B2-1	820	SPPI
20	AR-20	B2-1	B3-1	1145	SPPI
21	AR-21	Gate 9	B3-1	900	SPPI
22	AR-22	B3-1	Gate 21	1235	SPPI
23	AR-23	Gate 7	B1-1	260	SPPI
24	AR-24	B1-1	Gate 8	1135	SPPI

Figure 10: SPP Road Layout



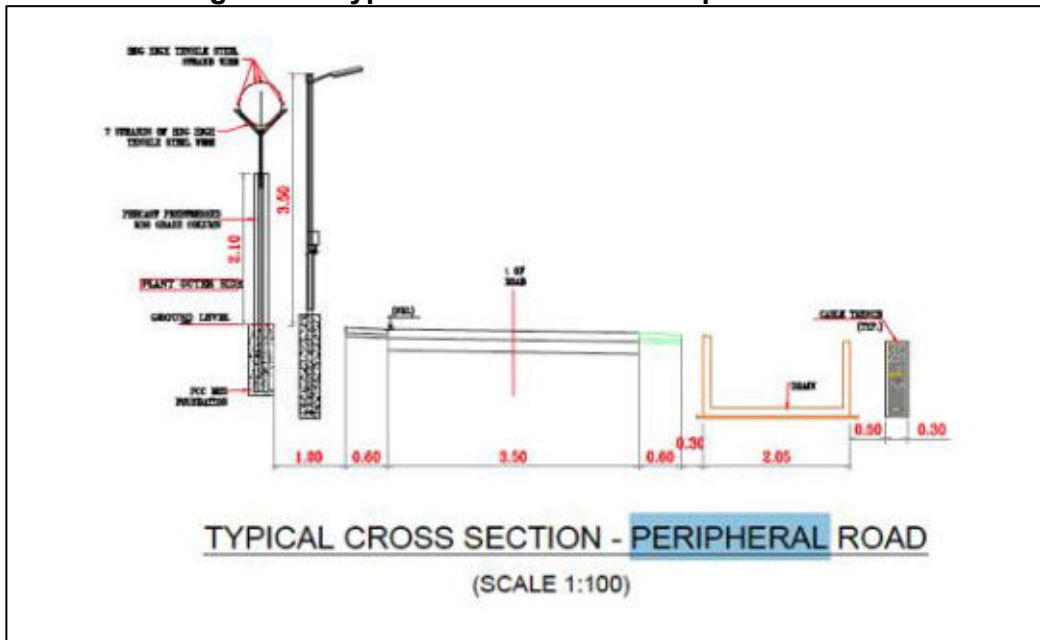
S NO	SYMBOL	DESCRIPTION
1		220kV TRANSMISSION LINE
2		APPROACH ROAD
3		EXISTING VILLAGE ROAD TO BE STRENGTHENED
4		VILLAGE ROAD
5		HIGHWAY
6		EXTENSION PLANT COMPOUND WALL
7		MAIN PLANT COMPOUND WALL
8		POOLING SUB STATION
9		SECURITY ROOM
10		SITE MAIN GATE
11		SCOPE OF BLOCK-5 EPC CONTRACTOR APPROACH ROAD (GATE-03 TO GATE-04 & GATE-01, GATE-02 TO B5-2)
12		SCOPE OF BLOCK-5 EPC CONTRACTOR PLANT CONNECTIVITY ROAD (SITE TO HIGHWAY) B5-1 TO GATE-1 & GATE-2 TO GATE-3

Source: APDCL

Notes: The boundary wall adjacent to the existing TL is to run immediately adjacent to the edge of the existing RoW. The extension plant shown is a future proposal and not part of the project, the boundary wall for this land is not included in the scope of the SIPP contractor.

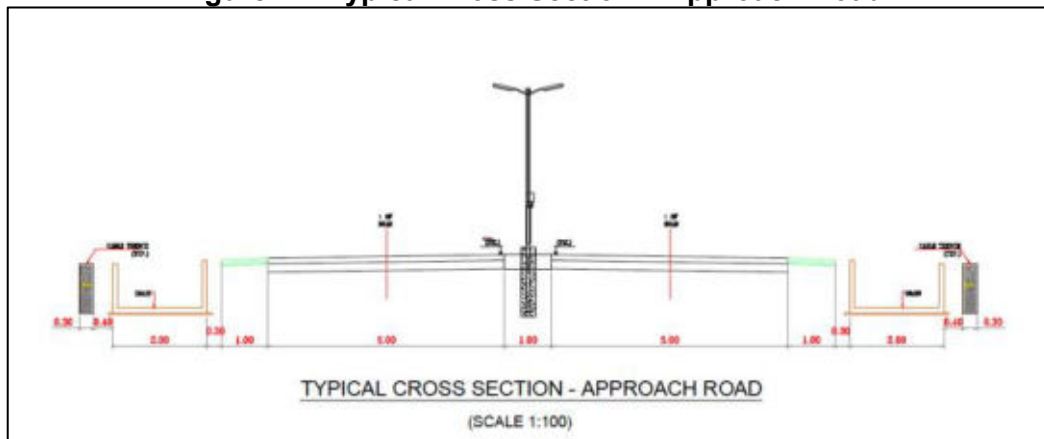
198. **Peripheral Roads:** the entire SPP boundary shall be accessed by the peripheral road, and it shall be illuminated by peripheral lighting system. The minimum average illuminance level of 5 lux shall be maintained all over the surface of peripheral road. The pole height shall be 3m and the PV array shall be free from shadow of peripheral lighting masts.

**Figure 11: Typical Cross Section Peripheral Road**



Source: DPR, 2023

**Figure 12: Typical Cross Section – Approach Road**



Source: DPR, 2023

**Site Drainage and Water Harvesting:** the SPP encompasses undulating terrain characterized by a series of small hills and valleys. Consequently, it is not feasible to establish an integrated gravity flow-based stormwater network. Instead, it is intended to create rainwater harvesting ponds in the low-lying areas, and the surrounding area's stormwater will naturally flow into these ponds. solar block will be equipped with its internal stormwater network, and these networks will discharge into their respective rainwater harvesting ponds. Subsequently, water from these ponds can be utilized for module cleaning following appropriate treatment. A comprehensive design for the site drainage and water harvesting system will be developed in the detailed design phase. The design

of the drainage system will account for the highest anticipated rainfall intensity, which is set at 100mm per hour.

199. **CCTV and Lighting:** to ensure comprehensive surveillance during construction and operation, closed-circuit television (CCTV) cameras will be strategically installed, covering the entire SPP site. The plant illumination system will consist of the following components:

- Street Lighting
- Yard Lighting
- Indoor Lighting
- Peripheral Lighting

200. A comprehensive design for the illumination system will be developed in the detailed design phase.

201. **Compound Wall, Block Fencing, Gates and Security Cabin:** an external compound wall of 4.0 m height above natural ground level shall be constructed all along the entire length of the solar power plant boundary. Over the 4.0 m high boundary wall, 0.6m high, 8 strands of anti-climbing barbed wire fencing shall be provided. The plinths and superstructure shall be of RCC with infill of brick / stone masonry / hollow block masonry.

202. Internal block boundary fencing shall be provided to demarcate the block boundaries. Fencing shall comprise of 2.4 m high galvanized chain link fence. Gates shall be provided for access to the blocks from all approach roads. Prefabricated security room (10 sqm) shall be provided near the entry gates with toilet and water facility for the security guards.

203. **Maintenance Building:** maintenance building for each block shall consist of the following:

- Supervisor room.
- Air-conditioned Office Room.
- Any other room as per system requirements.
- Storeroom
- Toilets (male and female).

204. Room sizing and layout shall be based on system requirements and for easy passage during O&M. The building may be RCC framed structure with brick / stone masonry / hollow block masonry walls or pre-fabricated type. Parking shed to accommodate at least 2 cars and 10 two wheelers shall be provided near the building. The parking shed shall be made of structural steel with permanently color coated roof sheets.

205. **Fire Protection:** fire protection systems shall include portable fire extinguishers and wheel / trolley mounted fire extinguishers. Adequate number of portable fire extinguishers of dry chemical powder and carbon dioxide type shall be provided at suitable locations in buildings. Wheel / trolley mounted mechanical foam type fire extinguishers, are proposed to be provided for protection of inverter transformers.

206. **Auxiliary Transformers:** auxiliary transformers shall be installed to power up the control circuit and plant auxiliaries. The transformer shall be installed for 1 x 100% of the total load requirements of the block. Transformers will be dry type power transformer. The transformers shall be free from annoying hum and vibration when it is in operation, even at 110% rated voltage.
207. **Community Access:** the original site layout did not provide for community access across the site. Based on the findings of the IEE the original designs have been updated to include two access routes across the site. The routes, which allow both pedestrian and vehicle access, are shown in Figure 3, Figure 4, Figure 5, Figure 6, and Figure 10. Further, community access across the blocks will need to be determined during the detailed design in response to community concerns raised during meaningful consultations for the IEE study.
208. **Module Cleaning System:** ground water is the source of water for the proposed SPP. The required water shall be drawn from bore wells and from rainwater harvesting ponds. This water, after treatment, shall be used for cleaning the solar PV modules and for other service requirements.
209. The solar PV modules shall be cleaned manually. Module cleaning system shall be designed considering minimum quantity of water as 2.5 liters per module. General cleaning cycle shall be every two weeks. Module cleaning system shall be with the following facilities.
- Bore wells and water extraction system from rainwater harvesting ponds
  - Water treatment system
  - RCC storage sumps and pumps
  - Main and distribution pipelines.
210. Any minimal water discharged during the cleaning process is naturally absorbed into the ground. The discharged water from this process will not contain any hazardous chemicals or materials.

#### 3.4.4 SPP Construction

##### Supply Chain

211. Considering relevant technical and commercial considerations, the SPP will seek to purchase goods and services from within India. Contractors will use locally sourced materials as far as practical to reduce transportation, but all raw materials will be sourced only from existing licensed sources e.g., aggregates from quarries which hold Prior Environmental Clearance and valid crusher operating documents from SPCB. Materials will not be sourced from quarries in the beds of rivers or other permanent watercourses, even if those quarries are licensed. Records to be kept of all the materials used and source with copies of licenses etc.
212. Selection of an environmentally safe and sound solar photovoltaic panel will be from a manufacturer who offers a facility for return of end-of-life equipment with take back guarantee provided. Solar panels installed will not contain hazardous materials e.g., cadmium, lead, or selenium. Equipment purchased for use on the SPP will be accompanied by letter from the manufacturer stating its composition and the leaching

potential of any heavy metal content to determine if it is acceptable and how it is to be disposed on at end-of-life.

### **Construction Activities**

213. Construction of the solar power plant will be semi-mechanized. This means a combination of both machine and labour will be utilized. The use of machines will mainly be for earthworks and excavation, and the installation of foundations. Following topographic and other engineering studies detailed designs will be approved by APDCL, following this pre-construction preparations will take place followed by construction. The contractor shall set up temporary construction facilities including material storage areas and labor camps for workers as laid out in the EMP. Construction process will generally follow these steps:

- Site establishment, setting up of construction site offices, storage areas etc.
- Importation of materials and equipment
- Clearance of any trees and vegetation
- Establishment of on-site access roads and drainage system
- Earthworks to create level construction platform, including terracing if required
- Installation of permanent buildings and other related facilities
- Installation of foundations using pre-cast concrete blocks, earth screw anchors or piles (whichever is most suitable)
- Installation of solar photovoltaic modules
- Excavation of cable trenches
- Installation of electrical equipment/connection of internal electrical connections
- External connection for power evacuation (CTU)
- Testing and commissioning
- Landscaping works and demobilization of construction site, waste disposal, etc.

### **Construction Vehicles**

214. Construction of the SPP will require various types of machinery and equipment. Exact plant types and numbers will be determined during the detailed design stage. However, for the purposes of this IEE study, an indicative equipment list is as follows:

- Backhoe
- Pick-up
- Excavator
- Ramming machine

- Cable pulling machine
- Telehandler
- Dumper
- Water tanker
- Small pile driver

215. There may be the requirement to transport abnormal loads to the site e.g., transformers. The delivery of any abnormal loads will be infrequent and timed to avoid road network peaks. The transport of abnormal loads will be co-ordinated with the relevant local police authorities to mitigate their impact on other road users. This will be included in the contractors Traffic Management Plan for the proposed activities under the solar PV component.

### **Power Requirement**

216. Power will be supplied through the existing grid network. The contractors will coordinate with ADPCL to connect construction camp sites and any ancillary facilities (e.g. concrete batching plant, hot mix) to the grid. The contractor may also choose to use temporary diesel generator set during construction as backup power.

### **3.4.5 Operation and Maintenance**

217. Operation and maintenance of the facility will include:

- Replacement of faulty PV modules
- Repair of inverters and other ancillary equipment
- Periodic cleaning of PV modules depending on soiling and sand/silt accumulation
- General upkeep of the territory within the solar PV plant site

218. A preventive maintenance program will be established for maintenance of the inverters; mounting structures; cables, etc.

### **Workforce**

219. The operation of each block requires a small team of people. The number of operational workers will depend on the final operation and maintenance concept but is expected to be up to 25 people per block required for continuous presence onsite. Additional specialists will be required to attend the facility to conduct repairs and maintenance of the equipment.

### **Waste Management**

220. Solar PV electricity generation produce little waste. Minimal waste will be generated during SPP operation, associated with the main control room / amenity building activities, maintenance, and repair work.



### **3.4.6 Decommissioning**

221. A typical design life of a solar PV facility is 20-30 years. The SPP components will be continuously maintained throughout the lifetime of the SPP which is taken as 25 years. The condition of equipment will be reviewed at the end of the design life to determine whether it remains in a viable condition to continue operation after that time. The facilities may be upgraded or renewed based on the cost-benefit analysis. The SPP will be dismantled once it is no longer economical, and the land plot reinstated to its current state (albeit not reprofiled).
222. During decommissioning, all above ground infrastructure will be removed. It is anticipated that the redundant solar PV panels will be returned to the supplier and either recycled or sold for reuse, depending on market conditions at the time. Below ground infrastructure such as buried cables will be removed to a depth of at least 0.5 m and backfilled with topsoil. The site will be re-seeded with native vegetation consistent with surrounding areas to avoid invasive species colonizing any bare ground. The success of bio-restoration will be monitored for two dry seasons following decommissioning, and remedial actions will be taken at locations where rates of restoration are below the expected levels. The decommissioning will abide by the relevant legislation and regulations that are applicable at the time and decommissioning will be planned at least six months in advance.

### **3.5 Pooling Substation Sub-component 1c**

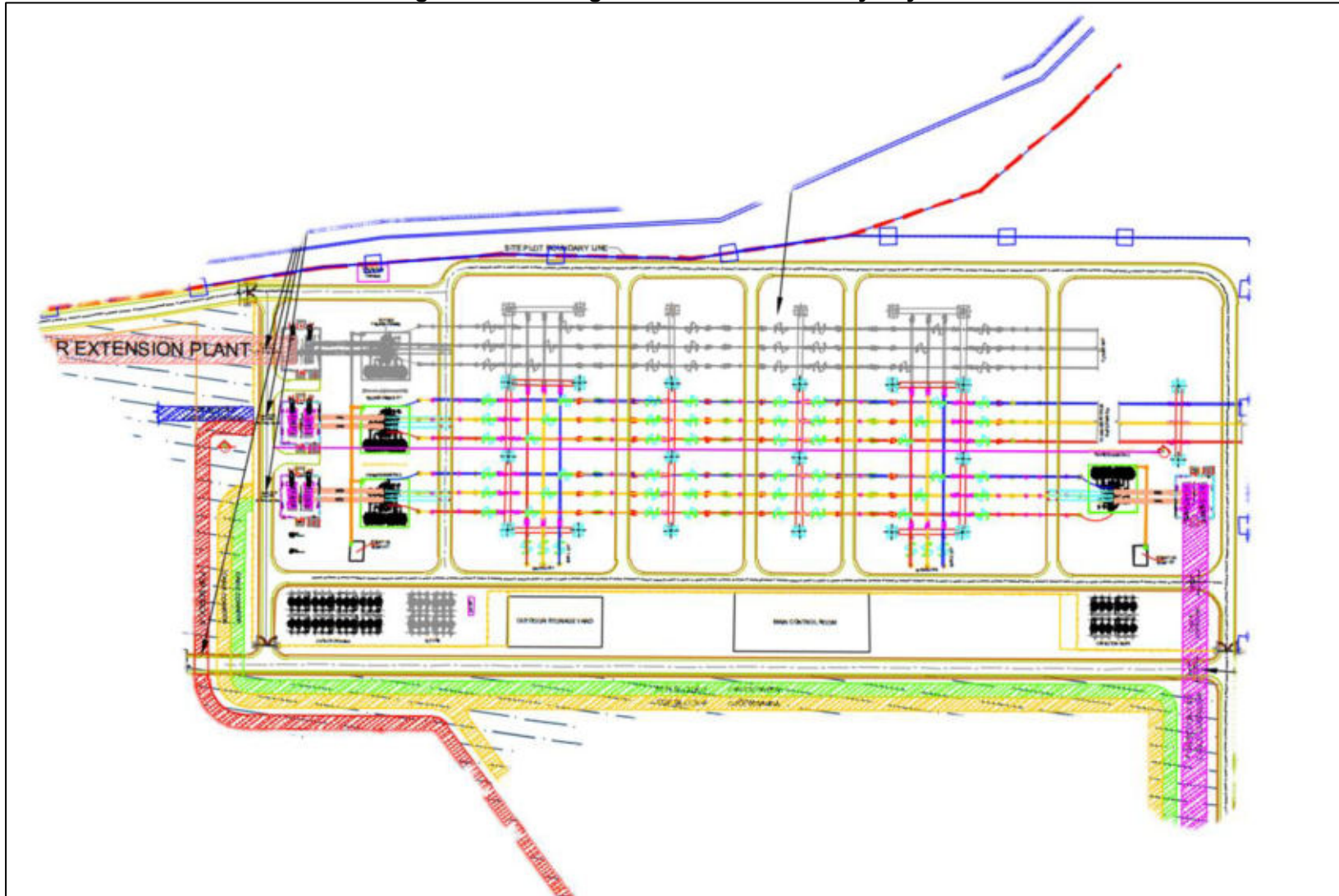
223. A pooling substation will be constructed to serve the SPP. Cable ducts from all blocks will feed to the substation into three power transformers, bus bays and then to the neighboring CTU switching substation and its associated loop-in-loop out connections to the grid. The pooling substation is located inside the western boundary of the site and will be placed adjacent to the CTU substation eliminating the requirement for transmission line towers between both substations.
224. Civil and structural works in the pooling substation include control building and foundations, bus bays and foundations, transformer foundations, transformer firewalls, transformer oil pit, cable trenches, fencing around electrical equipment etc. The control building shall be a single floor building comprising of control room, switchgear room, battery room, toilets, etc.

#### **Footprint**

225. The physical footprint of the substation is shown in

226. Figure **13**. A total of 8.9 hectares of land will be required. Space has been left for a bay extension in anticipation of the extension plant being built in future; however, the extension plant bay will not yet be installed.

Figure 13: Pooling Substation Preliminary Layout



Source: APDCL

## Design

227. Design of the HV substations (including GSS to be installed by CTU) shall follow the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022. Relevant environmental considerations from the regulations are as follows:

- a) The substation shall be constructed above the highest flood level and, wherever required, flood protection walls shall also be provided.
- b) The substation shall be designed for seismic requirement of the site as per relevant IS.
- c) Gas insulated substation (GIS) shall be constructed in seismic prone areas, coastal areas, high altitude areas, very heavily polluted areas and for locations where space is major constraint.
- d) The separation walls or fire barrier walls shall be provided between the transformers / reactors or between transformer / reactor and nearby building as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations.
- e) Soak Pit and Oil collecting pit:
  - 1) An oil soak pit shall be designed and provided below each oil filled transformer / reactor to accommodate at least 150% of total quantity of oil contained in the transformer / reactor with minimum 300 mm thick layer of gravels / pebbles of approximately 40 mm size (spread over a steel iron grating / trans rack) providing free space below the grating.
  - 2) Alternatively, an oil soak pit shall be provided below each transformer or reactor, to accommodate one third of total quantity of oil contained in the transformer / reactor with minimum 300 mm thick layer of gravels/ pebbles of approximately 40 mm size (spread over a steel iron grating/ trans rack) providing free space below the grating provided a common remote oil collecting pit of capacity at least equal to oil quantity in the largest size transformer or reactor is provided for a group of transformers or reactors and bottom of the soak pit below the transformer or reactor shall be connected to the common remote oil collecting pit with a drain pipe of minimum 150 mm diameter with a slope not less than 1/96 for fast draining of oil or water through gravity from soak pit to the common remote oil collecting pit.
  - 3) Every soak pit below a transformer or reactor shall be designed to contain oil dropping from any part of the transformer or reactor.
  - 4) The common remote oil collecting pit and soak pit (when remote oil collecting pit is not provided) shall be provided with automatic pumping facility, to always keep the pit empty and available for an emergency.
  - 5) The disposal of transformer oil shall be carried out in an environmentally friendly manner.
- f) Fire Detection, Alarm and Protection System for Substation and Switchyard:

- 1) A comprehensive fire detection, alarm, as well as fire protection system shall be installed in conformity with relevant IS. In addition, all buildings shall conform to National Building Code.
  - 2) All buildings inside the substation or switchyard such as control room building, GIS hall, relay room etc., shall be provided with fire detection and alarm system based on smoke detectors and/or heat detectors. The fire alarm system shall conform to relevant IS or IEC standards.
  - 3) Water hydrant system shall be provided for the following areas in the substations and switchyards:
    - a. Reliable Standby Power Supply system area
    - b. Auxiliary power supply system area
    - c. Stores
    - d. Firefighting pump house
    - e. Transformers or reactors
  - 4) All transformers of 10MVA or reactors of 10 MVAR and above rating shall be provided with High Velocity Water Spray System as per IS 15325 or High-Pressure Water Mist System as per NFPA 750 or compressed air-foam system as per NFPA.
- g) Lighting:
- 1) Adequate indoor and outdoor lighting including street lighting shall be provided for the substation and switchyard.
  - 2) Adequate normal and emergency AC and DC lighting shall also be provided in the control room and other identified locations of the substation or switchyard.
  - 3) Energy conservation measures and energy efficient lighting devices shall be adopted, while designing the lighting system.
  - 4) Average illumination levels shall be maintained as per relevant standard.
- h) Oil tanks of adequate capacities for storage of pure and impure transformer oil shall be provided.
- i) SF<sub>6</sub> filling, evacuation, filtering, drying and recycling plant with adequate storage capacity shall be provided at a substation or switchyard or for a cluster of substations and switchyards along with trolley for filling or evacuation of SF<sub>6</sub> circuit breaker or gas insulated switchgear (in case of GIS installation) and to monitor the purity, moisture content, decomposition product etc. of SF<sub>6</sub> gas.
228. For new bore wells for operational water supply at substations, (if required) approvals shall be obtained from authorities before they are installed. Treatment system will be provided to ensure all drinking water meets Government of India drinking water standards.

## Construction and Operation

229. Construction of the substation requires around 20-30 (5-10 skilled and remaining unskilled) workers; it will take approximately 9-12 months for the substation to be constructed.

230. When the design of the substation is finalized and approved, the construction activities commence in a similar order to the SPP. The contractor shall set up temporary construction facilities including material storage areas and labor camps for workers as laid out in the EMP. The boundary wall of the substation property is fenced to avoid unauthorized entry into the site. They will then start with clearing of vegetation and then installation. The foundation for the substation structures, transformer pads, cable trenches, rails, and other equipment will be constructed in accordance with the approved detailed design. Once all civil works are completed, the installation, erection, testing and commissioning of equipment follows in accordance with the prescribed specifications. No piling or blasting is required.

231. During the operation and maintenance phase, regular activities that will be implemented include routine monitoring and inspection by APDCL staff to check the condition and integrity of transformers and switchgear. Maintenance activities will include replacement of parts and equipment repairs.

### 3.6 SPP Infrastructure Sub-component 1e

232. This sub-component scope includes design, construction, and commissioning to comprise several activities.

- Strengthening of existing village roads for remaining blocks in the SPP (4.5km approximately, it excludes village roads associated with Blocks 4 and 5 which are included in the scope of Package 1)
- Remaining approach roads with drainage from public highway to remaining blocks in the SPP (9.6 km approximately, it excludes approach roads to Blocks 4 and 5 which are included in the scope of Package 1)
- Construction of internal roads with drainage within the common (administrative) area for use during O&M of the SPP (routing determined by contractor).
- SPP compound wall (54.5 km approximately) encompassing SPP project and associated facilities with gates and watch towers.
- SPP boundary shall be accessed by the peripheral road, and it shall be illuminated by peripheral lighting system.
- Administration (common) building and parking area with canteen and APDCL staff quarters including water (new borewells) and sanitation. Water supply systems shall include borewell, pumping system, water treatment and purification system, storage and distribution network for the buildings in administration building area. Location, depth and other details of borewell shall be decided after conducting ground water study. Fire protection systems shall include portable fire extinguishers and wheel / trolley mounted fire extinguishers. Adequate number of portable fire extinguishers of dry chemical powder and carbon dioxide type shall be provided at suitable locations in buildings.

**Figure 14: Administration Building Layout**



Source: APDCL

- Labor accommodation and site offices including water and sanitation, security cabin, quality control laboratory, workshop, garage, stores, etc.
- Common SPP power safety and security systems including the installation of 33kV underground cabling for the common (administrative) area from the 400/33kV pooling substation with control panel and 33kV/415V transformer, diesel generator set (175kVA\*, 415 V rated), back up batteries, air conditioning and ventilation, fire detection and prevention, lighting and CCTV cameras.

### Construction and Operation

233. Construction of the administration buildings requires around 20-30 (5-10 skilled and remaining unskilled) workers; it will take approximately 9-12 months for them to be constructed.

234. When the design of the infrastructure components is finalized and approved, the construction activities commence in a similar order to the SPP. The contractor shall set up temporary construction facilities including material storage areas and labor camps for workers as laid out in the EMP. The boundary wall will be installed first to avoid unauthorized entry into the site. They will then start with clearing of vegetation and then installation. The foundation for the buildings and then the structures will be constructed in accordance with the approved detailed design, followed by testing and commissioning of equipment in accordance with the prescribed specifications. No piling or blasting is required.

235. During the operation and maintenance phase, the administration buildings will be operated and maintained by APDCL staff. Maintenance activities will include replacement of parts and equipment repairs.

### **3.7 Construction Camps**

236. Construction camps (including equipment and materials storage areas) will be established for all blocks and the administration buildings. The location of the camps will be determined by the contractors and no specific location for any camp site has been provided to date by APDCL. However, siting of any camp will consider the restrictions provided in this IEE study, e.g., not locating within 50m of a water course or within 500m of residential areas.

### **3.8 Manpower and Equipment**

237. Construction and installation works will be undertaken by dedicated teams consisting of specialized units. APDCL have indicated that approximately 500 workers per block will be required during peak construction period. Substation and administration building works are anticipated to require around 40-60 people.

### **3.9 Cost and Schedule**

238. The total investment cost of the project is estimated at \$682 million (of which \$414.25 million will be funded by ADB), including physical and non-physical components. Construction period for each block will be 18 months from project commencement. For the SPPI and SPP Pooling substation, the construction period will be 12 months.

### **3.10 Associated Facilities Sub-Components 1e and 1f**

239. A connecting grid substation and transmission line will be constructed to connect the SPP to the grid. Neither of these facilities will be funded by the ADB but are (i) required for the functioning of the SPP and (ii) would not be installed without the SPP going ahead, and are therefore considered associated facilities. The following provides a short description of each sub-component which will be constructed and operated by a separate entity (CTU).

#### **3.10.1 Transmission Line**

240. Two loop-in-loop-out (LILO) 400kV transmission lines will be constructed between the CTU switching station and an existing 400kV line approximately 6km northwest of the SPP (see Figure 1, this shows indicative routes as the final route will be determined by the transmission service provider that will be appointed by CTU to install the associated facilities).
241. Each line comprises approximately 11 towers each. The LILO will be constructed and operated by a transmission service provider (TSP). The Central Transmission Utility (CTU) is responsible for the procurement process.

#### **3.10.2 CTU Substation**

242. The CTU substation (GSS) will be adjacent to the SPP western boundary, north of the pooling substation, (see Figure 10). The GSS will be constructed in accordance with Indian regulations and CEA guidelines per the pooling substation above.



### 3.11 Prohibited Items and Activities

243. The following items will be prohibited:

- PCBs will not be permitted for use in any equipment in substations. Equipment purchased to be accompanied by a letter from the manufacturer and material safety data sheet for insulating oil used confirming that it is guaranteed PCB free and labelled as PCB free.
- Processes, equipment, and systems are not to use chlorofluorocarbons (CFCs), including halon.
- No asbestos containing materials of any type will be used in the design and construction of facilities.
- Use of herbicides or burning to clear vegetation is strictly prohibited.
- No forced or child labor to be employed in construction with the minimum age for employment on construction site to be 18 given hazardous nature of works involved.

244. Further, the Project shall not engage in any activities described on the ADB Prohibited Investment Activities List in Appendix 5 of ADB's SPS, 2009.

## IV. ANALYSIS OF ALTERNATIVES

### 4.1 General

245. The following section provides an assessment of the 'no project' alternative, alternative locations, alternative site layout and alternative technologies considered for the SPP component.

### 4.2 'No Project' Alternative

246. The "No Project" alternative in this instance is defined as a decision not to undertake the proposed construction of the SPP components. The alternative would have no direct negative environmental impacts since no construction works would be involved. However, there is a substantial demand for renewable energy in Assam, driven by the Green Hydrogen Project of Numaligarh Refinery Limited, the Renewable Energy Storage project (a Memorandum of Understanding between APDCL and OTPC), the Electric Vehicle (EV) Charging requirements outlined in the Assam Electric Vehicle Policy, 2021, renewable power requirements for RPO compliance of APDCL, renewable power requirements to fulfill RPO obligations for Open Access consumers and Captive Power consumers, and Industrial Green Power Requirements. Based on the current and projected rate of electricity demand growth of 5.3% and on the renewables purchase obligations imposed on the state by central government, Assam needs to develop or contract for the equivalent of around 3,000 megawatts (MW) of solar capacity by 2030. It is anticipated that the demand will be met in part through the establishment and operation of the proposed SPP while without the proposed project component, these obligations and requirements will not be met by GoA. Further, Assam state's electricity supply mix is dominated by coal and gas, which accounted for about 70% in the state's electricity in 2022. This results in significant volatility in the supply cost with variability in fossil fuel prices. Domestic gas prices have more than doubled since early 2021, resulting in an increase in APDCL's average electricity purchase price of around 15% which has a significant impact on tariffs which are passed on to the consumers. In the 'No Project' scenario, the renewable energy objectives would not be met, leading to continued reliance on thermal power and the volatility of prices.

### 4.3 Alternative Locations

#### 4.3.1 SPP

247. Two alternative sites were considered for the SPP (see Figure 17) before the current site was selected. However, identifying even two locations for such a large SPP with adequate grid connectivity within the state was challenging. Both alternate sites possess important environmental features, including moderately dense vegetation. However, environmental constraints exist at the Lankaijan and Klurdung site due to the proximity of the Marat Longri Wildlife Sanctuary, situated approximately 1 km from the proposed SPP boundary. In contrast, the proposed SPP site does not have any protected area immediately adjacent, the nearest being the Rangapahar wildlife sanctuary in Nagaland.

#### 4.3.2 Access Roads

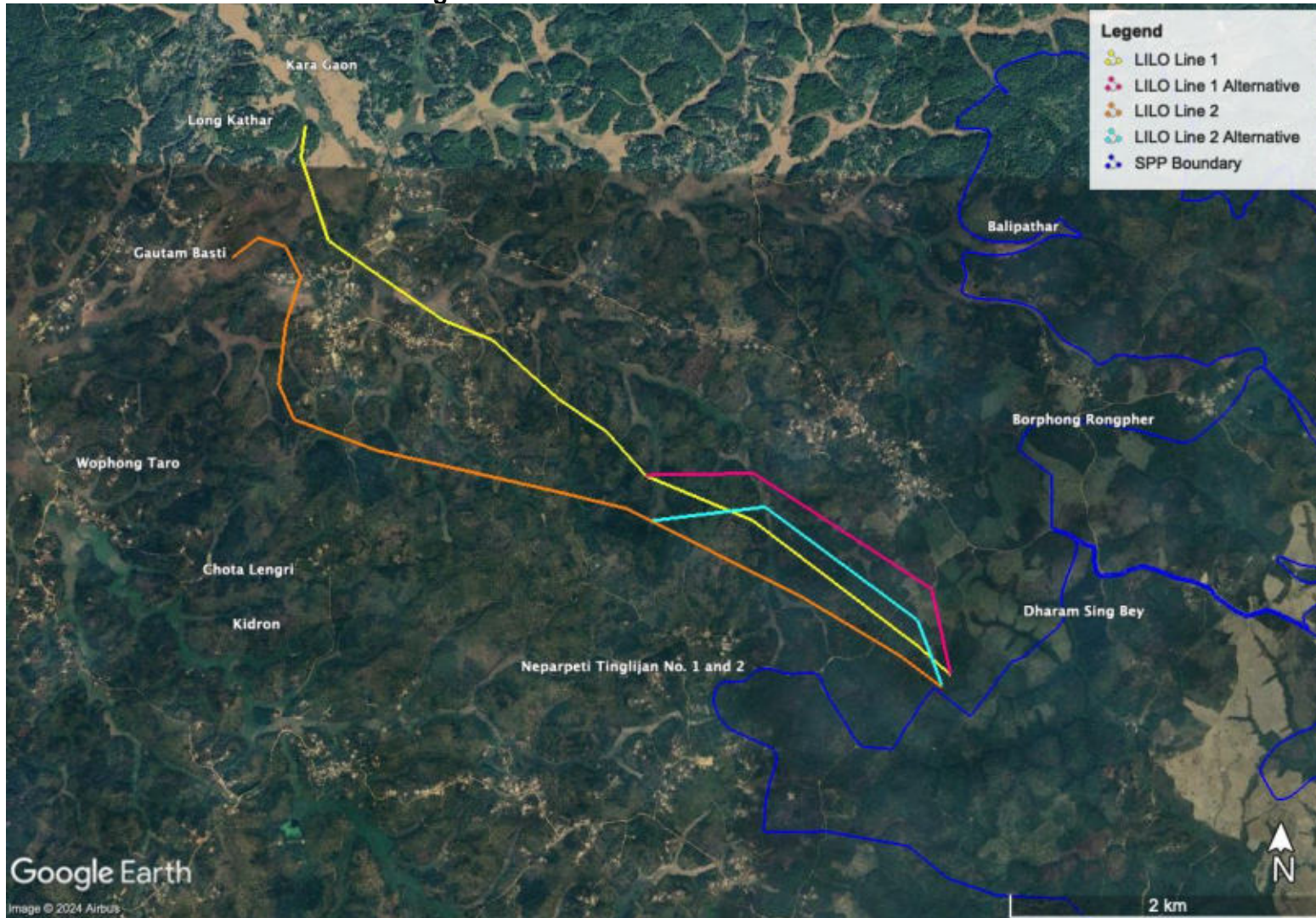
248. Several internal and external access roads have been proposed for the SPP component. None of the existing external access roads require re-routing and are considered to represent the most convenient routes from the main highway east of the site. Internal existing access roads will also be followed where possible. From an

environmental perspective, the current routes mean that the requirement for road construction works will be minimized. Some minor re-routing of internal access roads may be required during the detailed design phase. Specific requirements are made within this IEE study to ensure that any internal access roads that are re-routed do not enter the identified area of natural habitat within block 6.

#### **4.3.3 SPP TL Alignments**

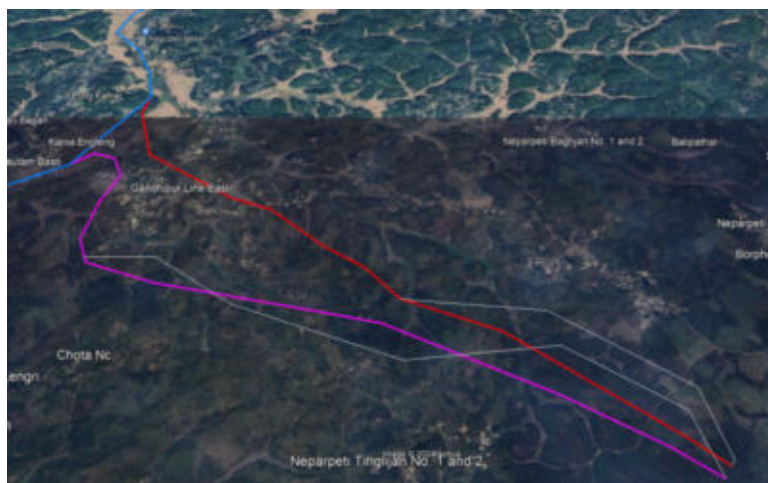
249. Alternative alignments have been assessed as part of this IEE study. These alignments were selected to assess if it is possible to avoid potential areas of natural habitat along the alignment of LILO 1 and LILO 2.
250. **Alternatives for LILO 1:** Out of total 5885 m length of the initial alternative for LILO 1, survey showed 2170 m length has 20% vegetation cover, and 3715 m length has 40% vegetation cover mostly with bamboo and secondary growth. This indicates that the alternative alignment would not impact upon any natural habitat, including areas of degraded natural habitat. This compares with approximately 2 ha of natural habitat to be affected by the planned LILO 1 (see section 7.4.2). No further alternative was considered since this initial alternative demonstrated natural habitat can be avoided.

Figure 15a: SPP TL LILO Initial Alternatives



Source: IEE Team, 2024

**Figure 16b: SPP TL LILO Revised Alternatives**



**Table 23: LILO 1 Initial Alternative Affected Natural Habitat**

Length (in m)	Land Use Land Cover
255	40% existing Powerarid
315	20%
175	40%
60	20%
65	40%
30	20%
75	40%
635	20%
35	40%
5	20%
45	40%
62	20%
75	40%
105	20%
175	40%
45	20%
235	40%
40	20%
145	40%
8	20%
120	40%
35	20%
290	40%
30	20%
315	40%
60	20%
640	40%
270	20%
275	40%
70	20%
95	40%
26	20%
245	40%
109	20%
50	40%
20	20%
95	40%
245	20%
310	40% AP 10 at proposed SS

Source: Detailed assessment of flora and fauna within the project area under the proposed 400kV D/C LILO line of both circuits from 400kV Misa - New Mariani (POWERGRID) line to the switching sub-station at Bokajan. APDCL, 2024

251. **Alternatives LILO 2:** Out of total 6372m length of the initial alternative LILO-2, survey showed 1355 m length is with 20% vegetation cover, 3962 m length is with 40% vegetation cover mostly with bamboo and 1055 m length is with 60% vegetation cover with secondary growth. This indicates that the alternative alignment would impact upon approximately 4.8 hectares of degraded natural habitat. This compares with approximately 8 hectares of natural habitat to be affected by the planned LILO 2 (see section 7.4.2). Since natural habitat is still affected a desk top review suggested a revised alternative LILO-2 could avoid additional areas of degraded natural habitat. However, the route was not surveyed by APDCL to confirm the situation on the ground.

**Table 24: LILO 2 Initial Alternative Affected Natural Habitat**

Length (in m)	Land Use Land Cover	
	40%	Gantry at proposed SS
410	40%	
65	20%	
380	60%	
44	20%	
100	60%	
670	20%	
560	40%	
36	20%	
107	40%	
30	20%	
255	60%	
665	40%	
55	20%	
152	40%	
20	20%	
388	40%	
33	20%	
95	40%	
25	20%	
45	40%	
185	60%	
20	20%	
115	40%	
135	60%	
45	20%	
625	40%	
57	20%	
185	40%	
255	20%	
615	40%	Tap Point Existing MN/ 0768, existing Powergrid 400kV line)

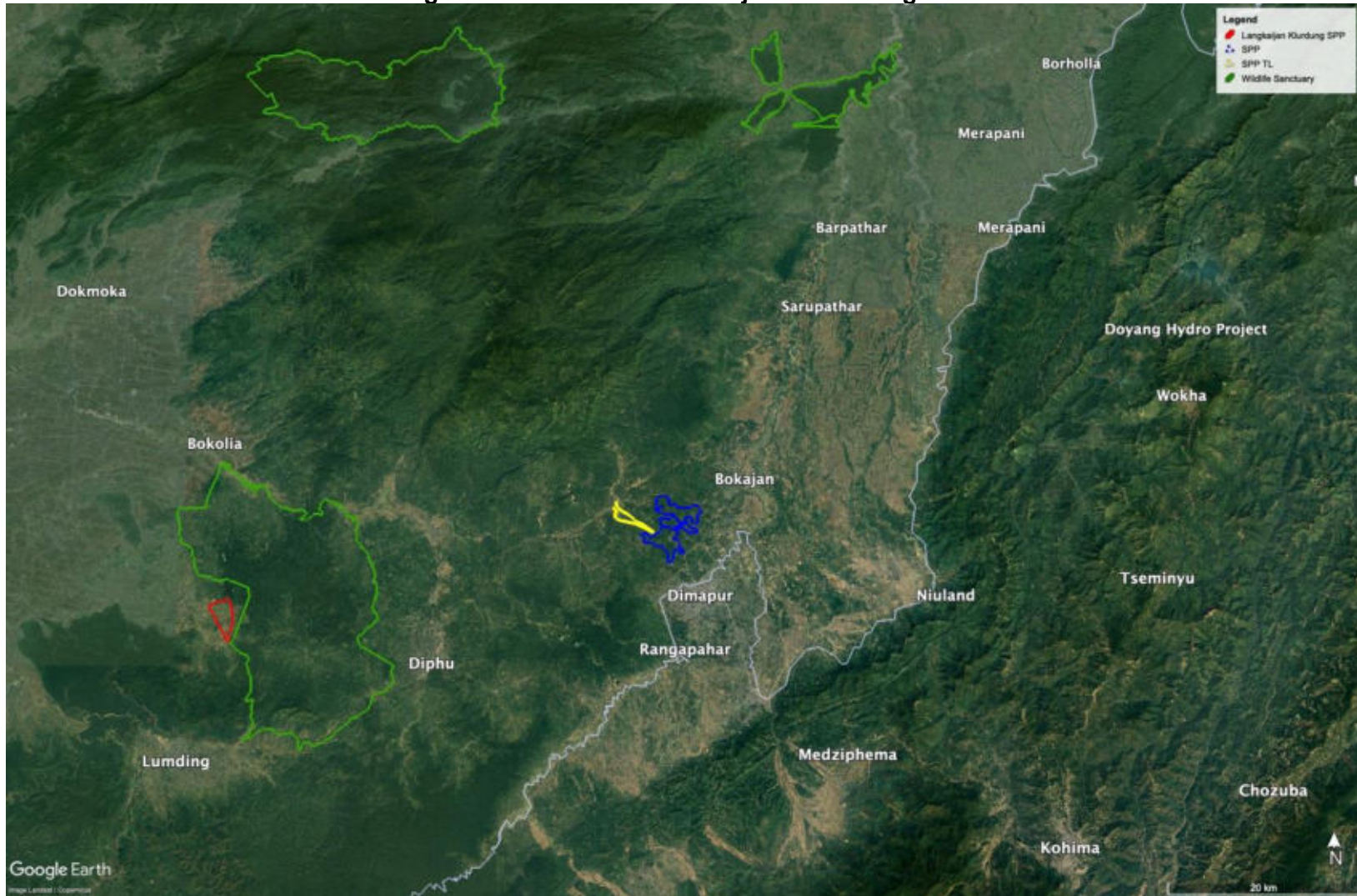
Source: detailed assessment of flora and fauna within the project area under the proposed 400kV D/C LILO line of both circuits from 400kV Misa - New Mariani (POWERGRID) line to the switching sub-station at Bokajan. APDCL, 2024

252. This initial assessment of alternatives shows that with planning, both LILO alignments can avoid impacting upon 12 ha of natural habitat, and as shown with LILO Initial Alternative 1, and potentially with LILO Revised Alternative 2 impacts can be avoided. However, it should be noted that these LILO lines are not funded by ADB but are associated facilities. Therefore, any requirement to re-route based on the findings of this IEE study would be a decision made by CTU. APDCL shall coordinate with CTU to adjust the SPP TL alignments to avoid or minimize impacts on natural habitat, based on the routing recommendations made in this IEE.

#### 4.4 Alternative Site Layout

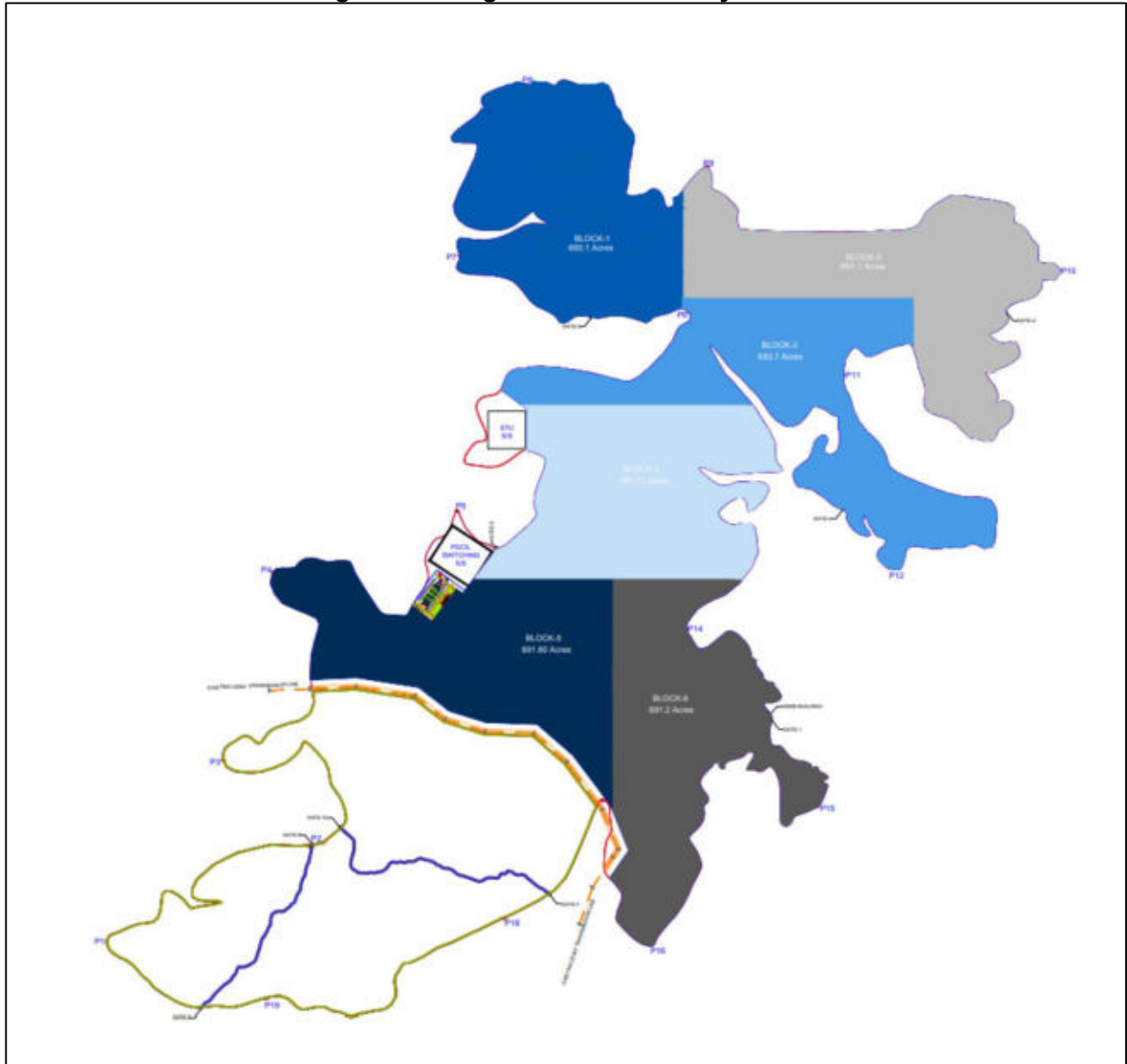
253. The layout of the six blocks within the boundary of the SPP has been gradually adjusted since inception. Initially the block boundaries were based on a simple plot map as shown in Figure 18. While the boundary of the site remains, the internal block boundaries have been adjusted to take into account use of the existing internal access roads and the site topography.

Figure 17: Location of Lankaijan & Klurdung site



Source: APDCL

Figure 18: Original SPP Block Layout



## 4.5 Alternative Technology

### 4.5.1 Modules

254. A range of module types have been considered as part of the DPR. The assessment concluded that Mono PERC modules have better efficiency and ability to perform at higher operating temperature than polycrystalline. They also have higher efficiency than polycrystalline modules and occupy lesser area than polycrystalline. Mono PERC are also less costly than bifacial modules. Consequently, Mono PERC modules are recommended at this location as it has comparatively higher estimated energy yield, better efficiency and is more economical.



#### 4.5.2 Water cleaning

255. The DPR considered two options for module cleaning, water based cleaning and robotic dry cleaning.

256. In wet based cleaning system, water is sprinkled over the modules with low pressure to clean the system. Fresh water shall be used to clean the modules. Water shall be free of floating oil or other immiscible liquids, floating debris and excessive turbidity. Approximately 2 liters of water is required to clean a single panel per cycle. For 1 MW capacity PV plant, typically, 1852 panels are installed and will require approximately 4000 liters of water (with 20% margin) for every cleaning cycle. So, typically 8,000 liters of water per month is required for two cleaning cycles/month. The water shall be fresh water (TDS < 1500 mg/L) with low mineral content (total hardness < 250 mS/cm).

257. Several robotic technologies provide a cost-effective method to clean solar panels. Many installations in India have already implemented this system. Robotic cleaning system eliminates water cost, manpower cost, and energy cost due to daily cleaning. The robots are self-powered, battery operated, powered from dedicated photovoltaic modules. For robotic cleaning, a guiding rail shall be attached over the solar panels. The guiding railing framework can move horizontally over the surface of the array of panel. For top to down movement, the robot moves on the railing framework. By sweeping its microfiber brushes connected to the head, the robot cleans the surface of the solar array. The system has its own battery which is charged through its own solar cell. This energy storage features allows the system to clean the panels in the night.

258. The DPR prepared an analysis of both technologies as provided below in Table 24.

**Table 25: Comparison of Cleaning Technologies**

Description	Water Based Cleaning	Dry Cleaning
Quantity / MW	4000 liters per cleaning cycle	Coverage area – 2 km, 3 robots/MW
Cost	INR 720/MW per cleaning cycle	INR 8 lakh/MW - CAPEX
Water usage	High	Low
Manpower	High	Low
Cleaning period	Two cycles per month (8000 liters a month, 96,000 liters a year)	Everyday
Maintenance costs	Low	High

259. The DPR concludes that for state like Assam, which has an average rain of 200 days wet module cleaning system shall be preferred as the site has low dust possibilities and does not require high frequent cleaning.

260. However, the DPR has not considered other alternatives, specifically semi-automated options, these include:

261. **Semi Automated Robotic Cleaning System:** in this type of cleaning, robots similar to those used in fully automated cleaning may be utilized, however, to clean all the rows of the SPP these robots have to be manually shifted from one row to another, or from one end of the tracker to the start of the next, or as the case maybe. There are different designs of machines available in the market, but there are mostly no bridges used to connect the rows and parking stations for robots.

262. **Vehicle Driven Cleaning System:** in this type of cleaning, the cleaning mechanism (usually a brush with controls) is attached to a tractor or another compatible vehicle that is driven by a human. Each machine has its own safety system for controlling the pressure of the brushes exerted on the PV panels by the driver / operator, to avoid any damage to the panel surface. Ample turning radius at the end of the rows is required so that the vehicle can easily turn around without wasting precious cleaning time, which typically leads to bigger land requirement as compared to the former option.
263. Neither did they consider that consultation has flagged water stress issues in Karbi Anglong despite available baseline data indicating groundwater availability. The type of solar PV module cleaning requires further consideration during detailed design with semi- or fully automated and dry methods encouraged. Detailed design for all blocks, the PSS and accommodation block will include a hydrological assessment and water balance that clearly shows groundwater availability on site and how the proposed water extraction rates could impact upon local aquifers and neighboring groundwater users. If the water balance indicates that there is potential for extraction rates to become unsustainable, the designs must include for semi- or fully automated and dry cleaning methods to be adopted. To complement groundwater supplies, the DPR suggests a system of rainwater harvesting ponds across the site to collect and store water during the monsoon season. They will be constructed of sufficient size to ensure groundwater levels are fully recharged prior to the dry season so that abstraction for cleaning will avoid a water stress situation and conflict with local community water users.

## V. IEE APPROACH

### 5.1 Assessment Boundaries

264. The boundaries of the assessment (or the SPP area of influence) have been divided depending upon the specific environmental and social characteristic to be affected and the type of activity. For example, the potential area of impact for construction phase noise around a village road will be different to the potential area of impact on air quality around the construction zone of the pooling substation. These boundaries are defined in Section 7 as part of the overall assessment process.

### 5.2 IEE Methodology

265. The methodology used to prepare this IEE is based on the requirements of ADB's Safeguard Policy Statement (2009) and the joint experience of the consultants involved in the IEE. The methodology comprises several activities as discussed below.

#### 5.2.1 Desktop Data Collection and Review

266. Background data and information collected by the team was obtained from published and unpublished sources, e.g., on climate, topography, geology and soils, natural resources, flora and fauna, agriculture, and socio-economic data. Review of the SPP layout and transmission line using Google Earth was undertaken. References to all sources used are made throughout the report.

#### 5.2.2 Site Surveys

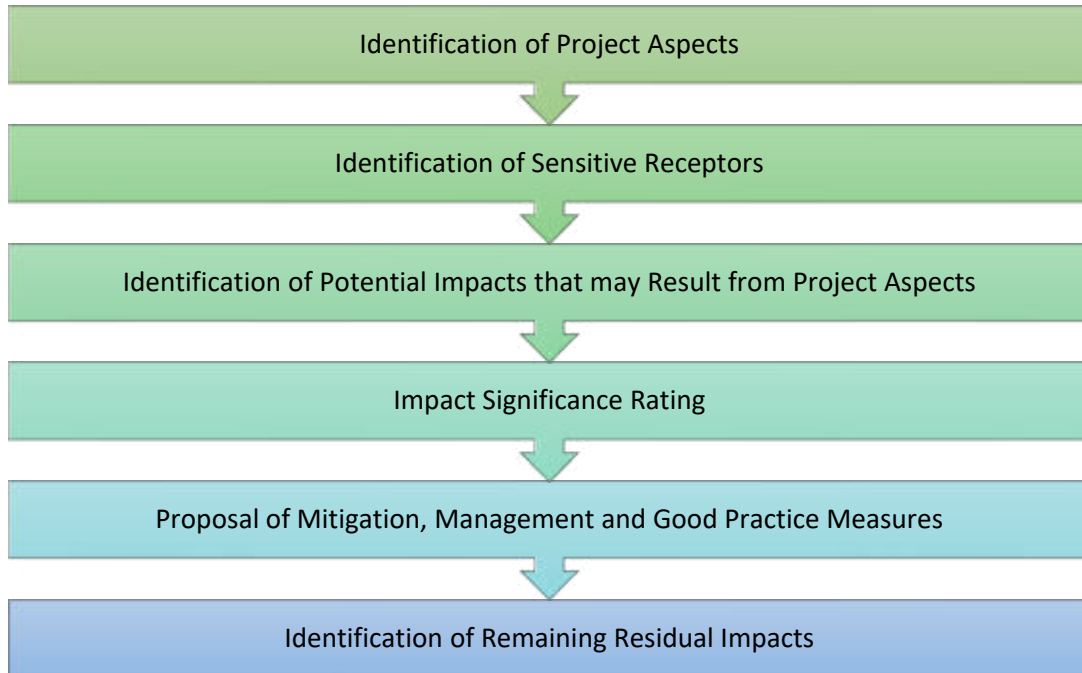
267. Several site inspections of the SPP and the SPP TL were conducted during 2023 and 2024. The potential areas of impact have been inspected by the IEE team during 2023-2024 and areas of potential environmental significance assessed carefully. Baseline ecological walkover surveys in 2023-2024 and instrumental physical environment monitoring (by an accredited laboratory in 2023 and 2024) has also been undertaken. Socio-economic surveys by the ADB TA Social Safeguards Consultant Team (responsible for preparation of the RIPP) have been completed in 2023-2024.

**Table 26: Primary Surveys Undertaken**

Topic	Survey
Noise	Monitoring of baseline noise conditions
Air	Monitoring of baseline air quality
Water	Monitoring of water quality
Social	Socio-economic survey and census
Biodiversity	Biodiversity survey
General site visit	To observe general site characteristics, including physical cultural heritage

#### 5.2.3 Impact Assessment Methodology

268. This IEE follows a set format during the impact assessment process as shown in the Table 27 flow chart and described further below.

**Table 27: Impact Assessment Process**

269. **Aspects:** firstly, the main environmental aspects of the project components are noted. An environmental aspect is any activity of the project components that interacts with the environment. E.g., an aspect of the project components that may impact upon air quality will be the movement of construction vehicles on unpaved roads through rural settlements.

270. **Identification of Sensitive Receptors:** once the main aspects of the project components have been identified any sensitive receptors within the SPP area of influence are noted. Examples of sensitive receptors include residents, rivers, groundwater, birds, etc. Identification of receptors is a key part of the impact assessment process as without a receptor there will be no significant impact. For example, if a substation generates high noise levels but there are no sensitive receptors who can hear the noise, then there will be no noise impact on them.

271. **Identification of Impacts:** thirdly, the potential impacts of the identified aspects are outlined and how they could impact upon the identified receptors, in the case above, this could be the movement of a construction vehicles creating dust on an unpaved road which impacts upon local villagers.

272. **Impact Significance Rating:** evaluation of impact significance follows a stepwise process as set out below.

273. Assign sensitivity ratings to receptors: the sensitivity of a receptor is defined on a scale of Very Low, Low, Moderate, High or Very High guided by the definitions for physical, ecological and social receptors below. These are derived from the baseline information, which shall be used to support the sensitivity ratings in the description of impact.

274. Determine the impact magnitude (or consequence) ratings: magnitude (or consequence) is determined based on a combination of the “intensity”, “duration” and “extent” of the impact following the designations set out below. Magnitude (or consequence) is assigned to the pre-mitigation impact (i.e. before additional mitigation

measures are applied, but taking into account embedded controls specified as part of the project description, Chapter 3) and residual impacts after additional mitigation is applied.

275. Determine impact significance rating: the significance of an impact is a function of the magnitude and the sensitivity of the impact determined using the matrix table below and is assigned to the predicted impact pre-mitigation and post-mitigation (residual) after considering all possible feasible mitigation measures in accordance with the mitigation hierarchy.
276. Assign additional ratings to describe the impact: qualifying ratings are assigned to criteria such as probability (or likelihood of the impact occurring), confidence (in the impact prediction), and, mitigation potential.
277. Applying the mitigation hierarchy: identification of mitigation measures in accordance with the mitigation hierarchy is done throughout the IEE process with emphasis placed on avoiding significant impacts where feasible. Certain avoidance mitigation measures may be identified early and become 'embedded' into the project design and specified in the project description, Chapter 3. These embedded controls are not 'added' to the list of mitigation measures or used to determine the post-mitigation significance. Additional mitigation measures may be identified during the impact assessment process and those agreed with APDCL (as reflected in the EMP) will be used to assess the post-mitigation significance ratings.
278. **Definitions of Impact Types and Criteria Used**
279. Impact Types: the table below defines the criteria used to categorize and describe impacts.

**Table 28: Impact Types**

Term	Definition
Nature of Impact	The direction of impact and whether it leads to an adverse effect (negative), beneficial effect (positive) or no effect (neutral)
Positive	An impact that is considered to represent an improvement to the baseline conditions or introduces a positive change to a receptor, including new effects
Negative	An impact that is considered to represent an adverse change from the baseline conditions or a negative change to a receptor, including new effects
Neutral	An impact that has no or minimal (negligible) effect on the baseline or receptor.
Type	Cause and effect relationship between the project activity and the nature of effect on receptor
Direct	Impacts that result from a direct interaction between a proposed project activity and the receiving environment (e.g. effluent discharge and receiving water quality). Sometimes referred to as primary impacts.
Indirect	Impacts that are not a direct result of a proposed project activity, often produced away from or as a result of a complex impact pathway. Sometimes referred to as secondary impacts.
Cumulative	A type of direct or indirect impact resulting from many proposed project activities, or from the project components together with other planned developments resulting in the same impact on the same receptor and increasing the resultant effects
Induced	A type of indirect impact resulting from the presence of the project components resulting in developments that are predictable but not planned (e.g. human in-migration along new access roads resulting in habitat loss, or human in-migration for jobs creating more demand for housing and shops, etc.).

Residual	The impacts that remain after implementation of the project and all associated mitigation and other environmental management measures.
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280. Definitions of Impact Assessment Criteria and Categories Applied: definitions of the criteria used in assessing impact significance and the assigned categories, and the additional criteria used to describe the impacts, are summarized in the table below.

**Table 29: Impact Definitions**

Criterion	Definition	Categories
Sensitivity	Sensitivity is a rating given to the importance and/or vulnerability (ability to withstand change) of a receptor e.g., the conservation value of a biodiversity feature or a cultural heritage resource or the vulnerability of a social receptor to change.	Very Low Low Medium High Very High
Magnitude (or Consequence)	A term describing the actual change predicted to occur to a resource or receptor caused by a project action or activity or linked effect. It is derived from a combination of Intensity, Extent and Duration and takes into account scale, frequency and degree of reversibility.	Very Low Low Medium High Very High
Intensity	A descriptor for the degree of change an impact is likely to have on the receptor which takes into account frequency of occurrence and degree of reversibility.	Very Low Low Medium High
Extent	The spatial scale over which the impact will occur.	Site Local Regional State National/International/Transboundary
Duration	Time scale over which the consequence of the effect on the receptor/s will last. [Note that this does not apply to the duration of the project activity]. The terms Intermittent and Temporary may also be used to describe the duration of an impact.	Short-term Medium-term Long-term Permanent
Probability	A descriptor for the likelihood of the impact occurring. Most assessed impacts are likely to occur but Probability is typically used to qualify and contextualize the significance of unplanned events or accidents.	Unlikely Possible Likely Highly Likely Definite
Confidence	A descriptor for the degree of confidence in the evaluation of impact significance.	Low Medium High Certain
Mitigation potential	A descriptor for the degree to which the impact can be mitigated to an acceptable level and/or confidence in the effectiveness of the mitigation.	None Very Low Low Medium High

### **Determination of Sensitivity**

281. Sensitivity is a term that covers the 'importance' (e.g. value of an ecological receptor or heritage resource) or 'vulnerability' (e.g. ability of a social receptor to cope with change)

of a receptor to a project-induced change. It takes into account 'irreplaceability' - measure of the value of, and level of dependence on, impacted resources to society and/or local communities, as well as of consistency with policy (e.g. conservation) targets or thresholds.

282. Broad definitions of sensitivity ratings for social, ecological and physical receptors are defined below. These are not exhaustive and may be modified on a case-by-case basis, as appropriate. Additional ratings can be developed for other receptors such as cultural heritage.

**Table 30: Sensitivity Ratings**

<b>Sensitivity Rating</b>	<b>Definition</b>
<b>Social Receptors</b>	Individuals, communities or groups of stakeholders
Very Low	Receptors who are not vulnerable or susceptible to project-related changes and have substantive resources and support to understand and anticipate Project impacts. Such receptors have the ability to avoid negative Project impacts, or to cope with, resist or recover from the consequences of a such an impact with negligible changes to their lives, or will derive little benefit or opportunities from the project.
Low	Receptors who have few vulnerabilities and are marginally susceptible to project-related changes but still have substantive resources and support to understand and anticipate a Project impact. Such receptors are able to easily adapt to changes brought about by the project with marginal impacts on their living conditions, livelihoods, health and safety, and community well-being, or will derive marginal benefits or opportunities from the project.
Medium	Receptors have some vulnerabilities and are more susceptible to project-related changes given they only have moderate access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not fully resilient to Project impacts but are generally able to adapt to such changes albeit with some diminished quality of life. For positive impacts, these receptors are likely to derive a moderate level of benefit or opportunities from the project.
High	Receptors are vulnerable and susceptible to project-related changes, and have minimal access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not resilient to Project impacts and will not be able to adapt to such changes without substantive adverse consequences on their quality of life. For positive impacts, these receptors are likely to derive a substantial level of benefits or opportunities from the project.
Very High	Receptors are highly vulnerable and have very low resilience to project-related changes. By fact of their unique social setting or context, such receptors have a diminished or lack of capacity to understand, anticipate, cope with, resist or recover from the consequences of a potential impact without substantive external support. For positive impacts, receptors are likely to derive substantial benefits or opportunities from the project which could lead to significant and sustained improvement in their quality of life.
<b>Ecological Receptor</b>	Species, habitats or ecosystems including processes necessary to maintain ecosystem functions
Very low	Species or habitats with negligible importance for biodiversity including habitats that are largely transformed or highly modified.
Low	Species or habitats listed as Least Concern (LC) on the International Union for Conservation of Nature (IUCN) Red List or on regional or national Red Lists and/or habitats or species which are common and widespread, of low conservation interest, or habitats which are degraded and qualify as modified habitat under international definitions (e.g. IFC or ADB).
Medium	Species, habitats or ecosystems listed as globally Vulnerable (VU) or Near Threatened (NT) on IUCN Red List; or on national or regional Red Lists etc. It includes habitats that meet definitions of 'natural habitat'; or ecosystems with important

Sensitivity Rating	Definition
	functional value in maintaining the biotic integrity of these habitats or VU or NT species.
High	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN Red List; or on national or regional Red Lists, range restricted species or internationally recognized migratory and congregatory species, but which do not qualify as Critical Habitat trigger species under international definitions (e.g. IFC or ADB). Habitats or ecosystems which are important for meeting national conservation targets which do not qualify as Critical Habitat. It can also include legally protected areas that are not Critical Habitat under international definitions (e.g. IFC or ADB).
Very high	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN Red List; or on national or regional Red Lists, range restricted species or internationally recognized migratory and congregatory species, which qualify as Critical Habitat trigger species under international definitions (e.g. IFC or ADB). Habitats of very high sensitivity may typically include legally protected areas that meet IUCN categories 1, 1a and 1b, KBAs or Important Bird Areas (IBAs) with biodiversity features that meet Critical Habitat criteria and thresholds under international definitions (e.g. IFC or ADB).
Physical Receptors	Water quality, soil quality, air quality, noise levels
Very Low	Receptors are highly resilient to project-induced change and changes remain undetectable and within any applicable thresholds.
Low	Receptors are resilient to project-induced change and changes, while detectable, are within the range of natural variation and remain within any applicable thresholds.
Medium	Receptors are moderately resilient to project-induced changes, but these changes are easily detectable, exceed the limit of the normal range of variation on an intermittent basis and / or periodically exceed applicable thresholds.
High	Receptors are vulnerable to project-induced change and changes are readily detectable, well outside the range of natural variation or occurrence, and regularly exceed any applicable thresholds.
Very High	Receptors are highly vulnerable to project-induced change and changes are easily detectable, fall well outside the range of natural variation or occurrence, and will continually exceed any applicable thresholds.

### **Determination of Magnitude (or Consequence)**

283. **Definitions of Criteria Used to Derive Magnitude (or Consequence):** the term magnitude (or consequence) describes and encompasses all the dimensions of the predicted impact including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- degree of reversibility; and
- its geographical extent and distribution.

284. Taking the above into account, Magnitude (or Consequence) is derived from a combination of Intensity, Duration and Extent. The criteria for deriving Intensity, Extent and Duration are summarized below.

**Table 31: Magnitude sub-criteria**

Criteria	Rating	Description
Criteria for ranking of the	Very Low	Negligible change, disturbance or nuisance which is barely noticeable or may have minimal effect on



Criteria	Rating	Description
INTENSITY of environmental impacts taking into account reversibility and frequency	Low	receptors or infrequently affect a small to proportion of the receptors. Minor (limited) change, disturbance or nuisance which is easily tolerated and/or reversible in the short term without intervention, or which may frequently affect a small proportion of receptors or infrequently a moderate proportion.
	Medium	Moderate change, disturbance or discomfort caused to receptors or which is reversible over the medium term, and/or which may frequently affect a moderate proportion of receptors.
	High	Prominent change, or large degree of modification, disturbance or degradation caused to receptors or which may affect a large proportion of receptors, possibly entire species or community and which is not easily reversed.
	Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	Site
Criteria for ranking the DURATION of impacts	Local	Impact is confined to within the project concession / license area and its nearby surroundings.
	Regional	Impact is confined to the region, e.g. coast, catchment, district, etc.
	State	Impact may extend beyond regional or district boundaries with state implications.
	National/ International/ Transboundary	Impact extends to or beyond the national scale or may be transboundary.
Criteria for ranking the DURATION of impacts	Short term	The duration of the impact will be <1 year or may be intermittent.
	Medium term	The duration of the impact will be 1-5 years.
	Long term	The duration of the impact will be 5-25 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	Permanent	The impact will endure for the reasonably foreseeable future (>25 years) and where recovery is not possible either by natural processes or by human intervention.

285. **Determining Magnitude (or Consequence) Ratings:** once the intensity, extent and duration are defined based on the definitions above, the magnitude (or consequence) of negative and positive impacts is derived based on the table below. It should be noted that there may be times when these definitions may need to be adjusted to suit the specific impact where justification should be provided. For instance, the permanent loss of the only known occurrence of a species in a localized area of impact can only achieve a "High" magnitude rating but could, in this instance, warrant a Very High rating. The justification for amending the rating should be indicated in the impact table.

**Table 32: Magnitude Rating**

Magnitude (or consequence) rating	Description*
Very High	Impacts could be EITHER: of high intensity at a regional level and endure in the long term; OR of high intensity at a state level in the medium or long term; OR of medium intensity at a state level in the long term.
High	Impacts could be EITHER: of high intensity at a regional level and endure in the medium term; OR of high intensity at a state level in the short term;

Magnitude (or consequence) rating	Description*
	OR of medium intensity at a state level in the medium term; OR of low intensity at a state level in the long term; OR of high intensity at a local level in the long term; OR of medium intensity at a regional level in the long term.
Medium	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a state level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a state level in the medium term; OR of low intensity at a regional level in the long term.
Low	Impacts could be EITHER of low intensity at a regional level and endure in the medium term; OR of low intensity at a state level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level and endure in the medium term.
Very Low	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low or medium intensity at a local level and endure in the short term. OR very low intensity with any combination of extent and duration.

\* Note: For any impact that is considered to be "Permanent" or "National/International" apply the "Long-Term" and "State" ratings, respectively. For impacts at the "Site" or "Local" level apply the "Local" level rating.

**Determination of Impact Significance**

286. **Matrix to Derive Impact Significance:** the significance of an impact is based on expert judgement of the sensitivity (importance or vulnerability) of a receptor and the magnitude (or consequence) of the effect that will be caused by a project-induced change. In summary, the impact assessment method is based on the following approach:

- Significance = Magnitude x Sensitivity
- Where Magnitude = Intensity + Extent + Duration

287. Once ratings are applied to each of these parameters the following matrix is used to derive Significance:

**Table 33: Impact Significance Matrix**

		Sensitivity				
		Very Low	Low	Medium	High	Very High
Magnitude (or consequence)	Very Low	Negligible (Very Low)	Negligible (Very Low)	Low	Low	Medium
	Low	Negligible (Very Low)	Low	Low	Medium	High
	Medium	Low	Low	Medium	High	High
	High	Low	Medium	High	High	Very High
	Very High	Medium	High	High	Very High	Very High

288. **Definitions of Significance Ratings** - Broad definitions of impact significance ratings are provided in the table below. Impacts of 'High' and 'Very High' significance require careful evaluation during decision-making and need to be weighed up against potential long-term socioeconomic benefits of the project to inform project authorization. Where there are residual biodiversity or other impacts of 'High' and 'Very High' significance this will require careful examination of offset or compensation feasibility and confirmation that an offset/compensation is possible prior to decision-making.

**Table 34: Significance Definitions**

Very High	<p>Impacts where an accepted limit or standard is far exceeded, changes are well outside the range of normal variation, or where long-term to permanent impacts of more than negligible (very low) magnitude (or consequence) occur to highly sensitive resources or receptors.</p> <p>For adverse residual impacts of very high significance, there is no possible further feasible mitigation that could reduce the impact to an acceptable level or offset the impact, and natural recovery or restoration is unlikely. The impact may represent a possible fatal flaw and decision making will need to evaluate the trade-offs with potential social or economic benefits.</p> <p>Positive social impacts of very high significance would be those where substantial economic or social benefits are obtained from the project for significant duration (many years).</p>
High	<p>Impacts where an accepted limit or standard is exceeded; impacts are outside the range of normal variation or adverse changes to a receptor are long-term. Natural recovery is unlikely or may only occur in the long-term and assisted and ongoing rehabilitation is likely to be required to reduce the impact to an acceptable level.</p> <p>High significance residual impacts warrant close scrutiny in decision-making and strict conditions and monitoring to ensure compliance with mitigation or other compensation requirements.</p> <p>Positive social impacts of high significance would be those where considerable economic or social benefits are obtained from the project for an extended duration in the order of several years.</p>
Medium	<p>Moderate adverse changes to a receptor where changes may exceed the range of natural variation or where accepted limits or standards are exceeded at times. Potential for natural recovery in the medium-term is good, although a low level of residual impact may remain. Medium impacts will require mitigation to be undertaken and demonstration that the impact has been reduced to as low as reasonably practicable (even if the residual impact is not reduced to low significance).</p> <p>Positive social impacts of medium significance would be those where a moderate level of benefit is obtained by several people or a community, or the local, regional or state economy benefits for a sustained period, generally more than a year.</p>
Low	<p>Minor effects will be experienced, but the impact magnitude (or consequence) is sufficiently small (with and without mitigation) and well within the range of normal variation or accepted standards, or where effects are short-lived. Natural recovery is expected in the short-term, although a low level of localized residual impact may remain. In general, impacts of low significance can be controlled by normal good international industry practice but may require monitoring to ensure operational controls or mitigation is effective. Positive social impacts of low significance would be those where a few people or a small proportion of a community in a localized area may benefit for a few months.</p>
Very Low	<p>Very minor effects on resources or receptors are possible but the predicted effect represents a minimal change to the distribution, presence, function or health of the affected receptor, and no mitigation is required.</p>
Negligible	<p>Predicted impacts on resources or receptors of very low or low sensitivity are imperceptible or indistinguishable from natural background variations, and no mitigation is required.</p>

## **Residual Impacts**

289. Once mitigation measures are declared and committed to, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.
290. The final step is providing compensatory measures to offset the impact, particularly where an impact is of high significance and none of the above are appropriate, e.g., for impacts to natural and critical habitat.

### **5.2.4 Stakeholder Consultations**

291. According to the ADB SPS, 2009:

*“The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:*

- (i) Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;*
- (ii) Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;*
- (iii) Is undertaken in an atmosphere free of intimidation or coercion;*
- (iv) Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and*
- (v) Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.*

*Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report.”*

292. APDCL have led stakeholder engagement activities. The stakeholder engagement has been undertaken with the support of the IEE team, specifically APDCL’s national consultants, with GreenCIndia, with additional consultations by ADB TA consultants and the findings presented in this IEE study.

## VI. DESCRIPTION OF THE ENVIRONMENT

### 6.1 Introduction

293. This section presents a description of the environmental baseline conditions, firstly at the state level and then at the sub-activity level covering the following topics. Ecological walkovers and socioeconomic surveys were conducted in 2023 and 2024 whilst the water, air, soil and noise data were collected in 2023 and 2024. The section also includes the baseline conditions of both the SPP and the SPP TL.

**Table 35: Data Types**

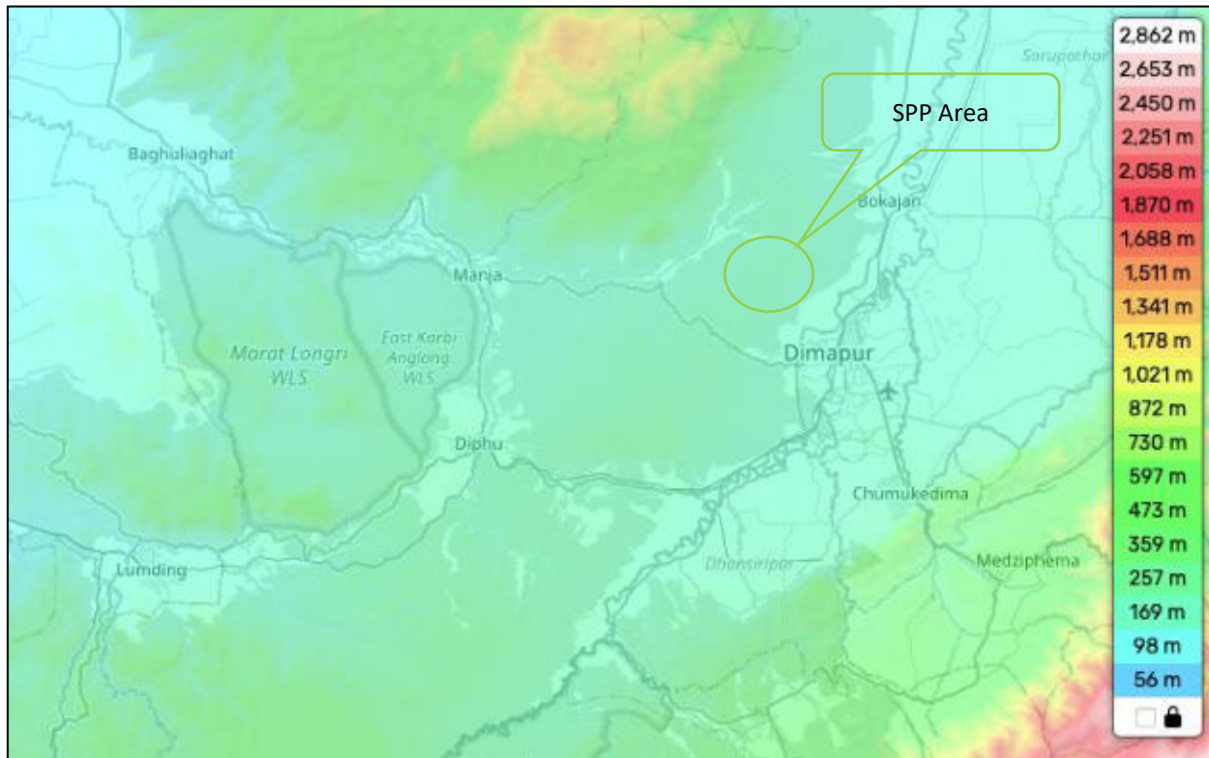
		Primary Data	Secondary Data
<b>Physical Environment</b>			
1	Topography	No	Yes
2	Geology and Soils	Yes	Yes
3	Natural Hazards	No	Yes
4	Climate and Climate Change	No	Yes
5	Climate hazards	No	Yes
6	Hydrology, Water Quality and Water Use	Yes	Yes
7	Air Quality	Yes	Yes
<b>Biological Environment</b>			
1	Protected and Notable Ecological Areas	No	Yes
2	Notable Habitat	Yes	Yes
3	Notable Species	Yes	Yes
<b>Socio-Economic Environment</b>			
1	Administration and Demographics	No	Yes
2	Local Economy	Yes	Yes
3	Tourism	No	Yes
4	Land Use and Landscape	Yes	Yes
5	Infrastructure	Yes	Yes
6	Noise and Vibration	Yes	Yes
7	Physical Cultural Resources and Cultural Landscape	Yes	Yes

### 6.2 Physical Environment

#### 6.2.1 Topography

294. The highest point in Karbi Anglong is the 'Singhason' peak, which stands at a height of 1,360 meters. Over 80% of the geographical area comprises steep to moderately sloping terrain, hilly landscapes, and gently undulating plains. The average elevation hovers between 300 to 400 meters above Mean Sea Level (amsl). Conversely, in the northern sector of Karbi Anglong, the slopes are steeper, gradually giving way to gentler inclines towards the south. The hills are generally NE-SW trending with height acquiring a maximum of 1,400m amsl.

**Figure 19: Topographic map of Karbi Along**



Source: <https://en-gb.topographic-map.com/map-lj834s/Karbi-Anglong/?center=26.27859%2C93.24573&zoom=10&lock=10%2C54%2C134>

295. The topography of the SPP is dominated by small undulating slopes and valleys with elevation ranging between 232m amsl in the south-west corner of the site to 185m amsl in the south-east of the side. Figure 20 and Figure 21 illustrate the general topographical features of the site.
296. There is no conspicuous regional gradient. However, a general slope can be found within the site area. The slope is in NW-SE direction (Figure 22). Rainwater as surface runoff would pass through this slope.

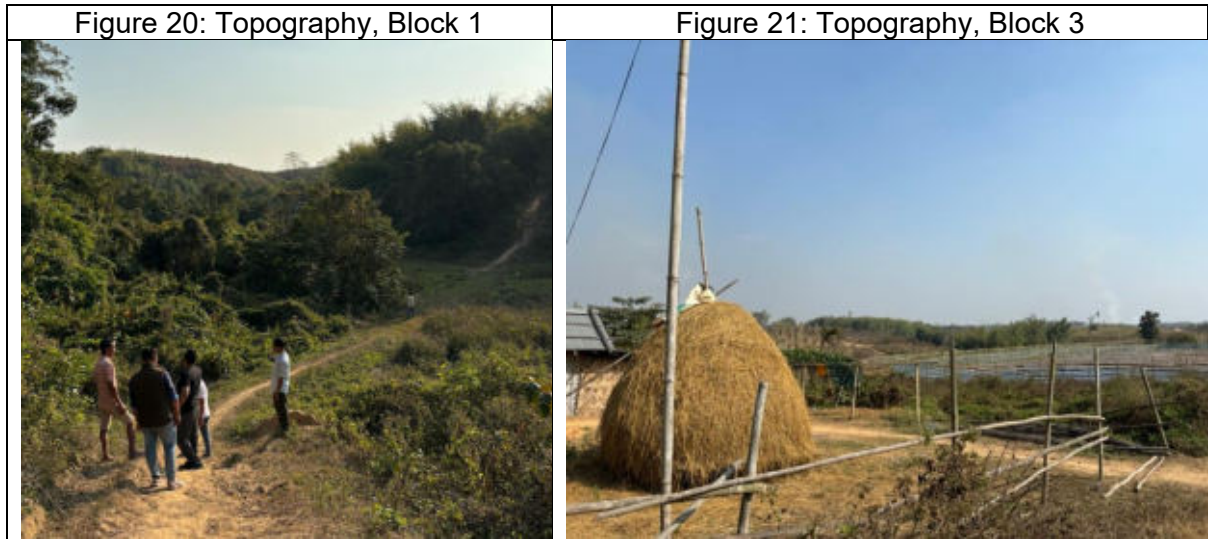
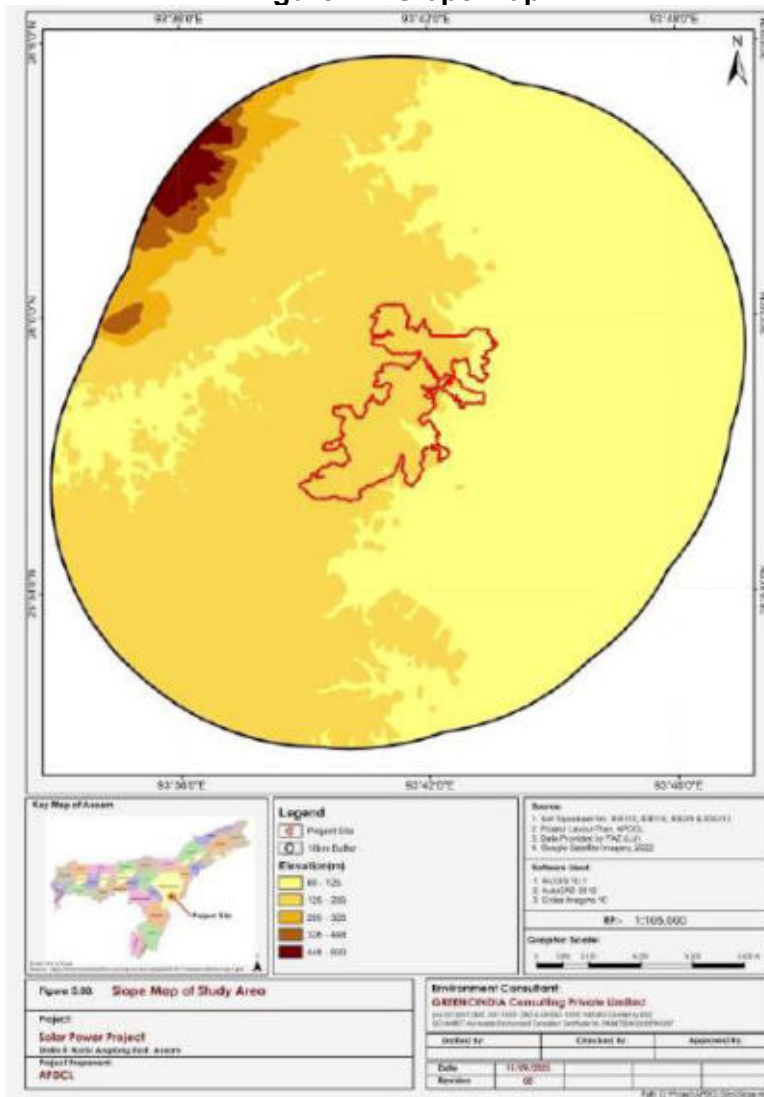


Figure 22: Slope Map

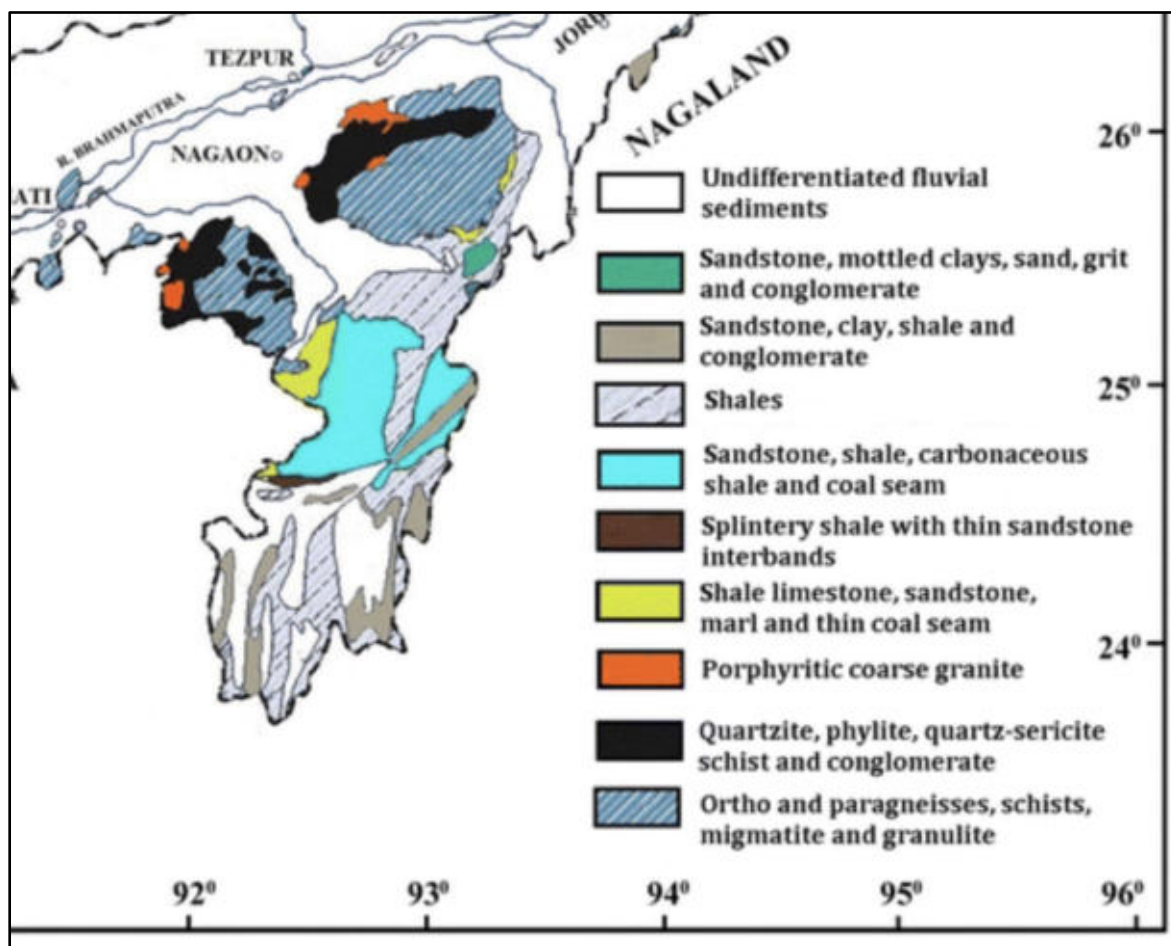


## 6.2.2 Geology and Soils

### Geology

297. From a geological perspective, the region exhibits a close connection to both the Archaean-origin Meghalaya plateau and the Purvanchal hills in the southern section of the Eastern Himalayas, which have a Tertiary origin.<sup>21</sup> The entire area has undergone significant geological activity, particularly during the Tertiary period, with pronounced disturbances occurring in the southeast. These disturbances resulted in the overlay of Tertiary rock layers atop the pre-Cambrian basement, accompanied by extensive metamorphism, folding, and faulting processes. The geological composition of Karbi Anglong traces the historical disposition of various litho-units in a foreland facies condition, reflecting the region's depositional history.

**Figure 23: Regional Geology**



Source: [https://www.researchgate.net/figure/Geological-base-map-of-Assam-modified-from-Geological-Survey-of-India-showing-the-fig1\\_313639253](https://www.researchgate.net/figure/Geological-base-map-of-Assam-modified-from-Geological-Survey-of-India-showing-the-fig1_313639253)

298. Karbi Anglong district comprises the oldest Archaean gneissic rocks followed by Precambrian Shillong Series with rock types of phyllites, schists, quartzites etc. Tertiary rocks starting from Eocene to Miocene age are available. This comprises Jaintia, Barail, Surma and Tipam series with various grades of shales, siltstone and sandstones. The

<sup>21</sup> <https://shodhganga.inflibnet.ac.in/handle/10603/169794>



recent to sub-recent alluvial deposit above it comprises clay, silt, sand, and gravel admistures with sands. Entire district can be divided into three units (1) Consolidated formations comprising oldest granite rock, gneisses etc. (2) Semi-consolidated rocks constituting the Tertiary rocks and (3) the unconsolidated alluvial sediments. The geological map is provided as Figure 23.

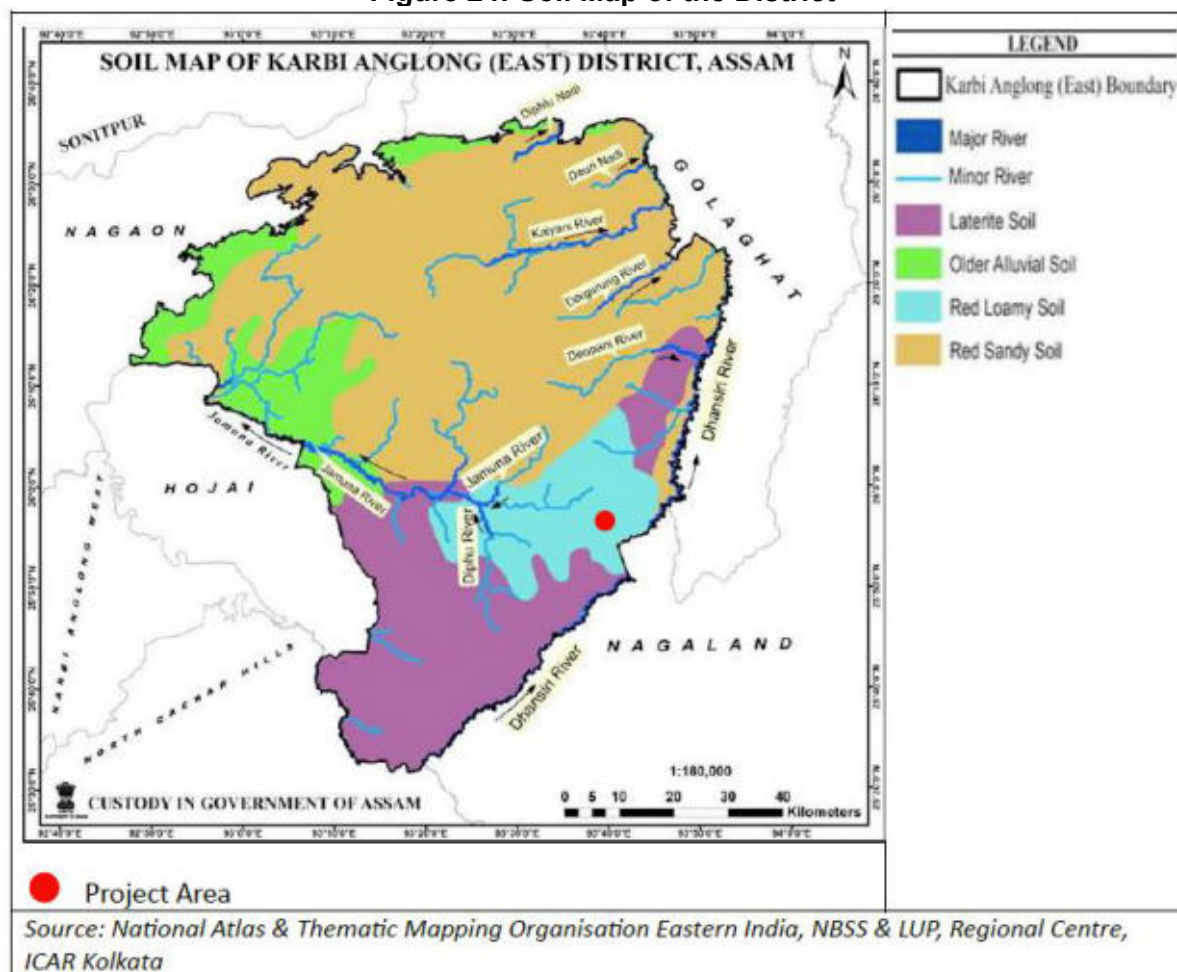
## Soils

299. The soil composition in Karbi Anglong originates from the Pre-Cambrian gneissic rock. The hill soils within the district exhibit good drainage characteristics and range in color from brownish to yellowish-red. According to the United States Department of Agriculture (USDA) soil classification, the soils in Karbi Anglong (East) can be categorized as inceptisols, alfisols, and ultisols. The district's soils are primarily composed of laterised red soils and non-laterised red soils. Laterised red soils are prevalent in the western part of the Diphu sub-division, both in highland areas and mountain valleys. On the other hand, non-laterised red soils are found in the eastern Diphu sub-division. The various soil types in the district play a crucial role in determining the socio-economic conditions of its inhabitants. Plains and river valleys offer the most suitable conditions for agricultural activities.

300. However, the region faces significant challenges related to soil erosion caused by water due to unscientific agricultural practices. Soils found in Karbi Anglong can be broadly classified into three main types:

- Red loamy soil mixed with clay: This type covers approximately 70% of the Diphu sub-division area and is well-suited for cultivating various crops such as potatoes, grams, and hill paddy.
- Old alluvium: Found in the extreme northernmost part of Diphu sub-division, this soil is particularly suitable for activities like tea plantation and the cultivation of various fruits and vegetables.
- Sandy and new alluvial soils: These soils are located in the Dhansiri valley and have an acidic character. They are well-suited for the cultivation of rice and jute.

Figure 24: Soil Map of the District



### 6.2.3 Natural Hazards

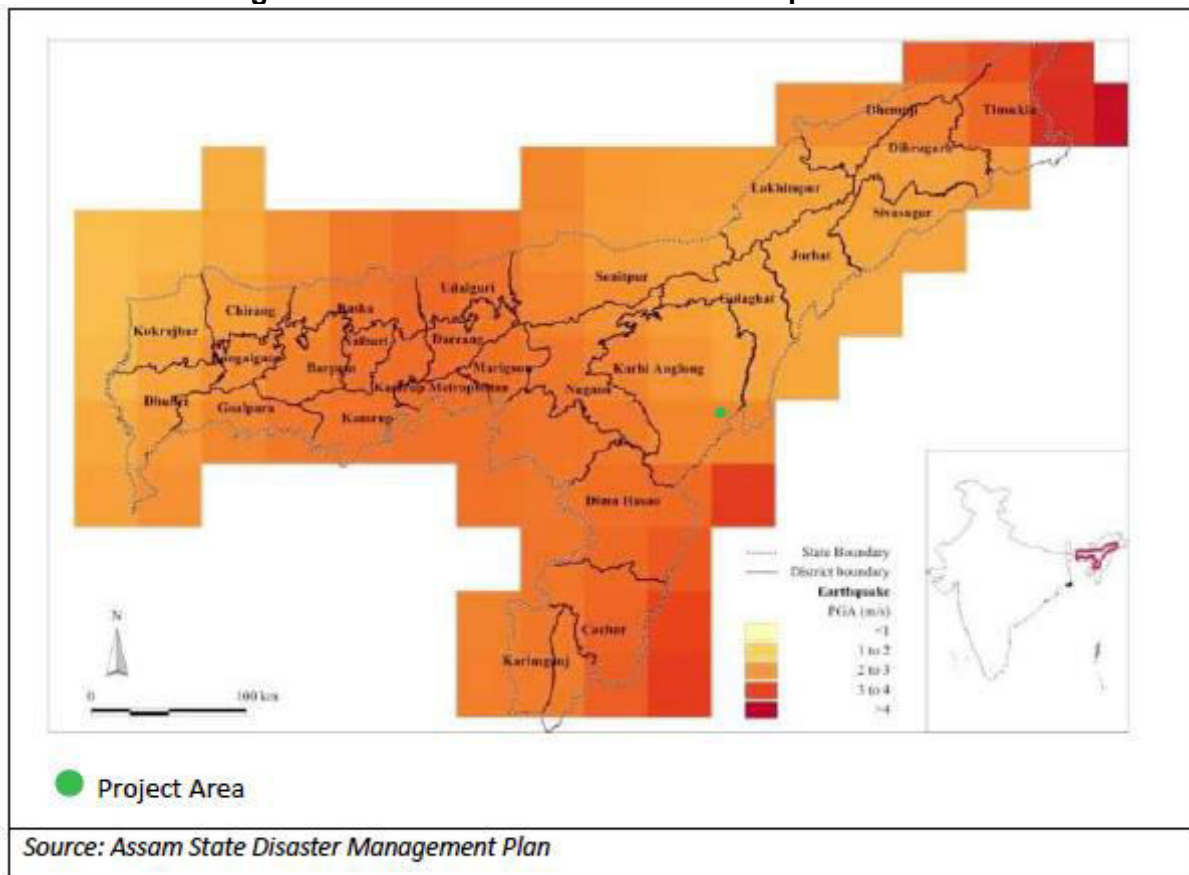
#### Seismicity

301. While Karbi Anglong has yet to witness a major earthquake, occasional mild tremors have occurred. However, due to its fragile geomorphology and vulnerable geography, situated within the high-risk Seismic Zone (V), the entire district is at substantial risk of earthquakes. The soil stability is notably unreliable, necessitating careful attention to construction and structural integrity.<sup>22</sup>

302. The following figure depicts the earthquake hazard risk zonation of the area.

<sup>22</sup> DPR, Fichtner, 2023

Figure 25: Peak Ground Acceleration Map of Assam



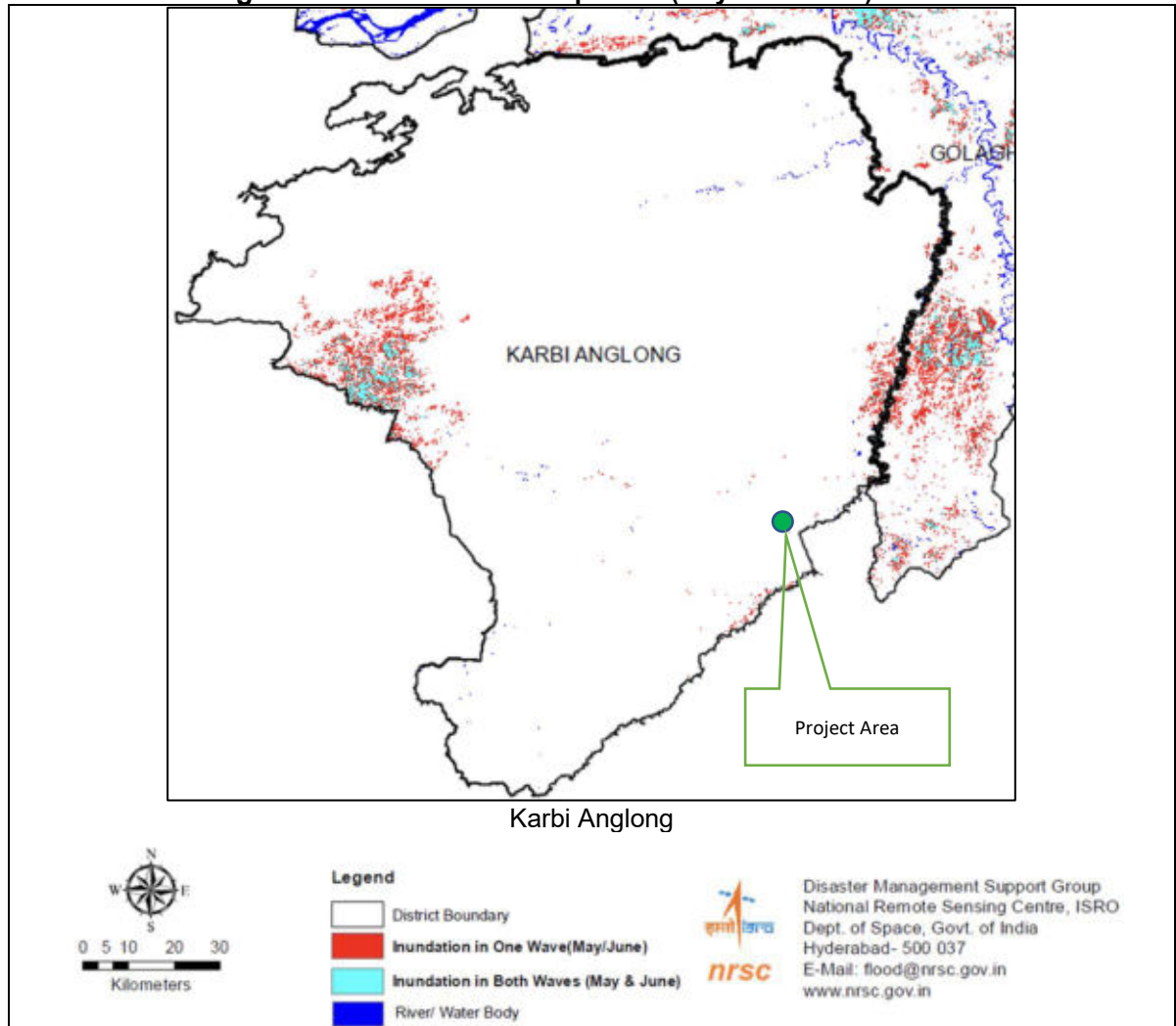
## Floods

303. The state of Assam is largely vulnerable to floods. With its vast network of rivers, the state is prone to natural hazards like flood and erosion which has a negative impact on overall development of the state<sup>23</sup>. The Brahmaputra and Barak River with more than 50 tributaries feeding them, cause flood devastation in the monsoon period each year. The flood prone area of the state as assessed by the Rastriya Barh Ayog (RBA) is 39.58 % of the total land area of Assam. Flash floods in the district of Karbi Anglong are a regular feature and the main rivers are Amrenge, Borpani, Kolioni, Dhansiri, Dikharu, Nambor, Deopani, Jamuna, Patradisha, Longnit, Doigrung which causes regular flash floods every year. Flood inundation pattern are shown in Figure 26 and indicate that the SPP and SPP TL are not located in flood inundation areas, however, consultations with the Executive Engineer of the Department of Irrigation did note that the absence of a well-structured drainage system leads to flash floods during the monsoon season.

23

<https://waterresources.assam.gov.in/portlets/flood-erosion-problems#:~:text=Flood%20Problem,the%20monsoon%20period%20each%20year.>

**Figure 26: Flood inundation pattern (May-June 2022)**



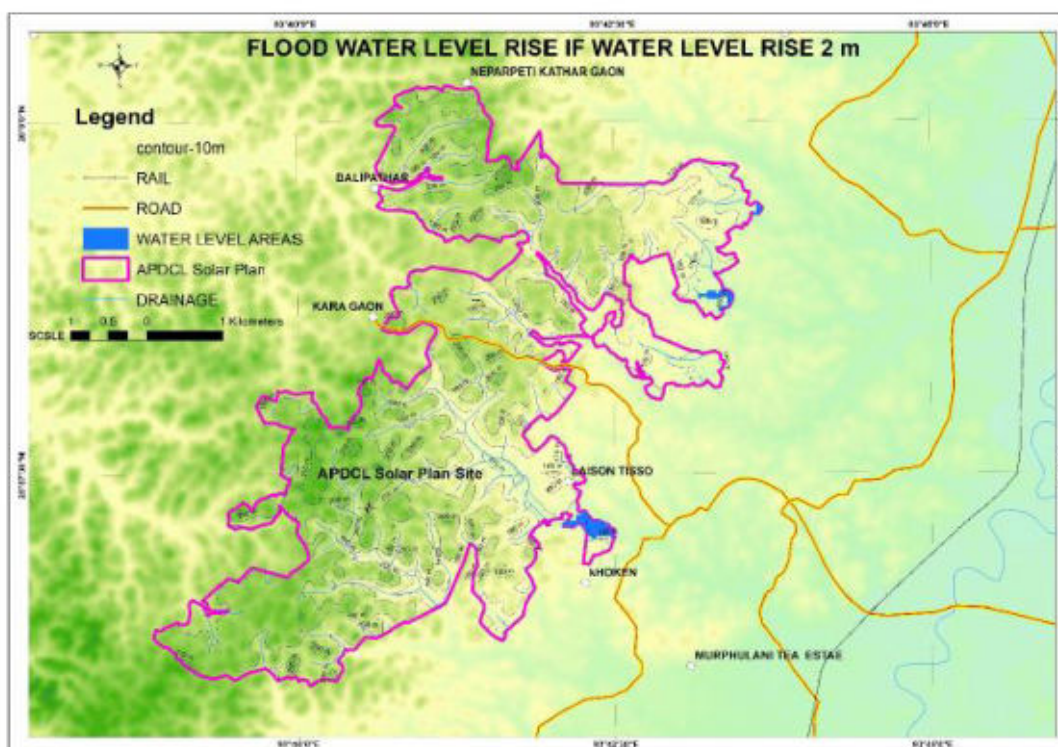
Source:

[https://ndrf.nrsc.gov.in/documents/Disaster\\_Document/2022/AS/asflood50dsc17072022\\_1800hrs/asflood50dsc17072022\\_1800hrs\\_vap2.pdf](https://ndrf.nrsc.gov.in/documents/Disaster_Document/2022/AS/asflood50dsc17072022_1800hrs/asflood50dsc17072022_1800hrs_vap2.pdf)

304. A flood prediction study<sup>24</sup> has been prepared to generate flood prediction maps. The study modelled flood situations at 2m, 5m, 10m, 20m and 40m and concluded that “*flood situation in this project is negligible and safe for Solar Panel installation.*”

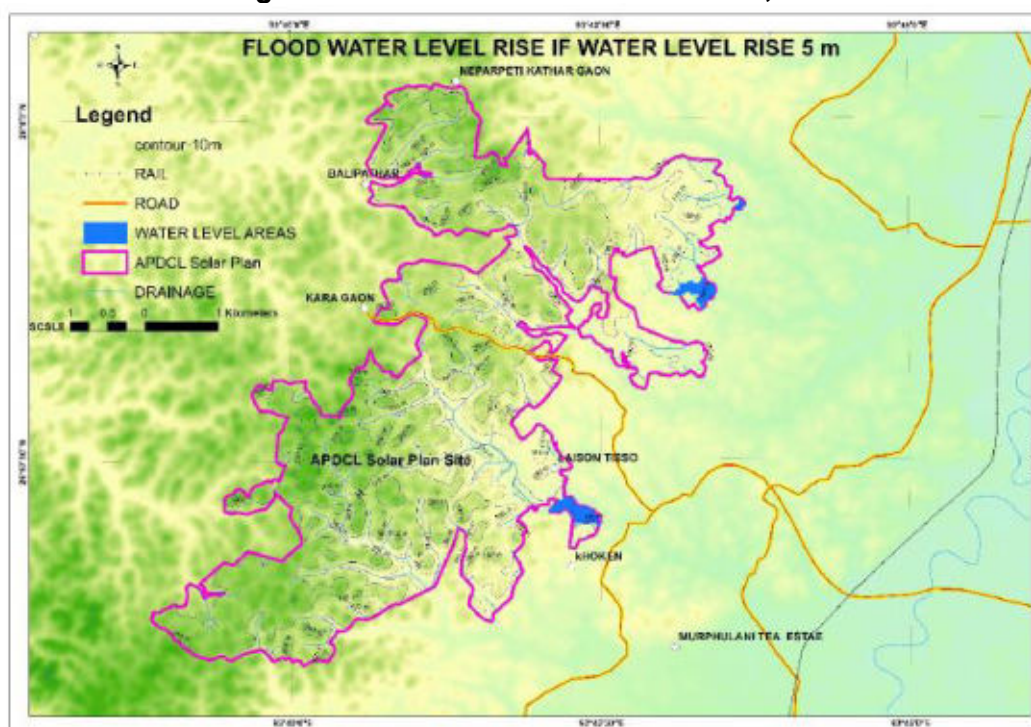
<sup>24</sup> Flood Prediction Study, Fichtner, 2023

**Figure 27: Modelled Flood Water Level, 2m**



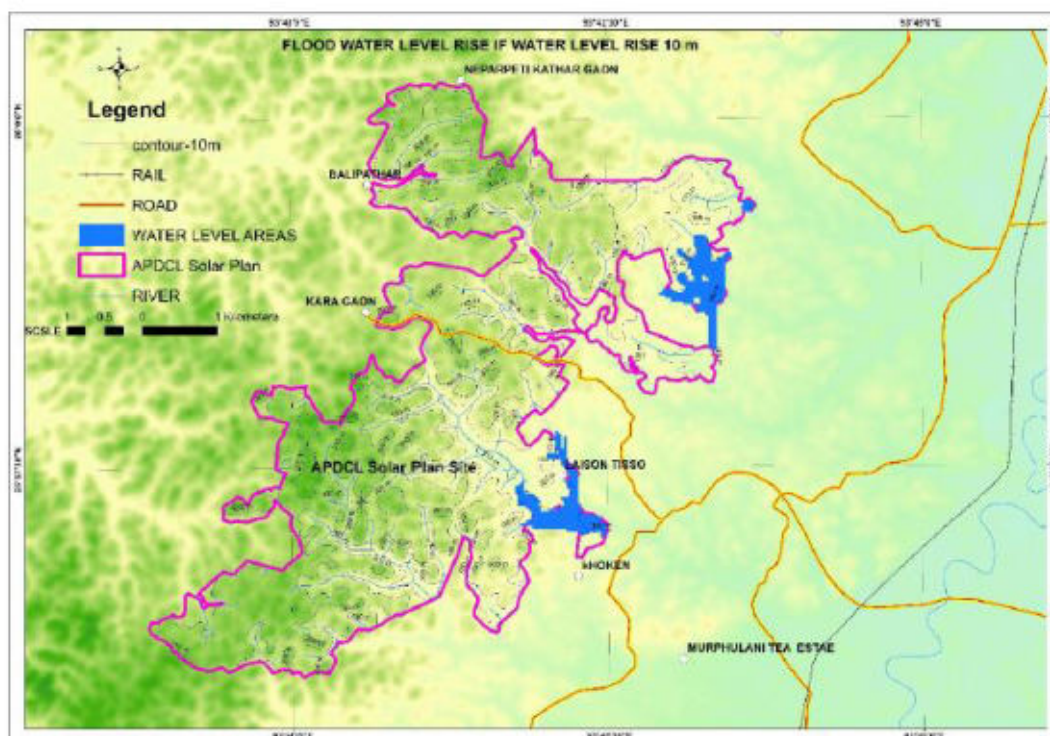
Source: Flood Prediction Study, Fichtner, 2023

**Figure 28: Modelled Flood Water Level, 5m**



Source: Flood Prediction Study, Fichtner, 2023

**Figure 29: Modelled Flood Water Level, 10m**

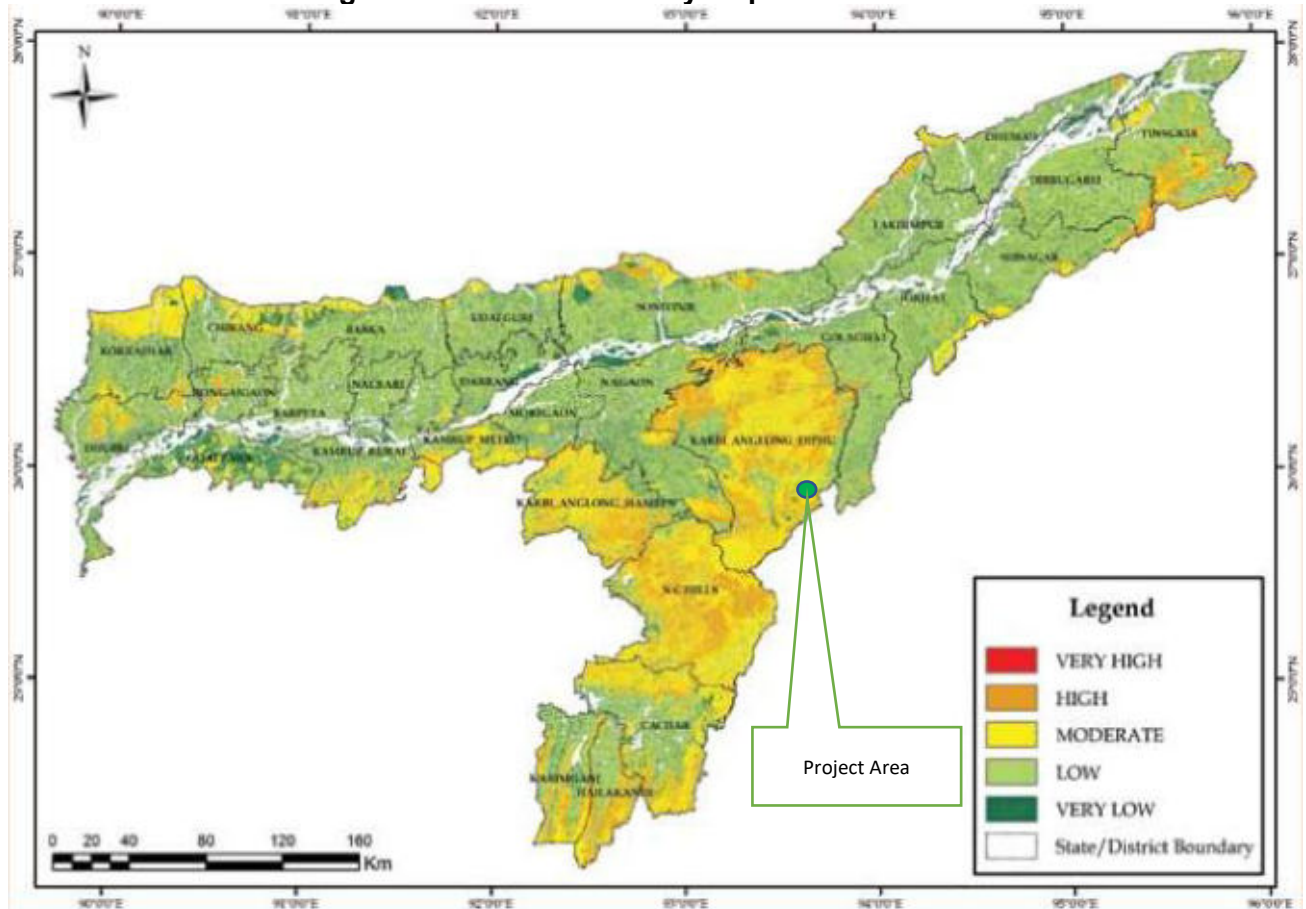


Source: Flood Prediction Study, Fichtner, 2023

## Forest Fires

305. A forest fire assessment<sup>25</sup> completed in 2014 indicated that Karbi Anglong is at moderate to low risk of forest fires. The assessment noted that Assam, and northeast India in general is subjected to man-made forest fire, in particular, for shifting cultivation. Evergreen/semi-evergreen forest is at highest vulnerability followed by deciduous forest and the least is for alpine forest. The assessment also noted a higher fire frequency in forest lying at 50-100m from roads with the minimum fire frequency observed at a distance of 150-200m. Further, the maximum fire incidences occurred at a distance 1000-1500m and the minimum at 2500-3000m from built-ups or settlement area.

<sup>25</sup> Forest Fire Assessment in Northeast India. North Eastern Space Applications Center, 2014

**Figure 30: Fire Vulnerability Map of Assam**

Source: <https://nesac.gov.in/assets/resources/2020/12/Forest-Fire-Assessment-in-NER.pdf>

## Tsunami

306. Tsunami cannot happen in Assam as it is landlocked.

## Landslides

307. There are no risks of landslides in the SPP and SPP TL area.

## 6.2.4 Climate

308. Karbi Anglong has a diverse climate due to various topographic features. The region, which combines plains and hills, has various climates throughout the region. Owing to the considerable variation in its topography, the entire district undergoes distinct climatic conditions across its different sections. Due to the circular airflow patterns of the southwest monsoon over the lower hills in the district, summer temperatures tend to be higher compared to the adjacent plains. The summer atmosphere is characterized by high humidity, leading to a rather uncomfortable climate. During summer temperatures span between 22 to 38°C. In contrast, winter, prevailing from October to February, brings milder temperatures ranging from 9 to 25°C.

309. The climate of Karbi Anglong district can be characterized by tropical monsoon humid climate with an average annual rainfall of about 1,700 mm, most of which receives from the southwest monsoon. The span from June to August marks the wettest phase in the

district, characterized by humid conditions and an overcast sky. This period witnesses the onset of monsoon rains, often beginning with scattered heavy showers.

310. Notably, June, July, and August stand out as the rainiest months. The eastern slopes receive notably more precipitation compared to their western counterparts. This disparity arises due to the rain shadow effect emanating from the Meghalaya plateau. Conversely, the winter months are primarily dry. Although September and October see a few diminishing monsoon showers that result in a relatively abrupt decrease in temperature, the rainfall during this phase seldom surpasses 350 mm.

311. Winter fogs are a common occurrence across the hills. These fogs are transported by easterly winds from the Brahmaputra plains, blanketing the entire northern foothills. Sometimes, these fogs persist for extended periods in the mornings. In the interior highland regions, afternoon fogs tend to form. These fogs descend from elevated areas in the morning, enshrouding valleys and plains for a significant portion of the morning hours.

**Figure 31: Climatic Conditions**

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)
	Daily Maximum	Daily Minimum	0830 hour	1530 hour	
Jan	23.6	11	88	70	12
Feb	26.3	12.8	78	56	22
Mar	29.8	16.4	68	50	58
Apr	30.6	20.3	75	62	188
May	31.4	22.9	79	70	243
Jun	32.2	25.2	83	77	295
Jul	32.1	25.8	84	80	326
Aug	32.6	25.8	83	80	266
Sep	31.8	24.9	83	81	198
Oct	30.6	22.3	83	79	121
Nov	28	17.3	84	77	16
Dec	24.9	12.5	87	76	6
Annual Total or Mean	29.5	19.8	81	72	1752

Source: Climatological Table 1981-2010, IMD, New Delhi

## Wind and Cyclone

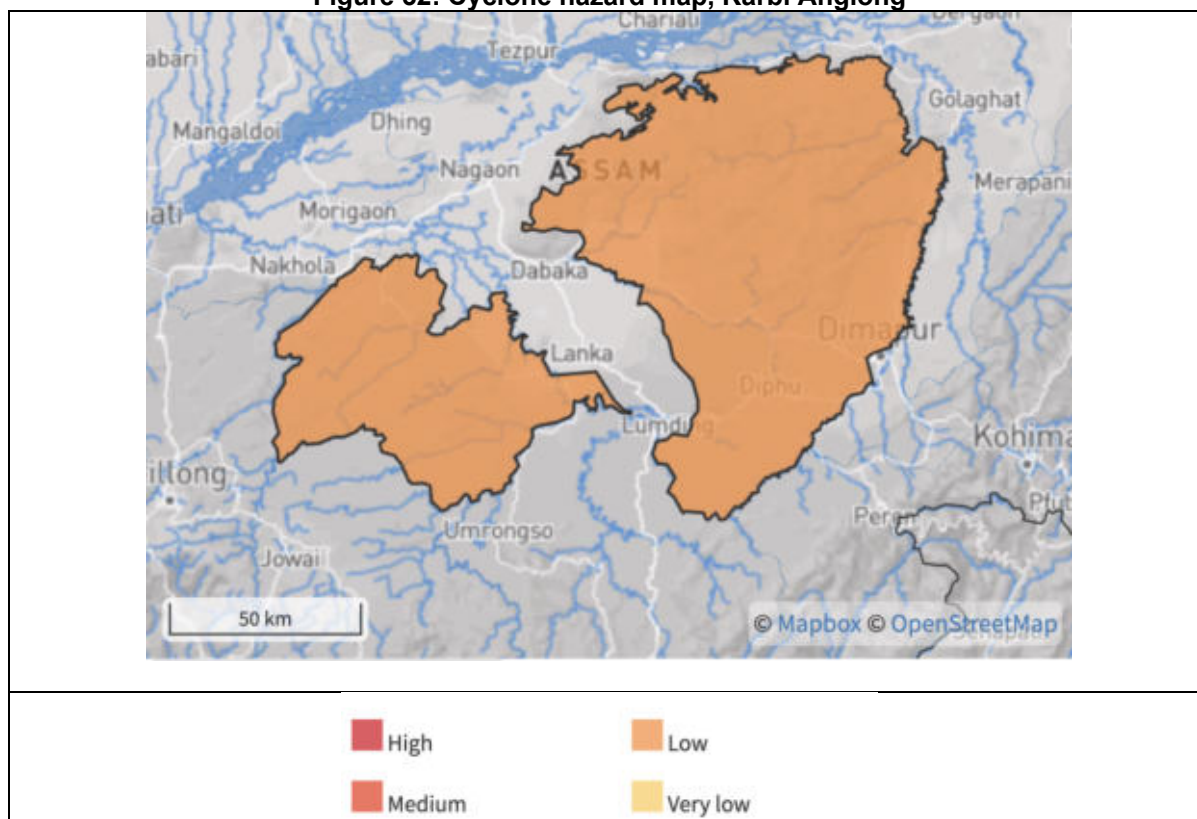
312. As per IS 875 - Part3:2015, the sites lie in a wind speed zone of 50m/s, which is considered as high damage wind zone. Due to its hilly terrain, the district is at risk of experiencing seasonal storms, particularly from March to May. The entire region could encounter significant damage from these storms, including the uprooting of trees, destruction of houses, disruption of communication networks, and harm to paddy fields.

313. In Assam cyclone hazard is overall classified as high. This means that there is more than a 20% chance of potentially damaging wind speeds in the state in the next 10 years<sup>26</sup>. The SPP although falls under Low Damage Risk Zone as shown in Figure 32.

<sup>26</sup> <https://thinkhazard.org/en/report/1487-india-assam/CY>



**Figure 32: Cyclone hazard map, Karbi Anglong**



Source: <https://thinkhazard.org/en/report/1487-india-assam/CY>

## 6.2.5 Climate Change

314. The following section provides extracts from the Project Climate Risk and Vulnerability Assessment Report <sup>27</sup>. The section summarizes key climate trends observed during the study period, 1951-2010.

### Temperature

315. Averaged annual mean maximum temperature time series has shown significantly increasing trends in Assam and is  $(+0.01) ^\circ\text{C}/\text{year}$  during 1951–2010 (study period). At the same time, averaged annual mean minimum temperatures have also shown significantly increasing trends in Assam and is  $(+0.01) ^\circ\text{C}/\text{year}$  during the study period. Annual mean diurnal temperature range (DTR) trends have shown no trends in Assam. Annual mean temperatures have increased significantly over all Assam. The study indicates increasing trend in winter mean maximum temperatures over Assam during 1951–2010. State averaged winter mean minimum temperatures have shown significantly increasing trends over Assam and is  $(+0.02) ^\circ\text{C}/\text{year}$ . Winter DTR has shown no trends over Assam. No trends have been observed for summer mean maximum temperatures. State averaged summer mean minimum temperatures have increased and is  $(+0.01) ^\circ\text{C}/\text{year}$ . Summer mean temperatures have shown no significant trends over Assam. Summer DTR showed significantly decreasing trends over Assam and is  $(-0.01) ^\circ\text{C}/\text{year}$ .

<sup>27</sup> Fichtner, 2023

## Rainfall

316. State averaged annual rainfall trend, summer season rainfall trend, monsoon and post monsoon rainfall trend have been decreasing over Assam while increasing trends have been observed over Assam only in winter season.

## Drought

317. Assam has been traditionally affected by floods; however, in the last few decades, droughts have occurred due to erratic rainfall patterns. A recent study showed that in Assam, the percentage of drought in August and September that represented monsoonal drought was about 15% during the course of 70 years. Additionally, Assam's overall percentage of drought was at 14.5%, indicating that dryness will occur throughout the year regardless of the season. The most hit district in terms of the number of times was Bishwanath Chariali, and the least affected was Karbi Anglong.<sup>28</sup>

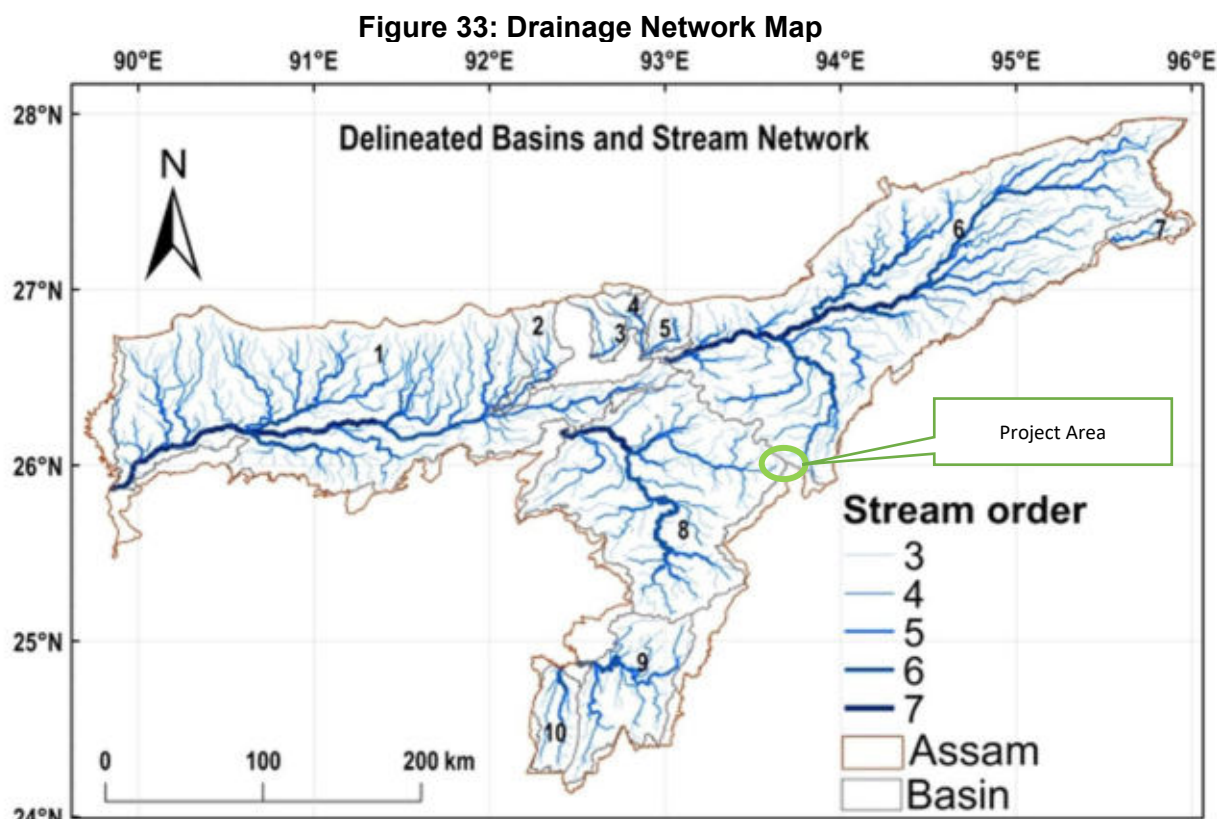
## 6.2.6 Hydrology and Water Use

### Surface water

318. The Brahmaputra flows down the plain of Assam east to west for 640 km up to Bangladesh border. Through its course, the river receives numerous tributaries (about 73) coming out of the northern, north-eastern and the southern hill ranges. The river with many tributaries drains an area of 56,480 km<sup>2</sup> of the state accounting for 72% of its total geographical area. Most of the right bank tributaries of Brahmaputra are well rainfed and are perennial while the left bank tributaries are mainly rainfed but perennial in nature. The drainage network of Karbi Anglong forms the upper catchment of Dhansiri river, Jamuna and Kopili rivers.

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<sup>28</sup> Singh, W.R., Barman, S., Vijayakumar, S.V. *et al.* Drought assessment in the districts of Assam using standardized precipitation index. *J Earth Syst Sci* 133, 43 (2024). <https://doi.org/10.1007/s12040-024-02256-9>



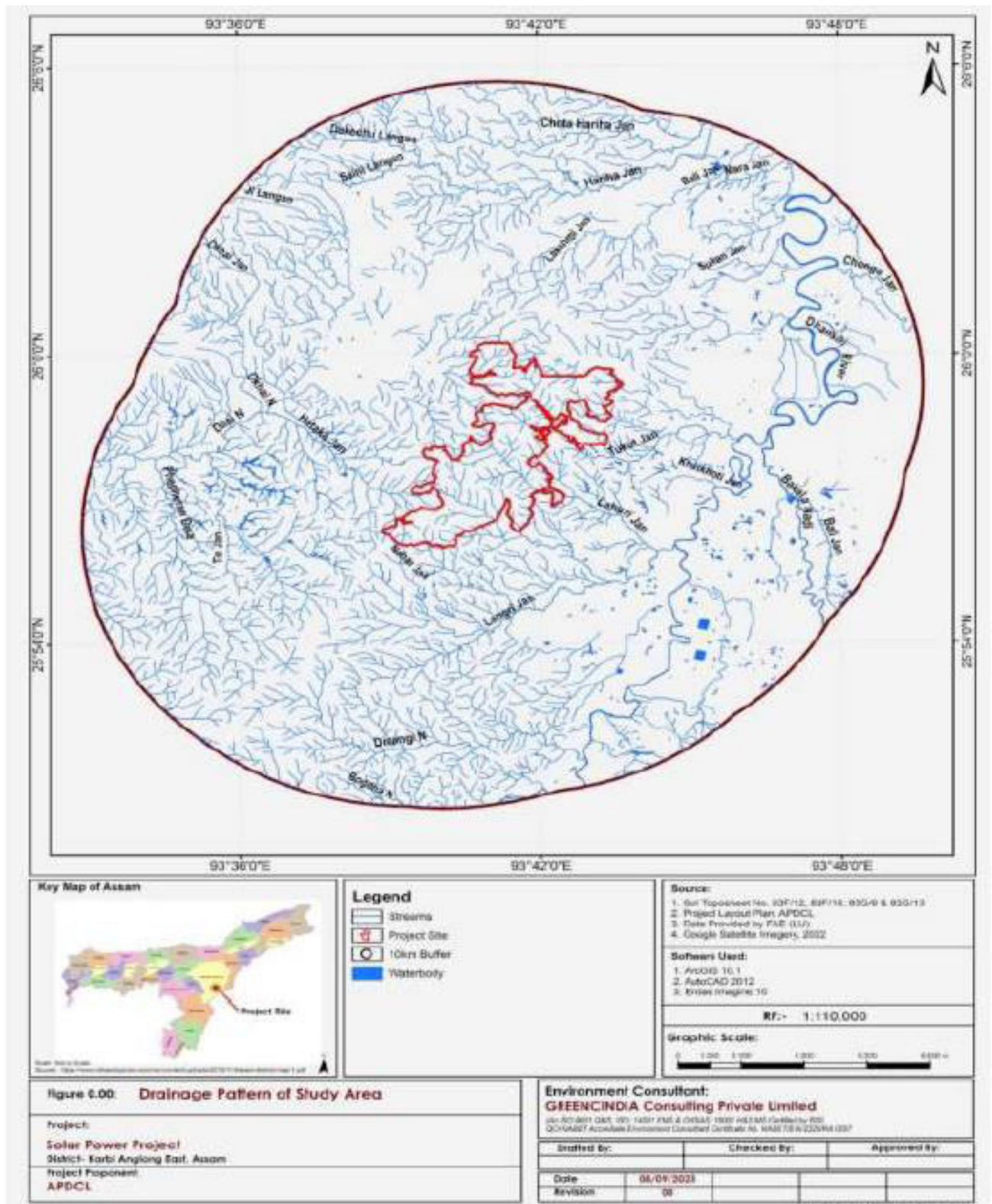
319. At district level, the rivers Dhansiri, Jamuna, Kaliyani, and Diphu are primarily responsible for influencing the watercourse configuration in Karbi Anglong. According to hydrogeological classifications, the area can be divided into three separate divisions, such as consolidated formations made up of the oldest granite rock type, gneisses, semi-consolidated rocks making up Tertiary rocks, and unconsolidated alluvial deposits. As illustrated by Figure 34, most of the SPP site drains east towards the Dhansiri and its tributaries.

**Table 36: Important Rivers in Karbi Anglong**

Name	Length in the District (km)	Place of Origin	Altitude of Origin (m)
Dhansiri	306	Laisang peak of Nagaland	122
Jamuna	226	Suiling Palteau	140
Kaliyani	99	Amringo Karbi Plateau	148
Deopani	27	Karbi Plateau	133

Source: District Irrigation Plan, Karbi Anglong

Figure 34: Drainage Map



Source: DPR, 2023

320. Surface water within the SPP boundary is limited to some small streams draining water from the site, less than a meter in width, see Figure 35. A wider, permanent stream flows beneath the SPP TL close to the tapping point with the existing HV OHL (Figure 36).

According to local villagers, the stream occasionally bursts its banks during high rainfall periods, resulting in localized flooding. Some small ponds have been dug around the SPP to provide water for irrigation and cattle.

Figure 35: Block 3 stream



Figure 36: Stream crossing SPP TL



Source: IEE Team, February 2024

Figure 37: Recently dug irrigation pond



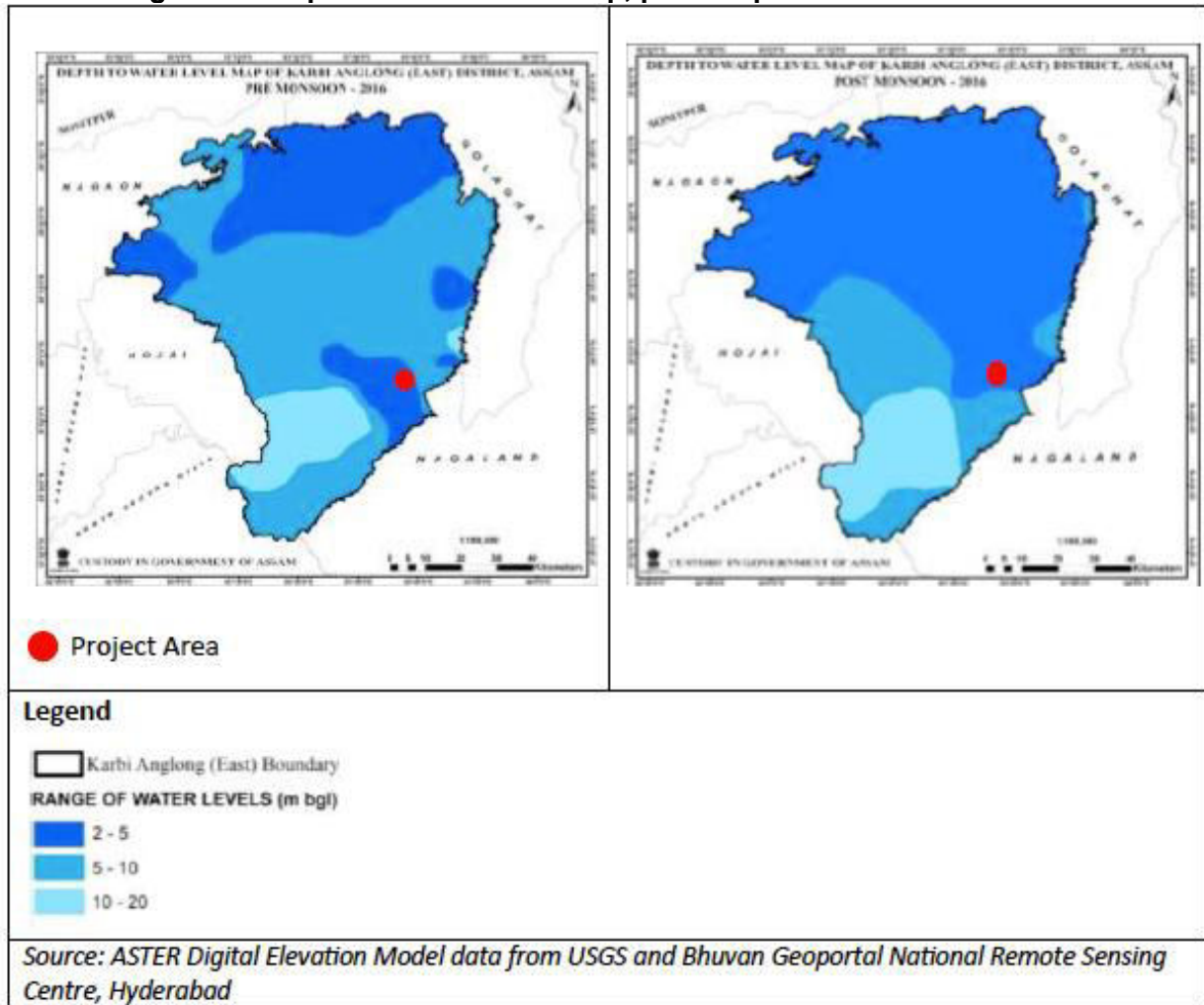
Source: IEE Team, February 2024

## Groundwater

321. In general, the groundwater level in the district varies according to local topographic conditions, i.e., in areas close to the undulating inselbergs / residual hills, water level is deeper and in areas situated in relatively flat alluvial plains water level is at a shallower depth. The depth to water level varies from 4 to 6 m in low terraced zone and 8 to 10 m in high terraced zones. In small valleys within denudational hills, the static water level is 5 to 7 m bgl with water level fluctuation ranging from 2 to 3 m. It has been observed that the water level during pre-monsoon ranges from 1.02 to 22.40 m bgl and during the post

monsoon water level ranges from 0.75 to 16.80 m bgl. The maximum depth to water level during pre-monsoon is 22.41m bgl at Diphu.

**Figure 38: Depth to Water Level Map, pre and post monsoon - 2016**



322. Based on the tube well data drilled by the Central Ground Water Board (CGWB) the subsurface aquifer geometry is visualized as follows:

- The shallow aquifer constitutes mixture of sand, clay with little gravel. Its thickness varies from 15 to 30 m. Ground water occurs under water table to semi-confined conditions.
- The deeper aquifers consist of fine to coarse sand and gravel with intercalation of clay bands. 3 to 6 aquifer zones are demarcated within stipulated depth.

323. Few dug wells are located within the site area. Monsoon water table has been recorded in those wells. The water table varies from 1.80 m to 2.20 m below ground surface in those wells.

324. The Project Hydrology Study (Fichtner, 2023) indicates that *“In the site proper, ground water is likely to be available within fractured rocks in small quantity (1000-2000 liters per hour) but pinpointed locations for drilling can be ascertained only after detail Resistivity survey and pump test.”* This suggests that a minimum of 24m<sup>3</sup> per day is available from extraction from the site, but this should be confirmed during detailed design.

325. Further, future climate change projections discussed in the DPR indicate that it is likely that the Assam state will become increasingly at risk from the effects of climate change. Increasing temperatures, decreasing water availability and more intense storm event will each cause impacts independently, and in some cases in combination. This could lead to change in seasonal water availability and minor disruptions to cleaning and increasing treatment costs.

## Water Use

326. According to data collected as part of the RIPP social survey most households use handpumps for drinking water (65%) while 33% use well water, and only 4% have access to piped water supply. Among them 70% have access to drinking water within the premises and 30% have it outside the premises. Details are given in Table 37.

**Table 37: Source of drinking water for the Households**

#	Source of drinking water	Household	%
1	Piped supply	14	3.8
2	Well	122	32.8
3	Pond / river	1	0.3
4	Hand Pump	241	64.8
	Total	372	100.0

Source: Source: APDCL, Nov 2023 - Dec 2023

327. The survey found that 46% of the household collect water within 10 meters and 43% collect water within 11-25 meters and 7% of the household collect from over 50 meters. The average distance of the source of drinking water is 22.6 meters and the average time spent is 6.58 minutes for collection of water. For details refer to Table 38

**Table 38: Distance of Main source of Water**

#	Distance of the main source of water	Household	%
1	Within 10 meters	50	45.5
2	11 to 25 meters	47	42.7
3	26 to 50 meters	5	4.5
4	More than 50 meters	8	7.3
	Total	110	100.0
5	Average distance	22.6 meters	
6	Average time for collection	6.68 minutes	

Source: Source: APDCL, Nov 2023 - Dec 2023

328. The survey found that in 95% of the households, both men and women are responsible for collecting water from outside premises while in only 5% of the household, only women have the responsibility to collect water from outside sources. For details refer to Table 39.

**Table 39: Person who collects water from outside sources**

#	Person	Household	%
1	Men	0	0.0
2	Women	5	4.5
3	Both	105	95.5
	Total	110	100.0

Source: Source: APDCL, Nov 2023 - Dec 2023

**Figure 39: Groundwater well close to SPP TL alignment**



Source: IEE Team, February 2024

## **6.3 Biological Environment**

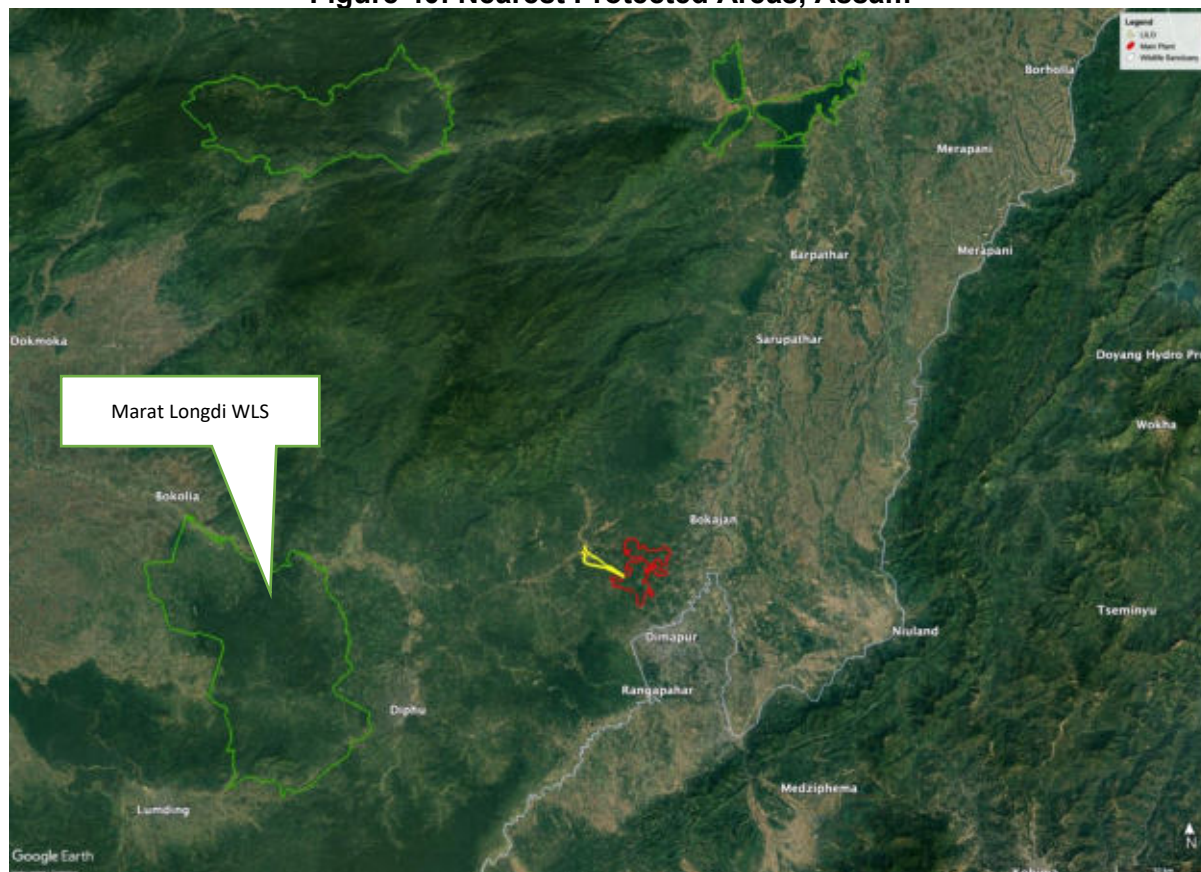
### **6.3.1 Protected Areas and Notable Ecological Sites**

#### **Nationally Protected Areas**

329. Protected areas (PA) in Assam occupy 3925 square km in area and constitute about 5% of the state's geographical area. The PAs include 5 National Parks and 17 Wildlife sanctuaries as well as 3 proposed Wildlife Sanctuaries, 4 Tiger Reserves, 5 Elephant Reserves, 2 Biosphere Reserves and 2 World Natural Heritage Sites. The nearest wildlife sanctuary in Assam is the Marat Longdi WLS at a distance of 26.3 km towards the western side of the SPP, see Figure 40.



**Figure 40: Nearest Protected Areas, Assam**



Source: IEE Team

330. The nearest wildlife sanctuary in Nagaland is the Rangapahar WLS at a distance of 9 km towards the southeast side of the SPP area, see Figure 41.

331. Presently, Assam has two UNESCO Natural World Heritage Sites - Kaziranga National Park and Manas National Park. Both the SPP and SPP TL are located more than 80km from these sites.

### Eco-sensitive Zones

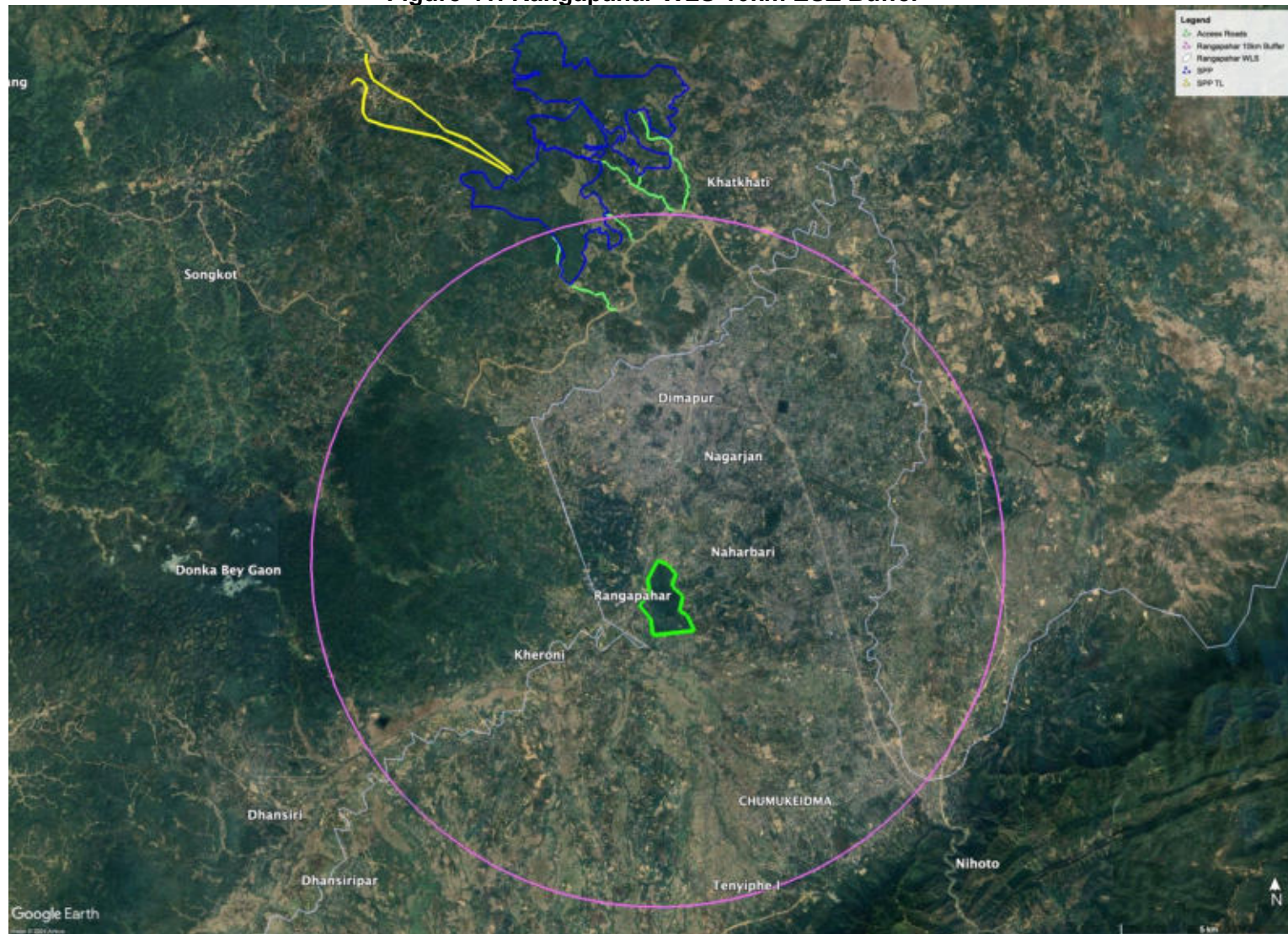
332. Eco-Sensitive Zones (ESZs) are areas around protected areas e.g., National Parks and Wildlife Sanctuaries notified by MoEF&CC, Government of India, under the Environment Protection Act 1986.<sup>29</sup> The basic aim is to regulate activities around protected areas so as to minimise negative impacts on the ecosystems of the protected areas. The ESZs of all the NPs and WLSs in Karbi Anglong are gazetted by the MoEF&CC with the exception of Deepor Beel WLS which has a notified ESZ. Neither the SPP, or the SPP TL fall within any notified ESZ, or a 10 km ESZ buffer from Assam PAs.

333. The MoEF&CC are yet to notify the ESZ for Ragapahar WLS in Nagaland. Until notified a 10km buffer applies around the site boundary. The SPP (and its access roads) is partially within this ESZ 10km buffer. No other parts of the SPP or SPP TL are located within ESZs for Nagaland PAs.

<sup>29</sup>

<https://moef.gov.in/wp-content/uploads/2017/06/1%20Guidelines%20for%20Eco-Sensitive%20Zones%20around%20Protected%20Areas.pdf>

Figure 41: Rangapahar WLS 10km ESZ Buffer



Source: IEE Team

334. According to the Guidelines for Declaration of ESZ Around National Parks and Wildlife Sanctuaries, the following activities are prohibited, regulated, and permitted:

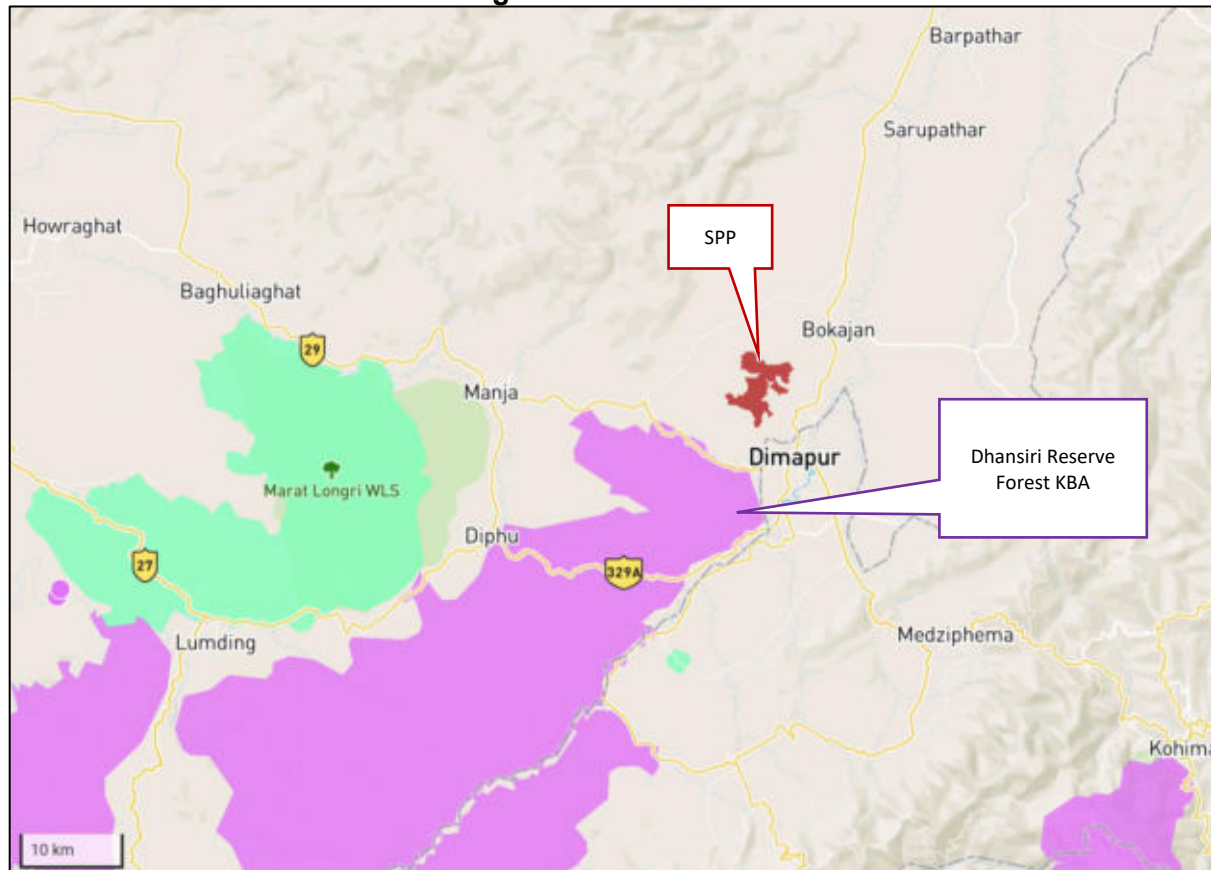
- Felling of trees – Regulated (with permission from appropriate authority)
- Setting industries causing pollution (water, air, soil, noise, etc.) – Prohibited
- Erection of electrical cables – Regulated (promote underground cabling)
- Widening of Roads – Regulated (through proper EIA). **APDCL communications with the Assam DFO and Public Works Department (PWD) have indicated that EIA is not needed for the road upgrading works but it needs to be confirmed with Nagaland no further permissions are needed since the ESZ applies to their WLS.**
- Use or production of any hazardous substances – Prohibited
- Discharge of effluents and solid waste in natural water bodies or terrestrial area – Prohibited

335. **There are no restrictions on the construction of solar power plants within ESZ.**

#### **Internationally Designated Sites**

336. Several important bird areas (IBAs) and Key Biodiversity Areas (KBAs) are found in Assam, the most relevant of which is the Dhansiri Reserve Forest KBA which is located approximately 6km southwest of the SPP (Annex C). Dhansiri Reserve Forest is also an IBA and is the second largest Reserved Forest in Assam (BirdLife International 2024a). The site was recognized as important for two Critically Endangered species of vulture (Key Biodiversity Areas Partnership 2024b), but there do not appear to be any recent records of these species from the site. The site was also recognized for the Endangered Green Peafowl (*Pavo muticus*) – now stated to be extirpated from the site (BirdLife International 2024a) – and White-winged Duck. Based on available information, this latter species seems unlikely – despite the size of the site – to have more than five reproductive units (breeding pairs) present. The Dhansiri Asian Elephant population, shared with the neighboring Lumding Reserved Forest, represents about 0.5% of the global population.

Figure 42: IBA/KBAs

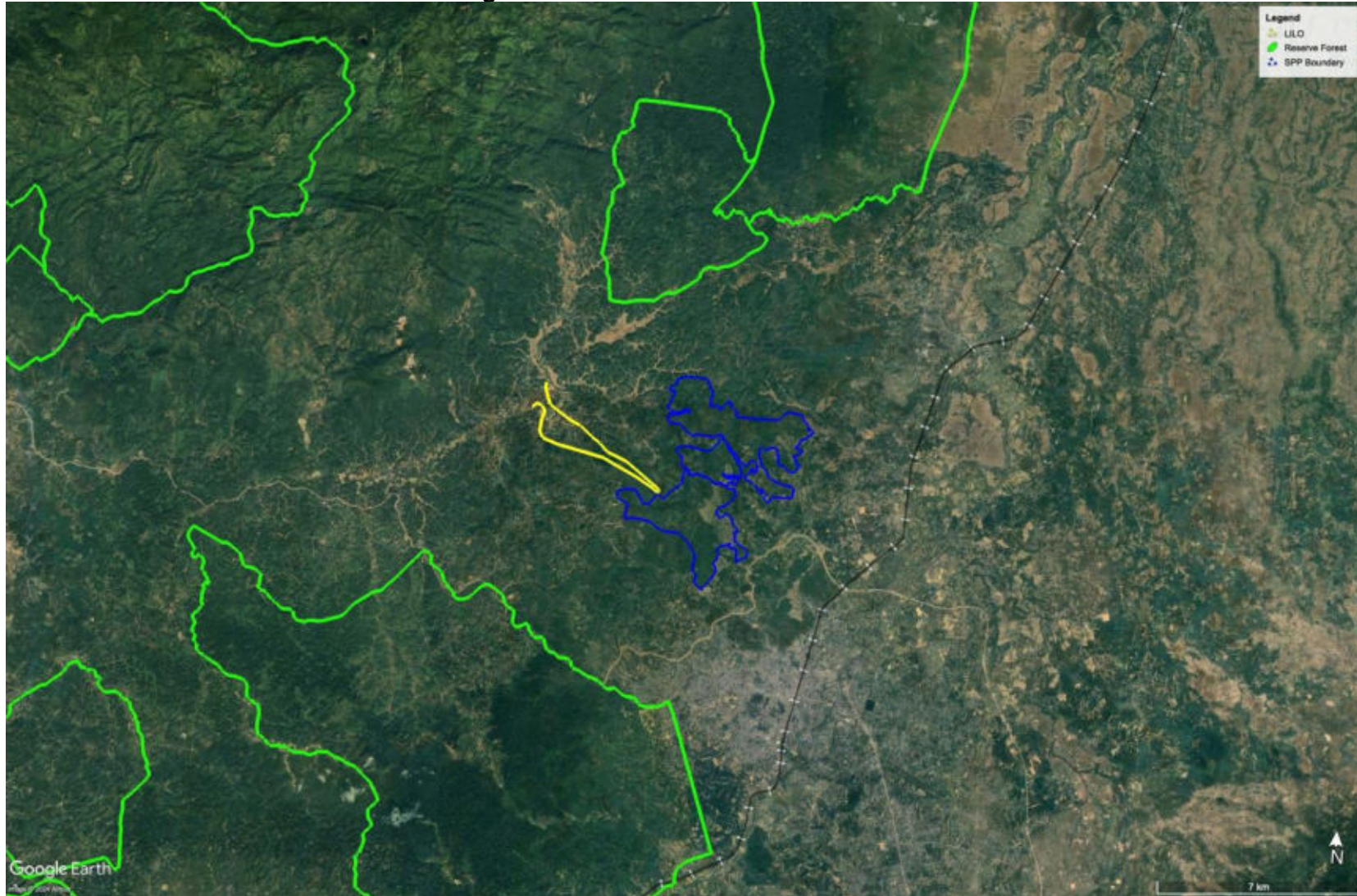


Source: IBAT 2024

### 6.3.2 Reserve Forests

337. Reserve forests (RF) are the most restricted forests and are constituted by the State Government on any forest land or wasteland which is the property of the Government. Reserved Forests are not considered legally protected areas by the Government of India. As such, Reserved Forests are treated separately from 'protected areas'
338. In reserved forests, local people are prohibited, unless specifically allowed by a Forest Officer in the course of the settlement. There are no reserve forests within 2.5km of the SPP and SPP TL, the nearest being Hidipi RF (2,724 hectares).

Figure 43: RF Around the SPP / SPP TL



Source: Karbi Anglong District Forest Office

### 6.3.3 Critical Habitat

339. A critical habitat assessment (CHA) of the Project including Outputs 1 and 2 has been undertaken and is included in full as Annex C. The CHA concluded that the SPP TL area of analysis (AoA) and SPP freshwater AoA qualify as ADB Critical Habitat because they both overlap a Key Biodiversity Area and the SPP TL AoA potentially also supports Critical Habitat for a migratory, Critically Endangered bird species – Bengal Florican. The SPP terrestrial AoA potentially qualifies as Critical Habitat because it overlaps two Reserved Forests (Table 40).

**Table 40: ADB Critical Habitat-qualifying biodiversity in the AoAs**

Biodiversity type	Species	ADB Critical Habitat criterion qualified <sup>30</sup>						Justification
		1	2	3	4	5	6	
1.Bird	Bengal Florican Houbaropsis bengalensis	✓						The SPP TL AoA could well seasonally support a globally significant proportion of this Critically Endangered migratory species' population.
2.Reptile	Black Softshell Turtle Nilssonia nigricans	✓						The SPP freshwater AoA may potentially support a globally significant proportion of this Critically Endangered species' population.
3.Reptile	Assam Roofed Turtle Pangshura sylhetensis	✓						The SPP freshwater AoA might possibly support a globally significant proportion of this Critically Endangered species' population.
4.Site	Dhansiri Reserve Forest Key Biodiversity Area						✓	Partially overlapped by the SPP TL AoA and SPP freshwater AoA, and likely to hold globally significant populations of Endangered Asian Elephant.
5.Site	Reserved Forest						?	Two in the terrestrial AoA which might possibly hold significant populations of restricted-range species (notably plants), or actually/potentially hold significant populations of other Critical Habitat-qualifying plants and/or animals.

340. The following summarizes the status of the identified species within the context of the SPP and SPP TL.

- **Bengal Florican** - Almost 0.7% of the global distribution of this globally Critically Endangered bird species is mapped as occurring within the SPP TL AoA (BirdLife International 2024i). The species' global population could be as low as 375 mature individuals, with >100 males in North East India (of which about half are in D'Ering Wildlife Sanctuary (BirdLife International 2024i). It is at high collision risk with

<sup>30</sup> ✓ = qualifies, or likely qualifies, the project AoA as supporting Critical Habitat. Based on available information. Critical Habitat criteria per ADB (2009): (1) Critically Endangered or Endangered species; (2) restricted-range or endemic species; (3) migratory or congregatory species; (4) unique assemblages of species that are associated with key evolutionary processes; (5) areas having biodiversity of significant social, economic, or cultural importance to local communities; and (6) including legally protected and internationally recognised areas which are supporting high biodiversity.

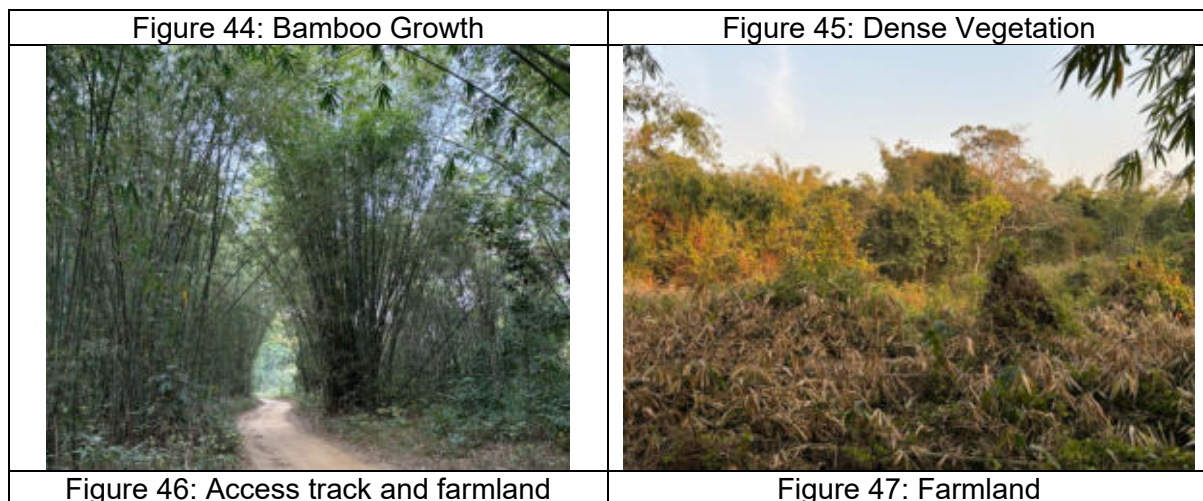
powerlines (Mahood *et al.* 2016). This species breeds in lowland grasslands but disperses widely into other grassland or similar cultivated habitats after breeding, at which time it is very difficult to detect.

- **Black Softshell Turtle** - This Critically Endangered species is restricted to the Brahmaputra River and its tributaries, as well as the Meghna River system and Karnaphuli River in Bangladesh (Praschag *et al.* 2021a). The SPP itself has no permanent streams (Sivasamy K, Fichtner Consulting Engineers, *in litt.* 2024), so it is unlikely to hold a significant population of this species. However, the SPP freshwater AoA extends over a larger area, and covers almost 0.7% of the species' mapped Extent of Occurrence (Praschag *et al.* 2021a).
- **Assam Roofed Turtle** - This Critically Endangered species is known only from foothills below 200 m around the Brahmaputra valley in Bangladesh and Northeast India (Praschag *et al.* 2021b). The solar plant is around 200 m elevation, but has no permanent streams (Sivasamy K, Fichtner Consulting Engineers, *in litt.* 2024), so it is unlikely to hold a significant population of this turtle. The solar freshwater AoA extends over a larger area, covering about 0.4% of the species' mapped Extent of Occurrence (Praschag *et al.* 2021b). On a precautionary basis, particularly given reports that hunting is limited in the SPP (Sivasamy K, Fichtner Consulting Engineers, *in litt.* 2024) and so turtle populations may be higher than elsewhere, Assam Roofed Turtle might possibly qualify the solar freshwater AoA as Critical Habitat.

#### 6.3.4 SPP Natural and Modified Habitat

341. Initial habitat mapping undertaken by the national consultant team (GreenCIndia) was inconclusive if the site comprised only modified habitat or if natural habitat was found within the SPP boundary. The map below (Figure 48) was produced and shows how the SPP site is dominated by agriculture, plantations, scrubland and bamboo. Further site visits (and a review of aerial images on Google Earth) by the IEE Team undertaken in 2024 identified that there was a possibility for certain portions of the site to be classified as natural habitat, specifically some areas in the northern and southern sections of the SPP where sparse and dense vegetation was noted (also noted by the habitat mapping in Figure 48). Additional site visits by the national consultants were undertaken to collect further data which has subsequently been analyzed along with transects by the IEE team. Based on this additional data and further analysis of historical aerial images, a potential area of primarily natural habitat (about 94 hectares) has been identified within a portion of Block 6 extending slightly into Block 5, see Note; map shows earlier SPP site boundary and extension area which is not covered by the project scope (as such the extension area was not studied further for the IEE and may support natural habitat in addition to the 94 ha identified within the SPP site. It has the potential for support a large area of natural habitat given the presence of sparse and dense vegetation)

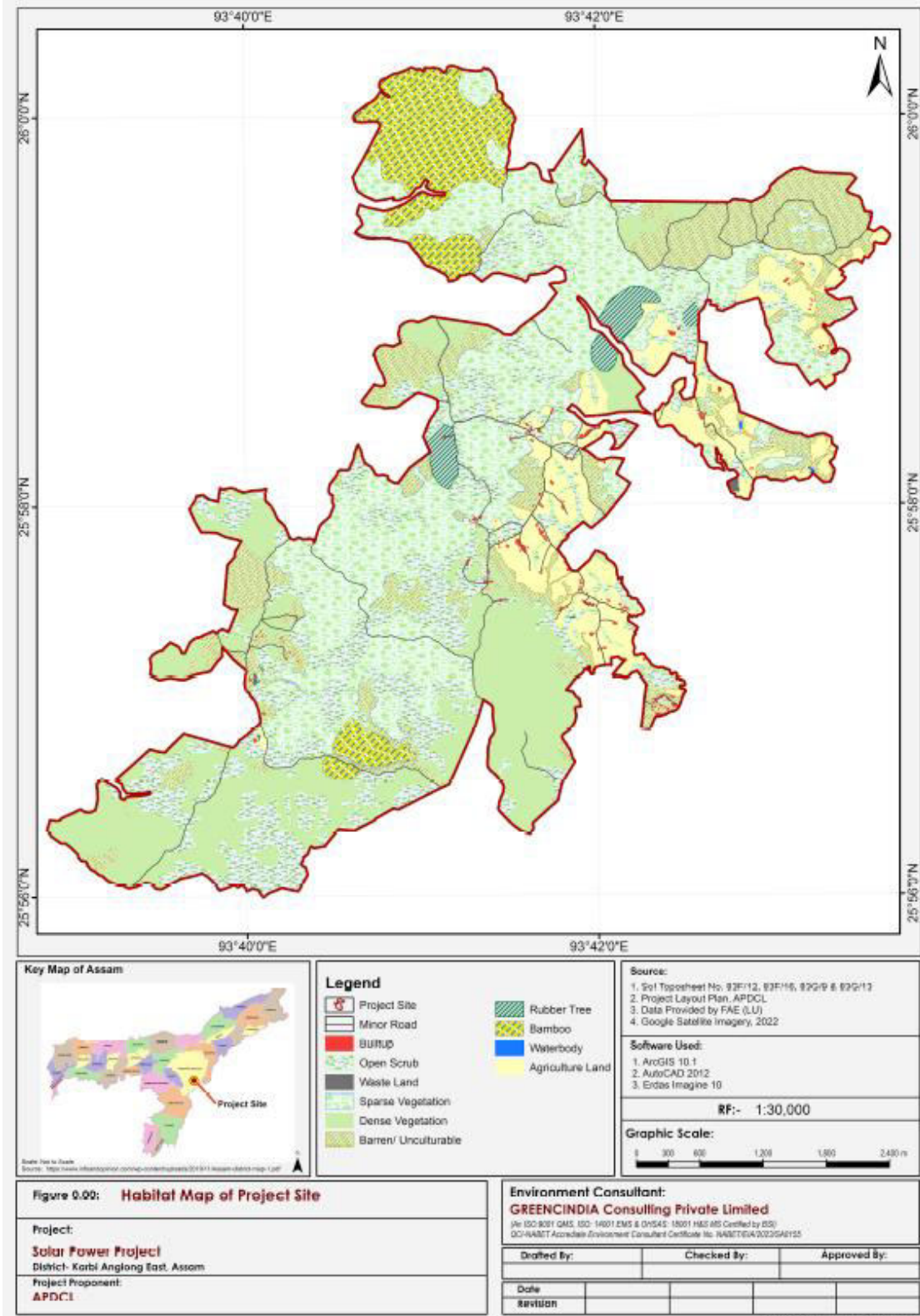
342. **Figure 49.** This natural habitat is not tall forest, but shorter, scrub forest, which is typical of this part of Assam. It is far from pristine natural habitat, it is degraded natural habitat e.g., with heavy logging, hunting, frequent clearings, and/or widespread invasive species but native species are still supported with secondary growth. The entire site would have supported similar habitat in years past but it has been subject to *jhum* cultivation (slash and burn) with evidence of recent clearing seen on Google Earth and actively ongoing at site by the local communities. Here there has been heavy degradation and major loss of native species. Thus, the remaining area of the SPP is defined as primarily modified habitat.





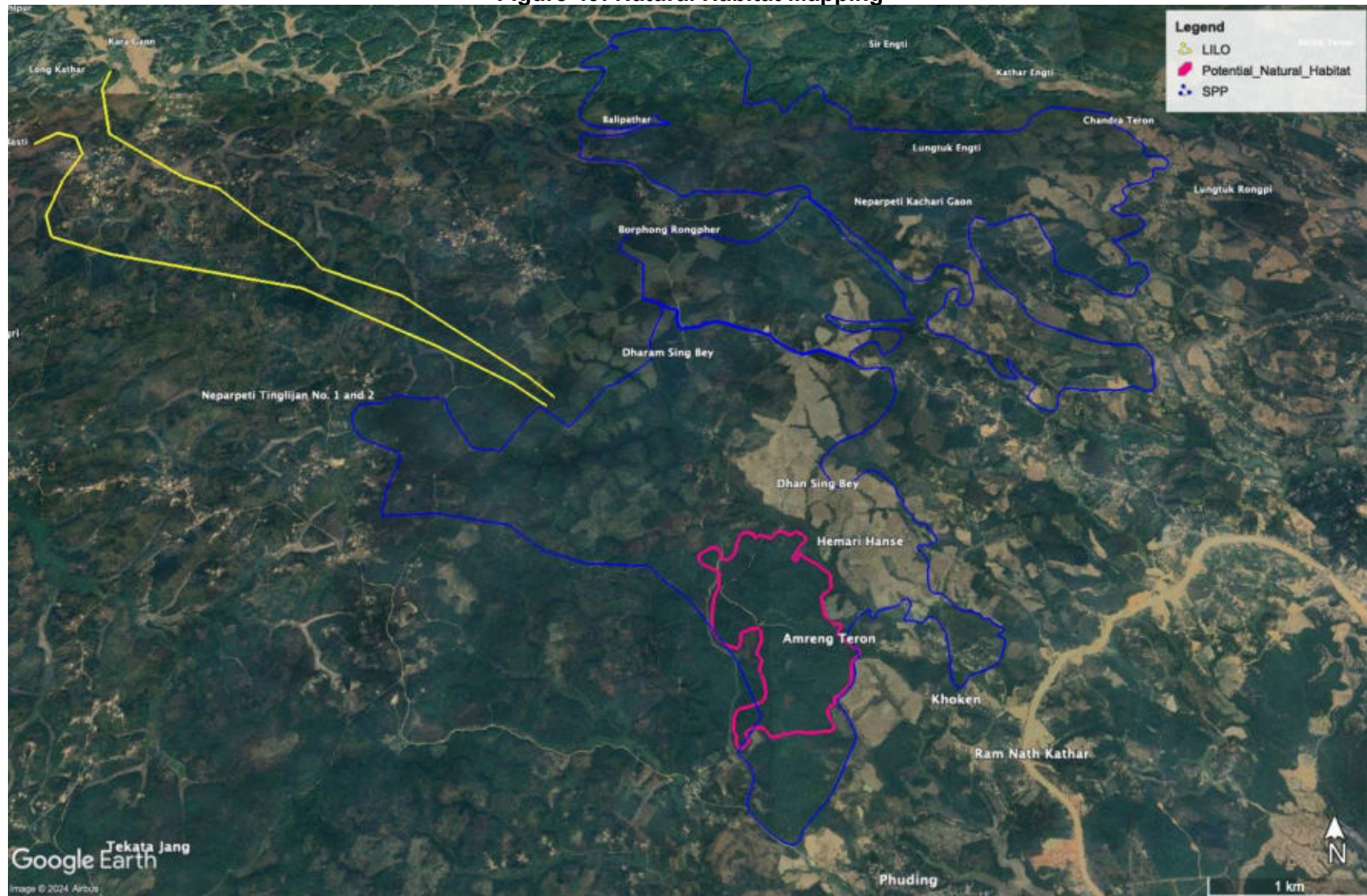


**Figure 48: Initial SPP Habitat Mapping**



Note; map shows earlier SPP site boundary and extension area which is not covered by the project scope (as such the extension area was not studied further for the IEE and may support natural habitat in addition to the 94 ha identified within the SPP site. It has the potential for support a large area of natural habitat given the presence of sparse and dense vegetation)

Figure 49: Natural Habitat Mapping

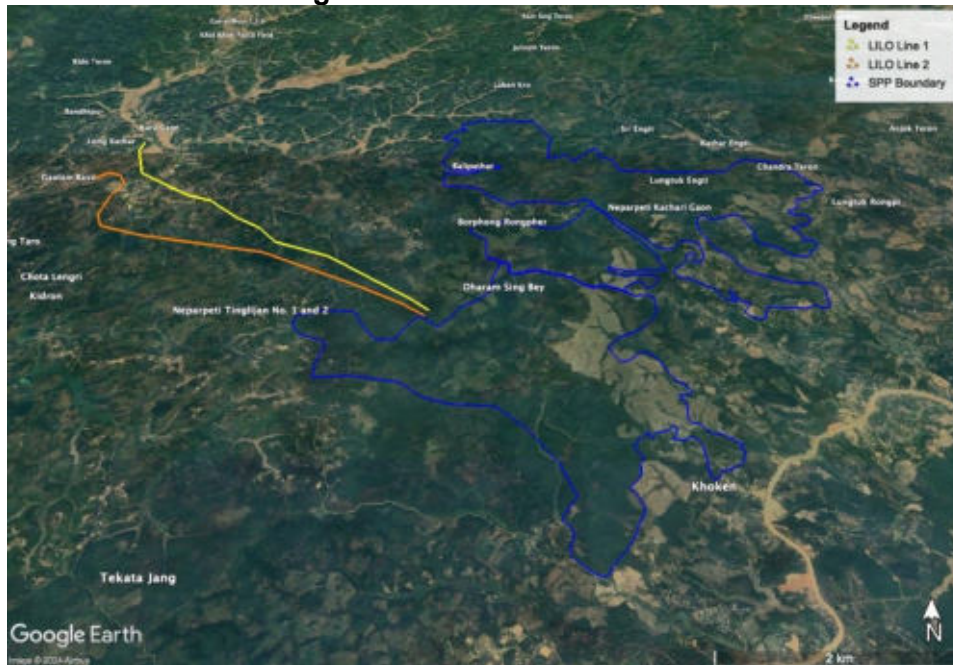


Source: IEE Team

### 6.3.5 SPP TL Natural and Modified Habitat

343. SPP TL habitat – Surveys of the SPP TL (LILO 1 and LILO 2) were completed in June 2024 to map vegetation cover and determine the presence of any natural habitat along the alignment.

**Figure 50: LILO 1 and LILO 2**



Source: IEE Team, 2024

344. Vegetation cover of the SPP TL was categorized into six categories viz.

- 0% - Absent (Habitat has been completely lost)
- 20% - Very Poor (Habitat that has been substantially damaged by human factors)
- 40% - Poor (Heavily degraded habitat, with major loss of native species e.g., modified)
- 60% - Moderate (More degraded natural habitat – e.g., with heavy logging, hunting, frequent clearings, and/or widespread invasive species)
- 80% - Good (Natural habitat which has been degraded in some way – e.g., selective logging, hunting, some clearings, and/or some invasive species)
- 100% - Benchmark (Pristine natural habitat; the best quality of the type in the region).

345. The following items indicate the status of the two LILO lines.

346. **LILO 1:** Out of total 5690 m length of LILO 1, 1515 m length has 20% vegetation cover, 3300 m length is with 40% vegetation cover mostly with bamboo and 875 m length is with 60% vegetation cover with secondary growth. This indicates that approximately 15% of the alignment is located within more degraded natural habitat.

**Table 41: LILO 1 Vegetation Cover**

Length (in m)	Land Use Land Cover	
	40%	20%
255	40%	20%
315	40%	20%
175	40%	20%
60	40%	20%
65	40%	20%
30	40%	20%
75	40%	20%
635	40%	20%
35	40%	20%
5	40%	20%
45	40%	20%
62	40%	20%
75	40%	20%
105	40%	20%
175	40%	20%
45	40%	20%
235	40%	20%
40	40%	20%
145	40%	20%
8	40%	20%
120	40%	20%
35	40%	20%
290	40%	20%
30	40%	20%
315	40%	20%
65	40%	20%
725	40%	20%
120	60%	20%
80	40%	20%
420	40%	20%
275	60%	20%
150	40%	20%
480	60%	20%

Source: Detailed assessment of flora and fauna within the project area under the proposed 400kV D/C LILO line of both circuits from 400kV Misa - New Mariani (POWERGRID) line to the switching sub-station at Bokajan. APDCL, 2024

347. **LILLO 2:** Out of total 6100 m length of LILLO 2, 690 m length is with 20% vegetation cover, 3585 m length is with 40% vegetation cover mostly with bamboo and 1825 m length is with 60% vegetation cover with secondary growth. This suggests that approximately 30% of the alignment is located within more degraded natural habitat.

**Table 42: LILLO 2 Vegetation Cover**

Length (in m)	Land Use Land Cover	
	60%	20%
1210	60%	20%
85	40%	20%
495	60%	20%
40	40%	20%
65	60%	20%
205	40%	20%
30	60%	20%
255	40%	20%
665	60%	20%
55	40%	20%
152	60%	20%
20	40%	20%
388	60%	20%
33	40%	20%
95	60%	20%
25	40%	20%
45	60%	20%
185	40%	20%
20	60%	20%
115	40%	20%
135	60%	20%
45	40%	20%
625	60%	20%
57	40%	20%
185	60%	20%
255	40%	20%
615	60%	20%

Source: Detailed assessment of flora and fauna within the project area under the proposed 400kV D/C LILLO line of both circuits from 400kV Misa - New Mariani (POWERGRID) line to the switching sub-station at Bokajan. APDCL, 2024

### 6.3.6 Tiger Corridors

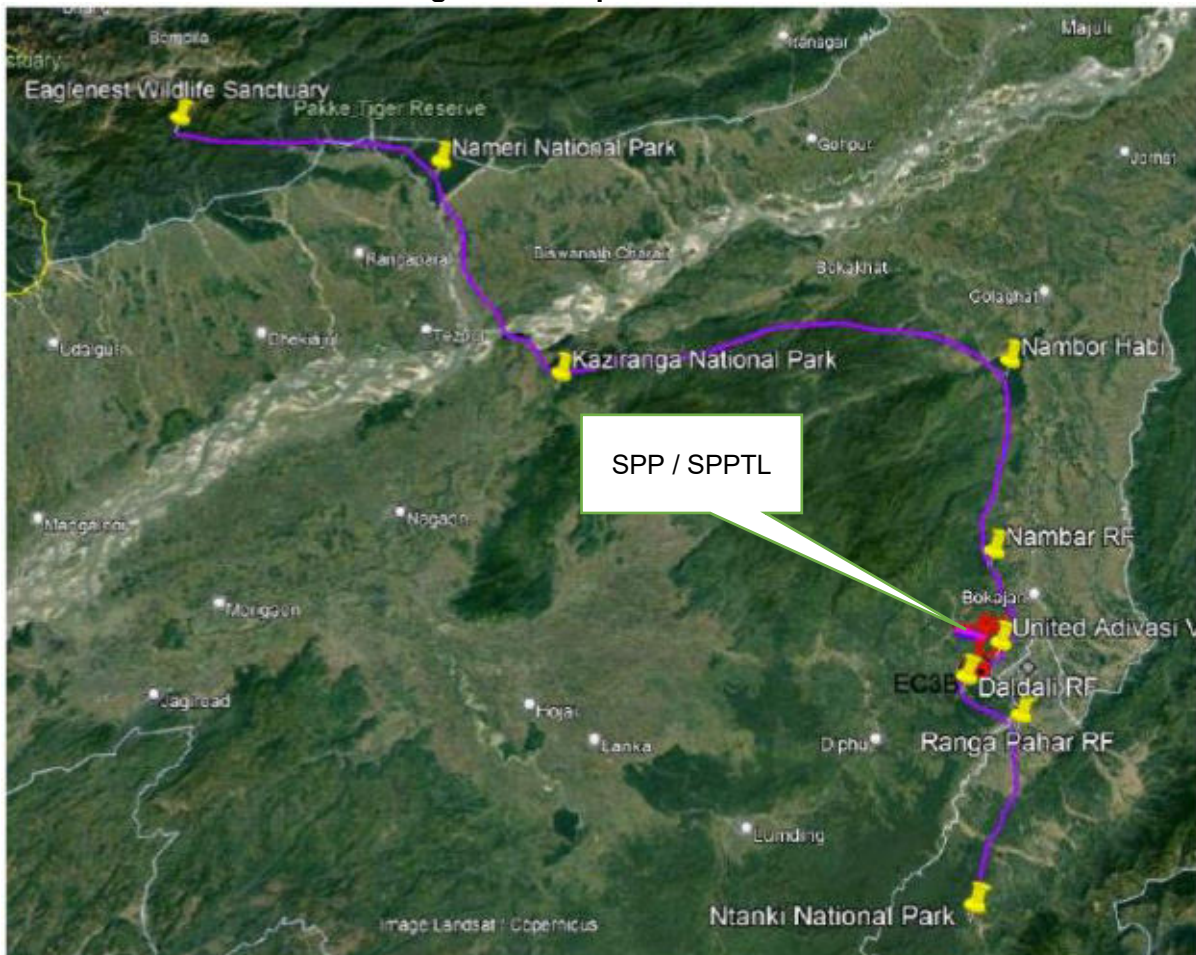
348. The National Tiger Conservation Authority in collaboration with the Wildlife Institute of India has published a document titled "Connecting Tiger Populations for Long-term Conservation", which has mapped out 32 major corridors across the country. It sets out management interventions for the corridors, which are operationalized through a Tiger Conservation Plan, mandated under section 38V of the Wildlife (Protection) Act, 1972. No tiger corridors have been identified within 50km of the SPP.

349. Anecdotal information received during site visits (February, 2024) indicated that there had been a recent tiger sighting in the one of the villages close to the SPP TL. The sighting was reported by several residents. Consultation with Karbi Anglong DFO (February, 2024) on this topic indicated that there could possibly be wandering tigers in the SPP and SPP TL areas, but it was not their main habitat and they would rarely be present.

### 6.3.7 Elephant Reserve Corridors

350. The nearest elephant reserve is coinciding with Reserve Forest and is about 4.5km distant. An unnotified elephant corridor, known as the Nahorlangso Elephant Corridor, is located approximately 4 kilometers from the SPP boundary, which supposedly starts from Ntangi National Park in Nagaland and tentatively goes through Kaziranga National Park, Nameri National Park in Assam, up to Eaglenest Wildlife Sanctuary/Tawang Valley outside of Assam to the north. This elephant corridor is situated alongside NH 29 and passes through several reserved forests like the Lahorijan Protected Reserve Forest (PRF), Hidipi PRF, Daldali PRF, Augustine Kramsa village, and Adivasi village. Some elephant sightings around the SPP have been reported by villagers, presumably wandering elephants in search of food. Consultation with the DFO Karbi Anglong, Environment and Forest Department of Assam and Principal Chief Conservator of Forests, Wildlife and Chief Wildlife Warden in December 2023 confirmed the location of the elephant corridor and that elephants may venture to the SPP site looking for food, but it is not on their migratory pathway.

**Figure 51: Elephant Corridor**

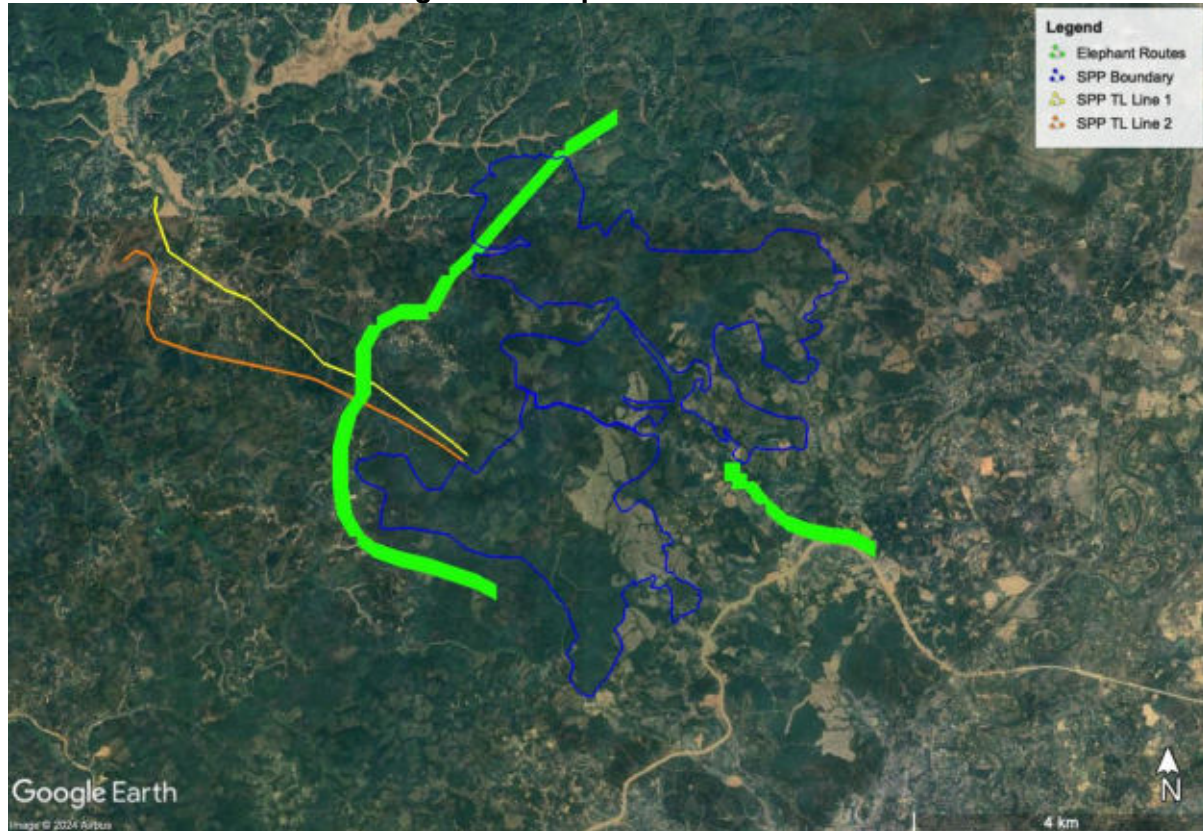


Source: APDCL

351. Further consultation with the community around the SPP has been undertaken to understand if there are areas, around the SPP boundary, where elephant movements can be observed. Based on the interviews with locals by the IEE Team in June 2024, the following was inferred:

- Most movements observed take place/reported in the June-August months, which is the ripening season of crops with one movement reported in September-October (monsoon season)
- During the interviews, it was reported that a single wandering group of elephants was observed to have moved along the SPP site as seen by locals.
- One local family (Khatkhathi area) reported elephant attack, on house/shop (1.5km from Block 6 boundary) twice during 2022-2023.

**Figure 52: Elephant Movements**



Source: IEE Team, 2024

- Elephants were observed to be typically moving during the evening/night.
  - Size of herds varied from 2-5. Most reported herd size was 2-3 members.
  - One local respondent reported seeing a herd of 30-40 elephants near the Jericho Baptist Church along a stream/nullah adjacent to the church in Rengma phen, Koragaon. Elephants were observed to be walking calmly and foraging along the path.
  - The route of movement is typically along the western boundary of the SPP, although one movement reported from south-east side (Figure 51).
352. Based on these results of villager surveys, the movement of the elephants is associated with a selective feeding urge particularly during crop/ripening season in the agricultural lands both adjacent to site boundary and inside the western part of the solar park site.

353. **National Elephant Conservation Authority (NECA).** On the recommendation of Gaj report 2010, establishment of a statutory body as National Elephant Conservation Authority (NECA) was proposed by the amendment of the Wildlife Protection Act of 1972. The proposal is still in the processing stage. **Project Elephant**, initiated in February 1992, is a scheme backed through the central Government of India. This application is devoted to helping the safeguarding and powerful management of elephants in states where wild elephant populations exist freely.

### 6.3.8 General Flora

354. An ecology survey was completed in 2023 by national consultants (GreenCIndia) for the SPP and can be found in full as Annex K. The following summarizes the findings of the survey relating to flora. The floristic survey in the SPP area revealed an enumeration of 153 (64 trees, 25 shrubs and 64 herbs) species none of which were critically endangered, endangered or endemic. The summary of plant inventory and diversity indices is illustrated in Table 43.

**Table 43: Summary of plant diversity and diversity indices in SPP area, East Karbi Anglong, Assam**

Parameters	Tree	Shrub	Herb
No. of quadrat studied	80	80	160
Total area surveyed (in sq. km)	32	2	0.16
No. of species	64	25	64
Total density (individuals ha <sup>-1</sup> )	411	14370	354875
Margalef species richness index	10.86	3.01	7.28
Shannon-diversity index	3.77	2.31	3.7
Simpson dominance index	0.03	0.14	0.03
Pielou evenness index	0.90	0.72	0.89

### 6.3.9 General Fauna

355. The following provides a summary of the fauna identified in the SPP as part of the ecological surveys in 2023. An additional 'wet season' survey of the SPP was completed in May 2024 (see Annex J) focusing on amphibians and reptiles. The following sections provide the findings from both the dry season survey completed in 2023 and the wet season survey of 2024.

#### Invertebrates

356. The term invertebrates comprises organisms that do not retain the vertebral column in their adulthood. The survey was done to assess invertebrates of habitats such as freshwater bodies, wetlands, grasslands, forests, agricultural lands and open scrublands. The target groups being insects, arachnids, gastropods and crustaceans. Other groups were not included mainly because they are mostly marine or due to the cost and manpower feasibility of the survey work required. A total of 108 species belonging to 13 orders and 41 families were recorded during the survey.

#### Anurans

357. Amphibians include anurans (order: anura), caudates (order: caudata) and caecilians (order: Gymnophiona). However, caecilians are fossorial, while caudates are only found in high



altitude water bodies in India (>900m asl) (Frost 2023). Anurans are considered to be biological indicators as they are very sensitive to changes in their microhabitat owing to their skin and narrow niches. A survey on the anurans of the SPP site was conducted in the month of November 2023 and then in the wet season 2024.

358. **Dry Season** – 7 species belonging to 4 genera were identified from water bodies such as ponds, pools and puddles and burrows. Dicroglossidae was the most speciose family with four species (*Minervarya syhadrensis*, *Minervarya teraiensis*, *Hoplobatrachus tigerinus* and *Euphlyctis cyanophlyctis*). While family Bufonidae, family Microhylidae and family Ranidae were represented by one species each (*Duttaphrynus melanostictus*, *Microhyla mymensinghensis* (taxonomy used in GreenCIndia report out of date) and *Hylarana leptoglossa* respectively). All species recorded are categorized as Least Concern as per IUCN Red List.

**Table 44: Identification of anurans encountered in SPP – Dry Season**

Family	Genus	Species	IUCN Red List Category
Bufonidae	<i>Duttaphrynus</i>	<i>melanostictus</i>	Least Concern
Dicroglossidae	<i>Minervarya</i>	<i>syhadrensis</i>	Least Concern
Dicroglossidae	<i>Minervarya</i>	<i>teraiensis</i>	Least Concern
Dicroglossidae	<i>Hoplobatrachus</i>	<i>tigerinus</i>	Least Concern
Dicroglossidae	<i>Euphlyctis</i>	<i>cyanophlyctis</i>	Least Concern
Microhylidae	<i>Microhyla</i>	<i>mymensinghensis</i>	Least Concern
Ranidae	<i>Hylarana</i>	<i>leptoglossa</i>	Least Concern

359. **Wet Season** - During the wet season survey eleven species belonging to five genera were identified from water bodies such as ponds, pools and puddles and burrows (and reported by the community). Dicroglossidae was the most speciose family with five species. All species recorded are categorized as Least Concern as per IUCN Red List.

**Table 45: Identification of anurans encountered in SPP – Wet Season**

Family	Scientific name	Common name	IUCN Conservation Status	Remarks
Rhacophoridae	<i>Polypedates leucomystax</i>	Common tree frog	Least Concern	Observed during survey and reported by local people
Bufonidae	<i>Duttaphrynus melanostictus</i>	Asian common toad	Least Concern	Observed during survey and reported by local people

Family	Scientific name	Common name	IUCN Conservation Status	Remarks
Dicroglossidae	<i>Minervarya nepalensis</i>	Nepal cricket frog	Least Concern	Observed during survey and reported by local people
Dicroglossidae	<i>Minervarya pierrei</i>	Pierre's wart frog, Pierre's cricket frog	Least Concern	Observed during survey and reported by local people
Dicroglossidae	<i>Minervarya teraiensis</i>	Terai Cricket Frog	Least Concern	Observed during survey and reported by local people
Dicroglossidae	<i>Minervarya syhadrensis</i>	Sahyadri Cricket Frog	Least Concern	Observed during survey and reported by local people
Dicroglossidae	<i>Euphlyctis cyanophlyctis</i>	Indian skipper frog or skittering frog	Least Concern	Observed during survey and reported by local people
Dicroglossidae	<i>Hoplobatrachus tigerinus</i>	Indian bullfrog	Least Concern	Observed during survey and reported by local people
Microhylidae	<i>Microhyla mymensinghensis</i>	Mymesingh narrow-mouthed frog*	Least Concern	Observed during survey and reported by local people
Ranidae	<i>Humerana humeralis</i>	Bhamo Frog, Boulenger's Green Frog	Least Concern	Observed during survey and reported by local people
Ranidae	<i>Hylarana leptoglossa</i>	Long-tongued frog	Least Concern	Observed during survey and reported by local people

Source: Detailed Amphibian and Reptilian Study for the 1000 MW Solar Park at Lahorijan, Karbi Anglong, 2024

\*Note survey taxonomy used in report is out of date

## Reptilia

360. Reptilia is a class of vertebrates which breathe air and are largely cold-blooded. Class reptilia is divided into four orders: Testudines (turtles and tortoises), Squamata (lizards and snakes), Crocodylia (Crocodyles, alligators, caimans, and gharials) and Rhynchocephalia (Tuatara). In the series of surveys conducted all recorded individuals belong to the order Squamata.

361. **Dry Season** - All the species recorded were categorized as Least Concern in the IUCN Red List. Six species were recorded, all of which are of different genera. Two species of skink were found; one under leaf litter and another resting in a burrow during daytime. Out of the two snakes, one is venomous and one non venomous. A road kill of Red-Tailed Bamboo pit viper (*Trimeresurus erythrurus*) was found. The Yellow-speckled Wolfsnake was found near burrows of *Hylarana leptoglossa* at night time. The characteristic call of Tokay gecko (*Gekko gekko*) was heard from a bamboo grove at day time.

**Table 46: Identification of Reptiles encountered in SPP – Dry Season**

Order	Family	Genus	Species	English Name	IUCN red list
Squamata	Scinidae	<i>Lygosoma</i>	<i>albopunctata</i>	White-spotted supple skink	Least Concern
Squamata	Agamidae	<i>Calotes</i>	<i>versicolor</i>	Oriental garden lizard	Least Concern
Squamata	Colubridae	<i>Lycodon</i>	<i>jara</i>	Yellow-speckled Wolfsnake	Least Concern
Squamata	Scinidae	<i>Eutropis</i>	<i>multifasciata</i>	Many-striped Skink	Least Concern
Squamata	Viperidae	<i>Trimeresurus</i>	<i>erythrurus</i>	Red-Tailed Bamboo pit viper	Least Concern
Squamata	Gekkonidae	<i>Gekko</i>	<i>gekko</i>	Tokay Gecko	Least Concern

362. List of Reptilia encountered during site visit and reported by local people are presented in the table below.

**Table 47: Identification of Reptiles encountered in SPP – Wet Season**

Order	Family	Scientific name	English Name	IUCN Conservation Status	Remarks
Squamata	Colubridae	<i>Dendrelaphis pictus</i>	Painted Bronzeback Tree Snake	Least Concern	Observed during survey and reported by local people
Squamata	Elepidae	<i>Naja kaouthia</i>	Monocled Cobra	Least Concern	Observed during survey and reported by local people

Order	Family	Scientific name	English Name	IUCN Conservation Status	Remarks
Squamata	Elepidae	<i>Bungarus fasciatus</i>	Banded Krait	Least Concern	Observed during survey and reported by local people
Squamata	Varanidae	<i>Varanus bengalensis</i>	Bengal Monitor Lizard	Near Threatened	Observed during survey and reported by local people
Squamata	Agamidae	<i>Calotes versicolor</i>	Oriental Garden Lizard	Least Concern	Observed during survey and reported by local people
Squamata	Gekkonidae	<i>Cnemaspis assamensis</i>	Assam day Gecko Lizard	Vulnerable	Observed during survey and reported by local people
Squamata	Gekkonidae	<i>Gekko gekko</i>	Tokay Gecko	No record	Observed during survey and reported by local people
Squamata	Gekkonidae	<i>Hemidactylus flaviviridis</i>	Northern House Gecko	Least Concern	Observed during survey and reported by local people
Testudines	Geoemydidae	<i>Cuora amboinensis</i>	Southeast Asian Box Turtle	Endangered	Reported by local people
Testudines	Geoemydidae	<i>Cuora mouhotii</i>	Keeled Box Turtle	Endangered	Reported by local people

Note: During consultation local people reported that, Southeast Asian Box Turtle and Keeled Box Turtle are rarely found in the area earlier but now day not observed in the area.

## Avifauna

363. Birds belong to the class Aves. Birds play important roles in the food web, thereby, maintaining ecological balance and also as seed dispersers. Previous bird sighting records were accessed through online based citizen science platforms such as ebird and inaturalist. The area was heavily altered for agriculture and other forms of exploitation. The workers anecdotally observed tree felling and one occasion of bird hunting by villagers. These factors may contribute to loss of avifaunal biodiversity and population decline of the less resistant species.

364. 20 species of birds were identified in this survey. 19 species were listed as Least Concern while one species was listed as Near Threatened. Two species were listed in schedule I of the Wildlife Protection Act, 1972, while the other 18 species were listed in schedule II. Long-tailed nightjar was the only species observed at night time. An unidentified raptor was observed on one occasion but its identity could not be ascertained. Although a mixed flock of common myna (*Acridotheres tristis*), chestnut-tailed starling (*Sturnia malabarica*) and pied starling (*Gracupica contra*) were observed feeding on winged termites outside the SPP site, only the pied starling was observed inside the SPP site. Ashy woodswallow and Amur falcon were recorded only on

transmission lines. Four migratory species were recorded (See Table 48): *Falco amurensis* was characterized as a passage visitor while *Vanellus cinereus*, *Lanius cristatus* and *Lanius schach* were characterized as winter visitors (Grimmett et al. 2016). Bengal Florican was not observed.

**Table 48: Birds recorded in SPP Site**

#	Family	Genus	Species	English Name	Resident/visitor
1	Accipitridae	<i>Elanus</i>	<i>caeruleus</i>	Black-Winged Kite	Resident
2	Caprimulgidae	<i>Caprimulgus</i>	<i>macrurus</i>	Large-Tailed Nightjar	Resident
3	Charadriidae	<i>Vanellus</i>	<i>cinereus</i>	Grey-Headed Lapwing	Winter visitor
4	Ciconiidae	<i>Anastomus</i>	<i>oscitans</i>	Asian Openbill	Resident
5	Columbidae	<i>Spilopelia</i>	<i>chinensis</i>	Spotted Dove	Resident
6	Sularis	<i>Copsychus</i>	<i>Sularis</i>	Oriental Magpie Robin	Resident
7	Benghalensis	<i>Coracias</i>	<i>benghalensis</i>	Indian Roller	Resident
8	Falconidae	<i>Falco</i>	<i>amurensis</i>	Amur Falcon	Passage visitor
9	Pycnonotidae	<i>Pycnonotus</i>	<i>cafer</i>	Red-Vented Bulbul	Resident
10	Motacillidae	<i>Motacilla</i>	<i>alba</i>	White Wagtail	Resident
11	Motacillidae	<i>Anthus</i>	<i>rufulus</i>	Paddyfield pipit	Resident
12	Laniidae	<i>Lanius</i>	<i>cristatus</i>	Brown Shrike	Winter visitor
13	Laniidae	<i>Lanius</i>	<i>schach</i>	Long Tailed Shrike	Winter visitor
14	Corvidae	<i>Dendrocitta</i>	<i>vagabunda</i>	Rufous Treepie	Resident
15	Sturnidae	<i>Sturnia</i>	<i>malabarica</i>	Chestnut Tailed Starling	Resident
16	Zosteropidae	<i>Zosterops</i>	<i>palpebrosus</i>	Indian White-eye	Resident
17	Artamidae	<i>Artamus</i>	<i>fuscus</i>	Ashy Woodswallow	Resident
18	Muscicapidae	<i>Saxicola</i>	<i>ferreus</i>	Grey Bushchat	Resident
19	Ardeidae	<i>Bubulcus</i>	<i>ibis</i>	Cattle Egret	Resident
20	Psittaculidae	<i>Psittacula</i>	<i>Alexandri</i>	Red-Breasted Parakeet	Resident

## Mammalia

365. There are 257 mammalian species in Northeast India and 161 mammalian species in the state of Assam (Talukdar et al. 2021). A series of surveys were conducted to enumerate the mammals present in the SPP site through indirect approach and chance encounters. A rhesus macaque (*Macaca mulatta*) was sighted tied to a tree in a village. A single individual bat was sighted. Mammalian diversity was minimal in this area. Jungle cat pugmarks and scats were recorded. Besides these, cattle and goats were sighted commonly in the periphery of human settlements. Jungle cat was the only mammal listed under WPA, 1972 (Schedule II). All recorded species were categorized as Least Concern in the IUCN Red List.

**Table 49: Mammals encountered in SPP Site**

Species	Common name	IUCN red list	WPA, 1972
<i>Felis chaus</i>	Jungle cat	Least concerned	Schedule II

<i>Macaca mulatta</i>	Rhesus macaque	Least concerned	Not listed
<i>Bos indicus</i>	Zebu (cow)	Not evaluated	Not listed
<i>Capra hircus</i>	Domestic goat	Least concerned	Not listed

366. Additional consultations completed by the IEE team in June 2024 with the community indicated that:

- Vultures - Previously many; now very few or none seen
- Fox- not seen now
- Bats; small *Microchiroptera* – observed in Peepal trees
- Turtles - small species in rivers/streams
- Blond Bellied Langur – Observed in 2023 by one family in Kedaphen, Longkhatha village
- Chinese Pangolin- Observed in 2022-2023 (Kedaphen, Longkhatha village)
- No Slow Loris, Hoolock Gibbon, Hog deer were reported by any of the respondents.

### 6.3.10 SPP TL Flora and Fauna

367. Detailed flora and fauna surveys of the SPP TL have not been completed. However, it can be assumed that at least those species identified within the SPP can also be found within the SPP TL RoW. Further, it is also possible that the critically endangered Black Softshell Turtle, Assam Roofed Turtle and Bengal Florican could be present based on the findings of the CHA. However, none of these species have been recorded at the site or SPP TL to date.

## 6.4 Socio-economic Environment

### 6.4.1 General

368. The Karbi Anglong district is positioned in the central region of Assam, spanning from latitudes 25°32'N to 26°36'N and longitudes 92°10'E to 93°50'E. It shares its borders with Nagaon and Golaghat districts to the north, the North Cachar Hills district to the south, Golaghat district and Nagaland to the east, and Meghalaya to the west. Karbi Anglong covers a total geographical area of 10,434 square kilometers, which constitutes 13.3% of the entire land area of Assam. Notably, this district holds the distinction of being the largest in terms of land area within the state. The district enjoys autonomy under the provision of Sixth Schedule of the Indian Constitution.

369. The population of the district is predominantly tribal. The major tribal ethnic groups of this district are Karbis, Bodos, Kukis, Dimasas, Hmars, Garos, Rengma Nagas, Tiwas, and Man (Tai Speaking). Besides, many non-tribals also live together in this hill region. According to the 2011 census, Karbi Anglong District (East+West) has a population of 965,280, This gives it a ranking of 451st in India (out of a total of 640). The district has a population density of 93 inhabitants per square km. Its population growth rate over the decade 2001-2011 was 17.58%. Karbi Anglong has a sex ratio of

950 females per 1000 males, of which 95,103 (14.39%) live in urban areas. Scheduled Castes and Scheduled Tribes are 33,523 (5.07%) and 345,220 (52.23%) of the population respectively.

370. The languages in Assam are varied, ranging from Assamese to the Bodo language, which is one of its native indigenous tribes. Ahomiya/Assamese is widely spoken in the state and also in the surrounding districts. Karbi is another language spoken in the study area. Other languages spoken include Hindi and English.

## 6.4.2 General Socio-Economic Profile

### State Level

371. Assam is predominantly rural, and the economy is primarily agrarian in nature with almost 70% of the population directly dependent on agriculture as a source of income and another 15% of the population directly on allied activities for its living. Contribution of agriculture and allied activities towards state GSDP in 2019-20 is 15.64%. There are some non-food crops like jute, mesta, cotton etc. also grown to some extent by farmers in the kharif season.
372. Agriculture is the main source of income for the people along with horticulture, livestock, plantation, sericulture, weaving, etc. Tribals are generally self-sufficient and mostly rely on wild vegetables found in hills both for domestic consumption and commercial purpose. Cultivation of land is the main occupation of both men and women. Income from the cultivation of land is supplemented by selling labour seasonally and by engaging in allied agricultural work such as raising pigs or chickens and small businesses. Only a few men are engaged in trade and professional employment. The per capita income of Assam is the lowest in India. Assam is a rural state with a few urban cities and industrial centers. Assam's isolated location, far away from the main production centers of India, is one of the key reasons for its low level of economic progress. Its adverse climatic conditions also contribute to sluggish economic growth.
373. In 2019, Assam reported 5,447,805 visitors, thus, bringing forth a scenario of the subsequent increase in the tourists visiting Assam with each passing year. In 2017-18, Assam Tourism Development Corporation (ATDC) received earnings estimated at INR 4.22 crore, much higher than that received in 2016-17, which was estimated at Rs 2.24 crore. Many locals are engaged in tourism-based livelihoods in the surrounding districts including vehicle supply, hotels, shops, handicrafts, restaurants, etc.
374. Assam is endowed with petroleum, natural gas, coal, limestone and many other minor mineral resources such as quartzite, kaolin, silliminites, clay, feldspar, granite, etc. Assam is the pioneer state in the country as far as exploration and production of petroleum is concerned. Assam accounts for about 26% of India's crude reserve and 12% of natural gas. Assam is the most industrialized state in the northeast of India and has maintained its leading position in the industrial sector in the country, although residents of Karbi Anglong are not employed in these sectors in any major way. The state is a pioneer in small scale industries and boasts of the largest number of special export promotion zones. It has a large base of skilled and industrial labour, making it an ideal destination for knowledge-based and manufacturing sectors.

### Local Level

375. At the local level the average family size of the sampled household is found to be 3.75. The sex ratio of the households is 899 females for 1000 males, marginally lower than the national sex ratio of 958 females for 1000 males as per the Census carried out in 2011.

The overall literacy is 93.9%, for the males it is about 95.4% and among the female's literacy is about 92.2%.

376. In the age group of 6-15 years all the children are enrolled in schools and most of them have either completed or are in primary or middle level. In this age group more females are in middle level and more male are in the primary level. Among the adolescents and the youth in the age group of 16 to 25 years, most of them have achieved either secondary or higher secondary level of education. None in this group have achieved post-graduation level of education. Further no one has any technical degrees. Among the females in this age group about 3% are illiterates and no one among the males are illiterate. The overall literacy rate among the surveyed household members is 94% which was 72% according to the 2011 census. All the respondents can read and write Assamese and Karbi.
377. Most of the population are cultivators (54.5% males and 3.2% females). The household members are engaged in other occupation like business and small trades (6%), government jobs (5%), private jobs (3.5%). Among the female members a large percentage (59.2%) are homemakers. Around 17% are students, almost equal for both the sexes.
378. Only 8% of the population live below the poverty line (BPL) and they have BPL ration cards. 87% of them possess above poverty line ration cards and 5% do not have any ration cards.
379. Household assets like a mobile phone, television, and, LPG connection are adequately present in the households. A computer or a laptop is possessed by 20% of the households. A radio is available in less than 20% of the households. Washing machines are used by only 15% of the households. Appliances like air conditioners, geysers, room heaters are possessed by only 5% or less of the households. For transportation, bicycle is present in 74% of households, 2-wheelers in 49% of households and cars in 15% of households. Livestock like pigs, cow, goat, sheep, buffalo are present in all households.
380. All the households in the SPP are having agricultural lands, the average possession being 1.85 bighas. About 29% are having 0.5 to 1 Bigha, 21% are having 1 to 1.5 Bigha and 26.5% are having land in the range of 1.51 bigha to 2 Bigha. Less than 10% are having 3 or more Bighas. The cost per bigha of agricultural land is very high at INR 300,000. The government circle rate is INR 200,000.
381. Rice is the major crop cultivated by majority of households. Chilies and potatoes are some of other crops cultivated by the people in the SPP. Rice is cultivated by 95% of the households in a total area of 617.14 bighas and the average yield per bigha is 7.88 quintals. The average price per quintal of rice is INR 1,998.
382. The households have different sources of earnings. Agriculture (farming) is one of the major sources of income for the families which is reported by 93% of the households living in the SPP area. The next source of income is from wage labour work, reported by half of the households, and one third reported income from livestock management. Business contributes income for 15% of the families, government job for 13% and private job for 8% of the households respectively. For 6% of the household's income from self-employment is one of the sources. About 5% of households cited other sources like income from NREGA, rent, land lease out and pension.
383. The total average income of the families from all the sources is INR 193,509. The average annual income from government job is INR 406,776 followed by income from private job which is INR 183,871, and from business which is INR 158,796. From wage



labour the average annual income is INR 779,68. The income from agriculture where majority of the households are engaged is the lowest at INR 40,702.

384. The average annual expenditure of the households is INR 119,183. The households spend around 23% of their total expenditure on food. The other major expenditures are on transportation (8.1%), gas (8%), education (7.4%), clothing (7.2%) and on social functions (7%). About 3.4% of the total annual expenditure is on electricity.
385. In the SPP except for one household, none of the families have taken a personal loan. Only 4% of the households have reported they are receiving benefits from different government schemes. Out of the people taking benefit from government schemes, 79% of women and 21% men have taken the benefit. The benefit received is loan in case of 50% of households and trainings and employment received by 7% each.
386. Majority of the households in the SPP area have bank accounts (99.7%). About 95% of the households reported having bank account in the name of male members and in 76% of the households the account is in the name of the female members. The joint account is there in only 5% of the households.
387. There is no migration reported except one household in the SPP area.
388. There is no major incidence of illness in the SPP area as reported by the households. Only 7% of the households reported illness of their family members during last one year. The common diseases reported are appendicitis, stroke, kidney stone, chest infection, dengue, and, stomach pain. All of them have taken allopathic treatment and the average cost of treatment reported to be INR 3,500. The respondents did not take any loan for the treatment.
389. About 22% of the households reported to have social or health insurance. The social and health insurance are in the joint names of the male and female members in majority of the households (59%). In 35% of the households only a male member and in 6% of the household only a woman is covered.

### **6.4.3 Gender and Vulnerable People**

#### **Gender**

390. Education is considered very important for girls and boys as reported by the women in the SPP area. It is found that higher education amongst females is less than males. Girls are mostly educated till 10th or 12th standard. The distance of the colleges and cost of the traveling is a bottleneck for higher education for girls. The educational scenario for the girl child between the age group of 6 to 15 years is good, as all the girls are enrolled in schools.
391. The women in the SPP area are engaged in various economic activities to supplement their family income, in addition to household work. Majority (75%) of women are engaged in agriculture and about 44% are engaged in animal husbandry. About 72% of the households reported that their women are contributing to the household income.
392. Women have healthy participation in the household decision making process. The participation of women is relatively stronger on aspects related to savings/amount to be saved whereas on family/ household expenditures women sometimes have a say in the allocation of their earnings. It was found that both men and women participate in the decision-making process for family or household expenditures and assets. About 90% of

the households stated that both men and women make decisions on buying expensive items, buying items for personal use, or spending money on personal recreation.

393. Women play a significant role in the household financial decision-making, but they have lesser rights on property ownership. Only about 9% of the women stated that they have rights on household property, or their name is there in the household property.
394. Women play a key role in the decision-making process of children education, particularly regarding school admission. This highlights women' significant role in ensuring the well-being of children. More than 90 % of the women asserted that they have a say on the child's admission in the school.
395. Similar is the situation on health where in more than 90% of the households both men and women collaborate to care for sick family members and contribute equally to decision making process regarding health aspects such as visiting a health facility, taking the sick child to hospital or providing health care to child at home. Further both men and women play a crucial role in the decision-making process related to social function such as marriages, rituals and festivals within families.
396. Women self-help groups (SHGs) exist in the state of Assam. About 82% of households stated that SHGs are operating in their localities / villages. Most of the women informed that they do not have any traditionally acquired specific skills. Only about three women reported that they have taken skill training on handicraft and handloom.
397. Almost all the women feel that the SPP will be beneficial. Most of the women (82%) perceive that uninterrupted supply of electricity will help them carrying out household works and about 46% feel that it will help in the education of the children.

### Vulnerable Households

398. In the SPP area only 8.3% of the Households are BPL households and 5.6% are women headed households. Landless households are non-existent and a physically challenged person is present in only one of the households. For details refer to Table 50.

**Table 50: Vulnerable Households**

#	Vulnerable Household	Nos	%
1	BPL Household	31	8.3
2	Household with Physically challenged person	1	0.3
3	Landless Household	0	0
4	Women Headed Household	21	5.6

Source: APDCL, Nov 2023 - Dec 2023

### 6.4.4 Land Use and Access

399. Land use within the SPP and the SPP TL is heavily modified by human activity and comprises a mix of sparse and dense predominantly modified habitat, agricultural land, scrub land, rubber plantations and smallholdings. As noted above, small patches of natural habitat can be observed across the site, with the most dominant area being approximately 94 hectares in Block 6. Portions of the SPP TL RoW have also been identified as natural habitat (approximately 12 hectares).
400. Figures below illustrates the varied nature of land use across the SPP and SPP TL.



<p>Figure 53: Agricultural Land (#1)</p> 	<p>Figure 54: Bamboo growth (#2)</p> 
<p>Figure 55: Agricultural clearing (#3)</p> 	<p>Figure 56: Agricultural land, SPP TL (#4)</p> 
<p>Figure 57: Track through scrub towards pooling SS (#5)</p> 	<p>Figure 58: Plantation (#6)</p> 
<p>Figure 59: Bamboo harvesting (#7)</p>	<p>Figure 60: School (#8)</p>



Figure 61: Lemongrass cultivation (#9)

Figure 62: SPP TL tapping point (#10)

401. According to observations during field surveys, the principal crop of the area is paddy. This was confirmed in the RIPP social survey which indicated that rice is the major crop cultivated by 95% of the households. Chilies and potatoes are some of other crops cultivated by the people in the SPP area.

402. Rice is cultivated by 95% of the households in a total area of 617.14 bighas and the average yield per bigha is 7.88 quintals. The average price per quintal of rice is INR 1,998. Chilies are cultivated by 6.2% in a total area of 15.4 bighas and the average yield per bigha is 5 quintals. The average price per quintal of chilli is INR 5000. Details are given in Table 51.

403. Locals informed that they follow a pattern similar to jhum cultivation, where they practice extensive cultivation for a period of three years and then leave the land barren for around five years.

**Table 51: Cropping pattern and average yield**

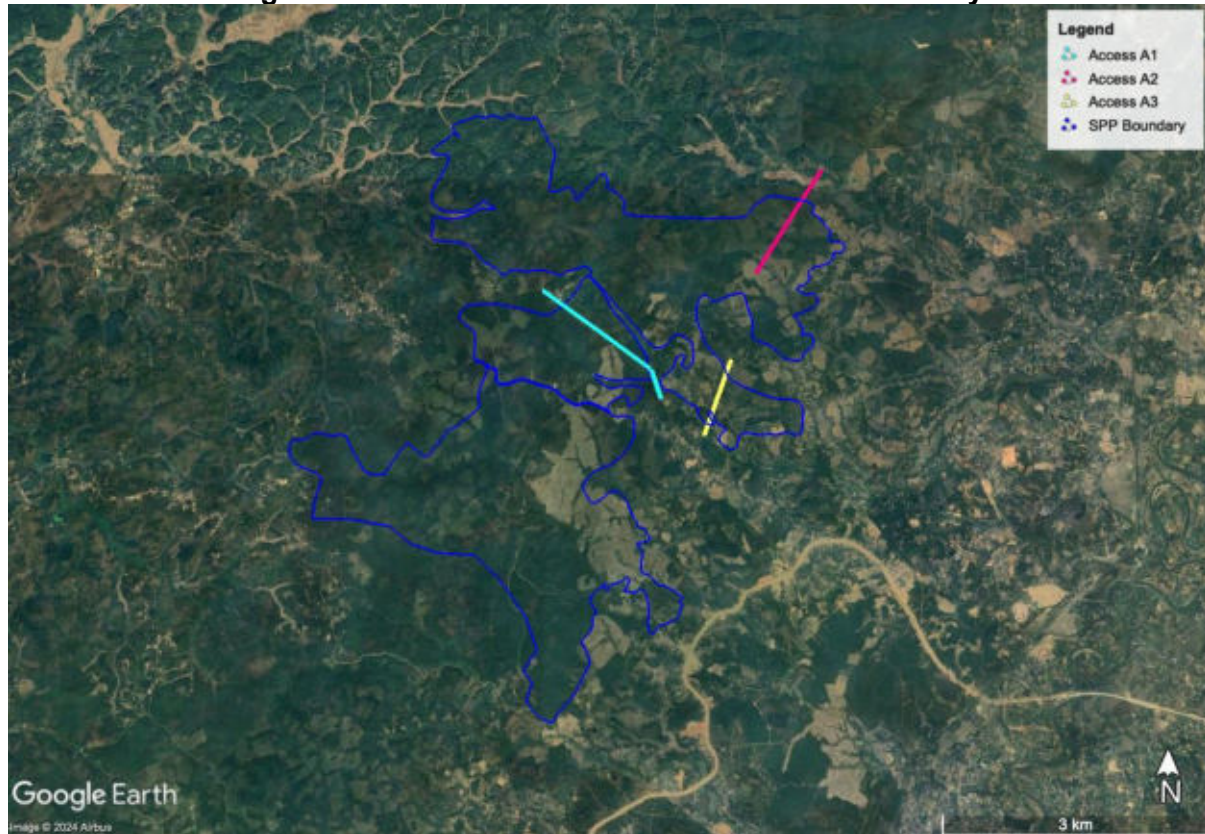
#	Crops	No of HH	%	Total Area (Bigha)	Total Yield in Quintals	Average yield in quintals	Price per unit/quintal (INR)
1	Rice	353	94.9	617.14	4861	7.88	1998
2	Wheat	2	0.5	1.1	12	10.91	2667
3	Maize	2	0.5	1.2	4.5	3.75	3000
4	Oilseeds	2	0.5	0.6	6	10.00	3500
5	Pulses	5	1.3	1.62	20	12.35	4000

6	Brinjal	3	0.8	3	90	30.00	3667
7	Chilli	23	6.2	15.4	78.2	5.08	5000
8	Potato	18	4.8	6.1	215	35.25	2000
9	Cabbage	3	0.8	0.62	6	9.68	1667

Source: APDCL, Nov 2023 - Dec 2023

404. **Access** - Some village roads/footpath/access routes inside the solar park site planned to be closed by APDCL were visited by the IEE team in June 2024 and evaluation was conducted in consultation with users. Based on the consultation with locals, the following were inferred:

- Three access roads (in addition to the two being maintained by APDCL in the original plan presented in the project description) are important routes for locals and they use them to either enter the solar park site (for farming, collection of woods, fodder, grazing of cattle, plant/flower/banana leaves collection for religious rituals (Shikari Puja (prayer to forest/nature) is conducted under a tree, potentially in some spots inside solar plant), meeting relatives/friends who are presently residing inside the solar PV plant area (to be relocated) or moving across the SPP to the other side using access road as a short cut.
- The access road at A1 is important as they use it for moving across the other side of the solar PV plant and even for students to go to school. APDCL has planned to keep/develop the approach road near this short cut for continued access, but locals feel this shortcut is important as they have been using this for a long time and it is easier for them.
- There are other shortcuts through the solar PV plant area which the locals use as an alternate to the main roads which will get blocked. The main access roads will be retained but moving products/crops to markets is also done through short cuts and hence livelihoods will get impacted if the access to them gets closed.
- Locals are concerned that access will be blocked and routes lost due to the solar PV plant and this will prevent them from collecting products (leaves/wood, etc.) from the site.
- Not all locals were aware the routes will be lost and have requested alternative access routes to those lost.

**Figure 63: Access Routes Discussed with Community**

#### 6.4.5 Religion and Tribes

405. The households interviewed in the RIPP social survey belong predominantly to the Hindu religion (99.7%) and all of them belong to Scheduled Tribe.

#### 6.4.6 Transportation

406. Karbi Anglong district is connected by road though NH-36, NH-39 and NH-329. Karbi Anglong Autonomous Council Transport (KAACT) buses runs at regular interval from the district headquarters to places like Guwahati, Diphu and Hojai. Bokajan and Diphu railway station are the main railway stations in the district. There is no airport in the district.

407. There are numerous village roads connecting the SPP to the main highway NH-29 east of the SPP. Several of these roads will be upgraded as part of the SPP (see Figure 10). Access to the SPP TL will be via local roads approached from the western side of the SPP. Although most main roads are in good condition, some roads are in poor condition or are unpaved, narrow and encroached by local shops/vendors and private residences, this is also true of one of the village access roads used by the IEE consultant to visit the SPP site in February 2024. Although not all village roads were inspected as part of this IEE, based on Google Earth images and roads travelled around the SPP, other village roads are in a similar condition.

408. Within the SPP and SPP TL area the most common form of transport appears to be motorcycle which allows quick and easy access around the undulating site. Internal roads within the SPP are mainly unpaved and do not have any form of drainage system. Many of the roads, or tracks, are difficult to move along without four wheel-drive vehicles, and in other locations, especially around the SPP TL, access is extremely difficult and time

consuming even with four-wheel drive due to huge potholes and rutting of the tracks, hence the locals preferring to use motorbikes.

**Figure 64: Internal Road within SPP**



Source: IEE Team, February 2024

#### **6.4.7 Electricity Supply**

409. All houses are electrified in the SPP area, a number of distribution lines cross the site connecting homes to the grid. The main purpose of using electricity is lighting and the other uses are cooking and pumping water for agriculture. However, electricity supply is irregular. The daily supply in summer and winter is almost similar at 12 hours per day and in monsoon, the availability is even less (9 hours per day).

410. The average expenditure on electricity consumption is INR 358 per month. There is demand of more regular electricity as reported by 82% of the households surveyed in the RIPP social survey. In the absence of reliable supply of electricity, about 90% of the households are using some form of non-electric energy. About two-third of the households use kerosene/diesel as non-electric energy and more than 50% use battery as non-electric energy. About



**Figure 65: Distribution line in SPP**

Source: IEE Team, 2024

8% of the households use gas and very few households (only 1%) are using solar energy. The households used more than one kind of fuel for cooking. LPG (98%) and wood (92%) are the common cooking fuel used by majority of households.

#### 6.4.8 Community Facilities

411. No community facilities, such as medical or educational, have been identified within the SPP. A school is located approximately 100m from the SPP TL. For college most of the residents either visit Bokajan (sub-division) or to Dimapur which is far and most incur costs for accessing them. Medical services are provided through primary health centers (PHC) and sub-centres in villages or else the population mostly depend on facilities in Bokajan and Dimapur. Ambulance services are available as stated by most of the households.

**Figure 66: School close to SPP TL**



Source: IEE Team, 2024

#### 6.4.9 Community Health and Sanitation

412. Among the RIPP surveyed households very few reported illness of their family members. Only 7% of the households reported illness of their family members during last one year preceding the survey. For details refer to Table 52.

**Table 52: Major illness in the family during last one year**

#	Illness	No. of HH	%
1	Yes	25	6.7
2	No	347	93.3
	Total	372	100.0

Source: APDCL, Nov 2023-Dec 2023

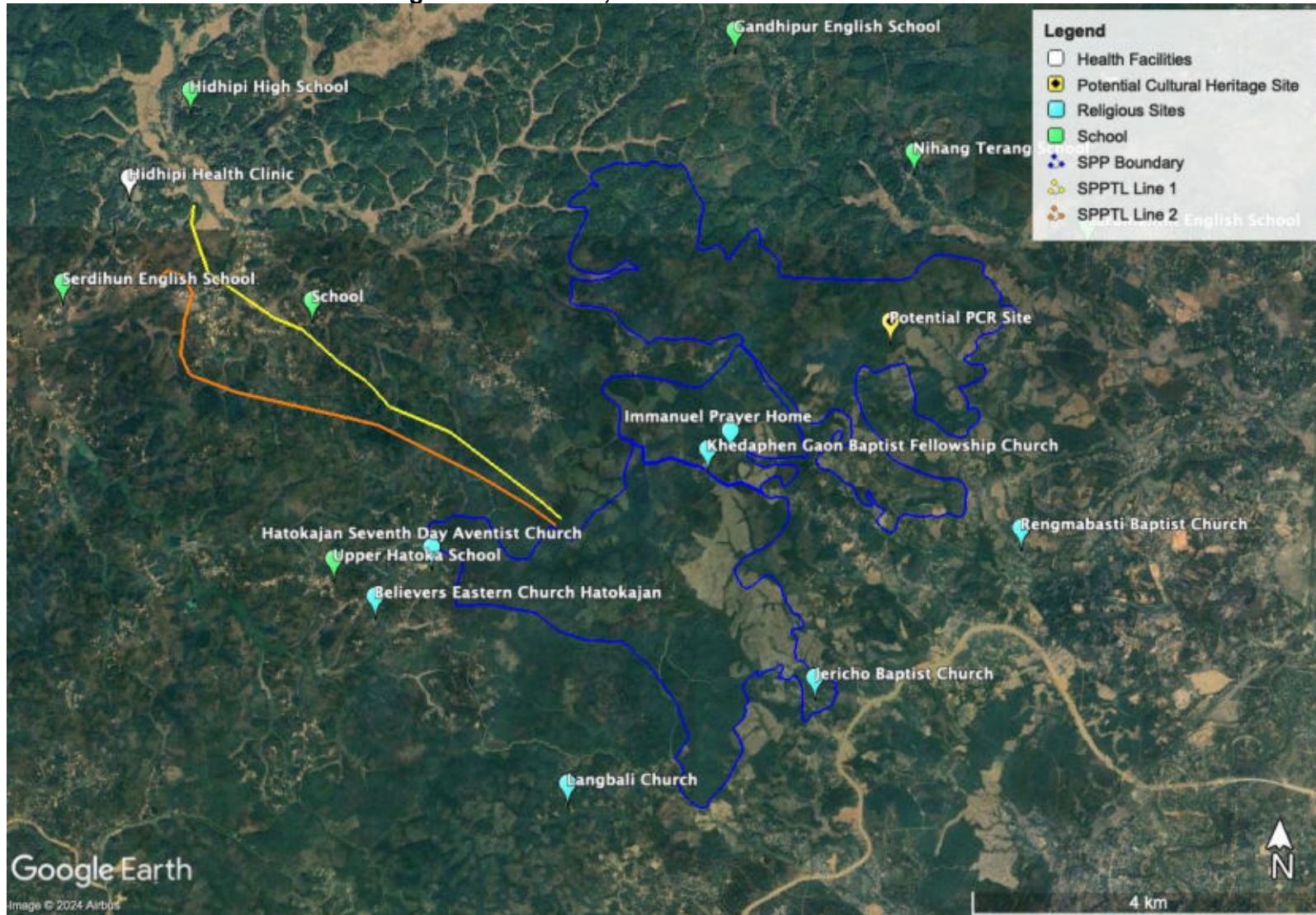
413. Among these 25 families only one member had fallen ill during the last one year. The incidence of appendicitis, stroke, kidney stone, chest infection, dengue, stomach pain etc.



was reported by the households. All of them have taken allopathic treatment and the average cost of treatment reported to be INR 3,500. For treatment the families spend from their own income and have not taken any loan.

414. It was found that all the households are having a toilet facility either a pour flush or a dry pit latrine at their homes. About 63% of the households are having a pour flush toilet. The rest of the families are having a dry pit latrine (36%). Only two households did not have a toilet.

Figure 67: Schools, Churches and Health Clinics



Source: Google Earth / IEE Team

**Table 53: Type of toilet facilities at the households**

#	Toilet Facility	Household	%
1	Pour flush	235	63.2
2	Dry pit latrine	135	36.3
3	No Toilet	2	0.5
	Total	372	100.0

Source: Source: APDCL, Nov 2023 - Dec 2023

415. In Assam, 2,974 persons per 100,000 population were reported to have suffered from malaria during the three months preceding a survey, lower than the national rate of 3,697 per 100,000 population<sup>31</sup>. According to two surveys, the rate of malaria in Assam increased slightly between from 2,710 to 2,974 per 100,000 (2021 to 2023). Rural residents are more likely to suffer from malaria (3,066 per 100,000) than are urban residents (1,910 per 100,000). Assam reported approximately 205 cases of malaria in 2022. This was a decline compared to the previous year's reported cases. Overall, the number of malaria cases has dropped significantly over the last decade.

416. In 2022, the number of dengue cases across Assam was reported to be 191, up from about 33 dengue cases in 2020. The highest number of dengue cases were recorded in 2016 across the state with over six thousand cases. As per the data of the Ministry of Health and Family Welfare, from 2018 to 2022 a total of 730 people died of Japanese Encephalitis in India, out of which 442 were from Assam only.<sup>32</sup>

417. Assam is categorized as a low HIV prevalence state with an estimated adult HIV prevalence of 0.08% (0.07–0.10) which is lower than the national prevalence of 0.22%<sup>33</sup>. It is estimated that Assam had 1,160 new HIV infections in 2020 (NACO HIV estimations report, 2020). Assam is also a highly vulnerable state for HIV transmission due to it being the gate-way of the north-eastern states; it being surrounded by three high prevalence states of Manipur, Mizoram, Nagaland and Meghalaya; large numbers of young population from the state are also migrating to other cities for employment; Assam has a large private health sector which caters to all the north-eastern states; large number of female migrants come from other north-eastern states, West Bengal, and Nepal for employment; and education and reported drug use. Knowledge of AIDS among women, does not vary much by women's age, but there are substantial differentials by all the other background characteristics.<sup>34</sup> Three-quarters (76%) of urban women have heard about AIDS, compared with only 30% of rural women. Knowledge of AIDS is much greater among women from other backward classes (58%) than for women in the other caste/tribe groups. Knowledge also varies greatly by media exposure, ranging from 11% among those who are not regularly exposed to any media to 84% among those who regularly read newspapers or magazines.

## 6.4.10 Waste Management

### Municipal Solid Waste

418. The urban local bodies in the state are yet to take necessary steps for proper management of MSW in the field of collection, segregation, storage, transportation, processing and disposal. In Assam, door to door collection of MSW has been taken up

<sup>31</sup> <https://rchiips.org/nfhs/assam.shtml#>

<sup>32</sup> <https://www.indiatvnews.com/health/rise-in-japanese-encephalitis-cases-raise-concern-in-assam-2023-08-06-885187>

<sup>33</sup> <https://asacs.assam.gov.in/information-services/present-hiv-aids-scenario#:~:text=Assam%20is%20categorized%20as%20a,NACO%20HIV%20Estimations%20report%202020>.

<sup>34</sup> <sup>34</sup> <https://rchiips.org/nfhs/assam.shtml#>

by Guwahati Municipal Corporation along with Silchar, Umrangshu, Maibang, Halflong, Badarpur, Karimganj and Sivasagarh town municipal bodies. In other parts, old practices are continued i.e. MSW collected from roadside bins provided at different locations in an interval of 2 – 3 days and taken into the dumping ground. For transportation of MSW generally tractor, truck, tipper, hand cart etc. are used. Practically no proper segregation of waste is practiced. In Paschim Boragaon area, Guwahati, a temporary storage facility has been set up by Guwahati Municipal Corporation. For processing of MSW there is no processing plant yet. One MSW processing unit is coming up in Dibrugarh district of Assam. Guwahati city has no sanitary landfill. All local bodies are utilizing low lying areas for disposal/dumping of MSW as they do not have any proper, scientific, well-developed landfill sites. Necessary landfill site for 100TPD MSW facility in Dibrugarh town has been selected. Guwahati Municipal Corporation has developed a waste processing and disposal facility (general segregation, recycling and dumping, not engineered sanitary facility). There are no other composting or incineration facilities available in Assam. For Karbi Anglong there is no disposal system that can be used for environmentally safe and sound disposal of waste. Nearest engineered solid waste management facility is in West Bengal.

### **Hazardous Solid Waste**

419. There are 55 numbers of hazardous waste generating industries in 13 districts of Assam, however, the quantity of hazardous waste authorized to be generated in these districts have not been reported. Further, based on the annual returns submitted by the occupiers about 29,435 MTA of hazardous waste generated during 2016-17. Among the 13 district of Assam, district Chirang generates maximum quantity of hazardous waste i.e. 25,661 MT which is about 80% of total generation<sup>35</sup>. As per the information provided by Assam PCB, there is difference between the quantities of waste generated and disposed/recycled/utilized which is due to the carry forward balance of the previous year. In Assam, there are 12 authorized Schedule-IV recyclers for recycling of commonly hazardous wastes (i.e. used/waste oil and lead bearing wastes) having authorized capacity of about 53,200 MTA, however, the quantity recycled by these recyclers is only 9,742 MT during the year 2016-17. The details of such recyclers are given in

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<sup>35</sup> [https://cpcb.nic.in/uploads/hwmd/Annual\\_Inventory2016-17.pdf](https://cpcb.nic.in/uploads/hwmd/Annual_Inventory2016-17.pdf)

420. Table **54** and

421. Table 54.

422. Assam Pollution Control Board has directed all **Hazardous Waste Generators in Assam** involved in generation/ recycling/ utilization/ co-processing/ pre-processing and/or disposal of hazardous waste to get themselves registered on the portal <https://geo.nic.in/nhwts/> within August 2023. This portal, namely “National Hazardous Waste Tracking System (NHWTS)” has been developed by Central Pollution Control Board to track generation, transportation, storage, recycling, utilization, and disposal of hazardous waste in the country.

423. There is no common engineered hazardous waste landfill or Treatment Storage Disposal Facility (TSDF) facility in Assam and the hazardous waste generated in the state is either being recycled/utilized(captive)/stored at the generator’s premises or disposed through captive facilities/other states in common TSDF. Nearest engineered facility is in West Bengal. PCBA is coming out with a facility in Dibrugarh District and awarded the M/S Mumbai Waste Management Limited to design, finance, build and operate an integrated TSDF and CBWTF facility in May 2023 (not completed as of July 2024).

**Table 54: Number and Capacity of Authorized Recycling/Utilizing Facilities in Assam**

Type of Recycling Facilities	No of Facilities authorized for recycling / utilization / Co-processing of HW	Total Authorized Capacity (MTA)	Quantity Recycled/ Utilized/ Co-processed (MT) during the year
Lead bearing waste including battery waste	6	26100	9041.651
E-waste	0	0	0
Paint and ink sludge/residues	0	0	0
Used oil	6	27100	700.2
Waste oil			
Total	12	53200	9741.851

Source: CPCB

**Table 55: List of the Units Registered with PCB, Assam As Hazardous waste Recyclers/Reprocessors**

Sl. No.	Name and Address of the Units	Waste (Qty.)
<b>(i) Lead waste re-processors</b>		
1.	M/s Royal Industries 15th Mile, Village-Burni, P.O.-Jorabat, Dist- Kamrup (Assam), Pin 793101.	Lead Acid Battery Plates and Lead Scrap - 900 MTA
2.	M/s. Nirmaan Industries D-7, DICC Campus, Numalijalah, P.S.-L. Amingaon, Guwahati, Dist – Kamrup (Assam).	Lead Acid Battery Plates and Lead Scrap - 1200 MTA
3.	M/s. S.R. Battery Works Murmura Gaon, Na-Pamuua, Mariani Road, Cinnamora, Dist-Jorhat (Assam)	Lead Acid Battery Plates and Lead Scrap - 2400 MTA
4.	M/s. Anubhav Industries, Industrial Growth Centre, Chaygaon, Village- Chattabari, P.O.-Chaygaon, Dist- Kamrup (Assam).	Lead Acid Battery Plates and Lead Scrap - 9600 MTA
5.	M/s. Shree Sai Vamika Industries, Gauripur, Near Shiv Sai Steel, North Guwahati, Dist- Kamrup (Assam).	Lead Acid Battery Plates and Lead Scrap - 9600 MTA
<b>(ii) Used oil &amp; waste oil re-processors</b>		
1	M/s. Modern Lube Industries, Barsha Para Industrial Area, Guwahati-34.	Used oil - 1000 KLA
2	M/s. Progressive Industries, Rani Industrial Area, Dist-KamrupGuwahati-34.	Waste oil- 1000 KLA Used Oil- 500 KLA
3	M/s Allied Industries, Digboi, Dist-Tinsukia (Assam).	Waste oil- 720 KLA
4	M/s. East End Petro Chemicals (P) Ltd., Dibrugarh (Assam).	Used oil - 600 KLA

Source:

[https://pcb.assam.gov.in/sites/default/files/swf\\_utility\\_folder/departments/pcb\\_lipl\\_in\\_oid\\_8/portlet/level\\_1/files/LIST%20OF%20THE%20UNITS%20REGISTERED%20WITH%20STATE%20POLLUTION.pdf](https://pcb.assam.gov.in/sites/default/files/swf_utility_folder/departments/pcb_lipl_in_oid_8/portlet/level_1/files/LIST%20OF%20THE%20UNITS%20REGISTERED%20WITH%20STATE%20POLLUTION.pdf)

### 6.4.11 Physical Cultural Resources

#### World Heritage, national and state cultural heritage sites

424. Presently, Assam has two UNESCO Natural World Heritage Sites – Kaziranga National Park (KNP) and Manas National Park (MNP). None of them are cultural heritage sites. The ancient pyramids of Assam, known as Charaideo Moidam, are on track to

potentially achieve UNESCO World Heritage Site status as a Cultural site. Government of Assam through Government of India has submitted proposal to UNESCO for its nomination, making it the sole historical site in India under consideration. Following the nomination, a UNESCO team conducted site inspections. These pyramids, serving as the final resting place for Ahom royal family members, possess profound historical significance. This proposed WHS is about 150km distant.

425. There are 55 monuments of national importance in Assam that have been recognised by Archaeological Survey of India (ASI) but none are in Karbi Anglong. 96 state protected monuments have been recognized by the Directorate of Archaeology in Assam under the “The Assam Ancient Monument and Records Act, 1959” and “The Assam Ancient Monument and Records Rules 1964”. Table 56 lists the state protected monuments in Karbi Anglong.

**Table 56: State protected and locally important PCR in Karbi Anglong**

State Monument ID	Name/ Description	Distance (km) from SPP / SPP TL	District	Coordinate location
S-AS-44	Borgang Rock Inscription	62	Karbi Anglong	26°11'10.72"N, 93°2'32.32"E
S-AS-45	Ruins at Sarthe Rangpha	63	Karbi Anglong	26°6'16.89"N, 93°0'44.94"E
S-AS-46	Burhagosain Than	62	Karbi Anglong	26°13'42.75"N, 93°2'39.41"E
S-AS-47	Rock-cut Durga at Tilapara	53	Karbi Anglong	26°15'11.53"N, 93°9'51.35"E
S-AS-48	Rock-cut Ganesa at Boga Doul	52	Karbi Anglong	26°14'15.90"N, 93°10'51.46"E
S-AS-49	Metha-long-A	96	Karbi Anglong	25°52'35.24"N, 92°32'39.01"E
S-AS-50	Ruins at Sikari Rongpi Gaon	45	Karbi Anglong	26°20'43.41"N, 93°24'37.98"E

Source: IEE Team, 2024

### Local festivals and culture

426. The major festivals celebrated in Assam are Bihu, Baishagu, Ali-Ai-Ligang, Baikho, Rongker, Rajini Gabra Harni Gabra, Bohaggiyo Bishu, Ambubashi Mela and Jonbill Mela and so on. The people of Assam also celebrate Holi, Durga Puja, Diwali, Swaraswati Puja, Lakshmi Puja, Kali Puja, Idd, Muharram, Me-Dam-Me-Phi, the birth and death anniversaries of Vaishnava Saints Srimanta Sankardev and Madhabdev. The tribals of Assam have their own colourful festivals like the Kherai Puja of the Bodos, the Baikhu and Pharkantis of the Rabhas, Ali-ai-ligang and Parag of the Mishing tribe, the Sagramisawa wansawa and laghun of the Tiwas.<sup>36</sup> Classical Assamese music is divided into Borgeet and Ojapali which combines narrative singing with dancing. The music of Ojapali has a raga system of clear traditional orientation. Traditional crafts like pottery and terracotta work, brass craft, jewellery making, musical instruments making, cane and bamboo craft, silk and cotton weaving, and woodcraft are a major source of employment for the people of Assam. Customs and traditions play a significant role in the society and the Assamese strictly adhere to the customs laid down by their forefathers, pertaining to their communities. These customs are beliefs that originated in the past and have been followed ever since, generation after generation. The weddings, birth, death and festivals in Assam include many customs that are supposed to be followed by all.

<sup>36</sup>

<https://culturalaffairs.assam.gov.in/frontimpotentdata/festivals-of-assam#:~:text=The%20major%20festivals%20celebrated%20in,Jonbill%20Mela%20and%20so%20on.>



## Archeological value of the terrain

427. The East Karbi Anglong district is rich in pre-historic sites as evidenced from past and recent findings. Most of the findings are concentrated in the Diphu and Bokajan Sub-Divisions. A rich treasure of image of Ganesh, Kartik and Hara-Gaauri were found in the Devasthan of Howraght. Along with it, tombs with small gate panels images and engraved gate panels were found. A number of door lintels were scattered over the area. The locality shows evidence of ten temples and three Shiva lingas. This region is situated on the boundary dividing Nagaon and Karbi Anglong districts. About 15 km from Howraghat, in Jaljurigaon, remnants of a stone inscription or Sila Lipi, have been reported. According to available information, there is an inscribed copper plate or Tamor Pholi in the neighbouring Eradighalpani village.<sup>37</sup> Recently, a sword of unknown period has been found in the vicinity of Diphu town in Karbi Anglong where many of the distribution lines are planned. It was found by some labourers while cutting earth. Numerous broken pieces of potteries with designed, pointed knobs were found abundantly with the sword, thus indicating the flourishing of some kind of civilization in the past. The sword has been preserved in the District Museum, Diphu. Recently several elongated stones with faints incised lines had been found in Diphu town. Further exploration of the area has been done yet. The elongated stones are worshipped by the public as Shiva Lingas in a temple. The state in which the archaeological objects are found scattered. Based on the available information, there is potential for chance find in Karbi Anglong district. Directorate of Archaeology has yet to conduct archaeologist investigation in East Karbi Angling district.

**Figure 68: Physical Cultural Resources**

Church in Block 4

Immanuel Prayer Home



Jericho Baptist Church

Possible Graveyard



<sup>37</sup> <https://karbi.wordpress.com/archaeological-evidence/>

## Site Cultural Heritage

428. Several cultural heritage sites are present within the SPP site:

- Khedaphen Gaon Baptist Fellowship Church – Located in Block 4. The small building is located adjacent to the existing village access road, which will remain in-situ, bisecting block 4. APDCL have confirmed that, at the request of villagers, the Church will be relocated prior to the start of construction.
- Immanuel Prayer Home – an all-religion prayer house with accommodation facility for guest. Community consultations indicated that they were unaware of the need to relocate the prayer house.
- Jericho Baptist Church – located in Block 6. Community consultations indicated that they were unaware of the need to relocate the church.

429. The IEE team also investigated a site identified as a potential PCR on Google Earth (see Figure 67). Consultation with the community indicated that they were unaware of the site as marked – it is anticipated it was incorrectly marked. However, according to the community a small temple is present close to the SPP boundary (anticipated to be outside) although it could not be confirmed by the IEE team, so its location still needs to be confirmed. They indicated it was not of significant cultural value to them. A sign indicating the presence of a graveyard was also noted during site visits by the IEE team. Consultations with villagers living close to this area suggested that the graveyard was not within the SPP site itself, however the exact location of the graveyard in relation to the SPP has not yet been confirmed by the IEE team. Consultations also identified some trees under which prayer/rituals are performed are inside the SPP that have been used for generations; but social safeguards survey team has not mapped any such resources to date.

430. Several other churches have been identified close the SPP boundary or SPP TL alignment (see Figure 67). Hatokajan Seventh Day Adventist Church is the closest to the SPP boundary, approximately 500m away.

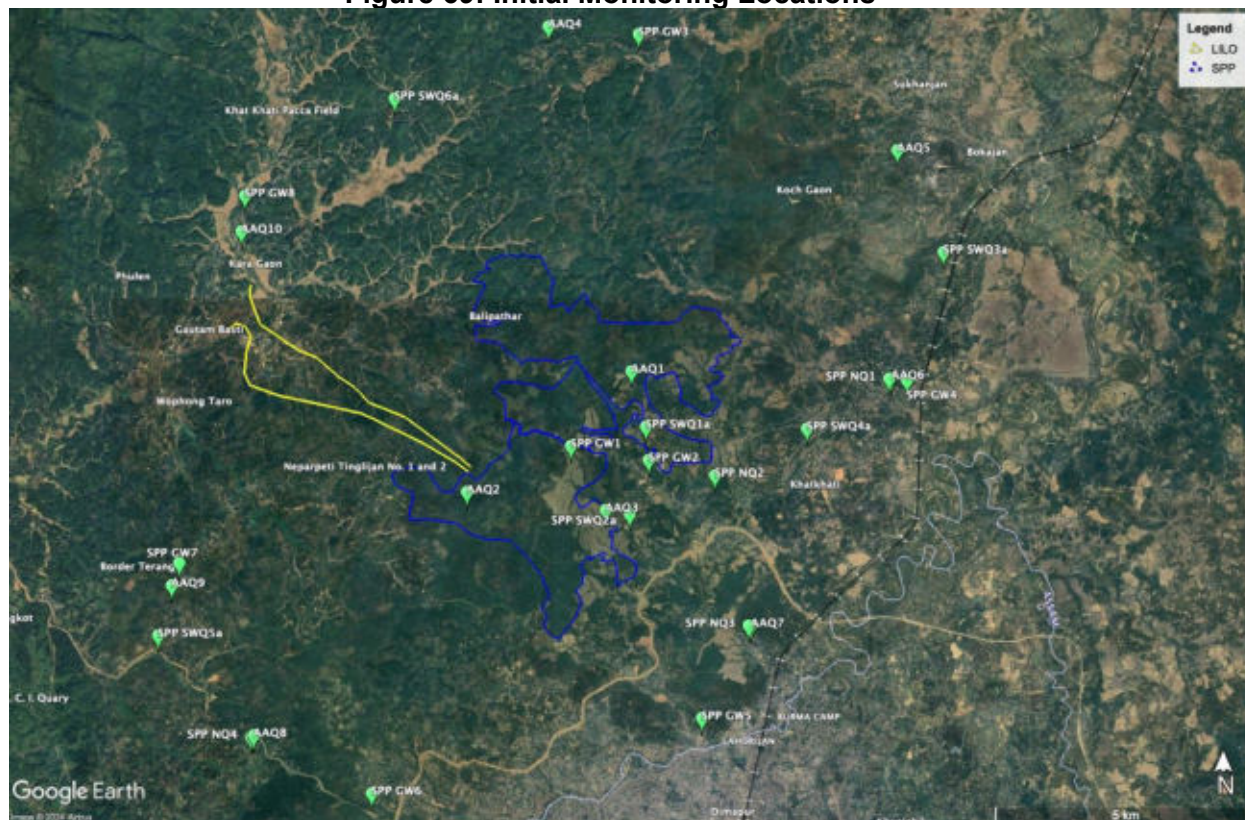
## 6.5 SPP / SPP TL Physical Baseline

431. The environmental baseline monitoring is undertaken to determine the ambient air, water, and soil quality and ambient noise levels and how they are currently affected by anthropogenic activities in and around the SPP. Monitoring is done to determine the quality of the ambient environment before the start of any kind of SPP/SPP TL related activities, as it provides a means of comparison with impact monitoring during implementation. It will also be used simply to check whether any unexpected change is occurring to existing conditions.

### 6.5.1 Initial Monitoring

432. Primary tests were conducted in 2023 by a recognized laboratory Econ Laboratory and Consultancy. The environmental monitoring for air, water, soil and noise were conducted using standard methodologies prescribed by the Central Pollution Control Board. 10 locations for air quality, 6 locations for surface water quality, 11 locations for groundwater quality, 5 locations for ambient noise monitoring and 6 locations for soil sampling were selected, taking into consideration location of sensitive receptors and existing site conditions, to collect the baseline environmental data. The environmental baseline results, sampling and testing methodologies are attached in full as Annex D.

Figure 69: Initial Monitoring Locations



Source: Google Earth / IEE Team

### Ambient Air Quality

433. In order to assess the Ambient Air Quality (AAQ), samples of ambient air have been collected at 10 different locations in the study area (SPP + 5 km radius) and analyzed for specific primary air pollutants, as per CPCB guidelines. The parameters PM<sub>10</sub> and PM<sub>2.5</sub>, NO<sub>2</sub> and SO<sub>2</sub> were monitored by taking one sample for 24 hours, twice a week for one week in the month of January 2023. CO was monitored by taking one sample for one hour on selected monitoring days. The recorded values are provided in Table 57.

Table 57: Ambient Air parameters from study area

Code & Location	Latitude	Longitude	Distance in km	Direction	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	NO <sub>2</sub>	CO
					µg/m <sup>3</sup>		mg/m <sup>3</sup>		
<b>National Standard (24hrs)</b>					<b>100</b>	<b>60</b>	<b>80</b>	<b>80</b>	<b>2</b>
<b>WHO Guideline (24hrs)</b>					<b>45</b>	<b>15</b>	<b>40</b>	<b>25</b>	<b>4</b>
AAQ1: (Neparpeti Kachari Gaon)	25°58'52.92"N	93°42'25.95"E	0	NE	38	33	13.3	4.86	0.45
AAQ2: (Near Parlen Larthe)	25°57'38.93"N	93°40'33.25"E	0	W	38	33	12.4	5.36	0.45
AAQ3: (Laison Tisso)	25°57'27.53"N	93°42'8.69"E	0	ESE	41	36	13.8	5.4	0.45
AAQ4: Dilwajan	26°2'25.13	93°41'29.11"E	7.90	N	80	59	8.1	3.42	0.39

Code & Location	Latitude	Longitude	Distance in km	Direction	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>	NO <sub>2</sub>	CO
					µg/m <sup>3</sup>		mg/m <sup>3</sup>		
Koch Gaon	"N								
AAQ5: Bokajan	26° 1'8.77" N	93°45'29.10"E	8.61	NE	97	64	12.1	3.46	0.47
AAQ6: Nothong Teron Village	25°58'48.37"N	93°45'22.51"E	6.37	ENE	96	63	13.3	3.42	0.21
AAQ7: Near NH 129	25°56'16.47"N	93°43'46.07"E	5.16	SW	78	53	10.4	3.26	0.36
AAQ8: Near NH 29	25°55'8.67"N	93°38'5.47"E	5.1	SSW	89	64	12.1	3.56	0.36
AAQ9: Near Khotma Kachari	25°56'41.70"N	93°37'11.14"E	5.64	SW	96	63	18.4	3.63	0.45
AAQ10: Near Karagaon	26° 0'19.83"N	93°37'57.42"E	8.88	NW	81	60	18.1	3.46	0.45

434. The value of PM<sub>10</sub> varies between 38 µg/m<sup>3</sup> to 96 µg/m<sup>3</sup> and the value of PM<sub>2.5</sub> varies between 33 µg/m<sup>3</sup> to 64 µg/m<sup>3</sup>. The higher concentration of PM<sub>10</sub> and PM<sub>2.5</sub> may be due to proximity of off-site monitoring sites to an industrial area and vehicular pollution and the dominant wind direction. Anthropogenic sources include fuel combustion, domestic cooking in some areas and fuel combustion for vehicles in the study area. Concentration of PM<sub>2.5</sub> were observed in all sites to be exceeding the WHO guidelines. PM<sub>2.5</sub> is exceeding Gol standards in a couple of locations but not at the site itself which complies with the national standards. PM<sub>10</sub> is observed at many sites to be exceeding the WHO guidelines, but on the site is compliant with them.

435. The source of SO<sub>2</sub> in the study area is mainly from burning fuels containing sulphur or emissions from coal combustion depending on the sulphur content in the coal. Sulphur dioxide reacts with other substances in the atmosphere to form sulphate aerosols (USEPA, 1982)<sup>38</sup>. Since most sulphate aerosols are part of PM<sub>2.5</sub>, they may have an important role in the health impacts associated with fine particulates (WHO, 1979)<sup>39</sup>. However, the values of sulphur pollutants in this case were found well below the NAAQ standard and WHO guideline. The value of SO<sub>2</sub> in the study area ranges from 8.1 µg/m<sup>3</sup> in AAQ4 to 18.4 µg/m<sup>3</sup> in AAQ9.

436. In the study area, the NO<sub>2</sub> varies between 3.26 µg/m<sup>3</sup> at AAQ7 to 5.4 µg/m<sup>3</sup> at AAQ3. The values of Oxides of Nitrogen were found well below the NAAQ standard and WHO guideline. The primary sources of NO<sub>2</sub> are motor vehicles, electric utilities and residential sources that burn fuels. NO<sub>2</sub> is one of the main ingredients involved in the formation of ground level ozone, which can trigger serious respiratory problems. It reacts to form

<sup>38</sup>USEPA (United States Environmental Protection Agency). 1982. Air Quality Criteria for Particulate Matter and Sulfur Oxides. EPA-600/8-82-029, December, Research Triangle Park, N.C.

<sup>39</sup>WHO (World Health Organization) 1979, "Sulfur Oxides and Suspended Particulate Matter," Environmental Health Criteria 8 Geneva

nitrate particles, acid aerosols, as well as NO<sub>2</sub>, which also cause respiratory problems (NAPAP 1991)<sup>40</sup>.

437. The values of CO in the study area varies from 0.21 mg/m<sup>3</sup> to 0.47 mg/m<sup>3</sup> at AAQ10. The values recorded were below the prescribed standard of NAAQ and the WHO guideline.

### Water Quality

438. Groundwater is the major source of drinking water in the area. Besides, it is an important source of water for the agricultural and the industrial sector. The water quality parameters of surface and ground water resources within the study area have been studied for assessing and evaluating the anticipated impacts of the SPP on the water environment. Primary surveys were conducted in October to December 2022. Six groundwater and five surface water samples were collected and analyzed for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and agriculture activities. The location of ground water and surface water sampling is shown in Figure 69. The results of the water quality monitored during the study period is given in Table 587.

**Table 58: Result of Ground Water Analysis (GW1 to GW6)**

Sl. No	Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6	ISO 10500: 2012	
									Acceptable limit	Permissible limit
1	Turbidity	NTU	<5	<5	<5	<5	<5	<5	1	5
2	pH	--	7.3	7.2	7.4	7.1	7.4	7.2	6.5-8.5	N.R.
3	Conductivity	µS/cm	584.0	595.0	610.0	570.0	566.0	560.0	-	-
4	Total Dissolved Solids	mg/l	260.0	272.0	281.0	255.0	240.0	248.0	500	2000
5	Alkalinity as CaCO <sub>3</sub>	mg/l	76.2	75.0	76.4	79.0	81.0	94.0	200	600
6	Total Hardness as CaCO <sub>3</sub>	mg/l	120	123	132	132	136	143	300	600
7	Calcium as Ca	mg/l	31.4	42.8	40.5	32.1	40.5	38.2	75	200
8	Magnesium as Mg	mg/l	14.9	15.8	12.4	12.5	18.3	12.6	30	100
9	Sodium	mg/l	28.1	32.9	35.9	30.1	22.7	25.3	-	-
10	Potassium	mg/l	12.4	11.9	10.2	15.5	17.8	14.5	-	-
11	Bicarbonate	mg/l	156.2	150.0	146.4	139.0	151.0	154.0	-	-
12	Chloride as Cl	mg/l	45.3	37.9	40.1	56.6	38.2	45.5	250	1000
13	Sulphate as SO <sub>4</sub>	mg/l	30.2	35.1	42.0	37.1	38.8	41.4	200	400
14	Nitrate as NO <sub>3</sub>	mg/l	1.80	1.51	1.82	1.89	1.60	1.57	45	NR
15	Fluoride as F	mg/l	0.24	0.20	0.29	0.17	0.25	0.16	1.00	1.50

<sup>40</sup>NAPAP (National Acid Precipitation Assessment Program). Various years, 1987–91, Washington, D.C.: Government Printing Office.

Sl. No	Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6	ISO 10500: 2012	
									Acceptable limit	Permissible limit
16	Phenolic compound as C6H5OH	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
17	Cyanide	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	NR
18	Aluminum	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.03	0.2
19	Arsenic	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
20	Cadmium	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	NR
21	Chromium as Cr+6	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	NR
22	Iron	mg/l	0.65	0.62	0.51	0.61	0.48	0.70	0.3	NR
23	Copper	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
24	Lead	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	NR
25	Manganese	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.1	0.3
26	Mercury	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	NR
27	Zinc	mg/l	0.14	0.16	0.25	0.22	0.19	0.23	5	15
28	Silica	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	-	-
29	Selenium	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	-	-

Source: On-site monitoring/sampling and analysis by EEPL

For DL-Detection Limit, BDL-Below Detection Limit, refer Table 58.

**Table 59: Detection Limit**

Sl. No.	Parameter	Unit	Detection limit (DL)
1	Cyanide (as CN)	mg/l	0.008
2	Phenolic Compounds	mg/l	0.001
3	Total Chromium ( as Cr)	mg/l	0.005
4	Zinc (as Zn)	mg/l	0.005
5	Aluminum (as Al)	mg/l	0.01
6	Copper (as Cu)	mg/l	0.005
7	Manganese (as Mn)	mg/l	0.005
8	Nickel (as Ni)	mg/l	0.005
9	Arsenic (as As)	mg/l	0.005
10	Lead (as Pb)	mg/l	0.005
11	Selenium (as Se)	mg/l	0.005
12	Cadmium (as Cd)	mg/l	0.005
13	Hg	µg/l	0.05
14	Iron	mg/l	0.1

Source: As per sensitivity of analytical methods and instruments

439. The data revealed that the pH value of ground water samples varied from 7.1 to 7.4. The water samples are slightly alkaline. The reasons for such conditions may be due to different types of buffers that may be present in the ground water and presence of weak basic salt in the soil. Alkalinity is an estimate of the ability of water to resist change in pH upon the addition of acid. The minimum alkalinity of the ground water was found to be 75 mg/l in sample at GW2 and the maximum was observed as 94 mg/l in the sample at GW6.
440. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles. All samples are within the permissible limit as per ISO 10500:2012.

441. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate (CaCO<sub>3</sub>). The maximum total hardness of ground water was found to be 143 mg/l in the sample at GW6 and the minimum was observed as 120 mg/l in the sample at GW1. All the samples were reported to be within the acceptable limit (300 mg/l) as well as the permissible limit recommended by ISO 10500:2012. Ca<sup>2+</sup> was reported to be within the acceptable limit of 30 mg/l. Mg<sup>2+</sup> was also found remaining within the acceptable limit of 30 mg/l. Natural sources of hardness principally are limestones which are dissolved by percolating rainwater made acidic by dissolved carbon dioxide.
442. The maximum chloride concentration (56.6 mg/l) was found at GW4 and the minimum (37.9 mg/l) was recorded at GW4. All the samples were within the acceptable limit of 250 mg/l.
443. Fluoride in groundwater has drawn worldwide attention due to its considerable impact on human physiology. Though fluoride is considered as an essential element at very lower concentration for human beings, higher concentration leads to health defects. The maximum average level of fluoride (0.29 mg/l) was found in GW3 and the minimum value (0.16 mg/l) was found at GW6. All samples were within the acceptable limit of 1mg/l as well as within permissible limits of 1.5 mg/l. However, iron levels exceeded the acceptable limits.
444. The sampling results of the surface water monitoring are given in Table 60.

**Table 60: Physico-chemical characterization of surface water**

S.N	Parameters	SPP SWQ1a	SPP SWQ2a	SPP SWQ3a	SPP SWQ4a	SPP SWQ5a	SPP SWQ6a	Class A SW Standard
1	pH Value at 25°C	7.1	7.13	7.26	7.19	7.15	7.2	6.5-8.5
2	Total Dissolved Solids, mg/l	280	296	254	236	218	306	-
3	Boron (as B), mg/l	0.24	0.25	0.16	0.15	0.14	0.13	-
4	Calcium (as Ca), mg/l	20.0	22.4	30.8	27.6	24.4	32.8	-
5	Chloride (as Cl), mg/l	40	35	35	40	45	45	-
6	Fluoride (as F), mg/l	0.50	0.55	0.35	0.30	0.30	0.30	-
8	Iron (as Fe), mg/l	0.38	0.40	0.36	0.44	0.42	0.31	-
9	Magnesium (as Mg), mg/l	4.80	5.28	2.88	2.88	2.88	2.88	-
10	Nitrate (as NO <sub>3</sub> ), mg/l	5.3	5.8	7.6	7.0	6.5	6.1	-
11	Sulphate (as SO <sub>4</sub> ), mg/l	26.2	29.0	24.3	31.1	28.0	25.9	-
12	Total Alkalinity (as CaCO <sub>3</sub> ), mg/l	110	120	80	70	60	60	-
13	Total Hardness (as CaCO <sub>3</sub> ), mg/l	120	138	114	106	98	94	-

S.N	Parameters	SPP SWQ1a	SPP SWQ2a	SPP SWQ3a	SPP SWQ4a	SPP SWQ5a	SPP SWQ6a	Class A SW Standard
14	Arsenic (as As), mg/l	BDL	BDL	BDL	BDL	BDL	BDL	-
15	Zinc (as Zn), mg/l	0.71	0.74	0.48	0.44	0.41	0.39	-
16	Dissolved Oxygen DO, mg/l	4.6	4.8	4.6	4.4	4.4	4.2	6.0
17	Biochemical Oxygen Demand BOD, mg/l	3.8	3.6	3.4	3.4	4.1	3.4	2
18	Fecal Coliform, MPN/100ml	34	46	63	15	19	23	50

445. pH is an important chemical parameter that determines the suitability of water for various purposes. pH of water is very important for the biotic communities because an average pH is adopted by most of the aquatic organisms. pH of the study area varied from 7.1 to 7.26. TDS was observed in the range of 218 mg/l to 306 mg/l. Dissolved oxygen is one of the key factors of natural or wastewater; it is influenced by physico-chemical parameters and biological activity in the water body. Moderate dissolved oxygen was recorded in the study area.

**Table 61: Water Quality Criteria as per CPCB**

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	<ul style="list-style-type: none"> <li>Total Coliform Organism MPN/100ml shall be 50 or less</li> <li>pH between 6.5 and 8.5</li> <li>Dissolved Oxygen 6mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20°C 2mg/l or less</li> </ul>
Outdoor bathing (Organized)	B	<ul style="list-style-type: none"> <li>Total Coliform Organism MPN/100ml shall be 500 or less</li> <li>pH between 6.5 and 8.5</li> <li>Dissolved Oxygen 5mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20°C 3mg/l or less</li> </ul>
Drinking water source after conventional treatment and disinfection	C	<ul style="list-style-type: none"> <li>Total Coliform Organism MPN/100ml shall be 5000 or less</li> <li>pH between 6 to 9</li> <li>Dissolved Oxygen 4mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20°C 3mg/l or less</li> </ul>
Propagation of Wild life and Fisheries	D	<ul style="list-style-type: none"> <li>pH between 6.5 to 8.5</li> <li>Dissolved Oxygen 4mg/l or more</li> <li>Free Ammonia (as N) 1.2 mg/l or less</li> </ul>
Irrigation, Industrial Cooling, Controlled Waste Disposal	E	<ul style="list-style-type: none"> <li>pH between 6.0 to 8.5</li> <li>Electrical Conductivity at 25°C micro mhos/cm Max. 2250</li> <li>Sodium absorption Ratio Max. 26</li> <li>Boron Max. 2mg/l</li> </ul>



Designated Best Use	Class of Water	Criteria
	Below-E	• Not Meeting A, B, C, D and E Criteria

446. Comparing the values of pH, DO, BOD and total coliform with 'Use based classification of surface waters' published by Central Pollution Control Board given in Table 60 the majority of the surface water samples do not meet the criteria for A, B and C, primarily due to BOD levels and in one case fecal coliforms. Therefore, surface water must be considered unsuitable for outdoor bathing and drinking water even with conventional treatment.

447. The maximum total hardness of surface water samples in study area was found to be 138 mg/l in sample and the minimum was observed as 94 mg/l which is at moderate level.

448. **Alkalinity:** The maximum alkalinity of samples was found to range between 60-120 mg/l in the study area.

449. **Chloride:** The maximum chloride concentration (45 mg/l) was found at SW5 and SW6 and the minimum (30 mg/l) was recorded at SW2 and SW3.

450. **Fluoride:** The level of fluoride ranged between 0.35 mg/l to 0.55 mg/l.

### Soil Sampling

451. For studying soil profile of the region, 6 sampling locations were selected to assess the existing soil conditions in and around the SPP area representing various land use conditions. The colour of the soil samples collected varied from light brown to brown. The pH of the samples ranges from 7.23 to 7.44 and the EC ranges from 312  $\mu$ mhos/cm to 426  $\mu$ mhos/cm. The soil texture of the study area was found to be sandy loam in nature. The values of total nitrogen in the soil ranged from 152.7 kg/ha to 199.5 kg/ha and the values of available phosphorus ranged between 18.2 kg/ha to 23.9 kg/ha. The organic matter ranges from 0.79% to 1.03% of the soil samples. The physico-chemical characteristics of soil samples collected is provided in Table 62.

**Table 62: Soil characteristics in study area**

S. N	Parameters	Test Method	S1	S2	S3	S4	S5	S6
1	pH	IS 2720 (Part-26)	7.31	7.23	7.33	7.29	7.31	7.44
2	Organic Matter, % by mass	IS 2720 (Part-22)	1.03	0.79	0.89	0.86	0.95	0.92
3	OC %	AGSS/CHEM/SO P/SOIL/06	0.60	0.46	0.50	0.56	0.51	0.49
4	Electrical Conductivity, $\mu$ S/cm	IS 2720 (Part-21)	426	326	312	386	418	412
5	Calcium Carbonate, mg/kg	IS:2720(Part-27)	38.1	29.2	33.6	31.7	36.9	35.4
6	Total Nitrogen, kg/ha	AGSS/CHEM/SO P/SOIL/02	199.5	152.7	167.4	174.2	177.9	158.2
7	Available Phosphorus, kg/ha	AGSS/CHEM/SO P/SOIL/01	23.8	18.2	19.4	21.1	23.9	21.5

S. N	Parameters	Test Method	S1	S2	S3	S4	S5	S6
8	Available Potassium, kg/ha	IS:2720(Part-47)	235.2	180.0	212.0	226.7	245.3	193.5
9	Exchangeable Ca, Meq/100gm	IS:2720(Part-27)	14.8	11.3	12.4	13.6	12.1	11.8
10	Exchangeable Mg, Meq/100gm	AGSS/CHEM/SO P/SOIL/04	27.0	20.7	25.0	21.5	26.7	22.6
11	Available Micronutrients, mg/kg	AGSS/CHEM/SO P/SOIL/05	101.7	77.8	87.6	92.3	88.6	94.6
12	Boron, mg/kg	AGSS/CHEM/SOP-ICPMS/02	17.0	13.0	15.0	14.0	14.0	15.0
13	Chlorine, mg/kg	AGSS/CHEM/SO P/SOIL/06	16.7	12.8	13.6	14.2	13.6	13.8
14	Copper, mg/kg	AGSS/CHEM/SOP-ICPMS/02	17.8	13.6	16.4	16.7	16.4	16.8
15	Iron, mg/Kg	AGSS/CHEM/SOP-ICPMS/02	63.0	48.2	55.7	51.2	61.0	59.3
16	Manganese, mg/kg	AGSS/CHEM/SOP-ICPMS/02	26.0	19.9	23.2	23.6	21.6	22.9
17	Molybdenum, mg/kg	AGSS/CHEM/SOP-ICPMS/02	23.3	17.8	18.7	18.1	19.3	18.5
19	Zinc, mg/kg	AGSS/CHEM/SOP-ICPMS/02	25.0	19.1	19.6	22.4	21.4	25.3
19	Nickel, mg/kg	AGSS/CHEM/SOP-ICPMS/02	8.5	6.5	7.6	7.9	6.9	7.2
20	Texture	IS 2720 (Part-12)						
21	Sand, % by mass		43.4	49.8	43.6	43.8	43.1	43.4
22	Silt, % by mass		30.0	28.1	30.2	39.7	30.0	30.0
23	Clay, % by mass		26.6	22.1	26.2	26.5	26.9	26.6

452. The full results can be found in Annex D.

### Noise Monitoring

453. Baseline noise monitoring was completed at five locations in 2023. Noise levels were recorded during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The noise level was recorded continuous for 24 hours at an interval of 1 hour averages. The noise level was monitored once during the study period at each monitoring location. The noise level is recorded in dB(A).

454. Automatic sound level meter (SLM 100) was used for measuring the noise levels. This instrument measures sound pressure level (SPL), maximum sound pressure level (max) and equivalent continuous noise level (Leq).

455.

456. Table 632 shows the ambient noise quality standards as per CPCP. It is concluded that the noise levels recorded at various stations are higher in the daytime than the permissible level for industrial and residential areas in few locations.

**Table 63: Ambient Noise Recorded from study area**

Code & Location	Latitude	Longitude	Distance in km	Direction	Max	Min	Avg
SPP NQ1	25°58'48.37"N	93°45'22.51"E	6.37	ENE	82	55	69
SPP NQ2	25°57'48.97"N	93°43'22.95"E	1.95	E	93	23	60
SPP NQ3	25°56'16.47"N	93°43'46.07"E	5.16	SW	109	25	97
SPP NQ4	25°55'8.67"N	93°38'5.47"E	5.1	SSW	103	36	71
SPP NQ5	26° 2'25.13"N	93°41'29.11"E	7.90	N	82	61	51 (?)

### 6.5.2 Supplemental Monitoring

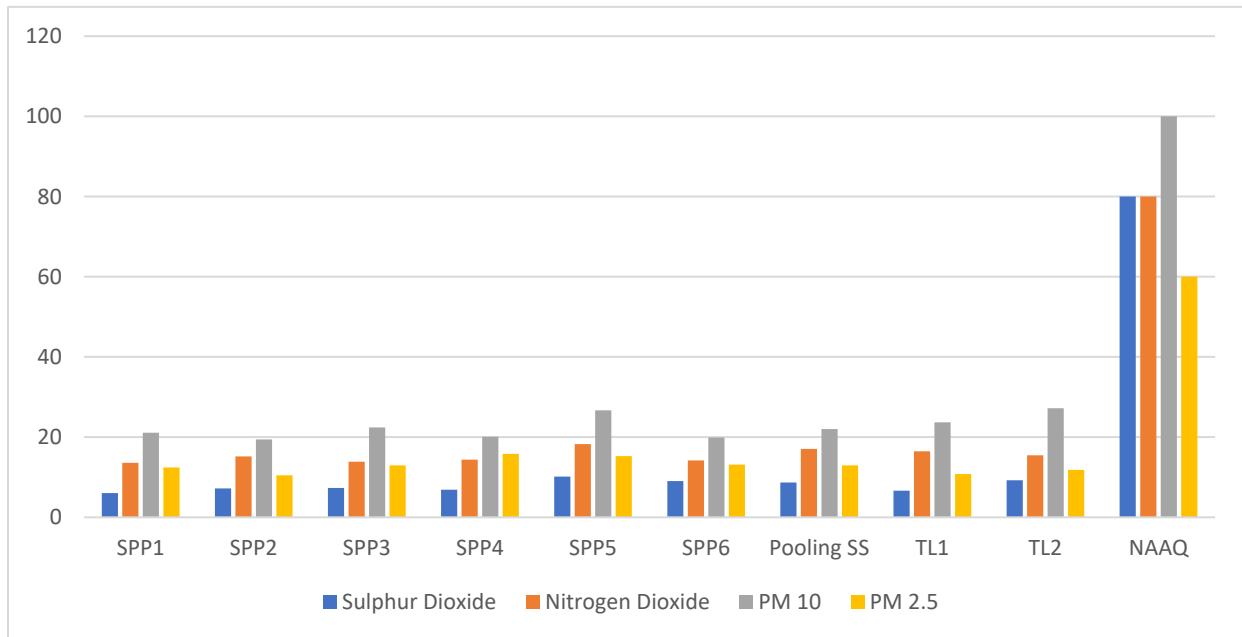
457. Further instrumental monitoring has been undertaken at sites in and around the SPP, pooling SS and SPP TL to supplement the initial monitoring that was mainly undertaken some distance from the SPP boundary. The figure below shows the monitoring locations for noise, air quality and surface water quality. The full results can be found in Annex D.

**Figure 70: Supplemental Monitoring Locations**

Source: Google Earth / IEE Team

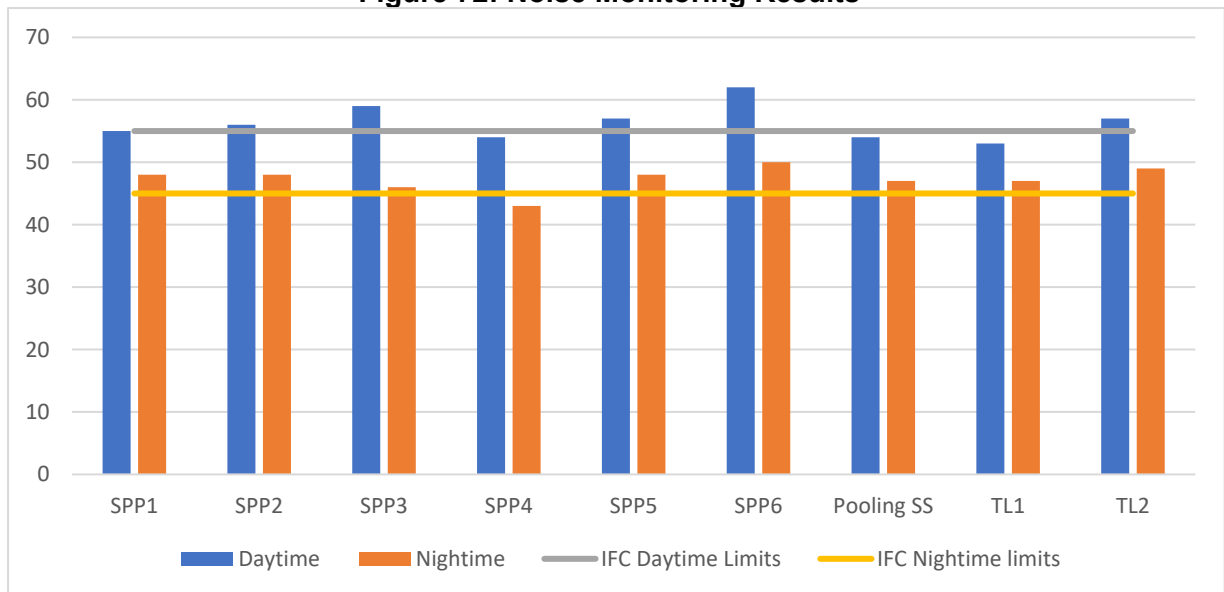
458. Air quality monitoring undertaken at nine locations indicated that air quality is good at the sampled sites and well within NAAQS and the WHO guideline values.

**Figure 71: Air Quality Monitoring Results ( $\mu\text{g}/\text{m}^3$ )**



459. Noise monitoring results at the same locations as air quality monitoring showed that generally daytime and nighttime noise levels were just within, or slightly exceeding IFC guideline limits for daytime and nighttime noise.

**Figure 72: Noise Monitoring Results**



460. Surface water quality was monitored in three locations. The following table provides the results of the monitoring.

**Table 64: Water Quality Monitoring Results**

#	Parameter	Unit	SPP SWQ1	SPP SWQ2	SPP SWQ3
1	pH	-	7.26	7.01	7.11
2	Electrical Conductivity	$\mu\text{s}/\text{cm}$	95.0	115	88.0
3	Turbidity	NTU	11.3	65.1	34.1

4	Color	Hazen	2.0	5	5.0
5	Chemical Oxygen Demand (COD)	mg/l	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)
6	Dissolved Oxygen	mg/l	6.2	6.1	6.2
7	Biochemical Oxygen Demand (BOD) 3 Days at 27°C	mg/l	BLQ(LOQ:2.0)	BLQ(LOQ:2.0)	BLQ(LOQ:2.0)
8	Total Suspended Solid	mg/l	23.0	132	75.0
9	Total Dissolved Solids	mg/l	53.0	64	49.0
10	Oil and Grease	mg/l	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)
11	Total Phosphate	mg/l	0.085	BLQ(LOQ:0.02)	0.12
12	Total Nitrogen	mg/l	9.26	99.5	8.41
13	Total Coliform	MPN/100 ml	79	84	90
14	Fecal Coliform	MPN/100 ml	<2	<2	<2

## **VII. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

### **7.1 Preamble**

461. This portion of the report identifies the environmental and social impacts of the solar PV component and proposes mitigation measures to eliminate the impacts or where this is not possible, reduce their significance. Cumulative, induced and transboundary impacts are addressed at the end of the section under individual headings.

### **7.2 Impact Screening and Scoping**

462. The following table provides impact screening and scoping pre-mitigation. With the exception of impacts on receptors that are of high or very high sensitivity which are considered, impacts that are not listed are due to no or very low magnitude of impact being anticipated or the risk being unlikely to occur e.g. landslide risk is not present. This is followed by discussion of the potential impacts and measures to mitigate the impacts to a satisfactory level, with a focus on those impacts that are of very high or high significance pre-mitigation.

Table 65: Impact Screening and Scoping

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
<b>Physical Resources</b>									
<b>Air Quality and Climate Change Emissions</b>									
Nearby communities including along off-site access roads / workers / habitats	C/D	<b>Dust</b> from the movement of construction vehicles on roads and from land clearing, land leveling and excavation works etc.	High	Local	Medium term	Medium	Medium	Medium	Definite
Nearby communities / workers	C/D	<b>Combustion emissions</b> from stationary and mobile equipment, hot mix, concrete batching, burning of vegetation primarily during construction stage.	Medium	Local	Medium term	Low	Medium	Low	Definite
Global climate / workers	C/D O&M	<b>SF6</b> leaks from gas insulated electrical equipment	Low	International/ Transboundary	Permanent	High	Low	Medium	Possible
Global climate / workers	C	<b>GHG</b> emissions from vegetation clearance	Low	International/ Transboundary	Permanent	High	Low	Medium	Highly likely
Global climate / workers	O&M	<b>GHG emissions from generation of RE</b>	High	International/ Transboundary	Permanent	Very High	Low	High (Beneficial)	Definite
<b>Climate Change Risk</b>									
Project infrastructure	O&M	<b>Increased temperature</b> could impact upon the	Medium	Site	Long term	Medium	Medium	Medium	Likely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		performance of equipment.							
Project infrastructure	O&M	<b>Increased wind speed</b> could lead to damaged equipment.	Medium	Site	Long term	Medium	Medium	Medium	Likely
<b>Soils</b>									
Soils	C/D	<b>Soil compaction</b> from movement of construction plant etc.	Medium	Site	Long term	Medium	Medium	Medium	Highly Likely
Soils	C/D O&M	<b>Soil erosion</b> on slopes across the SPP from vegetation removal across the site.	High	Site	Long term	Medium	Medium	High	Highly Likely
Nearby communities / habitats	C	<b>Spoil disposal</b>	Medium	Local	Long term	Medium	Medium	Medium	Possible
Nearby communities / habitats	C/D O&M	<b>Soil contamination</b> from leaks and spills of hazardous liquids.	Low	Site	Long term	Low	Medium	Low	Possible
Nearby communities / habitats / surface water	C/D O&M	<b>Sediment laden runoff</b> from exposed slopes.	High	Local	Long term	High	Medium	High	Highly Likely
Nearby communities / habitats	C	<b>Use of Licensed Sources for Material</b> for the road rehabilitation works etc. No new borrow pits or quarries will be opened.	Medium	Regional	Short term	Low	Low	Low	Definite
<b>Hydrology, Water Resources and Water Quality</b>									
Existing drainage system /	C/D O&M	<b>Disruption of existing surface water drainage</b>	Medium	Local	Long term	Medium	Medium	Medium	Definite



Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
adjacent landowners or users / habitats		<b>patterns</b> through changes in site layout to accommodate equipment, buildings and access roads etc.							
Nearby communities / habitats / surface and groundwater	C/D O&M	<b>Water contamination</b> via leaks and spills of hazardous liquids.	Low	Local	Long term	Low	Medium	Low	Possible
Nearby communities / habitats / surface and groundwater	C/D O&M	<b>Effluent discharge</b> from construction camps and accommodation / office blocks.	Medium	Local	Long term	Medium	Medium	Medium	Definite
Nearby communities / habitats	C/D O&M	<b>Groundwater depletion</b> for construction water and during operational phase for module cleaning	High	Local	Long term	High	Medium	High	Possible
<b>Natural Hazards</b>									
Project infrastructure / workers / forest habitats and wildlife	C/D O&M	<b>Forest Fires</b> are possible mainly resulting from human activities around the SPP and SPP TL.	Low	Local	Long term	Low	High	Medium	Likely
Project infrastructure / adjacent landowners or users	C&D O&M	<b>Floods</b> are possible on site, but studies have shown there are likely to be minor. SPP is unlikely to	Low	Local	Long term	Low	Medium	Low	Likely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		induce flooding on adjacent land							
Project infrastructure / workers	C/D O&M	<b>Earthquakes</b> can potentially occur and could impact upon SPP infrastructure.	Medium	Site	Long term	Medium	Medium	Medium	Possible
Project infrastructure / workers	C/D O&M	<b>Cyclones</b> could occur and damage equipment.	Medium	Site	Long term	Medium	Medium	Medium	Likely
<b>Noise and Vibration</b>									
Nearby communities including along off-site access roads / workers / wildlife	C/D	<b>Construction/decommissioning equipment noise</b> , e.g. excavators, diesel generators, etc.	High	Local	Medium term	Medium	High	High	Definite
Nearby communities including along off-site access roads / wildlife	C/D	<b>Construction vibration</b> , e.g. from the movement of heavy goods vehicles long access roads.	Medium	Local	Medium term	Low	High	Medium	Possible
Nearby communities / wildlife	O&M	<b>SPP and PSS/GSS equipment noise</b>	Low	Local	Long term	Low	Medium	Low	Definite
<b>Biological Resources</b>									
<b>Internationally Recognized Sites and Nationally Protected Areas</b>									
Protected areas	C/D O&M	<b>Encroachment into nationally protected WLS in AoA</b>	Very low	Regional	Long term	Very low	Very high	Medium	Unlikely
Protected areas	C/D O&M	<b>Encroachment into internationally protected areas</b>	Very low	Regional	Long term	Very low	Very high	Medium	Unlikely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		(KBA and IBA in AoA)							
Reserve forest	C/D O&M	<b>Encroachment into Elephant Reserves and Critical Habitat Reserved Forest in AoA</b>	Very low	Regional	Long term	Very low	Very high	Medium	Unlikely
<b>Critical and Natural Habitat</b>									
Critical habitat	C	<b>Loss / fragmentation of critical habitat for turtles and Bengal florican</b> through clearance of vegetation and fencing of site and SPP TL.	Very Low	Site	Long term	Low	Very High	Medium	Unlikely
Natural Habitat	C	<b>Loss / fragmentation of natural habitat</b> through clearance of vegetation and fencing of site and SPP TL, natural habitat supported is degraded and not pristine.	High	Site	Long term	High	Medium	High	Likely
Modified habitat	C	<b>Loss / fragmentation of modified habitat</b> through clearance of vegetation and fencing of site and SPP TL.	High	Site	Long term	High	Low	Medium	Definite
<b>Flora</b>									

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
Trees	C	<b>Tree cutting</b> within the SPP	Medium	Site	Long term	Medium	Medium	Medium	Definite
Trees	C	<b>Tree cutting</b> within the SPP TL RoW – precautionary intensity since final route is still to be determined and no tree count is available. Tree trimming during the operational phase to maintain clearances beneath SPP TL	Medium (TBC)	Site	Long term	Medium (TBC)	Medium	Medium (TBC)	Definite
Other vegetation	C/O&M	<b>Vegetation clearance</b> , including special status flora within the SPP boundary and SPP TL RoW. Vegetation cutting during the operational phase to maintain clearances beneath SPP TL and control growth within the SPP.	High	Site	Long term	High	Low	Medium	Definite
Vegetation	C/D	<b>Spread of invasive species</b>	Medium	Regional	Long term	High	Low	Medium	Likely
<b>Fauna</b>									
Wildlife	C/D O&M	<b>Poaching</b> of wildlife by workers of special status fauna outside of protected areas etc.	Very Low	Local	Long term	Very Low	Very high	Medium	Unlikely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
Wildlife	C/D O& M	<b>Poaching</b> of other wildlife by workers outside of protected areas etc.	Medium	Local	Long term	Medium	Medium	Medium	Possible
Wildlife	O& M	<b>Fragmentation of wildlife corridors</b> through the installation of fences across the SPP site.	Low	Local	Long term	Low	High	Medium	Definite
Wildlife	C/D	<b>Direct mortality of species</b> through construction works, e.g. vehicle accidents.	Low	Site	Medium term	Low	High	Medium	Possible
Wildlife	C/D	<b>Construction noise</b> from equipment and machinery.	High	Local	Medium term	Medium	High	High	Definite
Wildlife	C/D	<b>Accidents</b> including traffic accidents on off-site access roads and around work zones.	Low	Local	Medium term	Low	High	Medium	Possible
Wildlife	C/D O& M	<b>Lighting</b> used to illuminate work areas and site facilities and boundary during operational phase.	Medium	Local	Long term	Medium	High	High	Highly likely
Wildlife	O& M	<b>Elephant</b> damage to solar panels from wandering elephants	Medium	Site	Long term	Medium	Medium	Medium	Possible
Wildlife	O& M	<b>Electrocutions</b> via contact with live electrical equipment.	Low	Site	Long term	Low	High	Medium	Possible
Wildlife, specifically birds	O& M	<b>Collisions</b> with transmission lines of other birds including	Very low	Site	Long term	Very low	Very high	Medium	Possible

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		special status fauna outside of protected areas							
<b>Socio-economic Resources</b>									
<b>Economy and Livelihoods, Land Use</b>									
Community	C/D O& M	<b>Employment opportunities</b> for the community and region in general.	High	Regional	Long term	Very high	Medium	High (Beneficial)	Definite
Community and global climate	O& M	<b>Climate resilient energy supply</b> to Assam.	High	State	Long term	Very high	Medium	High (Beneficial)	Definite
Private land and property	O& M	<b>Land Acquisition and loss of livelihoods</b>	High	Site	Long term	High	High	High (see RIPP)	Definite
Nearby communities	C/D O& M	<b>Disrupted or loss of access to water resources</b> due to access to solar power plant being prevented	Medium	Local	Long term	Medium	High	High (see RIPP)	Definite
Nearby communities	C/D O& M	<b>Access to timber and NTFP</b> during construction and operational phases	Medium	Local	Long term	Medium	High	High (see RIPP)	Definite
Social and environmental receptors	C	<b>Impact of resettlement site(s)</b> on environment and social receptors (sites are not yet identified)	High (TBC)	Regional	Long term	Very high	Medium	High (TBC)	Highly likely
<b>Access, Social Infrastructure and Utilities</b>									
Nearby communities	C/D O& M	<b>Access across site and to social infrastructure/PCR blocked</b> during	Medium	Local	Long term	Medium	High	High (see RIPP)	Definite

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		construction and operational phases							
Nearby communities and social infrastructure	C/D O&M	<b>Impacts to local infrastructure</b> due to pressure on health services etc.	Medium	Regional	Long term	High	Medium	High	Possible
Nearby communities and road users	C/D	<b>Disruption</b> to traffic during road works and by construction vehicles/works.	High	Local	Medium term	Medium	Medium	Medium	Highly likely
Nearby communities and road users	C/D	<b>Removal of distribution poles and unintended damage to existing roads, property and utilities</b> by construction vehicles/works.	Medium	Local	Medium term	Low	Medium	Low	Possible
<b>Visual Impact</b>									
Nearby communities	C/D O&M	<b>Change in landscape</b> through change in land use and installation of transmission towers.	High	Local	Long term	High	Medium	High	Definite
Nearby communities	C/D O&M	<b>Lighting</b> of the site at night.	Medium	Local	Long term	Medium	Medium	Medium	Highly likely
Nearby communities	O&M	<b>Glint and glare</b> from solar PV modules.	Medium	Local	Long term	Medium	Medium	Medium	Likely
<b>Physical Cultural Resources</b>									
Churches and temples on-site	C	<b>Impacts to known cultural heritage sites</b>	Medium	Site	Long term	Medium	Medium	Medium	Definite

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
Unknown cultural heritage	C	<b>Chance finds</b> taking a precautionary principle assuming possible finds of state level importance given archaeological value of East Karbi Anglong	Medium	Site	Short term	Very low	High	Low	Possible
<b>Waste management</b>									
Community and habitat	C	<b>Spoil disposal</b> from land leveling and road works	Medium	Local	Long term	Medium	Medium	Medium	Possible
Community and habitat	C/D	<b>Generation for disposal of general inert construction waste</b> (paper, plastic etc.)	Medium	National (as no engineered disposal facilities in Assam state)	Medium term	High	Medium	High	Definite
Community and habitat	C	<b>Generation for disposal of organic waste from clearing of vegetation</b> (trees, shrubs, etc.)	High	Regional	Short term	Medium	Medium	Medium	Definite
Community and habitat	C/D	<b>Generation for disposal of hazardous materials</b> (oil drums, cans etc.)	Low	National (as no engineered disposal facilities in Assam state)	Medium term	Medium	Medium	Medium	Definite
Community and habitat	O&M	<b>Generation for disposal of hazardous materials</b>	Low	National (as no engineer	Long term	High	Medium	High	Definite



Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		including oil, lead acid batteries etc.		ed disposal facilities in Assam state)					
Community and habitat	C/D O&M	<b>Generation for disposal of e-waste</b> including PV modules	High	National (as no engineered disposal facilities in Assam state)	Long term	Very high	Medium	High	Definite
<b>Health, Safety and Facilities Management</b>									
<b>Community Health and Safety</b>									
Community	C/D	<b>Risk of accidents</b> including trespassing on construction site, traffic accidents on off-site access roads and around work zones.	Medium	Local	Medium term	Low	High	Medium	Possible
Community	C/D	<b>Presence of workers</b> in the local area affecting general community activities	High	Local	Medium term	Medium	Medium	Medium	Definite
Community	O&M	<b>Presence of workers</b> in the local area affecting general community activities	Medium	Local	Long term	Medium	Medium	Medium	Definite
Community	C/D O&M	<b>Social conflict, security and safety</b> including excessive force used by security staff and presence of	Low	Local	Long term	Low	High	Medium	Unlikely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		workers affecting vulnerable groups							
Community	C/D O&M	<b>SEAH of community</b>	Low	Local	Long term	Low	High	Medium	Possible
Community	O&M	<b>Risk of accidents involving electrical equipment</b> from trespassing on the SPP or from SPP TL	Low	Site	Long term	Low	High	Medium	Possible
Community	O&M	<b>EMF</b> from SPP affecting human receptors	Low	Local	Long term	Low	Medium	Low	Definite
Community	O&M	<b>EMF</b> from SPP TL affecting human receptors of regularly occupied properties remaining in the right of way	Medium	Site	Long term	Medium	Medium	Medium	Definite
<b>Worker's Rights and Occupational Health and Safety</b>									
Contractors staff / sub-contractors	C/D	<b>Risk of accident involving workers</b> through operation and movement of heavy equipment, plant, vehicles, and machineries, working conditions, transport-loading and unloading risks, road related accidents for drivers especially for material/equipment transport, excavations,	High	Site	Medium term	Medium	Medium	Medium	Highly likely

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
		electrical and fire hazards, working in remote location, etc.							
Contractors staff / sub-contractors	C/D	<b>Exposure to hazardous substances</b> or conditions (dust, noise, cement, chemicals)	High	Site	Medium term	Medium	Medium	Medium	Definite
Contractors staff / sub-contractors	C/D	<b>Inadequate sanitation and welfare</b> including communicable diseases spread – at project site and accommodation, drinking water provision etc.	High	Site	Medium term	Medium	Medium	Medium	Highly likely
Operational staff	O&M	<b>Risk of workplace accidents</b> electrical and fire hazards, working in remote location, etc.	Medium	Site	Long term	Medium	Medium	Medium	Possible
Operational staff	O&M	<b>Inadequate sanitation and welfare</b>	Medium	Site	Long term	Medium	Medium	Medium	Likely
Contractors staff / sub-contractors / operational Staff	C/D O&M	<b>Workers' rights ignored.</b>	Medium	Site	Long term	Medium	Medium	Medium	Possible
Contractors staff / sub-	C/D	<b>SEAH of workers</b>	Low	Site	Long term	Low	High	Medium	Possible

Receptor	Phase	Impact	Intensity	Extent	Duration	Magnitude	Sensitivity	Significance	Probability
contractors / operational staff	O&M								
Contractors staff / sub-contractors / operational staff	C/D O&M	<b>Use of child or forced labor, employment of under 18s on the project</b>	Low	Site	Long term	Low	Very high	High	Unlikely
Contractors staff / sub-contractors / operational staff	C/D O&M	<b>Use of foreign/migrant workers, or unskilled members of local community</b>	Medium	Site	Long term	Medium	High	High	Likely
<b>Construction Camps, Hot Mix, Batching Plant and Temporary Facilities</b>									
Nearby community and habitats	C/D	Disruption and disturbance from operation of construction camps	High	Local	Medium term	Medium	Medium	Medium	Definite
Nearby community and habitats	C	Disruption and disturbance from operation of concrete batching including dust and noise	High	Local	Medium term	Medium	Medium	Medium	Definite
Nearby community and habitats	C	Disruption and disturbance from operation of hot mix plant including air pollution	High	Local	Medium term	Medium	Medium	Medium	Definite
Nearby community and habitats	C/D	Disruption and disturbance from operation of temporary storage sites	Medium	Site	Medium term	Low	Medium	Low	Definite

## 7.3 Impacts to Physical Resources

### 7.3.1 Air Quality and Climate Change Emissions

463. This section discusses emissions of atmospheric pollutants and greenhouse gases during construction and operation of the SPP outputs and associated mitigation measures to be adopted.

#### Potential Impacts

##### **Construction Phase**

464. Engines and processes that combust fuels, depending upon the nature of the fuel, may have the potential to emit atmospheric pollutants including nitrogen oxides<sup>41</sup> (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), carbon monoxide (CO) and particulate matter (PM)<sup>42</sup>, greenhouse gas carbon dioxide (CO<sub>2</sub>) and volatile organic compounds (VOCs)<sup>43</sup> that include both atmospheric pollutants and greenhouse gases. The following planned activities under the SPP outputs involve fuel combustion, resulting in a low magnitude from combustion emissions:

- Operation of petrol and diesel-powered vehicles along roads, as well as construction plant and machinery on works sites and at camp sites.
- Operation of diesel power generators at construction camps during the construction phase.

465. GHG emissions will also arise from the clearing of vegetation and the subsequent decomposition of vegetation matter, the impact intensity will be low but the magnitude high given the global impact of GHG emissions.

466. However, the biggest source of emissions in the construction phase is the fugitive dust emissions the magnitude of which will depend on the extent of earthworks required in each block (to create a level construction platform) and being undertaken at any one time as well as the type of foundations used (excavations also generating dust) and weather conditions at the time. Dust impacts are more likely to occur during the dry season when it is preferable to undertake the work for other reasons, as rainfall acts as a natural dust suppressant. Dust resulting from excavations and earthworks typically comprises large diameter particles, which settle rapidly and close to the generation source. According to the screening guidance of the UK's Institute of Air Quality Management (IAQM) for construction dust,<sup>44</sup> assessment relating to dust generation is required where there is a human receptor within 250m of the boundary of the site or within 50m of the access roads. Medium magnitude of impact will result.

467. The SPP is in a rural area with generally good air quality although particulate matter may exceed the WHO guidelines during the driest periods. Individual properties in close proximity may be adversely affected by dust and have cause for complaint, the nearest scattered individual properties and villages will be immediately adjacent to the site boundary. In the case of the SPP there are numerous properties within 500m of the SPP boundary, all of which could be impacted by construction dust. However, these properties

<sup>41</sup> NO<sub>x</sub> includes nitrogen dioxide (NO<sub>2</sub>) and nitric oxide (NO).

<sup>42</sup> Particulate matter is used in this context to describe inhalable particles generally PM<sub>10</sub> and below.

<sup>43</sup> The term VOC is loosely applied to a wide range of organic compounds but in this context, it is used as defined in the UNECE VOC Protocol (1991) as "all organic compounds of an anthropogenic nature, other than methane, that are capable of producing photochemical oxidants by reactions with nitrogen oxides in the presence of sunlight".

<sup>44</sup> <https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf>

are only likely to be affected when works occur within 250m of their location, i.e., work sites close to the site boundary, which represent a smaller portion of the SPP site. No WLS or Reserved Forest is within 50m of the site. Impacts may be greater along the access roads being rehabilitated due to the road works and track out since properties are immediately adjacent and the village roads are not surfaced, or in the vicinity of any batching plant or hot mix plant located on or off site. The SPP TL is also located in a rural area, it will involve excavation and earthworks but except for a couple of towers there are few sensitive receptors immediately adjacent.

468. In the absence of mitigation to control air pollution, impacts of the SPP are likely to be short term in respect of each block (medium term for the SPP as a whole) and cause localized exceedance of national air quality standards and WHO guidelines, especially for particulate matter. However, impacts are readily mitigated. Overall, the unmitigated impacts on ambient air quality will be of medium significance.

### **O&M Phase**

469. Minimal dust and combustion emission generation is expected to occur during the O&M phase caused by maintenance vehicles passing along the access roads which will be infrequent. Therefore, the impact of dust and vehicle exhaust emission generated during O&M is not considered any further.

470. In relation to climate change, SF<sub>6</sub> is a non-toxic greenhouse gas used as a dielectric in gas insulated substations (GIS) as well as switch gear and other electrical equipment. 1kg has a global warming potential of 22,800 carbon dioxide equivalent (CO<sub>2e</sub>) i.e., equivalent to an average car covering 160,000 km. Due to high global warming potential, SF<sub>6</sub> contributes to climate change if it is released into the atmosphere during operation, maintenance or during end-of-life disposal. The SF<sub>6</sub> contained in GIS and switchgear equipment varies greatly according to type and manufacturer.

471. Sulphur Hexafluoride (SF<sub>6</sub>) can have impacts to health of workers and the environment, A major leak of SF<sub>6</sub> from equipment installed at the PSS and GSS is the worst-case scenario but could occur during operation if equipment is not well maintained, or at end of life if the equipment is not appropriately disposed. Climate change is a global concern, however, the intensity of a worst-case SF<sub>6</sub> release will be low if considered in percentage terms compared to the 36 billion annual global CO<sub>2e</sub> emissions, thus of medium significance. During the O&M phase SF<sub>6</sub> containing equipment will need to be periodically replaced.

### **Decommissioning Phase**

472. Similar to the construction phase a change in ambient air quality may arise during decommissioning as a result of fugitive dust, particulate matter emissions, NOX, CO, SO<sub>2</sub> and VOC from activities like the use of diesel power generators, vehicles and equipment. However, such impacts are expected to be localized and no greater than those of construction. During decommissioning SF<sub>6</sub> equipment will need to be removed from site completely.

## **Air Quality Mitigation and Management Measures**

### **Design Phase**

473. Although not likely to occur given that new equipment will be installed at the PSS and GSS, leaks of SF<sub>6</sub> could possibly occur and therefore it is considered prudent to manage SF<sub>6</sub> according to GIIP as follows:

- If no alternative the use of SF<sub>6</sub> in gas insulated equipment must be minimized as part of design requirements.
- Design of any gas insulated equipment will comply with international norms and standards for handling, storage, and management of SF<sub>6</sub>.
- Equipment to be hermetically pressure sealed "sealed for life" units and be tested and guaranteed by the supplier at less than 0.1% leakage rate.
- Installation designed and operated so that any leakage will trigger an alarm at the substation requiring O&M staff to rectify the situation immediately.
- Provide SF<sub>6</sub> leakage detector at each substation.
- Use of SF<sub>6</sub> in fire extinguishers to be avoided.

474. Only "green" diesel generator (DG) sets are to be used for the permanent facilities with supplier certification on meeting the GoI emission standards. Stack emissions of diesel generator set to comply with national emission standards with the stack height designed according to both national requirements and IFC EHS General Guidelines.

### **Pre-construction Phase**

475. During the pre-construction phase, SPP contractors including the private sector, as part of their C-SEMP, will be responsible for the preparation and implementation of a Dust Management Plan and a Pollution Prevention Plan covering emissions to air management in accordance with GIPP such as the IFC EHS Guidelines. Emergency Response Plan (ERP) comprising specific requirements to manage SF<sub>6</sub> will be prepared and implemented to deal with the event of any accidental leaks during the construction phase.

476. Off the national and state highway only bitumen surfaced village roads of adequate width to allow vehicles to traverse without damage to the adjacent properties will be used for access to the construction site to minimize dust impact. This will require the off-site access roads to be surfaced at the start of works. The contractor will be responsible for surfacing any unpaved village roads. Construction details for strengthening of village roads and approach roads shall be as per IRC-37 Guidelines and Assam State PWD requirements; they will all be bitumen surfaced. A boundary wall will also be constructed around the entire SPP which will help reduce dust dispersion. Contractors shall also install solid temporary fencing at all work sites where residential receptors can be found within 500m.

### **Construction Phase**

477. To manage dust and combustion emissions a range of GIPP measures will be applied to the SPP and extended to the SPP TL. These measures are outlined in detail in the EMP as found in Annex A. Specific measures to manage dust in the areas close to the SPP boundary (within 250m) and on off-site access roads include:

- Halt ground clearing, land leveling, earthworks and excavation works during periods of high wind where significant wind-blown dust is observed from the site to residential receptors.
- Ensure an adequate supply of bowsers on all access roads and carry out watering for dust control at least twice a day on all village roads being upgraded, more if weather

conditions require it. Watering shall occur in dry weather with temperatures of over 25°C, or in windy weather. Avoid overwatering as this may make the surrounding muddy.

- Dust control measures will also be implemented on all access roads within 50m of residential / sensitive receptors.
  - Vehicle movements will be restricted to defined access routes and demarcated working areas (unless in the event of an emergency).
  - A strict site speed limit of 20 km/hr will be enforced for SPP related vehicles including those using off-site access roads, approach and internal roads, inside and outside of the SPP boundaries having turned off the national/state highway. On long distance haul routes before turning off the national/state highway national speed limits to be followed.
  - Excavated materials will be stockpiled where practical at least 250m from sensitive receptors, such as homes, schools, and health facilities. If this is not possible, ensure regular watering of stockpiles to prevent dust impacts.
  - Vehicles carrying fine aggregate materials will be sheeted with canvas or tarpaulin to help prevent dust blow and spillages.
  - Undertake weekly dust soiling checks of surfaces of adjacent properties within 250m of the SPP boundary and within 50m of off-site access roads during earthworks and help with cleaning of external surfaces of property if dust is evident.
  - If there is an increase in existing background air pollution or complaints are received contractor will be required to implement additional dust mitigation e.g., barricading/isolating sources of dust, use of wheel wash etc.
478. To supplement the current baseline data and to provide a basis for monitoring the contractor will undertake air quality monitoring per the EMoP to confirm current background levels in the subproject area prior to the commencement of any activity on-site. Further on-going air quality monitoring will be completed at the baseline locations throughout construction and at areas where any complaints from residents are received.
479. Air emissions mitigation associated with cement batching and hot mix plants are discussed separately under section 7.6.3.

### **Operational Phase**

480. Operational phase mitigation will focus on the management of SF<sub>6</sub>. Specific requirements include:
- During operation, regular visual and technical inspections of PSS and GSS will be undertaken, SF<sub>6</sub> leakage detection kits will be provided at substations, and gas pressure alarms are to be installed. These will be remotely monitored where SS is not staffed and daily inspection is not an option, such that any leaks can be immediately addressed.
  - Ensure SF<sub>6</sub> is removed in accordance with International Electrotechnical Commission (IEC) standard 61634 to a very low pressure so losses of SF<sub>6</sub> are less than 0.5% at end of life and then reused, recycled, or destroyed in a high-temperature incinerator.



- Define a safe SF<sub>6</sub> retrieval arrangement, with appropriate handling, storage, disposal process for end-of-life equipment in accordance with international good practice.

### **Decommissioning Phase**

481. During the decommissioning phase the contractor will follow all of the measures outlined for the construction phase, noting that in 25 years' time new technologies are likely to be available to limit air quality impacts, e.g., electric construction vehicles, improved methods for dust suppression, etc., and where these are available, they should be used rather than any out-of-date measures proposed in this IEE.

### **Residual Impacts**

**Table 66: Air Quality and Greenhouse Gas Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Post Mitigation	
C/D	Dust from the movement of construction vehicles on roads and from land clearing, land leveling and excavation works, etc.	Medium	The detailed mitigation measures provided by the EMP should ensure that any residual impacts are of low significance due to high degree of confidence in effectiveness of the mitigation.	Low
C/D	Combustion emissions from stationary and mobile equipment, hot mix, concrete batching, burning of vegetation primarily during construction stage.	Low	Residual impacts should be reduced to very low with application of GIIP techniques to manage combustion emissions due to high degree of confidence in effectiveness of the mitigation	Very Low
C/D O&M	SF <sub>6</sub> leaks from gas insulated electrical equipment	Medium	Provision of the design and O&M mitigation measures should ensure that residual impacts are of low significant, due to high degree of confidence in effectiveness of the mitigation	Low
C	GHG emissions from vegetation clearance	Medium	GHG emissions will still result from composting of waste but are offset by the climate change benefit of RE.	Medium

### **7.3.2 Climate Change Risk**

482. The following section summarizes the key risks and impacts identified by the project Climate Risk Screening Assessment (CCA).

### **Potential Impacts**

#### **O&M Phase**

483. The main climate impacts on the SPP are likely to be due to temperature increases, increased cloud cover, and extreme events, as follows:

- Solar modules have an operating lifetime of 20 or more years and are vulnerable to hail, wind, and extreme temperatures. Solar cell output is usually rated at 25°C with output typically decreasing by about 0.25% (amorphous cells) to 0.5% (most crystalline cells) for each temperature rise of 1°C.
- Studies consistently show that the inverter, which converts direct current power output into alternating current (DC to AC), is the most unreliable component of a photovoltaic system, accounting for up to 69% of unscheduled maintenance costs. However, they are not usually directly exposed to the weather and are not especially vulnerable to climate change.
- During cloud cover, solar photovoltaic panel output can decrease by 40%–80% within a few seconds, increasing just as dramatically when the sky clears. For large arrays, this rapid fluctuation can cause localized voltage and power quality concerns.
- Higher wind speeds, e.g., cyclones, can damage structures. Further, winds can increase dust particle deposits, which decrease solar photovoltaic cell output, but higher winds can also cool the modules, increasing efficiency and output.

## Climate Change Adaptation Measures

### Design Phase

484. Based on the above, the CCA recommends the following adaptation measures:

- Assure structures are strong enough to withstand higher winds. The foundations and racking system will be designed to withstand powerful cyclones, which will limit the probability of generation unavailability as well as reducing any potential hazard of panels being lifted up and blown onto adjacent properties.
- Use designs that improve passive airflow beneath mounting structures, reducing panel temperature and increasing power output.
- Choose modules with more heat-resistant photovoltaic cells and module materials designed to withstand short peaks of very high temperature.
- Where solar energy is likely to become more diffuse with changes in cloud cover, rough-surfaced photovoltaic modules are more efficient and output can be improved under overcast conditions by selecting an appropriate tilt angle.
- Where clouds are likely to pass over modules more quickly, consider micro-inverters for each panel (in place of small numbers of large, centralized inverters) to improve stability and increase power output.

## Residual Impacts

**Table 67: Climate Change Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
O&M	Increased temperature could	Medium	Despite the best estimates of the CCA the exact nature of	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
	impact upon the performance of equipment.		climate change impacts is unknown. Design recommendations should however reduce with a high degree of confidence the potential for damage to SPP equipment resulting from extreme events. Residual impacts are therefore still possible although they should be of low significance in terms of the damage caused.	
O&M	<b>Increased wind speed / extreme events</b> could lead to damaged equipment.	Medium		Low

### 7.3.3 Soils

485. This section discusses potential impacts on soils during construction and operation of the SPP project component and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

486. Soil Compaction and Erosion - Erosion is a natural process by which wind and rain wear away soils that have poor cohesion or are steeply sloping. Where the land surface is disturbed and when vegetation and topsoil are removed, erosion rates increase. This will be a specific issue across the SPP when vegetation is removed from the site where topography is undulating. The earthworks envisaged for SPP site development will alter drainage lines which will increase the risk of soil erosion which in turn will increase the dust impact. Soil erosion impacts can be long term and of high magnitude if left unmitigated. Further, the passage of construction vehicles across the site can compact the topsoil/subsoil and cause its structure to be lost, affecting future productivity of the land. Soil compaction impacts can be long term and of medium magnitude if left unmitigated.

487. Spoil Disposal - The magnitude of which will depend on the extent of earthworks required in each block (to create a level construction platform). Any excavated soils from the SPP site are anticipated to be used as fill for other areas of the site, or where needed for road construction. Where any excess material remains, it will need to be transported to licensed disposal sites or shared with the community for beneficial use. Excavated material from SPP TL tower footings will be backfilled into the excavated area and compacted. Any excess spoil material will be spread around the base of the tower.

488. Soil contamination – Leaks and spills of hazardous liquids can occur during the construction phase. The use of hazardous liquids will be primarily associated with the use of construction vehicles and plant and diesel generators. Impacts will be localized throughout the construction phase and any spillage is unlikely to have significant impacts beyond work zones.

489. Material Requirements - Any aggregate (sands or gravels) required for construction of tower foundations (e.g., fill material beneath tower pads), substation works and more importantly, village roads, will be obtained from state licensed quarries and/or borrow pits, or from excavated material from the SPP site itself as part of land grading works. As long

as cut is balanced with fill from the SPP and licensed borrow pits are utilized the impact significance will be low.

### **Operational Phase**

490. **Leaks and Spills** - Without suitable containment measures, it is possible that leaks of oil from oil containing equipment could impact upon soils (and groundwater). However, substations will be constructed in accordance with the specific national guidelines discussed in Section 3.5. Broadly, these guidelines require an oil soak pit to be designed and provided below each oil filled transformer to accommodate at least 150% of total quantity of oil contained in the transformer. However, there remains a risk that spills and leaks of oil could occur from oil storage areas, but they would generally be contained within the SS.

### **Decommissioning Phase**

491. Soil compaction, erosion and leaks and spills of hazardous liquids are possible during this phase, although the use of hazardous liquids during this phase will be of a lower intensity than the construction phase. Removal of equipment and use of heavy equipment might lead to the removal of some shrubs and grasses across the site and induce erosion on some slopes. However, such impacts are expected to be localized and no greater than those of construction.

## **Mitigation and Management Measures**

### **Design Phase**

492. Where practical designs shall ensure that cut material is balanced with fill across the SPP. Once earthworks are completed all disturbed areas are to be revegetated using native grass species sourced from the site. The contractors design teams shall also identify presence of any unstable land/steep slopes over 10 degrees and avoid these in the layout. Where solar PV modules and other SPP infrastructure are not on flat land the contractors will conduct geotechnical/slope stability analysis. Design to ensure all slopes where vegetation clearance is required to be graded with drainage installed to minimize soil erosion. Bioengineering methods can be considered for providing slope protection. Any site landscaping must ensure the resulting slope design/topography does not exacerbate any soil erosion.

493. To manage leaks from oil containing equipment substations designs will include at minimum 110% impermeable bunds to transformers/storage areas used for oils etc. and follow the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, including Soak Pit and Oil collecting pit as follows:

- An oil soak pit shall be designed and provided below each oil filled transformer / reactor to accommodate at least 150% of total quantity of oil contained in the transformer / reactor with minimum 300 mm thick layer of gravels / pebbles of approximately 40 mm size (spread over a steel iron grating / trans rack) providing free space below the grating.

- Alternatively, an oil soak pit shall be provided below each transformer or reactor, to accommodate one third of total quantity of oil contained in the transformer / reactor with minimum 300 mm thick layer of gravels/ pebbles of approximately 40 mm size (spread over a steel iron grating/ trans rack) providing free space below the grating provided a common remote oil collecting pit of capacity at least equal to oil quantity in the largest size transformer or reactor is provided for a group of transformers or reactors and bottom of the soak pit below the transformer or reactor shall be connected to the common remote oil collecting pit with drain pipe of minimum 150 mm diameter with a slope not less than 1/96 for fast draining of oil or water through gravity from soak pit to the common remote oil collecting pit.
  - Every soak pit below a transformer or reactor shall be designed to contain oil dropping from any part of the transformer or reactor.
  - The common remote oil collecting pit and soak pit shall be provided with automatic pumping facility, to always keep the pit empty and available for an emergency.
  - The disposal of transformer oil shall be carried out in an environmentally friendly manner.
494. A 110% bunded, secure storage area will also be provided at SS sites for oil and in each block/administrative area for other hazardous liquids. Designs for the SS and other materials storage areas to include an undercover, locked but well-ventilated storage area of suitable size and that will not reach extreme temperatures for accommodating all fuel, oil and chemicals to be stored during O&M with impermeable floor and bunded to 110% capacity to contain any spill or leak. Bund will not be connected to the drainage system. Spill prevention kits (sorberent pads, loose sorberent material, etc.) will be provided at storage areas and other at-risk locations within clearly labelled containers.
495. Finally, all substation drainage should be connected to an interceptor tank to trap any oil and grease before discharge of site drainage water from substations.

### **Pre-construction Phase**

496. A Site Preparation and Vegetation Management Plan will be prepared. The plan shall map the SPP and identify areas where the removal of existing vegetation shall be minimized. The vegetation will only be removed where essential for construction. Beneath all solar PV modules vegetation cover shall be retained or reestablished at a minimum height of 400 millimeters. The plan shall also outline a sequenced construction method, for revegetating areas immediately construction activities are completed in one area rather than undertaking earthworks on all parts of the site at the same time to minimize the area of bare ground exposed.
497. Contractors will also be responsible for the preparation and implementation of a Pollution Prevention Plan covering and environmentally sound and safe storage, use, and disposal of all fuels, chemicals and oils used on site and an emergency preparedness and response plan in the event of any leaks or spills (e.g., of oil, etc.).
498. No new borrow pits will be established outside of the SPP site, if practical and suitable material available the contractor may use excess spoil material from the SPP site for any road filling activities. Only licensed off-site material sources will be used. Due diligence review will be undertaken before the Contractor signs any contract with an existing borrow pit or quarry owner for fill material. This is to include a review of existing borrow pit/quarry locations for sources of material, licenses and approvals to determine suitability and ensure that the borrow pits/quarries used are not within the ESZ of protected areas, an

elephant reserve, reserve forest etc. Contractors shall be responsible for ensuring that any materials sources are existing licensed facilities and are not located within any nationally or internationally designated or recognized sites or reserved forest.

### **Construction and Operational Phase**

499. To manage topsoil and prevent soil erosion and pollution from hazardous materials a range of good international industry practice measures will be applied. These measures are outlined in detail in Annex A.

500. As part of the overall management process contractors shall conduct bi-monthly training of workers on pollution prevention control including good housekeeping and how to clean up oil/fuel/chemical spills and dispose of contaminated sorbent material which would be treated as a hazardous waste. This will include emergency preparedness and response procedures (drills) in case of spill. Training for subcontractors before commencement of works will also be completed. Similar will be provided for O&M workers.

### **Decommissioning Phase**

501. Soil quality should be tested especially below storage areas and transformers to confirm no residual contamination; although this should have been avoided through EMP measures any contaminated soil should be remediated. Contractors will re-vegetate any bare slopes using native species, it will be necessary to add good quality soil if the latter was eroded or removed by the SPP implementation. Other measures, relating to mitigate impacts of leaks and spills of hazardous liquids during the construction phase will be adopted for decommissioning.

### **Residual Impacts**

**Table 68: Soils Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/D	<b>Soil compaction</b> from movement of construction plant etc.	Medium	Residual impacts will be medium as there is limited mitigation available to manage the impact.	Medium
C/D O&M	<b>Soil erosion</b> on slopes across the SPP from vegetation removal across the site.	High	Residual impacts will be of low significance in the long term if the required measures e.g., revegetation are implemented but during construction medium residual impacts anticipated. There is a low degree of confidence in the effectiveness of the mitigation, given the size of the site, number of contractors, and uncertainties in the final design and construction methods to be adopted.	Medium

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
			Impacts are not irreversible in the long term.	
C/D O&M	<b>Spoil disposal</b>	Medium	Balancing cut with fill and disposing of soils at licensed facilities should ensure that any residual impacts are of low significance.	Low
C/D O&M	<b>Soil contamination</b> from leaks and spills of hazardous liquids.	Low	Residual impacts will remain of low significance as a pollution incidence is still possible during works.	Low
C/D O&M	<b>Sediment laden run-off</b> from exposed slopes	High	Revegetation of slopes and retaining vegetation wherever possible should ensure that in the longer term there will be low residual impacts although during construction medium residual impacts anticipated. There is a low degree of confidence in the effectiveness of the mitigation, given the size of the site, number of contractors, and uncertainties in the final design and construction methods to be adopted. Impacts are not irreversible in the long term.	Medium
C	<b>Use of Licensed Sources for Material</b> for the road rehabilitation works etc. No new borrow pits or quarries will be opened.	Low	Low residual impacts are anticipated if licensed existing sources are used.	Low

### 7.3.4 Hydrology, Water Resources and Water Quality

502. This section discusses potential impacts on hydrology, water resources and water quality during construction and operation of the SPP and SPP TL and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

503. Changes in the slopes within the SPP and presence of impermeable surfaces will affect the natural recharge of the site to groundwater due to a reduction in greenfield area at the site although as the modules will be elevated (provided mass concrete foundations are avoided) land beneath them would still be available for groundwater recharge. Impacts will be long term, localized and of medium intensity and significance.

504. The works will involve the use or generation of some or all the following materials that have the potential to contaminate surface waters:

- Fuels and lubricating oils.

- Paints and solvents.
- Leachate from solid and hazardous waste storage areas at camp sites and work zones.
- Raw sewage from offices and camp sites.

505. There are few surface water features within the SPP, or close to the SPP TL that could be significantly affected. Only one small stream was identified on the SPP site during site visits during the dry season. During the monsoon season flow seasonal channels are, however, likely to be widespread across the site draining from the site to the neighboring land and streams, with surface water percolating into soil and groundwater, or gathering within ponds in depressions on site. One small stream has also been identified beneath the SPP TL alignment. Works in this area will be short term and limited to areas around the tower pads – accordingly pollution of this stream is considered unlikely. There are no surface water courses close to substations. Wastewater from concrete batching yards is discussed below under section 7.6.3.

506. Although large volumes of water are not anticipated to be required at each worksite, there will be the need for technical and drinking water supplies during the construction phase. Uncontrolled exploitation of water resources via newly developed boreholes could impact upon existing users of the water resources surrounding the SPP.

507. On commencement of construction the SPP will be fenced and closed to the community (as discussed under social impacts). Several community water resources (ponds and borewells) have been identified across the site and these will no longer be available to access. This will only affect the community living around the SPP who use site resources. Alternative water sources will be required to mitigate this long-term impact.

### **O&M Phase**

508. The main water requirement will be for cleaning of PV modules requiring 2 liters/module to clean, with cleaning twice per month. To complement groundwater supplies the DPR suggests a system of water harvesting ponds across the site to collect and store water during the monsoon season. APDCL consultants calculated that approximately 270m<sup>3</sup> of water will need to be abstracted per day (18 hours x 15 m<sup>3</sup>/hour) to supplement the rainwater harvesting ponds during the dry season and a total of 12 boreholes will be required across the SPP site (two per block). The Project Hydrology Study (Fichtner, 2023) suggests that a minimum of 24m<sup>3</sup> of groundwater per day is available for extraction from boreholes across the site for module cleaning – enabling 288 m<sup>3</sup>/day to be abstracted. Estimates provided as part of the Projects DPR indicate that there is sufficient water availability to supply the required volumes for solar PV module cleaning – but it does not provide further details on this subject and therefore it is important that water availability is confirmed during detailed design considering increasing temperatures, decreasing water availability and more intense storm events which could lead to change in seasonal water availability and minor disruptions to cleaning and increasing treatment costs.

509. Other water requirements for substations and accommodation blocks are not anticipated to be significant and can be supplied via groundwater boreholes.

510. Leaks of oil from substation equipment and stores could impact upon groundwater, but the requirements outlined above under Soils will ensure that leaks and spills are managed in accordance with national guidelines and good international industry practice.



511. Flood events are addressed below under natural hazards.

### **Decommissioning Phase**

512. During this phase impacts will be similar to and not more significant than the construction phase, e.g., potential pollution events.

### **Mitigation and Management Measures**

#### **Design Phase**

513. Groundwater Availability for Module Cleaning - The type of solar PV module cleaning requires further consideration during detailed design with semi- or fully automated and dry methods encouraged. Detailed design for all blocks, the pooling SS and accommodation block will include a hydrological assessment and water balance that clearly shows groundwater availability on site and how the proposed water extraction rates could impact upon local aquifers and neighboring groundwater users. If the water balance indicates that there is potential for extraction rates to become unsustainable, the designs must include measures for semi-automated (or fully automated) and dry cleaning methods to be adopted in combination with rainwater harvesting ponds to limit groundwater extraction.

514. Rainwater harvesting ponds to be constructed of sufficient size to ensure groundwater levels are fully recharged prior to the dry season so that abstraction for solar photovoltaic panel cleaning during the dry season will avoid a water stress situation and conflict with local community water users. Rainwater harvesting ponds shall be designed so as not to limit the flow of water to downstream off-site water users, and so as not to create a breeding ground for mosquitoes resulting in increased vector borne disease etc.

515. A groundwater extraction plan will be developed by the contractors to include details of abstraction requirements throughout the year, recharge rates of the rainwater harvesting ponds, methods to monitor groundwater abstraction and aquifer recharge rates and a program to monitor local groundwater supplies around the SPP to ensure no overextraction of groundwater. The plan shall also include a specific requirement to prioritize water abstraction from the rainwater harvesting ponds over groundwater.

516. Community Water Resources – During the detailed design phase the contractors will identify all neighboring households currently using water sources within the SPP boundary and confirm if any are used for drinking water or other purposes by the existing local communities who will remain in the adjacent area following land acquisition. If additional water resources to those in the IEE and RIPP are identified, consultations shall be undertaken with the local community to determine what measures are to be taken with respect to ensuring continued access to a supply of water.

517. To ensure these households continue to have access to water the Jal Jeevan Mission program <sup>45</sup> (envisioned to provide safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India) will need to become functional prior to any restrictions on villagers' access to the water source within the SPP. If the Jal Jeevan Mission program will not become functional prior to any restrictions on villagers' access to the water source with the SPP. If the Jal Jeevan Mission program will not become functional prior, APDCL shall ensure the households access to water through other alternatives in sustainable way (e.g., borewell outside the site boundaries).

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<sup>45</sup> <https://jaljeevanmission.gov.in>

518. Wastewater - Wastewater from construction camps will be connected to a septic tank with soak away so no untreated wastewater will be disposed of to surface water or ground during construction, septic tank/soakaway effluent to meet national general wastewater standards. Wastewater from the permanent facilities housing more than 25 persons (including the pooling substation and administration block) will be connected to a package wastewater treatment plant, meeting national effluent standards for treated water to be reused for irrigation purposes with treated water used for landscaping water or washing of solar PV modules. Other permanent facilities will be connected to septic tank with soak away.
519. Drainage - Designs will keep new impermeable surfaces to a minimum since the site forms part of a natural groundwater recharge zone. The layout of the solar PV modules is to be designed to avoid blocking or destroying the natural drainage pattern, minimizing the need for culverts, diversions, bank, and bed modifications. Drainage design will be provided for access roads, at the substation and administration block to manage runoff during operation.
520. The contractors will conduct a detailed flood and drainage risk assessment and incorporate effective drainage design (at 1 in 100 years allowing for climate change) to prevent possible waterlogging of SPP infrastructure during the wet season, placing electrical equipment above highwater level, whilst ensuring through the provision of attenuation on-site (retention ponds) that surface runoff from the SPP site is no more than the greenfield runoff rate so as not to exacerbate waterlogging of adjacent land. For roads edge and cross-drainage will be provided with check dams on steeper gradients and with culvert inverts set to allow a natural bed to form. On off-site access roads the road level must not be increased without adequate drainage being provided to avoid surface water entering neighboring properties. No surface water drainage will be permitted to discharge direct to surface water, detailed design to include for sediment traps and oil interceptors to be fitted, including on all the access road drainage ditches.
521. The boundary wall design will ensure all natural drainage channels are maintained, minimizing the need for culverts, and that the base flow of streams will not be reduced. If the boundary wall must cross drainage routes a sufficiently large culvert inverted below ground level must be installed in the dry season to allow a natural bed to form and natural flow to be maintained.

### **Pre-construction Phase**

522. Management Plans - At this stage contractors will prepare and implement their Pollution Prevention Plan covering the protection of water resources and environmentally sound and safe storage, use, and disposal of all fuels, chemicals and oils used on site and an emergency preparedness and response plan in the event of any leaks or spills (e.g., of oil, etc.) following GIIP such as set out in the IFC EHS guidelines.
523. Baseline Data - For surface waterbodies or groundwater sources within 50m of the SPP or off-site access roads being rehabilitated baseline water quality sampling will be required to confirm their current water quality status at least one week prior to the commencement of any actively onsite. Any drilling or excavation works within 50m of existing boreholes and wells that will continue to be used for drinking water by the community will require pre-construction and post construction water quality monitoring against national drinking water standards to ensure no contamination of the local community supply.

524. Permits for Abstraction - Construction water to be sourced from an existing licensed commercial supplier (preferred option especially for potable water supplies) where available, rainwater harvesting or surface water during the wet season. If using an existing surface water or an existing borewell for construction water, permissions to be obtained from authorities including NOC from CGWB for the abstraction together with the agreement of local communities before abstraction. Prior agreement is required from local community users to use any existing surface water/borewell or local piped water either temporarily during construction or permanently for accommodation / office blocks; in cases where use of local water source is not agreed contractor to import tanked water to the site. Permissions for new borewell installations including NOC from CGWB shall be obtained together with agreement of local communities before drilling and abstraction. A water meter will be provided on all borewells for monitoring of water abstracted, and any water used for drinking water purposes treated to meet drinking water standards.

### **Construction Phase**

525. To manage potential impacts to hydrological resources during construction of all components a range of good international industry practice measures will be applied during all phases. These measures are outlined in detail in the mitigation plan in Annex A. If any water source, water pumps or water supply pipes are disrupted or damaged during works the contractors must provide the affected users with an adequate, alternative drinking water supply meeting national standards whilst immediately repairing the damage caused

### **O&M Phase**

526. Water use – Should groundwater monitoring results identify impacts to community groundwater resources the contractors will be responsible for reducing groundwater extraction for solar PV module cleaning and adopting alternative methods.

### **Decommissioning Phase**

527. The mitigation measures proposed for the construction phase will be adopted.

### **Residual Impacts**

**Table 69: Residual Impacts – Hydrology, Water Resources and Water Quality**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
Pre-mitigation		Mitigation Applied		
C/O&M	<b>Disruption of existing surface water drainage patterns</b> through changes in site layout to accommodate equipment, buildings and access roads etc.	Medium	The mitigation measures outlined above will ensure that residual impacts are of low significance. There is a high degree of confidence in the effectiveness of the mitigation.	Low
C/D O&M	<b>Water contamination</b> via leaks and spills of hazardous liquids.	Low	Measures adopted as part of designs should ensure there are any leaks and spills that would affect surface and groundwater are of low significance, but there remains a risk of a pollution incident during works.	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/O&M	<b>Effluent discharge</b> from construction camps and accommodation / office blocks.	Low	The mitigation measures outlined above will ensure that residual impacts are of low significance, but there remains the risk of a pollution incident during works.	Low
O&M	<b>Groundwater depletion</b> during operational phase for module cleaning	High	If wet cleaning methods are adopted the potential for residual impacts will remain during the operational phase potentially exacerbated by climate change. However, regular monitoring of groundwater conditions and adoption of dry-cleaning methods in combination with reduced groundwater use, should ensure that any significant residual impacts to local groundwater supplies in the future are of low significance. Given mitigation is available that does not require there is a high degree of confidence in it being effectiveness but this relies on APDCL and the contractors giving this matter adequate consideration during detailed design. Impacts are not irreversible in the long term.	Medium

### 7.3.5 Natural Hazards

528. This section discusses potential impacts natural hazards may have on the SPP/SPP TL during construction and operation phases and associated mitigation measures to be adopted.

#### Potential Impacts

529. Forest Fires - Forest fires could occur around the site potentially damaging infrastructure close to the site boundary. Much of the dense vegetation on the SPP itself will be removed, with low growing vegetation beneath the solar PV modules maintained, thereby limiting the potential for forest fires on the site itself. Any that did occur could on the site due to electrical fault or similar could affect neighboring land. Forest fires may also be started by workers during the construction phase, prior to vegetation clearance.

530. Floods – There is a possibility of floods occurring on site. Assessment of this issue as part of the DPR indicates that flooding impacts will be of low significance on infrastructure.

531. Seismic Events - The region is highly seismic. Seismic activity could damage infrastructure leading to secondary impacts such as power outages.

532. Cyclones – This issue is discussed above under the topic of climate change.

## Mitigation and Management Measures

### Design Phase

533. In the first instance all designs will incorporate specific measures, as required by national design and construction codes, to mitigate the risk of damage from seismic events, and other natural hazards. All structural designs will be checked for building and seismic safety by an independent expert, separate to the design team, to confirm national standards and good international industry practice guidelines are met. A 10-meter buffer clear of dense vegetation will be maintained around electrical infrastructure to act as a fire break.

534. SPP infrastructure is to be situated above the maximum water level (allowing for climate change) and following a risk assessment to incorporate adequate drainage design to accommodate flows for a 1 in 100 return period (allowing for climate change) to avoid waterlogging or flash flooding of the SPP during the wet season. Further, per Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022:

- The PSS and GSS shall be constructed above the highest flood level and, wherever required, flood protection walls shall also be provided.
- The substation shall be designed for seismic requirement of the site as per relevant IS.

535. The final surface level of SPP TL tower sites shall be at least 0.5 m above the existing ground level and highest flood level and shall be constructed in such a way as to be adequately drained to prevent washouts and flooding impacts to adjacent properties.

### Construction Phase

536. Fires will be strictly prohibited across the site during the construction phase. No burning of vegetation will be permitted.

### O&M Phase

537. Routine vegetation maintenance to be undertaken across the site, specifically beneath the solar PV modules and in the 10m fire break around the electrical infrastructure. Emergency drills will be held to ensure prompt response to any natural hazard that did occur.

## Residual Impacts

**Table 70: Residual Impacts – Natural Hazards**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
Pre-mitigation		Mitigation Applied		
C/OM	Forest Fires are possible mainly resulting from human activities around the SPP and SPP TL.	Medium	Provision of fire breaks should ensure that the site is not affected by forest fires, or any fire on site does not affect adjacent areas. However, it	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
			cannot be entirely ruled out. Residual impacts remain low due to the sensitivity of the site and surrounds to fire.	
OM	<b>Floods</b> are possible on site, but studies have shown there are likely to be of low significance. Activity is unlikely to induce flooding.	Low	Low significance of residual impact identified as long as flood risks are incorporated into designs, risk of flood on some parts of the site will still remain.	Low
C/OM	<b>Earthquakes</b> can potentially occur and could impact upon SPP infrastructure.	Medium	As long as national design standards for seismicity are considered residual impacts will be of low significance, although there is still a risk of earthquake the resulting damage should be reduced.	Low
O&M	<b>Cyclones</b> could occur and damage equipment.	Medium	Adoption of the proposed climate change adaptation measures should ensure that residual impacts are of low significance, although there is still a possibility of cyclone the resulting damage should be reduced.	Low

### 7.3.6 Noise and Vibration

538. This section discusses the impacts of noise and vibration during construction and operation and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

539. General - During this phase, commencing with land clearance, noise will be generated from the removal and/or cutting of vegetation, the movement of construction vehicles, the operation of plant, equipment, and machinery on-site, presence of construction workers at the construction site, temporary worker camps and any overnight accommodation etc. No deep piling or blasting works is envisaged, but shallow piling for installation of solar PV module foundations and TL towers may be required. These activities will create noise impacts and in the absence of mitigation, short term, localized exceedance of noise standards/guidelines will occur although impacts are readily mitigated and reversible with ease in short term. Per the Government of India noise standards and WHO community noise guidelines, noise levels should not exceed 50 dBA (daytime) and 40 dBA (nighttime) in 'silent zones', 55 dBA (daytime) and 45 dBA (nighttime) in residential settings, 65 dBA (daytime) and 55dBA (nighttime) in commercial areas, and 70dBA in both the day and nighttime in industrial areas.

540. The anticipated construction equipment/machinery to be used at the site for various construction activities together with noise data for this equipment are presented in the table below as obtained from the British Standards: code of practice for noise and vibration on construction and open sites.

**Table 71: Noise Level of Typical Construction Equipment**

Activity	BS 5228-1:2009 Ref	Equipment	Noise Level (dBA)
Site Clearance	Table C.2, 4	Tracked Excavator (22t)	52
Earthworks	Table C.2, 13	Dozer (11t)	78
	Table C.2, 20	Tracked Excavator (25t)	68
	Table C.6, 28	Wheeled Loader (25t)	76
Material Handling	Table C.2, 30	Dump truck (29t)	79
	Table C.2, 38	Roller (18t)	79
	Table C.2, 40	Vibratory Roller (3t)	73
	Table C.2, 42	Hydraulic Compactor	78
	Table C.2, 20	Concrete mixer truck	80
	Table C.4, 22	Concrete Mixer (26t)	76
Stationary	Table C.4, 84	Deisel Generator	74
Road construction	Table C.5, 1	Asphalt paver (18t)	84

541. The accumulation of noise from the above activities can introduce potential impacts at residential receptors around the site. Under assumed worst-case circumstances where all equipment is operating at the same location for 50% of the working day, the combined cumulative noise level perceived at 10m distance from the source would be 88.5dB(A). This is a worst case for noise during construction, as it is not expected that all this equipment will be located in the same area and operate concurrently. As noise levels dissipate with distance, the potential for noise impacts at receptor locations will decrease with increase in distance from the noise source. Table 71 sets out the noise levels at various distances.

**Table 72: Noise Levels at Various Distances**

#	Distance (m)	Noise Level (dBA)
1	10	88.5
2	50	75
3	100	69
4	150	65
5	250	61
6	500	55

\* These calculations are based on the noise prediction methods contained in Annex F of BS 5228-1:2009. They assume that the intervening ground is hard, and use the simple barrier attenuation method.

542. Note, these figures assume a worst-case scenario. Around 50% of works will be occurring within the core of the site beyond 500m of the nearest receptors. However, those receptors located adjacent to the site boundary (closest being immediately adjacent at about 10m distance) will be significantly affected by elevated noise levels within 500m of their homes in the worst-case scenario. The SPP is in a rural area with low background noise levels. Baseline monitoring at two locations closest to the SPP boundary (SPP2 and SPP4 – both within 20m of the SPP boundary) showed that the ambient daytime noise levels were 56 and 54 dBA respectively. Therefore, the worst case impacts will be perceptible to residents being a 30 dBA increase above background. Only at about 500m will the construction noise not be perceptible above background.

543. Construction noise will also be elevated along the off-site village roads to be rehabilitated. Interventions in this area will be of a shorter period than works within the SPP boundary. Nonetheless elevated noise levels will be a nuisance to residential receptors during the daytime. Once the off-site access road rehabilitations are completed traffic levels will increase significantly during the construction phase as materials are transported to the site. This will further increase noise levels in the areas close to the off-site access roads. The noise will intermittent as vehicles move along the road with the

intensity peaking as modules and other SPP equipment are delivered to site, after which the number of vehicle movements should start to reduce slightly, consequently reducing noise levels.

544. Substation Construction Noise – There are no receptors within 500m of the substation. No significant noise impacts on receptors are anticipated.
545. SPP TL Construction Noise – Noise from the construction of the SPP TL will be short term and will only affect a low number of receptors living closest to tower locations where excavation works and tower erection will be completed.
546. Vibration – No deep piling or blasting works is envisaged. Any requirements for rock breaking shall be undertaken using hydraulic hammer. There is a risk that construction vehicles and vibratory rollers used during off-site road rehabilitation could cause structural and cosmetic damage to neighboring properties adjacent to the off-site village access roads when they are rehabilitated. Any properties within 5m of the works could be at risk. Beyond that distance impacts are unlikely based on experience of similar situations.<sup>46</sup> No properties outside of the SPP boundary are considered likely to be impacted by vibration from the SPP itself.

### **O&M Phase**

547. Corona Noise - Literature studies undertaken by EirGrid indicates that “Corona Noise” becomes a significant issue from 350-500 kilovolts (kV) and above. There are a number of sensitive receptors living in proximity to the SPP TL that could potentially be affected by corona noise.
548. New Substation Noise – There are no human receptors within 500m of the pooling substation. Although there will be construction noise no significant impacts on receptors are anticipated.
549. SPP Noise – In relation to operational impacts, a solar power plant is an inherently quiet installation and there will be only intermittent vehicle movements required for O&M. However, sources of noise on site will include inverter fans necessary to keep them cool and emergency diesel generators.

### **Decommissioning Phase**

550. Excepting the off-site road works which will not occur during decommissioning impacts will be of similar significance to those associated with construction of the SPP e.g., noise from the movement of construction vehicles.

## **Mitigation and Management Measures**

### **Design Phase**

551. At the SPP and, although no significant noise impacts have been identified, at the GSS and PSS contractors will ensure that the design enables operation to always comply with 1-hour LAeq 70 dB(A) at the site boundary, 45 dB(A) at the nearest residential properties, and 40dB(A) within 100m distance from silent zones. This shall be achieved by ensuring the maximum sound power level of equipment at 1 m is 70 dBA through use of sound attenuation, set back from adjacent properties etc. The quietest available equipment with manufacturer-supplied noise mitigation will be installed. This requirement shall be

<sup>46</sup> See Environmental Impact Assessment for the Kvsheti – Kobi Road Section. ADB, 2019.



extended to all SPP equipment, including inverters. A boundary wall will be constructed around the entire SPP which will help attenuate noise. Contractors shall provide a noise model or calculations for review and approval to illustrate how noise standards/guidelines will be met during operation. APDCL shall also coordinate with CTU to ensure that the SPP TL is designed to reduce the impacts of corona noise through conductor design, corona rings, etc.

552. Permanent diesel generators or other noisy sources will not be permitted within 500m of any residential receptor. Only "green" diesel generator (DG) sets are to be used for the permanent facilities with supplier certification on meeting the project noise standards. DG sets shall be installed outdoors with acoustic enclosure to meet project noise standards or housed in a separate building away from other buildings. DG sets to be provided with visco damper type vibration dampening pads (suitable for the loads and vibration they are required to carry) with minimum vibration transmitted to the surface the DG set is resting on.

### **Pre-construction**

553. Contractors will be responsible for the preparation and implementation of a Noise Management Plan reflecting good international industry practice such as the IFC EHS Guidelines. Contractors will ensure that the construction complies with 1-hour LAeq 70 dB(A) at the site boundary, and, based on daytime works, 55 dB(A) at the nearest residential properties including located those in commercial zones, and 50dB(A) within 100m distance from silent zones. Contractors will be required to measure and confirm the distance from their construction works to sensitive receptors to confirm if the noise standards per Section 2.10.3 can be met based on their construction methods or if temporary acoustic barriers are required. The plan will identify the areas required around the SPP for installation of temporary noise barriers. The Contractors shall provide a noise model or calculations for review and approval to illustrate how noise standards/guidelines will be met during construction. Contractors to also undertake pre-construction noise monitoring per the EMoP to confirm current background noise levels in and around the SPP / SPP TL at least one week prior to the commencement of any actively on-site.

### **Construction Phase**

554. To manage potential noise impacts during construction a range of good international industry practice measures will be applied. These measures will be particularly important in all areas within 500m of residential properties. Here the important mitigation measures will be:
- a) Informing people in advance of noisy activities and to ensure that construction is only undertaken during daytime periods. Where practical works should avoid the weekend near residential properties.
  - b) Installation of temporary noise barriers will be applied along the boundary of the SPP where residential receptors can be found within 500m. The temporary barrier shall be in place until the permanent boundary wall is completed. The barrier shall be constructed with sufficient height and absorption capacity to ensure that the project noise standards are not exceeded at the nearest receptors. Temporary noise barriers may also be installed along off-site access roads during construction where complaints are received from residents.
555. All other proposed construction phase noise mitigation measures are outlined in detail in Annex A.

556. **Vibration** - Where properties are within 5m of the off-site access roads to be upgraded, compactors with a higher vibration frequency (above 40 Hz) and a lower drum weight will be used for road works. Making multiple passes at a low vibration levels is much less likely to produce damage than a smaller number of passes at a high vibration level. For off-site village access roads the contractor will identify properties within the zone of influence for vibration (at least 5m from the roadside) and undertake pre-construction structural surveys to identify level of risk. If risk of structural damage to properties is identified due to the current structural condition consideration of alternative construction methods or temporary relocation of occupants during works if at risk shall be undertaken. The structural survey will also serve as the baseline in in case of any claim for damages. Structural or cosmetic damage to be repaired by the contractor to at least pre-project condition at their own cost.

### **Decommissioning Phase**

557. Measures adopted for the construction phase will be extended to the decommissioning phase.

### **Residual Impacts**

**Table 73: Residual Noise and Vibration Impacts**

<b>Phase</b>	<b>Potential Impact</b>	<b>Impact Significance</b>	<b>Residual Impacts</b>	<b>Impact Significance</b>
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
C/D	<b>Construction/decommissioning equipment noise, e.g. excavators, diesel generators, etc</b>	High	Some short-term elevated noise impacts may occur during the daytime at individual receptors. Keeping work to short durations and the use of temporary mobile noise barriers should reduce the noise levels to acceptable levels during the working day. Residual impacts will be of medium significance to immediately adjacent properties. There is a low degree of confidence in the effectiveness of the mitigation, given the size of the site, number of contractors, and uncertainties in the final design and construction methods to be adopted.	Medium

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
			Impacts are not irreversible in the long term.	
C/D	<b>Construction vibration</b> , e.g. from the movement of heavy goods vehicles long access roads.	Medium	Residual impacts will be of low significance to immediately adjacent properties within 5m, as there is a high degree of confidence in the effectiveness of the mitigation.	Low
O&M	<b>SPP and PSS/GSS equipment noise</b>	Low	Residual impacts to any nearby receptors will be of low significance given the distances to the nearest properties.	Low

## 7.4 Biodiversity

### 7.4.1 Internationally Recognized Sites and Nationally Protected Areas

#### Potential Impacts

558. Neither the SPP or the SPP TL are located within, or adjacent to internationally, nationally designated sites or recognized sites, including Reserve Forest, in Assam State. However, several of the SPP village roads to be rehabilitated and a small portion of the SPP are located within 10km of the Rangapahar WLS, in Nagaland State. This is the default ESZ where none is gazetted. As noted in Section 6.2.1 SPP works are permitted within ESZs. Initial consultations have indicated that no further assessment of the SPP access roads within the ESZ is required. However, consultation with Nagaland officials is on-going to confirm this status and no access road works will commence until it is confirmed no permission from them is needed.

#### Mitigation and Management Measures

##### Construction and O&M Phase

559. Temporary facilities such as construction camps, batching plants, and, hot mix will mostly be set up within the SPP boundaries; but if such facilities are off site they will be located on modified habitat outside of all sites of ecological importance. Only licensed off-site material sources will be used for gravel, sand etc. Off-site haul routes are permitted through reserve forests if the roads are existing paved roads. These measures will ensure that there are low significant residual impacts to designated sites of ecological importance.

## Residual Impacts

**Table 74: Residual Impacts – Designated Sites and Reserve Forest**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/O&M	Encroachment into nationally protected WLS in AoA	Medium	Although of very high sensitivity measures to ensure no encroachment into these areas will ensure that the residual significance of impacts will be low. It should also be noted that encroachment into these areas is unlikely due to their distance from the main SPP site and SPP TL. No encroachment into Rangapahar WLS is anticipated, however, as it is within 10km consultations should be completed with relevant Nagaland officials to gain their no objection to the proposed SPP works in the ESZ.	Low
C/O&M	Encroachment into internationally protected areas (KBA and IBA in AoA)	Medium		Low
C/O&M	Encroachment into Elephant Reserves and Critical Habitat Reserved Forest in AoA	Medium		Low

### 7.4.2 Habitat

#### Potential Impacts

560. Modified and Natural Habitat Loss, Degradation, Fragmentation, and Simplification -

The main area of the SPP (1,661 ha) has been classified as primarily modified habitat and within this area vegetation cover will be lost. For the solar power plant, the existing habitat shall not be restored to the current situation since it will need to be maintained for safety reasons. Habitat impacts include soil compaction, dust deposition during earthworks etc.

561. A small portion of the site (i.e. 94 ha) mostly in Block 6 is classified as primarily natural habitat. The layout of the solar PV modules in Block 6 and a small part of Block 5 could encroach on this natural habitat. If 94 ha of natural habitat were lost to the solar power plant to maximize energy generation, this would constitute significant conversion of natural habitat for renewable energy use and would be of high significance. Further, since alternatives are available to convert this 94 ha of natural habitat would not be in accordance with ADB's Safeguard Policy Statement 2009 natural habitat requirements.

562. SPP TL Natural Habitat – Surveys of the SPP TL (LILO 1 and LILO 2) indicate that based on the indicative route proposed:

- Approximately 15% of the LILO 1 alignment is located within degraded natural habitat. Given a RoW of 46m this would equate to approximately 4 hectares of natural habitat.
- Approximately 30% of the LILO 2 alignment is located within degraded natural habitat. Given a RoW of 46m this would equate to approximately 8.3 hectares of natural habitat.

563. Critical Habitat Loss, Degradation, Fragmentation, and Simplification - A Critical Habitat Assessment prepared for the project (see Annex C) concluded that the SPP TL area of analysis (AoA) and SPP freshwater AoA qualify as ADB Critical Habitat because

they both overlap a KBA - Dhansiri Reserve Forest. The SPP terrestrial AoA potentially qualifies as Critical Habitat because it overlaps two Reserved Forests. As not above, the SPP and SPP TL do not extend into any KBA or Reserved Forests and conditions have been added to the EMP to ensure that no works occur in these areas. The Critical Habitat Assessment notes that the SPP itself is unlikely to hold significant populations of Black Softshell Turtle or Assam Roofed Turtle, however, there is one permanent stream bisecting the SPP TL and it could be possible that turtles are present in this area. The SPP TL AoA potentially also supports Critical Habitat for Bengal Florican, a migratory, Critically Endangered bird species. Since it moves 15-80 km from its breeding sites to areas characterized by dry unmanaged grasslands and low-intensity agriculture in floodplains with low human population outside of protected areas and Reserve Forests it is possible it could be found within the area of the SPP TL. None of these species have been identified during site surveys undertaken to date. But further studies by Bengal Florican experts would be needed to rule out its presence in the SPP TL alignment. Based on the above, it is considered unlikely that the SPP works will have highly significant impacts on critical habitat species, but it is possible that operation of the SPP TL could.

## Mitigation and Management Measures

### Design Phase

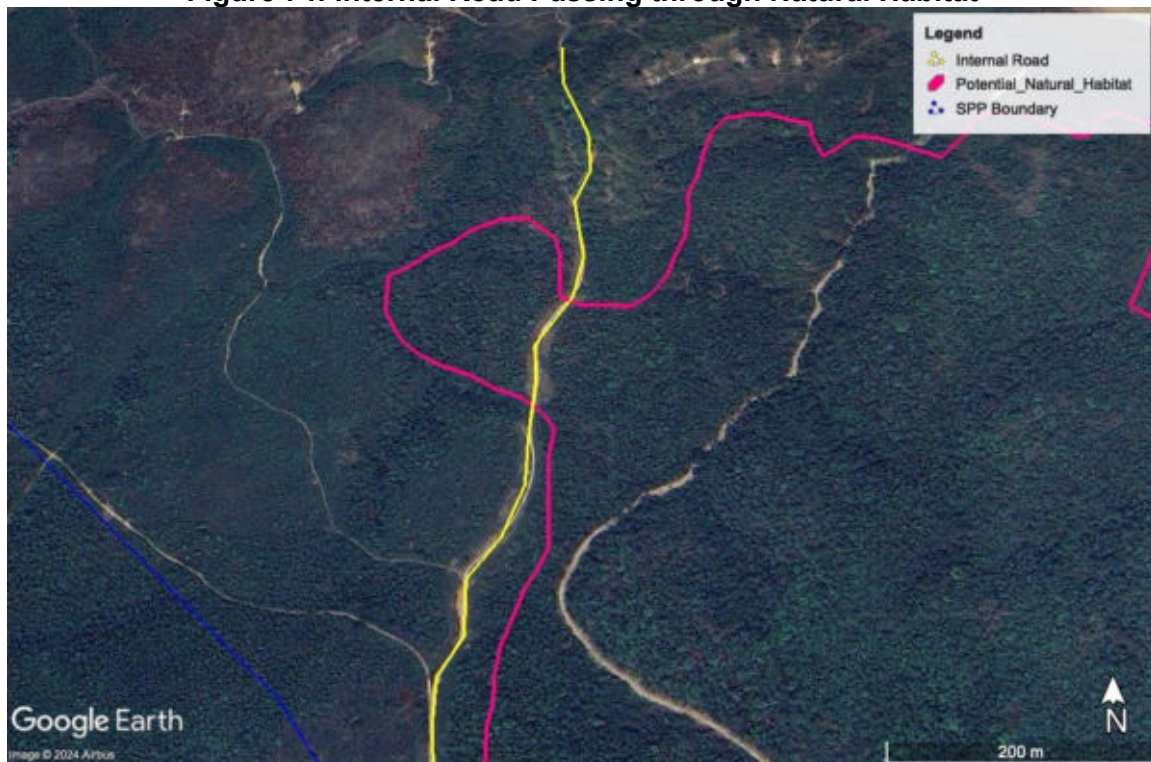
564. During the process of IEE preparation multiple rounds of discussions on the loss of natural habitat have been held between the IEE team and APDCL to ensure that the 94ha area of natural habitat is not significantly affected and that the least possible SPP infrastructure is in this area. APDCL has committed that only one boundary wall and one internal approach road will pass through a small portion of the natural habitat. The figures below show these areas. Contractors for Blocks 5 and 6 will need to ensure that this 94ha is avoided by their solar PV module layouts.

**Figure 73: Site Boundary Passing through Natural Habitat**



Source: Google Earth / IEE Team

**Figure 74: Internal Road Passing through Natural Habitat**



Source: Google Earth / IEE Team

565. The boundary wall construction will clear only a small corridor through the natural habitat, approximately 540 meters long. The cleared area will be approximately 5 meters wide, meaning a total of just over 0.25 hectares of natural habitat will be lost. The boundary wall is to be placed on the edge of an existing transmission line ROW in which vegetation is already maintained by the operator for safety reasons. The internal road is an existing track and will not be widened and no tree cutting is required in this area. In total, natural habitat loss will occur across less than 1% of the site and be of medium significance.
566. The contractors' ecologist and botanist shall conduct a habitat survey and tree inventory against the findings of the IEE. Design and construction will be undertaken such that works (including all approach roads, internal and peripheral roads, temporary construction roads, boundary walls, material and waste storage areas, workshops, offices, other related facilities, and any labor camps) will not encroach on the 94ha area mapped as natural habitat with the only exception being the boundary wall and main approach road which follows an existing road alignment. Internal road construction will be restricted to the current track within this part of the SPP, no widening of this track will be permitted, and no vegetation clearance permitted either side of it. Other small areas of natural habitat (as confirmed through ecological survey) identified on the rest of the site will be avoided to the extent possible.
567. To balance energy generation with land take and habitat loss, contractors will select the most efficient solar PV modules to minimize the land take required for the works and thus maximize modified habitat loss and the retention of existing vegetation cover that does not need to be cleared for construction or affect solar PV module efficiency through shading.

568. Per section 4.3.3, alternative alignments were assessed for the LILO lines to determine their impacts on natural habitat. Alternative LILO 1 illustrated that natural habitat could be avoided completely while the amount of affected natural habitat along Alternative LILO 2 could be reduced significantly, to around 4.8 hectares or more with some additional modifications to the route. APDCL will coordinate with CTU to adjust the SPP TL alignments based on the routing recommendations made in this report, i.e., adopt routing that minimizes impacts to natural habitat as outlined in Section 4.3.3. APDCL will also coordinate with CTU to ensure SPP TL designs include the requirement for bird diverters along the entire length of the earth wire on both lines.

### **Pre-Construction**

569. Contractors will prepare a biodiversity management plan to include the specific requirements of this IEE, including training measures and protocols for the management of special status species.

570. Pre-construction surveys will be completed by an ecologist and botanist per Section 7.4.3 to confirm the extent of natural habitat within the final proposed layout/route of the SPP and SPP TL and the presence or absence of critical habitat species identified in this IEE. Toolbox training will be provided to workers in blocks supporting natural habitat and for the SPPI informing them on a regular basis about restrictions to enter this part of the SPP. Toolbox training will also be provided to SPP contractors staff regarding identification and management of the Black Softshell Turtle and Assam Roofed Turtle.

571. The area of natural habitat in Block 5/Block 6 will be demarcated prior to the start of construction and signs places around the area warning workers not to enter this area to avoid disturbing it.

### **Construction Phase**

572. Contractors (especially Block 6 and the SPPI contractor) will make at least weekly routine inspections of the area of natural habitat to ensure that no encroachment into the area has occurred upon taking on the site.

### **Residual Impacts**

**Table 75: Residual Impacts – Designated Sites and Reserve Forest**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/D O&M	<b>Loss / fragmentation of critical habitat for turtles and Bengal florican</b> through clearance of vegetation and fencing of site and SPP TL.	Medium	No measurable impacts in terms of loss / fragmentation of critical habitat have been identified. Turtle species of concern for critical habitat are not anticipated to be present, and there is confidence in the mitigation proposed in the unlikely event they were found. Bengal florican is at risk of collision from the SPP TL and without close cooperation with CTU residual impacts could possibly occur on this species (see below).	Medium
C/D O&M	<b>Loss / fragmentation of natural habitat</b>	High	Measures incorporated in this IEE ensure that identified	Medium

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
	through clearance of vegetation and fencing of site and SPP TL.		natural habitat is mainly avoided. Residual impacts will remain of medium significance. There is a low degree of confidence in the effectiveness of the mitigation, given there is a desire to maximize energy output from the SPP and it relies entirely on the final design of the contractors avoiding the 94 ha.	
C/D O&M	<b>Loss / fragmentation of modified habitat</b> through clearance of vegetation and fencing of site and SPP TL.	Medium	Clearance of modified habitat will occur across the site. The loss of modified habitat cannot be mitigated due to the scale involved. However, this is not considered to represent a highly significant impact and any residual impacts will be of medium significance.	Medium

### 7.4.3 Flora and Fauna

573. This section discusses potential impacts on flora and fauna during construction and operation and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

574. During the construction phase, the key potential impacts to flora and fauna relate to vegetation clearance within the 1,755 ha SPP (and potentially adjacent to village roads), vehicle movements, the siting of temporary facilities including construction camps and the presence of workers.

575. Tree cutting – During the construction phase 2,395 trees will be cut within the SPP. Tree cutting will also be required along the SPP TL alignment. Details regarding trees to be cut for the SPP TL will not be known until the final design is completed but is expected to be of a similar magnitude.

576. Vegetation clearance - Impacts will arise because of ground vegetation clearance for the preparation of the SPP site itself, SPP TL tower sites and clearance of the RoW, temporary facilities etc. As noted above, the majority of the site is modified habitat and post-mitigation the remaining area of natural habitat will be largely retained. No special species of flora have been identified during survey works.

577. Spread of non-native or invasive species - Spread of non-native or invasive species from the site to habitats outside or brought to the site on vehicles will reduce the ecological value of an area.

578. Poaching and deliberate killing of animals - The introduction of a temporary workforce to the area may increase the risk of poaching / deliberate killing of animals by workers at or near temporary construction camps.



579. Direct mortality of and disturbance to fauna - Vegetation clearance and earthworks can lead to direct fatalities of fauna. In particular nesting birds, and potentially turtles, may be impacted during vegetation clearance and burrowing animals during earthworks. Indirect fatalities can also occur when excavations (for foundations or cable trenches) are left open. Impacts are likely to be at individual not population level. Collisions with construction vehicles can also occur. Construction noise and visual disturbance can result in short term, localized effects, although many animals will become habituated to the noise. This may result in a medium-term adverse effect. Impacts are likely to be at an individual level, not a population level.

### **O&M Phase**

580. Fencing – Two types of fencing will be installed at the SPP site; a solid boundary wall and internal block fencing. Fencing and walls can act as a barrier to the movement of turtles and mammals across the site. Given the large size of the SPP site this is of high significance to the movement of fauna along wildlife corridors across the site. That said, no important wildlife corridors have been identified.

581. Elephant Corridors – An elephant corridor has been identified toward the south-southwest side of the SPP, located within a 4 km radius from the SPP boundary. This information was provided by the Assistant Conservator of Forests (ACF), Central Range, Manja, East Division Karbi Anglong, through letter no. CR/APDCL/2023-24/1433 dated August 2, 2023. Consultations have been completed by the IEE team and APDCL with the community and it is understood that wandering elephants can occasionally be seen in and around the SPP site, specifically along its western and northern boundaries. These elephants could easily break any boundary wall and cause damage to the SPP infrastructure.

582. Electrocutions - Electrocutions may occur on the electrical equipment of the SPP or when a bird or bat completes a circuit by simultaneously touching two energized parts or an energized part and a grounded part of electrical equipment on a transmission tower (usually with the span of its wings). According to the American Eagle Foundation the majority of electrocutions occur on MLV lines (33kV and below)<sup>47</sup> the reason being that the spacing between conductors are narrow enough to be bridged by a wingspan. Also, poles that contain closely spaced energized parts (such as transformers) can be especially hazardous to birds of all sizes. This finding corresponds with that of the US Fish and Wildlife Service (FWS) which state that most bird electrocutions occur on MLV lines and poles compared with HV lines. Birds can be electrocuted on HV lines; however, it is rare, especially at higher voltages, due to the spacing between live and ground.<sup>48,49</sup> Electrocution on the SPP TL therefore considered a negligible risk.

583. Elephants are not considered to be at risk of electrocutions on the SPP TL because the SPP TL lines will be much higher than the trunk height of an elephant. But they may be at risk if they enter the SPP itself.

584. Bat Collisions - Impacts to bats have been excluded from further study based on a review of recent literature which states there is no national or international (published, peer reviewed) literature on bat fatalities from power line collision.<sup>50</sup> In addition, Orbach & Fenton (2010) cite only 'anecdotal reports' of bats colliding with other stationary objects including television towers. One bird study in California did however report a

<sup>47</sup> American Eagle Foundation. Promote Avian Friendly Power Lines. <https://www.eagles.org/take-action/avian-friendly-power-lines/>

<sup>48</sup> <https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/electrocutions.php>

<sup>49</sup> Guidance on appropriate means of impact assessment of electricity power grids on migratory soaring birds in the Rift Valley / Red Sea Flyway. GEF, UNDP, Birdlife International. 2015

<sup>50</sup> EirGrid Evidence Based Environmental Studies. Study 3: Bats. December 2015

single (unidentified) bat found during a search for bird carcasses surrounding a 110 kV power line (Dedon et al., 1989).

585. **Bird Collisions** - Collisions occur when birds fly into the conductors of TL. Bird size, agility, experience, flocking, territorial or courtship activities, weather, time of day, human activities, configuration and location of the line, line placement, and line size can all contribute to these collisions. Many species of birds are especially vulnerable to collisions with HV power lines because of the height of these structures with respect to flight altitude, and because of their low visibility.<sup>51</sup> Of particular relevance is the risk of Bengal Florican collisions. The Critical Habitat Assessment identified the area around the SPP TL as being a potential non-breeding habitat for this critically endangered bird. eBird records were searched for this species. The species is at greater risk of collision compared to other birds but the closest records came from sites approximately 65 kilometers to the north. Since it moves 15-80 km from its breeding sites to areas characterized by dry unmanaged grasslands and low-intensity agriculture in floodplains with low human population outside of protected areas and Reserve Forests it is possible it could be found within the area of the SPP TL. In the absence of survey input of a Bengal florican expert their presence cannot be ruled out in the SPP TL area and marking is recommended on a precautionary basis. Also of interest is Amur falcon (*Falco amurensis*) (Least Concern) which move on migration pathways in the area. eBird records confirmed the individual presence of Amur falcons in the area of the SPP TL. During migration, this species often congregates in huge roosts on passage through India. Approximately 18 km to the east, eBird records in November 2023 noted over 500 falcons perched on power lines and feeding on insects in the adjoining areas. Approximately 25 km to the southeast observers noted tens of thousands of roosting Amur falcons. Falcons are agile fliers with keen eyesight, thus at minimal risk of collision. However, when birds amass in such numbers, collision could be a concern. Because it is difficult to predict if birds will concentrate in the SPP TL area, no marking for this species is recommended. Slender-billed vultures (CR) may also utilize the area. eBird records were searched for this species. The closest records came from sites approximately 65 kilometers to the north. Vultures can collide with wires but since no vulture nests or restaurants were noted in the project notes, it is not possible to predict where risk is elevated. This species congregates in large flocks at carcasses. Thus, carcass disposal should be some distance away to reduce the likelihood of power line interactions.

586. The creation of a “lake effect” due to the scale of the solar plant is considered to be a negligible risk to birdlife.

### **Decommissioning Phase**

587. Decommissioning of the site will allow habitat to be restored, no significant impacts are anticipated.

### **Mitigation and Management Measures**

#### **Design Phase**

588. **Fencing and Access** – APDCL will identify 60m wide wildlife corridors to be retained. Contractors will incorporate smaller, local wildlife corridors and habitat areas minimum 20 m in width into their design. These are where tall vegetation and trees are allowed to grow, to create habitat structure for the movement of small mammals and reptiles, most

<sup>51</sup> Avian mortalities due to transmission line collisions: a review of current estimates and field methods with an emphasis on applications to the Canadian electric network. Avian Conservation and Ecology, 2013

beneficial around the site and block boundaries, adjacent to drainage lines and ponds and maintaining connections with the 94ha of primarily natural habitat with other areas of dense vegetation. As noted in section 3.4.3, internal fences will be 2.4 m high galvanized chain link fence. Internal fences will use a large mesh size (ideally 150mm x 150mm) to allow for the movement of small turtles and mammals. Internal fences shall include 300mm gaps at the base to allow the continued movement of turtles and mammals across the blocks. The external boundary wall will also be provided with 300mm gaps at the base in the vicinity of natural drainage channels, near waterlogged areas, rainwater harvesting ponds, adjacent to retained natural habitat, or created habitat areas, or crossing over an area acting as a wildlife corridor to allow for the continued movement between habitats of turtles, mammals etc. In all other locations 1500m wide 300mm high gaps will be placed in the base every 250m. External boundary wall and block fences to be screened by a native species vegetation buffer of sufficient width to minimize visual impact of the fence line and SPP infrastructure on adjacent local communities.

589. Elephant Movements - To protect the SPP boundary wall against stray elephants a hanging solar electric fence will be included in the design immediately in front of it to protect against occasional elephants roaming into the SPP site; the western and northern boundaries are most at risk from wandering elephants based on the baseline information available.
590. Vegetation Maintenance - To facilitate mowing within the SPP to control vegetation, solar PV modules to be positioned at least 500 mm above ground level with cabling suitably protected, this will allow the vegetation to be maintained above 400 mm beneath the panels.
591. Electrocutions – Electrocutions on the SPP infrastructure can be avoided through secure fencing of electrical equipment to prevent access to small mammals. The FWS have indicated that electrocutions from HV power lines are rare nonetheless this IEE takes a precautionary approach. According to recent technical papers electrocution can be far more controlled than collision since the problem is a physical one, whereby a bird bridges certain clearances on a pole structure, the solution is relatively straightforward, and involves ensuring that a bird cannot touch the relevant components.<sup>52</sup> Thus, APDCL shall coordinate with CTU to ensure that SPP TL tower designs ensure that clearances are provided between live wires and grounded surfaces to accommodate best practice. Table 76 provides recommended transmission clearances to provide adequate separation for large birds such as eagles. In general, transmission line designs provide adequate separation for large birds due to the inherent clearances required on high voltage lines

**Table 76: Phase-to-ground voltage and spacing recommendations.**

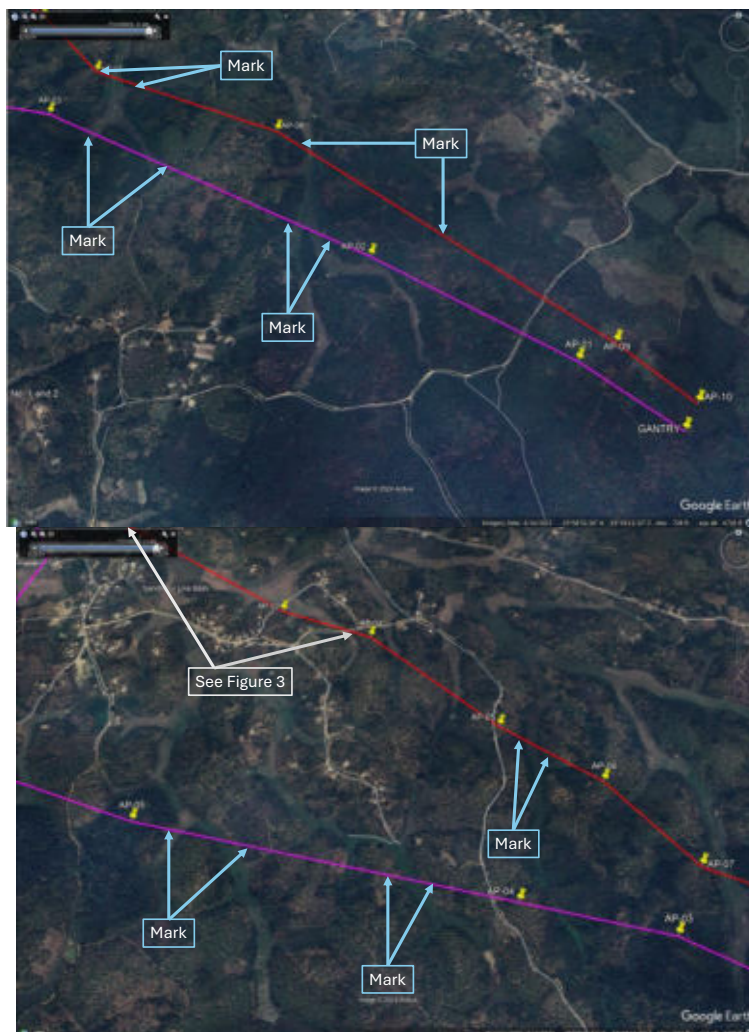
Line	Phase-to-Ground Voltage	Phase-to-Phase Spacing	Phase-to-Phase Spacing	Phase-to-Ground Spacing	Phase-to-Ground Spacing
Voltage (kV)	Voltage (kV)	Horizontal (cm)	Vertical (cm)	Horizontal (cm)	Vertical (cm)
400	231	325	274	239	188

Source: APLIC 2006; National Electrical Safety Code Calculations

<sup>52</sup> Guidelines on How to Avoid or Mitigate Impact of Electricity Power Grids on Migratory Birds in the African-Eurasian Region. AEWA Conservation Guidelines No. 14. 2012

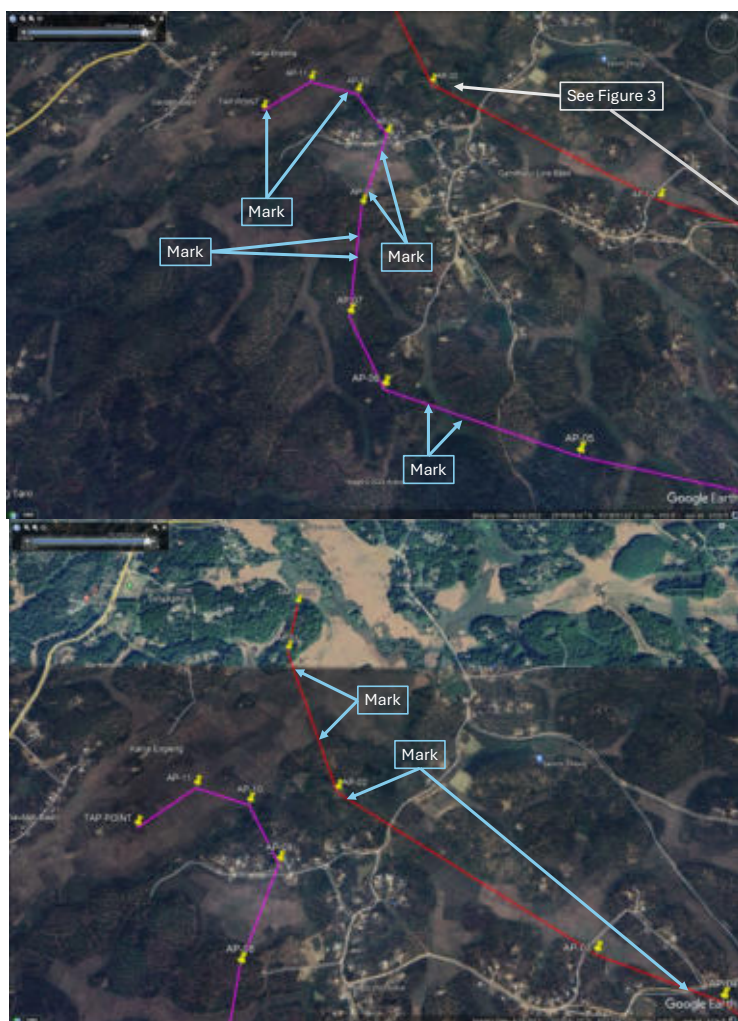
592. **Bird Collisions** – To reduce the risk of impacts to the critically endangered Bengal Florican, and birds in general, bird divertors (wire markers) are recommended along the earth wire of the entire alignment of the SPP TL (both lines). APDCL will be responsible for coordinating this requirement with CTU and their contractors. Bird divertors shall be spaced at 10m intervals and designed and installed according to CEA guidelines.<sup>53</sup> The divertors chosen should be high visibility glowing line markers which are effective in low light. It is important that the markers are placed on the earth line on the top of the tower as this is the least visible to birds. According to some reports, this can reduce collision accidents by 50-85%.<sup>54</sup> The entire length of the line is to be marked, but the key areas for collision risk to Bengal florican and which would benefit most from having bird divertors are shown in the below images.

593. 33kV and below electrical and fiber optic cabling within the SPP site will be undergrounded (UG) - no overhead lines will be installed except the 400kV connection between the pooling substation and 400kV switching station.



<sup>53</sup> [https://cea.nic.in/wp-content/uploads/pse\\_\\_\\_td/2021/01/Technical\\_Specifications\\_for\\_Bird\\_Flight\\_Diverter.pdf](https://cea.nic.in/wp-content/uploads/pse___td/2021/01/Technical_Specifications_for_Bird_Flight_Diverter.pdf)

<sup>54</sup> [http://birdsandpowerlines.org/cm/media/Protecting\\_birds\\_on\\_powerlines.pdf](http://birdsandpowerlines.org/cm/media/Protecting_birds_on_powerlines.pdf)



### **Pre-construction Phase**

594. **Tree Felling Permits** – Contractors are to ensure APDCL obtains the tree felling permits in advance and follow any other applicable national and state requirements prior to felling of any trees. Public trees to be cut will be compensated by compensatory afforestation as per forest department requirements and the requisite forest department approvals for any tree cutting will be sought pre-construction. APDCL will provide funds to the forest department based on the number of public trees counted by the contractor to be cut and monitor the progress of the compensatory plantation process that it has funded to ensure that planting takes place such that no net loss of biodiversity is obtained. Compensation for the loss of any private trees would be based on their replacement cost, as defined in the RIPP.

595. **Habitat Surveys and Tree Cutting** - During the design phase contractors shall complete a habitat survey in order to confirm the area and type of modified and natural habitat situated within their respective blocks / work areas. The detailed survey shall include tree enumeration to quantify the number, size and species of trees (initial tree counting for the SPP is provided in Appendix M) to be cut and the quality of forest and other vegetation cover lost, to calculate the compensatory reforestation required for the detailed design for no net loss of biodiversity.

596. Contractors shall engage field ecologists to undertake walkovers to confirm the presence or absence of sensitive receptors and critical habitat species identified in IEE. Adaptive management measures to be applied according to the findings of the surveys.

597. Prior to the cutting of any tree, ecologists will survey the tree to ensure there are no nesting birds present in the tree. If nests are present the contractor will consult with ecologists to determine the most suitable actions to avoid harm to the nests and birds. If any special status species (IUCN VU, CR, EN) are observed in the trees ADB will be informed by APDCL and tree cutting ceased until appropriate mitigation plans have been prepared.

598. Demarcation of work zones – The contractors will:

- Demarcate working areas and avoid encroachment outside the agreed corridor of impact. Do not clear any vegetation unless it is essential to allow construction.
- Follow design drawings and implement careful construction practices to avoid damage to trees.
- Natural habitat to be demarcated by the contractors prior to the start of any works on the main approach road.
- Natural habitat be demarcated by the contractors prior to the start of any works around the Block 6 boundary.
- Natural habitat be demarcated by the contractors prior to the start of any works within Blocks 5 and 6.
- Other sensitive habitats that need to be avoided during construction (e.g., specific trees that are to be retained or smaller areas of natural habitat) will be marked for protection by the contractor's ESM and Ecologist who shall make a pre-work survey of the work sites to identify and conduct an inventory of trees to be cut prior to the start of works with the PMC. Only the marked trees within the site are to be felled after joint verification and approval of tree list.

### **Construction Phase**

599. A range of measures for the protection of flora and fauna is provided by Annex A. Key measures include:

- Tree felling in accordance with national requirements and vegetation clearance will be completed only after the required ecological surveys and checks have been completed.
- Speed limits on vehicles and restriction to existing and dedicated haul routes will prevent direct mortality and habitat disturbance from vehicles. Pre-clearance site surveys and the movement of animals out of the working corridor will prevent direct mortality. There may be some low level unavoidable direct mortality, but this would not be significant in the short or long term.
- Where possible trees or scrub are to be cleared outside the bird breeding season, if this not possible due to weather restrictions on access, trees cleared during breeding season to be checked by an experienced ornithologist for nests prior to clearance, if present clearance to be postponed until the adult birds and young have left the nest.

- For ground nesting birds site clearance and earthworks to be scheduled to take place outside the breeding season. If works affecting habitats that could be used by ground nesting birds must take place during the breeding season, they must only be carried out following an on-site check for nesting birds by an experienced ornithologist. Only when this indicates no nesting birds are likely to be harmed by the works should the works proceed. If ground nesting birds are found to be present, work will not take place in that area until the adult birds and young have left the nest. Meanwhile a protection zone will be clearly marked around the nest site to prevent any accidental disturbance or damage.
- Prior to earthworks, area will be checked by an experienced ecologist for any signs of burrows, turtles, etc. If determined to be occupied, work will not take place in that area during the breeding season. Meanwhile a protection zone will be clearly marked to prevent any accidental disturbance or damage. Outside the breeding season only manual digging under close supervision of the ecologist will be permitted. For works affecting the drainage channels these will not be undertaken during the wet season.
- Pre-clearance surveys of invasive species combined with the demarcation and treatment of non-native species will prevent their spread. Monitoring post-construction will ensure that newly restored areas are not inundated with non-native species from adjacent areas. Use of GIIP such as cleaning of machinery before import to site, wheel washes on site, etc. will avoid import of invasive species. Where foundations are dug and cable trenches are used, they will be fully covered at all times to prevent small mammals and turtles from falling into them.
- This risk relating to poaching can be reduced by appropriate worker training sessions and implementation of a strict code of conduct with regards to treatment of local fauna.
- Where low growing species (e.g. grasses) are present they must be retained beneath the solar PV panels/modules during construction as far as construction methods permit. On completion of construction the land beneath the solar PV panels is to remain vegetated. If cleared for construction, it will be revegetated with low growing species native to the district. Temporarily disturbed areas will also be similarly revegetated on completion of construction and the entire site will be maintained free of invasive species.
- Use of herbicides or burning to clear vegetation is strictly prohibited.

### **O&M Phase**

600. There would be no significant effects on ecology during the operation of the SPP, other than those discussed above (habitat loss and fragmentation, collision along the SPP TL) so specific operational phase mitigation is not provided. However, for maintenance works the same mitigation measures should be implemented as for the construction phase. Further, all contractors staff will be orientated by their E&S Manager on the importance of wildlife conservation, what to do if wildlife is sited on site, etc.

601. In conjunction with CTU, APDCL will complete monthly post construction fatality (carcass) monitoring of the LILO lines during the first two years of operation, in line with GIIP, to determine the effectiveness of the proposed bird diverters.<sup>55</sup> If Amur falcon begin congregating in the vicinity of the SP TL during migrations, this should also be recorded.

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<sup>55</sup> <https://www.ifc.org/en/insights-reports/2023/bird-bat-fatality-monitoring-onshore-wind-energy-facilities>

## Residual Impacts

Table 77: Residual Flora and Fauna Impacts

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C	<b>Tree cutting</b> within the SPP	Medium	Impacts remain but compensation planting for tree cutting will ensure that any residual impact significance is compensated for in the long term.	Medium
C	<b>Tree cutting</b> within the SPP TL RoW – precautionary intensity since final route is still to be determined and no tree count is available. Tree trimming during the operational phase to maintain clearances beneath SPP TL	Medium (TBC)	Impacts remain but compensation planting for tree cutting will ensure that any residual impact significance is compensated for in the long term per national requirements to go towards the SPP ensuring no net loss of biodiversity is achieved.	Medium (TBC)
C/O&M	Vegetation clearance, including special status flora within the SPP boundary and SPP TL RoW. Vegetation cutting during the operational phase to maintain clearances beneath SPP TL and control growth within the SPP.	Medium	Impacts remain but no high significance residual impacts anticipated. The avoidance of 94 ha of natural habitat and habitat creation activities in the site is necessary to ensure no net loss of biodiversity is achieved.	Medium
C/D	Spread of invasive species	Medium	Impacts will be of medium significance even if the proposed mitigation measures are well managed, since the risk of spread still exists.	Medium
C/D O&M	Poaching of wildlife by workers of special status fauna outside of protected areas etc.	Medium	Impacts will be of low significance if the proposed mitigation measures are well managed.	Low
C/D O&M	Poaching of other wildlife by workers outside of protected areas etc.	Medium	Impacts will be of low significance if the proposed mitigation measures are well managed, there is a high degree of confidence in the mitigation.	Low
O&M	Fragmentation of wildlife corridors through the installation of fences across the SPP site.	Medium	No important wildlife corridors have been identified, further, adoption of spacing below fences and walls and retention or creation of wildlife corridors will help the free movement of small species across the SPP.	Medium
C/D	<b>Direct mortality of species</b> through construction works, e.g. vehicle accidents.	Medium	Impacts are possible within the SPP, but no important species identified on the site to date. Possibility of mortality along the	Low



Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
			SPP TL is low and the likelihood of encountering special status turtles is low, but still possible.	
C/D	<b>Construction noise</b> from equipment and machinery.	High	No high significance residual impacts anticipated, as mitigation measures can be effective. Impacts are not irreversible in the long term.	Medium
C/D	<b>Accidents</b> including traffic accidents on off-site access roads and around work zones.	Medium	Impacts will be of low significance if the proposed mitigation measures are well managed as they can be effective.	Low
C/D O&M	<b>Lighting</b> used to illuminate work areas and site facilities and boundary during operational phase.	High	No high significance residual impacts anticipated, as the mitigation measures can be effective to reduce light pollution.	Medium
O&M	<b>Elephant</b> damage to solar panels from wandering elephants	Medium	Impacts will be of low significance if the proposed mitigation measures are well managed.	Low
O&M	<b>Electrocutions</b> via contact with live electrical equipment.	Medium	Electrocution risk on SPP will be minimized by fencing whilst on the TL it will be minimized with the adoption of the proposed voltage spacing recommendations. This action will need to be implemented by CTU under separate funding to the Project. Given the voltage of the TL there is confidence that the mitigation will be implemented by default through design.	Low
O&M	<b>Collisions</b> with transmission lines of other birds including special status fauna outside of protected areas	Medium	Inclusion of bird diverters will help reduce the potential risk of collisions with LILO lines but will not entirely eliminate the risk. However, risk remains as there is very low confidence in the mitigation potential as this action will need to be implemented by CTU under separate funding to the Project.	Medium

## 7.5 Socio-economic

### 7.5.1 Economy and Livelihoods, Land Use

602. This section discusses impacts on economy and livelihoods, land use and the issue of land acquisition and compensation and associated mitigation measures to be adopted. The information has been extracted directly from the project RIPP. Further information on this topic can be found in the RIPP itself.

#### Potential Impacts

603. Economy and Employment - Impacts to the economy and employment are anticipated to be largely beneficial in all respects. The SPP will generate a substantial number of jobs during the construction phase, with over 3,000 workers. Considering at least 20% being unskilled workers, around 600 jobs will potentially be created for neighboring communities. There is a risk that this could mean that the labour pool for other economic activities is reduced during the construction phase, but this would return to normal after construction is completed. During O&M around 30 jobs per block will be created, including the substation, this would mean over 200 employees at the site, a portion of which would also be unskilled labour used for vegetation maintenance, etc. Decommissioning would also generate a substantial number of jobs. The SPP will also reduce dependency on other fuel sources, and potentially reduce tariffs leading to regional economic benefits.

604. Land Acquisition - A total of 18,000 bigha of land will be acquired for the construction of the solar PV plant and its related facilities such as the site boundary wall, internal roads, staff quarters, switching stations etc. This total includes the area for the extension plant which APDCL will acquire for future development, although it will not be developed at this point. Out of the total 18,000 bigha<sup>56</sup> (2,400 ha), 16,511 bigha (2201.5 ha) is KAAC land and 1,489 bigha (198.5 ha) is customarily owned land by the indigenous people/scheduled tribe for which Karbi Anglong Autonomous Council (KAAC) has issued customary rights to the land users. Only 8.2% of the land which will be acquired belongs to customary land/privately owned land. Plantation area will be affected. The area of affected rubber plantation is 270 bigha, chitranala is 480 bigha and bamboo is 50 bigha. Total number of affected households is 1,277 who are customary landowners.

605. A total of 38 residential structures will be affected, owned by 32 customary landowners. One religious church is agreed with the local community to be relocated. Additionally, 102 number of agricultural tenants will be affected who are using the customary landowners' land on lease basis and built structures (total 102 structures built by tenants). There are no households living below the poverty line or non-titleholders or landless households. There are also no households headed by disabled persons.

606. The SPP TL alignment passes through areas of forest (none of which is Reserve Forest) and agricultural land. Compensation for affected lands will be in accordance with national regulations. Approximately 0.94 hectares of permanent land will be required for towers and 54 hectares will be within the RoW.

607. Impacts to water supply are discussed above under the topic of hydrology; there will also be restriction on access to timber and NTFP that local communities gather from the land since access will be blocked.

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<sup>56</sup> 7.5 bigha is 1 ha

## Mitigation and Management Measures

608. SPP affected households will be eligible and entitled for compensation for loss of land and non-land asset and any loss of income and livelihood. Lack of legal documents of their customary rights of occupancy or land titles shall not affect their eligibility for compensation, however people having no land record or informal settlers will be eligible and entitled for non-land assets.

609. All SPP affected/displaced households and persons will be entitled to a combination of compensation packages and resettlement assistance depending on the nature of ownership rights on lost assets and scope of the impacts including socio-economic vulnerability of the displaced persons and measures to support livelihood restoration if livelihood impacts are envisaged. The displaced/affected households will be entitled to the following compensation and assistance:

- Compensation for the loss of land, crops/trees at their replacement cost
- Compensation for structures (residential) and other immovable assets at their replacement cost
- Alternate housing or cash in lieu of house to physically displaced households (who are having legal ownership) not having any house at site
- Compensation for non-land asset and assistance to tenants using the land of land owners for agriculture purpose including assistance for livelihood restoration
- Assistance for shifting and provision for the relocation site (if required)
- Assistance for vulnerable households
- Rebuilding and/or restoration of community property resources/facilities including religious structures
- Livelihood restoration measures

610. The SPP adopts cash compensation at full replacement for lost structures and relocation assistance, according to the RIPP Entitlement Matrix. However, APDCL will coordinate with KAAC to find out alternate land for relocation and the APs can be resettled in the new site. Consultation with KAAC found that there are alternate lands available nearby and they will explore options to assist the displaced persons (DPs) to find new land and relocation site(s). The resettlement site will provide new residences to the displaced households. APDCL together with the RIPP implementing NGO, PMC and contractor will demarcate the site with due consultation with KAAC and the DPs. The layout planning and development of infrastructure facilities will be done in consultation with Gaon Bura and KAAC. The resettlement site will be located in a safety zone and within the vicinity of the Rengma Basti (Long Kathar). KAAC will allot the land as there is availability of land in the project area. The alternate land shall be KAAC land and shall be free from encumbrances and shall not trigger further land acquisition or involuntary resettlement. The resettlement site must be selected on modified habitat, and not require tree cutting. Houses constructed at the site must be structurally sound with septic tanks connected to soakaways and drinking water meeting Gol water quality standards. No asbestos must be used in housing construction. Since the site is not yet identified, the IEE will need to be updated before any works on it commence to ensure impacts on the environment and social receptors at the selected site(s) are identified and managed.

611. Compensation for the SPP TL and CTU substation will be completed according to national regulations.

## Residual Impacts

**Table 78: Economy and Livelihoods, Land Use Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C	Land Acquisition and loss of livelihoods	High (see RIPP)	Residual impacts will remain and will therefore be compensated for per the RIPP. Relocation will still have negative impacts to people who perhaps do not wish to move. A GRM has been prepared to manage complaints received during the relocation process. Other temporary impacts during the construction phase will be managed by the RIPP as noted above.	High
C/D O&M	Disrupted or loss of access to water resources	High (see RIPP)	Residual impacts will remain and must be compensated for by provision of alternative water resources; these must be in place prior to the start of construction.	High
C/D O&M	Access to timber and NTFP	High (see RIPP)	Residual impacts on livelihoods will remain and will therefore be compensated for through livelihood restoration per the RIPP.	High
C	Impacts of resettlement site(s)	High (TBC)	IEE will need to be updated before any works on the resettlement site(s) commence to ensure its impacts on the environment and social receptors at the selected site are identified and managed. Significance of impacts should be reduced if siting criteria are followed.	Medium (TBC)

## 7.5.2 Access, Social Infrastructure and Utilities

### Potential Impacts

#### Construction Phase

612. Access – Two access roads have been included within the site layout (see Figure 2: SPP Block Layout). Both routes have been agreed upon by the community and APDCL. Since these will permit some public access to the site each block will be fenced to prevent access to the electrical infrastructure. However, as noted in Section 6.4.4 and Figure 63, there are at least three other access routes which the community would like to retain. Removal of these access routes, without adequate consultation with the community may

result in complaints when construction commences, and the boundary wall is installed or blocks fenced.

613. Medical facilities – Many workers will be on-site during peak construction periods. This could place a strain on local medical facilities if illness and accidents occur on a regular basis throughout the construction and decommissioning phases. Demand may also occur during the O&M stage.

614. Educational Facilities – No education facilities are in the SPP site and none of the schools identified in

615.

616. Community **Health and Sanitation**

617. Among the RIPP surveyed households very few reported illness of their family members. Only 7% of the households reported illness of their family members during last one year preceding the survey. For details refer to Table 52.

**Table 52: Major illness in the family during last one year**

#	Illness	No. of HH	%
1	Yes	25	6.7
2	No	347	93.3
	Total	372	100.0

Source: APDCL, Nov 2023-Dec 2023

618. Among these 25 families only one member had fallen ill during the last one year. The incidence of appendicitis, stroke, kidney stone, chest infection, dengue, stomach pain etc. was reported by the households. All of them have taken allopathic treatment and the average cost of treatment reported to be INR 3,500. For treatment the families spend from their own income and have not taken any loan.

619. It was found that all the households are having a toilet facility either a pour flush or a dry pit latrine at their homes. About 63% of the households are having a pour flush toilet. The rest of the families are having a dry pit latrine (36%). Only two households did not have a toilet.

620. **Figure 67** are close to haul routes or the site boundary. One school is located close to the SPP TL, but outside of the right of way. In this area there can be some short-term noise and air quality impacts to the school. It is also possible that there could be some restrictions to accessing the school during line stringing. Since construction works will be medium term, and workers may bring their families this could place a strain on local education facilities. Demand may also occur during the O&M stage.
621. Electricity Network – Removal of the existing electricity network poles from the SPP could impact upon users around the SPP connected to the network, although it is anticipated most of the power lines provide power to properties that will be relocated and so will become redundant.
622. Roads – Road upgrading to provide access to the SPP is one of the activities of the SPP component. During these works there will be localized short term impacts to road users which could result in some short delays and potential blocking of access routes. These roads once upgraded will take construction traffic which will result in disruption and disturbance to road users.

### **O&M Phase**

623. No other significant impacts to access, social infrastructure and utilities are anticipated during the O&M phase.

### **Decommissioning Phase**

624. No other significant impacts to access, social infrastructure and utilities are anticipated during the decommissioning phase. There is a possibility that roads could be damaged by vehicles removing equipment, but the condition of roads in 25 years' time is difficult to determine at this stage.

### **Mitigation and Management Measures**

#### **Design Phase**

625. As part of detailed design, APDCL and contractors will consult with the local community to determine if any additional access routes are required through the blocks before the boundary wall and internal fence. This should be completed as part of facilitated access workshops where all members of the community living within 500m of the SPP are invited to attend and put forward suggestions for access across the site, or within specific blocks. Of specific interest would be the locations mapped below. Residual impacts will remain of high significance until consultations are completed with the community to incorporate all their needs relating to access around and through the SPP.

#### **Pre-construction Phase**

626. During this phase the contractors for all components will be responsible for preparing and implementing a Traffic Management Plan. They will also provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions at least 72 hours before the disruptions. Prior to the commencement of works all activities will be announced in local papers, at least one month in advance of works.
627. Contractors will check with relevant local authorities (electric, water, telecoms) whether there are known pipes, cables, or other utility lines and carry out a scan using cable avoidance tool to identify any unknown underground utilities prior to excavation. Should

utilities need relocating or required to be removed, consult with the relevant utilities and local community to ensure that there is no change in supply because of these changes. In particular, alternative power supply connections will be required as distribution lines are removed. Contractors to identify in consultation with service providers appropriate measures to minimize period of disruption to utilities and reduce health and safety risks. If services must be disrupted contractors (via service providers if appropriate) to notify affected communities well in advance of any power outage etc. Obtain necessary clearances consistent with the regulatory requirements from other utilities that could be affected by the SPP component, including the removal of existing electricity distribution network across the site (if not needed for electricity supply). As the distribution company for Assam, APDCL will be responsible for ensuring that removal of the existing electricity distribution poles across the SPP to facilitate construction does not affect the supply of users off-site.

628. Access routes to the site will be upgraded but condition surveys of the roads and adjacent drainage, utilities etc. should be completed before construction commences.

### **Construction Phase**

629. During construction mitigation measures relating to maintaining access to properties and managing off-site access roads will be implemented by contractors (Annex A).

630. Each contractor will be responsible for the provision of a medical center for workers. The medical center will be staffed full-time by a doctor and nurse. The center will be equipped to manage small medical emergencies and minor ailments. An ambulance and defibrillator shall also be kept at the center. Any major injury will be treated at local hospitals with an evacuation plan in place given the remoteness of the construction site.

631. CTU contractors will be responsible for ensuring that access to the school close to the SPP TL is available during school hours. Issues relating to safety around the school are discussed below under the topic of community health and safety.

### **Residual Impacts**

**Table 79: Access, Social Infrastructure & Utilities Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/O&M	Access across site and to social infrastructure/PCR blocked	High	Residual impacts will remain of high significance until consultations are completed with the community to incorporate all their needs relating to access in the Project area.	High
C/D O&M	Impacts of local infrastructure	High	Provision of a medical facility for contractor should reduce the burden on local medical facilities. CTU contractors will be responsible for any impact management close to the school close to SPP TL.	Medium
C/D O&M	Disruption to traffic	Medium	Implementation of the Traffic Management Plan and other mitigation measures should ensure that any residual	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
			impacts are of low significance. Regular communication with the community will also help ensure that impacts are minimized.	
C/D	Removal of distribution poles and unintended damage to existing roads, property and utilities	Low	Impacts will be of low significance if the proposed mitigation measures are well managed, but risk of damage still remains.	Low

### 7.5.3 Visual Impact

632. This section discusses the visual impacts of the SPP during the operational phase of the SPP and associated mitigation measures to be adopted.

#### Potential Impacts

633. The solar power plant will be an incongruous feature in the rural landscape at the site being an industrial installation and visual impacts are unavoidable. Receptors may also experience glint (a momentary flash of bright light, typically experienced by moving receptors) and glare (a continuous source of bright light typically experienced by static receptors) especially those to the south since this will be the direction the solar photovoltaic modules are orientated.

634. Then there may be night-time intrusion from artificial lighting of the solar power plant in otherwise dark skies. The extent to which adjacent properties experience visual impact depends on the level of topographic and vegetative screening that exists whilst the significance of the impact depends to an extent of personal preference.

635. The site itself slopes from west to east and visual impacts from the SPP are more likely to be observed to the east of the SPP, although in general the villages around the SPP are small and the number of people affected will be relatively low. This specific area is not known to be an important, or culturally significant landscape and is not an area for tourism.

#### Mitigation and Management Measures

##### Design Phase

636. Detailed design to minimize visual impact and clutter:

- A facilitated workshop will be held between APDCL and contractors to agree visual design standards so there is visual cohesion between all blocks and the common (administrative area) during the O&M.
- Contractors to consult with local communities within 500m of the site boundaries to get their views and input into the site layout.

637. Orientate and layout the solar photovoltaic panels to prevent glint and glare at adjacent properties. Solar panels to have an anti-reflective coating to minimize glint and glare and maximize light absorption, tables/racks to be anti-reflective made of galvanized steel or aluminum – the use of the vegetative buffer around the site may help reduce this impact.



638. Buildings will be designed in keeping with the traditional Assam vernacular.

639. Minimal outdoor lighting to be installed to minimize disturbance; if required it must be of low intensity with little or no blue wavelength and operated using passive infra-red (PIR) technology movement sensors set at person height so as not to be kept permanently on overnight, it must be directional and shielded, so light does not fall outside the allocated land plots. If lit externally buildings will be designed with non-reflective dark-colored cladding materials to avoid reflecting light.

640. Minimize the use and height of security fencing. Site boundary and block fences to be planted with a vegetation buffer to screen views.

### **Residual Impacts**

**Table 80: Residual Visual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
O&M	Change in landscape	High	This subjective impact maybe significant to some and not to others. Coordination with the local community on designs and placing a vegetation buffer around the site boundary may go some way to limiting the residual significance of impacts, but depending on personal opinion the SPP may still result in residual impacts of high significance to some members of the community. Likewise, the SPP TL will also result in some residual impacts, although it is noted that for both SPP and SPP TL the number of affected receptors will be relatively low.	High
O&M	Lighting	Medium	The proposed mitigation measures should help ensure that any residual impacts are of low significance to adjacent properties.	Low
O&M	Glint and glare	Medium	The proposed mitigation measures should help ensure that any residual impacts are of low significance to the adjacent properties.	Low

### **7.5.4 Physical Cultural Resources**

641. This section discusses the impacts upon physical cultural resources (PCR) during construction and operation and associated mitigation measures to be adopted.

#### **Potential Impacts**

642. Several PCRs have been identified within the SPP, two churches and one prayer home. The Church in Block 4 will be relocated to a resettlement site located outside of the SPP, as agreed upon by the community currently living in the SPP area. Consultations

with the community of the Jericho Church in Block 6 and the Immanuel Prayer Home found they were not aware of any proposed measures to relocate their facilities.

643. A temple was also identified close to the SPP boundary, anticipated to be outside but its location to be confirmed. Consultations with the community did not indicate that it was of any significance to them.
644. It is also possible that a graveyard could be present within the boundary of the SPP. However, consultations with the community were inconclusive regarding its exact location although it was suggested it was not within the SPP site itself.
645. Some trees under which prayer/rituals are performed are reported by consultations to be inside the SPP and it will be difficult if access to them is blocked and they are not allowed to perform in those sites as they are using them since generations. However, as documented in the RIPP the social safeguards survey team has not identified any to date.
646. Other churches have been identified in the area around the SPP and SPP TL. Hatokajan Seventh Day Adventist Church is the closest to the SPP boundary, approximately 500m away. This site will not be significantly impacted by the SPP or SPP TL.
647. It is possible that chance finds could occur during excavation works for all components given Karbi Anglong has good potential for archaeological finds.

## **Mitigation and Management Measures**

### **Design Phase**

648. Contractors shall conduct an inventory of above ground physical cultural resources checking against the findings of the IEE. The inventory is to be compiled by a qualified physical cultural resources expert who is appointed by the contractor following a site walkover and local community consultation, and in conjunction with the RIPP consultants. Of particular importance is to identify the presence of any graveyard and the temple on the site and to re-confirm the temple's specific cultural importance to the community and if it can be removed from the site. It is also important to identify any trees under which prayer/rituals are performed. Consultations shall also be completed with the community regarding Jericho Baptist Church and Immanuel Prayer Home to discuss preferred relocation sites. Resettlement of the Block 4 church will be completed per the requests of the community and per the RIPP.
649. If additional physical cultural resources to those in the IEE and RIPP are identified, consultations shall be undertaken with the local community and/or Department of Archaeology to determine what measures should be taken with respect to protecting them through the design and layout. Physical cultural resources will only be relocated if they are of local community religious/cultural importance, their users are being resettled/access is blocked, and they have specifically requested they be relocated. In all other cases access to be maintained. Removal or blocking of access to trees where prayers/rituals are performed will be an issue; such trees are to be retained with access arrangements made for continued use if the community requires it and no alternative arrangement can be agreed with them.

### **Pre-construction Phase**

650. Once vegetation has been cleared a second archaeological site walkover will be undertaken by a qualified physical cultural resources expert (archaeologist) appointed by

the contractor to identify any previously unknown resources and review the potential for archaeological features to be encountered underground. Demarcation of physical cultural resources to be avoided and retained.

### **Construction Phase**

651. A Chance Find Procedure will be developed for implementation in the event physical cultural resources are found. The procedure will include at least the following:

- If suspected physical cultural resources are encountered, all works at the find site should be immediately halted.
- The find should be assessed by a competent local official managing cultural issues, and procedures to avoid, minimize or mitigate impacts to such physical cultural objects should be agreed in writing with them.
- Work should not begin until the procedures to avoid, minimize or mitigate impacts to the physical cultural resources have been agreed and implemented in full.
- If avoidance is not feasible, and no alternatives to removal exist, and the SPP benefits outweigh the anticipated cultural heritage loss from removal which is unlikely unless in case of resource of local value, following clearance of ADB the physical cultural resources should be removed and preserved using the best available technique in accordance with relevant provisions of national heritage protection laws and decrees.
- Records should be maintained of all finds, including chain of custody instructions for movable finds.
- All construction workers to be made aware of the chance-find procedure and types of finds to be reported.

### **Residual Impacts**

**Table 81: Residual PCR & Cultural Landscape Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C	Impacts to known cultural heritage sites	Medium	Despite the relocation of churches and prayer house, the community may not be entirely satisfied with the removal of the church to another location. Residual impacts however will be of low significance as the facilities will be retained in consultation with communities albeit in another location. Removal or blocking of access to trees where prayers/rituals are performed will be an issue; such trees to be identified and retained with access arrangements made for continued use if the community requires it.	Low
C	Chance finds taking a precautionary principle	Low	Implementation of a chance find procedure will ensure that	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
	assuming possible finds of state level importance given archaeological value of East Karbi Anglong		residual impact significance will be low.	

### 7.5.5 Waste Management

652. This section discusses the impacts of waste management and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

653. Waste Management - Various waste types will be generated at worksites during the construction phase, including:

- Inert construction waste – e.g., concrete, bricks, soil
- Domestic waste – e.g., food waste, packaging waste (cardboard, plastic, wood). Given more than 3,000 workers could be present on-site during peak work periods, over one ton of domestic waste could be produced daily (assuming around 400 grams per person)
- Liquid waste, some of which will be classed as hazardous – e.g., waste oil (non-PCB), sanitary discharge.
- Electronic waste – mainly generated during the O&M and decommissioning phases, but also possible if equipment is broken during installation. All faulty equipment arriving at site will be returned to vendors.
- Waste vegetation – including trees and shrubs cut on site. Vegetation across the site is dense in many locations and large volumes will need to be cleared. Approximately 2,400 trees will be cut and removed from site along with large quantities of bamboo and ground vegetation.
- Spoil material – where practical and cut will be balanced with fill across the site. Where additional spoil is generated, it will need to be disposed of.

654. Inert and domestic waste can be appropriately managed through the adoption of good international industry practice measures around the work site in construction and in the administrative blocks during the operational phase. Solid and hazardous waste management facilities exist in India, if not Assam. However, solid and hazardous waste such as waste oil can contaminate soils and groundwater if they are not stored, handled and disposed of correctly.

655. As noted above, during the O&M phase faulty and any broken electrical and electronic equipment will need to be removed from site, this could include PV modules which may contain heavy metals. In sufficient quantity these heavy metals can cause significant pollution events.

656. During decommissioning all the modules and electrical and electronic equipment will need to be removed from site. Further, all equipment from the pooling substation will be removed, unless it is retained for alternative use (e.g. the SPP may be upgraded in the future with more efficient modules which would still require PSS, GSS and LILO). It is possible that items such as the accommodation block and internal roads may be retained

for other purposes, but other infrastructure such as fences, gates, security buildings, etc., will be removed.

657. Hazardous Liquids - Hazardous liquids will be stored at work sites during construction and at substations during O&M, e.g., oil, fuel, solvents, etc. Spills and leaks of these liquids can result in soil and water pollution. This issue is discussed above under Soils and Hydrology.

658. Lead Acid Batteries - Batteries in substations are used for back-up power supply. Batteries will most likely need to be replaced periodically through the O&M phase and then disposed of during decommissioning.

## **Mitigation and Management Measures**

### **Design Phase**

#### 659. General

- Solar PV panels will not contain heavy metals.
- No asbestos containing materials of any type will be used in the design and construction of any SPP facilities.
- Use of chlorofluorocarbons (CFCs) including halon is prohibited.
- PCBs will not be used in transformers or other SPP facilities or equipment.
- Minimize the use of lead-acid batteries with Li-Ion In preference.
- Composting and package incineration facilities will be included in the design to manage O&M domestic waste.

660. Solar PV Blocks – Detailed designs shall ensure that cut material is balanced with fill across the SPP to minimize the creation of inert waste. For vegetation waste the contractor will seek to avoid cutting of trees and clearing of dense vegetation where it is not required for construction and there is no shading of solar PV modules or interference with other equipment and cables. To facilitate removal mass concrete foundations are not to be used, pre-cast concrete foundation blocks or pile driven foundations will make the land restoration easier and reduce the need for disposal of foundation blocks. Control buildings shall include toilets connected to package STPs to treat wastewater and domestic waste segregation and storage facilities. Maintenance buildings shall be provided with specific areas for the storage of hazardous liquids and broken/faulty e-waste. The areas shall be bunded and well-ventilated and capable of storing all the waste materials that will be generated from the block.

661. Administration Block – The block will be designed to include a package STP to treat wastewater. Facilities for the storage of domestic waste will also be provided in accordance with the requirements of Annex A, as will storage for hazardous liquids and broken/faulty e-waste.

662. Pooling Substation and Grid Substation - In the design phase it will be important to ensure that substation waste management / hazardous materials storage areas are well designed, and that consideration is given to the battery types and battery room design.

663. The substation contractors will provide a well-designed, covered area where materials can be segregated. The waste storage area will be of sufficient size to accommodate all anticipated storage requirements and can be locked, is well-ventilated and will not reach extreme temperatures. Fuel/oil/chemical/waste storage areas must have an impervious floor and be bunded so that the capacity of each bund is sufficient to contain at least 110% of the maximum design storage capacity within storage area, not connected to the surface water drainage system.
664. 24V, 30V, 48V, 110V, 220V DC batteries will ideally be lithium-ion type instead of lead acid or nickel cadmium to reduce hazardous waste generation although all battery types are e-waste. The batteries will conform to relevant Indian standards. A separate room for substation batteries will be provided with ventilation and exhaust fan for taking out fume gases and provision of remote monitoring of substation batteries (if not staffed) and exhaust fan will also be made.

### **Pre-construction Phase**

665. Contractors will prepare and implement a Waste Management Plan dealing with all solid and hazardous waste as well as wastewater generated in an environmentally sound and safe manner. It will ensure waste generation is reduced, all surplus materials will be reused or recycled, and disposal will be the last resort. Of specific importance is the management of vegetation waste and e-waste. The latter will include solar PV panels and equipment containing SF6, oil and lead acid batteries. The waste management plan will include specific sections relating to the management of these waste types.
666. Equipment Procurement - Selection of an environmentally safe and sound equipment from a manufacturer who offers a facility for return of faulty/broken/end-of-life equipment with take back guarantee provided. Solar modules must not contain hazardous materials e.g., cadmium, lead, or selenium. Equipment purchased is to be accompanied by letter from the manufacturer stating its composition and the leaching potential of any heavy metal content to determine if it is acceptable and how it is to be disposed on at end-of-life.

### **Construction Phase**

667. During the construction phase, typical waste management issues can be managed through mitigation measures outlined in Annex A. The Contractor will remove all waste from the work sites at the completion of the workday and send it for storage on-site before final disposal. Storage facilities shall comprise enclosed containers suitable for each type of waste be marked adequately specifying the waste types and shall not be mixed with other wastes. Contractors for disposal will be appropriately licensed, records of waste generated and disposed by route with agreements with waste management contractors will be retained.
668. Inert and Domestic Waste (liquid and solid) - Inert waste materials including any spoil material which cannot be re-used on site or donated for beneficial use by the community will be disposed of or recycled at licensed inert waste management facilities in Assam. Recycling of domestic waste will use authorized vendors; any domestic waste for disposal must be taken to a engineered sanitary landfill the nearest of which is in West Bengal through arrangement by the contractor. Domestic waste must not be given to the municipality for disposal given the lack of facilities within Assam.
669. Hazardous and E-Waste – Any hazardous and e-waste will be handled, stored, collected, and disposed on according to the specific management measures outlined in Annex A. This will include the strict requirement for segregation of hazardous and e-waste

and disposal at licensed facilities in India. Any e-waste created will be returned to the manufacturer or, if not possible, disposed of at a suitable licensed hazardous waste facility within India, the nearest of which is in West Bengal, at the cost of the contractor.

670. Organic Waste – After seeking to avoid the cutting of trees and clearance of vegetation, for the large volume of organic waste the contractor will follow the step-wise approach below:

- Handover trees to government as per the legal requirements
- Offer any residual trees and bamboo to the local community as construction material or fuel wood.
- Use any residual trees and bamboo for construction works, e.g., construction of temporary shaded rest areas for workers, etc.
- Establish a composting area for remaining organic waste to be reused on site as topsoil.
- Any organic waste that cannot be re-used or composted, e.g., large tree stumps that cannot be easily grounded, should be:
  - Compacted using compactors to reduce the volume of organic waste to be removed off-site.
  - Collected by an authorized waste management company, or supplied to a company for use as biomass, wood chips, etc.

### **O&M Phase**

671. During this phase contractors, APDCL and the private sector will be responsible for ensuring waste management and disposal in line with national waste management regulations. Any e-waste will be returned to the manufacturer or disposed of at a licensed hazardous waste facility.

### **Decommissioning Phase**

672. It will need to be ensured that e-waste is re-used or disposed of in accordance with the law and good international industry practice at that time. APDCL and the private sector shall outline the procedure for dismantling and handling equipment as part of their D-EMP. Personnel and labour contractors involved in the dismantling process shall receive training ensure avoidance or minimization of such damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable pollution.

673. All non-hazardous and hazardous wastes (including from the pooling substation) shall be removed from site and either recycled, returned to vendor to e-waste (if suppliers are still in business or the guarantee is honored at end of life) or disposed of in accordance with the law and best practice at that time. This will include any equipment containing SF6 and any lead acid batteries.

### **Residual Impacts**

**Table 82: Waste and Spoil Material Residual Impact**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C	Spoil disposal from land leveling and road works	Medium	Impacts of medium significance will remain due to the volumes involved as a	Medium

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
			result of the scale of development.	
C/D	<b>Generation for disposal of general inert construction waste</b> (paper, plastic etc.)	High	Some impacts of medium significance may remain due to the scale of the construction/decommissioning works and low confidence in mitigation effectiveness given the lack of waste management facilities within Assam requiring inter-state disposal by the contractor.	Medium
C	<b>Generation for disposal of organic waste from clearing of vegetation</b> (trees, shrubs, etc.)	Medium	Application of the step-wise management of organic waste should ensure that any residual impacts are managed, but due to the volume of vegetation involved impacts remain of medium significance during construction.	Medium
C/D	<b>Generation for disposal of hazardous materials</b> (oil drums, cans etc.)	Medium	Standard mitigation measures applied to the construction phase will ensure that any residual significance is low – mainly due to the fact that the volume of hazardous waste generated is likely to be small.	Low
O&M	<b>Generation for Disposal of Hazardous Materials</b> including oil, lead acid batteries.	High	During this phase only very small quantities of waste are anticipated each year. Residual impacts will be very of medium significance due to the nature of this hazardous waste and low confidence in mitigation effectiveness given the lack of waste management facilities within Assam requiring inter-state disposal by the contractor.	Medium
C/D O&M	<b>Generation for disposal of e-waste</b> Including PV modules	High	Ensuring there are take back schemes for faulty/broken equipment and disposal of waste at hazardous waste management facilities should help ensure that any residual impacts are managed, but they remain of high significance given the sheer volume of solar PV panels involved. Further, re-use of old modules at the decommissioning phase will further limit direct impacts. Impacts are not irreversible in the long term.	High



## 7.6 Health, Safety and Facilities Management

### 7.6.1 Community Health & Safety

674. This section discusses potential health and safety impacts to the local community during construction and operation and associated mitigation measures to be adopted.

#### Potential Impacts

##### Construction Phase

675. Construction activities have the potential to increase the threats to community safety and security during the construction phase. The key types of impacts are likely to be:

- Potential conflict between workers, security personnel and local community members resulting in upset or injuries
- SEAH/GBV issues due to interaction between construction workers and women in the local communities.
- Increased hazards and risk of accidents due to access to worksites especially off-site access road works which can be less readily secured. Children are specifically vulnerable to these types of hazards.
- Increased risk of road/traffic accidents causing injuries or fatalities. Construction activities will result in increased traffic flows on off-site village access roads that are narrow and used by local residents. Children are also specifically vulnerable to road accidents.

676. However, as the population surrounding the immediate boundary of the SPP and along the SPP TL is generally low and the risk of impacts to these communities is relatively low, it still needs to be managed. The population along external access roads is, as expected, higher and impacts, including vehicle and pedestrian access, along these routes could be more significant to the communities.

677. The most likely potential impacts on community health in the construction phase are:

- Increases in dust, noise and water pollution (see Sections 7.3.1, 7.3.6 and 7.3.4)
- Increases in disease vectors such as mosquitoes (waterlogging) and rodents (if food/drink is not stored properly and solid/liquid wastes are not managed adequately) with accompanying increased incidence of vector-borne diseases. These topics are discussed separately under Section 7.5.6.
- Increased risk of incidences of communicable diseases arising from interaction between workers living in the construction camps with local people. There will be a risk of communicable diseases (e.g., TB and sexually transmitted diseases such as HIV/AIDS) passing through the workforce and possibly extending into the community.
- Increased risk of water-borne diseases if liquid and solid waste management is not implemented effectively and water sources protected. This topic is discussed separately under Section 7.5.6.

##### O&M Phase

678. Site Security - The presence of security staff and security perimeter fencing will ensure that no person can legally enter the site. However, the use of security personnel can have negative impacts, for example the IFC note that the potential for sexual harassment or

sexual violence against women can increase from an expanded presence of private or public security forces in a project area.<sup>57</sup>

679. EMF - Based on a recent in-depth review of the scientific literature, the World Health Organization (WHO) concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields.<sup>58</sup> However, to be prudent, given the 400 kV SPP TL, this issue has been considered further as part of this IEE. Further, as health risk cannot be disproved, the WHO (June 2007) recommends compliance exposure guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP (1998) has set the limits at 50 Hz for the public exposure as: (i) electric field strength (kV per meter) is 5 kV/m, and (ii) magnetic field strength is 100  $\mu$ T; while for the occupational exposure as: (i) electric field strength is 10 kV/m, and (ii) magnetic field strength is 500  $\mu$ T.

- Pooling and Grid Substations - Due to the design of the equipment that substations contain, they do not produce a significant external electric field. However, they do generate a magnetic field. Magnetic field levels at the boundary of a substation are typically at a level of 1 or 2  $\mu$ T, but this decreases very quickly as you move away. At approximately 1-2 meters from the substation, the magnetic field is usually lower than the field found in a home.<sup>59</sup> Accordingly, no significant impacts to residential receptors is anticipated. Further, there are no residential receptors within 500m of the substations.
- SPP – similar to the substations, no EMF impacts beyond the SPP boundary are anticipated. The local community were concerned about radiation from the SPP but the solar PV panels are designed to absorb solar radiation rather than emit radiation. It will be important for APDCL to conduct awareness raising to relieve the concerns of the community on radiation.
- SPP TL - transmission lines produce both electric and magnetic fields. Electric fields are created by differences in voltage. The strength of the electric field is measured in kilovolts per meter (kV/m). Any electrical wire that is charged will produce an associated electric field. This field exists even when there is no current flowing. The higher the voltage, the stronger the electric field at a given distance from the wire. Magnetic fields are created when electric current flows; greater the current, stronger the magnetic field. Electric fields are strongest close to a charged conductor, and their strength rapidly diminishes with distance from it. The strength of the magnetic field is measured in microtesla,  $\mu$ T. The SPP TL will be constructed to respect safety zones (with no people living directly beneath lines) but there are no specific guidelines for EMF in India. The height of the conductor and number of circuits influence if electric field strength can be met in the ROW (outside the safety clearance) where structures may still remain, maximum magnetic fields beneath 400kV lines may exceed GIP exposure levels. In the United Kingdom National Grid 2012 guidelines state the maximum magnetic field beneath a 400kV line will be around 100  $\mu$ T, with the typical field being in the range of 5-10  $\mu$ T. ICNIRP exposure levels for the general public at 50 hertz are 100  $\mu$ T. The maximum electric field beneath a 400kV line will be around

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<sup>57</sup> GOOD PRACTICE HANDBOOK. Use of Security Forces: Assessing and Managing Risks and Impacts. Guidance for the Private Sector in Emerging Markets, IFC, 2017

<sup>58</sup> <https://www.who.int/peh-emf/about/WhatisEMF/en/index1.html>

<sup>59</sup>

<https://www.nationalgrid.com/stories/energy-explained/is-living-next-to-substation-safe>

11kV, with the typical field being in the range of 3-5 kV. ICNIRP exposure levels for the general public at 50 hertz is 5 kV.

**Decommissioning Phase**

680. Impacts will be similar to those identified during the construction phase but for a shorter duration.

## Mitigation and Management Measures

### Design Phase

681. During the design phase it is important that all infrastructure is designed with the safety of the community in mind. The design requirements will be different for the various activities; however, the general theme of design phase is that all SPP infrastructure will be constructed in accordance with national safety codes and safety clearances. Designs will ensure that there can be no illegal access to substations. The PSS is included within the main SPP boundary wall thereby preventing illegal access to the site. The SPP will be secured with the boundary wall, internal block fences and CCTV. This should prevent access to the electrical infrastructure on the site. More specifically, the following safety measures will need to be followed during detailed design.
682. EMF – Designs to ensure EMF levels within the site boundary are within international industry good practice levels as per ICNRP (reference and peak values) for occupational exposure and at the site boundary and along the retained community access routes within those for community exposure. Contractor to provide EMF calculations for review and approval.
683. Substations and SPP - Separation walls or fire barrier walls shall be provided between the transformers / reactors or between transformer / reactor and nearby building as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations. Designs will also ensure that there can be no illegal access to substations.
684. SPP TL – APDCL will liaise with CTU to ensure the following measures will be applied by the SPP TL contractors:
- Include in the design of all towers anti-climb features together with posting of written and visual warning signs to include the ISO 7010 “Hazard Type: Electrical Symbol” warning of the risk of electrocution.
  - Each tower shall be fitted with a number plate, danger plate and a set of phase plates per circuit. The arrangement for fixing these accessories shall not be more than 4.5 m above the ground level.
  - Design of the SPP TL will ensure no properties in the safety clearance plus the EMF guidelines can be achieved at the nearest properties to the route; EMF levels will be monitored to confirm.
685. Off-site Access Roads - In upgrading the village roads contractors will provide permanent pedestrian safety barriers outside the entrances to schools, health centers and market areas or other locations where there is a greater chance children or the elderly may be seeking to cross the road. Zebra road crossing to also be marked on the road in these areas once surfaced. Road safety signs including speed limits are to be provided at the entrance to the village and approach roads, at the entrances to village areas, by schools, health centers, and markets, and then at 1 km intervals. Speed limits for SPP traffic on the off-site access roads once turning off the national/state highway as well as approach and internal road speed limit will be capped at 20 km/hr, given the nature of the roads and traffic which will be using the road. Design of access from blocks to the approach road and from the approach road to village road to provide adequate sight lines for all drivers and warning signage – gates to be set sufficiently far back to prevent vehicles having to stop/queue.

### **Pre-construction Phase**

686. Pre-construction is another important phase for community health and safety. During this phase the contractors will be responsible for the preparation and implementation of a Community Health and Safety Plan outlining all of the relevant measures in the EMP relating to community health and safety. The Community Health and Safety Plan shall include flow chart and contact details to deal with that situation should any community member be impacted during the works. The plan shall also include specific requirements for the management of security staff aligned with IFC's Good Practice Handbook: Use of Security Forces: Assessing and Managing Risks and Impacts (IFC, 2017). Additionally, a Traffic Management Plan will be prepared considering both the safety of pedestrians and vehicles and the need to avoid traffic congestion; it is to be developed in consultation with relevant local authorities to ensure proper execution of traffic controls including where temporary blockage of one lane of the road or footpath is needed for rehabilitation works.

687. Communications with the community will be critical to the success of the SPP. Specific mitigation measures to ensure communications with the community are effective and on-going, include:

- Local disclosure of the IEE including an executive summary translated into Assamese and Karbi via the APDCL website, GP offices and construction site offices of APDCL and the contractors.
- Provide brochures and posters on the main findings of the IEE and where the full version can be accessed, as well as a translation of the executive summary of the IEE, will be printed in Assamese and Karbi and made available/displayed for public scrutiny at places easily accessible to affected persons.
- Provide notice boards around the SPP boundary and along off-site village access roads and in adjacent villages including details of the GRM including the name, designation, contact numbers, address of both the APDCL and contractor's GRM focal persons plus the timeline and process of redressal together with a suggestion box that will be regularly checked for any grievances received.
- Prepare a Safety Awareness leaflet to be distributed to all homes within the vicinity of the work sites. The leaflets shall provide information relating to the risks of interfering with the SPP, SPP TL and substations. The leaflets will be written in Assamese and Karbi using Non-Technical language and will provide illustrations to convey messages where practical.
- Local communities as well as individual property owners within 500m are to be consulted when selecting sites for temporary construction facilities outside of the SPP prior to finalization of their location.
- Deliver face-to-face electrical safety awareness training to local children including their parents and their teachers at all educational facilities within at least 500m of the site and village roads used for access.
- Provide construction work site safety awareness sessions at all educational facilities within at least 500m of the site and village roads used for access.
- Provide EMF awareness sessions at villages within 500m of the site and SPP TL. The awareness sessions should provide information regarding the findings of the IEE on EMF and specifically discuss best practice reference limits for EMF and how they have been applied to the SPP.

### **Construction Phase**

688. During the construction phase contractors will review measures to mitigate community health and safety impacts on a regular basis, and consult community leaders every month, informing them on the status of implementation and results, and discussing any changes needed to the EMP sub-plans (especially the Community Health and Safety Plan) in advance of proposed changes. The contractors will undertake face-to-face meetings with all communities/residents and schools, health centers, places of worship and community centers within 500m of the SPP boundary to keep them fully informed of the nature of works and latest schedule, notifying them individually at least one month prior to the commencement of works of the intended start date and schedule.

689. A range of other general good practice measures (see Annex A) will be employed by the contractors relating to the provision of access (for both the SPP site and the off-site access roads), and road safety as well as the requirement for periodic training sessions relating to sexually transmitted diseases.

690. Implementation of the GRM will be a key focus of the contractor's activities. The contractor's safeguards team will act as site GRM Focals and keep affected persons and local communities informed of the status of work and be readily available onsite to receive, document and deal with grievances at site level. The SPP will also encourage use of the GRM and clarify that this does not prevent affected persons from pursuing any legal action, if they feel it is needed, and inform communities about the ADB Accountability Mechanism and their possibility to resort to it if any grievance is not resolved by the project level.

### **O&M Phase**

691. As part of their O-ESMP, contractors, APDCL and the private sector will be responsible for the inclusion of a security management plan, aligned with the requirements of IFC's Good Practice Handbook: Use of Security Forces: Assessing and Managing Risks and Impacts (IFC, 2017).

### **Decommissioning Phase**

692. Road safety measures, per the construction phase as well as other general construction phase community health and safety mitigation measures will be applied during the decommissioning phase.

### **Residual Impacts**

**Table 83: Community Health and Safety Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/D	Risk of accidents (including traffic accidents)	Medium	A range of mitigation measures have been provided to help manage the risk of accidents occurring. However, despite these measures it is still possible that accidents could occur due to unforeseen circumstances.	Low
C/D	Presence of workers	Medium	Proposed mitigation measures, including the	Low
O&M	Presence of workers	Medium		Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/D O&M	Social conflict, security and safety	Medium	development of and implementation of a community health and safety plan should ensure that social conflicts are minimized. However, the number of security personal present associated with all blocks and infrastructure means that residual impacts are possible.	Medium
C/D O&M	SEAH of community	Medium		Medium
O&M	Risk of accidents involving electrical equipment	Medium	The safety measures recommended in this IEE, coupled with national safety standards, should ensure that all infrastructure is constructed and maintained to a standard which prevents significant impacts to community health and safety.	Low
O&M	EMF from SPP	Low	None anticipated beyond the site boundary / SPP TL RoW.	Low
O&M	EMF from SPP TL	Medium		Medium

## 7.6.2 Workers' Rights and Occupational Health and Safety (OHS)

693. The main activities that may result in OHS issues are:

- use of heavy equipment.
- works involving live power lines and equipment.
- construction vehicles.
- lack of, or poor application of, personal protective equipment (PPE).
- wildlife e.g., snake bites
- poor sanitary and welfare conditions at camps and work sites.
- lack of first aid and medical facilities.
- lack of firefighting equipment.
- SEAH / GBV
- exposure to EMF and SF<sub>6</sub>.

694. Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, loss of man-hours, labor abuses and to ensure fair treatment, remuneration and working and living conditions. These issues need to be considered not only for workers who are directly employed but also sub-contractors and those that maybe informally employed including daily labor.

### Potential Impacts

#### Construction Phase

695. The construction works are expected create at least 500 direct employment opportunities per block and around 50 for the substation and SPPI during the peak of the construction period. Most workers will be engaged by the contractors and will consist of an unskilled, semi-skilled to skilled workforce. However, contractors may employ subcontractors who report to them, and in turn they may use work gangs and daily labor increasing the risk of labor related issues. During the operational phase maintenance

works will be undertaken by the O&M contractors, APDCL or private sector depending on the block and how APDCL decide to manage the sovereign blocks after the initial three years management period.

696. The expected impacts on worker rights and H&S because of construction, activities and O&M are as follows:

- Risk to workers H&S due to hazardous construction activities and inadequate living conditions; and
- Violation of workers' rights.

697. Risks exist to construction workers particularly those who have not received adequate training or are familiar with the hazards associated construction of electrical infrastructure, working at height or medically unfit for the work involved. Inexperienced workers under the age of 18 would be particularly vulnerable from working on a hazardous construction site. Unskilled local labor, work gangs and daily labor is also more vulnerable as they would be less experienced and/or unlikely to receive the training required. Migrant and illiterate workers can also be particularly vulnerable if they cannot read signage etc. Health and safety hazards faced while working at construction sites, handling machines, plant and equipment, driving vehicles etc. could result in minor or major injuries, potentially in the worst-case even death. Working with electricity is particularly dangerous activities required. Only trained, medically fit workers are permitted to work with electricity and at height. Construction workers will be required to handle materials such as concrete, chemicals, fuels, etc. which will increase health risks if personal protective equipment is not used.

698. Poorly designed temporary worker camp/overnight accommodation and sanitation and welfare facilities may pose a health threat and nuisance to the workers due to unsanitary and unhealthy conditions. Uncontrolled vending of food and drinking water at worksites may also pose a risk with respect to the transmission of diseases like typhoid, diarrhea, and dengue fever.

699. Given that there will be individual worker camps for each block, SPPI and polling substation (as well as SPP TL) there is the potential for up to 9 construction camps across the SPP. No camp sites (except for SPP TL) will be permitted outside of the SPP boundary. The number of camps and workers creates the potential for highly significant impacts of medium-term duration.

### **O&M Phase**

700. **EMF** - The National Institute for Occupational Safety and Health (NIOSH) and other US government agencies do not consider EMF a proven health hazard.<sup>60</sup> However, according to the WBG electric utility workers typically have a higher exposure to EMF than the public due to working in proximity to electric power lines and equipment.<sup>61</sup> Solar PV equipment also generates low frequency EMF. No specific information or studies have been identified that suggest EMF from SPP equipment would result in harm to workers health.

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<sup>60</sup> <https://www.cdc.gov/niosh/docs/96-129/default.html>

<sup>61</sup> WBG EHS Guidelines. Electric Power Transmission and Distribution. 2007.



701. Electrocution - Working with live equipment during operation of the substation and SPP also involves safety risks specifically relating to electrocution. Other day to day accidents could occur but are likely to be uncommon and not life threatening.
702. SF<sub>6</sub> and other hazardous materials - When an arc is formed in SF<sub>6</sub> gas small quantities of lower order gases are formed. Some of these by-products are toxic and can cause irritation to eyes and respiratory systems. This is a concern if the interrupters are opened for maintenance or at disposal of the interrupters. Normally these impacts only occur in enclosed areas. Contact with other hazardous materials such as oil can also pose a hazard.

### **Decommissioning Phase**

703. Similar potential impacts as the construction phase can be anticipated, but over a shorter period and with a lower number of workers.

## **Mitigation and Management Measures**

### **Design Phase**

704. Most mitigation measures for the design phase relate to EMF and the safe design of substation buildings to protect workers. The provided mitigation measures (Annex A) are based primarily on national safety standards and the requirements of IFC EHS Guidelines. The measures ensure that issues such as fire safety, sanitation and noise levels are all accounted for in building designs – that includes measures for the administration block, etc.
705. Further, for all component construction works contractors will be required to undertake a health and safety risk assessment through a workshop during the design (and at other key stages) so it can inform both design and pre-construction preparations, considering both occupational and community H&S risks resulting from subsequent stages of the SPP operation. The facilitated workshop will involve the design and construction team of the contractors and O&M staff.
706. A range of design measures have been proposed to ensure the safe management of SF<sub>6</sub> under the topic of air quality, above.

### **Pre-construction Phase**

707. During the pre-construction phase an important focus will be on the establishment of plans and workers contracts to ensure that provisions are in place to manage the health and safety of workers and ensure workers' rights are respected. Specifically, the following are required:
- a) Occupational Health and Safety Plan & Emergency Response Plan(s). H&S plan to include emergency preparedness and response plan including flow chart and contact details to deal with situation should any construction worker or community member in the event of an incident during the works. The requirements of OHS Plan are included in Annex E. The plan will also include an OHS Training Plan including induction training as set out in the EMP (Annex A).
  - b) Labor Management Plan addressing employment of migrant workers, sanitation and welfare, gender-based violence/sexual exploitation, abuse, and harassment prevention etc. Medical insurance will be provided for all workers with sick leave

allowance per national norms but with minimum 7 days a year to ensure symptomatic workers do not attend site due to no work-no pay policies.

- c) Camp / Accommodation Management Plans. Given that there will be multiple camps across the site it will be important for the contractors to manage the sites well. Specific measures for construction camps are included under the topic of Camps and Plant below.
- d) Code of Conduct (CoC) and information video/brochure/leaflet for distribution to all workers during induction addressing culturally acceptable practices etc. CoC must be informed by the C-SEMP and address the following aspects:
- Zero tolerance in respect of health and safety.
  - Requirement on always wearing PPE on site.
  - Zero tolerance of bribery or corruption.
  - Respect for local community and customs, avoiding community conflict situations.
  - Zero tolerance of illegal and unacceptable activities/behavior, including but not limited to engagement in: prostitution; gender-based violence/sexual exploitation, abuse, and harassment; illegal sale or purchase of alcohol; sale, purchase, or consumption of drugs; gambling; fighting.
  - Alcohol and drugs policy and testing regime.
  - Role of workers in good housekeeping.
  - Role of workers in maintaining good hygiene including communicable disease measures e.g., social distancing.
  - Respect of wildlife and the environment.
  - Description of disciplinary measures for infringement of the code of conduct and other employer rules (e.g., immediate removal from site, fine etc.) will be included in staff contracts.

708. During pre-construction contractors shall also establish, through their Labour Management Plan, procedures for engagement of the workforce, for example through setting targets for local employment based on initial assessment of the labor market for unskilled and semi-skilled work force. Contractors shall also ensure mitigation measures included in Annex A are included in workers contracts, including measures relating to working hours and salary and provision of insurance for workers.

709. Establish a formal Grievance Mechanism for workers. Carry out awareness raising amongst formally and informally employed workers including those of sub-contractors about the GRM at the start of their employment, including details of how to submit a grievance to PIU/PMC and/or to the Contractor.

### **Construction Phase**

710. Extensive provisions for the health and safety of workers during the construction phase are included in Annex A. These measures are based on the requirements of national regulations and IFC EHS Guidelines.

### O&M Phase

711. O&M contractors, APDCL and the private sector will be responsible for following all national labour laws and health and safety laws and regulations (including those for sanitation and welfare). Other GIIP measures will also be employed during the operational phase, such as ensuring all electrical hazards feature written and visual warning signs that meet the IEEE standards to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of the risk of electrocution and that potable water will be supplied that meets national drinking water standards and ISO 10500 drinking water parameters (full suite).

### Decommissioning Phase

712. Mitigation measures, per the construction phase will be applied during the decommissioning phase.

### Residual Impacts

**Table 84: Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	<b>Pre-mitigation</b>		<b>Mitigation Applied</b>	
C/D	Risk of accidents involving workers	Medium	Inclusion of specific mitigation measures recommended by the IFC EHS Guidelines as well as the requirements for preparation and implementation of an OHS plan, training of staff and provision of health and safety specialist on the contractors team should ensure that whilst hazards may remain low significance of residual OHS impacts will remain during the construction phase. In addition, the contractors will be responsible for following all of the relevant national health and safety standards.	Low
C / D	Exposure to hazardous substances	Medium	Application of GIIP measures for the workforce should ensure that any residual impacts are of low significance.	Low
C/D	Inadequate sanitation and welfare	Medium	Provision of adequate sanitation and worker welfare conditions should ensure that any residual impact significance is low.	Low
O&M	Risk of workplace accidents	Medium	Mitigation measures proposed should help manage risks. However, accidents cannot be completely ruled out during the lifecycle of the SPP.	Low
O&M	Inadequate sanitation and welfare	Medium	Provision of adequate sanitation and worker welfare conditions should ensure that	Low

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
			any residual impact significance is low.	
C	Workers' rights ignored.	Medium	Impacts anticipated to be of low significance after application of mitigation measures.	Low
C/D O&M	SEAH of workers	Medium	Potential for SEAH still exists due to the presence of potentially more than 3,000 workers on site a large percentage of which will be male.	Low
C/D O&M	Use of child or forced labor, employment of under 18s on the project	High	Contract provisions should help ensure there is no forced/child labour but given more than 3,000 workers this will need to be carefully managed.	Medium
C/D O&M	Use of foreign/migrant workers, or unskilled members of local community	High	Contract provisions should help ensure workers are adequately trained but given more than 3,000 workers this will need to be carefully managed.	Medium

### 7.6.3 Construction Camps, Hot Mix Plant, Batching Plant and Other Temporary Facilities

#### Potential Impacts

713. Design and Siting – Improper siting and design of construction camps and other temporary facilities can have negative impacts to adjacent receptors from presence of workers and water quality through poor management and inappropriate disposal of liquid waste and spills of hazardous liquids. Rock crushing plants and concrete batching plants can also have impacts on sensitive receptors located downwind of the sites if the plants are too close to the residential areas.

714. Construction Camps – Construction camps including offices and labor camps. They constitute a temporary land use change and raise issues related to activities such as impacts to air quality for diesel generators; poor sanitation arrangement and improper methods used for disposal of solid wastes and effluent; and transmission of communicable diseases to the local people by the construction workers due to inappropriate health monitoring facilities. As many as nine construction camps maybe required across the SPP

715. Concrete Batching Plants – Batching plants can create high levels of dust. Potential pollutants in batching plant wastewater include cement, sand, aggregates and petroleum products. The main sources of wastewater at batching plants are contaminated storm water runoff, dust control sprinklers, the agitator washout station, the agitator charging station, the slumping station, and cleaning and washing areas. These substances can adversely affect the environment by:

- Increasing water pH.
- Increasing the turbidity of waterways (turbidity is a measure of the cloudiness of a suspension).

716. Hot Mix Plants – Asphalt will be needed for access roads potentially requiring hot mix plant. However, it is assumed that the contractor will procure asphalt for all roads (due to the low volumes required).

717. Temporary Storage Sites – These areas will be used to store materials and equipment on a temporary basis during construction works. Materials may also need to be stored close to work sites to allow quick and easy access to these materials, e.g. stockpiles of aggregates, pre-cast culverts, etc.

## **Mitigation and Management Measures**

### **Pre-construction Phase**

718. As part of the C-SEMP, the contractors shall prepare and implement the following plans:

- **Construction Camp Management Plan** - The plan shall cover such aspects as community relations, restriction of access to camp and facilities, induction briefing on camp rules and local issues/sensitivities, camp rules (such as restrictions on alcohol, drugs use; discipline; noisy activities; community liaison; no poaching; environmental protection measures applicable to the camp site; decommissioning and re-cultivation, etc.); workers welfare. The plan shall also describe power supply methods. The plan will also include the layout of the site, including location of temporary storage areas for waste, equipment maintenance areas, lubricant and fuel storage sites with indication of the distance from watercourses, description of sewage management and waste management activities. The plan shall also provide a specific section describing the energy supply sources on site, e.g., mobile generators, connection to the grid, transformer requirements, etc. Consultations with local communities for their views as part of preparing the plan and before the construction camp is developed are required.
- **Concrete Batching Plant Management Plan** – Describing the layout and management of concrete batching plant, including wastewater discharge, dust management, etc.
- Plans for hot mix, storage sites as required.

### **Construction Phase**

719. Camp Sites - The Contractor will ensure the following conditions are met regarding camp sites:

- Rainwater run-off arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system will be fitted with oil and grease interceptors.
- There will be no direct discharge of sanitary or wash water to surface water.
- The contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites.
- The contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas.
- The contractor will provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site.
- The PMC will undertake regular monitoring of the construction camps to ensure compliance with the C-SEMP and the Construction Camp Site Plan.

- The contractor will ensure that potable water for construction camps and workers meets the necessary water quality standards of the GoI. At least 2 liters of water per person per day.
- Indoor work areas to be designed to be well ventilated and lit in accordance with IFC EHS Guidelines on OHS.
- Camps will include adequate sanitation and welfare facilities for all construction and O&M workers to be posted at or visiting the SPP including indoor kitchen with provision for non-wood based cooking facilities, eating, and segregated sleeping facilities per ILO Worker Accommodation guidelines with an adequate number of indoor toilets/washrooms with a hot and cold running water supply which are connected to septic tank with soakaway. However, If more than 25 persons are accommodated package sewage treatment plant will be provided instead. Septic tank or STP effluent is to comply with GoI effluent standards. Minimum of one toilet, one wash basin and one bathing facility provided for every six persons.
- Ensure the ILO worker accommodation guidelines are incorporated in the design, see Annex G.
- Sufficient number of indoor toilets for men and women shall be provided in all admin and accommodation buildings; it should not be necessary to go outside to use the toilet.
- All worker accommodation to have access to a dining area with AC or adequate ventilation. In the common (administrative) area dining area shall have the arrangement to seat 25 people at one time. For each dining area adequate space will be provided for stores, preparation, cooking by service provider or staff, serving and washing facilities.
- Toilets will be kept sufficiently away from cooking areas.
- Air cooled split type air conditioners shall be provided for all indoor buildings.
- Adequate ventilation will be provided with exhaust fans given in the toilets and cooking areas.
- Rainwater harvesting facilities will be provided for all building roofs.
- Buildings will be designed to be "green" with energy efficiency and water resource saving features incorporated.
- Construction camps will need to be generally reinstated, however the potential for long term community development facilities will be explored at these locations.

720. Concrete Batching Plants – The following measures will be followed to limit the potential for pollution from batching plants:

- To limit impacts from dust, the following conditions will apply:
  - Batching plants will be located not within 500m of any residential area.
  - The entire batching area traversed by vehicles – including driveways leading into and out of the area – will be paved with a hard, impervious material.
  - Sand and aggregates will be delivered in a dampened state, using covered trucks. If the materials have dried out during transit, they will be re-wetted before being dumped into the storage bunker.
  - Sand and aggregates will be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one meter above the height of the maximum quantity of raw material kept on site and extend two meters beyond the front of the stockpile.
  - The hopper or bunker will be fitted with water sprays, which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition.
  - Overhead storage bins will be totally enclosed. The swivel chute area and transfer point from the conveyor will also be enclosed.

- Rubber curtain seals may be needed to protect the opening of the overhead bin from winds.
- Conveyor belts which are exposed to the wind and used for raw material transfer will be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas will be fully enclosed.
- Conveyor belts will be fitted with belt cleaners on the return side of the belt.
- Weigh hoppers at front-end loader plants will be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front-end loader should be damp, as they are taken from a dampened stockpile.
- Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work will be dust-tight.
- Silos will be equipped with a high-level sensor alarm and an automatic delivery shut-down switch to prevent overfilling.
- Cement dust emissions from the silo during filling operations must be minimized. The minimum acceptable performance is obtained using a fabric filter dust collector.
- Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere.
- An inspection of all dust control components will be performed routinely – for example, at least weekly.
- All contaminated storm water and process wastewater will be collected and retained on site.
- All sources of wastewater will be paved and bunded. The specific areas that will be paved and bunded include the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues.
- Contaminated storm water and process wastewater will be captured and recycled by a system with the following specifications:
  - The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain.
  - Water captured by the bunds will be diverted to a collection pit and then pumped to a storage tank for recycling.
  - An outlet (overflow drain) in the bund, one meter upstream of the collection pit, will divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours).
  - Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments.
  - Wastewater will be pumped from the collection pit to a recycling tank. The pit will have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails.
  - Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity. This will restore the system's storage capacity, ready to deal with wastewater generated by the next rainfall event. Uses for recycling tank water include concrete batching, spraying over stockpiles for dust control and washing out agitators.

## Residual Impacts

**Table 85: Construction Facilities Residual Impacts**

Phase	Potential Impact	Impact Significance	Residual Impacts	Impact Significance
	Pre-mitigation		Mitigation Applied	
C/D	Disruption and disturbance from operation of construction camps	Medium	If the mitigation measures suggested are implemented, specifically those relating to siting of facilities, residual impacts will be of low significance	Low
C	Disruption and disturbance from operation of concrete batching including dust and noise	Medium		Low
C	Disruption and disturbance from operation of hot mix plant including air pollution	Medium		Low
C/D	Disruption and disturbance from operation of temporary storage sites	Low		Low

### 7.7 Cumulative and Induced Impacts from Other Projects

721. Key cumulative impacts identified in this IEE and related to other projects (as opposed to cumulative impacts from the SPP and associated facilities which are addressed above) are all associated with the on-going highway construction works on NH-29. Cumulative impacts will include potential for increased noise and dust around the portions of the external access roads connecting to NH-29 and the increased risk of accidents involving members of the community due to the large amount of construction vehicle movements to and from the SPP during the peak periods of construction. In these areas it is important that contractors responsible for external road works in these areas pay extra attention to these issues. Specifically, more regular watering of access roads in this area is recommended, along with close supervision of vehicle movements ensuring they respect speed limits.

722. Key induced impacts are all related to future expansion of the solar PV plant which will be facilitated by the presence of the PSS and ability to evacuate power through the associated facilities. Impacts of any expansion would be similar to the impacts predicted in this IEE, however, cumulatively the significance of impacts on habitat loss and fragmentation, and would be of greater significance than with the 750 MWac SPP alone. Impacts of any future expansion can be managed by ADPCL following the same measures as set out in the EMP including retaining any areas that are primarily natural habitat. Any future expansion would need to be in accordance with national laws and regulations. The expansion would be done independently of the project but is facilitated by it since the SPP TL would provide the means for power evacuation and space for a bay extension shall be left at the PSS.

723. There may be some induced economic development because of the solar power plant e.g., small businesses could be set up and rental income could be generated by leasing or renting house to staff working for the solar power plant. In turn this may encourage the development of new properties etc. Any such induced development will need to be in accordance with the national laws and regulations. It should also be noted that any such future development is entirely independent of the solar power plant.



## **7.8 Transboundary Impacts**

724. The SPP and SPP TL will not result in any significant transboundary impacts except in relation to climate change as discussed above.

## VIII. STAKEHOLDER ENGAGEMENT, INFORMATION DISCLOSURE AND GRIEVANCE MECHANISM

### 8.1 Public Consultation Requirements and Objectives

725. According to the ADB SPS, 2009:

*“The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:*

- *Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;*
- *Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;*
- *Is undertaken in an atmosphere free of intimidation or coercion;*
- *Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and*
- *Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.*

*Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report.”*

726. The following are the main objectives of the consultations, noting in particular that the site is in a tribal area and triggers ADB’s SPS 2009 IP safeguards:

- To share the activity scope information and benefits with the people and to ascertain consensus of tribal and indigenous people on the acceptability of the activity
- To seek their support for design and implementation to avoid any potential negative impact
- To seek their consent for the activity to avoid any potential negative impact
- Make people aware about the activity and its potential adverse impacts including temporary and permanent environmental, social, health and safety impacts with proposed mitigation and compensation measures.
- Develop thorough coordination between all stakeholders for the successful implementation of activity
- To make the people aware about the next plan of action relating to activity implementation.
- Make them aware about the implementation schedule, mitigation measures, grievance redress mechanism etc. affected persons and communities’ consultations requirements and plans and seeking their views on continued participation.

## 8.2 Stakeholder Engagement Activities

727. To date a range of different consultation sessions with 735 people (356 male, 380 female) have been undertaken for environmental and social safeguards during 2023 and 2024. Of these 151 consultees were contacted in relation to the IEE (76 male, 75 female) whilst the rest were consulted for social safeguards which also included cross-cutting themes such as discussions on access and water supply. The following sections summarize the findings from the environment safeguard consultations completed to date.

## 8.3 Government Department Consultations

728. The following provides a summary of the consultations completed in 2023 by the national GreenCIndia IEE team on behalf of APDCL.

729. **CCF, Department of Forest (19/07/2023).** Mr. Bikram Rongpei, Chief Conservator of Forests (CCF) at the Forest Department, mentioned that the forested region primarily consists of deciduous trees like Teak and Sal. In the SPP area, vegetation predominantly consists of herbs and shrubs, with limited dense vegetation. Letter also received confirming that the SPP and SPP TL does not fall within forest land, or any protected area, including ESZ of Assam, and that no species belonging to Schedule 1 of the Wildlife Protection Act, 1972 are reported from the SPP site (see Annex K).

730. **Executive Engineer, Department of Irrigation (19/07/2023).** Gautam Ranghang, the Executive Engineer of the Irrigation Department, explained that the primary sources of irrigation are small streams, with the Dhansiri River being a significant water source. The government supported Yamuna River Scheme plays a crucial role in the local irrigation system. During the monsoon season, the groundwater level remains at approximately 150 to 200 feet, but in the summer, it drops below 90 feet. The absence of a well structured drainage system leads to flash floods during the monsoon season.

731. **DPO, Department of Disaster Management (19/07/2023).** Smita Shetty, the District Project Officer (DPO) at the Department of Disaster Management, highlighted the presence of natural disasters such as river basin flooding caused by storms, primarily occurring during the months of February and March. Additionally, there are anthropogenic disasters like fires. Currently, there are no multipurpose shelters available, and schools and community halls are used as alternatives in such situations.

732. **Joint Director, Department of Health & Family Welfare (19/07/2023).** Dr. B S Rongpei, the Joint Director of Health & Family Welfare, noted that this area is susceptible to both communicable diseases such as dengue and non-communicable diseases including diarrhea, diabetes, and hypertension. They conduct virtual programs to combat diseases like dengue, malaria, and chikungunya, as well as immunization campaigns. While there is a community hospital, government health workers like ASHA and GOI frontline workers are essential for regular initiatives like vaccination. However, he expressed concerns about the poor state of infrastructure, which could worsen during emergency situations.

733. **Assistant Engineer, Department of Water Resources (19/07/2023).** Rimli Kramsapi, Assistant Engineer at the Department of Water Resources, provided an overview of the prevailing water situation. The community primarily relies on stream water for their daily needs, despite the presence of deep tube wells. Groundwater is not their primary source of water.

734. **Assistant Inspector, Department of Agriculture (20/07/2023).** Assistant Inspector Mr. Gopal Thaosen reported that the region comprises 175,521 hectares of non - irrigated agricultural land and 121,530 hectares of uncultivated land. The majority of the population is engaged in primary agricultural activities, with an average landholding of 15 - 16 bigha per family. Cultivated crops include paddy, pineapple, and ginger. Shifts in agricultural practices have seen a reduction in *jhum* cultivation and sugarcane farming, with an increase in rubber and betel nut plantation. There is also a focus on commercial crops. Livestock such as pigs, cows, donkeys, ducks, etc., are commonly raised. According to him, the introduction of the SPP is expected to improve the socio - economic conditions in the area by creating secondary and tertiary job opportunities.

735. **Chief Executive Member, Karbi Anglong Autonomous Council (20/09/2023)** Mr. Tuliram Ronghang, CEM, KAAC, expressed his enthusiasm about the proposed SPP and expressed his full support.

736. Additional consultations with government officials were undertaken by the ADB TA IEE Team during 2024 as follows:

737. **Karbi Anglong Autonomous Council Head Office, Diphu: Chief Executive Member, Chairman, Ministers, Chairman PWD Board, and other members (15/12/2023)** The Council noted supported for the project but the following issues are to be attended to:

- Concern about solar radiation from project and harmful effect as per myth they have heard (community awareness in villages to be conducted)
- Council provide representation to the minorities who constitute a considerable proportion of the total population of the sub-division.
- Non-Cadastral lands inside park area. Farming is done by migratory farmers who are tenants. No compensation provision present.
- In ADC area, Gaon Bura (village head) can allot lands to tenants for cultivation after taking permission from ADC
- Cultural sites inside the project area are to be avoided

738. **Mr Vikram Gupta, Principal Chief Conservator of Forests, Wildlife and Chief Wildlife Warden, ADC and Vikram Singh Rongli, DFO Karbi Anglong, Environment and Forest Department of Assam (15/12/2023).**

- Forest maps are not digitized, only dated paper maps are available from DFO and can be shared with project team (data received from Environment and Forest Department used to inform the IEE)
- Lahorijan proposed reserved forest (PRF) is within Karbi Anglong
- Elephant corridor is about 2 to 3 km from SPP site and elephants seen during paddy harvesting time.
- No tiger reported from the study area.
- Bengal Slow Loris, Chinese Pangolin, Western Hillock Gibbon, Blond Bellied Langur are found in Karbi Anglong.

- Assam Frog (*Polypedates assamensis*) endemic to Assam is not available in Karbi Anglong
  - No impact is anticipated on wildlife and forest during SPP implementation
  - No objections from Forest Office regarding installation of power lines in the area
  - No reports of electrocution/collision of wildlife reported from the area
  - No human/wildlife conflicts reported in the area
739. **Vikram Singh Rongli, DFO Karbi Anglong, Environment and Forest Department of Assam (14/02/2024).** DFO noted that:
- No records of any IUCN CR, EN, VU species in the area.
  - Forest maps are not digitized, only dated paper maps are available from DFO and can be shared with IEE team.
740. **RP Singh, PCCF and Head of Forest, for Forests and Sameer Baidya, Deputy CCF, for Forests, Environment and Forest Department, Aranya Bhawan, Panjabari, Guwahati (23/04/2024)**
- GIS maps of forest areas are available through proper channel by application to Forest Department by APDCL.
  - Wildlife details can be provided by PCCF Wildlife Office
  - For all components in WLS and ESZ permission is required.
741. **Sandeep Kumar, PCCF and Chief Wildlife Warden, for Wildlife and DD Gogoi CCF for Wildlife, Environment and Forest Department, Aranya Bhawan, Panjabari, Guwahati (23/04/2024)**
- Rangapar WLS in Nagaland - intimation to be provided through official channel
  - Species – Bengal Florican – no sighting; Elephants - present; Bos Gauras - in Karbi Anglong; Hoolock Gibbon – in Marat Longri WLS; Capped Langur - present; Chinese Pangolin - present; Assam Roofed Turtle - not present; Leopard and Small Cats - present; Bengal Slow Loris - not present; Karbi Anglong forests are important for dispersal of tigers.
742. **Dr. Deepi Rekha Kouli, Director, Directorate of Archaeology, Assam, Ambari, Guwahati (24.04.2024)**
- For state protected monuments - same as ASI regulations - 100m restricted and 200m regulated zone from structure boundary
  - Directorate of Archaeology, Assam also takes care of unprotected sites (unregulated monuments)
  - Chance find – potential to find present. If chance find – intimation to Chief Executive Member of concerned Autonomous Council is to be done and Directorate of Archaeology, Assam. If discovered preserve the find, provide fencing from APDCL fund.

743. **Karbi Anglong East, Division Forest Officer (13/05/2024).** DFO noted, in writing, (see Annex K) that he was unaware of any of the following species being present in the SPP boundary, or within a 5km buffer: Bengal florican, Tiger, Hoolock Gibbon, Capped Langur, Gaur, Assam Roofed Turtle, White-winged duck, White-rumped vulture, Slender-billed vulture. He did however note that Asian Elephant are occasionally present within the 5km buffer zone of the SPP during harvesting times. This information was also confirmed in writing by the Office of the Range Forest Officer, Karbi Anglong East Division, in writing on 10<sup>th</sup> May 2024 (see Annex K). DFO also confirmed 27 elephant deaths in the district as a result of man-elephant conflict since 2019. Only one elephant was electrocuted, close to Diphu in the last ten years (2016).
744. **Karbi Anglong West, Division Forest Officer (08/05/2024).** A letter was sent to DFO requesting information relating to the site (see Annex K). No response has been provided to date.
745. **The Principal Chief Conservator of Forest & Head of Forest Force, Department of Environment, Forests & Climate Change, Government of Nagaland.** A letter was sent to requesting no objection for the siting of the SPP within the 10km ESZ of Rangapahar WLS (see Annex K). No response has been provided to date of this IEE being disclosed. However, a consultation was subsequently held with the PCCF as below.
746. **Department of Environment, Forest and Climate Change of Nagaland, Kohima (VC mode) Dharmendra Prakash, PCCF and Head of Forest, Nagaland Ved Pal Singh Additional PCCF (Territorial) and Chief Wildlife Warden, Nagaland (10.06.2024).** Following comments were made:
- No issues or objections will be there from Nagaland if projects in ESZ of the Rangapara WLS
  - Larger issue is the Disputed Area Belt (DAB). Assam and Nagaland share a 512-km long border. The disputed area belt (DAB), which includes reserve forests, lies in Assam's Golaghat and Jorhat districts and Nagaland's Wokha and Mokokchung districts. For years, the Central Reserve Police Force has remained deployed to the DAB as a neutral force. The Supreme Court earlier constituted some commissions, including one that was set up in 1971 and headed by the then Law Commission chairman KVK Sundaram, to resolve the dispute but the efforts yielded no positive results. Each state claim ownership of the DAB. If SPP components fall inside the DAB then Nagaland will object as case is sub-judice in Supreme Court of India.
747. APDCL have confirmed that the site is not in the DAB, as confirmed with their discussions with the Revenue Secretary.

## 8.4 Local Community Consultations

748. Consultations were carried out by national consultants (GreenCIndia) during 2023. Additional ad-hoc consultations were completed by the ADB TA IEE Consultant during December 2023 (in presence of ADB) and February 2024. Consultations were also carried out by the social team with villagers at seven locations (some in presence of ADB) during January-February 2024. Follow up consultations on elephants, access and PCR were completed during June 2024.
749. A total of 878 participants attended the consultations of which 453 were males and 426 were females. Locations and number of participants are described in **Table 86** and the issues raised during the consultations are described in Table 87. A list of participants and signatures are provided in Annex F.

**Table 86: Locations and Participants in General Consultations**

#	Type	Location	District	Date	Male	Female	Total
1	IEE	Longhup Timung	Karbi Anglong	21.07.2023	12	23	35
2	IEE	Longkathar	Karbi Anglong	21.07.2023	7	19	26
3	IEE	Barli Bosti	Karbi Anglong	21.07.2023	18	9	27
4	IEE	Long Kathar	Karbi Anglong	22.01.2024	34	19	53
5	IEE	Karagan, Longhup Timing	Karbi Anglong	14.12.2023	55	22	77
6	IEE	Main Tisso Longkathar	Karbi Anglong	14.12.2023	11	12	23
7	IEE	Kandbura Rongphar	Karbi Anglong	12.02.2024	4	4	8
8	IEE	Chan Teron	Karbi Anglong	12.02.2024	1	0	1
9	IEE	Bini Hanse (transmission line)	Karbi Anglong	13.02.2024	0	1	1
10	IEE	Barli Bosti	Karbi Anglong	10.06.2024	3	2	5
11	IEE	Keda Phen	Karbi Anglong	10.06.2024	3	1	4
12	IEE	Sarumanti	Karbi Anglong	10.06.2024	2	0	2
13	IEE	Main Tisso Longkathar	Karbi Anglong	11.06.2024	6	1	7
14	IEE	Lalmati	Karbi Anglong	11.06.2024	6	0	6
15	IEE	Nihangtarang	Karbi Anglong	11.06.2024	6	3	9
16	IEE	Rengma Phen	Karbi Anglong	11.06.2024	2	1	3
17	IEE	Amrironmpi	Karbi Anglong	11.06.2024	1	2	3
18	IEE	Khatkhati	Karbi Anglong	12.06.2024	2	2	4
19	General Social	Karagaon	Karbi Anglong	25.01.2024	28	19	47
20	General Social	Khat Khati	Karbi Anglong	25.01.2024	79	15	94
21	General Social	Nahorjan	Karbi Anglong	27.01.2024	24	15	39
22	General Social	Lalmati	Karbi Anglong	27.01.2024	25	27	52
23	General Social	Borlingrijan	Karbi Anglong	29.01.2024	8	16	24
24	General Social	Lahorijan	Karbi Anglong	30.01.2024	9	21	30
25	Agricultural Tenants	Longkup Tokbi, (A)Karagaon	Karbi Anglong	08.01.2024	3	3	6
26	Agricultural Tenants	Longkup Tokbi, (B)Karagaon	Karbi Anglong	08.01.2024	9	4	13
27	Agricultural Tenants	Longkup Tokbi, (C)Karagaon	Karbi Anglong	09.01.2024	13	6	18
28	Agricultural Tenants	Longkathar	Karbi Anglong	14.01.2024	8	6	14

#	Type	Location	District	Date	Male	Female	Total
29	Shopkeepers	Long Kathar market	Karbi Anglong	03.02.2024	15	0	15
30	Shopkeepers	Vivekananda kendra, Suromanathi, Khat Khati	Karbi Anglong	06.02.2024	5	8	13
31	Shopkeepers	Suromanathi English School LP	Karbi Anglong	06.02.2024	2	2	4
32	Indigenous People	Nahorijan	Karbi Anglong	27.01.2024	10	0	10
33	Indigenous People	Long Kathar	Karbi Anglong	30.01.2024	14	0	14
34	Indigenous People	Karagaon	Karbi Anglong	29.01.2024	13	0	13
35	Indigenous People	Khat Khati	Karbi Anglong	02.02.2024	9	0	9
36	Indigenous People	Lalmati	Karbi Anglong	30.01.2024	6	0	6
37	Women	Long Kathar	Karbi Anglong	30.01.2024	0	21	21
38	Women	Karagaon	Karbi Anglong	29.01.2024	0	17	17
39	Women	Khat Khati	Karbi Anglong	02.02.2024	0	30	30
40	Women	Nahorjan	Karbi Anglong	02.02.2024	0	21	21
41	Women	Lalmati	Karbi Anglong	30.01.2024	0	39	39
42	Women	Borlingrijan (Wophong Taro)	Karbi Anglong	29.01.2024	0	15	15
43	Women	Lahorijan	Karbi Anglong	30.01.2024	0	20	20
Total					453	426	878

**Table 87: Issues Raised and their Response During IEE and General Social Consultations**

Core Issues Raised/Discussed by the Participants	Response by APDCL Officials/IEE Team	IEE Reference / Where Addressed
Employment opportunities for Karbi people including women during execution of the SPP.	APDCL will try to accommodate as much as possible employment to the locals during the execution of the SPP based on their skills. At the same time, demand for permanent employment will not be possible and hence there is no commitment on permanent employment.	IEE estimates that around 20% of the 3,000 strong workforce will be unskilled workers, or approximately 600 people, see Section 7.5.3.
Are there any specific development activities for women. Employment, especially for women is required	APDCL has a women centric development plan which is at a draft stage. Will disclose, once finalized at the highest decision-making level.	A Gender Action Plan has been developed for the Project.
Are there any plan to enhance electricity distribution system in the SPP affected area?	APDCL will undertake to upgrade the capacity of the existing distribution transformers and add new transformers according to the demand of power	No further recommendations made in the IEE, distribution line



Core Issues Raised/Discussed by the Participants	Response by APDCL Officials/IEE Team	IEE Reference / Where Addressed
	supply. Will take steps to use AB cable instead of bare wires in the area. If required, APDCL will set up a new substation to provide better electricity supply in these areas.	component is part of the overall project that also includes SPP component. Separate IEE is available for this.
Experience issues like education, health (malaria and dengue) and infrastructure such as roads, safe drinking water etc. Is there any plan to provide such basic facilities to the affected village.	Under CSR remit, APDCL will take up with KAAC and other concerned departments for the development of roads, school buildings, hospital buildings etc. APDCL along with KAAC will try to provide safe drinking water to the affected villages.	No further recommendations made in the IEE as they are CSR activities beyond the scope of the SPP (with the exception of upgrading of off-site village access roads and replacement water supplies).
There are natural water bodies in the form of streams. Request authorities not to disturb such water bodies during the execution of the works.	APDCL will ensure to take necessary steps to preserve such natural waterbodies during the execution of the works.	Protection of water sources and provision of additional sources if needed is discussed as part of Section 7.3.4.
Locals use open well and there is water scarcity issues in the area especially during summer season	None provided	Protection of water sources and provision of additional sources if needed is discussed as part of Section 7.3.4
How to resolve issues/conflicts during the execution of the SPP?	APDCL will propose a Grievance Redressal Mechanism to resolve any issue, conflict through continuous dialogue in a peaceful manner.	A GRM is provided by Section 8.9.
The drinking water quality in the area is poor, and there is a lack of public facilities. Residents rely on private wells for their water supply.	None provided	Protection of water sources and provision of additional sources if needed is discussed as part of Section 7.3.4.
Access to medical services is challenging due to the distance to primary health centers, exacerbated by poor road conditions, especially during emergencies. Improvement of the roads is required. No good medical facilities found in and around site.	None provided	No further recommendations made in the IEE as they are beyond the scope of the SPP (with the exception of upgrading of off-site village access roads and replacement water supplies). However, CSR in respect of allowing access to SPP medical facilities is an option for APDCL.
Proximity to schools is limited, with not every village having primary schools or Anganwadi centers. Residents must travel 1-2 kilometers to reach schools, and the road conditions are subpar.	None provided	No further recommendations made in the IEE as they are beyond the scope of the SPP (with the exception of upgrading of off-site village access

Core Issues Raised/Discussed by the Participants	Response by APDCL Officials/IEE Team	IEE Reference / Where Addressed
Better schools are required.		roads and replacement water supplies).
The road conditions in the area are generally inadequate, and they deteriorate further during the monsoon season.	None provided	No further recommendations made in the IEE as they are beyond the scope of the SPP (with the exception of upgrading of off-site village access roads and replacement water supplies).
Local communities in Longhup Timung, Longkathar, and Barli Bosti support the activity, expecting significant economic and infrastructural development in the region.	None provided	None required
Anticipate the growth of supporting industries and increased job opportunities.	None provided	None required
Local residents gather forest products for household needs but are not economically reliant on these resources.	None provided	Loss of access to resources is primarily dealt with in the RIPP with livelihood restoration support if required
Agriculture is an important economic activity within the SPP site.	None provided	Section 7.5.2 summarizes the requirements of the RIPP and the measures for compensation for the loss of livelihoods, crops, etc.
The SPP does not currently provide benefits related to potable water for the villagers.	None provided	Protection of water sources and provision of additional sources if needed is discussed as part of Section 7.3.4.
It was reported that single (stray) to group of elephants was observed to have moved along SPP site as seen by locals. Crop damage by elephants raised during harvest season. Damage to property was reported and cause of concern for some houses/shops near the Khatkhati highway near the SPP boundary. One local family (Khatkhati area) reported elephant attack, on house/shop (1.5km from Block 6 boundary) twice	None provided	Damage to solar power plant by elephants has been considered in the IEE

Core Issues Raised/Discussed by the Participants	Response by APDCL Officials/IEE Team	IEE Reference / Where Addressed
<p>during 2022-2023. The route of movement is typically along the western boundary of the SPP site, although one reported from south-east side also.</p>		
<p>Many of locals not aware of the SPP and that the churches will be relocated</p> <p>Khedaphen Gaon Baptist Fellowship Church and the Immanuel Prayer Home, Barli Bosti – an all-religion prayer house with accommodation facility for guest is planned for relocation</p> <p>Locals are not aware that the Jericho Baptist Church planned to be relocated. The church is of high importance to the locals. Since locals use the church, its removal will be an issue. The church is although used infrequently as local population is very low. The compensation can be paid to the church committee, and they will reconstruct the church. APDCL to identify and procure alternate location.</p> <p>Some trees under which prayer/rituals are performed are inside the SPP and it will be difficult if they are not allowed to perform in those sites as they are using them since generations.</p>	None provided	Impacts on physical cultural resources are discussed as part of Section 7.5.4.
<p>Access roads/village tracts/footpaths are important routes for locals and they use them to either enter the SPP site (for farming, collection of woods, fodder, grazing of cattle, plant/flower/banana leaves collection for religious rituals (Shikari Puja (prayer to forest/nature), meeting relatives/friends who are presently residing inside the SPP area (to be relocated) or moving across the site to the other side where they reside</p>	None provided	Loss of access to resources is primarily dealt with in the RIPP with livelihood restoration support if required, but the retention of three routes in addition to the two already planned by ADPCL is recommended by the IEE.

Core Issues Raised/Discussed by the Participants	Response by APDCL Officials/IEE Team	IEE Reference / Where Addressed
<p>using access road as a short cut.</p> <p>Some access road in Main Tisso Longkathar is important as they use it for moving across to the other side of the SPP and even for students to go to school. APDCL has planned to keep/develop the main access/road near this short cut, but locals feel this shortcut is equally important as they have been using this for a long time and easier for them.</p> <p>There are other shortcuts through the SPP area which the locals use as alternate to the main roads (to be retained), which will get blocked. Farming products/crops moving to markets are also through these short cuts and hence will get impacted.</p> <p>Locals are concerned that access will be blocked as some routes will be lost due to solar plant and prevent them of collecting products (leaves/wood, etc.) they do from the SPP site.</p> <p>Moving from one side of the SPP site to the other will be difficult if access blocked and they will have to take longer, alternate route - more time consuming</p> <p>Locals are not aware the routes will be lost. Locals requested alternates for access routes to be lost.</p>		

750. Consultations were also carried out by the Social Team at four locations in the SPP affected area during January 2024 with Agricultural Tenants involved in agricultural activities based on periodic lease from the tribal people. A total 51 people (family members of agricultural tenants) attended the consultations out of which 32 were males and 19 were females. Locations and number of participants are described in Table 88 and summary findings of the consultations are described in Table 89. List of participants are provided in Annex F.

**Table 88: Agricultural Tenant Consultation**

#	Location	District	Date	Male	Female	Total
1	Longkup Tokbi, Karagaon	Karbi Anglong	08.01.2024	3	3	6
2.	Longkup Tokbi, Karagaon	Karbi Anglong	08.01.2024	9	4	13
3	Longkup Tokbi, Karagaon	Karbi Anglong	09.01.2024	13	6	18
4	Longkathar	Karbi Anglong	14.01.2024	8	6	14
Total				32	19	51

**Table 89: Summary Findings of Public Consultations – Agricultural Tenants**

Core Issues Raised/Discussed by the Participants	IEE Reference / Where Addressed
Lose livelihoods, not comfortable at present after learning about the proposed activity. Have come more than 200 km away from their village in search of livelihood. Have worked hard to develop the soil for cultivation and now earning decent income to support their family here and parents and kids at original villages.	Section 7.5.2 summarizes the requirements of the RIPP and the measures for compensation for the loss of livelihoods, crops, etc.
Have constructed temporary houses. Few have borewell for irrigation. Compensations for the assets and borewell should be provided to them as citizens of Assam.	Section 7.5.2 summarizes the requirements of the RIPP and the measures for compensation for the loss of livelihoods, crops, etc. Protection of water sources and provision of additional sources if needed is discussed as part of Section 7.3.4.

751. Consultations were carried out at three locations in the market areas and institutions outside of the SPP boundary during February 2024 with shopkeepers and institutions. A total 32 people (shopkeepers and members of two institutions) attended the consultations out of which 22 were male and 10 were female. Locations and number of participants are described in 89 and summary findings of the consultations with shopkeepers and are described in Table 91. A list of participants are provided in Annex F.

**Table 90: Location and Number of Participants in Consultations with Shopkeepers and Institutions**

#	Location	District	Date	Male	Female	Total
1	Long Kathar market	Karbi Anglong	03.02.2024	15	0	15
2.	Vivekananda kendra, Suromanathi, Khat Khati	Karbi Anglong	06.02.2024	5	8	13
3	Suromanathi English LP School	Karbi Anglong	06.02.2024	2	2	4
Total				22	10	32

**Table 91 : Summary Findings of Public Consultations – Shopkeepers and Institutions**

Core Issues Raised/Discussed by the Participants	IEE Reference / Where Addressed
Support the SPP, as it will bring good to the area.	None required

Core Issues Raised/Discussed by the Participants	IEE Reference / Where Addressed
Expect more income if SPP is executed as, it will create more business opportunities and can add more shops like restaurants, big grocery shops etc.	IEE notes that many jobs will be generated and there will be benefits to the local economy, see Section 7.5.3.
There will be negative impact in terms of movement of heavy trucks, vehicles, traffic and road safety etc.	Issues relating to traffic and road safety are discussed in Section 7.6.1, with specific requirements for traffic management plans and community health and safety plans.
The road condition is very bad. APDCL should ensure a good road for heavy vehicles. APDCL should plan for proper road safety mechanism to avoid any accidents in the market area.	Some off-site village roads will be rehabilitated as part of the SPP. Other road rehabilitation works are beyond the scope of the SPP. Issues relating to traffic and road safety are discussed in Section 7.6.1, with specific requirements for traffic management plans and community health and safety plans.
Lots of positive impacts will be there. Road will be developed. Business opportunities for existing shopkeepers will be enhanced as well as it can create new business opportunities for others. Employment opportunities for local people.	None required.
<ul style="list-style-type: none"> <li>• Proper road should be developed for the movement of heavy vehicles before the start of works.</li> <li>• Proper road safety measures should be taken to avoid any accidents</li> <li>• There should be a committee to resolve any issues arising during the project implementation.</li> <li>• Issues should be resolved peacefully.</li> <li>• Employment should be provided to local people.</li> </ul>	<ul style="list-style-type: none"> <li>• Some off-site village roads will be rehabilitated as part of the SPP.</li> <li>• Issues relating to traffic and road safety are discussed in Section 7.6.1, with specific requirements for traffic management plans and community health and safety plans.</li> <li>• A GRM has been prepared to resolve disputes and grievances.</li> <li>• Where possible employment will be provided to locals, specifically unskilled labour positions. No specific commitment to the number of positions is given, but it could be as high as 600.</li> </ul>

## 8.5 Consultations with IPs

752. Consultations were carried out at five locations in the SPP affected area during January and February 2024 with tribal populations. Karbi Anglong District is a Sixth schedule area under the Constitution of India. Consultations with the scheduled tribe people in the SPP area will be continued further during the SPP implementation. A total 52 people (scheduled tribe) attended the consultations. Locations and number of participants are described in Table 92. The summary of the issues raised and their clarification and mitigation is given in Table 93. List of participants are provided in Annex F.

**Table 92: Locations and Participants in Consultations with Indigenous People**

#	Location	District	Date	Male	Female	Total
1	Nahorijan	Karbi Anglong	27.01.2024	10	0	10
2.	Long Kathar	Karbi Anglong	30.01.2024	14	0	14
3	Karagaon	Karbi Anglong	29.01.2024	13	0	13

#	Location	District	Date	Male	Female	Total
4	Khat Khati	Karbi Anglong	02.02.2024	9	0	9
5.	Lalmati	Karbi Anglong	30.01.2024	6	0	6
Total				52	0	52

**Table 93: Summary Findings of Public Consultations – Indigenous Peoples**

Core Issues Raised/Discussed by the Participants	IEE Reference / Where Addressed
<ul style="list-style-type: none"> <li>There should be a proper road for transportation by trucks, traffic management, safety during construction etc.</li> <li>There are primary schools on the roadside, special attention should be made for the safety of school children during school hours to prevent accidents, to reduce noise and air pollutions etc.</li> </ul>	<ul style="list-style-type: none"> <li>Some off-site village roads will be rehabilitated. Other road rehabilitation works are beyond the scope of the SPP. Issues relating to traffic and road safety are discussed in Section 7.6.1, with specific requirements for traffic management plans and community health and safety plans.</li> <li>Measures to mitigate noise and air quality impacts are discussed in Sections 7.3.1 and 7.3.6 respectively.</li> </ul>
Loss of land is the most important threat. If compensation is provided for loss of land, then the local people will support.	Section 7.5.2 summarizes the requirements of the RIPP and the measures for compensation for the loss of livelihoods, crops, etc.
The local people foresee some threats for their women and socio-cultural identity.	A Resettlement and Indigenous Peoples Plan and Gender Action Plan have been prepared for the project.
People were willing to work in the SPP. SPP should give priority to the local people including women.	IEE estimates that around 20% of the 3,000 workforce will be unskilled workers, or approximately 600 people, see Section 7.5.3.
There is no of hunting of animals by local people.	None required.
The local people expect employment opportunity, better electricity supply, scope for small business for locals	<ul style="list-style-type: none"> <li>IEE estimates that around 20% of the 3,000 workforce will be unskilled workers, or approximately 600 people, see Section 7.5.3. Further, economic benefits to local businesses are anticipated per Section 7.5.3.</li> <li>The SPP will contribute to a more stable electricity supply for the region.</li> </ul>
Loss of land permanently for the SPP which will disturb the livelihoods.	Section 7.5.2 summarizes the requirements of the RIPP and the measures for compensation for the loss of livelihoods, crops, etc.
Proper traffic and safety measures to avoid accidents, regular consultations with locals to mitigate issues.	Issues relating to traffic and road safety are discussed in Section 7.6.1, with specific requirements for traffic management plans and community health and safety plans. The IEE also recommends regular consultation with communities to manage issues arising during the construction and operational phases, see Section 7.6.1.
Infrastructure facilities should be developed in the affected villages such as construction of Anganwadi centers, health sub-centers, development of school boundaries etc,	No further recommendations made in the IEE as they are CSR beyond the scope of the SPP (with the exception of upgrading of off-site village access roads and replacement water supplies).

753. Consultation was carried through key informant interviews among the Gaon Bura i.e. traditional village heads who are representative of the local community. Consultations focused on collecting information on the existing socio-cultural systems among the indigenous peoples. SPP benefits were shared with the community leaders including the mitigation measures. Because the area is dominated by the tribal population, consent has been obtained from the tribal leaders as no objection to the SPP and support towards the SPP. Key issues discussed, response received are summarized in Table 94 and the details of signed consent are attached in the RIPP.

**Table 94: Summary Consultation among Tribal Leaders**

<b>Opinion/views and concerns about the planned Activity</b>	
Awareness about the SPP	All the Gaon Bura including Sarkari Gaon Bura are aware of the SPP from the beginning as KAAC has called meetings with them in the council Diphu and they were involved during field visits of APDCL and KAAC officials.
Positive impacts	SPP will create employment opportunities for affected villagers. SPP will boost business opportunities for locals to start their small business during implementation and operation. SPP may create tourism as this will be the largest solar power project in Assam bordering Nagaland. SPP will boost infrastructure. SPP will enhance electricity supply.
Negative impact	Loss of land, loss of livelihood as most of the land losers are involved in farming, plantations etc.

## 8.6 Consultation with Women

754. Women consultation was conducted at nine sites through focused group discussions. The objective of the consultations was to make gender inclusive project planning. Consultation also captured socio-economic status of women. Consultations were carried out along the villages in the SPP area by the ADB TA social safeguards team in January 2024. A total 163 women participated in the group discussions. Summary details on the locations and number of participants are provided in Table 95 and the findings are provided in Table 96. A list of participants along with photographs are provided in Annex F.

**Table 95: Consultation with Women**

#	Location	District	Date	Male	Female	Total
1.	Long Kathar	Karbi Anglong	30.01.2024	0	21	21
2.	Karagaon	Karbi Anglong	29.01.2024	0	17	17
3.	Khat Khati	Karbi Anglong	02.02.2024	0	30	30
4.	Nahorjan	Karbi Anglong	02.02.2024	0	21	21
5.	Lalmati	Karbi Anglong	30.01.2024	0	39	39
6.	Borlingrijan (Wophong Taro)	Karbi Anglong	29.01.2024	0	15	15
7.	Lahorijan	Karbi Anglong	30.01.2024	0	20	20



Total	0	163	163
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**Table 96: Summary of findings of gender consultation**

<b>Core Issues Raised/Discussed by the Participants</b>	<b>IEE Reference / Where Addressed</b>
There is no major concern, or any issues highlighted by any of the women covered under the consultation. Only in Soreng some of the women raised the issue of safety as the work is on electricity and in Lachung the tribal women only voiced their concern about frequent load shedding and tripping which is a major concern during tourist season which need to be stopped.	SPP will be constructed according to national safety standards. Further a range of GIIP measures are provided by Annex A to manage electrical safety issues.
Most of the women feel that the proposed SPP is safe for the women and they do not have major concerns.	None required.
There should not be damage to the environment, minimum cutting of trees to be ensured.	This IEE comprises a detailed EMP (Annex A) to ensure that damage to the environment is mitigated to the extent possible. Cutting of trees across the SPP will however, be inevitable.

## 8.7 Future Consultation Strategy

755. Consultation will be continued throughout the SPP lifecycle especially during implementation with conscious effort to increase the participation of women in benefit sharing. Future consultations will be carried out by the APDCL, concerned contractor and the PMC. For future consultations during the implementation, following processes are envisaged:

- APDCL and PMC will identify appropriate methods for consultation and dissemination platforms for broader reach in close collaboration with concerned contractors.
- APDCL and PMC will develop appropriate communication materials in local language (Assamese and Karbi) considering the fact that affected people includes scheduled tribe or indigenous peoples in close collaboration with concerned contractors.
- For disclosure, the communication materials will include the positive and negative impacts of the SPP, mitigation measures, grievance redress mechanism, construction schedule and executive summary of the safeguard document (IEE)
- Contractors will give advance notice about the consultations or other engagement and will disseminate properly for wider participation of beneficiaries or affected people especially scheduled tribe or indigenous peoples.
- Consultation and engagement process will be utilized to address the complaints, concerns and implementation issues raised by the affected people during the consultation.
- There will be budgetary provision to implement the future consultation and dissemination strategy.

## 8.8 Disclosure

756. APDCL with support from the contractors and PMC, will continue the disclosure process during implementation by providing relevant information in a timely manner, in an accessible place, and in a form and language understandable to affected persons and other stakeholders. The draft IEE will be made available in corporate and site offices of APDCL and at the site office of concerned contractor. The summary IEE In local language (Assamese and Karbi) will also be made available to the project affected people and beneficiaries including the indigenous peoples residing in the SPP areas of Karbi Anglong District through APDCL site offices, website and on request. The draft and final IEE will be disclosed on the websites of ADB and APDCL and implemented by APDCL prior to commencement of any construction works in resettlement impacted areas. The monitoring reports on EMP implementation to be prepared by APDCL and submitted to ADB will also be posted on the ADB's website.

## 8.9 Grievance Redress Mechanism

757. A grievance is an issue, concern, problem, or claim (perceived or actual) that an individual or community group wants to see resolved. A Grievance Redress Mechanism (GRM) is a locally based, site-specific extra-legal way to deal with and resolve activity-related grievances/complaints faster than legal mechanisms and thus enhance project performance standards in terms of environmental and social safeguards. APDCL will take relevant concerns of affected persons and other stakeholders seriously and ensure that they are actively able to raise and discuss their concerns throughout the project cycle by setting up a GRM.

758. The GRM will aim to provide affected persons and other stakeholders with a clear and simple way of filing a suggestion or complaint on the environmental, health and safety performance of the SPP. The GRM will also cover social safeguards. According to ADB's SPS 2009, the GRM must address complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs and without retribution. Given these requirements, handling of grievances on the implementation of the SPP will be as discussed in this chapter.

759. APDCL will establish a project component-specific Grievance Redress Mechanism (GRM) to receive and manage any grievances (complaints) that may arise from the SPP works and facilitate prompt resolution of affected persons' issues, concerns, problems, or claims. Affected persons may include members of the local community or construction workers. The GRM will address environmental and social safeguard and other related eligible grievances/complaints raised by affected persons, in a timely and culturally appropriate manner.

760. The GRM will ensure that:

- physically or economically displaced people receive appropriate compensation in accordance with the RIPP;
- the basic rights and interests of every person affected by the environmental and social performance of APDCL and their contractors are protected; and
- issues, concerns, problems, or claims arising from any poor environmental [or social] performance of APDCL and their contractors during the conduct of pre-construction, construction, operation and maintenance activities are promptly and effectively addressed.

761. Recourse to the GRM does not impede access to the country's judicial or administrative remedies. Affected peoples can approach the court of law at any time and independently of the grievance redress process. Affected peoples may (subject to eligibility criteria) also access ADB's Accountability Mechanism<sup>62</sup> whereby people adversely affected by ADB-financed projects can express their grievances, seek solutions, and report alleged violations of ADB's operational policies and procedures, including ADB's Safeguard Policy Statement 2009.
762. The GRM will be set up upon loan effectiveness and be fully operationalized prior to the commencement of any civil works, including enabling works. APDCL, PMC and all contractors will appoint GRM focals. All staff of APDCL PMU and PIU, PMC, and the contractors, as well as local and associated government and other entities directly involved in the GRM process will receive a training prior to the start of works to fully understand their roles and responsibilities within the GRM as well as approaches to constructively resolve activity-related grievances/complaints. Upon any handover APDCL O&M staff will also be trained.
763. Communities around the SPP (up to 500m) will be made aware of this GRM as well as how to access it, including addresses and contact numbers, through (i) community awareness raising during community or one-on-one meetings; (ii) pamphlets distributed to the general public in the direct vicinity of the SPP in Assamese/Karbi and additionally Hindi/English for workers; and (iii) notices on the social media/cable and/or local newspaper, as well as notice boards on work-sites, at APDCL's local offices, and on APDCL website etc. with details of the GRM together with details of the project and where the IEE can be obtained to capture a wider audience. Any concerned person or group of people can file a complaint through the GRM, at any time and at no cost. Pre-construction, APDCL will be responsible to post clearly visible signboards at the project sites with contact details including the name and phone number of their GRM focal person, together with suggestion boxes that will be regularly checked for any grievances received. During construction and O&M, the contractor will be responsible for posting these signboards, including contact details with the names and phone numbers of both APDCL and contractor's GRM focal persons as well as the suggestion box to be regularly checked at the construction site. Any concerned person or group of people can file a complaint through the project's GRM, at any time and at no cost. The time frame for receiving a response will be made known to the grievant. Investigations and deliberations on the grievances will be communicated to the grievant and outcomes publicly disclosed.
764. APDCL has an established Consumer Grievances Redressal Forum (CGRF) where a consumer may approach with grievances related to their power supply in the APDCL supply area. Since it relates to power supply issues it needs to be augmented by the project level GRM, but consumers may also approach it in the first instance for referral to the correct avenue to raise a project level grievance. The CGRF at different levels consists of Level-1, Level-2, District Level CGRF and State Level/Company CGRF. Level-1 is Sub-Divisional level where a consumer may approach any issues which is looked after by the Sub-Divisional Engineer. Level-2 is Divisional level where Assistant General Manager is taking action of the issues of consumers. District Level CGRF is the Circle level forum which is supervised by the Chief Executive Officer of each Circle. State Level/Company CGRF is supervised by the Chief General Manager (CR, Marketing and Safety), APDCL who is the Chairperson of this level. There are 5 members including Chairperson in each District level CGRF where the Chief Executive Officer is the Chairperson on that level and also in State Level CGRF as the consumer dispute

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<sup>62</sup> There are two parts to ADB's Accountability Mechanism, problem solving led by ADB's special project facilitator can assist the complainant in finding solutions to their problems, while compliance review, led by a three-member panel, can investigate alleged violations of ADB's operational policies and procedures, including safeguard policies, and recommend corrective actions to ensure project compliance.

resolution authority where one Member nominated by the Assam Electricity Regulatory Commission (AREC) as an Independent Member. The Chief General Manager (CR, Marketing and Safety), APDCL is present Chairperson of State Level CGRF.

765. Address and Contact details of State Level CGRF is:

Office of the Chairperson  
State Level Consumer Grievances Redressal Forum  
APDCL, Old AERC Building, 1st Floor  
ASEB Campus, Sixmile, Guwahati-781022  
Phone No. +913613154404

766. APDCL, PMC and contractor's focals will actively engage with the affected local communities and construction workers throughout pre-construction, construction and at the onset of operation, providing an opportunity for community members or workers to approach them with any grievance/complaint. Affected peoples may also lodge grievances/complaints online through APDCL's website with dedicated link/message box, by phone/WhatsApp at numbers provided, by submitting a note in a suggestion box kept on site, by sending a letter, or in person at a site office or at the APDCL's closest office. . All staff and workers of APDCL PMU and PIU, PMC, Contractors and subcontractors (if any), will also be made aware of the existence of the GRM and must know who to direct any complainant to, if approached regarding a grievance. Local government representatives/Autonomous Council members will also be briefed by APDCL on the GRM and so be able to take up complaints and pass them onto APDCL or the contractor to be addressed. APDCL management will have overall responsibility for timely grievance redressal on safeguard issues with the support of their GRM focal for ensuring disclosure, registration of grievances, and communication with the grievant.

767. An exhaustive grievance log must be kept at all times on-site by the contractor's focal. Any grievance/complaint received, whether minor or major, whoever it was first addressed to, must be reported to the contractor's focal and documented, including: name of the person making the complaint; date and time the complaint was received; relation of the complainant to the activity; nature of the complaint; details of all meetings held, including participants, date, issues discussed and decisions taken; details of all actions taken towards resolution of the grievance; log of all formal communication sent to the complainant informing of the evolution of the process etc. All entries to the grievance register, no matter how minor or whether resolved at an initial informal level on site or at any of the formal levels of the GRM, along with updates on ongoing or completed actions taken to address the grievance will be included in monthly reports by the contractor to APDCL and detailed in the quarterly project reports and environmental monitoring reports to be submitted by APDCL to ADB. APDCL will also notify ADB immediately of any grievances that enter the third stage (GRC) of the GRM or are related to immediate risk to human life, or impending damage to structures, flora or fauna, or physical cultural resources. Once a resolution has been proposed to the complainant, they will be asked to sign a form acknowledging receipt of that proposal and providing their approval or refusal, as applicable; this form will be added to the grievance/complaint register and once all actions are taken the associated entry will be closed but not deleted.

768. In grievance redress it is important for grievance handlers to be clear on the issues involved and why the grievant is dissatisfied. The first step is an honest appraisal of whether the grievance received is proactive or reactive to a situation, how it is relevant to the proposed project, and if it falls under the national and ADB policy and legal framework as described in Chapter 2. This will enable ineligible grievances to be identified. For those that are eligible the facts must then be established in full through soliciting information

and observations in the field, in communication with the grievant and others to clearly define the problem to be resolved. The grievance handlers need to be able to clearly appraise the grievant of their grievance's relevance to the project, and the applicable national and ADB policy and legal framework, so that both sides have common understanding of the context. Once the problem is clear, options for resolution can then be analyzed, and a time bound grievance resolution action plan agreed with the grievant for implementation by APDCL or their contractor. Once a resolution has been proposed to the complainant, the grievant will be asked to sign a form acknowledging receipt of that proposal and providing their approval or refusal, as applicable; this form will be added to the grievance/complaint register and once all actions are taken the associated entry will be closed but not deleted. Implementation of the actions must then be monitored by the APDCL GRM focal with regular follow-ups. Whilst resolution may be quickly reached, the grievance can only be fully closed out once all actions have been completed and the grievant has confirmed their satisfaction. Implementation of the actions must therefore be undertaken by APDCL as promptly as is possible and ideally within 15 working days of being agreed, though this will depend on the nature of grievances involved. PMC will also monitor the operationalization of the GRM and the effectiveness of the grievance resolution process along with APDCL PMU and both will recommend improvements to increase the efficiency, timeliness and fairness of the process.

769. The GRM will follow a four-tier structure, one informal, and three formal tiers. **Error! Reference source not found.** summarizes the process.

#### **Tier 1: Informal Site-level grievance handling protocol**

- The contractors will define a site-level grievance handling protocol, as initial input to the GRM.
- For any urgent matter, in particular emergency and health and safety issues, the contractor's site-level focal will take note of the grievance/complaint and get immediately in contact with their site supervisor for immediate action. Short-term issues (e.g. dust, noise, leaks, inappropriate behaviour, conflict, etc.) may be corrected immediately under the direction of the focal and supervisor, in collaboration with contractor's Project Manager and respective construction workers.
- If it cannot be rectified by the contractor, then the on-site resident EHS staff will provide the most easily accessible first informal level of contact to address it. If construction workers wish to file a complaint and are not comfortable logging it informally with the contractor, then they can also raise it informally with the resident EHS staff.
- In case of immediate risk to human life (including transport route) or impending damages to structures the resident EHS officer to get in contact with the Environmental and Social Manager (ESM) who shall have the power to halt works until corrective action is taken.
- Whatever the source and the form in which the grievance/complaint is received and its nature, it should be accepted by the focal and registered in the grievance register.<sup>63</sup>
- A log of all active complaints, even if resolved at this informal level of GRM, must be communicated to APDCL GRM focal fortnightly by the contractor's on-site focal.
- Grievances to be redressed within three working days of the grievance first being raised.

#### **Tier 2: First Formal level of GRM**

- If no resolution or understanding on the grievance is informally reached after three working days, or the grievant chooses, they can direct their grievance directly to the formal GRM process, or if an informal grievance is deemed more than minor, the grievance will be

<sup>63</sup> If the complaint is not eligible, the complainant should be informed of the reasons in writing and directed onto other appropriate mechanisms if applicable.

formally registered by the PIU focal and resolved within seven working days of it being filed.

- APDCL PIU Project Manager and GRM focal are in charge of this first level.
- All grievances/complaints will be sorted by the focal for their eligibility, level of urgency and by nature (suggestions or comments, grievances/complaints related to adverse impacts of the activity on an individual or group, violations of law, etc.). The focal will send a formal reply to the complainant within 3 working days of the receipt of the grievance/complaint, to acknowledge receipt, provide the complaint's registration number, and set up a meeting in presence of the contractor's project manager. Through the first formal reply,<sup>64</sup> the complainant will be informed of the process and of his/her possibility to subsequently escalate the complaint in case no resolution were found at this stage; contacts to the second level GRM will be included.
- During the meeting other participants may be called upon, including but not limited to: contractor's ESM, SCLO, Ecologist/Botanist, Health and Safety Specialist (HSS) and Labour Officer, PMC resident EHS supervisor etc. The affected person(s) may come in presence of two representatives of their choice (selected to be gender inclusive), including a representative of their IP group if applicable.
- This first meeting shall take place no later than one week after receipt of the grievance/complaint.<sup>65</sup> During the meeting, the complainant and contractor's site-level focal will agree on the course of action to be taken and timeline to resolution. Details of the meeting will be documented; minutes of meeting will be signed by both complainant and the contractor's site-level focal and annexed to the grievance's file. If both parties do not agree on a resolution, the complaint may be escalated to the second level of GRM. If both parties agree, the contractor (and subcontractors, as applicable) will take remedial action, keeping the complainant informed at each stage or every fortnight, whichever the shortest. Such actions should be taken in the briefest delay, within a maximum timeframe of 30 days. However, all simple complaints, will be resolved within 7 days of the meeting being held. Following resolution, if the complainant is not happy with the resolution or if no action has been taken within the agreed timeframe, they can escalate the grievance to the second level of GRM.
- A log of all active complaints, even if resolved at this first formal level of GRM, must be communicated to APDCL GRM focal fortnightly by the PIU focal.

### **Tier 3: Second Formal level of GRM – PMU Level**

- The second level of the GRM is headed by the PMU headed by the APDCL Project Director.
- If a complaint has not been resolved at the first level of GRM, it is escalated to the second level. If workers wish to file a complaint and are not comfortable logging it with the first level GRM, they can file it directly to this second level of GRM. All complaints will be sorted by eligibility and level of urgency and by nature (suggestions or comments, grievances/complaints related to adverse impacts on an individual or group, violations of law, etc.).
- Just as for the first level, all grievances will be properly recorded, and the concerned person or group will be informed formally of receipt; timeline; and resolution. PMU focal will send within 3 days of receipt a letter to the complainant acknowledging receipt; within 15 days a meeting should be held and resolution action plan and timeline agreed upon with the complainant.
- The meeting should include PMU's project director and SPP project manager, PIU's GRM focal, the complainant who may be accompanied by or represented by two representative (selected to be gender inclusive) including one Autonomous Council/IP representative if

<sup>64</sup> Same template of this first communication is recommended to be followed project wide.

<sup>65</sup> This timeline may only be extended if the affected person/group requests for a later date for the meeting based on availability. If the complainant has difficulty to travel to meeting location upon short notice, the location of the meeting may be flexible.

applicable, PMU's environment, health and safety, and/or social officer, as well as PMC EHS supervisor, other members if applicable, including contractor's representative. In addition, a independent panellist will be included from government or civil society e.g., local rural office representative, community organization representative, forest officer etc. As in the first level, the second level may have two outcomes: if the parties found a resolution and the complainant signed their approval of the resolution, such actions should be taken in the briefest delay, within a maximum timeframe of 30 days. However, all simple complaints, will be resolved within 7 days of the meeting being held. If no resolution has been reached, the grievance is forwarded to the third level of the GRM.

#### **Tier 4: Third Formal level of GRM – PMU Management level**

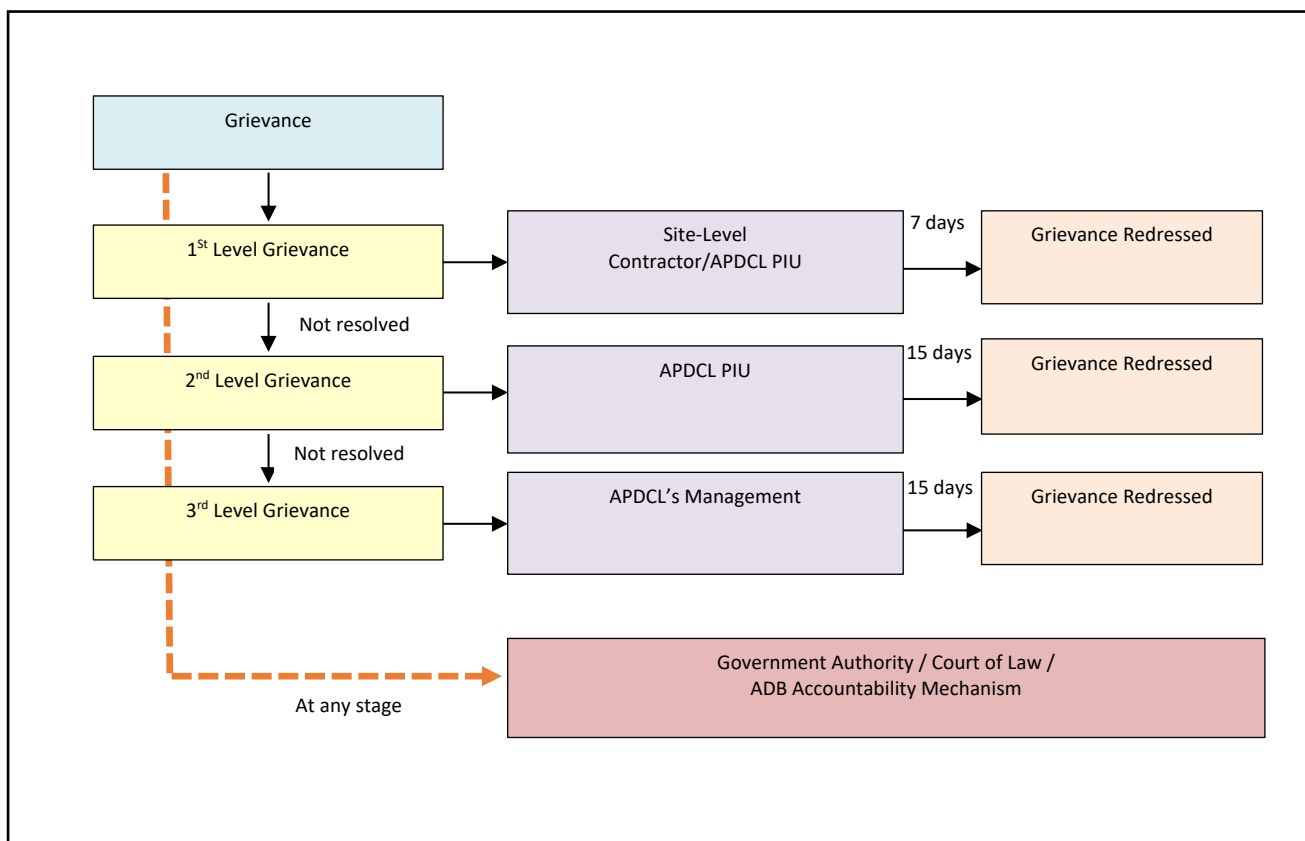
- The same process of logging the grievance complaint, communicating with the complainant and reporting will be followed.
- The third level of GRM is handled by APDCL's Managing Director who will form a grievance redress committee and chair the meeting and made up of APDCL Managing Director supported by the APDCL PIU GRM Focal, Project Director, PMU E&S safeguards staff, PMC environment specialist, two representatives of the complainant including indigenous peoples representative (with gender balance) if applicable, as well as above, a representative of the contractor, independent panellist of government representatives for environment or social issues (such as but not limited to land revenue, forest office, directorate of archaeology/ASI office, municipality representatives etc.), NGOs or CSOs representatives, etc.
- The grievance redress committee will agree on the resolution approach and action plan, inform concerned parties about actions to be taken and their timeline, and will monitor progress through regular follow-ups. Resolution will be as prompt as possible; receipt of complaint will be acknowledged to the complainant within 3 days, the resolution approach agreed upon within 15 days and actions taken within 30 days. However, all simple complaints will be resolved within 7 days of the meeting being held. Approval of the resolution by the complainant will be sought in writing. If the complainant is still dissatisfied after this stage, they may avail of the court of law or ADB's Accountability Mechanism.
- All entries to the site's grievance/complaints register, whether resolved at initial informal level on site or at any of the three levels of the GRM, along with updates on ongoing or completed actions taken to address the grievance/complaint, will be included in monthly reports by the contractor to PIU and in periodic monitoring reports from APDCL to ADB. PMC will monitor the overall grievance resolution process along with PIU and will recommend any improvements to increase the efficiency, timeliness, and fairness of the process.

770. **Budget.** APDCL and the contractor will need to provide staff for and allocate budget for the GRM that will sufficiently cover the costs of its operations including initial awareness raising, capacity development trainings, support services, field inspections, meetings, documentation, and supplies etc.

	<b>GRM Meeting Composition</b>
First Tier	PIU Project Manager PIU GRM Focal Contractors safeguard staff representative PMC resident EHS supervisor Two representatives of affected person (gender/IP)
Second Tier	PMU Project Director PIU Project Manager PIU GRM Focal Contractors safeguard staff representative

	PMC resident EHS supervisor Two representatives of affected person (gender/IP) Independent panelist (government official or CSO)
Third Tier	APDCL MD PMU Project Director PIU GRM Focal PMU E&S Safeguard Officers PMC Environment Specialist (international) Two representatives of affected person (gender/IP) Independent panelist (government official or CSO)

**Figure 75: Structure of Formal Grievance Redress Mechanism**



Source: IEE Team

771. **Unresolved grievances.** If the established GRM is not able to resolve the issue, then it must pass to the courts of law or alternatively an affected person can use the Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters or ADB India Resident Mission. A complaint can be submitted in any of the official languages of ADB’s developing member countries. ADB Accountability Mechanism information will be included in the relevant information to be distributed to the affected communities, as part of disclosing the GRM. Despite the GRM, a grievant shall have access to the country’s legal system at any stage and accessing the country’s legal system can run parallel to accessing the GRM and is not dependent on the outcome of the GRM resolution.





## IX. ENVIRONMENTAL MANAGEMENT PLAN

### 9.1 Introduction

772. ADB's Safeguard Policy Statement (SPS) 2009 requires that an Environmental Management Plan (EMP) be prepared to ensure construction and operation of the SPP and the associated SPP TL will be undertaken in accordance with its safeguard requirements. The EMP is an overarching document that will guide environmental management implementation, supervision, and monitoring of APDCL and their contractor's activities. It aims to ensure compliance with (i) ADB's Safeguard Policy Statement 2009 requirements and international good practice as set out in the related International Finance Corporation (IFC) Environment, Health and Safety (EHS) general and Electric Power Transmission and Distribution guidelines, and ILO's Safety and Health in Construction and worker accommodation guidelines, and (ii) applicable environmental, health and safety requirements of the Government of India (GoI) and Government of Assam (GoA), including the international agreements to which the GoI is a signatory too, as well as having cognizance of the sensitivity of local ecological and human receptors. The EMP also provides guidance to APDCL on how they can collaborate with CTU to ensure any high risks related to the 400kV switching station and transmission line are managed and the associated facilities of the SPP component achieve an environment, health and safety outcome consistent with the outcome expected from the SPP component.

773. The EMP provides summary information of the types of impacts and risks anticipated because of the SPP and SPP TL and provides detailed information about the required mitigation and monitoring measures with respect to the following stages: (i) design, (ii) pre-construction, (iii) construction, (iv) operation and maintenance, and (v) decommissioning as well as implementation arrangements and reporting requirements. The main impacts and risks that have been identified by the Initial Environmental Examination (IEE) are summarized as follows:

- Need to clear large swathes of vegetation to construct the SPP -- whilst most blocks are dominated by modified habitat, in which there are small patches of natural habitat, in Block 6 is a large block of about 94 ha of natural habitat albeit with small patches of modified habitat. This needs to be retained intact in order to avoid the SPP component resulting in significant conversion and degradation, whilst no net loss of biodiversity must be achieved through the creation of wildlife corridors or habitat areas to compensate for smaller patches lost. Tree cutting will need to be compensated for following national and state requirements.
- SPP and SPP TL area of analysis may potentially support critical habitat for two species of turtle; black softshell and Assam roofed. No permanent streams are reported present on the SPP so they may not be found on site itself, but one is found along the SPP TL. No other species trigger critical habitat for the SPP blocks; but the SP TL is potential critical habitat for Bengal florican.
- Blocking wildlife access routes through the site; of most concern is elephant. Their main habitat is outside the site but they have occasionally been observed to enter the site to find food and would pose a risk to SPP infrastructure and to the safety of the SPP workers.
- Dust and noise generated during construction of the SPP including from large volumes of construction traffic using narrow unsurfaced village roads with receptors immediately adjacent, for this reason all village roads used will be upgraded to a bituminous surfacing.

- Exposure of large areas of soil due to vegetation clearance increasing soil erosion, dust levels, sediment laden surface water runoff, and increasing the risk of invasive species spread.
- Pollution risks related to construction and O&M including from fuel, oil and chemical storage, sanitation facilities, and use of diesel generator sets.
- Pressure on local water resources during the dry season due to construction water needs and the sinking of several new borewells for washing of solar PV panels during the O&M phase.
- Occupational health and safety risks to construction and O&M workers related to remote site and working with electricity.
- Community health and safety risks related to unauthorized access to the SPP given construction works and electrical infrastructure will be present, as well as risks related to use of the public highway for construction access and an influx of workers to the SPP site.
- Blocking local community access routes through the site; two routes through the site will be retained to provide access to the market and the safety of users will need to be ensured.
- Need to relocate locally important religious resources (churches and prayer hall, possible graveyard and temple to be located) in acquiring land for the SPP in consultation with local communities and some potential for unknown archaeology to be encountered since Karbi Anglong East has not yet been surveyed by Department of Archaeology for unprotected resources.

774. Prior to the approval of designs APDCL will consult ADB regarding the need to update the IEE based on the resettlement site, final SPP design proposed by contractors/private sector and final TL route; at minimum an addendum will be required setting out the final layout. As required, the IEE and EMP will be updated for review, clearance and disclosure by ADB before design approval is granted by APDCL and the start of any related works including construction site establishment, clearance and preparation. To ensure the mitigation and monitoring measures are implemented a program of environmental supervision and monitoring will be undertaken during the SPP implementation by the Project Management Unit (PMU) and Project Implementation Unit (PIU) for the SPP and their Project Management Consultants (PMC).

775. The definitive version of the EMP cleared by ADB is the most recent version disclosed on its website. The EMP is dynamic and can be updated as appropriate during the SPP implementation if the changes are in compliance with the ADB SPS, 2009. However, any update to the EMP will first need to be cleared by ADB. The EMP will form part of all bidding and contract documents for all contract packages/requests for proposals/lots and during design and pre-construction, construction, and commissioning the contractors will be responsible for implementing all relevant measures for the works in their contract package/lot under supervision and monitoring of APDCL. During O&M the contractors will be responsible for EMP implementation for the duration of their contract. For ADB project funded components this will be the initial three year O&M phase after which the responsibility for O&M implementation will pass to ADPCL, unless the contract is extended. For private sector O&M contracts will be for 25 years up to handover to ADPCL nearer the time. If decommissioning it will be the responsibility of the private sector to restore the site back to the condition it was received in.

776. Any updates to the EMP will be incorporated into the contract document. The contractors must always follow the definite version of the EMP which is the version disclosed on ADB's website. This includes any updates in response to unanticipated impacts. In addition, for any requirements for corrective action due to non-compliance, appropriate action will be agreed between APDCL and ADB. The action will need to be taken by APDCL and their contractors to bring project implementation back on track. The contractors will be responsible to cover the costs where corrective action is required due to non-compliance on behalf of the contractor, its subcontractors or third parties with the EMP.

## 9.2 Environmental Mitigation Plan

777. The environmental mitigation plan tables provide the feasible and cost-effective environmental mitigation required and project standards/guidelines to be followed during the design, pre-construction, construction and commissioning, O&M, and decommissioning phases of the SPP component for the activities or issues listed to reduce the potentially significant, adverse environmental impacts and risks to acceptable levels and generally ensure international good practice, and national environmental, health and safety requirements are followed.

778. Some commitments that must be commenced during the design and pre-construction phase will continue to be implemented by the Contractors during the construction phase (including a 540 days or 18 months defects liability period) and during O&M for the duration of the contract.

## 9.3 Environmental Monitoring Plan (EMoP)

779. The EMoP sets out the minimum provisions for quantitative environmental monitoring and performance standards to be achieved.

780. Monitoring activities including laboratory analysis for air quality, noise, surface water and groundwater quality, and soil are to be carried out by accredited suitably qualified and experienced third-party monitoring experts. Quantitative monitoring activities may be modified during implementation, depending on the Contractors' performance and analytical results obtained. If performance is worse than expected, corrective action will be identified, and environmental monitoring activities adjusted accordingly by APDCL to help resolve any unsatisfactory performance.

781. In addition to quantitative monitoring there will also be supervision and monitoring of EMP implementation, the performance standard being all EMP measures are implemented in full at the appropriate time.

## 9.4 Construction Site-Specific EMP (C-SEMP)

782. The C-SEMP is the document that the Contractor will prepare outlining how they intend to implement the EMP during the construction phase and ensure that all the mitigation and monitoring is completed according to the implementation arrangements specified in the EMP and the IEE.

### Contracting Structures

For Component 1a, 1b, 1c and 1d APDCL will hire contractor under the ADB project to design and build the SPP.

For 1a and 1b the contractor will be engaged for a further 3 years of operation and maintenance (O&M). After this, the contractor may continue to be engaged by APDCL for

any number of the O&M years, including potentially the decommissioning phase. It is however currently anticipated that APDCL will take over the O&M phase from the contractor after the first three years of O&M is completed.

For 1c and 1d the handover to APDCL will be upon completion of the DLI period.

Upon hand over to APDCL, APDCL will be responsible for taking on EMP implementation for O&M and decommissioning phases.

For Component 2 a special purpose vehicle (SPV) or “company” will be established between APDCL and a Private Investor. The SPV will likely hire their own contractor for the design and construction phase and potentially the same or a separate contractor for the O&M and decommissioning phases assuming APDCL to not request for handover. For this EMP, it is assumed the private sector will fulfill all roles from design to decommissioning, through their respective contractors.

Reference to contractors throughout this EMP should also be taken to refer to the private sector.

If responsibilities change at any point the organization taking on the responsibilities will also be responsible for the corresponding EMP implementation, APDCL should update the EMP responsibilities accordingly.

783. The C-SEMP will describe the precise implementation details and the location of the required mitigation and monitoring activities, the persons at the contractor responsible for the mitigation and monitoring and other persons with roles or responsibilities related to EMP implementation, the schedule, budget, training and induction, and record keeping and reporting arrangements. The C-SEMP and all its topic and site-specific sub-plans will be submitted to the PMC and PIU for approval at least 30 days before taking possession of any work site including for site establishment, preparation or clearance. Except for survey works related to the design process no access to the site will be allowed until the C-SEMP is approved by the PMC and PIU.

784. The C-SEMP will include the following topic specific plans:

**Table 97: C-SEMP Topic Specific Plans**

Plan	Approvals	
	APDCL PIU	PMC
Construction Method Statement	Yes	Yes
Dust Management Plan	Yes	Yes
Noise Management Plan	Yes	Yes
Pollution Prevention Plan including Emergency Response Plan	Yes	Yes
Occupational Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Community Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Biodiversity Management Plan including Invasive Species Control Procedure and Wildlife Encounter Protocol	Yes	Yes
Site Preparation and Vegetation Management Plan including site layout plan	Yes	Yes

Plan	Approvals	
	APDCL PIU	PMC
Solid and Hazardous Waste Management Plan	Yes	Yes
E-waste Management Plan	Yes	Yes
Traffic Management Plan	Yes	Yes
Labour Management Plan	Yes	Yes
Code of Conduct	Yes	Yes
Chance Find Procedure	Yes	Yes
Communication Plan	Yes	Yes
Training and Induction Plan	Yes	Yes

785. The following site-specific plans will also be required, including:

**Table 98: C-SEMP Site Specific Plans**

Plan	Approvals	
	PIU	PMC
Construction Camp, Labor Accommodation, Sanitation and Welfare Facility Plan(s) including layout plan	Yes	Yes
Concrete Batching Plant Management Plan(s) including layout plan	Yes	Yes
Hot Mix Plant Management Plan(s) including layout plan	Yes	Yes
Construction Workshops and Storage Area Management Plan(s) including layout plan	Yes	Yes
Offsite Village Roads Traffic Management Plan(s) - specific to each village access road mapping receptors (these will be subplans of Traffic Management Plan)	Yes	Yes
Heritage Management Plan(s) - specific to each physical cultural resource flagged within the IEE	Yes	Yes

## 9.5 Operation Site-Specific EMP (O-SEMP)

786. The O-SEMP is the document that the O&M contractor, private sector or APDCL O&M team if handed over will prepare for the O&M phase outlining how they intend to implement the EMP during the O&M phase and ensure that all the mitigation and monitoring is completed according to the implementation arrangements specified in the EMP and the IEE. It will describe the same information per the C-ESMP but for the O&M phase. The O-SEMP and all its topic and site-specific sub-plans will be submitted to the PMC and PIU 30 days prior to operation.

787. The O-SEMP will include the following plans:

**Table 99: O-SEMP Plans**

Plan	Approvals	
	APDCL PIU	PMC
Pollution Prevention Plan including Emergency Response Plan	Yes	Yes
Occupational Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Community Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Biodiversity Management Plan including Invasive Species Control Procedure and Wildlife Encounter Protocol	Yes	Yes
Solid and Hazardous Waste Management Plan	Yes	Yes
E-waste Management Plan	Yes	Yes
Labour Management Plan	Yes	Yes
Code of Conduct	Yes	Yes
Communication Plan	Yes	Yes
Training and Induction Plan	Yes	Yes

## 9.6 Decommissioning Site-Specific EMP (D-SEMP)

788. The D-SEMP is the document that the decommissioning contractor, private sector or APDCL team will prepare for the decommissioning phase outlining how they intend to implement the EMP during it and ensure that all the mitigation and monitoring is completed according to the implementation arrangements specified in the EMP and the IEE. It will describe the same information per the C-ESMP but for the decommissioning phase. The D-SEMP and all its topic and site-specific sub-plans will be submitted to the PMC and PIU 30 days prior to decommissioning works commencement.

789. The D-SEMP will include the following plans:

**Table 100: D-SEMP Plans**

Plan	Approvals	
	APDCL PIU	PMC
Decommissioning Management Plan	Yes	Yes
Dust Management Plan	Yes	Yes
Noise Management Plan	Yes	Yes
Pollution Prevention Plan including Emergency Response Plan	Yes	Yes

Plan	Approvals	
	APDCL PIU	PMC
Occupational Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Community Health and Safety Plan including Risk Assessment and Emergency Response Plan	Yes	Yes
Biodiversity Management Plan including Invasive Species Control Procedure and Wildlife Encounter Protocol	Yes	Yes
Solid and Hazardous Waste Management Plan	Yes	Yes
E-waste Management Plan	Yes	Yes
Traffic Management Plan	Yes	Yes
Labour Management Plan	Yes	Yes
Code of Conduct	Yes	Yes
Communication Plan	Yes	Yes
Training and Induction Plan	Yes	Yes

## 9.7 Overarching Implementation Arrangements

790. The SPP Project Implementation Unit (PIU) of APDCL will be responsible for ensuring correct implementation of the EMP and approving the contractors' C-SEMPs, O-SEMPs and D-SEMPs to comply with ADB's safeguards requirements and environmental, health and safety (labor) national regulations. For this, the PIU will include a qualified environment officer (PIU EO), health and safety officer (PIU HSO) and social safeguard officer (PIU SSO) employed by APDCL on a permanent or contractual basis. The PIU safeguard unit will be assisted by qualified environmental, health and safety specialists of the PMC in supervising the implementation of the EMP / C-SEMPs / O-SEMPs / D-SEMPs.

791. The cost for implementing mitigation and monitoring measures as outlined in the EMP will be included in the contractor/private sector contracts.

792. If any change in design, unanticipated environmental or social impacts become apparent during implementation, the contractor will be required to inform PIU who in turn will be required to immediately inform ADB and (i) assess the significance of such unanticipated impacts; (ii) evaluate the options available to address them; and (iii) update the IEE and EMP taking appropriate corrective action where necessary before commencing or recommencing the related works.

793. The following sections provide the specific implementation requirements for all parties.

## 9.8 APDCL Management, PMU and PIU

794. Under the oversight of APDCL management, and reporting to the PMU coordinating the overall project, the PIU for the SPP is responsible for supervising the PMC and contractors and for EMP implementation for overall compliance with ADB's SPS (2009)



requirements and environment-related legal covenants. APDCL management is ultimately responsible to ensure EMP compliance.

### 9.8.1 Primary Responsibilities

795. The PIU's responsibilities include the following, but not limited to:

- a) Ensuring adherence to all applicable national and state environment, health, safety, and labor laws and regulations in force at the time.
- b) Ensuring adherence to ADB's Safeguard Policy Statement (2009) and the related IFC Environment, Health and Safety (EHS) general and power transmission and distribution guidelines (2007) as well as the ILO Safety and Health in Construction and worker accommodation guidelines.
- c) Ensuring adequate management support, budget, staff, and other resources are allocated to satisfactorily implement, supervise, and monitor implementation of the EMP during all phases.
- d) Latest upon loan effectiveness appointing suitably qualified and experienced environment officer, health and safety officer and social safeguards officer to the PIU to support EMP implementation throughout all phases.
- e) Locally disclosing the IEE and other environmental safeguards documents, including publication on APDCL's website. Help with translation of the IEE into local languages (Assamese and Karbi) or an explanation of its content will be extended free of charge to affected persons on request.
- f) Incorporating the EMP into the bidding and contract documents before issuing tenders/request for proposals and contract awards.
- g) Reviewing bids to ensure they are in accordance with the EMP requirements prior to contract award.
- h) Preparing a detailed training plan, providing training venues, and providing with support of PMC a suite of training activities for APDCL staff and contractors in relation awareness raising on EMP implementation.
- i) Adopting a zero-tolerance approach to OHS and enforcing all APDCL staff to comply with OHS requirements of the EMP including wearing of appropriate PPE on site to set a good example to the contractors and their workers.
- j) Implementing the EMP throughout all phases or, if responsibilities are delegated, supervising, and monitoring its implementation by the contractors.
- k) Reviewing and approving the contractor's outline and detailed designs as well as their C-SEMP / O-SEMP / D-SEMP and sub-plans to ensure they incorporate and are in accordance with the EMP requirements.
- l) Updating the IEE/EMP as required in consultation with ADB prior to approval of the resettlement site and contractor's outline and detailed designs with respect to any changes from the design assessed. Obtaining ADB's clearance for the IEE/EMP update prior to approval of the designs and the commencement of any work, including site establishment, preparation and vegetation clearance. Once cleared, ADB will disclose the updated IEE/EMP on its website whilst APDCL will locally disclose it. All updates to the IEE/EMP are subject to ADB clearance before adoption before they become effective.
- m) Ensuring that necessary compensation is paid to the forest department for cutting of trees before the commencement of related work.

- n) Ensuring the contractors secure all necessary CTE, CTO and other permissions before the commencement of related work, maintain records with copies of all the clearances, permits, licenses, and insurances obtained.
- o) Ensuring the contractors provide adequate training to their subcontractors and all workers including daily EHS toolbox talks and emergency response drills; suggesting topics for the trainings based on site observations.
- p) Identifying areas for improvement, unsafe acts, and any non-compliances with the EMP by the contractors and/or APDCL staff and instructing for corrective actions to be taken by them to bring implementation back on track.
- q) Thoroughly investigating all unanticipated impacts, near-misses, accidents, and chance finds; preparing a detailed incident report where applicable, identifying and instructing on corrective actions particularly to avoid any repetition of near-misses and accidents.
- r) Reporting to ADB of any non-compliance or breaches with ADB safeguard requirements in a timely manner and take corrective actions promptly.
- s) Monitoring and reporting on EMP implementation including reporting on EMP implementation in quarterly progress reports and preparing semi-annual EMRs for submission to ADB up until the completion of construction, reverting to annual up until the ADB project completion report, or for longer period if it is required by the ADB PCR. Submission to ADB for disclosure on their website, as well as for local disclosure.
- t) Undertaking with the support of PMC monthly EHS meetings including site walkover inspections to determine the status of EMP implementation by the contractors during construction as well as random “spot check” site visits to audit their EMP implementation. Minutes of monthly meetings and findings of site walkover inspections will be attached to the EMRs to be submitted to ADB.
- u) Preparing a community liaison plan to elaborate on ongoing consultation and information disclosure in relation to EMP implementation considering gender, vulnerable groups, and indigenous peoples; preparing consultation materials for distribution to affected communities, including conducting public awareness programs.
- v) Undertaking and documenting all ongoing consultation, details of consultations such as minutes of the meetings, photographs to be documented in the environmental monitoring reports (EMRs) submitted to ADB.
- w) Establishing and operationalizing the GRM for affected persons (construction workers and local community members) in line with the IEE, including appointing GRM Focals and establishing a Grievance Redress Committee (GRC), disseminating contacts, recording and promptly resolving grievances received. All ongoing grievance-related information will be documented in the EMRs submitted to ADB.
- x) Building up and sustaining institutional capacity in environmental management, health, safety and labor management.
- y) For O&M under the responsibility of APDCL instead of a contractor undertaking the environmental monitoring as set out in the EMoP during all phases, documenting quantitative and qualitative monitoring results; for quantitative monitoring hire accredited, and quality assured, third-party laboratories.
- z) Reporting any unanticipated impacts, major incidents (including fatalities), and chance finds to ADB within 48 hours of them occurring along with an incident report with corrective action plan.
- aa) Reporting to ADB any grievances submitted to the third formal stage of the GRM immediately upon receipt.

- bb) Developing and taking all requisite corrective action in case of any non-compliance with the EMP including repair of any property damages and financial compensation (insurance) for health and safety incidents.

### 9.8.2 Reporting

796. APDCL will be responsible for the following documents and reports:

**Table 101: APDCL Reporting Responsibilities**

Documents	Responsible Person	Destination of the documents	Submission timing		
			Design period	Construction period	Operation period
Bid/Request for Proposal and Contract Documents (addition of environmental requirements)	PIU EO with support PIU HSO and PIU SSO	ADB	X		
Updated IEE /EMP	PIU EO with support PIU HSO and PIU SSO	ADB	X (when IEE is finalized)	X (when any changes are made to IEE / EMP due to unanticipated impacts)	X (when any changes are made to IEE / EMP due to unanticipated impacts)
Training and Induction Plan	PIU EO with support PIU HSO and PIU SSO	APDCL/ Contractor	X (for design and construction)		X (for operation)
Community Liaison Plan	PIU EO with support PIU HSO and PIU SSO	APDCL/ Contractor	X (for design and construction)		X (for operation)
Consultation and Grievance Redress Reporting (included in QPRs)	PIU SSO with support PIU EO	ADB		X (Quarterly)	X (Quarterly)
Incident Reports (included in QPRs)	PIU HSO and EO	ADB		X (Quarterly)	X (Quarterly)
Quarterly Progress Reports (QPR)	PIU EO with support PIU HSO and PIU SSO	ADB	X (Quarterly)	X (Quarterly)	X (Quarterly)
Unanticipated impacts, major incident (including fatalities) and change find reports	PIU HSO and PIU EO	ADB		X (48 hours)	X (48 hours)
Environmental monitoring reports (EMR), including consultation, grievances and incidents	PIU EO with support PIU HSO and PIU SSO	ADB	X (every 6 months)	X (every 6 months)	X (annual until PCR issued or longer if recommended within the PCR)

### 9.8.3 EMR

797. Following loan effectiveness, environmental monitoring reports (EMRs) will be submitted to ADB on a semi-annual basis by APDCL up to the completion of construction reverting to an annual basis during operation up to the ADB project completion report (PCR) with safeguards inputs also provided to quarterly progress reports. If

recommended within the PCR, annual operational monitoring reporting will be continued until all issues have been closed out to the satisfaction of ADB. EMRs will be due for submission to ADB within 15 days of the month following period end, e.g., before mid-July and mid-January each year. The EMRs will describe SPP implementation progress, any scope or design changes, compliance against safeguard requirements that are covenanted in the legal agreements, progress with environment mitigation implementation, quantitative monitoring results in accordance with the EMoP, and grievances received.

798. Draft EMRs submitted by APDCL during SPP implementation will first be reviewed by ADB with comments on quality and acceptability provided and then, once resubmitted to ADB and are cleared for disclosure, are to also be disclosed locally (in the same places as the IEE report was originally disclosed) by APDCL and on the ADB website. Any outstanding comments will be flagged to APDCL for ongoing action.

#### **9.8.4 APDCL PIU Safeguards Unit**

799. APDCL will create as part of the PIU a dedicated safeguards unit for the SPP at headquarters (corporate) level to manage the above-mentioned tasks and environment, health and safety risks (and any social impacts) of its SPP activities during all phases including O&M and decommissioning. The unit will be staffed by a suitably qualified and experienced PIU EO and PIU SSO and a suitably qualified and experienced PIU HSO with IOSH/NEBOSH certification, all with 12-15 years of experience (either on a contractual or permanent employment basis). APDCL may source the dedicated staff through a direct hiring (either on a contractual or permanent employment basis) or through deputation from another department. Since there may be shortage of suitably qualified and experienced environmental, health and safety professionals presently employed in APDCL given the focus on electrical engineering making a direct hiring is the advised approach.

### **9.9 Contractors (Private Sector)**

800. Through the contract, APDCL will delegate responsibility for implementing all relevant measures during design, pre-construction, construction, O&M, and decommissioning for the duration of their contract. The contractors will be required to comply with the EMP during the design, preconstruction, construction, O&M and decommissioning phases, closely supervised and monitored by APDCL. The contractors will be responsible for reporting environmental safeguards progress and performance at least monthly to APDCL including record and quantitative monitoring data required by the EMoP and providing necessary inputs to the quarterly progress reports and EMRs for the duration of their contract. The requirement to undertake relevant mitigation and monitoring actions as set out in this EMP applies to the construction site, offsite village roads used for access, operational plant, as well as any temporary or permanent labor camps or overnight accommodation provided for workers during both the construction and operation phases.
801. The contractors have the ultimate responsibility for EMP implementation under APDCL. However, the contractors are required to ensure that the EMP requirements are cascaded down to all sub-contractors and workers undertaking works relating to the SPP component, regardless they are formally or informally employed, and to be responsible for supervising and monitoring their sub-contractors in turn. Contractors workers will need to abide, in their behavior and work, to directives issued by their employer with regards to environmental, health and safety management.

802. The contractors will be responsible for the preparation of their C-SEMP for the construction phase, O-SEMP for O&M phase and D-SEMP for the decommissioning phase. The C-SEMP will need to be fully compliant with the EMP and the IEE and will need to be prepared within 30 days of Contract award and approved 30 days prior to access to the site including for site establishment, preparation and clearance. The O-SEMP will need to be fully compliant with the EMP and the IEE and will need to be prepared 30 days prior to operation. The D-SEMP will also need to be fully compliant with the EMP and the IEE and it will need to be prepared 30 days prior to decommissioning.

### **9.9.1 Specific Responsibilities**

803. In addition to the above, the contractors will be responsible for:

- a) Implementing all measures and responsibilities allocated to the contractor under the EMP for the full duration of the contractor's involvement.
- b) Ensuring adherence to all applicable national and state environment, health, safety, and labor laws and regulations in force at the time.
- c) Ensuring adherence to ADB's Safeguard Policy Statement (2009) and the related IFC Environment, Health and Safety (EHS) general and power transmission and distribution guidelines (2007) as well as the ILO Safety and Health in Construction and worker accommodation guidelines.
- d) Ensuring the outline and detailed designs reflect the EMP requirements; seeking to ensure it has the same or no worse impact than the indicative design which was assessed in the IEE.
- e) Supporting APDCL to update (as required) the IEE in respect of their outline and detailed design by providing sufficient details to inform a revised project description and any subsequent reassessment of impacts and risks.
- f) Undertaking and documenting a facilitated health and safety (H&S) risk assessment considering all phases.
- g) Preparing a C-SEMP and sub-plans as specified in the EMP for review and approval by APDCL prior to the commencement of works including site establishment and an O-SEMP and sub-plans as specified in the EMP for review and approval by APDCL prior to the commencement of operations – see tables.
- h) Ensuring adequate budget, staff and other resources are allocated to comply with and implement the contractor's responsibilities under the EMP and to supervise and monitor the active construction site and operational plant to protect the environment and ensure the health and safety of all workers and affected communities.
- i) Ensuring suitably qualified and experienced safeguard officers, as per the EMP requirements have been appointed to undertake regular on-site supervision and monitoring activities before the commencement of works.
- j) Adopting a zero-tolerance approach to OHS, enforce all workers to comply with the OHS requirements of the EMP including the wearing of appropriate PPE on the construction site.
- k) Obtaining all necessary CTE, CTO and other permissions before the commencement of related work, share copies of all clearances, permits, licenses, and insurances obtained.
- l) Providing – in part with the support from APDCL – and ensuring attendance at EHS trainings for formal and informal construction workers and other personnel as required.

- m) Ensuring that all workers including all formal and informal employees and subcontractors understand their responsibilities to implement the EMP and mitigate environmental impacts and risks associated with pre-construction, construction and operational activities.
- n) Supporting APDCL in undertaking ongoing consultation and implementing the site-level GRM; in particular, the contractor's GRM Focal shall thoroughly document details of complaints and make its best efforts to resolve the complaints at site level; all this information is to be included in the contractor's monthly reports to APDCL.
- o) Undertaking environmental monitoring as set out in the EMoP during pre-construction, construction and operation and documenting qualitative and quantitative monitoring results; for quantitative monitoring the contractor is to hire accredited, and quality assured, third party laboratories.
- p) Submitting monthly environmental management reports to APDCL (these monthly reports will be stand-alone but included as part of the contractors' monthly progress reports) relating to the work undertaken over the reporting period and documenting the environmental measures including monitoring activities that have been carried out, problems encountered, record and monitoring data including near misses and incidents, grievances received, and follow-up actions that were taken (or will be taken) to correct the problems.
- q) Informing APDCL immediately in case of any approved outline or detailed design changes or unanticipated environmental impacts occurring during implementation, and as required, provide any information needed to APDCL to enable them to promptly update the IEE/EMP for clearance by ADB before any changes are implemented.
- r) Informing APDCL within 24 hours in case of chance find or major incident (including fatality) on site and providing within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented.
- s) Informing APDCL immediately in case of any non-compliance and help them to prepare as necessary a corrective action plan for clearance by ADB, the contractor is required to implement all necessary corrective action requested by APDCL to ensure the SPP remains in compliance with national and state regulatory requirements, ADB's SPS 2009, loan covenants and EMP requirements.

### 9.9.2 Contractors Reporting

804. The contractors will establish their own internal systems for monitoring and reporting their EMP implementation. The contractors will formally submit monthly environmental management reports per an agreed template to the PIU. Complete photographic records will be kept by the contractor covering all activities on site as well as key locations such as the construction site, offsite access roads, operational plant, receptors adjacent, workshops, stores, sanitation and welfare facilities, temporary or permanent labor camps or overnight accommodation etc. Photographs of key areas will be taken prior to site establishment and construction activities beginning to provide the environmental baseline. Copies of all geo-referenced photographs will be submitted to the PIU along with the contractor's monthly report. Specifically, the contractor will be responsible for the following documents and reports:

**Table 102: Contractor Reporting Responsibilities**

Documents	Responsible Person	Destination of the documents	Submission timing			
			Design period	Construction period	Operation period	Decom. Period
Health and Safety Risk Assessment	HSS	PMC, PIU	X	X (updated prior to the start of construction)	X (updated prior to the start of)	X (updated prior to the start of decom. and then annually updated)

Documents	Responsible Person	Destination of the documents	Submission timing			
			Design period	Construction period	Operation period	Decom. Period
				and then annually updated)	operation and then annually updated)	
Outline and detailed design for approval	ESM / HSS	PMC, PIU	X (Once, prior to the start of construction)			
C-SEMP including all subplans for approval		PMC, PIU	X (Once, prior to the start of construction)	X (updated through construction as needed)		
O-SEMP including all subplans for approval		PMC, PIU			X (prior to the start of operation, updated through operation as needed)	
D-SEMP		PMC, PIU				X (prior to the start of decommissioning, updated as needed)
Environmental, health and safety checklists		PMC, PIU		X (every week. to be completed daily)	X (every week. to be completed daily)	X (every week. to be completed daily)
Monthly environmental management reports, including monitoring records and data per EMoP requirements		PMC, PIU	X (every month)	X (every month)	X (every month)	X (every month)

### 9.9.3 Contractors Staff

805. To prepare and implement their C-SEMP/O-SEMP/D-SEMP and to supervise and monitor EMP and C-SEMP/O-SEMP/D-SEMP implementation a team of specialists will be required as part of the contractor's team as illustrated in the following figure and described in detail below. If a contractor is awarded more than one contract package (SPP block) then an entirely separate EHS team is to be employed for each of them. There will also be a need for the contractor to employ ad-hoc specialist inputs to deliver specific EMP tasks that are assigned to them e.g. physical cultural resources expert for pre-construction survey work, pollution control expert for the design of oil bunds and storage areas etc.

**Figure 76: Contractors Environmental, Social, Health and Safety Team**

#### 9.9.4 Environmental and Social Manager

806. During construction, operation and decommissioning (as applicable) contractors must retain the expertise of an Environmental and Social Manager (ESM) who is an environment specialist, to prepare, implement and continually update the EMP/C-SEMP/O-SEMP/D-SEMP and to oversee and report on its implementation throughout the contract period. The ESM will be the contractors main focal point for all environmental, social, health and safety issues associated with the SPP and will lead the other team members listed below. **ESM will be engaged for all phases.**

807. The ESM will be a suitably qualified and experienced full-time member of staff on the contractor's roster and should be on site at least five days per week. The required qualifications of the ESM are as follows:

- Bachelors and masters degree in environmental sciences, environmental management or related field.
- At least 15 years' experience in on-site environment, health and safety supervision and monitoring.
- Experience of at least five construction projects of a similar type, location setting, size and scale.
- Experience of construction projects receiving IFI funding whilst being conversant with national laws and regulations and IFI environment safeguards policies and requirements.

808. Specifically, in overseeing EMP implementation and managing the safeguard team, the ESM shall be responsible for:



- Identifying any areas of environmental sensitivity on the site and along village roads used to access it, including physical cultural resources and with the support of the ecologist and botanist areas of natural habitat to be avoided.
- Incorporate mitigation requirements written in the EMP in preparing the C-SEMP/O-SEMP/D-SEMP and their sub-plans.
- Translate mitigation requirements written in the C-SEMP and its sub-plans and the O-SEMP/D-SEMP and its sub-plans into practical measures on the ground.
- Ensure that all staff are fully aware of the environmental sensitivities of the site and their responsibilities, as outlined in the management plans (e.g., via practical toolbox talks ahead of the construction).
- Keep records, take field notes and photographs to demonstrate compliance with the EMP / C-SEMP / O-SEMP / D-SEMP.

809. In addition, the ESM will be responsible for the preparation and completion of weekly environmental checklists and an environmental section of the contractor's monthly progress reports that shall be submitted to the PMC and PIU for review. The PMC shall provide a template of the checklist to the contractor.

810. The monthly reports, which will include the weekly environmental checklists, shall contain sections relating to:

- General progress of the contract and key construction works undertaken or milestones met.
- Records of and data from environmental monitoring.
- Environmental incidents, e.g., spills of liquids, fatalities, etc.
- Progress of any environmental initiatives, e.g., energy savings, recycling, etc.
- Conclusions and recommendations (corrective action plan).

811. The ESM shall provide daily toolbox training at the construction site and operational plant as well as monthly toolbox training with the Labour Officer on code of conduct, sanitation and welfare at the labor camp site/overnight accommodation. The ESM shall keep a record of all monthly training and toolbox training undertaken.

### 9.9.5 Ecologist and Botanist

812. The contractor shall engage an ecologist and a botanist on a part-time basis **for construction phase only**. They will have a degree in ecology, botany, or similar, and at least 5-10 years' experience of biodiversity surveys (flora and fauna) and for the ecologist the assessment, management and supervision of similar projects in forest habitat type. The botanist will be specialized in Assamese flora and fauna. The specialist will report directly to the ESM and will be responsible for the following:

- Pre-clearance and post-construction surveys including the extent and quality of habitats on site
- Oversight of land clearing activities and removal of vegetation (the ecologist must be on site full time during site establishment, clearance and vegetation removal)
- Wildlife encounter protocol
- Biodiversity no net loss and enhancement measures (wildlife buffers/corridor design)

### 9.9.6 Health and Safety Specialist & Health and Safety Supervisors

813. The contractor shall hire a suitably qualified and experienced Health and Safety Specialist (HSS) **for all phases**. The H&S specialist shall have at least 15 years on-site experience of health and safety supervision including on at least 5 projects of similar type, location setting, size and scale of project and solar construction and operation. They will have NEBOSH/IOSH certification or equivalent, and relevant bachelors and masters qualification. They will need experience of construction projects receiving IFI funding whilst being conversant with national laws and regulations and IFI environment safeguard policies and health and safety requirements. The HSS shall report directly to the ESM. The main responsibilities of the HSS will be:

- Provide H&S training, including daily toolbox training sessions at each work site.
- Provide inputs to the C-SEMP / O-SEMP / D-SEMP and approve H&S risk assessments and plans for specific work activities.
- Conduct routine site inspections and issue internal stop notices, if necessary, for unsafe activities.
- Maintain H&S statistics log for near misses, as well as incidents.
- Provide H&S input to Contractors reports.

814. The HSS will be a suitably qualified and experienced full-time member of staff on the contractor's roster and should be on site at least five days per week. If the contractor works more than five days per week, or more than one shift, during days or hours off an alternate suitably qualified and experienced Senior Engineer having NEBOSH/IOSH certification or equivalent will be required to provide cover for them, acting on the advice of, and reporting to ESM.

815. The HSS will be supported (**for construction phase**) by full-time, dedicated, on-site Health and Safety Supervisors with at least one steward to each 50 persons to ensure each active construction site is to have adequate health and safety supervision to ensure the health and safety of all workers and local communities. They will require 5 years of supervision experience, a relevant bachelors degree and NEBOSH/IOSH certification or equivalent.

### 9.9.7 Labour Officer

816. The Labor Officer will have at least 5 years of labor management expertise including on construction sites with a bachelors in social science or related field. They will act as the GRM focal for workers at the construction site, operational plant, labor camp site/overnight accommodation for receiving and fixing grievances in the logbook. Responsible for organizing regular formal meetings and consultations with the workers. Conducts weekly checks of labor, sanitation and welfare facilities, ensures records of trainings, timesheets and pay slips are maintained, and communicates issues to the HSS and Contractor Management to ensure timely corrective actions where necessary. The Labour Officer will prepare the Labor Management Plan and manage all labor related issues in coordination with the ESM and HSS. **The labour Officer will be engaged for the construction phase only.**

### 9.9.8 Social and Community Liaison Officer (SCLO)

817. Responsible for organizing regular formal meetings and consultations with the community to keep them informed of progress, e.g. construction schedule and changes in the schedule and to receive feedback from the community on any related environmental and social issues (excluding resettlement and compensation issues which will be managed by separate NGO responsible for RIPP implementation). Records findings of consultations and communicates issues to the ESM and Contractor Management to ensure timely corrective actions where necessary. Completes weekly site visits to all neighboring villages to complete informal meetings with the community. The SCLO will act as the contractor's GRM focal to keep affected persons informed of works and be available to receive and deal with any grievances at the contractors' site level. Qualified with a Bachelors degree in social science or similar suitable qualification. They will have at least 5 years of experience in Stakeholder Engagement and Consultations for major infrastructure projects including experience in Assam and with indigenous peoples. Good understanding of social sensitivities of Assam and community structure and specialized consultation needs are essential. **SCLO will be engaged for the construction phase only.**

### 9.9.9 Management Systems

818. Contractors will have a corporate EHS policy and environmental management certifications including ISO 14001 (or equivalent) and H&S management certifications such as ISO 45001 or equivalent. For the SPP it must be ensured contractors have experience of working in natural habitats and to ensure adverse impacts due to their non-compliance are avoided e.g., clearing habitat contrary to the EMP etc.

### 9.9.10 Staff Costs

819. Table 106: Indicative Implementation Budget provides the staffing costs for EMP implementation.

### 9.9.11 Control of Records

820. The list of records that must be available by the contractor for review must include amongst others:

- Definitive IEE and EMP (as disclosed on the ADB website)
- Legal register (of applicable national and state legislation)
- Environmental, health and safety (labor) permits and licenses
- Contractor's certifications and insurances
- Tree felling permits, vehicle emission test certificates etc.
- Training plan and training records (including inductions)
- Community liaison plan, community awareness documentation and records of all consultations undertaken
- Records of emergency preparedness and response drills
- Document review and approval records
- C-SEMP and sub-plans and copies of approval records

- O-SEMP and sub-plans and copies of approval records
- D-SEMP and sub-plans and copies of approval records
- Completed site checklists and photographic records
- Copies of correspondence related to EHS issues
- Corrective and preventive action request records
- H&S Risk Assessment
- Incident record and incident reports
- GRM register
- Work program and schedule
- List of equipment and maintenance log
- Route/program of construction material transportation
- Records of maintenance and cleaning schedules for sediment and oil/grease traps
- Records of quantity of discharged wastewater and concentration of pollutants
- Waste disposal records and waste transfer notes including waste disposal sites and instructions for waste transportation
- Log of material inventories and consumption
- Chance find records (if any)
- Staff contracts, timesheets and pay slips
- Labor Camp / Overnight Accommodation Audit Reports
- Water Quality sampling results
- Air Quality and Noise test results
- EMF measurement results
- Property surveys
- Habitat surveys
- Tree inventory

821. These records shall be kept on-site by the Contractors' ESM and available for inspection at any time.

## **9.10 Project Management Consultant (for all works under SPP EMP)**

822. The PMC will support APDCL in ensuring the correct implementation of the EMP, and all related documents. It is assumed that the PMC will be engaged up until the end of the first three years of O&M. APDCL will then have an option to extend the consultancy or manage contractors themselves past this period, with respect to the remainder of O&M and the decommissioning phase.

### **9.10.1 Pre-construction Responsibilities**

823. The PMC shall be responsible for the following:

- a) Guiding APDCL on the implementation of the EMP during the pre-construction.

- b) Support APDCL in preparing a detailed training plan.
- c) Support delivery of safeguard training and capacity building activities and provide on-the-job guidance to APDCL safeguards staff and the contractors on ensuring compliance with the EMP requirements.
- d) Evaluate the environmental aspects of the contractors' method statements and working drawings and recommend corrective actions needed, if any, to ensure compliance with the environmental and social requirements.
- e) Supporting APDCL in reviewing the contractors' outline and detailed designs, their C-SEMP / O-SEMP and sub-plans for compliance with the EMP to ensure these documents incorporate and are in accordance with EMP requirements; recommend modifications to these documents to be compliant with: (a) the environmental and social requirements of the contracts and as reflected in the EMP, and (b) the <sup>[11]</sup><sub>SEP</sub> conditions of environmental approvals of the GoI or GoA, where required.
- f) Supporting APDCL in ensuring that their contractors secure all necessary CTE, CTO and other permissions before the commencement of related work, maintain records with copies of all the clearances, permits, licenses, and insurances obtained. Checking laborers have valid ID cards to access the site and the contractor has valid labour licenses and insurances including provisions for community liability during the period of construction and their operation.
- g) Provide guidance to the contractors on how their respective C-SEMP/O-SEMP will be implemented including the: (a) requirements for each mitigation measure, and (b) implementation schedule of each mitigation measure taking into consideration the general requirement that no specific construction or operational activity will be approved to be commenced if the associated mitigation measures for such activity are not ready <sup>[11]</sup><sub>SEP</sub> before work commences.
- h) Supporting APDCL in ensuring the contractor provides adequate EHS training to their subcontractors and all workers including communication of emergency plans, daily EHS toolbox talks and emergency mock response drills; topics for the trainings to be suggested based on site observations.
- i) Provide guidance to the PIU Safeguard Officers on the environmental and social aspects with emphasis on compliance monitoring and reporting.
- j) Developing formal systems and templates for APDCL staff, contractor, and PMC safeguard staff to supervise, monitor and report on day-to-day implementation all aspects of EMP implementation, including the immediate reporting of non-compliances, unanticipated impacts, accidents, chance finds, grievances etc.
- k) Develop the compliance monitoring system to be used for monitoring the contractors' performance relative to environmental requirements, including the preparation of: (a) monitoring and corrective action forms and checklists, (b) inspection procedures, and (c) documentation procedures.
- l) Conduct orientation sessions with the Contractors on the compliance monitoring system to be used, notification of non-compliance, and the process of requiring contractors to implement corrective measures when necessary <sup>[11]</sup><sub>SEP</sub>.
- m) Supporting APDCL in preparing a community liaison plan.
- n) Assist APDCL with establishing and operating the grievance redress mechanism, including creating a grievance record tracker which is to be updated on a weekly basis.

- o) Supporting APDCL in updating the IEE/EMP as required in consultation with ADB prior to approval of the outline or detailed designs to reflect any changes from the indicative designs assessed by the IEE.
- p) Supporting APDCL in reporting on EMP implementation within the quarterly progress reports and preparing EMRs for submission to ADB.

### 9.10.2 Construction and O&M Responsibilities

824. The PMC shall be responsible for the following:

- a) Guiding APDCL on the implementation of the EMP during construction and operation.
- b) Following the formal systems and templates developed for supervision and monitoring and support APDCL safeguards staff to undertake day-to-day supervision to ensure that contractors adhere to all the provisions in the EMP as well as their C-SEMPs / O-SEMPs and sub-plans as approved by APDCL.
- c) Keep daily records and photo logs of site observations to inform preparation of the semi-annual EMRs.
- d) Supporting monthly EHS meetings including site walkover inspection to determine the status of EMP implementation by the contractor during construction and operation as well as random “spot check” site visits to audit their EMP implementation.
- e) Reporting any unanticipated impacts, grievances, unsafe acts, or EMP violations to APDCL, identifying areas for improvement, and assist them in implementing solutions and remedial measures.
- f) Supporting APDCL in reporting on EMP implementation within the quarterly progress reports and preparing EMRs for submission to ADB.
- g) Supporting APDCL with updating of the IEE/EMP as necessary if any unanticipated impacts (including project scope or design changes) occur during implementation.
- h) Supporting APDCL to undertake ongoing meaningful consultation with affected communities to keep them informed of progress and with local disclosure of the findings of the IEE and EMRs etc.
- i) Supporting operationalization of the GRM and assisting APDCL in resolving grievances received.

### 9.10.3 Upon Completion of Contract

825. The PMC shall prepare a report on each contract's environmental and social compliance performance, including lessons learned that may help APDCL in their environmental monitoring of future projects at the end of construction, and upon activity completion in respect of the O&M phase. The reports will be an input to the overall project completion report.

### 9.10.4 Reporting

**Table 103: PMC Reporting Responsibilities**

Documents	Responsible Person	Destination of the documents	Submission timing		
			Design period	Construction period	O&M period
Compliance reports	IES, IHSS	PIU, ADB	X (every month)	X (every month)	X (every month)
Completion reports	IES, IHSS	PIU, ADB		X (at completion of construction phase contract)	X (at completion of project)

### 9.10.5 PMC Staff

826. The PMC shall have the following named staff on their roster. They will also be able to call upon all necessary experts to support these more generalist consultants with resolving any site-specific issues and to deliver the capacity building trainings; experts to be available on a call-off basis.

Figure 77: PMC Environmental, Social, Health and Safety Team



### 9.10.6 International Environmental Specialist (IES)

827. The IES will work closely with the contractors' ESM and the APDCL safeguards team on general environment focused tasks associated with EMP implementation such as conducting environmental trainings and briefings to provide environmental awareness on ADB and national environmental safeguards policies, requirements and International industry good practices; ensuring baseline monitoring and reporting of the contractors' compliance with environmental mitigation and monitoring measures during design, pre-construction, construction and operation.

828. The IES will (i) review all documents and reports regarding the integration of environment aspects including the Contractors' C-SEMP / O-SEMP and subplans, (ii) supervise the Contractors' compliance to the EMP/C-SEMP/O-SEMP, and (iii) prepare monthly compliance reports.

829. The IES shall have a Master's degree in environmental science / environmental management, or other relevant environment fields. He/she should have at least 15 years of total experience in carrying out environmental impact assessment and management of infrastructure projects and minimum of 10 years' experience in supervision, monitoring and implementation of EMPs and preparing environmental monitoring reports, including for solar power and transmission line projects. Specific tasks include:

- a) Informed by the EMP training requirements assist APDCL in identifying training needs for PIU and preparing the training plan with suitable trainings on environmental, health, safety and labor issues including on-site trainings.
- b) Conduct training sessions for PIU staff, resident PMC staff, and contractors on the requirements and implementation of the EMP on at least a bi-annual basis with orientation will be conducted prior to contractor being given access to site for site establishment, preparation and clearance.
- c) Assist APDCL to establish a multi-layer Grievance Redressal Mechanism including GRC to resolve the grievances of environment, health, and safety (labor) matters in a timely manner, raising awareness of its existence with the affected communities and keeping documentation.
- d) Ensure that all necessary clearances, consents & permissions (including but not limited to CTE, CTO, hazardous wastes permit, labour licenses etc.) from Assam State Pollution Control Board, Forest Departments and other line departments are in place.
- e) Obtain and maintain a copy of all environment related statutory clearances and permits required for implementation EMP.
- f) Assist APDCL to implement, monitor and supervise the EMP and solve environmental issues that may arise during the pre-construction, construction and operation stage.
- g) During the preparation of bidding documents, ensure APDCL include environmental responsibilities as explained in the IEE as “Environmental Contract Specifications (ECS)” and review the bidding documents to confirm that necessary EMP provisions and a copy of the disclosed EMP (as per ADB website) are included in the contracts prior to award for further implementation and compliance.
- h) Assist APDCL to review outline and detailed designs to confirm they incorporate all EMP measures and also review the Contractor’s C-SEMP / O-SEMP and subplans.
- i) Ensure that recent, up to date information disclosure and meaningful consultations have been conducted and that all the primary baseline physical, chemical and biological data of environmental elements including per the EMoP pre-construction requirements are in place prior to contractor being given access to site for site establishment, preparation, and clearance.
- j) Ensure that the location and timing of checking / testing all environmental parameters are in accordance with the EMoP and results are reflective of site and seasonal conditions.
- k) Prepare or review (if already existing) monitoring checklists for weekly, fortnightly, and monthly checklists (as necessary) for monitoring implementation of the EMP by the contractor and by PMC EHS team.
- l) Facilitate monthly EHS meetings/site walkovers during the construction period to check APDCL and resident EHS supervision and monitoring activities and adequate implementation of EMP measures and, advise APDCL and contractors if improvements are needed, document each site visit in field visit note including photographs. In addition to monthly site visits carry out at least quarterly in-depth environment audits and random spot checks of all contractors to verify compliance.
- m) Assist PIU in undertaking quantitative monitoring required by the EMoP and provide advice (e.g. templates) for adequate record keeping for environmental monitoring purposes.
- n) Facilitate ongoing information disclosure (including local IEE and EMR disclosure) and consultations between APDCL, the contractor and local people or other relevant agencies where necessary, prepare a community liaison plan, and assist APDCL in conflict resolution on environmental issues during executing stage of the SPP.



Maintain proper records of all environment related grievances and consultations and details on how they were addressed.

- o) Help APDCL and the contractors respond to any environmental grievances and to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues.
- p) Based on review of the IEE and EMP, make necessary updates/amendments (including conducting additional meaningful consultations) for ADB review and clearance if design/scope changes occur or any other unanticipated impacts arise during implementation and any issues are not covered.
- q) Prepare EHS good practice guidelines and SOP for operational EHS management for adoption by APDCL, as the mechanism by which the O&M EMP measures will be implemented.
- r) Prepare or review (if already existing) reporting formats for monthly, quarterly, semiannual monitoring reports of the contractor.
- s) Prepare monthly, quarterly, and EMRs (on agreed template) based on at least monthly site visits to all active construction sites and completed checklists for submission to the APDCL and ADB throughout implementation.
- t) Preparation of completion reports at the end of the construction contracts and on the implementation activities of the EMPs. The reports shall document with photographs all good practices adopted (so that such practices can be incorporated in future projects), trainings and workshops conducted, and the improvements noticed after training, consultations and analysis of grievances redressal.

### **9.10.7 National Ecologist**

830. The Expert will have a Master's or a higher degree in ecology or related field. They will have relevant professional experience of 15 years or more in undertaking ecological survey (flora and fauna) and assessments with particular expertise in botany. At least 5 years of supervision of vegetation clearance and construction works in the field. Flora and fauna survey experience in the Northeast states of India and Assam is required. Experience in training and developing good practice guidance is essential. Specific tasks for the specialist will be:

- a) Support the IES to deliver their tasks with respect to the biological environment, providing training on biodiversity requirements, ensuring outline and detailed designs, C-SEMP / O-SEMP and subplans are reflective of biodiversity requirements,
- b) Monitor in coordination with the forest department implementation of the compensatory reforestation plan for tree cutting and the restoration of disturbed land ensuring that no net loss of biodiversity is achieved,
- c) Conduct ecology surveys and checks per the EMP/EMoP, conduct ongoing consultations with the forest department and local persons regarding wildlife sightings, oversee the wildlife encounter protocol, and supervise all vegetation clearance/cutting of trees, demolition works, earthworks, and all works located within forest or scrub habitat even if not designated forest land,
- d) Participate in monthly EHS meetings/site walkovers.
- e) Provide ecological inputs to development of good practice EHS guidelines and SOP for operation and providing APDCL staff training on the same.

- f) Provide ecological inputs to monthly, quarterly, EMRs (on agreed template) based on at least monthly site visits to all active construction sites and completed checklists for submission to the APDCL and ADB throughout implementation.

### **9.10.8 International Health and Safety Specialist (IHSS)**

831. The expert will have a Master's degree in field related to construction health and safety management and a recognized formal construction health and safety qualification e.g. IOSH or NEBOSH is essential. They will have at least 15 years' experience in carrying out health and safety supervision, monitoring and implementation of occupational and community health and safety plans for construction of major infrastructure projects. Experience in facilitating health and safety risk assessment workshops, trainings, and developing good practice guidance is essential. Specific tasks include:

- a) Lead on H&S training activities, ensuring detailed designs, C-SEMP / O-SEMP and subplans are reflective of H&S requirements, etc.
- b) Facilitate health and safety risk assessment workshops for the design, construction, and operational risks to be attended by APDCL and their contractors and resulting in risk assessments that will inform approval of detailed designs and the development of H&S Plans under the C-SEMP / O-SEMP.
- c) Participate in monthly EHS meetings/site walkovers. Undertake at least monthly site visits to all active work sites during the construction period.
- d) In addition to monthly site visits, carry out at least quarterly in-depth H&S audits and random spot checks of all contractors to verify compliance.
- e) Help APDCL to respond to any H&S incidents including incident reporting and corrective action.
- f) Provide H&S inputs to development of good practice EHS guidelines and SOP for operation and providing APDCL staff training on the same.
- g) Provide H&S inputs to monthly, quarterly, EMRs (on agreed template) based on at least monthly site visits to all active construction sites and completed checklists for submission to the APDCL and ADB throughout implementation.

### **9.10.9 National Labour Specialist**

832. The expert will have a Bachelor's degree or higher in field related to labor law and a minimum of 5 years of work experience in compliance to labor laws and labor acts, factory act, workforce management and related fields. Specific tasks as follows:

- a) Support the IES to deliver their tasks with respect to labor, leading on labor training activities, ensuring detailed designs, C-SEMP / O-SEMP and subplans are reflective of labor requirements, etc.
- b) Participate in monthly EHS meetings/site walkovers. Undertake at least monthly site visits to all active work sites during the construction period.
- c) In addition to monthly site visits, carry out at least quarterly in-depth labor audits including of labor camp/overnight accommodation, sanitation and welfare facilities, and random spot checks of contractors to verify compliance
- d) Help APDCL to respond to any labor disputes including incident reporting and corrective action. Facilitate consultations between the contractor and workers or other relevant agencies where necessary and assist APDCL in conflict resolution on labor

issues during executing stage of the activity. Maintain proper records of all labor related grievances and consultations and details on how they were addressed

- e) Provide labor inputs to development of good practice EHS guidelines and SOP for operation and providing APDCL staff training on the same.
- f) Provide labor inputs to monthly, quarterly, EMRs (on agreed template) based on at least monthly site visits to all active construction sites and completed checklists for submission to the APDCL and ADB throughout implementation.

#### 9.10.10 National Resident Environment, Health and Safety Specialist

833. The expert will have a degree or a higher qualification in a field related to health and safety, with at least 5 years of experience in construction industry, preferably of renewable energy projects or major civil works or major transmission/distribution works. The specialist will spend at least 90% of the allocated time on site. They will be responsible for the following:

- a) Day-to-day supervision to ensure that the Contractor adhere to all the EHS provisions in the Environment Management Plan (EMP);
- b) Report any violations to IES, IHSS and Labor Officer as appropriate and assist in implementing solutions and remedial measures;
- c) Coordinate the implementation of the grievance redressal mechanism and assist APDCL to resolve on-going issues of environmental, social and health impacts during construction.

#### 9.10.11 Staff Costs

834. The Table 14 provides the staffing costs for EMP implementation.

### 9.11 EMP/C-SEMP/O-SEMP D-SEMP Review and Update

835. The contents of the EMP/C-SEMP/O-SEMP/D-EMP will be reviewed and updated periodically to evaluate the environmental controls and procedures therein to make sure they are still applicable to the activities being carried out and effective. Reviews will be undertaken by the contractors, PMC and PIU as follows:

- Full EMP/C-SEMP/O-SEMP will be reviewed in detail on an annual basis, decommissioning is not anticipated to take longer than 12 months;
- Relevant parts of the EMP/C-SEMP/O-SEMP/D-EMP will be reviewed following a reportable or major incident;
- Relevant parts of the EMP/C-SEMP/O-SEMP/D-EMP will be reviewed in case of any issues/grievances or failure of mitigation to reduce impacts occurs; and
- Relevant parts of the EMP/C-SEMP/O-SEMP/D-EMP will be reviewed following the receipt of an updated site specific or topic specific sub plan.

836. The review will include analysis of the monitoring data, monitoring reports, incident reports, complaints/grievances, and feedback from stakeholders. Any update to the EMP requires ADB review and clearance, whilst any update to the C-SEMP/O-SEMP/D-EMP requires APDCL and PMC review and clearance.

### 9.11.1 Corrective Actions

837. If any performance standards are breached or any of the safeguard requirements that are covenanted in the loan agreements are found not to be satisfactorily complied with by APDCL and their contractors, an appropriate, time bound, budgeted, corrective action plan (CAP) will be developed and implemented as agreed upon with ADB to rectify unsatisfactory performance or safeguard noncompliance. PIU and PMC will also issue corrective action requests to the contractor during their day-to-day supervision and monitoring of EMP Implementation as required.

### 9.12 Meetings and Site Visits

838. PIU will convene monthly EHS meetings to be attended by contractor's management and EHS team to discuss progress; initially progress will be discussed in relation to design actions and as the activity progresses will move onto pre-construction, construction and operational actions. During the monthly EHS meetings areas for improvement, unsafe acts, and any non-compliances, time-bound corrective actions and responsibilities to address them will be discussed, agreed, and documented. PIU EO, PIU SSO and PIU HSO and the PMC will be given delegated authority to instruct the contractor to take corrective action at any time in relation to EMP implementation, alternative the person holding the delegated authority must immediately act upon their instruction.

839. For any ADB supervision missions to ongoing construction works contractors will provide all ADB staff or staff consultants with a site health and safety induction and adequate PPE in accordance with Table 2.7.1 of the IFC EHS General Guidelines - Occupational Health and Safety Section.

### 9.13 Capacity Development

840. To build capacity of PIU and the contractors for implementation of the EMP and other safeguard requirements, a training program will be delivered. The training program will be implemented as per training modules provided in the following table, training needs will be further determined and elaborated in a training plan. Training modules can be changed during construction phase based on requirements of the contractors. The basic objective of giving training to the different stakeholder is to enhance their capabilities for implementation of the EMP and EMoP during construction and operation.

841. Delivery of the training program is part of the SPP cost that includes institutional strengthening, capacity building and training whilst the contractor will factor in their attendance within the contract amount.

842. It is recommended that the training be given:

- Upon the award of contracts to each contractor
- Before the start of construction work Including site establishment, preparation and clearance
- Refresher(s) during construction
- Before commencement of O&M.

**Table 104: Training Requirements**

<b>Training Session</b>	<b>Required Attendees/Recipients</b>	<b>Delivery Mode/Duration</b>	<b>Training Conducted by</b>	<b>Budget Source</b>
Introduction to ADB's Safeguard Policy Statement (2009), IFC EHS Guidelines, GOI and GOA requirements, and EMP including EMOP	PIU, Contractors' Management and EHS Teams	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES and IHSS	PMC Budget
EMP implementation for outline and detailed design	PIU Contractors' Design Teams and EHS Teams	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES, IHSS, and Ecologist	PMC Budget
Facilitated common design workshop (design stage)	PIU, Contractors Management, Design, and EHS Teams	Facilitated workshop In Person/ 1-3 days	Safeguard Unit of PIU / PMC IES, IHSS and Ecologist	PMC Budget
Biodiversity management and classification of habitat types	PIU, Contractors Management, Design, and EHS Teams	Lecture session, presentation, and discussion. In Person/ 1 day	PMC IES and Ecologist with Expert Support on habitat classification per ADB SPS 2009	PMC Budget
Facilitated H&S workshop (design stage)	PIU, Contractors Management, Design, and EHS Teams	Facilitated workshop In Person/ 1 day	PMC IHSS and Resident EHS Supervisor	PMC Budget
E-waste management (initial run at start of project, and then again at start of construction and commencement of operation)	PIU, Contractors Management, Construction, and EHS Teams	Lecture session, presentation, and discussion. Online/ 0.5 day	Safeguard Unit of PIU / PMC IES with Expert Support on e-waste Gol legislation	PMC Budget
GRM operation (initial run at start of project, and then again at start of construction and commencement of operation)	All GRM levels- GRM Focal Points, GRC, PIU, Contractors Management, EHS Team, GRM Focal Points of Contractors, Local Government Representatives,	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES and Resident EHS Supervisor	PMC Budget
EMP implementation for pre-construction and construction, including workshop on C-SEMP preparation	PIU, Contractors' Construction and EHS Teams	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES, IHSS, Ecologist and Labor Expert	PMC Budget
Site preparation and vegetation management	PIU, Contractors' Construction and EHS Teams	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES and Ecologist	PMC Budget
Facilitated H&S workshop (construction stage)	PIU, Contractors Management, Construction, and EHS Teams	Facilitated workshop In Person/ 1 day	PMC IHSS and Resident EHS Supervisor	PMC Budget
Environmental quality monitoring	PIU, Contractors Management and EHS Teams	Lecture session, presentation, and discussion.	Safeguard Unit of PIU / PMC IES, IHSS and	PMC Budget

Training Session	Required Attendees/Recipients	Delivery Mode/Duration	Training Conducted by	Budget Source
requirements; site supervision and monitoring including use of detailed monitoring framework (checklists) and preparing period Environmental Monitoring Reports		In Person/ 2 days	Resident EHS Supervisor	
Site restoration	PIU, Contractors Management, Construction, and EHS Teams	Lecture session, presentation, and discussion. Online/ 0.5 day	Safeguard Unit of PIU / PMC IES, Ecologist and Resident EHS Supervisor	PMC Budget
EMP implementation for operation, including workshop on O-SEMP preparation	PIU, Contractors' Operation and EHS Teams, APDCL O&M team	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of PIU / PMC IES and IHSS	PMC Budget
Facilitated H&S workshop (operation stage)	PIU, Contractors Management, Operation, and EHS Teams, APDCL O&M team	Facilitated workshop In Person/ 1 day	PMC IHSS	PMC Budget

## 9.14 Implementation Schedule

843. The definitive version of ADB disclosed EMP shall be incorporated into the contract document/request for proposal. Strictly no contracts will be awarded until this is incorporated. Further, no site establishment, preparation, clearance or construction activity is to take place before APDCL has received and approved the contractor's C-SEMP including all sub-plans. Tentative implementation schedule of the SPP is listed in the following table. The contractors will submit a more detailed implementation schedule for the detailed design, pre-construction, construction and operation once the contract is awarded.

**Table 105: Key EMP Milestones in Implementation Schedule**

S. No	Description	Indicative Time Frame
1	SPP Implementation	
A	Bidding Documents	01-07-2024 to 01-10-2024
B	Procurement	01-10-2024 to 01-01-2025
C	Construction commencement	01-01-2025 to 01-04-2025
D	Construction Completion	20-06-2026 to 30-09-2026
E	Defects Liability Period	540 days from end of construction.
2	Pre-Construction and Construction Phase	
A	Implementation of mitigation measures and conduct environmental monitoring for which APDCL is responsible	Immediate implementation, noting EMP requirements must be reflected in contract for which bidding documents may be issued prior to ADB project approval
B	Establishment of GRM	Immediate implementation, latest within one month of loan effectiveness, or before start of works on site if sooner.

S. No	Description	Indicative Time Frame
C	Nomination (appointment) of APDCL PIU EO, PIU SSO and PIU HSO (safeguards unit)	Latest within one month of loan effectiveness for the PIU safeguard support, or before start of works on site if sooner.
D	Appointment of PMC	PMC must be appointed within three months of loan effectiveness and prior to the approval of outline and detailed design, C-SEMP approval, site establishment, preparation, clearance etc.
E	Implementation of mitigation measures and conduct environmental monitoring for which contractor is responsible	Upon award of the contract
F	Updating the IEE/EMP to reflect final design and obtaining ADB clearance of update	Prior to approval of the outline and detailed design (as needed)
G	Submission and approval of the Construction Specific Environmental Management Plan (C-SEMP)	One month before the start of works including any site establishment, preparation and clearance work
H	Monthly EMR for Project's Monthly Progress Report	5 <sup>th</sup> day after effective month (covering the month prior)
I	Semi-Annual EMR during construction for submission to ADB	15 <sup>th</sup> day after effective 6-months; the last construction EMR will be submitted after the commissioning and DLP of all works documenting in depth how all pre-construction and construction activities were complied with
J	Restoration of construction sites	Before demobilization of construction contract
K	Submission and approval of the Operation Specific Environmental Management Plan (O-SEMP)	One month before the start of operation of SPP
4	Operation Phase	
A	Implementation of mitigation measures and monitoring activities for operational period	Upon commissioning
B	Monthly EMR for Project's Monthly Progress Report	5 <sup>th</sup> day after effective month (covering the month prior)
C	Annual EMR during operation for submission to ADB	15 <sup>th</sup> day after effective 6-months; the first operational EMR will be submitted 12 months after the last construction EMR was submitted up until the ADB PCR is issued
5	Decommissioning Phase	
A	Implementation of mitigation measures and monitoring activities for decommissioning period	Upon decommissioning
B	Monthly EMR for Project's Monthly Progress Report	5 <sup>th</sup> day after effective month (covering the month prior)

## 9.15 Budget

844. Costs will be associated with implementation of the mitigation plan, EMoP and capacity development. Necessary budgetary provisions must be planned and allocated by APDCL for implementing the environmental measures of the SPP as part of the EMP. The main EMP budget items have been identified for implementing the environmental management and monitoring and capacity development activities required, and an indicative budget allocated for each. The budget will be refined during implementation but enables preparedness for financial requirements.

845. For contract related costs, these are only an estimate based on an estimate of the construction and installation cost, since the contracts are subject to competitive bidding it will be for the contractor/consultants to reflect in their BOQ and ensure adequate budget is provided in their bids for the EMP implementation. The construction EMoP will be part of the contractor's contract. The CTU SPP TL costs will be borne by them and are not included in this budget, except for supervision and monitoring staff that will be shared and bird diverters which APDCL may need to procure if CTU contractors are to fit them to the SPP TL.

**Table 106: Indicative Implementation Budget - Staff**

Item	Quantity	Estimated Rate (\$)	Estimated Total Amount (\$)	Budget Source
<b>PIU Safeguard Unit – during 24 months construction and 3 years O&amp;M (after this period annual rates can be applied)</b>				
PIU Environmental Officer	60 months	1,200	72,000	APDCL
PIU Social Safeguards Officer	60 months	1,200	72,000	APDCL
PIU Health and Safety Officer	60 months	1,200	72,000	APDCL
Training session expenses	500/session x 14	-	7,000	APDCL
Expenses for consultation, GRM etc.	100/60 months	-	6,000	APDCL
<b>PMC Safeguard Specialists – During construction and 3 years O&amp;M (after this annual rates can be applied if needed)</b>				
International Environmental Specialist	15 months	15,000	225,000	PMC Contract
International Occupational Health and Safety Specialist	12 months	15,000	180,000	PMC Contract
National Biodiversity Specialist	12 months	1,500	18,000	PMC Contract
National OHS Specialist	12 months	1,500	18,000	PMC Contract
National Labour Specialist	18 months	1,500	27,000	PMC Contract
National Social Safeguards Specialist	12 months	1,500	18,000	PMC Contract
National Gender Specialist	6 months	1,500	9,000	PMC Contract
National Community Development and Livelihood Specialist	6 months	1,500	9,000	PMC Contract
<b>Contractor's Safeguards Team – Provided on a monthly basis</b>				
Environment and Social Manager – <b>All Phases</b>	-	1,200	-	Contractors Contract
Health and Safety Specialist (with NEBOSH/IOSH) – <b>All phases</b>	-	1,200	-	Contractors Contract
Health and Safety Specialist per specialist (number of staff depends on construction method statement) – <b>Construction phase only</b>	-	1,000	-	Contractors Contract
Ecologist – <b>Construction phase only</b>	-	1,200	-	Contractors Contract
Botanist – <b>Construction phase only</b>	-	1,200	-	Contractors Contract
Labor Officer – <b>Construction phase only</b>	-	1,200	-	Contractors Contract
Social and Community Liaison Officer – <b>Construction phase only</b>	-	1,200	-	Contractors Contract



**Table 107: Indicative Implementation Budget - General**

Activity	Item	Quantity	Estimated Rate (\$)	Estimated Total Amount (\$)	Budget Source
Block 4	Component 1a (Package 1, Lot 1) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Contractors Contract
Block 5	Component 1a (Package 1, Lot 2) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Contractors Contract
Block 1	Component 1b (Package 2, Lot 1) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Contractors Contract
Block 3	Component 1b (Package 2, Lot 2) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Contractors Contract
Block 2	Component 2 (lot 1) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Private Sector Contractors Contract
Block 6	Component 2 (lot 2) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	858,000	Private Sector Contractors Contract
Pooling SS	Component 1c (Package 3) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	200,000	Contractors Contract
SPPI	Component 1d (Package 4) Contractor's EMP implementation cost (including PPE provision) – estimated at 1.2% of civil works costs (0.2% to cover O&M phase)	Lump sum	-	498,000	Contractors Contract
Block 4	Component 1a (Package 1, Lot 1) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	8,974	Contractors Contract
Block 5	Component 1a (Package 1, Lot 2) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	8,218	Contractors Contract
Block 1	Component 1b (Package 2, Lot 1) Pre-construction/construction/commissioning	Lump sum	-	8,974	Contractors Contract

Activity	Item	Quantity	Estimated Rate (\$)	Estimated Total Amount (\$)	Budget Source
	oning environmental quality monitoring EMoP				
Block 3	Component 1b (Package 2, Lot 2) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	8,974	Contractors Contract
Block 2	Component 2 (Lot 1) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	8,974	Private Sector Contractors Contract
Block 6	Component 2 (Lot 2) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	8,542	Private Sector Contractors Contract
Pooling SS	Component 1c (Package 3) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	7,886	Contractors Contract (O&M APDCL)
SPPI	Component 1d (Package 4) Pre-construction/construction/commissioning environmental quality monitoring EMoP	Lump sum	-	13,130	Contractors Contract (O&M APDCL)
All SPP Lots and Packages	Tree Compensation (additional budget from CTU for SPP TL required, not yet quantified)	2,395	25	59,875	APDCL
SPP TL	Habitat Surveys (final route)	1,000	1	1,000	CTU or APDCL
SPP TL	Bird Diverters	1,200	50	60,000	CTU or APDCL
SPP TL	Carcass Surveys	1,000	24	24,000	CTU or APDCL
<b>Total</b>				<b>6,063,611</b>	

**Table 107: Sub-component 1a: Package 1 Lot 1 (Block 4) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	2 (TBC)	6	648
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				

Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				
Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
<b>Total Monitoring Budget</b>				<b>8,974</b>

**Table 108: Sub-component 1a: Package 1 Lot 2 (Block 5) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air Quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2	6	432
Air Quality	157	2	6	1,884
Water quality	54	1 (TBC)	6	54
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				
Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
<b>Total Monitoring Budget</b>				<b>8,218</b>

**Table 108: Sub-component 1b: Package 2 Lot 1 (Block 1) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				

Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	2 (TBC)	6	648
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				
Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
<b>Total Monitoring Budget</b>				<b>8,974</b>

**Table 109: Sub-component 1b: Package 2 Lot 2 (Block 3) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	2 (TBC)	6	648
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				

Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
Total Monitoring Budget				<b>8,974</b>

**Table 110: Component 2a Lot 1 (Block 2) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	2 (TBC)	6	648
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	2 (TBC)	1	108
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				
Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
Total Monitoring Budget				<b>8,974</b>

**Table 111: Component 2a: Lot 2 (Block 6) Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
<b>Pre-Construction</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	1 (TBC)	6	324
Drinking water source for potability	60	1 (TBC)	6	360

Commissioning and First Year O&M				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
Ongoing O&M (2 <sup>nd</sup> and 3 <sup>rd</sup> Years)				
Noise	36	1	Annual per EMOP – 2	72
Air Quality	157	1 (TBC)	Annual per EMOP – 2	314
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120
Total Monitoring Budget				<b>8,543</b>

**Table 112: Sub-component 1e: Pooling Substation Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
Pre-Construction				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source for potability	60	1 (TBC)	1	60
Construction				
Noise	36	2 (TBC)	6	432
Air quality	157	2 (TBC)	6	1884
Water quality	54	1 (TBC)	6	54
Drinking water source for potability	60	1 (TBC)	6	360
Commissioning and First Year O&M				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	2	1	72
Air quality	157	2	1	314
Water quality	54	1 (TBC)	1	54
Drinking water source	60	1 (TBC)	1	60
EMF	36	1	1	36
Ongoing O&M (2 <sup>nd</sup> and 3 <sup>rd</sup> Years)				
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120 (APDCL)
Total Monitoring Budget				<b>7,886</b>

**Table 113: Sub-component 1d: Package 4 SPPI Environmental quality monitoring budget**

Parameters per Monitoring Plan	Rate in USD	Quantity/location	Frequency	Total in \$
Pre-Construction				

Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	5	1	180
Air quality	157	5	1	785
Water quality	54	5 (TBC)	1	270
Drinking water source for potability	60	1 (TBC)	1	60
<b>Construction</b>				
Noise	36	5 (TBC)	6	1080
Air quality	157	5 (TBC)	6	4710
Water quality	54	5 (TBC)	6	270
Drinking water source for potability	60	1 (TBC)	6	360
<b>Commissioning and First Year O&amp;M</b>				
Property and Physical Cultural Resources	N/A	1	1	1000
Tree and Habitat Surveys	N/A	1	1	1000
Noise	36	5	1	180
Air quality	157	5	1	785
Water quality	54	5 (TBC)	1	270
Drinking water source	60	1 (TBC)	1	60
<b>Ongoing O&amp;M (2<sup>nd</sup> and 3<sup>rd</sup> Years)</b>				
Drinking water source	60	1 (TBC)	Annual per EMOP – 2	120 (APDCL)
<b>Total Monitoring Budget</b>				<b>13,130</b>

## **X. CONCLUSIONS AND RECOMMENDATIONS**

### **10.1 Conclusions**

846. This IEE study has established that in general there are no significant environmental issues that cannot be either totally prevented or adequately mitigated to levels acceptable to the national standards and international good practice guidelines. Mitigation and monitoring measures have been included in the EMP for this solar PV component, incorporated into the IEE study, which will ensure that residual impacts are of medium to low negligible significance. APDCL will implement the EMP measures ensuring adequate budget and human resources are allocated.

847. However, several residual impacts of high significance have been identified that do require further attention during implementation relating to the SPP TL, e.g., impacts to natural habitat. In addition, issues relating to access across the site have been raised by the community and it is important that this issue and PCR impacts are further assessed in close collaboration with the community during the detailed design phase by APDCL, contractors and the private sector.

### **10.2 Recommendations**

848. The EMP for this solar PV component, its mitigation and monitoring programs, will be included within the bidding documents for works and requests for proposals from the private sector by APDCL. The bid documents/request for proposal will state that contractors or the private sector will be responsible for the implementation of the requirements of the EMP allocated to them (including detailed design, O&M and decommissioning phase actions) and preparing their own Construction Specific EMP (C-SEMP), O&M Specific EMP (O-SEMP) and Decommissioning Specific EMP (D-SEMP), which will adopt all the conditions of the EMP and add in site specific elements that are not currently known, such as storage and camp locations. This will ensure that all potential bidders are aware of the environmental requirements of this solar power plant and factor in environment, health and safety and other costs. The EMP and all its requirements will then be added to the contractor or private sector's contract, thereby making implementation of the EMP a legal requirement according to the contract. The contractors will then prepare their detailed designs and SEMP's which will be approved by APDCL with their works supervised and monitored by them. APDCL will also supervise and monitor CTU associated facility activities. Should APDCL note any non-conformance with the EMP (and SEMP's) the contractors or private sector can be held liable for breach of the contractual obligations. To ensure compliance contractors and the private sector are required to employ a team of environment, health and safety experts to monitor and report activities throughout the phases they are responsible for. Project Management Consultants will also include environment, health and safety experts to support APDCL with supervision and monitoring of EMP implementation and to build the capacity of APDCL.

849. This IEE including EMP are considered sufficient to meet the environmental assessment requirements of ADB for the solar power plant at project approval stage. However, before the detailed designs and resettlement site(s) are approved by APDCL and works commence on site, and in case of change in scope or other unanticipated impact, the need for the IEE study to be updated to reflect the final detailed designs and resettlement sites selected will be determined in consultation with ADB, and any update (or addendum) reviewed, and cleared by ADB for disclosure on the ADB website and locally.



850. Lastly, it is important to note that there are several important issues raised in this report relating to the SPP TL which will be the responsibility of CTU and their contractor to implement. This IEE study has made recommendations that should be adopted by CTU, including the requirement for bird diverters, consideration of alignment changes, etc. However, the SPP TL is an associated facility and is not funded by ADB or the project. Associated facilities should achieve an outcome consistent with the project (e.g. environmental, health and safety management, meaningful consultation and informed participation, information disclosure, grievance redress, no significant conversion or degradation of natural habitat, no reduction in the population of critically endangered or endangered species, no net loss of biodiversity, and no significant damage to PCR etc.) but the decision to adopt the mitigation measures can only be taken by CTU in coordination with APDCL.