Initial Environmental Examination

Project Number: 51308-009
June 2022

India: Tripura Power Distribution Strengthening and Generation Efficiency Improvement Project

Tripura State Electricity Corporation Limited Distribution Component

Volume 1: Main Report

Prepared by Tripura State Electricity Corporation Limited, Department of Power, Government of India for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 30 March 2022)

Currency unit	-	Indian rupee (Rs)
Rs1.00	=	$ 0.0132
$1.00	=	INR 75.86

ABBREVIATIONS

AAAC	All Aluminum Alloy Conductor
ABC	aerial bundled conductor
ACSR	Aluminum Conductor Steel Reinforced
ADB	Asian Development Bank
ASI	Archaeological Survey of India
AT&C	aggregate technical and commercial losses
BIS	Bureau of Indian Standards
CAP	corrective action plan
CEA	Central Electricity Authority
CGWA	Central Ground Water Authority
CPCB	Central Pollution Control Board
CTE	Consent to Establish
CTO	Consent to Operate
CWLW	Chief Wildlife Warden
DPR	detailed project report
EHS	environmental, health and safety
EHSG	environmental, health safety guidelines
EIA	Environmental Impact Assessment
EMF	electromagnetic field
EMoP	environmental monitoring plan
EMP	environmental management plan
EPC	engineering, procurement and construction
ESD	electrical subdivision
ESMP	environmental and social management system
ESZ	ecologically sensitive zone
GHG	greenhouse gas
GIIP	good international industry practice
GRC	grievance redressal committee
GRM	grievance redress mechanism
HDD	horizontal directional drilling
HoFF	Head of the Forest Force
HVDS	high voltage distribution system
IBA	important bird area
IBAT	Integrated Biodiversity Assessment Tool
ICNIRP	International Commission for Non-Ionizing Radiation Protection
IEE	initial environmental examination
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	key biodiversity area

LBS	load break switches
MOEF&CC	Ministry of Environment, Forest, and Climate Change
MRSS	Main Receiving Substation
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board of Testing and Calibration Laboratories
NBWL	National Board of Wildlife
NGT	National Green Tribunal
NSRCC	Netaji Subhas Regional Coaching Centre
OHL	overhead line
O&M	operation and maintenance
PAI	project area of influence
PCB	polychlorinated biphenyl
PCC	Plain Cement Concrete
PCC	power control center
PCCF	Principal Chief Conservator of Forests
PCR	physical cultural resources
PIA	project area of influence
PIU	project implementation unit
PMU	project management unit
POP	persistent organic pollutant
PPE	personal protective equipment
RMU	ring main unit
ROW	right of way
SEAA	State Level Environmental Impact Assessment Authority
SPCB	state level pollution control board
TDS	Total Dissolved Solids
TERC	Tripura Electricity Regulatory Commission
TPCB	Tripura Pollution Control Board
TSECL	Tripura State Electricity Corporation Limited
TTAADC	Tripura Tribal Areas Autonomous District Council
TVM	Tri-vector Meter
WHO	World Health Organization
WLS	wildlife sanctuary

WEIGHTS AND MEASURES

dB(A)	-	A-weighted decibel
amp	-	ampere
ckm	-	circuit km
km	-	kilometer (1000 meters)
kV	-	kilovolt (1000 volts)
kWh	-	kilowatt-hour (1000 watts)
kWp	-	kilowatt peak
LV	-	low voltage
m	-	meter
sqm	-	square meter
MVA	-	mega volt ampere (1000 kVA)

NOTES

In this report, "$" refers to US dollars unless otherwise stated.

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EXECUTIVE SUMMARY

1. The Government of India has requested the Asian Development Bank (ADB) to finance a project comprising distribution strengthening and generation efficiency improvement to help improve energy security, power quality, efficiency, and resilience of the power sector in the state of Tripura. The project will be implemented over five years with a completion date by December 2027.

2. Under Output 2 and Output 3 of this project, Tripura State Electrical Corporation Limited (TSECL) will develop a more resilient distribution network, establish a test laboratory, and install smart meters, including advanced metering infrastructure. The proposed distribution component will strengthen and modernize the power distribution network, reduce technical losses, and increase the reliability of the distribution network of TSECL. To achieve this objective, the scope of the distribution component includes: (i) renovate and modernize 27 existing 33/11 kilovolts (kV) substations, including control room equipment and protection systems; (ii) install 150 auto-reclosers, 350 sectionalizers, and 2,000 fault passage indicators at 11 kV and 33 kV lines, supply of cable fault locator and test van; (iii) install and upgrade 2,667 km of 11 kV, 33 kV and low tension distribution lines including the supply and installation of 100 ring main units associated with underground cabling and a high voltage distribution system (HVDS) pilot for agricultural feeders in areas of sparse settlement to also address issues of unauthorized power tapping in one electricity subdivision, (iv) set up a modern test laboratory for testing and maintenance of distribution equipment and to act as a training center for TSECL staff and engineers; and (v) replacement of 100,000 household meters with smart meters and advanced metering infrastructure for smart metering systems establishment. ADB will finance these components through a project loan. Successful implementation of the project will improve reliability of supply to residential and commercial customers in the state. A reliable electricity supply will lead to social and economic benefits and improved conditions for schools, hospitals, and other social services. The executing agency for the ADB loan will be the Power Department, Government of Tripura. The implementing agency for the distribution component will be TSECL.

3. This initial environmental examination (IEE), which includes the environmental management plan (EMP) for the distribution components of the project, is prepared in compliance with ADB's Safeguard Policy Statement (2009), and national environmental, health and safety requirements. Per ADB's Safeguard Policy Statement (2009), the project is categorized as A for environment due to the generation component under Output 1 having the potential to result in significant adverse irreversible or diverse environmental impacts and requiring an Environmental Impact Assessment. Output 2 and Output 3 are unlikely to cause any such environmental impacts due to the following facts: (i) overhead distribution components are mostly in semi-urban and rural areas which do not support high biodiversity values; no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; (ii) some distribution components are located in dense urban/city areas which will involve conversion from overhead to underground lines, again no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; and (iii) there will not be any major, large-scale civil or structural works involved in the distribution component, most works will be electrical and mechanical. Construction of a new building of up to 3 floors for the test laboratory will be the largest civil or structural works. Overall construction, operation and maintenance of the distribution components is likely to give rise to direct, indirect, and, induced environmental impacts that are mostly minor/low in magnitude, site-specific, generally reversible, temporary and of short duration primarily during construction works. Potential impacts and risks can be easily mitigated through the adoption of international good practices for environmental management as set out in the

International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines including the General Guidelines and those on Electric Power Transmission and Distribution dated 30 April 2007. The selection and design of new equipment will comply with national requirements as well as considering international good practice per the IFC EHS Guidelines particularly with respect to avoiding the use of polychlorinated biphenyl (PCB) oil in the purchase of new transformers (already banned in India) and the use of all asbestos containing materials in the new construction. Therefore, significant adverse irreversible, diverse, or unprecedented environmental impacts are unlikely to arise for Outputs 2 and 3 and this IEE was prepared to document the environmental assessment.

4. Of the protected areas in Tripura, Bison National Park in Trishna Wildlife Sanctuary, Clouded Leopard National Park in Sepahijala Wildlife Sanctuary and Rudrasagar Lake Ramsar site support critical habitat. The state supports critical habitat for two species and possible critical habitat for seven species mostly associated with habitat in and around the wildlife sanctuaries. Within a 10 km project area of influence (PAI) around the 27 existing substations and test laboratory site, Rajnagar 33/11 kV substation is the closest to a legally protected area (Trishna Wildlife Sanctuary) at 633m, but it is outside the notified ecologically sensitive zone (ESZ). Panisagar 33/11 KV substation is 2.7 km away from Rowa Wildlife Sanctuary and its notified ESZ. Melaghar 33/11 kV) is 2.3km from Rudrasagar Lake Important Bird Area and Ramsar Site, Jatanbari substation is about 6km from Gumti Wildlife Sanctuary and about 6.5 km from Damboor Lake which is a proposed Ramsar Site, and the test laboratory is about 6.5 km from Sepahijala Wildlife Sanctuary including the Clouded Leopard National Park. Within 10 km of the 27 existing substations the nearest notable Archaeological Survey of India (ASI) and Government of Tripura protected cultural resources are the state protected Ujjayanta Palace at Agartala (823 m from Netaji Subhas Regional Coaching Centre (NSRCC) substation); an ASI Ancient Mound (Shyamsundar Ashram Tilla) at Jolaibari (1.4 km from Jolaibari substation); the state protected Neermahal Water Palace at Melaghar (2.9 km from Melaghar substation); and ASI sculptures and rock-cut reliefs at Unakoti (7.5 km from Kailasahar substation). All these works are on modified habitat within the boundaries of existing substations and a sub-divisional office and no critical habitat species or chance finds are likely to be encountered within the sites.

5. The principles that have been (and will be) adopted by TSECL for the selection of route alignments of the various distribution lines are: (i) use existing alignments and/or the road Right of Ways (ROW) wherever available; (ii) avoid legally protected areas including national parks, wildlife sanctuaries, protected ASI and Government of Tripura monuments; (iii) avoid other internationally and nationally recognized sites such as Key Biodiversity Areas, Important Bird Areas, ESZ, notified forest areas including protected forests, reserve forests and proposed reserved forests, and the regulated area associated with protected ASI and Government of Tripura monuments; and (iv) minimize damage to existing trees and properties encroaching into existing RoWs ensuring safety clearances are maintained. Undergrounding and conversion of existing bare conductors to covered and aerial bundled conductors shall be helpful in reducing existing electrocution risks to wild animals. None of the new indicative or existing 33/11 kV route alignments are passing (or will pass) through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972 although some are within 10km and very near to the boundary of the ESZ e.g., 11kV Digalbagh Feeder is 147m from Rowa Wildlife Sanctuary ESZ. Rudrasagar Lake is also avoided. Neither are any new indicative or existing 33/11 kV distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300m from) ASI or Government of Tripura protected monuments. Some existing low-tension distribution lines may route alongside roads that pass through or adjacent to notified forest areas and protected monuments (e.g., Boxarnagar Electrical Sub-Division supports forest range and has low-tension lines adjacent to the Boxarnagar Stupa, an ASI protected monument) — in such locations once

the low-tension lines have been mapped site-specific assessment and management planning with full time ecological and/or archaeological supervision will be required with rerouting outside the area of concern or undergrounding rather than reconductoring the preferred option. Since the distribution routes assessed are only indicative and will not be finalized until the contractors are on board, during project implementation this IEE and EMP will need to be updated and cleared by ADB with any government clearances or permissions obtained before distribution routings are approved by TSECL and works commence.

6. Site visits (reconnaissance surveys) to sample distribution lines were conducted based on a district sensitivity matrix developed for the distribution component; approximately 93.5 ckm (35%) of the 33 kV lines (both underground and overground covered conductor) out of a total length 270 ckm, 102.6 ckm (7%) of 11 kV lines (including both covered conductor and underground cables) out of a total 1,497.46 ckm and 80 ckm (9%) of 0.4 kV lines out of a total of 900 km were surveyed. The total km visited was 276.1km out of the total 2,667 km, a 10% sample. No critical habitat species were encountered during site visits; but District Forest Officials have reported sightings of the two primate species and the following may occasionally be encountered in modified habitat along the distribution lines for which mitigation measures include pre-construction ecological checks prior to tree cutting or earthwork, prohibiting poaching and firewood collection by construction workers, the adoption of bird and primate sensitive design to minimize electrocution risk etc. Their presence or absence is to be confirmed by field ecologists during route surveys: *Aquilaria malaccensis* (Agarwood, a globally critically endangered species) where trees present especially in plantation, *Nilssonia nigricans* (Black Softshell Turtle, a globally critically endangered species) if temple ponds crossed, *Gyps bengalensis* (White-rumped Vulture, a globally critically endangered and Schedule I species under the Wild Life Act, 1972), *Manis pentadactyla* (Chinese pangolin, a globally critically endangered and Schedule I species under the Wild Life Act, 1972) in rural areas, and *Trachypithecus phayrei* (Phayre's Leaf Monkey, a globally endangered and Schedule I species under the Wild Life Act, 1972) and *Macaca leonina* (Northern Pig Tailed Macaque, a globally vulnerable and Schedule II Part 1 species under the Wild Life Act, 1972) in rural areas/plantation especially within 10km of Wildlife Sanctuaries. In Kanchanpur subdivision of North Tripura district, definite critical habitat for the critically endangered, endemic gecko *Cyrtodactylus montanus* is found with records including those from rocky roadside cuttings adjacent forest areas above 600 m asl. Ecology survey would be needed to confirm its presence or absence; but no distribution line works are proposed in its mapped area of occurrence in the Jampui Hills block, starting about 1.75km south of Vangmung substation. For all distribution lines the District Forest Officers will be actively engaged by TSECL and the contractors throughout project implementation. A wildlife identification and rescue protocol will be adopted, to be further developed in consultation with forest and wildlife officials as per site-specific requirements with all vegetation clearance and earthworks undertaken under ecological supervision. No physical cultural resources were identified along the sample distribution lines that would be directly impacted, but care will need to be taken to avoid damage to those adjacent to the route alignment. Many existing distribution lines to be reconducted especially low-tension lines were observed to be passing over houses with poles located in private compounds whilst some were seen to cross school compounds or playgrounds. To uphold safety clearances and minimize community health and safety risks during operation rerouting is required as part of reconductoring works with great care taken in dismantling the existing conductors.

7. Potential environmental impacts were identified in relation to the design, location, construction, operation and maintenance of the distribution infrastructure and mitigation measures have been developed in respect of all potentially negative impacts identified. Potential construction impacts relate to disturbance of land in the substation and test laboratory footprints and the ROW of distribution lines as well as adjacent communities with pollution, health and safety

risks to workers and the community if the construction activities are not well managed by TSECL and their contractors. Pollution, health and safety risks to workers and the community will remain during operation and maintenance works. Environmental audit of the 27 existing substations identified the presence of old equipment, particularly transformers that leak and which may contain PCB oil, depending on the date of manufacture and schedule of oil replacement. Based on assessment against United Nations Industrial Development Organization (UNIDO) guidance at least one substation was identified as being at risk of having transformers containing PCBs. Any removal, storage, and disposal of phased out transformers will be done in accordance with international good practice and the Government of India's regulations. Outside of the scope of the distribution component, Government of India regulations already require TSECL to complete the de-chlorination or the removal of all PCB-contaminated transformers before 31 December 2025.

8. Small informal group community consultations were conducted during preparation of the IEE, including at existing substations, the test laboratory and along sample distribution line routes for consultees to express any views on environmental and social conditions, or concerns they had regarding the distribution components. In total 174 participants (28% female and 72% male) were consulted for the distribution component. The consultations were conducted along sample distribution lines visited, during substation audits, and at the test laboratory site. The consultations were held between December 2020 and May 2022. Meaningful consultations were limited because of COVID-19 advisories and large gatherings not being permissible at the time of site visits. Further, for rural substations, being in more isolated locations away from village centers adjacent receptors were either absent or few, resulting in a lower rate of consultation participation. Since consultations were primarily based on on-the-spot discussions women participants were very rare, making female representation poor for the distribution component. No significant environmental and social concerns were raised, although in rural areas existing unemployment and water availability issues were reported. Overall, all consulted were looking forward to the benefits of improved electricity services. This IEE will be made available by TSECL to the public and will be disclosed to a wider audience locally (with executive summary translated into Bengali language) via the TSECL website, TSECL offices (Head Office, Circle and Division), all 27 existing substations, and other construction site offices. Meaningful consultation will be continued during implementation of the distribution component to ensure all interested stakeholders and affected local communities are fully engaged, have an opportunity to raise any concerns before the commencement of works, and can inform the development and implementation of final routings of distribution lines etc. To address distribution component-specific issues from affected persons, a Grievance Redress Mechanism will be established by TSECL, the details of which will be disseminated to local communities during future consultations.

9. An EMP has been prepared for the distribution component. The EMP includes (i) corrective action for existing facilities i.e. 27 existing substations; (ii) mitigation measures for environmental impacts during implementation, including ensuring detailed designs take into account biodiversity and physical cultural resource measures, the high seismic risk of the state, and climate change adaptation measures; upholding safety clearances especially where existing lines pass over houses rerouting as needed, and avoiding passing over school compounds or playgrounds; adhering to electromagnetic field (EMF) exposure, dust and noise guideline levels; ensuring drinking water quality for workers; approving contractor's wildlife identification and rescue protocol, pollution prevention, solid and hazardous waste management, and health and safety management plans prior to works; prohibiting PCB use in new transformers and asbestos containing materials in construction; and, community awareness raising activities by TSECL and the contractors on the health and safety risks of distribution infrastructure; and (iii) an environmental monitoring program, including monitoring of health and safety incidents. The responsible entity for mitigation, monitoring, and reporting is TSECL. Mitigation measures will be

assured by a program of environmental supervision and monitoring to be conducted during the construction and operation stages. Any unanticipated impacts or requirements for corrective action during implementation of the distribution component will be reported by TSECL to ADB.

10. TSECL will establish a safeguard unit initially as part of the project management unit to support with EMP implementation, supervision, and monitoring during both construction and operation. This will be staffed with a suitably qualified and experienced Environmental and Social Safeguard Officer and a Health and Safety Officer (with professional certification) both with 12-15 years of experience. Project implementation consultants will include an Environment Consultant (with ecological expertise) and Health and Safety Consultant with professional certification to assist with site-specific assessment and provide on-site support, as well as capacity building and trainings. Further, the Engineering, Procurement and Construction (EPC) Contractor will be required to have suitably qualified and experienced, dedicated on-site counterpart staff including an Environment Manager and Health and Safety Manager with professional certification supported by several health and safety stewards on-site. ADB TA consultants will help TSECL develop standard operating procedures (SOP) addressing the environment, health and safety impacts and risks of its substations, test laboratory and maintenance including recording of any occupational and community health and safety incidents.

11. This IEE including EMP are considered sufficient to meet the environmental assessment requirements of ADB for the distribution component. However, following selection of final route alignments but before the commencement of works, and, in case of any unanticipated scope or design changes occurring during project implementation, this IEE and EMP will be updated by TSECL and cleared by ADB.

I. INTRODUCTION

A. Project Background and Rationale

1. Tripura is the second most populated state amongst the north-eastern states of India after Assam with a total population of about 4.1 million.[1] It shares about 850 km of international border with Bangladesh to the west, north and south and Mizoram and Assam on the eastern side. Tripura's economy is predominately agrarian which accounts for about 47% of Tripura's gross state domestic product in 2017–2018 and about 42% of the population depends on agriculture and its allied activities.[2] Despite having an opportunity to become the economic gateway between Northeast India and Bangladesh which offers enormous potential for international trade, the state remains industrially backward due to its poor infrastructure facilities.

2. Tripura state's per capita electricity consumption of 470 kilowatt-hours (kWh) is far below the national average of 1,122 kWh in 2017[4] due to limited economic activity. However, Tripura has achieved 100% household electrification (825,938 consumers)[3] as of March 2019 under Prandhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhaya)[4] based on government records of formal connections. Though the Saubhaya scheme has improved the last mile connectivity, the lack of upstream distribution strengthening investment results in an unreliable electricity supply for consumers. The poor quality of electricity supply is one of the contributory factors to low socio-economic development in Tripura, compared to other progressive states.

3. The existing distribution network is aged, overloaded and uses older technologies making its operation and maintenance challenging, particularly during heavy rain, storms and mist that are common in many parts of the state. To meet the Government of Tripura's objective of connecting the unconnected and supplying 24x7 quality, reliable and affordable power supply to domestic, commercial, agriculture and industrial consumers within a fixed time, the 24x7 Power for All (PFA) programme was launched in 2016 by Government of Tripura with active support from the Government of India.[5] The program had aspired to supply reliable electricity in the state and it was planned to achieve loss reductions by bringing down both commercial and technical losses by up to 15% by FY2020 under the mandate of the Ujwal DISCOM Assurance Yojana scheme. The Aggregate Technical and Commercial (AT&C) losses in FY2018-19 were still 29.6%.[6] As of 2022, there has been a delay in achieving the targets. This is due to multiple reasons including a lack of upstream distribution strengthening with lengthy distribution feeders, lack of modern protection and monitoring devices, under sized conductors and inadequate number and capacity of distribution substations and transformers. There is also a lack of adequate funds within the Government of Tripura required to meet the O&M challenges exacerbated by the low revenue generation from power distribution due to high AT&C losses, power theft, inaccurate / obsolete meters, aged assets, high and subsidized tariff for poor and agricultural consumers leading to below cost revenue recovery that has led to the poor financial sustainability of the distribution utility and makes it less attractive for private sector participation. Power reliability issues continue

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[1] The population of Tripura as per data obtained from Unique Identification Aadhar India updated on 31 May 2020. Government of India. 2020. *Unique Identification Authority of India.* Delhi.

[2] Government of Tripura. 2017. *Economic Review of Tripura, 2017–2018.* Tripura.

[3] Tripura State Electricity Corporation Limited. 2019. *Detail Project Report (Distribution Component)*

[4] Saubhagya scheme is a Government of India project that aims to attain 100% electrification and provide free electricity to households below the poverty line. The scheme provides the last-mile connection to all interested households with no upfront fees for the electricity connection.

[5] Government of India and Government of Tripura. 2016. *24x7 Power For All.* Delhi. https://powermin.gov.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_tripura.pdf

[6] Tripura State Electricity Corporation Limited. 2019. *Detail Project Report (Distribution Component)*

to remain unaddressed under the current energy sector schemes of Government of Tripura resulting in customer dissatisfaction and reduced economic output.

4. Tripura State Electricity Corporation Limited (TSECL) is the authority responsible for power sector planning, transmission, and distribution and was established or corporatized from Tripura Power Department on 1 January 2005 once the Electricity Act 2003 was enacted. TSECL functions under the oversight of the Power Department, Government of Tripura, which is headed by a secretary rank officer who is also the chairman (non-executive) of TSECL (ex officio). The Power Department sets the various policies and strategies related to power generation, transmission, distribution, and rural electrification in the state along with liaison with the central government on issues related to power. As of March 2019, TSECL, owns around 29,389 circuit kilometers (ckm) of low-tension lines, around 14,819 ckm of 11 kV lines and 891 ckm of 33 kV lines. 66 kV and above lines up to 400 kV account for 1,393 ckm. The total transformation capacity at different transmission voltage levels is 1,125 megavolt amperes (MVA) (Table 1-1).

Table 1.1 Summary of Existing Distribution Network

Sl. No.	Particulars	Unit	Capacity
1	Low tension line (overhead)	ckm	28,398
2	Low tension line (underground)	km	50
3	Low tension line (ABC)	km	941
Low tension total		**ckm**	**29,389**
4	11 kV Line (overhead)	ckm	14,247
5	11 kV Line (underground)	km	416
6	11 kV Line (ABC)	km	156
11 KV total		**ckm**	**14,819**
7	33 kV Line (overhead)	ckm	870
8	33 kV Line (underground)	km	21
33 kV total		**ckm**	**891**
Total Distribution line (11 kV, 33 kV and low tension)		**ckm**	**45,099**
9	Capacity of Distribution Transformers (DTRs)	MVA	1,125
10	No. of DTRs	No.	15,403

ABC = aerial bundled conductor, DTR = distribution transformer, kV = kilovolt, MVA = megavolt-amperes
Source: TSECL

5. Additional investments are required by Government of Tripura in the existing distribution network to ensure adequacy, efficiency and reliability in the distribution system and improve commercial viability. Government of India has requested Asian Development Bank (ADB) to finance a project comprising distribution strengthening and generation efficiency improvement to help improve energy security, power quality, efficiency, and resilience of the power section in Tripura. ADB will provide a loan of $220.00 million under the *Tripura Power Distribution Strengthening and Generation Efficiency Improvement Project.* It will be aligned with the following impacts: power quality, efficiency financial sustainability and resilience of power sector in Tripura improved.[7] The project will have the following outcome: energy security in Tripura improved. The proposed loan has four outputs:

(i) Output 1: Rokhia power plant upgraded to double its capacity and its efficiency[8]
(ii) Output 2: Resilience of distribution network strengthened and modernized.
(iii) Output 3: Smart meters and advanced metering infrastructure established.

[7] Government of India and Government of Tripura. 2016. *24X7 Power For All.* Delhi.
[8] Separate EIA has been prepared for Output 1, the draft disclosed on 8 March 2022 is available at: https://www.adb.org/projects/documents/ind-51308-009-eia

(iv) Output 4: Institutional capacity for planning, implementation, financial management, and gender mainstreaming improved.[9]

6. Under Outputs 2 and 3 the distribution component of the project will:

(i) Renovate and modernize of 27 33/11 kilovolts (kV) distribution substations including control room equipment and protection systems (25 existing substations plus one under construction substation and one recently commissioned substation under separate funding arrangement, which will become part of distribution network being upgraded).
(ii) Install 150 auto-reclosers, 350 sectionalizers, and 2,000 fault passage indicators at 11 kV and 33 kV lines, supply of cable fault locator and test van.
(iii) Install and upgrade 2,667 ckm of 11 kV, 33 kV and low tension 0.4 kV distribution lines including 143.46 km of underground cables (new 33/11kv and existing 11kV overhead conversion), 1,624 km of covered conductor overhead lines (new 33/11kV and existing 11kV overhead conversion) and 900 km of low tension 0.4kV lines conversion to aerial bundled conductors (ABC) including the supply and installation of about 100 ring main units associated with underground cabling and a high voltage distribution system (HVDS) pilot for agricultural feeders in areas of sparse settlement to also address issues of unauthorized power tapping in one electricity subdivision.
(iv) Set up a modern test laboratory for testing and maintenance of distribution equipment (distribution transformers, other materials and equipment procured from suppliers prior to field use) and act as a training center for TSECL staff and engineers within the grounds of an existing TSECL Sub-Division office at Gokulnagar.
(v) Replacement of 100,000 household meters with smart meters and advanced metering infrastructure for smart metering systems establishment.

7. The executing agency for the ADB loan will be the Power Department, Government of Tripura. The implementing agency for the distribution component (Outputs 2 and 3) will be TSECL. The loan will be on-lent by Government of India through the Government of Tripura to TSECL (as implementing agency). TSECL shall finance contingencies and project management expenses using counterpart funds.

B. Initial Environmental Examination and Approach

1. Requirement for Initial Environmental Examination

8. 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 to ensure that projects (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible;

[9] Output relates to capacity development and will have no environmental impact. It is therefore not considered further in the IEE. However, the supporting TA to this output will support preparation of the distribution sector roadmap that will outline the investment, strategies, and policies to meet future demand and service standards in which strategic environmental implications should be considered by TSECL. It will also support effective supervision and monitoring of construction including safeguards, and pilot testing of gender-sensitive workplace practices and incentivization of the engagement of women workers in some contracts under the project.

and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. All ADB projects must comply with the requirements of ADB's Safeguard Policy Statement, 2009 and Operational Manual F1, 2013 to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process.

9. 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. For a Category A project, an Environmental Impact Assessment (EIA) including an Environmental Management Plan (EMP) is required. For a Category B project, an Initial Environmental Examination (IEE) including an EMP is required and for a Category C project, an EIA or IEE is not required, although environmental implications need to be reviewed e.g., through preparation of a due diligence report.

10. The project has been categorized as Category A for environmental safeguards by ADB due to the potential for Output 1 to result in significant irreversible and diverse adverse impacts including the climate change impacts of using natural gas as fuel. Thus, an EIA was undertaken. Output 2 and Output 3 are unlikely to cause any such environmental impacts due to the following facts: (i) overhead distribution components are mostly in semi-urban and rural areas which do not support high biodiversity values; no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; (ii) some distribution components are located in the dense urban/city areas which will involve conversion from overhead to underground lines, again no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; and (iii) there will not be any major, large-scale civil or structural works involved in the distribution component, most works will be electrical and mechanical. Construction of a new building of up to three floors for the test laboratory will be the largest civil or structural works. Overall construction, operation and maintenance of the distribution components is likely to give rise to direct, indirect, and, induced environmental impacts that are mostly minor/low in magnitude, site-specific, generally reversible, temporary and of short duration primarily during construction works. Potential impacts and risks can be easily mitigated through the adoption of international good practices for environmental management as set out in the International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines including the General Guidelines and those on Electric Power Transmission and Distribution dated 30 April 2007. The selection and design of new equipment will comply with national requirements as well as considering international good practice per the IFC EHS Guidelines particularly with respect to avoiding the use of polychlorinated biphenyl (PCB) oil in the purchase of new transformers (already banned in India) and the use of all asbestos containing materials in the new construction. Therefore, as significant adverse irreversible, diverse, or unprecedented environmental impacts are unlikely to arise this IEE along with EMP has been prepared covering the potential adverse environmental impacts and risks of Output 2 and 3 to ensure they are assessed and mitigated in

compliance with ADB's Safeguard Policy Statement 2009.

C. Initial Environmental Examination Methodology

11. The IEE has been undertaken on behalf of TSECL by a team of ADB funded environment technical assistance consultants: national environment expert and team leader, Dibyendu Banerjee; national ecological expert, Arijit Choudhury; and national social expert, Samarendar Narayan Jena, between December 2020 and May 2022.

12. The IEE report describes the direct, indirect, cumulative, and induced impacts and risks of the distribution components on biological, physical, social, and physical-cultural resources in the study area during the construction and O&M phases. Direct impacts will be confined to existing substation footprints, the footprint of the sub-divisional office in which the test laboratory will be constructed, and right of ways (ROWs) of distribution line alignments. The assessment of environmental impacts and risks has been confined to the project area of influence as defined in ADB's Safeguard Policy Statement (2009). The general corridor of potential impact was taken as a 500 m radius around the existing substations/subdivisional office and 50m buffer along the distribution line alignments.

13. The IEE process involves the identification, scoping and assessment of the potential and perceived environmental, social, health and safety risks and impacts of the distribution component. It also involves the identification of avoidance and mitigating measures and the preparation of the EMP that shall be implemented and monitored to address the identified risks and impacts of the distribution component. The approach and methodology used to conduct the IEE is as follows:

(i) The IEE has been undertaken based on a review of the latest detailed project report (December 2019) developed by Development Consultant Pvt. Ltd. (DCPL) for TSECL, this included an initial list of substations and work required, a list of 33 kV and 11 kV distribution lines and works required together with indicative lengths, and a list of sub-divisions for the low tension 0.4kV conversions, plus the draft bidding documents.[10]

(ii) Review of Government of India and Government of Tripura guidelines, policies, regulations, and ADB Safeguard Policy Statement 2009 requirements. For standards and measures to adopt, international best practice guidelines, including the World Bank Group-IFC Environment, Health and Safety (EHS) general guidelines and the guidelines for Power Transmission and Distribution were referred.

(iii) Site visits (reconnaissance surveys) to sample distribution line alignments included in the scope (Annexure 1 and Table 1-2) were conducted based on a prepared district sensitivity matrix; the TA consultants visited approximately 93.5 ckm (35%) of the 33 kV lines (both underground and over ground covered conductor) out of a total length 270 ckm, 102.6 ckm (7%) of 11 kV lines (including both covered conductor and underground cables) out of a total 1,497.46 ckm, and 80 ckm (9%) of 0.4 kV lines out of a total of 900 km of low tension lines in the scope of work.

[10] It will be a requirement that the final route alignments and substation designs of the EPC contractors comply with the standards and measures specified in this IEE and the EMP and have the same or less environmental impact than is currently predicted. The IEE will need to be updated once the final route alignments, designs and construction methods have been submitted by the EPC contractors to TSECL for approval. The updated IEE report will be reviewed and cleared by ADB and disclosed prior to approval being issued by TSECL to the EPC contractors to commence works. The IEE may need to be updated again later to reflect any further changes in scope or design.

(iv) EHS audits of 27 existing substations were conducted, all 27 existing substations that shall be renovated and modernized under the distribution component were visited and audited (Annexure 2).

(v) Site visit (reconnaissance survey) to the test laboratory site at an existing TSECL Sub-Division office at Gokulnagar, about 10 km from Agartala city, was conducted.

(vi) Discussions with TSECL, consultation with other stakeholders, and public consultations. Consultations were held with probable affected persons, persons inhabiting in the nearby areas of the substations that are to be renovated, modified or bay extended and other stakeholders including the Chief Wildlife Warden and District Forest Officers while adhering to the official protocols for COVID-19 as issued by the Government of Tripura.

(vii) Site visits, audits, and consultation with the public and Forest/Wildlife Officials were conducted in December 2020, March 2021, October 2021, and April-May 2022 by the TA consultants along with the TSECL officials.

(viii) Collect primary and secondary baseline data for the substations and test laboratory as well as distribution lines. Primary baseline data was collected by an external agency (MITCON) for one season at 14 sample substations with respect to physical parameters, whereas secondary baseline data were relied on for the distribution lines, on the basis impacts would be lesser than those in the substations due to the transient, short duration of works at each location. Since the test laboratory site was identified after this monitoring was undertaken primary baseline data was not collected for it and will need to be obtained by the contractor pre-construction. The selection of the physical baseline monitoring sites and parameters were based on the presence of sensitive/vulnerable receptors near the substations and those that will involve the most civil works during implementation. Primary data (based on site observations at the substations, test laboratory and sample distribution line surveys) plus secondary data including integrated biodiversity assessment tool (IBAT) analysis were used for the ecological assessment. Socio-economic baseline data were informed by the Government of India, Census 2011 and observations made during the site visits.

(ix) Identifying, scoping, and evaluating the environmental (physical, biological, socioeconomic, and physical cultural resources) risks and impacts at different stages of implementation (construction and O&M) guided by the national and ADB environment safeguards framework. Impact assessment was informed by site visits, analysis of primary and secondary baseline data, and discussion with the TSECL project team.

(x) Development of mitigation measures based on identified impacts and risk to address the potential adverse impacts and develop an environmental monitoring plan (EMoP), budgeting for EMP implementation, GRM (workers and community), institutional strengthening, capacity building, monitoring, supervision, and reporting plan. The EMP including EMoP are to be an integral part of all bidding documents and Engineering, Procurement and Construction (EPC) contract documents.

14. The distribution component will be implemented by TSECL through EPC contractors. The locations of the 25 existing substations plus one under construction and one recently commissioned substation (both under separate funding arrangements) as well as the existing site for the test laboratory are fixed. However, as distribution line routings will be determined by the EPC contractors, the IEE is based on indicative routing alignments for a sample of the 2,667 km of distribution line connecting the 27 substations. Following selection of the final alignments, this IEE and EMP will need to be updated and cleared by ADB. The IEE and EMP will also be updated

and revised, if necessary, if there are any unanticipated impacts including a scope or design change. Any changes to the IEE and EMP will be subject to ADB clearance and disclosure.

15. For the purposes of the IEE, 19 33kV, 11kV and low-tension distribution lines (both OHL and UG cables) were visited by the ADB TA consultants. The total km visited is 276.1 km out of the total proposed line 2,667 km, a 10% sample. It should be noted that the indicative routing alignments assessed by the ADB TA consultants (Figure 1-1) may alter following the completion of detailed route surveys during the detailed design process and thus all routes are to be reassessed during implementation.

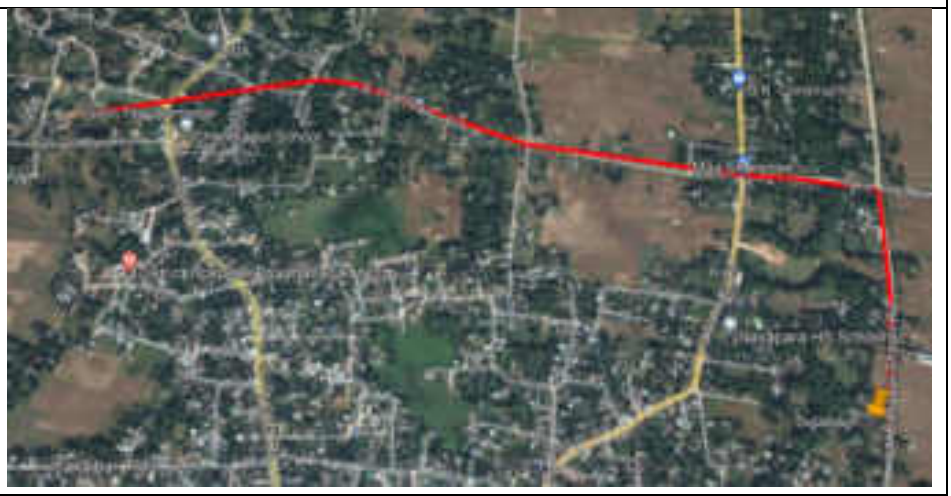
Table 1.2 Sample Distribution Lines Surveyed by ADB TA Consultant for Initial Environmental Examination

Administrative District	Electrical Circle	Electrical Division	Distribution line surveyed	Scope of work (DPR)	Status in Bid Document	km covered by survey
North Tripura	North	Dharmanagar	33 kV Mission Tilla - Panisagar-Dhamchara Line	12km 33kV new feeder with covered conductor	Pkg II, Lot 3	12
	Dharmanagar	Dharmanagar	11 kV Digalbagh Feeder to bifurcate existing Raghna Feeder 61km	8km 11kV new feeder with covered conductor	Pkg II, Lot 3	8
	North	Panisagar	33 kV Pecharthal Substation to 33 kV Panisagar Substation	16km 33kV new feeder with covered conductor	Pkg II, Lot 3	16
Khowai	Khowai	Teliamura	132 kV Gamaitilla Substation to 33kV Kalyanpur Substation	15km 33kV new feeder with covered conductor	Pkg II, Lot 2	15
West Tripura	Circle 1	Division 1, Agartala	33kV underground from 79 Tilla Grid 132 kV Substation to 33 kV Rampur Substation	6km 33kV new underground feeder	Pkg II, Lot 1	6
	Circle 1	Division 2, Agartala	33 kV underground from SM Nagar Subsation to Charipara Substation via Badharghat Substation	14km 33kV new underground feeder	Pkg II, Lot I	14
	Circle 1	Division 1, Agartala	33 kV underground from Adarsha Colony Substation to College Tilla Substation	3.5km 33kV new underground feeder	Pkg II, Lot I	3.5
	Circle 1	Division 2, Agartala	33kV underground from Bodgangnagar Substation to 33 kV Adarsha Nagar Colony Substation	15km 33kV new underground feeder	Pkg II, Lot I	15
	Circle 1	Division 2, Agartala	Aananda Nagar 11kV Feeder	18km 11kV conversion to covered conductor	Pkg II, Lot I	18
	Circle 1	Division 2, Agartala	11kV Golchakar to Dashamighat via Joypur	3.6km 11kV conversion to underground line	Pkg II, Lot I	3.6
	Circle 1: Agartala	Division 2, Agartala	ESD Sekherkote	15km conversion of Low Tension (0.4kV) Line to ABC	Pkg II, Lot I	15
	Circle 2: Agartala	Jirania	ESD Mandwi	20km conversion of Low Tension (0.4kV) Line to ABC	Pkg II, Lot I	20

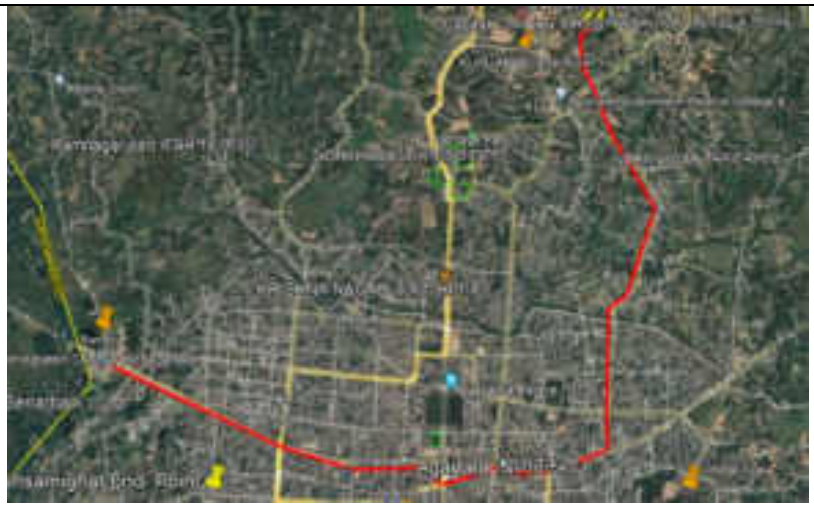
Administrative District	Electrical Circle	Electrical Division	Distribution line surveyed	Scope of work (DPR)	Status in Bid Document	km covered by survey
Sipahijala	Sepaijala	Bisalgarh	66 kV Gokulnagar Substation to 33 kV Madhupur Substation	14km 33kV new feeder with covered conductor	Pkg III, Lot 1	14
	Sepahijila	Bisalgarh	Dayarampur Feeder to bifurcate the existing Golaghati Feeder 99 km	46km new 11kV new feeder with covered conductor	Pkg III, Lot I	46
	Sepahijila	Rabindranagar	ESD Boxarnagar	25km conversion of Low Tension (0.4kV) Line to ABC	Pkg III, Lot I	25
South Tripura	South	Bagafa	66kV Bagafa Substation to 33kV Jolaibari Substation	18km 33kV new feeder with covered conductor	Pkg III, Lot 3	18
	Belonia	Santir Bazar	Bagfa Feeder to bifurcate the existing Santirbazar New Feeder 88km	15km 11kV new feeder with covered conductor	Pkg III, Lot 3	15
	Belonia	Belonia	Chittamura Feeder to bifurcate the existing Monaicherra Feeder 110 km	12 km 11kV new feeder with covered conductor	Pkg III, Lot 3	12
	Belonia	Sabroom	ESD Poangbari	20km conversion of Low Tension (0.4kV) Line to ABC	Pkg III, Lot 3	20
Total						**276.1**

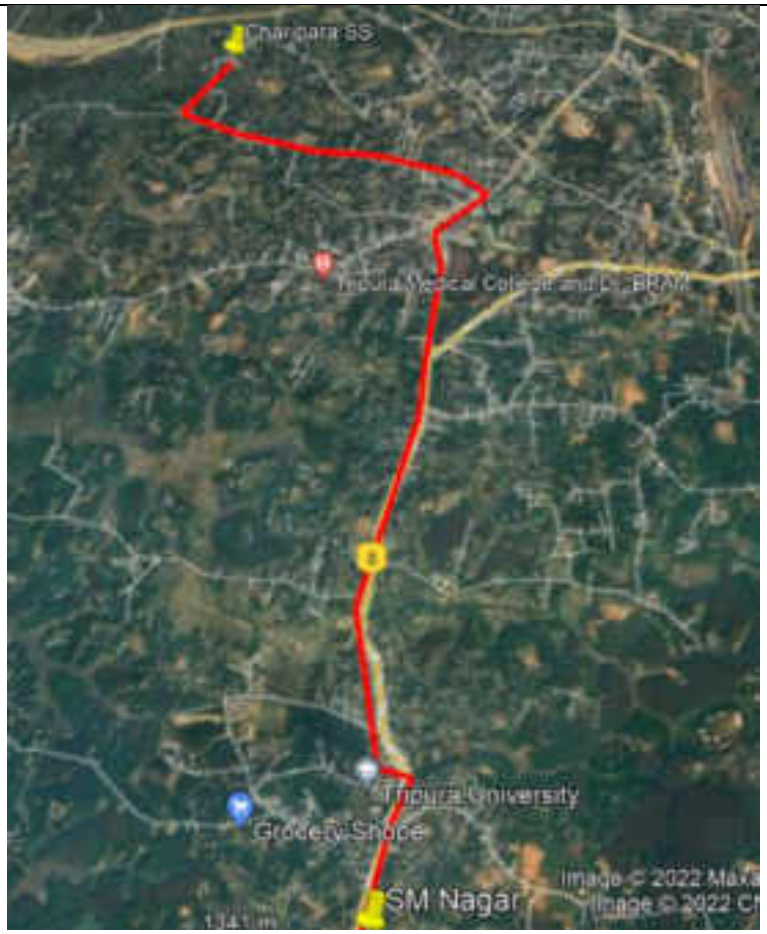
ADB = Asian Development Bank, DPR = detailed project report, ESD = electrical subdivision, WLS = Wildlife Sanctuary
Source: ADB TA Consultant

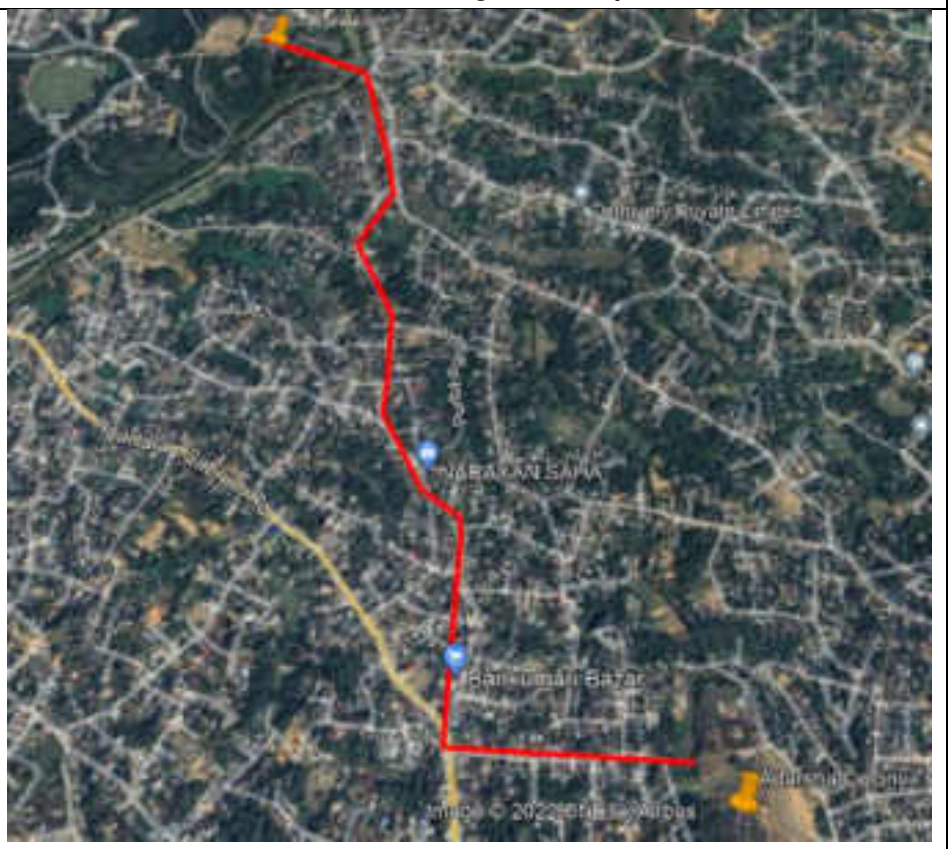
Figure 1.1 Route Map of Distribution Lines Visited for Initial Environmental Examination
(red line: indicative route; yellow line: main road, white line: other roads)

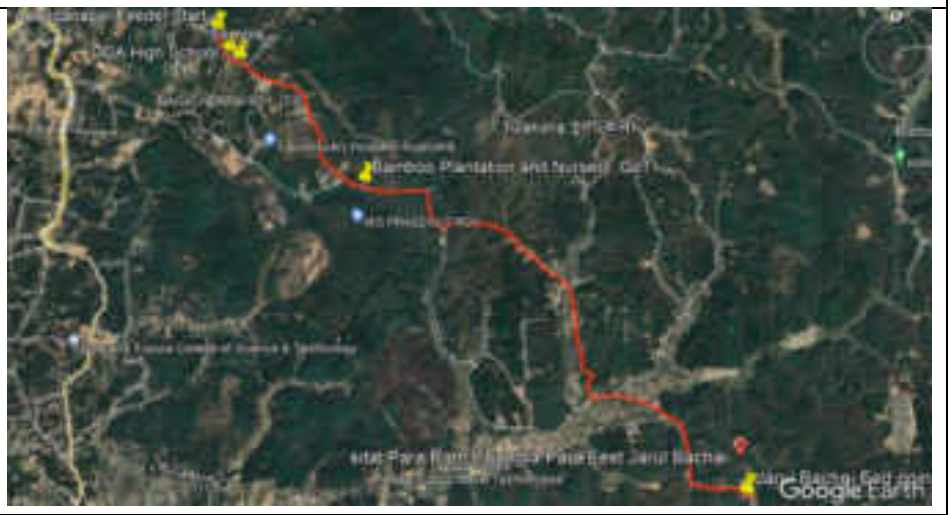
Distribution line surveyed	Indicative Alignment Map
33 kV Mission Tilla - Panisagar-Dhamchara Line Pkg II, Lot 3	
11 kV Digalbagh Feeder to bifurcate existing Raghna Feeder 61km Pkg II, Lot 3	

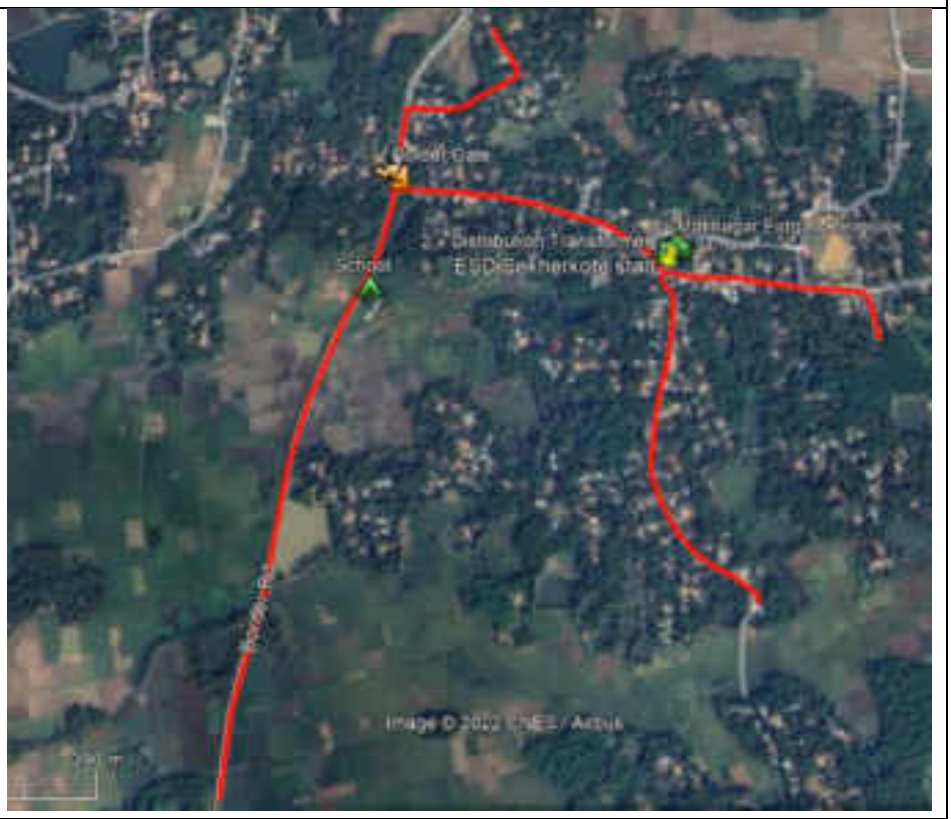
Distribution line surveyed	Indicative Alignment Map
33 kV Pecharthal Substation to 33 kV Panisagar Substation Pkg II, Lot 3	

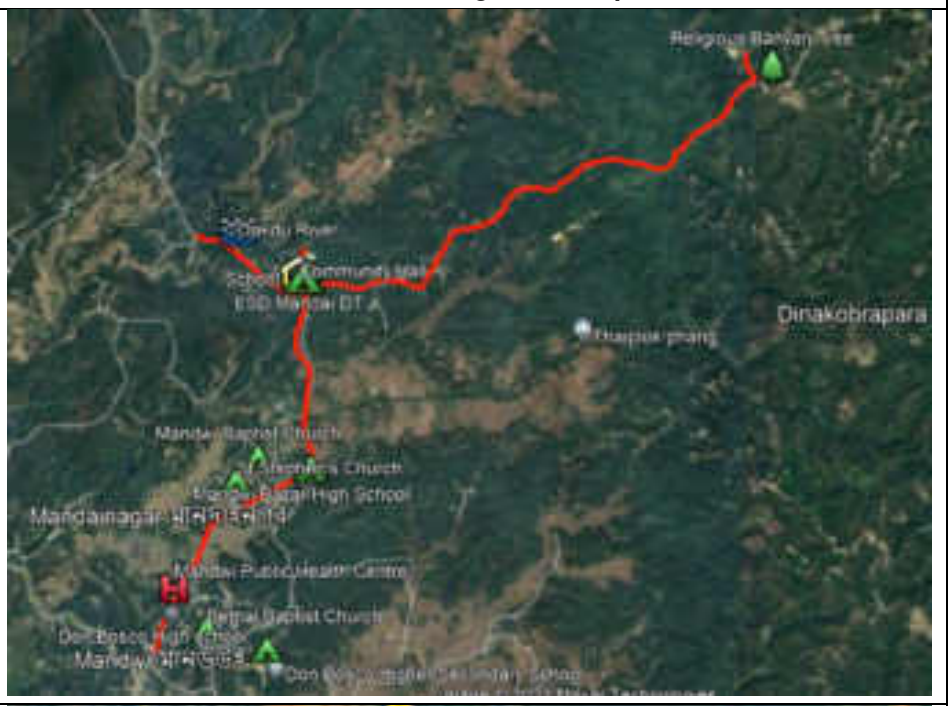
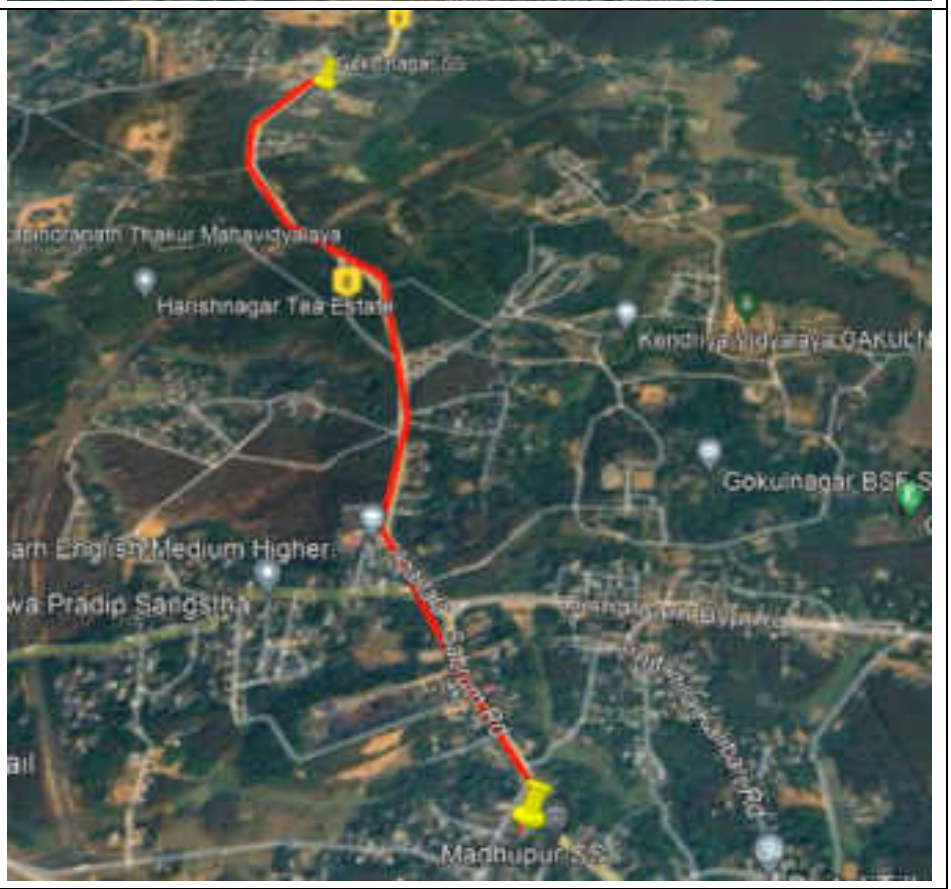
Distribution line surveyed	Indicative Alignment Map
132 kV Gamaitilla Substation to 33kV Kalyanpur Substation Pkg II, Lot 2	
33 kV (underground) from 79 Tilla Grid 132 kV Sub Station to 33 kV Rampur Substation Pkg II, Lot 1	

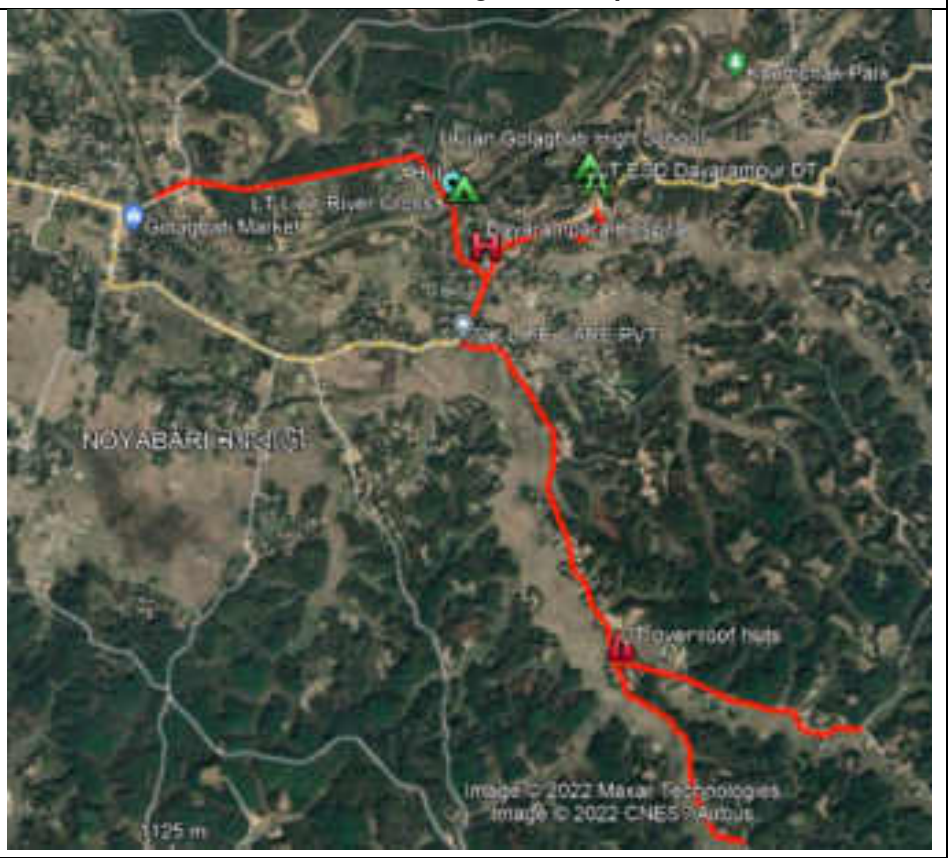
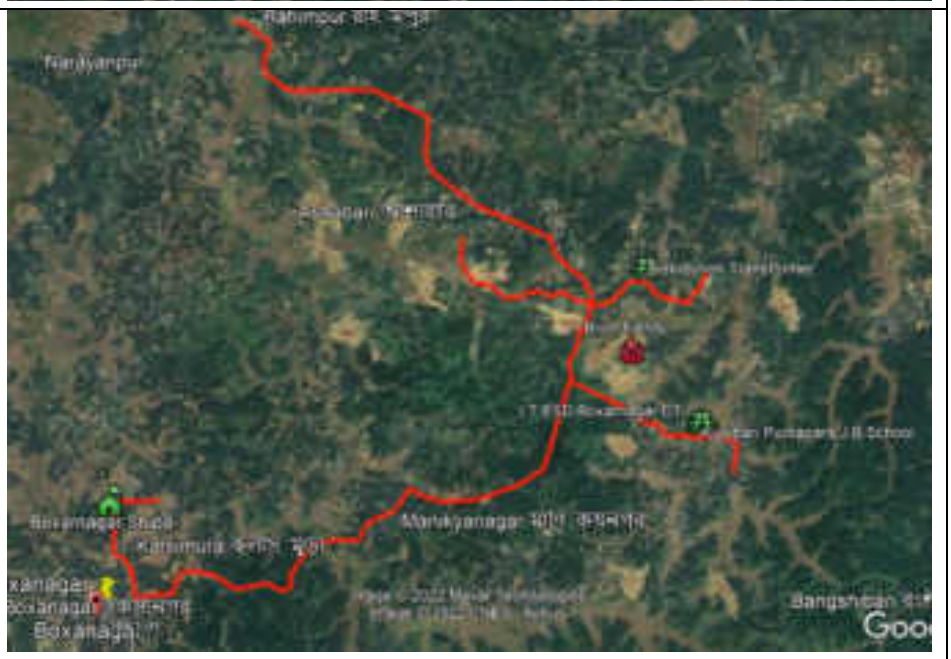
Distribution line surveyed	Indicative Alignment Map
33 kV (underground) from SM Nagar Substation to Charipara Substation via Badharghat Substation Pkg II, Lot I	

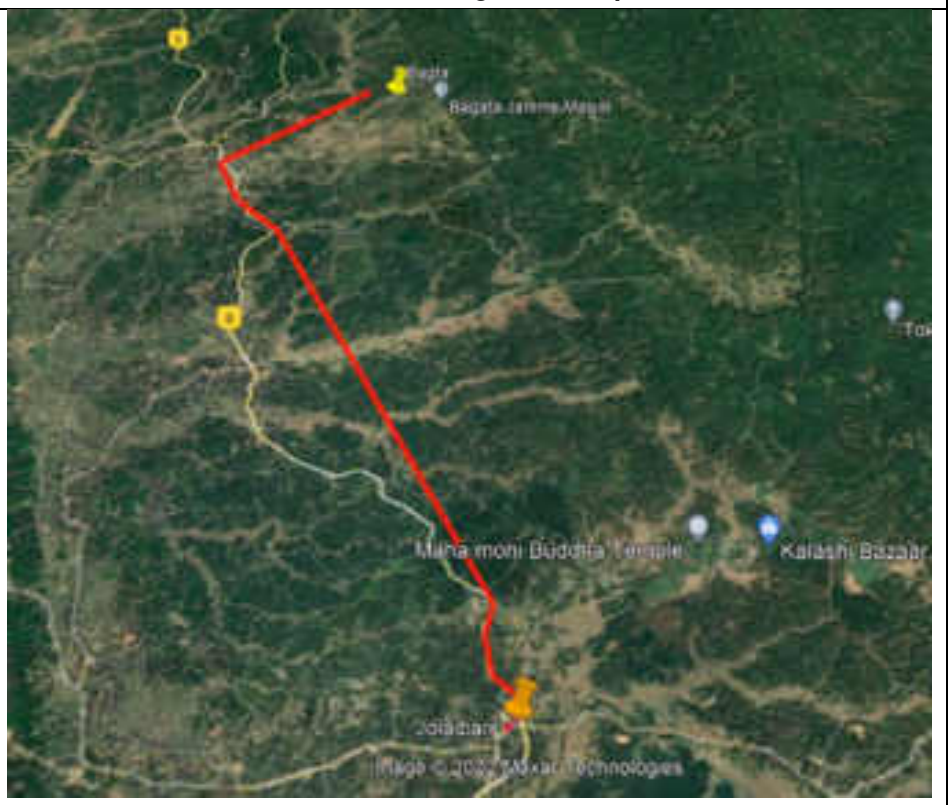
Distribution line surveyed	Indicative Alignment Map
33 kV (underground) Line from Adarsha Colony Substation to College Tilla Substation Pkg II, Lot I	

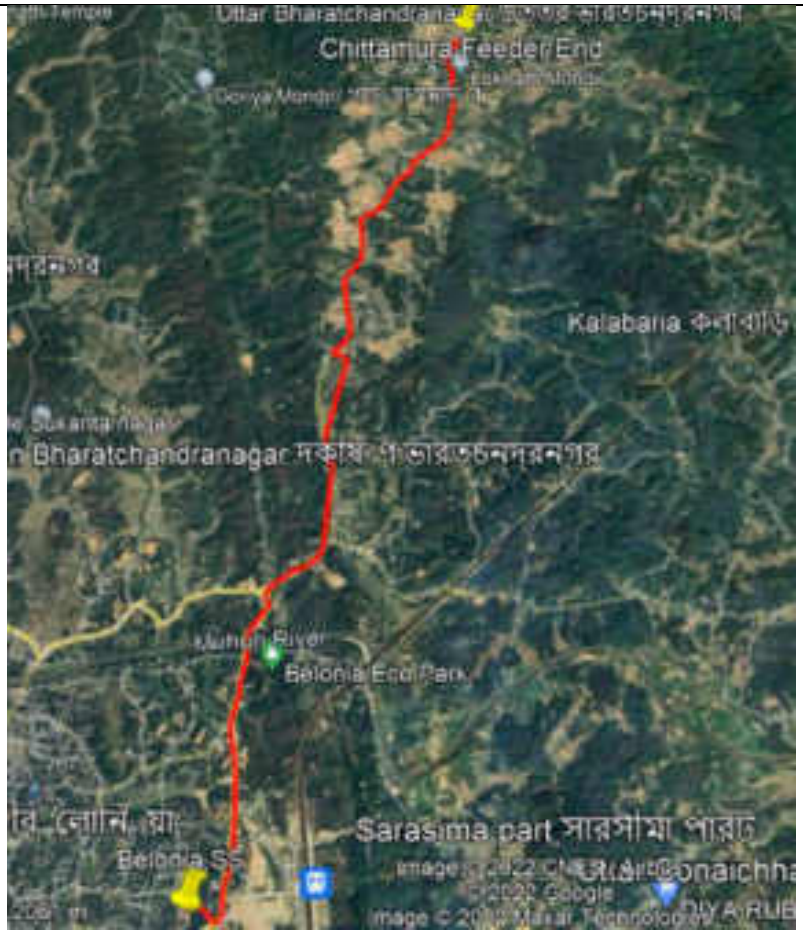
Distribution line surveyed	Indicative Alignment Map
33kV underground from Bodgangnagar Substation to 33 kV Adarsha Nagar Colony Substation Pkg II, Lot 1	
Aananda Nagar 11kV Feeder Pkg II, Lot 1	

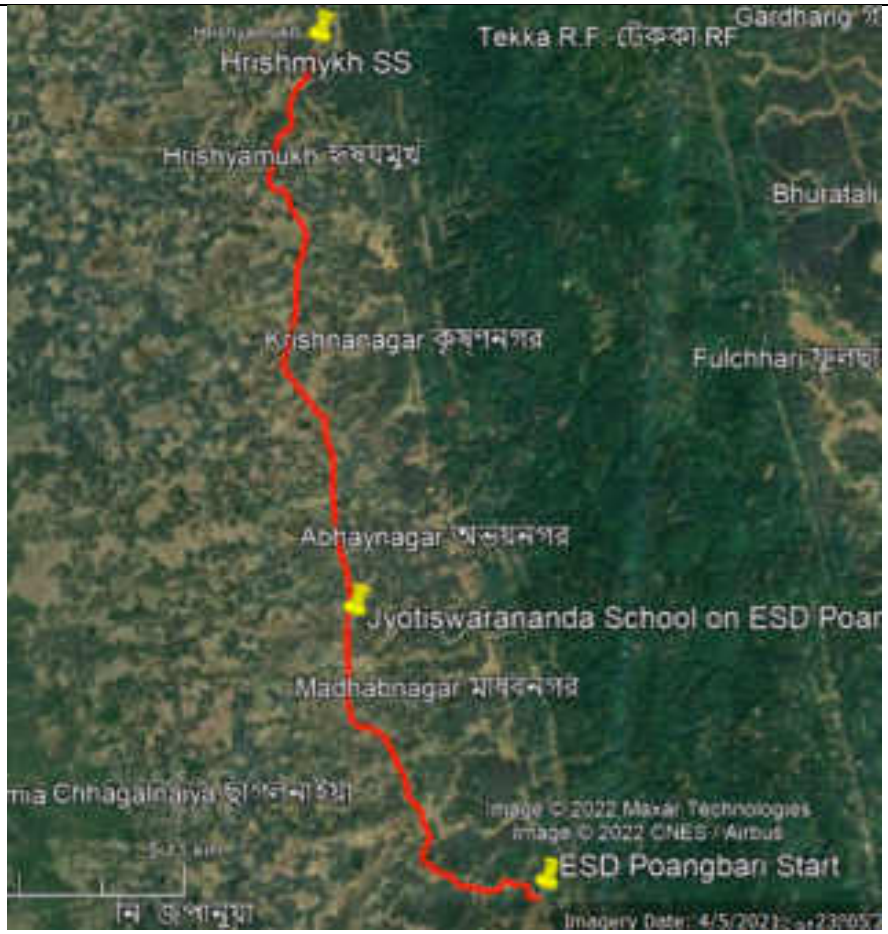
Distribution line surveyed	Indicative Alignment Map
11kV Golchakar to Dashamighat via Joypur Pkg II, Lot 1	
ESD Sekherkote Pkg II, Lot 1	

Distribution line surveyed	Indicative Alignment Map
ESD Mandwi Pkg II, Lot 1	
66 kV Gokulnagar Substation to 33 kV Madhupur Substation Pkg III, Lot 1	

Distribution line surveyed	Indicative Alignment Map
Dayarampur Feeder to bifurcate the existing Golaghati Feeder 99 km Pkg III, Lot 1	
ESD Boxarnagar Pkg III, Lot 1	

Distribution line surveyed	Indicative Alignment Map
66kV Bagfa Substation to 33kV Jolaibari Substation Pkg III, Lot 3	
11 kV Bagfa feeder to bifurcate the existing Santirbazar New Feeder 88km Pkg III, Lot 3	

Distribution line surveyed	Indicative Alignment Map
Chittamura Feeder to bifurcate the existing Monaicherra Feeder 110 km Pkg III, Lot 3	

Distribution line surveyed	Indicative Alignment Map
ESD Poangbari Pkg III, Lot 3	

Source: ADB TA Consultant

2. Initial Environmental Examination Report Structure

16. The IEE consists of nine sections: (i) Introduction, (ii) Policy, Legal and Administrative Framework, (iii) Description of the Project, (iv) Description of the Environment, (v) Anticipated Environmental Impacts and Mitigation Measures, (vi) Consultations, Participation, and Information Disclosure, (vii) Grievance Redress Mechanism, (viii) Environmental Management Plan (ix) Conclusion and Recommendations. The executive summary is also provided at the beginning of the report. The report is supported by annexes including the environmental audit report (Annexure 2) which was completed for the 27 existing substations and existing workshop.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

17. This chapter is about the applicability of national laws and regulations, international agreements, and ADB safeguards requirements to the distribution component. The chapter also lays out the various permissions required for the distribution component from national authorities. It considers the environmental, health and safety (EHS) policies and procedures that are presently available with Tripura State Electricity Corporation Limited (TSECL) as well as the existing environment safeguards capacity of TSECL with respect to environmental management plan (EMP) implementation.

A. National and State Environment, Health and Safety Regulatory Framework and Standards

18. The environment safeguards framework in India and Tripura consists of several acts, notifications, rules, and regulations to protect the environment and wildlife as detailed in Table 2-1. 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 Environment (Protection) Act 1986 was enacted with the objective of providing for the protection and improvement of the environment. It empowers the 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. 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). 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, power distribution projects, due to Government of India view they are non-polluting activities, 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 (floor) area, distribution components do not need prior environment clearance.

19. The Forest (Conservation) Act 1980 is also of note as 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. It provides guidance on the right of way (ROW) and tree cutting beneath distribution lines. For 11 kV line in forest area, the ROW is 7 m, whereas for 33 kV it is 15m. Where routing of distribution 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. One outer strip of 2 m shall be left free of encroachments to permit for maintenance of the power line. Cutting of trees in non-forest land require a tree cutting permit from the local forest department. All trees that are cut under a project must be compensated by compensatory afforestation as required by the Forest Department.

20. As per recently published minutes of the meeting[11] (1 February 2022) of the 66th meeting of the Standing Committee for National Board of Wildlife (NBWL) held on 31 December 2021 MoEF&CC will be requesting details of protected and forest areas with transmission [power] lines and the vegetation, terrain, and periodicity of maintenance of the area. Following this a guideline shall be framed for management of the protected or forest areas below transmission [power] lines. Future proposals for laying of transmission [power] lines submitted to the NBWL will need to be accompanied with a management plan for the area below the transmission [power] line. Permission is still being granted by NBWL for the laying of transmission [power] lines in protected and forest areas; an 11kV transmission line case in Gujarat included the condition that laying of underground lines was required if technically feasible, or else to lay overhead insulated lines whilst an 11 kV transmission line case in Rajasthan included for the option of laying underground lines to be examined, but that bird diverters were to be fixed per CEA guidelines indicating NBWL considered it unlikely in both cases the underground lines would be laid.

21. The main regulatory bodies responsible for administration of the environmental policy and legislation pertinent to the distribution component are:

(i) **Ministry of Environment and Forests, Forest, and Climate Change.** 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 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. No environmental clearances or forest or wildlife clearance will be required for the existing substations, test laboratory (which involves building and construction but on a site of only 1,500 square meters) and distribution lines. Based on the size of existing control buildings at the 27 existing substation none trigger this criterion.

(ii) **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 test laboratory building required an EC due to its size, it would be prior applied with Tripura SEIAA. However, given its size this is not required.

(iii) **Central Pollution Control Board (CPCB).** Statutory authority under the MoEF&CC with headquarters in New Delhi and has 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 distribution component shall be required to adhere to the various standards set by CPCB.

(iv) **Tripura State Pollution Control Board (TPCB).** Responsible for pollution control activities at the state level for Tripura 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. TPCB shall be

[11] http://forestsclearance.nic.in/writereaddata/Order_and_Release/211312301212166THMinutesofMeeting.pdf

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.

(v) **Tripura Forest Department.** 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. Recommendations for forest diversion accorded by the department are forwarded to MoEF&CC. The Chief Wildlife Warden (CWLW) is the head of the wildlife division, reporting to the HoFF and is responsible for the protection and conservation of all protected areas in the state besides dealing with all wildlife issues. The CWLW 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 MoEFCC. The distribution component may require permissions from the Forest Department for any felling of timber and non-timber tree and transit of felled trees. No forest clearance or wildlife clearance are required, although in relation to low tension lines which have not been mapped this will be reconfirmed by TSECL in consultation with the Forest Department during project implementation.

(vi) **Archaeological Survey of India (ASI).** Sitting under the Ministry of Culture, it is responsible for maintenance of ancient monuments and archaeological sites and remains of national importance. It also is 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 Tripura.

(vii) **Central Ground Water Board (CGWB) and Central Ground Water Authority (CGWA).** CGWB is a multi-disciplinary scientific organization under the Ministry of Jal Sakti, entrusted with 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. This NOC shall be required if new borewells are sunk in any of the 27 existing substations or for construction water.

(viii) **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.

(ix) **Ministry of Labor and Employment.** The ministry is responsible for protecting and safeguarding the interests of workers with due regard to creating a healthy work environment along with 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. Since labor is a subject in the concurrent list under the Constitution of India, the state governments also are also competent to enact legislations. These labor statutes are enforced and monitored through the Labor Commissioners.

(x) **Central Electricity Authority (CEA).** The CEA is a statutory organization constituted under the Electricity Supply Act 1948, which has been 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. The distribution components are required to adhere to the safety regulations and standards as prescribed by the CEA.

(xi) **Tripura Electricity Regulatory Commission (TERC).** The role of TERC is to ensure that electricity is provided to all households in the state 24/7 at an affordable price. It issues license for the transmission and distribution activities and for trading of energy in the state.

Table 2.1 Applicable National and State Environmental, Health, and Safety Requirements

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	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 structures and poles 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 management of forests. There are no forest areas impacted by the new distribution components. Applicable if existing low-tension distribution lines pass along road in the notified forest area or if there is an unanticipated impact (change in scope or design) during project implementation.	**Responsible Authorities:** MoEF&CC
4	National Conservation Strategy and Policy	It provides the measures to be taken for prevention and control of pollution and	**Responsible Authorities:** MoEF&CC

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
	Statement on Environment and Development, 1992	energy efficient devices in the distribution system	
5	National Resettlement and Rehabilitation Policy, 2007	Not applicable as there is no land acquisition involved, all lands in substations and at the sub-division office for the test laboratory are owned by TSECL. Distribution line construction does not involve land acquisition.	**Responsible Authorities:** Ministry of Rural Development
6	The Environmental (Protection) Act, 1986 The Environmental (Protection) Rules, 1987 & its amendments	Both construction and operation of the substations must comply with the legislation issued under this act and rules, the IEE process and implementation of the EMP will enable this. Construction and operation must also comply with the environmental quality standards as set out in **Annexure 3.**	Umbrella act under which environmental notifications, rules, schedules, and standards are issued. **Responsible Authorities:** MoEF&CC, Tripura DOF, CPCB and TPCB
7	The EIA Notification, 2006 as amended to 2016	Not applicable for the distribution line and the substation components as the EIA notification exempts these from obtaining prior environmental clearance. The test laboratory building could require prior environment clearance from SEIAA as a Category B project, but as the footprint is less than the size included in Schedule 1 of the EIA notification it is also exempt. Prior environment clearance 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 any Prior environment clearance required to operate.	Identifies projects and activities that require Prior environmental clearance and lays the procedure for obtaining the same. **Responsible Authorities:** MoEF&CC and SEIAA
8	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 TSECL which is a government body and which TSECL is required to respond within thirty days.	**Responsible Authorities**: Central Public Information Officers of Central Electricity Authority (CEA) and State Chief Information Commissioner, Tripura Information Commission
9	The National Environmental Appellate Authority Act, 1997 National Green Tribunal Act, 2010	TSECL 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

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
			appeals within 6 months of them being filled. **Responsible Authorities:** NGT
10	Central Ground Water Authority (CGWA) Notification no. 21-4/Guidelines/CGWA/ 2009-832 dated 14 October 2009	Applicable since some of the substations being upgraded intend to extract ground water through new bore wells; prior to construction permission to abstract will be required from CGWA in accordance with this notification.	**Responsible Authorities**: CGWA
11	Comprehensive Environmental Pollution Index (CEPI) 2018	Not applicable as the project does 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
12	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 TPCB for major construction plant to protect against pollution of surface and ground water. Need to adhere to the water quality standards per **Annexure 3.**	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:** TPCB
13	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 plant to protect against pollution of air. Need to adhere to the air emission standards per **Annexure 3.**	Empowers state pollution control boards to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission. **Responsible Authority:** TPCB

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
14	Noise Pollution (Regulation and Control) Act, 2000 and 2010 as amended	Applicable during both construction and operation, distribution components must adhere to the ambient noise emission standards; any diesel generator sets used by the contractor or TSECL must also be compliant per **Annexure 3.**	Standards for noise emission for various land uses and equipment have been issued. **Responsible Authority:** TPCB
15	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 Control Certificate*" (PUC) for the duration of their use to manage the vehicular emissions.	Empowers the State Transport Authority to enforce standards for vehicular pollution and issuance of PUC certificates. **Responsible Authority:** State Motor Vehicles Department
16	Indian Forest Act, 1927 Forest (Conservation) Act, 1980 as amended Forest (Conservation) Rules, 2003 & its amendments	No forest land is required to be diverted for new distribution components. Applicable if existing low-tension distribution lines pass along road in the notified forest area or if there is an unanticipated impact (change in scope or design) during project implementation. Permission is also required for tree felling 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 and Tripura DoF
17	Indian Forest (Tripura Second Amendment) Act, 1986	Not applicable as it deals with sawmills.	Amends the Indian Forest acts and adds a section 52A **Responsible Authorities:** Tripura DoF
18	Tripura Gazette Notification NO.F.7(44)/FOR/FP-2018-19/ RUBBER/38119-177 Dated 5 December 2020 regarding permission for extraction of rubber trees	Applicable as some existing distribution lines are passing through rubber plantations and some trees will be felled. The notification confirms the removal of permission for felling of rubber trees; however, owners need to intimate to the DoF range officers of any felling in advance.	**Responsible Authorities:** Tripura DoF
19	The Tripura Forest Transit Rules, 1952 & its amendments	Not applicable. The rules provide for transit passes for forest products including timber. Since no new distribution lines are passing through forest land, no trees within forest land shall be felled	**Responsible Authorities:** Tripura DOF
20	The Tripura Forest (Establishment and Regulation of Saw Mills and Other Wood Based Industries) Rules 1985 & its amendments	Not applicable as it deals with wood-based industries and sawmills.	**Responsible Authorities:** Tripura DOF

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
21	State of Tripura Guidelines for Extraction of Trees from Non-Forest Areas, 2010 Detailed Procedure for Extraction of Trees from Non-Forest Areas, 2010	Applicable since some trees will be felled.	Deals with the felling and transporting of both timber and non-timber trees in non-forest areas, timelines for registration and procedures for permissions for felling including service charges. It exempts registrations for fruit trees like mango, litchi, guava, and rubber trees. **Responsible Authority:** Department of Forest
22	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules 2007	Not applicable as no land is being acquired from scheduled tribes and no new distribution lines are passing through notified forest areas.	Provides rights related to title, usage, relief, development, and forest management including traditional and customary rights of forest-dwelling scheduled tribes. **Responsible Authorities:** Department of Forest, Department of Revenue and Department of Tribal Welfare
23	Biological Diversity Act, 1992 Biological Diversity Rules, 2004 Wildlife Protection Act, 1972 as amended	Proposed distribution components (Distribution Line, Substations and Test Laboratory) are not situated within a notified Protected Area, such as, national park or wildlife sanctuaries, neither are they situated within the notified Ecological Sensitive Zone (ESZ) of such a Protected Area. It may become applicable if there is an unanticipated impact (change in scope or design) during project implementation or in the event workers encounter any scheduled plants and animals since the sale, trade, or commerce of them is prohibited.	Provides for protection of PA from non-conservation activities. It also lists (schedules) plants and animals of which sale, trade, or commerce in is prohibited. **Responsible Authorities:** National Board of Wildlife (NBWL), State Board of Wildlife (SBWL) and Chief Wildlife Warden of Tripura
24	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	Not applicable as there is no land acquisition involved	Provides directions related to fair compensation of any land acquired for public works purpose. **Responsible Authorities:** Revenue Department and District Administration
25	The Provision of the Panchayats (Extension to the Scheduled Areas) Act, 1996	Not applicable as there is no land acquisition under Tripura Tribal Areas Autonomous District Council (TTAADC) areas involved	It applicable only for areas that have been declared under fifth schedule of the constitution, such as TTAADC.

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
			Responsible Authorities: TTAADC
26	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)
27	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	New distribution components (distribution line, substations and test laboratory) are not situated within 300m of an ASI or Government of Tripura notified monument. May be applicable for any existing low-tension distribution lines within the prohibited or regulated area or if there is an unanticipated impact (change in scope or design) during project implementation. Otherwise, the acts will only become applicable if there are any chance finds of physical cultural resources during excavation for construction.	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, Tripura Department of Archaeology
28	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
29	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
30	Manufacture, Storage and Import	Applicable as there shall be storage of hazardous chemicals including petroleum	**Responsible Authorities**: TPCB

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
	of Hazardous Chemicals Rules, 1989	products (oils etc.) at the substations and test laboratory.	
31	Regulation of Polychlorinated Biphenyls (PCBs) Order, 2016	Applicable. New transformers provided for the substations must be PCB free and any existing PCB containing transformers at the existing substations and along distribution lines must be inventoried and removed by the cut of date of 31st December 2025. Disposal of PCB containing equipment must be done as per Hazardous and Other Wastes (Management, & Trans-boundary Movement) Rules.	Provides guidance on the usage of PCBs and prohibits the usage of PCBs in any form by 31 December 2025. **Responsible Authority:** TPCB
32	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:** TPCB
33	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
34	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:** TPCB
35	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:** TPCB, Panchayats
36	The Plastic Waste Management Rules, 2016	Plastic will be generated for disposal in the wastes from packaging materials during both construction and operation period	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.

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
			Responsible Authorities: TPCB, Tripura's Urban Development Secretary and Village Panchayats
37	Hazardous and Other Wastes (Management, & Trans-boundary Movement) Rules, 2016 as amended in 2019	Applicable in relation to the management and disposal of hazardous wastes (used transformer oils, batteries, solvent-soaked rags etc.) that are used during construction and operation, especially in relation to operation of the substations and the test laboratory	Provides protection to the general public against improper handling and disposal of hazardous wastes. **Responsible Authority:** TPCB
38	Batteries (Management and Handling) Rules, 2001	Applicable as use and presence of batteries as back up in the in the substations. Used batteries must be properly disposed to TPCB authorized and registered recyclers.	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 TPCB. **Responsible Authorities:** TPCB
39	E-Waste (Management) Rules, 2016 as amended in 2018	Applicable during construction and operation used e-waste must be properly disposed to TPCB authorized and registered recyclers.	**Responsible Authorities**: TPCB
40	National Policy on Safety, Health and Environment at Workplace, 2009	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
41	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
42	Drinking Water Standard (IS 10500:2012)	Applicable as provides the standards of drinking water in India. The drinking water provided in construction, substations and test laboratory must adhere to the standards. The standard is given in **Annexure 3**	**Responsible Authorities:** Bureau of Indian Standards, CPCB, TPCB
43	Indian Factories Act 1948	Applicable till the time The Occupational Safety, Health and Working Conditions Code, 2020 comes into force, as there will be more than ten full time employees during the operation phase of the various distribution components	This act along with 12 other central labor laws has been rationalized and will be replaced by The Occupational Safety, Health and Working Conditions Code, 2020. However, the code is yet to

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
			come into force through an official gazette notification. **Responsible Authorities:** Ministry of Labor and Employment, Chief Inspector of Factories, Government of Tripura and District Magistrate as Inspector for the district
44	The Tripura Factories (Safety Officers) Rules, 1984	Applicable as the substation and test laboratory shall qualify as a factory during operation period. The safety officer employed during the operational phase should qualify as per the rules.	Deals with the qualifications and duties of the safety officer appointed in a factory. **Responsible Authorities:** Factories Welfare Officer, Government of Tripura
45	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996	Follow the requirements during construction. It is applicable till the time The Occupational Safety, Health and Working Conditions Code, 2020 comes into force, as ten or more building workers will be employed in construction work.	This act along with 12 other central labor laws has been rationalized and will be replaced by The Occupational Safety, Health and Working Conditions Code, 2020. However, the code is yet to come into force through an official gazette notification. **Responsible Authorities:** State Building and Other Construction Workers' Advisory Committee, Labor Commissioner
46	The Contract Labour (Regulation & Abolition) Act, 1970 The Contract Labour (Regulation & Abolition) Rules, 1971	Hiring of laborers with or without the knowledge of TSECL (the principal employer) must be done through a licensed contractor as per the act. It is applicable till the time The Occupational Safety, Health and Working Conditions Code, 2020 comes into force.	This act along with 12 other central labor laws has been rationalized and will be replaced by The Occupational Safety, Health and Working Conditions Code, 2020. However, the code is yet to come into force through an official gazette notification. **Responsible Authorities:** Labour Commissioner
47	Tripura Contract Labour (Regulation and Abolition) Rules 1978	It is applicable to construction and operation as more than 25 construction laborers will be hired for the various distribution components	Deals with hiring of laborers by a licensed labor contractor. It also provides for provision of rest rooms, canteens, toilets (one for every 25 laborers), first aid facilities, wages etc. **Responsible Authorities:** Directorate of Labour, Government of Tripura

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
48	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
49	The Child Labour (Prohibition and Regulation) Act, 1986 and its amendment	Applicable and it prohibits the employment of children below the age of 14 by the contractors or TSECL.	Prohibits employment of children below the age of 14 in the building and construction industry. **Responsible Authority:** Labor Inspector
50	The Trade Union Act, 1926	Applicable as it allows the formation of Trade Unions for the purpose of regulating the relations between workers and TSECL	**Responsible Authorities:** Registrar of Trade Unions, Tripura
51	Interstate Migrant Workers Act, 1979	Applicable, if migrant workers are employed during construction or operation	This act along with 12 other central labor laws has been rationalized and will be replaced by The Occupational Safety, Health and Working Conditions Code, 2020. However, the code is yet to come into force through an official gazette notification. **Responsible Authority:** Department of Labor
52	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 and timely payment of wages for all workers in India. **Responsible Authority:** Labor Commissioner
53	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 EPC contractors and TSECL.	The code repeals and consolidated the Workmen's Compensation Act, 1923, The Employees' Provident Funds and Miscellaneous Provisions Act, 1952, The Payment of Gratuity Act, 1972, The

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
			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 the contractors for the project. **Responsible Authorities:** Labor Commissioner, PF Commissioner
54	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
55	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 EPC contractor and TSECL 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, or injury to, any person or damage to any property **Responsible Authorities:** Labor Commissioner and District Magistrate
56	The Indian Electricity Act, 1910 and its amendments The Indian Telegraph Act, 1885	Applicable as new 0.4kV, 11kV, and 33kV overhead distribution lines with covered conductor will be laid. A Right of Way is required for laying of new overhead distribution lines. The applicable ROW for 0.4kV, 11kV and 33kV power lines are 1.2m, 7m and 15m respectively (**Annexure 3**)	Safety measures to be taken in laying of electrical lines and connections. **Responsible Authorities:** Central Electricity Authority (CEA)
57	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 distribution 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
58	Central Electricity Authority (Measures Relating to Safety and Electricity	Applicable as the acts deals with distribution and transmission companies and mandates the provision for safety requirements including mandatory	**Responsible Authorities:** CEA

Sl. No.	Name of Policy / Law / Regulation	Applicability to Project	Remarks
	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	appointment of an Electrical Safety Officer and their qualifications	
59	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	**Responsible Authorities:** CEA
60	Tripura Town and Country Planning Act, 1975	Pertains to development planning and use of rural and urban land in Tripura including provision for amenities including electric supply	**Responsible Authorities:** Tripura Urban Planning and Development Authority

CPCB = Central Pollution Control Board, CEA = Central Electricity Authority, CEPI = Comprehensive Environmental Pollution Index, CTO = Consent to Operate, CGWA = Central Ground Water Authority, CPA = Critically Polluted Areas, DOF = Department of Forests, EIA = Environmental Impact Assessment, MoEF&CC = Ministry of Environment, Forest, and Climate Change, NEP = National Environment Policy, NGT = National Green Tribunal, SEIAA = State Level Environmental Impact Assessment Authority, SPCB = state level pollution control board, TPCB = Tripura Pollution Control Board, TSECL = Tripura State Electricity Corporation Limited
Source: ADB TA Consultant

22. Clearances, Permissions and NOCs to be obtained for the project by both the borrower (TSECL) and the EPC contractors are given in Table 2-2. If existing low-tension distribution lines pass along roads in the notified forest area or are in the prohibited/regulated zone of protected monuments and after studying the alternatives rerouting is not an option then in addition to Table 2-2 forest and archaeology clearances will need to be obtained by TSECL prior to detailed design approval and construction. Clearances will need to be applied for early on as they can take 1-1.5 years to secure. If clearances are not legally required, then the EPC Contractor must secure written permission for the works from Department of Forests and/or ASI.

Table 2.2 List Of Consent Requirements for the Distribution Component

Sl. No.	Clearances / Permissions / NOC	Authority	Responsible Party	Status as of March 2022
1	Certificate of Registration of Principal Employer	Labor Commissioner, Ministry of Labor and Employment	TSECL	To be obtained prior to construction
2	Tree felling/trimming permissions	Forest Department		To be obtained prior to construction
3	NOC for installing bore wells for ground water withdrawal in substations and test laboratory where the new bore wells will be required	CGWA		To be obtained prior to construction
4	NOC for change of land use for establishing temporary construction camps (if outside TSECL land area)	Revenue Department and District Administration	EPC Contractor	To be obtained prior to construction
5	Consent to Establish (CTE) construction plant	State Pollution Control Board		To be obtained prior to construction
6	Consent to Operate (CTO) construction plant	State Pollution Control Board		To be obtained prior to construction
7	Labor License	Labor Commissioner, Tripura		To be obtained prior to construction
8	Pollution Under Control Certificates for construction vehicles	Motor Vehicles Department		To be obtained prior to construction
9	Pollution Under Control Certificates for test van	Motor Vehicles Department	EPC Contractor/ TSECL	To be obtained prior to supply of test van to TSECL (renewals to handled by TSECL)

CGWA = Central Ground Water Authority, CTE = Consent to Establish, CTO = Consent to Operate, EPC = engineering, procurement and construction, NOC = No Objection Certificate, TSECL = Tripura State Electricity Corporation Limited
Source: ADB TA Consultant

B. Applicable International Agreements

23. International agreements pertinent to the distribution component 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 2-3 provides the key international agreements that India is a signatory with potential applicability to the distribution component. 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.[12]

Table 2.3 List of Relevant International Agreements

Sl. No.	Name	Date of Ratification	Applicability	Remarks
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971	1 February 1982	No distribution lines are proposed near the only Ramsar Wetland (Rudrasagar Lake). Melaghar Substation is 2.3 km (aerial distance) from the lake and thus it will not be directly impacted. However, potential indirect impacts from the presence of new distribution lines on the wetland migrant bird species, while flying over the state to reach the lake to be considered by the IEE.	Deals with conservation and sustainable use of wetlands
2	Convention for the Protection of the World Cultural and Natural Heritage, 1972	14 December 1977	No World Heritage Site present in Tripura. New distribution line, substation and test laboratory components are away from designated heritage sites including those protected from ASI and Government of Tripura, but existing low-tension distribution lines may pass adjacent on road.	Addresses nature conservation and preservation of cultural properties
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

[12] https://www.ilo.org/dyn/normlex/en/f?p=1000:11210:0::NO:11210:P11210_COUNTRY_ID:102691

Sl. No.	Name	Date of Ratification	Applicability	Remarks
4	Convention on the Conservation of Migratory Species of Wild Animals, 1979	1 November 1983	Presence of elephants and migratory avian species in the Central Asian Flyway and the East Asian-Australasian Flyway as the distribution components are spread across the state. Potential indirect impacts from the presence of new distribution lines on migrant species to be considered by the IEE, the risk of hunting or poaching of migratory species by the workers to also 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	India has hazardous waste facilities so transboundary movement is unlikely
6	Convention For the Protection of the Ozone Layer, 1985	18 March 1991	Servicing and refilling of fire extinguishers 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	Some 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 under the distribution component 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.

Sl. No.	Name	Date of Ratification	Applicability	Remarks
10	United Nations Framework Convention on Climate Change, 1992	1 November 1993	It is applicable as Sulphur Hexafluoride (SF6) is present in gas insulated circuit breakers in Kadamtala and Mandai Substations. New equipment such as circuit breakers and RMU may also contain SF6 although solid dielectric (Hydrophobic Cycloaliphatic Epoxy (HCEP)) can be used in place of SF6 gas as an insulating medium.	Deals with reductions of greenhouse gases (GHG) to achieve 1.5°C target.
11	Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997	19 August 2002		
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. Existing transformers and other oil containing equipment may be contaminated with PCBs which must be removed by 31st December 2025 to comply with the Stockholm Convention	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:[13] Forced Labor, Equal Renumeration, 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, IEE = initial environmental examination, ILO = International Labor Organization PCB = polychlorinated biphenyl
Source: ADB TA Consultant

C. Borrower's Environment and Social Policies

24. TSECL has previously assisited POWERGRID Corporation Limited in implementing the World Bank funded North Eastern Region Power System Improvement Project (NERPSIP). The ownership of the assets created under the project was vested with the respective state governments / state utilities and they are responsible for operation and maintenance of the assets at their own cost upon commissioning. They thus have some limited exposure to and experience with the implementation of multilateral bank safeguard requirements. As part of the NERPSIP an Environment and Social Policy Statement states: "*TSECL aspires to achieve the goal of sustainable development through identification, assessment and management of social and*

[13] https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102691

environmental issues at both project planning and implementation stages, through use of state of the art system, following of statute and principles of avoidance, minimization and mitigation of inescapable issues with complete transparency and due social responsibilities". However, this policy statement was prepared solely for the NERPSIP and it is not a company wide policy which would apply to other activities; it was not adopted by TSECL as a whole nor disclosed.

25. Presently TSECL does not have a designated safeguard unit or health and safety division or staff. There is an officer based at the headquaters who has been dealing with the forest clearances for transmission lines under the NERPSIP. The engineers responsible for the substations at the sites perform addtional duties of Safety Officers required by the CEA regulations.

D. Asian Development Bank's Safeguards Policies

26. The ADB Safeguard Policy Statement, 2009 (SPS 2009)[14] broadly consists of three policy components: (i) Environment Safeguards, (ii) Involuntary Resettlement Safeguards, and (iii) Indigenous People Safeguards. The objectives of Environment Safeguards principle are to (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

27. Under SPS 2009 projects are categorized A, B, C according to the likely significance of impacts:

(i) Category A: Projects with potential for significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

(ii) Category B: Project with some adverse impacts, but of lesser degree and / or significance than category A. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.

(iii) Category C: Projects that are likely to have minimal or no adverse impacts. No EIA or IEE required, although environmental implications are still reviewed.

28. 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. Table 2-4 presents a comparision and gap analysis of ADB's SPS 2009 and Indian Requirements.

[14] https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf

Table 2.4 ADB SPS 2009 and Government of India Environmental Requirments Gap Analysis

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
Screening and Categorization	• 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. • The category of the project shall determine the level of environmental assessment. • EIA is mandatory for project activities that satisfy the defined threshold limits for category A • 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 • 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. • 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.	• As per ADB's Safeguard Policy Statement (2009) screening and categorization is required for all projects • Assigns categories based on potential impacts into either: i. Category A - EIA required (significant irreversible, diverse, or unprecedented adverse environmental impacts) ii. Category B – IEE required iii. Category C – no environmental assessment required but a review of environmental implications iv. Category FI – Environmental and Social Management System required	• Power distribution 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. • Based on the size of buildings at the 27 SS none trigger the building projects criterion and required prior environment clearance. • The test laboratory footprint is 1,500 square meters so screening and categorization is not required by Government of India since this size is exempt from needing to obtain prior environment clearance. • Under ADB's Safeguard Policy Statement (2009) the entire project including all the outputs is categorized as A, but as the distribution 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.

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
Environmental Assessment	• No assessment required for power distribution projects or small-scale building and construction	• 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.) • Assess potential transboundary and global impacts, including climate change.	• Major gap since as per Indian regulations power distribution 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. • However, to comply with ADB's Safeguard Policy Statement (2009) an environmental assessment has been prepared.
Analysis of Alternatives	• No analysis of alternatives required for power distribution projects or small-scale building and construction	• Category A (projects with significant impacts) are required to carry out alternative analysis. • 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. • Also "no project" alternative must be assessed.	• No gap as distribution components are unlikely to have significant irreversible, diverse, or unprecedented adverse environmental impacts but consideration has been given to alternatives as part of the environmental assessment.
Environmental Planning and Management	• No environmental planning and management required for power distribution projects or small-scale building and construction	• Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts • 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. • Prepare EMP addressing the potential impacts and risks identified by the environmental	• Major gap but this IEE including an EMP has been prepared to meet ADB's Safeguard Policy Statement (2009) requirements

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
		assessment which should include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.	
Meaningful Consultation	• No formal public consultations / public hearing is required for power distribution projects or small-scale building and construction	• 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.	• Major gap but meaningful consultations have been undertaken as part of the IEE
Information Disclosure	• Power distribution or small-scale building and construction projects do not require any information disclosure	• ADB will post in its website the following: a. Draft IEE prior to appraisal b. Final or updated IEE upon receipt c. Environmental monitoring report submitted by borrowers upon receipt • Local disclosure is also required	• 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
Grievance Redress Mechanism (GRM)	• GRM is not required	• Establish GRM to facilitate resolution of grievances or complaints received in the project	• Major gap exists but GRM to be established as per the requirements of ADB's Safeguard Policy Statement (2009)
Monitoring and Reporting	• No monitoring and reporting are required for power distribution projects or small-scale building and construction	• Borrowers are required to prepare and regularly submit periodic monitoring reports on the progress	• Major gap exists but monitoring measures in accordance with ADB's Safeguard Policy Statement (2009) are proposed

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
		of EMP implementation to ADB for review and disclosure • Prepare and implement corrective action plan if non-compliance is identified	
Biodiversity	• 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 or ESZ involve lengthy permission procedures. Projects obtaining permissions are mainly linear projects of national importance and are permitted with mitigation measures. • 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 >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. • 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	• ADB's Safeguard Policy Statement 2009 requires that the borrower assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. • 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 • 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. • ADB's Safeguard Policy Statement 2009 also lays down procedures for implementing projects in natural habitats, critical habitats, and Legally Protected Areas	• 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 in this event at project planning stage unless projects fall under the EIA Notification 2006. • Gaps persist especially as prior EC is not required for power distribution 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. In ESZ, undergrounding of distribution lines is encouraged but as distribution works do not require EC there no mechanism to consider site-specific biodiversity impacts involved. • However, to comply with ADB's Safeguard Policy Statement (2009) an environmental

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
			assessment has been prepared considering biological impacts.
Pollution	• The Environment (Protection) Rules, 1986 and various legislations address aspects such as air, noise, water pollution, hazardous substance management etc. • National Ambient Air Quality Standards have been specified as per MoEF&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 • Noise Standards has been specified as per the Noise Pollution (Control and Regulation) Rules, 2000 (Amended 2002). • Water quality standards have been specified as per MoEF&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. • Standards applicable to the distribution component are provided in **Annexure 3.**	• 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. • Refers to World Bank Group / IFC's EHS Guidelines for international good practice standards and measures for pollution control and prevention as per **Annexure 3**. If national regulations differ, more stringent will usually be followed. If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification.	• Limiting value of some pollutants specified in the Indian regulatory standards are different than those specified in World Bank Group / IFC's EHS guidelines and hence those that are applicable to the distribution components need to be established. • The guideline values of the five WHO air pollutants referred to by the 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 permissible concentrations. The major pollutant that is listed in the Indian standard but not by the WHO to which the 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. • Ambient noise limits for industrial receptors are lower as

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
			per the WHO community noise guidelines to which the EHS guidelines refer than the Government of India standard, whilst at residential receptors they are similar, but differ for sensitive and commercial zones. The Government of India introduces an additional receptor type not considered by the 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*') • National ambient surface water quality standards exist as well as drinking water standards (ISO 10500) • The guideline values for treated sanitary wastewater discharges referred to by the EHS 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 distribution. • Indian regulations have no provisions for ensuring pollution control is considered at project planning stage unless projects fall under the EIA Notification or

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
			will require a CTE/CTO from SPCB. • However, to comply with ADB's Safeguard Policy Statement (2009) an environmental assessment has been prepared considering impacts related to pollution risk.
Health and Safety	• Occupational health and safety standards included in various Indian labour laws and codes • Community health and safety of distribution projects is covered by CEA regulations including requirement to maintain vertical and horizontal safety clearances	• 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. • Refers to World Bank Group / IFC EHS Guidelines for the occupational health and safety guidelines to be followed	• No major gaps with respect to occupational health and safety as both the World Bank Group / IFC EHS guidelines and Indian regulations require safe work areas, the use of safety equipment and personal protective equipment (PPE) • Some gaps with respect to community health and safety as there are no standards for EMF
Physical Cultural Resources	• 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 • National legislation prohibits projects that are within 100m of protected monuments. For projects within 300m, permissions are first to be obtained from the competent authorities. • Chance finds as per Indian regulations are to be handed over to the authorities who shall inspect / assess the chance finds.	• 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 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	• Some gaps persist for locally important physical cultural resources especially where prior environmental clearance is not required under the EIA notification and impacts are not required to be assessed. • However, to comply with ADB's Safeguard Policy Statement (2009) an environmental assessment has been prepared considering impacts on all physical cultural resources.

Project Stage	Indian Requirements	ADB's Safeguard Policy Statement (2009)	Gap Analysis
	• 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.	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. • 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 • 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	

ADB = Asian Development Bank, CEA = Central Electricity Authority, CPCB = Central Pollution Control Board, CTE = Consent to Establish, CTO = Consent to Operate, EHS = environmental, health and safety, EIA = Environmental Impact Assessment, EMP = environmental management plan, ESZ = ecologically sensitive zone, GRM = grievance redress mechanism, GSR = General Statutory Rules, IEE = initial environmental examination, IFC = International Finance Corporation, MoEF&CC = Ministry of Environment, Forest, and Climate Change, NAAQS = National Ambient Air Quality Standards, PPE = personal protective equipment, SEIAA = State Level Environmental Impact Assessment Authority, WHO = World Health Organization
Source: ADB TA Consultant

29. The distribution component will follow national as well as international good practice guidelines related to environment, health and safety including those set out in the:

(i) IFC Environmental, Health, and Safety General Guidelines, 30 April 2007
(ii) IFC Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution, April 2007
(iii) International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for Limiting Exposure to time-varying Electric, Magnetic, and Electromagnetic Fields (UP TO 300 GHz)

30. Section 4 on Construction and Decommissioning of the IFC EHS General Guidelines (30 April 2007) will be applicable for the distribution component. In addition, the IFC EHS Guidelines for Electric Power Transmission and Distribution (30 April 2007) also needs to be considered while designing the substations and distribution line components and undertaking the environmental assessment. 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 project is required to comply with these guidelines regarding assessment of potential impacts and management measures, performance indicators and monitoring guidelines. TSECL shall follow the IFC EHS Guidelines for this project and shall also ensure that all appointed contractors and their subcontractors follow them.

31. The applicable international good practice standards and guidelines from the above-mentioned guidelines are set out in **Annexure 3.** Where international good practice standards or guidelines are more stringent than national, it is the most stringent that applies unless otherwise justified in this IEE report.

32. 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, 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.

III. DESCRIPTION OF THE PROJECT

A. Distribution Components and Locations

33. The distribution components are based in the state of Tripura, which has 8 districts (works shall be in all the 8 districts). The administrative map of Tripura is given in Figure 3-1. It shares about 850 km of international border with Bangladesh to the west, north and south and Mizoram and Assam on the eastern side. The distribution components shall be implemented through EPC contracts awarded by TSECL through ICB of 6 contract packages and 10 lots.

Figure 3.1 Administrative Map of Tripura

Source: https://en.wikipedia.org/wiki/List_of_districts_of_Tripura#/media/File:Tripura-district-map.svg

1. Output 2, Strengthening and Modernization of Distribution Network (packages 1-3, 5, and 6)

34. To improve the reliability of power supply to distribution electricity consumers and reduce technical losses, the project will (i) renovate and modernize 27 existing 33/11 kilovolts (kV) substations including control room equipment and protection systems; (ii) install 150 auto-

reclosers, 350 sectionalizers, and 2,000 sets of fault passage indicators at 11 kV and 33 kV lines, supply of cable fault locator and test van; (iii) install and upgrade 2,667 km of 11 kV, 33 kV and low tension distribution lines including the supply and installation of about 100 ring main units (RMU) associated with underground cabling and a high voltage distribution system (HVDS) pilot for agricultural feeders in one electricity subdivision. This component is divided into 4 packages. Package 1 deals with component (i) and (ii) as well as the RMU required for the underground cabling whilst packages 2 and 3 deal with the majority of component (iii) split between the roughly the northern, eastern, and western part of the state for package 2 while package 3 involves the same works in the southern part of the state. Package 6 covers the HVDS pilot and will include the remainder of component (iii) for agricultural feeders in one electricity subdivision (ESD) (either ESD Boxarnagar or ESD Sonamura) under Sipahijila Circle and District.

35. The list of substations for component (i) is given in Table 3-1 and Figure 3-2 while the details of circles selected for component (ii) are given in Table 3-2. The summary of the distribution lines is given in Table 3-3 and the package-wise summary in Table 3-4. The details of individual distribution lines are given in **Annexure 1**.

36. Package 1 deals with the renovation and modernization of 20 substations and 33kV Bay Extensions at 7 substations. Out of the 27 substations, Dighalbagh Substation has been selected for both Renovation and Modernization and a 33kV Bay Extension thus figures twice in the substation list. The total number of substations physically involved in component (i) is 27. Of these 25 are existing operational substations. One substation at Tillabazar is under construction under World Bank NERPSIP[15] (works on boundary walls were on going during the last site visit during late October 2021). POWERGRID is the implementing agency constructing the Tillabazar substation while existing staff of TSECL sometimes visit the site to understand the status of works; ownership of the substation will be transferred to TSECL to operate and maintain once completed. One substation at Charipara is nearly completed and its awaiting commissioning and start of operation. It is funded by Government of India under the Integrated Power Development Scheme supervised by TSECL.

37. The location details and surrounding environmental features of all substations and associated 33kV distribution lines from the existing substations are provided in this section, whereas the detailed substation environmental compliance audit report is provided as **Annexure 2.** All 27 existing substations are on the land owned by TSECL. The works will be carried out only within the land boundary of the existing substations and no land acquisition will be involved.

38. Renovation and modernization scope includes:

(i) electrical works (provision of 11 and 33 kV Vacuum Circuit Breaker (VCBs) with galvanized iron mounting structure; 33 kV relay and control panel for 33 kV feeder, 11 kV lightning arrestors, battery bank of 110V DC, 240Ah, valve regulated lead–acid (VRLA) type with all accessories and wooden mounting stand and battery chargers, indoor and outdoor type heat shrink termination kits, 11kV Cross Linked Polyethylene (XLPE) cable, 1.1kV grade polyvinyl chloride (PVC) control cable and other minor items; for installation of all items provision of mandatory spare parts etc.)

(ii) civil works (including replacement of existing foundations, if required as per existing condition and weight of new equipment offered; erection including testing

[15] https://projects.worldbank.org/en/projects-operations/document-detail/P127974?type=projects

and commissioning; dismantling and removal of all required equipment / structures / foundations (if required) / cables etc.

(iii) provision of portable class C, 3 kg carbon dioxide (CO_2) fire extinguishers and sand buckets, wall mounted first aid boxes and minimum 9 liters capacity water purifier having reverse osmosis plus ultraviolet plus ultrafiltration and Total Dissolved Solids (TDS) control, zero water wastage by re-circulation of rejected water.

39. The scope for 33kV Bay Extensions includes:

(i) electrical works including 33 kV VCB with galvanized iron mounting structures, 33 kV single phase multi core current transformers 400-200/1-1A with mounting structures; 33kV single phase potential transformer (PT) of outdoor type, oil filled with mounting structures; 33 kV, 800 amp isolators triple poles single throw which can be manually operated both with and without earth blade/switch, including mounting and operating mechanism;30 kV 10 kA (kiloampere) lightening arrestors (LA) station class with surge monitor and GI mounting structures; 33kV fuse unit 200 A/400 A with mounting structures; 33 kV relay and control panels for 33 kV feeder 110 V DC (with numeric relay and static Tri-vector Meter and communication port for supervisory control and data acquisition); 1.1kV control cables low tension PVC copper cables, switchyard support structures, earth mat materials and 33 kV disc insulators.

(ii) civil works including foundation works, site levelling, switchyard power control center (PCC) and gravelling and cable trenches. No control buildings are included in the scope of work.

(iii) erection including testing and commissioning.

40. The 33kV Bay Extensions involving power transformers and where civil works are required may result in potential adverse impacts and risks and are thus considered further within the IEE. Renovation and Modernization works especially where no civil works are involved are likely to have minimal environmental impact. However, the works at all substations will result in the generation of waste and involve health and safety risk, thus all substation works regardless of scope will be required to follow the EMP for the distribution component.

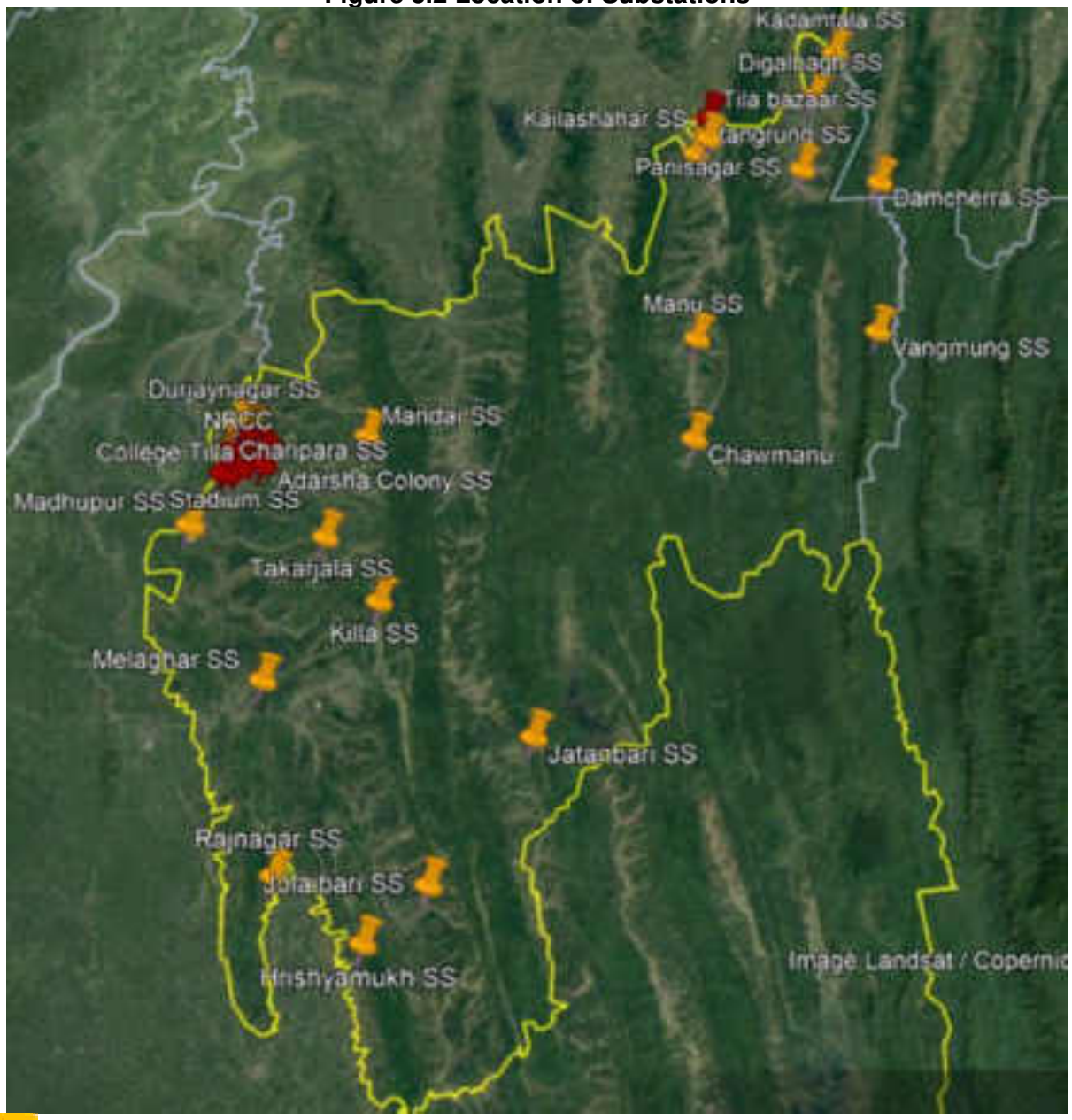
Table 3.1 Summary of Substations

Package	Substation Name (33/11kV)	Electrical Circle	Electrical Division	Electrical Sub-Division	District	Works Required Electrical Sub-Division	
Package I	1. Rajnagar	Belonia	Belonia	Belonia	South Tripura	Renovation and Modernization	Electrical + Fire + First Aid + Water
	2. Hrishyamukh	Belonia	Belonia	Belonia			Electrical + Fire + First Aid + Water
	3. Jolaibari	Belonia	Santirbazar	Bogafa			Electrical + Fire + First Aid + Water
	4. 33Killa	Gomoti	Udaipur	Killa			Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	5. Mandai	Circle 2, Agartala	Jirania	Jirania	West Tripura		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	6. Takarjala	Sepahijala	Jampaijala	Jampaijala			Electrical + Fire + First Aid + Water
	7. Capital Complex MRSS	Agartala I	Capital Complex	Agartala			Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	8. Melaghar	Sepahijala	Melaghar	Melaghar	Sipahijala		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	9. Manu	Ambassa	Manu	Longtarai Valley	Dhalai		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	10. Chawmanu	Ambassa	Manu	Longtarai Valley			Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	11. Kadamtala	North	Dharmanagar	Dharmanagar	North Tripura		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	12. Damcherra	North	Panisagar	Panisagar			Electrical + Fire + First Aid + Water
	13. Panisagar	North	Panisagar	Panisagar			Electrical + Fire + First Aid + Water
	14.Rangrung	Unakoti	Kailashahar	Kailashahar	Unakoti		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	15. Vangmung	North	Kanchanpur	Vangmun	North Tripura		Electrical + Fire + First Aid + Water
	16. Digalbagh*	North	Dharmanagar	Dharmanagar			Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	17. Durjaynagar	Circle 1, Agartala	Capital Complex, Agartala	Durjainagar	West Tripura		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	18. Rampur	Circle 1, Agartala	ED I Agartala	Rampur	West Tripura		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches

Package	Substation Name (33/11kV)	Electrical Circle	Electrical Division	Electrical Sub-Division	District	Works Required Electrical Sub-Division	
	19. Kailashahar	Unakoti	Kailashahar	Kailashahar	Unakoti		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	20. Madhupur	Sepahijala	Bishalgarh	Bishalgarh	Sepahijala		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	21. Jatanbari	Gomoti	Amarpur	Amarpur	Gumti		Electrical + Fire + First Aid + Water + Foundations + Cable Trenches
	Digalbagh*	North	Dharmanagar	Dharmanagar	North Tripura	33kV Bay Extensions	Electrical + Site Leveling + + Foundations + Cable Trenches
	22. Charipara	Circle 1, Agartala	ED II Agartala	Bordowali (Rural)	West Tripura		Electrical + Site Leveling + + Foundations + Cable Trenches
	23. Adarsha Colony	Circle 1, Agartala	ED II Agartala	Agartala			Electrical + Site Leveling + + Foundations + Cable Trenches
	24. Stadium	Circle 1, Agartala	Agartala	Agartala Sadar			Electrical + Site Leveling + + Foundations + Cable Trenches
	25. College Tilla	Circle 1, Agartala	ED I Agartala	Agartala Sadar			Electrical + Site Leveling + + Foundations + Cable Trenches
	26. NSRCC	Circle 1, Agartala	ED I Agartala	Agartala Sadar			Electrical + Site Leveling + + Foundations + Cable Trenches
	27. Tilla bazaar	Unakoti	Kailashahar	Kailashahar	Unakoti		Electrical + Site Leveling + + Foundations + Cable Trenches

*Digalbagh will have both renovation and modernization works and a 33 kV bay extension, this is the same existing substation listed twice
Source: TSECL

Figure 3.2 Location of Substations



Renovation and Modernization

33kV Bay Extensions

Source: ADB TA Consultant

41. The installation of auto-reclosers, and sectionalizers/load break switches (LBS) in eight electrical circuits, fault passage indicators at 11 kV and 33 kV lines on nine electrical circuits, and supply of one cable fault locator and test van for use by one electrical circuit (Capital Complex) are also part of this package which includes:

(i) provision of three phase outdoor 12 kV pole mounted Automatic Circuit Recloser (Auto-Recloser) complete with all accessories, 11 kV Lightning Arrestor with earth lead disconnectors, galvanized iron earth pipes, galvanized iron wire and standard

wire gauge (SWG) for earthing etc., provision of mandatory spare parts and erection including testing and commissioning activities including installations

(ii) provision of three phase outdoor 12 kV pole mounted automatic sectionalizers/LBS, 11 kV lightning arrestor with earth lead disconnectors, galvanized iron earth pipes, galvanized iron wire and Standard Wire Gauge (SWG) for earthing etc., provision of mandatory spare parts and erection including testing and commissioning activities including installations

(iii) provision of three sets per location of medium voltage overhead line fault passage indicators (FPI), telescopic insulated hot stick for installation of FPI on overhead lines up to 33 kV, installations, and trainings on FPI

(iv) cable fault locator and test van for low /medium voltage power cables up to 33 KV for fault identification, provision of training on cable fault location and testing and provision of trained staff (two persons) to carry out cable fault location and testing and to provide on-the job training to TSECL field staff

Table 3.2 Details of Circles Selected for Auto-Recloser and Other Items

Sl. No.	Package	Electrical Circle	District	Works Required
1	Package 1	Gomoti	Gomti	Supply and Installation of Auto-recloser and Supply and Installation of Sectionalizer / LBS (these items shall be erected on the existing 11kV lines and are not related to individual substations)
2		Khowai	Khowai	
3		Unakoti	North	
4		Sepahijala	Sephaijala	
5		Ambassa	Dhalai	
6		EC II	West Tripura	
7		Belonia	South Tripura	
8		Dharmanagar	North	
9		Circle No.I, Agartala	West Tripura	Fault Passage Indicator (Set of 3 per Location) (these items shall be erected on the existing 11kV lines and are not related to individual substations)
10		Circle No.II, Agartala	West Tripura	
11		Khowai	Khowai	
12		Ambassa	Dhalai	
13		Unakoti	Unakoti	
14		Dharmanagar	North	
15		Sepahijala	Sephaijala	
16		Gomoti	Gomti	
17		Belonia	South Tripura	
18		Capital Complex	West Tripura	Supply and Installation of Ring Main Units (these items shall be stationed in the street where underground cabling is being installed)
19		Capital Complex	West Tripura	Supply of Cable Fault Locator and Test Van (these items shall be stationed at Capital Complex MRSS but shall be utilized for the entire division)

LBS = load break switches
Source: TSECL

Figure 3.3 Illustrative Images of Installations

Type	Image
Auto-reclosure/sectionalizers (LBS) Source: India mart	  Auto Reclosure Unit Sectionalizer
Fault Passage Indicator Source India mart	 

FPI = fault passage indicator, LBS = load break switches
Source: ADB TA Consultant

42. This package also includes provision of about 100 12 kV motorized ring main unit (RMU) along with all accessories, mandatory spare parts civil works for foundation and earth mat as per approved design including site levelling / preparation and erection including testing and commissioning.

43. The RMU is a factory assembled, compact set of switchgear, enclosed in a metal cabinet, which is installed at the load connection points of a ring-type distribution network. Ring main conductors (underground cables) enter and leave the cabinet, inside are switches that can connect the load to one or both conductors, a circuit breaker, and a switch that connects by a cable to the existing distribution transformer. The RMU will be connected to the underground cables of the Capital Complex electrical circuit to be installed by the package 2 contractor. Installation of RMUs will reduce outage times by detecting faults early and automatically reconfiguring the network. They will be sited in the street, in an allocated space of a few square meters, but their location will not be determined until the Package 2 contractor has determined the routing of these underground lines. Thy will be installed by the package 1 contractor and connected in conjunction with the underground cabling works to be undertaken by the package 2 contractor. Since they involve civil works in the public domain their installation is considered further in the IEE. Except for the RMU works for installation of the auto reclosers, sectionalizers/LBS, and fault passage indicators will be erected on existing 11kV lines and will result in minimal environmental impact. They are therefore not considered further in the IEE. However, the works will still result in the generation of waste and involve health and safety risk, thus all works regardless of scope will be required to follow the EMP for the distribution component.

Figure 3.4 Illustrative 12 kV Ring Main Unit

Source: AB Electricals

44. **Packages 2, 3, and 6** compromise of installing and upgrading 2,667 km of 11 kV, 33 kV and low-tension distribution lines. Package 2 comprises of 3 lots for distribution lines falling under Electrical Circles EC-I, EC-II, EC-West, EC-Khowai, EC-Dharmanagar, EC-Unakoti and EC-Dhalai. Package 3 also has 3 lots and caters to distribution lines falling under Electrical Circles EC-Sepaijala, EC-Gomati, EC-Belonia. Roughly package 2 involves the northern, eastern, and western part of the state (North Tripura, Unakoti, Dhalai, Khowai and West Tripura districts) while the package 3 involves the southern part of the state (Sepahijhala, Gomti and South Tripura districts). Package 6 covers the HVDS pilot[16] and will include the remainder of component (iii) for agricultural feeders in one electricity subdivision – either ESD Boxarnagar or ESD Sonamura under Sipahijila Circle and District.

45. The scope of the distribution line works in Packages 2 and 3 includes laying of new 11 kV and 33 kV covered conductor overhead lines, laying of new 11 and 33 kV underground cables, conversion of 11 kV overhead lines to covered conductor and underground cables and conversion of low tension (0.4 kV) lines to ABC. Figures 3-10 and 3-11 show examples of the existing overhead lines (OHL) in Tripura with uncovered conductors, covered conductor, and ABC. The scope of the distribution works in Package 6 includes the installation of 11/0.4kV transformers connecting existing 11 kV lines and existing low tension agricultural connections to supply irrigation pumps in areas of scattered settlements which are prone to unauthorized power tapping. No new distribution lines will be installed under the HVDS pilot, and no existing lines converted, although 11 kV covered conductor and low tension (ABC) lines installed under package 2 may be used.[17] None of the new indicative route alignments are passing through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972. Neither are any new indicative distribution lines passing through notified forest areas or impacting on ASI or Government of

[16] Low voltage distribution systems employ lengthy low-tension lines from a single large capacity transformer resulting in system loss and affecting the performance of the distribution system. Unauthorized connections are also common due to bare low-tension conductors these result in overloading of the transformer. Low voltage also affects the efficiency of irrigation pumps sets. In a HVDS electricity is distributed to agricultural consumers off the 11kV network instead of from the lengthy low-tension lines. This requires the installation of numerous pole mounted 11/0.4kV transformers on the 11kV lines to step down the high voltage as near to the irrigation pump sets as possible; a short low tension (ABC) connection then supplies only a few irrigation pumps reducing losses and improving the quality of supply.

[17] Once the district for HVDS pilot is confirmed the IEE will need to be updated and revised based on the final scope of works proposed.

Tripura protected cultural resources. However, the new distribution line works may still result in potential adverse impacts and risks especially as they take place in/near the settlements/local community receptors and are thus considered further within the IEE. Further, some existing low-tension distribution lines may route alongside roads that pass through or adjacent notified forest areas and protected monuments whilst many do not meet existing safety clearances and pass over property resulting in potential adverse impacts and risks.

Table 3.3 Summary of Distribution Lines

Sl. No.	Name of Line	Length (ckm)
1	New 33 kV Line as underground cable	50
2	New 33 kV Line as Covered Conductor	220
3	New 11 kV Line as underground cable	4.2
4	New 11 kV Line as Covered Conductor	1270
5	Conversion of 11 kV Line to Covered Conductor	134
6	Conversion of 11 kV Line to underground cable	89.26
7	Conversion of low tension (0.4 kV) Line to Aerial Bundled Conductor	900
	Total length (ckm)	**2,667.46**

Source: TSECL

Table 3.4 Package-Wise Distribution Lines

Package	Name of Line	Length (ckm)
Package II	New 33 kV Line as underground cable	50
Package II	New 33 kV Line as Covered Conductor	107
Package II	New 11 kV Line as underground cable	4.2
Package II	New 11 kV Line as Covered Conductor	513
Package II	Conversion of 11 kV Line to Covered Conductor	134
Package II	Conversion of 11 kV Line to underground cable	89.26
Package II	Conversion of low tension (0.4 kV) Line to Aerial Bunched Cable	515
Total length under Package II (ckm)		**1412.46**
Package III	New 33 kV Line as Covered Conductor	113
Package III	New 11 kV Line as Covered Conductor	757
Package III	Conversion of low tension (0.4 kV) Line to Aerial Bunched Cable	385
Total length under Package III (ckm)		**1255**
Package VI	Number of new transformers for HVDS Pilot	545
Total length in ckm		**2667.46**

HVDS = high voltage distribution system
Source: TSECL

46. Underground cabling through horizontal directional drilling (HDD) machines shall be done for the laying of new 11 kV and 33 kV lines and conversion of 11kV lines. These 143.46 ckm of underground cabling are currently restricted within Agartala Municipal corporation area (Figure 3-5). Some very small sections of underground cables may be laid on other lines where railway crossings are present and where permissions from the railway authorities to draw overhead lines are not forthcoming. However, this scenario may only be determined once the surveys of all the distribution lines are completed by the EPC contractors and such lengths of underground cabling

are presently not included in Table 3-4. Some sections of underground cabling installed in ring main formation will connect to RMU which will be installed by the package 1 contractor, the package 1 and 2 contractors will work together to connect the cables to the RMUs.

Figure 3.5 Map Showing Agartala Municipal Corporation Boundary Area and Substations

Source: MapsofIndia

Source: ADB TA Consultants

47. 1,624 ckm of covered conductor lines will be laid all throughout the state. This includes both new 11 kV and 33 kV lines (1,490 ckm) and conversion of existing 11 kV lines with bare conductors (134 ckm). Covered conductor is a conductor covered with a dielectric material having no rated dielectric strength.[18] Covered conductors are typically used inside distribution equipment and for overhead high voltage installations. Covered conductors have the advantage of stopping

[18] https://www.gt-engineering.it/en/csa-canada-standards/ce-code/cable-and-conductor

pilferage of electricity and are safer for both humans and wildlife (especially birds and bats) as electrocution risks are reduced for all concerned. Figure 3-6 provides the representative images of covered conductors. The covered conductors that are proposed are 70 square mm triple layer type covered conductor with All Aluminum Alloy Conductors (AAAC) for 11 kV lines and 100 (99) square mm triple layer type covered conductors with AAAC for 33 kV lines.

Figure 3.6 Representative Images of Covered Conductor

Source: https://kjvalloys.in/covered-conductor/ and Research gate (https://www.researchgate.net/figure/Typical-layout-of-single-core-XLPE-cable_fig1_282219011)

48. Approximately 900 ckm of existing Low Tension 0.4 kV lines shall be converted to aerial bundled cable (ABC) lines. ABC lines are overhead power lines using several insulated phase conductors bundled tightly together, usually with a bare neutral conductor. A representative image is given in Figure 3-7. ABC lines are proposed to be XLPE insulated cables (aluminum cable twisted over a central bare aluminum alloy messenger wire) for use on Low-Tension OHL and the rated voltage is 1,100 volts. ABC should be confirming to Bureau of Indian Standards. These lines are proposed mainly where existing distribution lines pass near or along rubber plantations and where there is risk of overgrowth of vegetation. Tree branches falling on overhead lines and resultant outages and short circuits are an issue for TSECL especially during monsoon season and in inaccessible areas. ABC lines shall not be impacted by falling tree branches as they shall not meet the conductors which are insulated. These ABC lines shall also stop theft of electricity by illegal hooking. ABC lines are also safer to the community as electrocution risks are lowered. These lines are also environmentally friendly as less regular trimming of tree branches may be necessary and they are also safer for birds and bats who can perch without risks of electrocution.

Figure 3.7 Representative Images of Aerial Bundled Conductor

Source: India Mart and http://www.cncablewire.com/Product/Aerial_Bundle_Cable/

Figure 3.8 Existing Overhead Lines in Tripura with Uncovered Conductors


West Tripura, TR, India


South Tripura, TR, India


Bridhhanagar, TR, India


Radhakishoranagar, TR, India

Figure 3.9 Photograph of Existing Covered Conductors in Tripura

Source: ADB TA Consultant

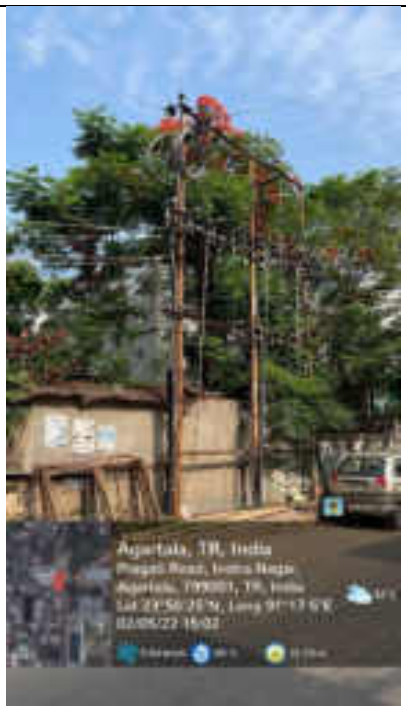
Figure 3.10 Photographs of Existing Low Tension Aerial Bunched Cables in Tripura

Source: ADB TA Consultant

Figure 3.11 Photographs Showing Status of Existing Line Condition and Structures

	
Electrical Subdivision (ESD) Sekherkote, Distribution Transformer, start point for Low Tension distribution line reconductoring	ESD Sekherkote anti climb plus anti-theft device
	
11kv Dashamighat to Golchakkar conversion to underground: end point distribution transformer and possible site for ring main unit	Golchakkar end point distribution transformer – ground mounted – congested area

	
ESD Mandwai: Distribution transformer start point for low tension distribution line	Existing pole foundation near ESD Poangbari start point
	
Pole mounted distribution transformer along ESD Poangbari distribution line	Existing pole foundation near Chittamura Feeder end point

	
Existing pole inside shop premises along the Bodhgangnagar-Adarsha Colony underground cable route	Conversion of overhead line to underground cable in front of TSECL head office, Agartala

Source: ADB TA Consultant

49. Package 5 is a test laboratory which is proposed as a test facility for distribution transformers, other material and equipment procured from various sources (suppliers). It is required due to the absence of similar independent facilities for testing of electrical utility equipment and materials in Tripura, and to provide a training facility. Testing will be carried out on sample / batch basis as per applicable Bureau of Indian Standards and accredited with National Accreditation Board for Testing and Calibration Laboratories (NABL) per ISO 17025:2005 prior to field use by TSECL. The test facility is planned to be constructed within about 1,500m^2 of TSECL land in Gokulnagar, beside the existing TSECL electrical subdivision office (Figures 3-12 and 3-13).

50. The scope of works for construction and establishment of the test facility includes:

(i) Civil works for construction of the test laboratory:
  (a) Up to a three-story building (1340 square meters) to house the indoor test equipment with sperate testing bays for above test facilities, temporary indoor storage area, control rooms and office area
  (b) Outdoor storage area with concrete floor for temporary storage of equipment (275 square meters)
  (c) Outdoor test yard for pole testing (100 square meters)
  (d) Fencing and gate, security hut, infrastructure for water (new bore well) and an electricity supply
  (e) Supply and installation of indoor overhead crane 5 tons and two forklifts of 2T

(ii) Supply, installation, testing / calibration, and commissioning of distribution transformer testing equipment and facilities

(iii) Supply, installation, testing / calibration, and commissioning of All Aluminum Alloy Conductor (AAAC)/Aluminum Conductor Steel Reinforced conductor testing equipment and facilities

(iv) Supply, installation, testing / calibration and commissioning of energy meter testing equipment and facilities

(v) Supply, installation, testing / calibration and commissioning of tubular steel pole testing equipment and facilities

(vi) Training of TSECL staff

(vii) Obtaining National Accreditation Board of Testing and Calibration Laboratories (NABL) accreditation as per IS: 17025:2005 (general requirements for all competence of testing and calibration laboratories). This accreditation demonstrates that the test laboratory operates competently and generates valid results) for all test facilities.

Figure 3.12 Map Showing Proposed Test Laboratory Location

Source: ADB TA Consultant

Figure 3.13 Zoomed in Map Showing Test Laboratory Site

Source: ADB TA Consultant

2. Output 3, Establish Smart Meters and Advanced Metering Infrastructure (Package 4)

51. To reduce commercial losses, the distribution component will replace existing outdated electromechanical meters with smart meters targeting about 100,000 households, and an advanced metering infrastructure with online meter reading, billing, and collection established.

52. Smart meter installation will result in minimal environmental impact. This component is therefore not considered further in the IEE. However, the works will still result in the generation of waste (including e-waste from old meters) and involve health and safety risk for both installers and end users. Thus, all smart meter works will be required to follow the EMP for the distribution component.

3. Status of Contract Packages

53. Table 3-5 shows the contract package and procurement status for the distribution component by TSECL.

Table 3.5 Summary of Contracts for the TSECL Works

Package	Lot	Scope	Bid Document	Contract Award	EMP Status	Remarks
1	-	Substation, auto reclosers and sectionalizers etc.	Issued	No	Draft EMP prepared by ADB TA consultants included in bid documents	Package 1 bid document included draft EMP informed by environmental assessment and clause that the EMP will be updated, updated version will be finalized and issued to the EPC Contractor for compliance before contract award
2	1	Distribution Lines	Issued	No	Draft EMP included (source unknown)	Packages 2 and 3 bid documents included a draft EMP but did not include a clause that the EMP will be updated. To comply with ADB's Safeguard Policy Statement (2009) the final EMP will need to be issued to the contractor for compliance before contract award, TSECL to contractually agree with the contractors that the final EMP will be followed.
	2	Distribution Lines	Issued	No		
	3	Distribution Lines	Issued	No		
3	1	Distribution Lines	Issued	No		
	2	Distribution Lines	Issued	No		
	3	Distribution Lines	Issued	No		
4	-	Smart Meters	No	-	-	

Package	Lot	Scope	Bid Document	Contract Award	EMP Status	Remarks
5	-	Test Laboratory	No	-	-	Include EMP in preparing bidding documents
6	-	Distribution Lines (HVDS)	No	-	-	

ADB = Asian Development Bank, EMP = environmental management plan, EPC = engineering, procurement and construction, TSECL = Tripura State Electricity Corporation Limited
Source: TSECL

B. Design Principles and Construction Activities

54. Summary features of the distribution components involved with respect to construction are given in Table 3-6. Tripura is in seismic zone V and earthquakes are quite frequent. New equipment installed in the substations shall be installed on foundations having proper seismic design conforming to IS 1893 for seismic analysis, IS:1893-84 for seismic zone and IS 2.2.4 for seismic acceleration. The test laboratory building will also need to meet seismic design requirements for buildings in seismic zone V whilst it will need to be confirmed that the existing control rooms of substations have been adequately constructed in the past to meet these requirements. Poles of the overhead distribution lines can be toppled due to earthquakes as well as strong winds causing disturbances in the distribution network. Poles shall therefore conform to Indian Standard (IS) requirements and concrete foundations to the poles shall be having proper seismic design conforming to IS:1893 for seismic analysis, IS:1893-84 for seismic Zone and IS 2.2.4 for seismic acceleration.

1. Substations and Test Laboratory

55. The substations shall be upgraded, and the test laboratory constructed, with completely new equipment involving the following construction activities within the existing boundary of the substations and on land owned by TSECL:

(i) Selection of contractor following International Competitive Bidding tender process,
(ii) Site survey and design,
(iii) Establishment of construction site, storage area, labor camp,
(iv) Sourcing and transportation of material and equipment,
(v) Site clearance including dismantling of old foundations and equipment (if required),
(vi) Site levelling and earthworks (required for the bay extensions and test laboratory),
(vii) Foundations with concrete (if required),
(viii) Installation of steel structures and substation gantries,
(ix) Installation of transformers and electrical equipment,
(x) Upgradation and modernization of existing control rooms at substations including for staff sanitation and welfare,
(xi) For the test laboratory the construction of a single-story building and outdoor storage area with concrete floor/test yard,
(xii) First aid and firefighting arrangements,
(xiii) Testing and commissioning prior to operation.

56. The design of the substation upgrades will be in accordance with Government of India requirements and international good practice regarding technical and environmental, health and safety performance standards as set out in the IFC EHS Guidelines. Use of PCBs and all asbestos

containing materials will be prohibited. Any temporary labor camps will be setup within the substation boundaries. In case of land not available within the substation, permissions shall be taken for establishing labor camps outside the substation at a suitable place following the measures provided in the EMP. Time to be taken for construction will be about 7 months for electrical and mechanical upgrading and 12 months with civil works involved requiring about 5 skilled and 15 unskilled workers.

Figure 3.14 Representative Images of Renovation Works at Substation

Ongoing works in TSECL Substation at Govinda Tilla, Amarpur (out of scope)

Source: ADB TA Consultant

Table 3.6 Summary Features of Distribution Components Involved

Key Features		Particulars
Land ownership and footprint	Permanent works	• Substations and test laboratory: TSECL land, within existing substations and sub-division office areas, no civil and electrical works are required to take place outside of the existing TSECL boundaries. • New distribution lines including RMUs for underground cables: mainly within ROWs of existing roads or highways. Agricultural and other private land shall be avoided to the extent feasible, but if unavoidable, then compensation of standing crop damage/trees during installation shall be paid at the market value during construction. • Existing distribution lines including RMUs for underground cables: permanent works (conversion of existing lines to covered conductor, ABC, or underground cables) shall be within existing ROW of lines or within ROWs of existing roads

Key Features		Particulars
		or highways, if minor realignment along other land uses including agriculture fields or other private land is required compensation of standing crop damage/trees during installation shall be paid at the market value during construction. • No land acquisition involved for substation, test laboratory and distribution line work.
	Temporary works e.g., construction camp, material storage site	• Substations and test laboratory: TSECL land within the existing substations and sub-division office areas, except for Vangmung and Kailashahar Substations which will need to find land outside. Kailashahar and Vangmung Substations do not have sufficient area within the substation for temporary facilities. In Kailashahar, there are some old buildings and land just outside the substation (but within the TSECL complex) which can be used. Jolaibari, Durjaynagar and NSRCC Substations have some available but limited open space for temporary facilities so may need to find extra land outside. • Distribution lines: within the ROW of the distribution line, for day-to-day storage or nearest TSECL substation for longer term storage requirements.
Construction	Construction method	• Per the construction method statement of EPC contractor • Manual construction with the involvement of powered mechanical equipment for substations, test laboratory and the OHL • For all underground cables HDD construction method will be utilized • Piling and blasting is not envisaged
Access	Access for construction	• Substations and test laboratory: existing road network available but entry to the Chawmanu Substation needs to be repaired and connected to the access road in front for entry of vehicles. Presently the entrance to this existing substation is inaccessible to vehicles. • Distribution lines: existing road network available. New lines shall be aligned mainly along the existing roads or highways for easy access for maintenance
	Transportation of materials and equipment	• By existing roads, highways, railways, or combination as per the logistics plan of EPC contractor
Construction Plant	Batching Plants etc.	• Unlikely to be required given small scale of construction works, although it will be for final determination of EPC contractor if they wish to utilize • Possibility of centralized construction plant being established by an EPC contractor to support quality assurance of materials and lessen dependence of suppliers • Construction plant are only to be set up at site after obtaining Consent to Establish and Consent to Operate from the Tripura Pollution Control Board
	Equipment	• EPC Contractor would bring their own construction equipment and machineries including transport vehicles for workers and equipment, heavy materials handling facilities like mobile

Key Features		Particulars
		crane, forklift, HDD machine etc.
Materials for Packages 1 and 4	Cement and steel	• Direct from cement and steel plants (bulk quantity) with valid environmental clearance, CTE and CTO or (if the quantity is less) wholesale distributors in the nearest settlement, source/brand shall be approved by TSECL (PIC) • Nearest cement plants are operating in Assam and Meghalaya and can be transported through any of the preferred means of transport to the construction sites
	Sand	• Direct from local approved quarries with valid EC, CTE and CTO
	Stone Aggregates	• Direct from suppliers with valid EC, CTE and CTO for crusher, stone aggregates in Tripura are supplied from approved quarries Assam (as existing stone quarries are virtually non-existent in Tripura, where brick bats are usually used in lieu of stone aggregates) • Brick aggregates from brick kiln with valid environmental clearance, CTE and CTO may be used if laboratory tests are passed, and their use is approved by TSELC (project management consultant (PIC))
	Electrical, Mechanical and Instrumentation Parts	• Direct from Original Equipment Manufacturers (OEM) or authorized distributors as per the Technical Specifications and as approved by TSECL (PIC)
Materials for Packages 2, 3 and 6 (distribution lines)	Cement, Sand and Stone Aggregates for foundation of poles	• Direct from cement and steel plants (bulk quantity) with valid environmental clearance, CTE and CTO or (if the quantity is less) wholesale distributors in the nearest settlement, brand / supplier shall be approved by TSECL (PIC) • Sand direct from local approved sources with valid environmental clearance, CTE and CTO • Direct from suppliers with valid environmental clearance, CTE and CTO either from approved quarries in Assam for stone or brick aggregates from brick kiln in Tripura, if their use is approved by TSELC (PIC)
	Galvanized Steel Tubular Poles	• From Original Manufacturers with minimum 3 years of experience as per the Technical Specifications and as approved by TSECL (PIC)
	Conductors	• Direct from Original Equipment Manufacturers (OEM) or authorized distributors as per the Technical Specifications and as approved by TSECL (PIC)
	Insulators, connectors, distributor box, clams, braces, transformers, and other accessories	• Direct from Original Equipment Manufacturers (OEM) or authorized distributors as per the Technical Specifications and as approved by TSECL (PIC) • Transformers to be installed will all be certified as PCB free
Other Resources	Power	• Temporary diesel generator set will be required during construction • For the test laboratory a diesel generator set will be required to be provided in case of the temporary power outage event

Key Features		Particulars
		during operation.
	Water	• EPC contractor will determine if they source canned drinking water from an existing supplier (as the preferred option) or provide treated water for workers; all drinking water provided will be regularly tested and confirmed to meet Government of India drinking water standards, if the EPC contractor provides their own supply permissions shall be obtained from authorities with the agreement of local communities. • Other construction water to be obtained from existing local ground / surface water sources depending on site conditions to be determined by the EPC contractor, permissions for which shall be obtained from authorities with agreement of local communities. • For new bore wells for operational water supply at substations and test laboratory where 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
Labor	Workers camps	• Construction labor camps within substations / TSECL land to be determined by EPC contractor (if such land is not available then the EPC contractor to submit all necessary documents demonstrating agreement for temporary land use with a private landowner to TSECL, including land ownership papers etc.) • Per design approved by TSECL (PIC) and to contain all basic requirements (beds and beddings, mosquito nets, artificial lights, natural lights, windows and ventilation, fans, emergency exits, firefighting equipment, kitchen and dining halls, mobile charging points, toilets and washing facilities, potable drinking water, recreational space. • Design of labor camps shall conform to IFC EHS guidelines, ILO's guidance on worker accommodation[19] and regulations of Government of India
	Construction staffing	• Most of the works required are manual labour intensive with the involvement of powered mechanical equipment, except where underground cabling shall be done with HDD machines • The exact size of the workforce including the number of unskilled, semiskilled, and skilled shall be determined by the EPC contractor based on the project scheduling which shall be approved by TSECL (PIC) • For working with electricity and at height only suitably qualified and experience labor will be used • Both local and external laborer shall be utilized for which the EPC contractor shall obtain labor licenses and Workmen Compensation Insurances
Wastes	Specific type of waste generated	• Non-hazardous waste includes all domestic and kitchen waste, packaging wastes including plastics, paper, cardboard, wood, etc. construction waste such as concrete, brick, rubble, iron scrap etc.

[19] https://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_ent/@multi/documents/publication/wcms_116344.pdf

Key Features		Particulars
		• E-waste: broken or used electrical equipment • Hazardous waste: used transformer oil, empty metal or plastic fuel/oil/chemical containers, transformer oil or solvent-soaked rags, used batteries etc. • Removed electrical and mechanical equipment will be handed over to TSECL or transported to designated TSECL Circle warehouse as per the direction of TSECL (PIC) • All the old bare conductor lines and poles shall be handed over to TSECL or transported to designated TSECL Circle warehouse as per the direction of TSECL (PIC) • TSECL will reuse or recycle using SPCB authorized vendors as per the condition of the equipment, if fit for use they will be stored for reuse by TSECL or they will be auctioned off as scrap material • Disposal of old transformers and other hazardous wastes shall be as per the Hazardous and Other Wastes (management and transboundary movement) Rules, 2016, Government of India. • Other wastes will be recycled using SPCB authorized vendors or suitably engineered and licensed waste management facilities for inert or solid waste

ABC = aerial bundled conductors, CTE = Consent to Establish, CTO = Consent to Operate, EPC = engineering, procurement and construction, EHS = environmental, health and safety, HDD = horizontal directional drilling, IFC = International Finance Corporation, NSRCC = Netaji Subhas Regional Coaching Centre, OEM = Original Equipment Manufacturers, OHL = overhead line, PIC = project implementation consultant, ROW = right of way, RMU = ring main units, SPCB = state level pollution control boards, TSECL = Tripura State Electricity Corporation Limited
Source: ADB TA Consultant

2. Overhead distribution lines

57. Once a contractor is selected following ICB tender process the works on new 33 kV and 11 kV overhead covered conductor distribution lines shall involve detailed GPS survey of proposed line routes and design as per CEA guidelines and vertical and horizontal statutory clearances,[20] establishment of the construction site, storage area and labor camp, and sourcing of materials and equipment. This will be followed by tree cutting or trimming and clearing of the Right of Way wherever required, staged transportation and supply of poles, conductors, and other accessories to the work sites as per the logistics plan of the EPC contractor, foundation works for poles, erection of pole structures (single, double, triple or four) with stays and struts, unrolling of cables, cable stringing, earthing and installation of accessories on the distribution line and finally commissioning when the distribution line will be connected to existing transformers at the start and end point.

58. For new 33 kV and 11kV lines, the construction for 1 km length shall be approximately 18-21 days (approximately 5 days for digging and erection of poles, 2-3 days for the installation of accessories, 10-12 days for stringing and 1 day for commissioning). To connect to the existing transformers TSECL will shut power for consumer during works for 5 hours (10am-3pm). Although it will vary depending on the plan of the EPC Contractor about 15 unskilled and 2 skilled laborers

[20] Per Central Electricity Authority (CEA) electricity rules/guidelines and IFC EHS Guidelines on Transmission and Distribution e.g., installation above or adjacent to residential properties or other locations intended for highly frequent human occupancy (e.g., schools or offices) will be avoided

shall be required for the construction of 1 km of overhead line which will be installed in a transient manner.

59. Figures 3-15, 3-16 and 3-17 show the general arrangements of steel tubular poles of existing lines along with sample photographs of the existing overhead lines in Tripura which will likely be followed by the EPC contractors. TSECL has confirmed they will avoid routing of any new alignment through notified forest area and EPC contractors shall also ensure that no alignment of the new lines passes through such an area. New lines may cross through rubber plantations or there may be dense vegetation adjacent to road ROWs and so felling / lopping of branches may be required to provide sufficient ROW and access for maintenance. The EPC contractor shall also ensure that alignment of lines do not cross through schools, hospital, private buildings etc. Permissions and approvals from the National Highways & Infrastructure Development Corporation Limited (NHIDCL) / Public Works Department (PWD) and railways shall be obtained where the distribution line shall be crossing the national highways, other road networks and railway lines. Temporary pedestrian and traffic diversions in the road crossings shall be put in place as per an approved traffic management plan in consultation with TSECL (PIC).

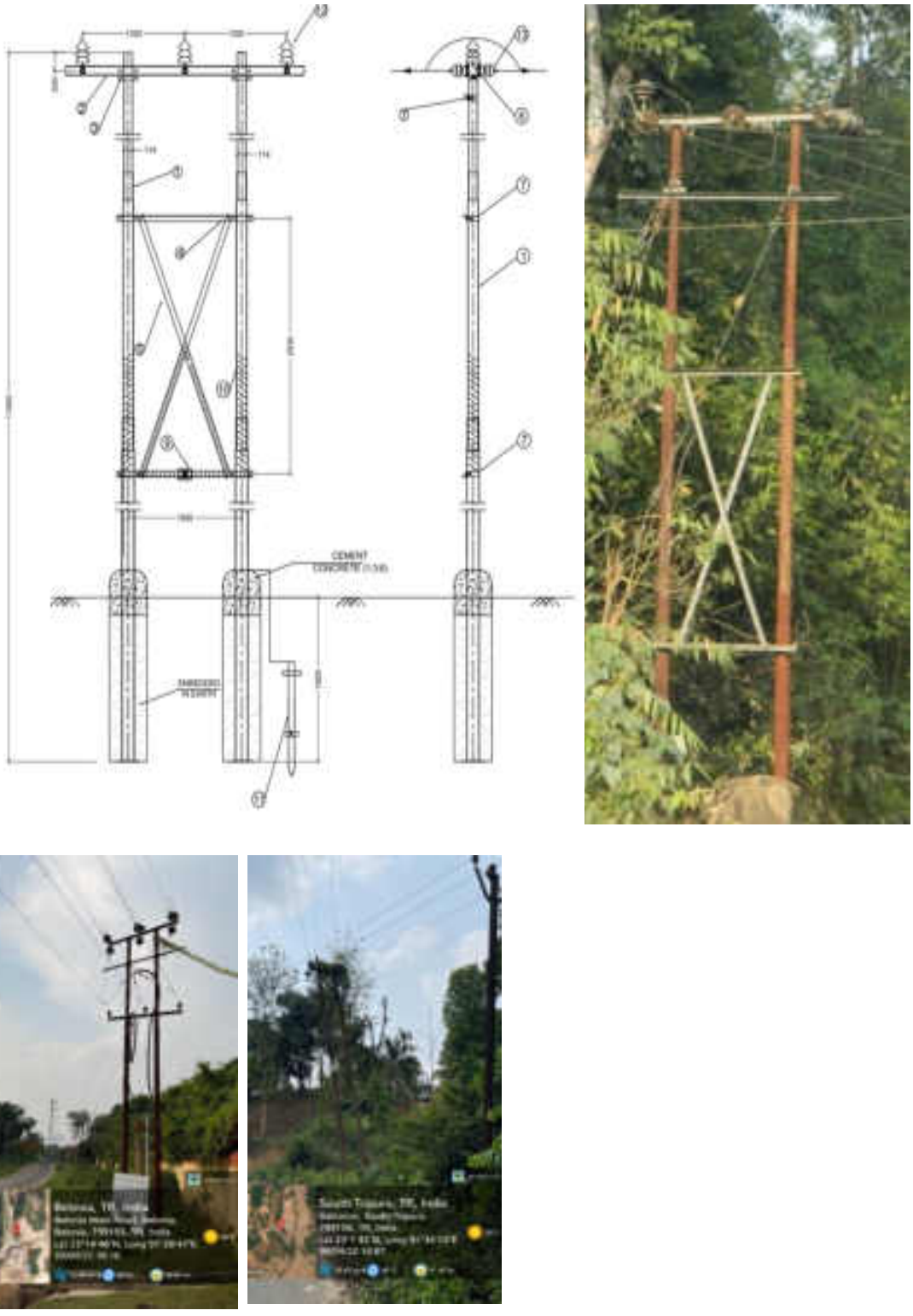
60. The exact number of poles required is to be defined by the EPC contractor based on the type of line (approximately 20 poles per km for 33kV covered conductor lines, 22 per km for 11 kV lines). There shall minimal excavation and soil removal only for installing new poles. Digging of any foundation pits is done manually using auguring tools, concrete mixture for foundation is cast, and poles are unloaded for erection which is done using chain and pulley blocks. Once the erection is done, the cross arms and pin insulators are mounted, and stringing of new wires is done manually with correct sag as per the CEA guidelines.

61. The new poles shall be provided anti-climbing devices. Scaffold and safety net below the distribution lines shall be used whenever works are in the settlement areas, across roads, railways or waterways, or as per the requirement of TSECL (PIC) to manage health and safety risks.

Figure 3.15 General Arrangement of 11 kV Steel Tubular Single Pole Structure and Photograph for Existing Overhead Lines

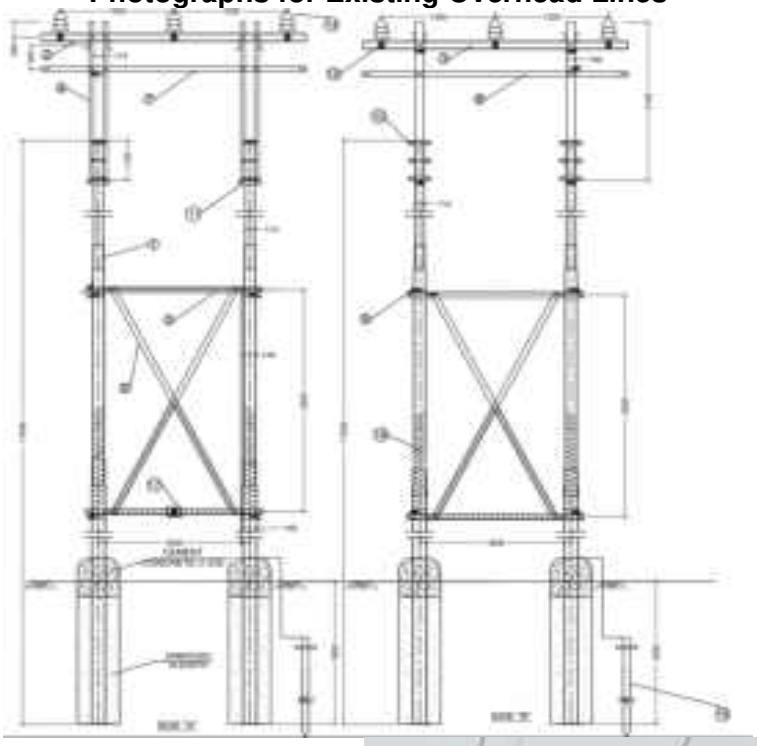
Source: TSECL (general arrangement) and ADB TA Consultant (photographs)

Figure 3.16 General Arrangement of 11 kV Steel Tubular Double Pole Structure and Photograph for Existing Overhead Lines



Source: TSECL (general arrangement) and ADB TA Consultant (photographs)

Figure 3.17 General Arrangement of 11m Steel Tubular Four Pole Structure and Photographs for Existing Overhead Lines



Source: TSECL (general arrangement) and ADB TA Consultant (photographs)

Figure 3.18 Representative Under Construction Photographs of Covered Conductor Installation

Source: NPTI

Source: Indiamart

Source: EPS Electric power synergies

Source: Hindustan Times

Figure 3.19 Representative Under Construction Photographs of ABC Installation

Source: IEE of ADB funded Uttar Pradesh Power Distribution Network Rehabilitation Project
https://www.adb.org/sites/default/files/project-documents/51395/51395-002-iee-en.pdf

62. Similar exercise shall be taken where old bare conductor lines shall be replaced with covered conductors and for low tension lines (with about 25 poles per km) ABC. The major difference shall be that all the existing poles (mostly Plain Cement Concrete (PCC) poles and some tubular steel poles) shall be replaced for the covered conductor lines with galvanized steel poles while for low tension lines they shall only be replaced where required. Minor rerouting of

the distribution line may be required to avoid sensitive receptors (due to encroachment on vertical and horizontal statutory clearances of the existing lines) or site conditions. If the existing pole is removed measures will be taken not to damage the pole during removal. Existing poles will be removed by pulling the complete pole from the ground; poles will not be cut off at the ground level. Poles will then be cleaned, and any material attached to the pole (including concrete) removed. Unused pits will then be backfilled and compacted completely with enough backfill piled above grade to prevent depressions being created by natural compaction. For new pole locations digging of any foundation pits is done manually using auguring tools, concrete mixture for foundation is cast, and poles are unloaded for erection which is done using chain and pulley blocks.

63. For the conversion of existing 11 kV lines to covered conductor, dismantling of existing poles (Plain Cement Concrete (PCC) or steel poles) and old conductors shall require approximately 5 days besides another 18-21 days for erection to commissioning of 1 km line (total 23-26 days for 1 km). The conversion of low-tension lines to ABC though shall not require all existing poles to be replaced and hence the time for 1 km line shall include dismantling for approximately 3 days, digging and erection of poles for approximately 3 days, 1 day for installation of accessories, 4-5 days for stringing and 1 day for commissioning. Thus, the total time for 1 km of low-tension line conversion to ABC shall be approximately 12-13 days. Approximately 15 unskilled and two skilled laborers shall be required for the 1 km of the works for conversion to covered conductor lines while for low tension conversion to ABC 10 unskilled and two skilled laborers shall be required. However, this may vary as per EPC Contractor's plans.

64. If no new poles are needed the reconductoring works shall only involve cutting or trimming of trees to ensure the ROW is maintained, dismantling of existing 1/2/3 phase bare conductors, cross arms, insulators, service tapings and other hardware followed by stringing, earthing, and installation of accessories including distribution boxes to provide customer connections which will be reinstated (service wires will not be upgraded but shall be changed for the particular consumers when converted to smart meters) after the reconductoring is completed. TSECL will be keeping existing distribution transformers in-situ and not replacing them.

65. For the HVDS component there will be the additional installation of 11/0.4 kV transformers. These will usually be installed on the existing single or double 11 kV line poles with transformers mounted on the pole itself (with switch gear and an enclosed control panel) or they may be ground mounted. Small concrete foundation with bunding and fencing will need to be constructed in the case of any ground mounted transformer, for which earth works are required.

3. Underground Distribution Lines

66. For works to 33 kV and 11 kV underground distribution lines, once a contractor is selected following ICB tender process, the EPC contractors shall first conduct a detailed route survey of the proposed underground lines including geotechnical investigations. They will establish the construction site, storage area and labor camp, and source materials and equipment for transportation to site as per the logistics plan of the EPC contractor. The underground cables will then be bored and laid using trenchless method through Horizontal Directional Drilling (HDD) machine. No open cut installation is currently proposed. The cables shall be laid in HDPE conduit pipes and where road crossing is present galvanized iron pipes shall be used. The HDD machines for trenchless technology use a drill and winch to install the underground cables without causing disturbance to the ground above except for at the entry and exit pits which are about one meter square (representative image of HDD provided in Figure 3-20 while photographs of HDD in progress given in Figure 3-21). The conduit pipes and cables are normally laid at about 1 m depth and are inserted and pulled through a small hole drilled between the entry and exit pits. The length

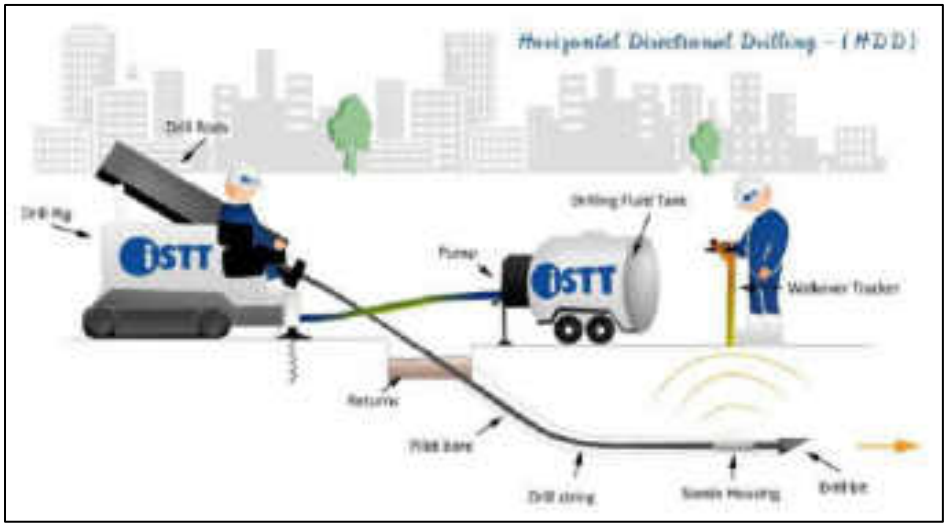
of the cable that the winch can fed is about 100 m to 150 m based on the terrain and alignment. Underground obstacles / water and gas pipelines are normally handled by identifying them in advance in consultation with the utility service providers and adjusting the alignment accordingly. Water is normally used as a drilling fluid to reduce noise and vibration.

67. Works shall be taken up during day and after obtaining necessary approvals and permissions of TSECL (PIC) and the municipalities (Dharmanagar and Agartala) and other utility providers. As the works will take place in the road ROW temporary pedestrian and traffic diversions shall be put in place including for loading and unloading of material and equipment as per an approved traffic management plan in consultation with TSECL (PIC). Approximately 5-7 days shall be required to lay 1 km of underground cable through HDD by using one HDD machine and between 5-7 construction workers.

68. TSECL presently plans to maintain the existing 89.26 km of 11 kV overhead lines (which is proposed to be converted to underground lines) including poles and conductors as a secondary backup line in-case the underground cables develop some faults so these will not be removed. Overhead lines in Agartala will be coming down eventually as per the plan of Agartala SMART city project.

Figure 3.20 Representative Image of Trenchless Technology and Components for Installation of Underground Cables

Source: ADB funded Bengaluru smart energy efficient power distribution project
https://www.adb.org/sites/default/files/project-documents/53192/53192-001-iee-en.pdf



Source: https://www.researchgate.net/figure/Components-of-Horizontal-Directional-Drilling-HDD_fig1_281272440

Figure 3.21 Representative Photographs of Drill Rig and Entry Pit in Trenchless Technology for Installation of Underground Cables

Source: ADB funded Bengaluru smart energy efficient power distribution project
https://www.adb.org/sites/default/files/project-documents/53192/53192-001-iee-en.pdf

Figure 3.22 Representative Photograph of Ring Main Unit Installation

Source: Zeek Box Media

69. For all distribution line works, the number of laborers shall be dependent on the working methods as adopted by the EPC contractor. Any temporary labor camps will ideally be setup within the boundaries of the nearest TSECL substation. In case of land not available within the substation, permissions shall be taken for establishing camps outside the substation at a suitable place following the measures provided in the EMP.

C. Operation and Maintenance

70. The EPC Contractor shall hand over the assets to TSECL once the commissioning is done. However, they shall be required to rectify, repair, or replace any defect/s in the design, engineering, materials, or workmanship found and notified during the defect liability period. TSECL has its own staff who are posted at the various substations, subdivisions, divisions, and circles who look after the O&M of its assets, undertake inspections, and any maintenance works to maintain the substations as per the Indian Electricity Rules, Tripura Electricity Regulatory Commission (TERC) and CEA guidelines. Regular O&M works shall be undertaken at the substation by the inhouse TSECL staff posted in the substations. They shall be assisted for special maintenance works, as required, by staff from the sub-division, division, circle, or headquarters. Similarly, O&M works for distribution lines shall be undertaken by the regular TSECL staff from the sub-divisions, division or circle as required. TSECL has also appointed Input Based Distribution Franchisees for O&M of its distribution lines under Electrical Division (ED) Mohanpur (West Tripura district), ED Sabroom (South Tripura district), ED Kailashahar (Unakoti district), ED Ambassa and ED Manu (both in (Dhalai district). Inspections are undertaken by TSECL linemen whilst these franchisees undertake regular and periodical maintenance as per their contract provisions and to maintain the distribution lines in accordance with the Indian Electricity Rules, Tripura Electricity Regulatory Commission (TERC) and CEA guidelines. Routine maintenance undertaken by the franchisees includes trimming of overgrown tree branches (if infringing on the conductors), changes of insulators and accessories (as per site conditions), reconductoring (if required as per site conditions), replacements of poles if damaged etc.

71. The test laboratory for equipment and material testing will undertake the electrical and mechanical testing of distribution transformers, other material and equipment procured from various sources (suppliers) such as poles or conductors prior to field use by TSECL. Testing of

three phase distribution transformer of rating 11/0.4 kV from 25 kVA to 500 kVA capacity will be undertaken.

72. The test facility shall have the capacity to test 15 number of transformers in a shift of 8 hours and minimum monthly quantity of 375 transformers. Among the tests to be conducted, the dielectric breakdown voltage test must be conducted on a sample of transformer oil and will involve the taking of oil samples from the transformers which will then be tested and disposed of. Samples are normally drawn from a drain valve at the bottom of the transformer where sludge, water and contaminant particles collect. It is important therefore, to flush the system thoroughly to ensure that the sample is drawn from the main bulk of the oil. This may involve removing two liters of oil, and even more if the equipment has been out of service for some time. There will be a risk of spills or leaks and contamination of soil either from the transformers during testing or from their storage and handling before and after testing in the yard of the test laboratory. No other chemicals will be required for the test. Other tests to be performed are electrical or mechanical.

73. This will be the first test laboratory in the state, so TSECL has no prior experience. The contractor will therefore provide comprehensive theoretical and hands-on training for nominated TSECL staff to operate the test laboratory independently. Further for the first six months trained staff shall be provided by the contractor to operate the test laboratory whilst providing on the job training for the nominated TSECL staff.

Figure 3.23 Transformer Testing Facility Illustrative Example

Source: indiamart.com

D. Existing Facilities

74. The distribution components involve work within existing facilities i.e., 27 substations to be upgraded. The existing 33/11 kV substations under TSECL are connected to existing interstate and national grid network via 132/66/33/11 kV substations (13) and 66/33/11 kV substations (11) and 400 kV, 132 kV and 66 kV transmission lines as well as with the Gumti HEP and the Baramora and Rokhia Gas Thermal Power Plants in the state. The power transfer may be sourced from any state. Underground cables and covered conductors and ABC replacing the overhead bare conductors will be connected to existing the poles and transformers.

75. The existing substations at which works are proposed are classified as existing facilities as per ADB's Safeguard Policy Statement (2009). An environmental audit of these substations (existing facilities) has been undertaken. The audit report in provided in **Annexure 2**, whereas the Corrective Action Plan (CAP) is provided in **Annexure 14**. The substation buildings should normally be designed to be earthquake proof although cracks have been noted during the environmental audit and thus the risk of building failure and level of risk to substation workers during an earthquake is heightened. The CAP that has been provided must be complied with by TSECL prior to contractors being allowed access to site unless TSECL has specifically included the corrective action in the contract for the EPC contractor to address as part of their scope of works.

76. In replacing existing overhead bare conductors EPC contractors will be required to ensure they comply with EMP requirements. Existing transformers in the distribution network may contain PCBs although no existing transformers are being replaced under the distribution component. TSECL is however required to inventorize and dechlorinate or remove all existing PCB containing transformers in conformance to the Government of India's Regulation of Polychlorinated Biphenyls Order, 2016 by 31st December 2025. In the interim period, existing pole mounted / ground mounted transformers that contain PCBs must only be retained by TSECL if in good condition, no leaks etc. Such transformers retained in-situ (distribution and substations) should all have PCB warning signs. Even if there is no risk of the transformers containing PCBs TSECL must maintain its existing transformers in good condition. Further where ground mounted transformers are retained these should all be fenced by TSECL to prevent access by the community for health and safety purposes and (especially those located close to a drain, stream, other waterbody, spring, groundwater well, or hand pump) retrofitted with 110% bunding to prevent oil leaking to soil, surface water, and groundwater and contaminating it.

E. Associated Facilities

77. There are no associated facilities linked to the distribution component.

F. Implementation Schedule

78. Construction of distribution component will be 3 years (36 months) with the defects liability period completed by end of 2026 followed by a year of O&M (2027) with the tentative implementation schedule in Table 3-7.

Table 3.7 Indicative Implementation Schedule

Description	Indicative Time Frame
Bidding Documents	May 2021
Procurement	October 2022
Construction Commencement	December 2022
Project Completion	November 2025
Defects Liability Period	October 2026

Source: ADB TA Consultant

G. Alternatives Analysis

4. No Project Alternative

79. Alternative analysis included consideration of the no project alternative. The no project alternative would have no direct negative environmental impacts since no construction works would be involved. However, socioeconomic benefits would not be realized. The existing

distribution network is aged, overloaded, and uses antiquated technologies making its operation and maintenance challenging particularly during heavy rain, storm and mist that are common in many parts of the state. Though Saubhaya scheme has improved the last mile connectivity, the lack of upstream distribution strengthening investment results in an unreliable electricity supply for consumers. The poor quality of supply is one of the contributory factors to low socio-economic development in Tripura compared to other progressive states and this situation will continue without intervention. Further, conversion of existing bare conductors to covered conductors and ABC lines shall also be helpful in reducing existing electrocution risks to both human beings and wild animals including avian fauna. Therefore, the with-project alternative was preferred over the no project alternative.

5. With Project Alternative

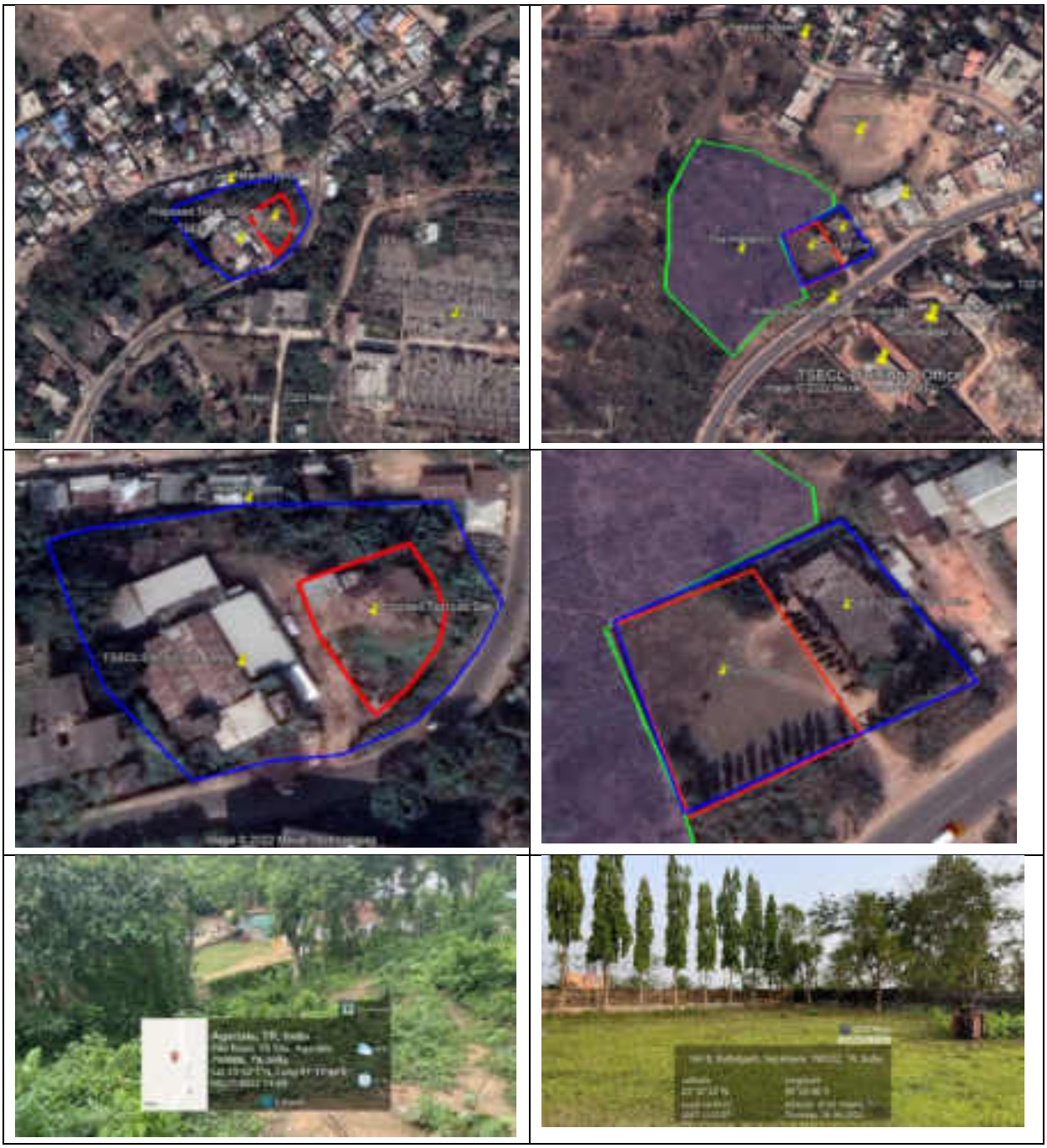
a. Alternative locations and routings

80. Since the substations which are to be taken up under the distribution component are already existing ones, no alternative analysis of the substation site locations has been done.

81. For the test laboratory two sites were evaluated. The originally identified site (Site 1, 500 square meters) at 79 Tilla is located within the Agartala municipal area on an elevated piece of land within the existing workshop of TSECL. The approach road is narrow with steep gradient. Cut and fill would be required as the site slopes and part of it will need to be increased in height by 2-3m to the construction level with slope stabilization work required. Two medium sized office buildings were also planned to be demolished. Soils on site appear to be contaminated from the existing use with part of the land used as storage for new or repaired transformers and hazardous and non-hazardous wastes being within the existing workshop area. The presence of habitation with the nearest houses immediately adjacent to the site boundary may result in significant impact during construction from noise and vibration including cut and fill and piling work, demolition, vehicle movement, and the risk of debris and material falling on the houses especially if the slope were to fail. In terms of operation, due to the presence of hand pumps and use of ground water by the nearest houses further contamination from spills or leaks may degrade ground water, assuming the same aquifer is being tapped. Based on preliminary environmental and social impact assessment this site was not selected by TSECL. The alternate site (Site 2, 2600 square meters) at Gokulnagar is housed inside the TSECL sub-division office. The topography is flat, and the approach road is the 10 m wide Shillong-Agartala-Sabroom main road. Two sides of the site are bounded by tea plantation estate. The number of trees enumerated inside the site boundary is 28 but all of them are found along the site boundary so none will need to be felled. The site is not contaminated and free of any structures. The nearest houses are about 135m from the site boundary with a temple at 138m. Sipahijila WLS is about 6.5m from the site boundary. Due to the more accessible but isolated location away from the main city, the site is more suitable for the test laboratory than Site 1 and was selected by TSECL.

Figure 3.24: Alternative Sites for Test Laboratory

Site 1: 79 Tilla, Agartala (Within existing TSECL workshop area)	**Site 2: Gokulnagar** (Within existing TSECL Subdivision area)



Source: ADB TA Consultant

82. Distribution lines were preliminarily selected by TSECL based on the requests of circle and division offices with lines requested for upgradation being either old lines (greater than 25 years), those passing through dense vegetation / rubber plantation where frequent faults occur, those requiring a double feeding system, bifurcation of feeders, or, conversion to a ring main system, and, in some cases, to mitigate power theft due to bare (uninsulated) lines, remove lines that pass over rooftops or through private properties, and, those requiring underground cabling due to lack or nonavailability of ROW in the urban areas. Based on prioritization of the lines, TSECL shortlisted several distribution lines.

83. **Existing Distribution Lines.** The preliminary route selection for upgrading of the existing lines shall be along the existing RoW therefore no alternative analysis of routings needs to be done although minor diversions may be required where there has been encroachment into the RoW and horizontal and vertical safety clearances are not met. For any minor diversions the principles for new lines will be followed. Due to the need for detailed ecological/archaeological assessment with respect to potential construction impacts and the lead in time required to secure wildlife, forest, and/or protected monument permissions TSECL decided conversion of existing lines routed through such locations would be excluded from the scope of the distribution component.

84. No 33kV or 11kV lines route through protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources. However, site visits found some existing low-tension in Electrical Sub Divisions routed alongside roads that pass through or adjacent to notified forest areas and protected monuments (e.g., Boxarnagar Electrical Sub-Division supports forest range and has low-tension lines adjacent to the Boxarnagar Stupa, an ASI protected monument) — once the low-tension lines have been mapped if such lines need to be involved in the scope of works then site-specific assessment and management planning must be undertaken by TSECL with full time ecological and/or archaeological supervision with rerouting outside the area or undergrounding[21] rather than reconductoring adopted as the preferred option.

85. Conversion of existing lines will only be permitted if school or hospital compounds and playgrounds are not crossed, or minor rerouting takes place to avoid them. Conversion of existing lines and related facilities must minimize damage to existing trees outside of forest areas and properties whilst ensuring horizontal and vertical safety clearances are maintained in all cases. Underground cables shall generally follow the existing overhead distribution line routes that they shall replace sticking to the existing RoW of the road, although a slight shift towards the road center and minor diversions may be required to avoid impact on public utility services etc.

86. **New Distribution Lines.** For new lines, only the start and end substation for 33 kV lines and the names of the 11 kV feeder to be bifurcated are confirmed by TSECL. The route surveys shall be conducted by the EPC contractors who will be responsible to determine the route alignment such that the route alignment principles are followed. The principles that have been/will be adopted by TSECL for selection of route alignments for the new distribution lines are:

(i) New lines that trigger Category A (activities with significant adverse environmental impacts that are irreversible, diverse, or unprecedented) shall not be taken up under the distribution component.

(ii) New lines resulting in the significant conversion or degradation of natural habitat, or which are routed within critical habitat[22] and have not been demonstrated through a site-specific assessment to comply with ADB's Safeguard Policy Statement 2009 critical habitat requirements shall not be taken up under the distribution component.

[21] In such situations conversion to underground cabling is the preferred (and feasible) option to eliminate all operational risks to wildlife if distribution lines are routing along existing roads but provided either covered conductor or ABC were used along with a primate/bird sensitive design, conversion would usually be beneficial in terms of reducing electrocution risk to wildlife from the existing bare conductors. Conversion to underground cabling would usually also benefit the setting of protected monuments by removing visual clutter although construction impacts and the higher chance of chance finds being made would need to be managed and thus may not be preferred by ASI. Since the impact will depend on the setting of the existing distribution line detailed site-specific ecological and/or archaeological assessment and management planning by professional ecologists or archaeologists is required.

[22] This refers to the Area of Analysis associated with the individual substation or distribution line as critical habitat is supported at state level (Chapter 4)

(iii) New lines and related facilities must avoid legally protected areas including national parks, wildlife sanctuaries, ecologically sensitive areas, protected ASI and Government of Tripura monuments.[23]

(iv) New lines and related facilities must avoid other internationally and nationally recognized sites such as Key Biodiversity Areas, Important Bird Areas, Ramsar sites, World Heritage Sites and their buffer zones, notified ecologically sensitive zones (ESZ) around protected areas, notified forest areas including protected forests, reserve forests, and proposed reserve forests,[24] and the regulated zone (up to 300 m) associated with protected ASI and Government of Tripura monuments.

(v) New lines and related facilities must avoid significant damage to local physical cultural resources and not require physical cultural resources to be removed from their current location.

(vi) New overhead lines must not be laid across school or hospital compounds or playgrounds.

(vii) New lines and related facilities must minimize damage to existing trees outside of forest areas and properties whilst ensuring horizontal and vertical safety clearances are maintained.

(viii) New lines must create minimum disturbance to existing pedestrian and traffic routes in terms of blockages or diversions.

(ix) New underground cables must avoid damage to public utility services (water or gas pipelines, telephone lines etc.)

b. Alternative Design and Construction

87. The principle that has (and will be) adopted for the selection and design of new equipment is to comply with national requirements as well as considering international good practice per the IFC EHS Guidelines particularly with respect to avoiding the use of PCB oils in purchase of transformers (already banned in India) and the use of all asbestos containing materials in new construction.

88. **Substations**. Use of alternative insulation mediums like air, gas, and oil for switchgears and RMU has been considered by TSECL. Gas insulated switchgears have several technical advantages over air and oil, notably their compact size and the insulating and fire extinguishing properties of gas and thus have been preferred by TSECL to date. However, gas-based insulators use SF6 which is a potent greenhouse gas and thus the EPC contractor shall minimize the quantity of SF6 by first preferring solid dielectric insulating medium (such as Hydrophobic Cycloaliphatic Epoxy) whilst ensuring the design of components using SF6 minimizes leakage.

89. **Distribution Poles.** There are many materials that can be used for distribution poles. The includes wood, cement concrete, reinforced cement concrete and steel poles including tubular and rail poles. Table 3-8 compares the various pole types. TSECL shall use galvanized iron tubular steel poles. Since the use of steel poles increases the risk of electrocution to wildlife compared to the use of wood or cement poles mitigation measures will need to be adopted to counter this risk.

[23] Initially two new lines that were passing through protected areas (WLS and their ESZ) were proposed by TSECL but were dropped due to the lead in time to secure wildlife clearances. Consultation with wildlife officials identified concerns regarding damage to overhead poles by bison with underground cabling required since it is a feasible option for 33kV and 11kV.

[24] List of notified forest areas is included in Annexure 7

Table 3.8 Alternate Analysis of Distribution Poles

Type	Wood	Plain Cement Concrete (PCC)	Reinforced Cement Concrete (RCC)	Tubular Steel	Steel Rail
Material	Usually, seasoned Sal wood	Concrete	Reinforced concrete	Galvanized Steel	Steel
Suitability	Up to 11 kV	Up to 33 kV	Up to 33 kV	Up to 33 kV	Up to 33 kV
Life Span	18 to 25 years	The life span of the PCC pole is more than wooden poles	Longer life than wooden poles but less than steel poles	40 years and can be increased further by painting	40 years and can be increased further by painting
Strength	Not strong as compared to other poles	The tensile strength is higher than wooden poles	Have greater mechanical strength than PCC but less than steel poles	Steel pole has higher mechanical strength than wooden, RCC or PCC poles	The rail pole has high mechanical strength than wooden, RCC or PCC poles
Span	Shorter spans up to 50 m	80-100 m	80-200 m	60 – 80 m	60 – 80 m
Areas used	Mainly in rural areas. Discontinued in Tripura (by TSECL) and rest of the country (by distribution entities)	Streets of cities	Both in cities and rural areas	Both in cities and rural areas	Overhead lines above the railway tracks
Height	10 m	7 - 8 m	6 – 17 m	7 – 16 m	11 – 13 m
Cost	Maintenance cost of the wooden pole is very high	Less than RCC	High cost of transport and installation	Installation and the cost of the pole are very high	Installation and the cost of the pole are very high
Advantage	• Suitable for lines of the moderate cross-sectional area • Natural insulating property • Such supports are cheap, easily available, provide insulating properties and, therefore, are widely used	• This type of pole can be used for a longer span • Cheaper than other poles • Require little maintenance • Good insulating properties	• The holes in the poles facilitate climbing of poles and at the same time reduce the weight of line supports • Require little maintenance • Good insulating properties	• Easy to transport • Normally cast ex situ, thus ensuring good quality control • Higher load-bearing capacity than wood poles and RCC poles • Long life span	• Easy to transport • Higher load-bearing capacity than wood poles and RCC poles • Long life span

Type	Wood	Plain Cement Concrete (PCC)	Reinforced Cement Concrete (RCC)	Tubular Steel	Steel Rail
	for distribution purposes in rural areas as an economic proposition				
Disadvantage	• Wooden poles generally tend to rot below the ground level, causing foundation failure • Double pole structures of are required to obtain a higher transverse strength and hence non economical • This type of pole is suitable for a shorter span • Difficult to obtain naturally • Pressure on forests and is presently discontinued	• Weigh more than wood and steel poles • Easily breakable	• High cost of transport owing to their heavy weight • Normally cast in situ, thus quality control can be an issue • Requires extra care in handling and erection	• Needs to be painted to avoid corrosion thus increasing cost and weight • Inadequate spacing in cross arms can be fatal to birds who may get electrocuted while trying to perch	• Very high cost • Mainly used in railway crossings • Needs to be painted to avoid corrosion thus increasing cost and weight

PCC = plain cement concrete, RCC = reinforced cement concrete, TSECL = Tripura State Electricity Corporation Limited
Source: ADB TA Consultant

90. **Underground Cables.** Underground distribution cables can be laid either through open cut trench excavation method (wherein trenches along the entire alignment is cut, cables are laid manually and then covered) or through using trenchless method through HDD machine. The trench method is a time-consuming method and disturbs both traffic and public and severs the water, gas pipelines and other public utilities. It also has greater amount of soil that is excavated and then dumped which is also not aesthetically pleasing. The trenchless method on the other hand causes minimal disturbances and soil excavations and TSECL shall adopt this method.

c. No Project Alternative

91. In a no project situation, although there will be no additional impacts on the environment, the beneficiary population will be in the present situation where they undergo the disadvantages

of the existing distribution system, being exposed to the health and safety issues from uninsulated cables as well as being subjected to blackouts/brownouts and ongoing economic losses.

H. Climate Risk Assessment and Adaptation Measures

92. Based on the characterization of projected climate change risks the design of the distribution infrastructure will incorporate adaptation measures to improve its resilience. Climate-based risk is dependent on: (i) the likelihood of an adverse climate event; and (ii) the effect of that event which depends among other factors on the sensitivity of the distribution infrastructure and its location and thereby its level of exposure to a given adverse climate hazard. Climate risk assessment was undertaken for the distribution component of the project by ADB TA Consultants.[25]

93. **Extreme Temperature–Low Risk.** The climate risk assessment identifies that annual average temperature in Tripura is expected to rise by 1.05°C for the period 2030s; 1.7°C for 2050s and 2.91°C for 2070s, relative to the average temperature for 1986-2005 of 25.28°C. Increases in ambient temperatures can result in a reduction of conductivity – a rise in 1 ºC may increase resistance by approximately 0.4%.[26] Furthermore, power distribution infrastructure works less efficiently during periods of higher temperature because of the additional resistance induced, increasing conductor sag, lowering ground clearances, etc. The sagging of power lines due to higher temperatures might also be hazardous, as well as forest fires caused by faulty electricity assets. Increased summer maximum temperatures and temperature variations will lead to higher demand for cooling and consequent increased peak demand and produce periods of sustained high electricity usage.

94. The overhead distribution lines and poles will not be adversely affected by the temperature rise over the duration of their lifespan as they will be designed to withstand ambient temperature of 45°C. XLPE insulated conductors conforming to IS-14255 and aluminum copper conductors shall be used. The XLPE insulated conductors can withstand high temperature till 140°C. Aluminum copper wires are also good conductors of temperature. Underground cabling is sensitive to temperature and moisture conditions of the soil and increase in temperature can reduce ratings and may lead damage. However, XLPE insulated cables shall also be used for underground cables too and will thus not be affected by increased temperature. However, temperature rise can lead to reduced rating and thus efficiency of transformers in the substations. The longevity of a transformer is proportional to its operating temperature and internal insulation which in turn is defined by three primary factors (i) temperature, (ii) moisture content, and (iii) oxygen content.[27]

95. **Precipitation Changes–Low to Medium.** Tripura is located near the Tropic of Cancer and experiences tropical climate. The monsoon season is normally from June to September when the state is prone to lightning and thunder. In the 2030s, 2050s and 2070s average annual mean precipitation change is projected to increase by 3.49 mm, 6.26 mm and 13.42 mm respectively. There will be decreasing water availability and more intense storm events. Substations and underground cables may be inundated during floods which could lead to short-circuiting, explosions, and fires. Infrastructure and equipment mounted at ground level in substations are especially susceptible. Excessive precipitation could lead to mass soil movements especially in

[25] ADB. 2022. Climate Risk and Adaptation Assessment, Tripura Power Distribution Strengthening and Generation Efficiency Improvement Project.
[26] ADB. 2021. Climate Risk and Adaptation in the Energy Power Sector. Manila.
[27] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3697416/

hilly areas causing damages such as uprooted poles, excessive soil settlement or erosion around foundations can result in structural damage to substation buildings or tilting of the distribution lines. Excessive fog and mist especially in rubber plantation areas may lead to a reduction in creepage distance in insulators due to which flashovers may occur resulting in line tripping and outages.

96. **Increased Wind or Cyclones–Low to Medium Risk.** More intense and frequent storm events are anticipated. Distribution lines are exposed to natural winds and may therefore be subjected to wind-induced vibrations. These vibrations may impair the reliability and lifespan of conductors and their accessories. The wind velocity during cyclones may exceeded the wind speed for which the substation and distribution lines are designed. Overhead distribution lines can be destroyed in high wind or cyclones due to extreme wind speeds or by trees or other debris falling on the conductors. Winds over 100km/hour can short circuit live electric wires and distribution components. This type of wind is difficult to predict. The climate risk assessment identified the probability of such occurrences is low and the pole design will be uneconomical if such situation is considered in the design for all poles. Steel grade of 540 MPa tensile strength has been specified to ensure line stability during high levels of wind and gusts in Tripura which is in wind zone 6.

97. The impacts of climate change on the power distribution network in Tripura are presented in Table 3-9 whereas adaptation measures for the TSECL distribution component are provided in Table 3-10.

Table 3.9 Impacts of Climate Change on Electricity Distribution Networks

Climate Variable	Impacts	Physical component	Level of Impact
Wind Speed and Storm	Wind and storm damage	Overhead lines Poles	Moderate to high
	Increasing heat convection	Overhead lines	Up to 20% capacity increase for each m/s rise in wind speed
Increasing Temperature	De-rating	Transformers	–1% load per 1°C rise
	Decreased conductivity	Overhead lines, Underground cables	Resistance rises ~0.4% per 1°C degree rise –0.5 to –1% line load capacity per1°C rise
	Sag	Overhead lines	4.5 cm per 1°C rise*
Increasing drought	Moisture migration	Underground cables	Reduces cable capacity by 29%
	Dry soil movement	Underground cables	Repair cost roughly $4,200 per fault
Extreme Rainfall/ Flooding	Inundation	Substation	Up to 100% loss of supply locally
	Structural damage	Poles	Up to 100% loss of supply locally
	Cable breakage	Underground cables	Up to 100% loss of supply locally
Landslides	Structural damage, Cable breakage	Substations, Poles, Underground cables	Up to 100% loss of supply locally

cm = centimeters, m/s = meters per second
*at conductor surface for 35°C ambient temperature and span of 400 meters
Source: CRA Report, 2022 from European Commission. 2011. *The Impact of Climate Change on Electricity Demand*.

Table 3.10 Adaptation Measures for the Distribution Component

Climate Change Events	Impacted Project Component	Possible Risks	Adaptation Measures
Increased ambient temperatures	Transformers and distribution lines	• Reduced ratings of distribution lines and transformers. • Sagging of distribution lines.	• Reconductoring of distribution lines with larger size conductors. • Improvements in line designs to minimize sags and improved safety. • Use of ventilation in construction of buildings – test laboratory.
Increase in precipitation/ flooding and increased isokeraunic level	substations, transformers, and distribution lines	• Damaged pole footings due to soil erosion • Flooding at substations • Increased power outages and downtime due to precipitation and lightening. • Safety clearance issues in power lines. • Increased food levels in some areas affecting safe clearance with distribution lines. • Sliding away of the supporting soil which might cause the disruption to poles	• Concrete foundations for poles and stays in overhead lines. • Earth mats at substation bay extensions. • Use of polymeric insulators for distribution lines. • Use of covered conductor lines for medium voltage distribution. • Use of insulated cables instead of open wires. • Earthing of pole structures. • Use of outdoor pole mounted type fuse switch disconnectors for low tension ABC line protection. • Installation of auto-recloses and sectionalizes to automatically restore line failures due to transient faults and to isolate sections with permanent faults. • Installation of Fault Passage Indicators in overhead and underground lines for detection and quicker restoration of faulty sections. • Additional ground levelling measures • Providing protection/ retaining wall for substations and other electric equipment in hilly terrain. • Site infrastructure away from heavily wooded areas/rigorously prune trees.
More frequent/ severe	Distribution lines	• Damaged poles/power lines	• Robust line design for new lines to withstand specified

Climate Change Events	Impacted Project Component	Possible Risks	Adaptation Measures
extreme events - cyclones, high winds and gust		• Damaged lines and substation infrastructure • Prolonged and costly power outages • Safety issues due to damaged power lines.	max wind and gust (wind zone 6) as per IS 802 – Part 1. • Use of steel poles with heavy grade steel (540 MPa tensile strength) for MV distribution lines. • Use of 2 / 3 / 4 poles structures in line design for additional strength and wind stability.

Source: adapted by ADB TA consultant from CRA Report, 2022

IV. DESCRIPTION OF THE ENVIRONMENT

98. To establish the baseline setting of the distribution components, desk studies and site visits (reconnaissance surveys) together with primary baseline data collection have been carried out for the project area of influence (PAI) of the substation/test laboratory locations and sample alignments of 33 kV, 11 kV and low tension 0.4kV distribution lines. Studies and site visits have been confined to the PAI as defined in ADB's Safeguard Policy Statement (2009). The general corridor of potential impact was taken as a 500 m radius around the substations and 50m buffer along the distribution line alignments, but direct impacts will be confined to the substations/test laboratory footprint area and right of way (ROW) of distribution line alignments (existing ROW for 33kV, 11kV, and low-tension distribution lines is 15m, 7m and 1.2m respectively). However, the potential impact zone for internationally and nationally internationally or nationally important biodiversity areas or physical cultural resources is considered up to 10km given their greater significance.

99. The baseline setting was established for various environment components including ecology, soils, water, air, noise, socio-economic aspects including occupational and community health and safety, and physical cultural resources. In this section, as the project activities are spread all over the state, the setting of the ditribution components as well as the general environmental setting of the state is presented. Primary baseline data was collected to supplement the secondary data including air quality, noise and water quality data undertaken by third party accredited laboratory, MITCON.

100. Further details on the setting of the 27 substations is included in the environmental audit in Annexure 2 whilst further details on the setting of sample distribution lines is given in Annexure 4.

A. Substations and Test Laboratory Setting

101. The 27 existing substations and test laboratory site at Gokulnagar are spread all across the state (extends from 22°56'N to 24°32'N and 91°09'E to 92°20'E) but are located within modified habitat. Eight of the substations are within or just on the outskirts of Agartala Municipal Corporation area (Figure 3-5). Another four substations and the test laboratory (10km from Agartala city) are within other urban areas; the test laboratory site has a tea garden immediately adjacent and is adjacent to a highway on one side. The remaining 15 substations are in rural areas. Most of the substations in rural areas are set in village areas where the surrounding habitats have been modified. Of these 15, Rangrung Substation is within a tea garden area, and Madhupur Substation has rubber plantation immediately adjacent to the substation compound.

102. Land use within the substations comprises control buildings, switch yards with electrical equipment, and open areas with exposed soil, grass, shrubs, and occasional trees; the available open space within the substations varies from 5% to 60% with Kailashahar Substation having least space to Mandai Substation having most space available. The test laboratory site is within the compound of the existing Gokulnagar sub-division office of TSECL, trees present as green belt along the site boundary will not need to be felled.

103. Within a 10 km project area of influence (PAI) around the 27 existing substations and test laboratory site, Rajnagar 33/11 kV substation is the closest to a legally protected area (Trishna

Wildlife Sanctuary) at 633m, but it is outside the notified ecologically sensitive zone (ESZ).[28] Panisagar 33/11 KV substation is 2.7 km away from Rowa Wildlife Sanctuary and its notified ESZ.[29] Melaghar 33/11 kV is 2.3 km from Rudrasagar Lake Important Bird Area and Ramsar Site, Jatanbari substation is about 6km from Gumti Wildlife Sanctuary[30] and about 6.5 km from Damboor Lake which is a proposed Ramsar Site, and the test laboratory is about 6.5 km from Sepahijala Wildlife Sanctuary which also includes the Clouded Leopard National Park.

104. Most of the substations and the test laboratory are located in flat terrain except Vangmung and Chawmanu substations which are located in elevated terrain. Vangmung Substation is located on a ridge (375m). Soil conditions at 25 existing substations were similar with apparent contamination of oil from spillage/leaks in one or more spots, mostly under the transformers. Defunct, old and new equipment, meters, cables and parts were scattered inside the compounds of all substations. Of the remaining 2 substations, the Tilla Bazar substation is being constructed and presently the site is open ground whereas the nearly completed Charipara substation lacks open soil as it is paved. Standing water was not observed in the substations. Ponds are located within the PAI of 23 substations. They are found immediately adjacent to Rampur (5m, 110m, 182m, 208m, 225m, 391m and 450m) and Jolaibari (12m, 15m and 40m) substation. Ponds are located within 500m of Jatanbari (50m, 68m, 70m, 189m, 216m, 255m, 260m, 311m, 385m, 398m, 444m and 450m), Damcherra (30m, 55m, 75m, 107m, and 171m), Melaghar (147 and 246m), Rajnagar (140m), Killa (434m), Manu (75m and 455m), Chawmanu (33, 73 and 82m), Kadamtala (243 and 268m), Vangmung (288m), Dighalbagh (27m, 62m, 136m, 236m, 227m, 279m and 298m), Panisagar (142, 190, 195, 243m), Rangrung (166m, 181m, 205m, 276m and 480m), Harishmukh (50m, 105m, 236m, 265m, 280m and 298m), Tilla Bazar (32m, 144m, 162m, 177m, 238m, 252m, 314m, 317m 334m, 342m and 453m), Durjaynagar (455m), Maadhupur (425m), Charipara (309m and 382m), Adarsha Colony (54m), Stadium (261m), NSRCC (116m, 190m, 191m, 267m and 458m) and Kailashahar (40m, 90m, 199m, 255m, 271m, 277m, 305m and 403m) substation. Rivers / streams are located close to 4 substations. Manu substation has Manu River at 185m. Hoara River is is 200m from the Collage Tilla substation. Takarjala substation is 240m to Bijoy River. Digalbagh substation has Juri River at 500m. Bore wells are located within the substation compound of Chawmanu, Digalbagh, Panisagar, Rajnagar, Jolaibari, Charipara, Madhupur and Durjanagar substation. Bore wells and handpumps are available in most of the rural areas around the substations where supply water has not reached. Handpumps are located in common areas such that all residences around the sources have access to them. Handpumps are also available in many of the individual houses in the semiurban areas. The baseline air and noise conditions experienced at select substations are discussed later in this section. Low magnitude of dust suspension was observed on access roads in rural areas mainly due damaged and unpaved road as traffic movement is low in the rural areas. In the urban areas, suspended dust, noise and vehicle emissions were observed to be moderate to high along access roads to substations in Agartala city and surroundings. Transformer hum was audible (monitored during environmental audit using mobile app) in some cases from nearly 5 meters and ranged between 48 dB(A) to 59 dB(A).

105. Vangmung and Damcharra substations are located within 5 km of the border with Mizoram state and these administrative areas have a high percentage of tribal population. Killa, Mandwi, Takarjala, Manu, Chawmanu and Vangmung are located within the Tripura Tribal Areas Autonomous District Council (TTAADC) Area. Land adjacent to the subsations includes

[28] 633m away from the notified ESZ of Trishna Wildlife Sanctuary (WLS) which is both a national protected area and IBA (790m from the WLS boundary itself)
[29] 2.9 km from the boundary of the protected area
[30] Both a national protected area and IBA

habitation/settlements, distance to nearest properties varies between 0-5m (at Damchara and Killa substation), 5-10m – (at Mandai, Durjanagar, NRCCS substation), 10-20m – (at Staduim, Kailashahra, Kadamtala, Panisagar, Digalbagh, Chawmanu, Jolaibari), 20-50m – Melagarh, and >50m up to 150m (at Adarsha Nagar, College Tilla substation). Residences are about 130m away from the test laboratory. There are some sensitive receptors including schools / educational institutes and hospitals within the PAI of the substations. A government (forest range) office is found adjacent to Panisagar Substation; a high school within 15m of Tillabazar Substation; primary and high schools are found within 50-70m of Manu Substation; the Industrial Training Institute (ITI) is within 50m of Kailashahar Substation; a police hospital is within 50m and the Tripura Sports School at 230m from Stadium Substation; a high school is found at 70m opposite to the Rangrung Substation; Mandwi Substation is 75m from the Drinking Water and Sanitation Plant of the Public Works Department, with a Girls Hostel at 110m; a Government of Tripura veterinary hospital is located 91m from Tilla substation; a hospital is about 185m from Vangmung Substation; College Tilla Substation is within Maharaja Bir Bikram University area with the Kendra Vidyalaya School at 215m and ILS Hospital at 290m. A playing field is about 50m from the test laboratory site.

106. Existing road network available but entry to the Chawmanu substation needs to be repaired and connected to the access road in front for entry of vehicles. Presently the entrance to this existing substation is inaccessible to vehicles. Except Panisagar and Kadamtala the substations had fencing but it was often breached/broken with gates remaining open 24 hours and doors to control rooms reportedly closed only at night. There are no security guards, except at NSRCC Substation and Rampur Substation, thus humans or animals can easily access the substation area, control room, as well as the switch yards. Cattle and livestock were observed to be inside the substation areas in some cases like Dhamchara Substation. Conflicts reported by TSECL staff in Kadamtala Substation where public agitation is due to frequent power failure and a lack of timely restoration (maintenance).

107. Within 10 km of the 27 existing substations notable Archaeological Survey of India (ASI) and Government of Tripura protected cultural resources are the state protected Ujjayanta Palace at Agartala (823 m from NSRCC substation and 1.97 km from College Tilla substation); an ASI Ancient Mound (Shyamsundar Ashram Tilla) at Jolaibari (1.4 km from Jolaibari substation, with Pujakhola Temple at 2.3km and Thakurani Tilla at 3km); the state protected Neermahal Water Palace at Melaghar (2.9 km from Melaghar substation); and ASI sculptures and rock-cut reliefs at Unakoti (7.5 km from Kailasahar substation). There are also some locally important physical cultural resources within 500m of the existing substations and test laboratory. A Hindu cremation site is located ajdacent to the southern fence (0m) of Kadamtala Substation. A church is located at a distance of 185m from Chawmanu Substation. A temple is found 138m from the test laboratory.

B. 33 kV Distribution Line Settings

108. The 270 ckm of 33 kV distribution lines (including new covered conductor lines and underground cables) are spread all across the state and pass through modified habitats. The degree of modification differs from heavy (e.g. settlements, industries, agricultural fields) to medium and light (e.g. tea gardens, rubber plantations, teak plantations, barren areas) but no characteristics of natural habitat are observed even where native flora and fauna may be supported. The terrain of these lines varies from flat to hilly/complex. Though the routings of the lines are still to be confirmed, the start and end substation and the km distance of all the 33 kV distribution lines are known. Based on the substation locations none of the lines proposed to be taken up will pass through legally protected areas or their ESZ notified under the Wildlife

(Protection) Act, 1972. Rudrasagar Lake is also avoided. Neither are any indicative distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300m from) ASI or Government of Tripura protected monuments. However, there may be locally important physical cultural resources (not ASI or Government of Tripura protected) that need to be avoided. For example, Chaturdash Devta Temple on the new 33kv underground line from Bodhgangpur to Adarsha Colony Substation, if the distribution line is aligned along National Highway 8 it will pass within 65m.

109. Land uses in the PAI include settlements, market areas with individual shops, rubber plantations and areas of dense vegetation, industrial areas/workshops, brick making plants, commercial land and agricultural cultivation. The sample route alignments visited were all following main roads. Rail crossings were present e.g. on the Pachertal-Panisagar alignment. Rivers were also present e.g. the Bodhgangpur-Adasha Colony alignment will cross the Haora River via a river bridge; the undergound cables would pass through existing pipelines passing across the bridge. Along the alignments in the urban/semi urban areas the ROW passes entrances to private properties; houses, shops, businesses such as garage/car repairs, welding and fabrication. There are some overhead lines that are passing through tribal dominated TTAADC areas though no land acquisition is required. In the tribal areas (e.g. on the Panisagar-Damcherra, Pachertal-Panisagar routes) and along routes in Agartala city area individual properties were recorded encroaching into the 33 kV RoW and safety clearances and this will need attention during route alignment. Sensitive land use like schools and hospitals were recorded in both rural and urban alignments mostly outside the ROWs e.g., Gamaitila-Kalyanpur had four schools in the ROW/PAI. Final route alignments of the EPC contractor will need to duly avoid impacting on these properties; further details of the setting of the sample 33 kV distribution lines are provided in Table 4-1 and Annexure 4 with maps of the indicative route alignments in Chapter 1.

110. Observed existing 33kV distribution transformers were not maintained with broken fence, oil leak and contamination seen in Sipahijila districts–being close to roads and private property they are a community health and safety risk.

111. 220 ckm of 33 kV overhead covered conductors lines are proposed to be installed primarily along the ROW exisitng roads and highways in semi urban and rural areas. This may require some felling of trees especially while installing the distribution poles. TSECL will as a principle try to avoid felling but lopping / trimming of branches may be involved. Whilst the number of trees to be lost cannot be determined until the route alignments are confirmed by the EPC contractor it has been estimated for the purpose of the IEE that up to 235 trees may need to be felled [31] including teak, rubber, jackfruit, gulmohar and ficus species based on the sample distribution lines surveyed.

112. 50 ckm of the 33kV distribution lines have been proposed for undergrounding within the Agartala city limits. No tree felling is proposed for these underground lines as these shall be laid through trenchless method using HDD technology.

[31] Based on discussion with TSECL officials that 10% of total new poles may require felling of trees although TSECL normally avoids any felling and tries to realign.

Table 4.1 Sample 33 kV Distribution Lines Setting

Sl. No.	Electrical Division/ Administrative Subdivision	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
1	Electrical Division Dharmanagar	33 kV Mission Tilla - Panisagar-Dhamchara Line	12	New line on covered conductor to follow route of existing 33kV line between Panisagar and Damcharra in North Tripura district and in the TTAADC area	Panisagar, Damcharra	Complex terrain with hilly topography. Seasonal streams. Hand pumps found in PAI but not within the ROW. Air quality/dust and noise levels are low. Existing line passes through plantation/dense vegetation (modified habitat) in certain sections which are inaccessible. Minor shifting of route towards the roadside in these areas will be required. May require trimming of tree branches for safety clearances. Three tribal households are present within the ROW of the existing line such that safety clearances are not being met, meeting safety clearances will need attention. Passes within 10km Rowa WLS but outside the ESZ – higher possibly to encounter critical habitat species but if shifting line to avoid the plantation/dense vegetation and provided a primate/bird sensitive design adopted and EMP followed, critical habitat requirements can be met.
2	Electrical Division Panisagar	33 kV Pecharthal Substation to 33 kV Panisagar Substation	16	New line on covered conductor to follow route of existing 33kV line between Pecharthal and Panisagar in North Tripura district	Pecharthal, Babutila	Passing through Pecharthal settlement and plantation. Topography is a mix of mostly flat and some stretches of rolling terrain. Groundwater use in the form of handpumps is found in the PAI but none are in the ROW. Dusty roads and moderate traffic noise pollution was recorded. Crosses national highway 8, Deo River and a railway line for approximately 300 m across a railway over bridge. Poles of the existing line have been shifted due to utility relocation works in the ongoing national highway 8 road expansion project. Some buildings/houses/shops are in the existing line ROW so safety clearances will need attention.
3	Electrical Division Teliamura	132 kV Gamaitilla Substation to 33kV Kalyanpur Substation	15	New line on covered conductor, to follow route of existing line passing from Gamaitila to Kalyanpur,	Gamaitilla, Teliamura, Trisabari, Chalitabari, Kamalnagar, Kalyanpur	ROW has flat topography with the Khowai River running parallel to it at 100m. Passes along sub-urban main road with moderate traffic with five road crosses. Land use along the route include residences and shops. ROW includes shop entrances and is adjacent to four school gates. Multiple trees need to be trimmed along the alignment. Passes over one

Sl. No.	Electrical Division/ Administrative Subdivision	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
				Teliamura in Khowai district		railway line. Dusty roads from suspended road dust. Noise is low along the road with moderate noise at the road crossings. Safety clearances will need attention, traffic safety management including caution signage will be required.
4	Electrical Division 1, Agartala	33kV underground from 79 Tilla Grid 132 kV Substation to 33 kV Rampur Substation	6	Agartala, West Tripura District	Ramnagar, Rampur, Agartala Sadar, Banamalipur, East Indranagar	Topography is flat, ROWs in urban area of Agartala city and surroundings. No surface or ground water sources in ROWs. Handpumps near some residences. Haora River crossing on the Adarsha Colony to College Tilla route. Moderate air pollution. Noise levels moderate to high near intersections. Underground cables passing through settlement area (includes residential, commercial, and other land uses) in Agartala including road crossings. Presence of buildings near the ROWs; traffic diversion and safety precautions are required during construction. No trees need to be affected if entry and exit pits appropriately located as the distribution lines shall be running in small diameter conduit underground. Care will need be taken not to impact many other overhead and underground utilities present.
5	Electrical Division 2, Agartala/ Sadar sub-division	33 kV underground from SM Nagar Substation to Charipara Substation via Badharghat Substation	14	Agartala, West Tripura District	SM Nagar, Amtali, Madhupur, Hapania, Charipara, Badarghat Agartala adar, Adarsha Colony	
6	Electrical Division 1, Agaratala/Sadara sub-division	33 kV underground from Adarsha Colony Substation to College Tilla Substation	3.5	Agartala, West Tripura District		
7	Electrical Division 2, Agartala/ Sadar sub-division	33kV underground from Bodgangnagar Substation to 33 kV Adarsha	15	Agartala, West Tripura District	Anandnagar, Aralia, Prataphgarh, Subhas Colony, Ashrampara, Khyerpur	ROW in flat terrain. Passes various land uses-settlement, factories/industrial areas. Crosses National Highway 8 and two other roads. Two railway crossings – 1 over bridge and one underpass. For the over bridge, the line will pass through pipelines along the bridge. Hoara River crossing over bridge with underground cables to pass through pipelines along the bridge. A large pond, which forms part of the Chaturdash

Sl. No.	Electrical Division/ Administrative Subdivision	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
		Nagar Colony Substation			Market, Maheshkhola	Devta Temple, an important local temple, is situated along National Highway 8. Protection of this pond is required. No groundwater wells in ROW. There is a sharp bend near the railway underpass and traffic management, speed control and signage will be required here and all along the national highway and main road stretches. Khyerpur Market is congested and will also require traffic management. HDD machines and materials must not block the shops and hamper business along this market stretch. No trees will be felled. Care will be needed not to impact other overhead and underground utilities present.
8	Electrical Division Bisalgarh	66 kV Gokulnagar Substation to 33 kV Madhupur Substation	14	New line on covered conductor to follow route of existing line from Gokulnagar Substation to Madhupur Substation	Madhupur, Gautam Nagar, Bisalgarh, Gokulnagar	ROW mostly passes flat terrain but, on some stretches, there is gently rolling terrain. No river crossing or surface water bodies in PAI but community handpumps found. Some dusty stretches along the road but low noise levels. ROW passes through semi-urban areas, small towns, market area and shops along the road; it crosses croplands in some areas. There is one railway crossing and three road crossings. Near Bisalgarh Bypass there are shops and small business-steel sheet seller/garages inside the ROW. Safety clearances will need attention. The road in this stretch is moderately busy. A ground mounted large distribution transformer is observed without any caution signage, broken fence, oil spill/contamination and undergrowth. It needs to be renovated by TSECL and possibly moved away from the road. No tree felling required, although some may need to be trimmed. Traffic control and safety management is required during construction. Care will need be taken not to impact the many other overhead lines and other utilities like telephone lines.

Sl. No.	Electrical Division/ Administrative Subdivision	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
9	Electrical Division Bagafa/ Belonia sub-division	66 kV Bagfa Substation to 33kV Jolaibari Substation	18	New line on covered conductor to follow route of existing line passing from Jolaibari Substation to Bagfa Feeder in Belonia, South Tripura	Jolaibari, Muhuripur, Charakbai, Santirbazar	ROW is in flat topography passing through rural setting with intermittent houses, fragmented vegetation, and cropland. Air quality good and noise levels are low. ROW crosses Muhuri River. Handpumps are present in the PAI near residences. One major road crossing is present. No tree felling will be involved. Shyamsundar Ashram Tilla is 1.77km, this is an ASI protected monument, whilst the locally important Sakyamuni Peace Pagoda is about 1.3km.

TTAADC = Tripura Tribal Areas Autonomous District Council
Source: ADB TA Consultant

C. 11 kV Distribution Line Settings

113. The 1,497.46 ckm of 11 kV distribution line (including new covered conductor lines and underground cables plus conversion of existing lines to covered conductor) are spread all across the state and shall also pass through modified habitat. The new lines are proposed to be along the ROW of existing roads and highways while the existing ones are along the ROW of existing roads and highways besides passing through agricultural land, rubber plantation and other private land. Though only the electrical divisions plus the names of the feeders to be bifurcated and the names of the feeders to be converted are available for new and existing lines respectively along with the km of line involved it has been confirmed (using the locations of existing feeders) none of the lines proposed to be taken up will pass through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972. Rudrasagar Lake is also avoided. Neither are any indicative distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300 m from) ASI or Government of Tripura protected monuments.

114. Land use in the PAI include settlements, roads, rubber plantations, commercial land and agricultural cultivation. There are some overhead lines that are proposed in tribal dominated TTAADC areas though no land acquisition is involved. The sample route alignments visited were all along roads except for Bagfa feeder where it enters rubber plantation. Along the roads in the urban/semi urban areas are entrances to private properties; houses, shops, buisiness such as garage/car repairs, welding and fabrication. On some alignments like the Dayarampara Feeder, in Sipahijilla, a major portion of the existing line to be converted crosses houses and private properties, including poles inside residential compounds while the end portion of the Chittamura Feeder in Belonia crosses over two shops-cum houses. For these overhead lines safety clearances will need attention. For lines to be converted to underground, Golchakkar to Dashamighat line in Agartala is an example of the existing overhead line passing over shops along the road. There are both educational establishments like schools and locally important cultural resources near the distribution lines. The final alignments will avoid impacting these properties; further details of the sample 11kV distribution lines visited are provided in Table 4-2 (Annexure 4) along with maps of the indicative routes in Chapter 1.

115. The terrain across which the 1,270 ckm new 11 kV on covered conductors and 134 ckm of existing lines to covered conductor shall pass varies from flat to hilly/complex in urban to rural areas. The laying of these lines may require some felling of trees especially while laying the distribution poles. TSECL will, as a principle, try to avoid felling although lopping / trimming of branches may be involved. Whilst the number of trees to be lost cannot be determined until the route alignments are confirmed by the EPC contractor, it has been estimated for the purpose of the IEE that up to 2,540 trees may need to be felled [32] including teak, ficus, gulmohar, jackfruit, arecanuts, mango, rubber species based on the sample distribution lines surveyed.

116. No tree felling is proposed for the underground lines as these shall be laid through trenchless method using HDD technology.

[32] Based on discussion with TSECL officials that 10% of total new poles may require felling of trees although TSECL normally avoids any felling and tries to realign.

Table 4.2 Sample 11 kV Distribution Lines Setting

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
1	Electrical Division Dharmanagar	11 kV Digalbagh Feeder to bifurcate existing Raghna Feeder 61 km	8	New 11kV on covered conductor to follow route of existing line in Dharmanagar, North Tripura District	Digalbagh, Nayapara, Chandrapur, Ragna	ROW passes along flat terrain in rural setting with land uses including croplands and settlements. One main road crossing/busy intersection with shops in ROW and private hospital beside the road, after which the road becomes narrow. Moderate traffic observed. Dusty roads with moderate noise levels. No surface water in ROW but ponds in PAI. No handpumps in ROW but present in houses in PAI. No tree feeling envisaged. Traffic management needed along road and especially at the intersection. Care to be taken not to impact another overhead and underground utilities present.
2	Electrical Division 2	Aananda Nagar 11kV Feeder	18	Conversion of existing line from Nagicherra to Jharul Bachal, West Tripura	Nagicherra, Dhupchara, Srinagar, Anandanagar, Jharul Bachai	Existing line is in the outskirts of Agartala city in semi-urban to rural settings. Four road crossing are present. Topography is mostly flat with some sections elevated, the existing line passes along a road, some sections of which have been built by cutting hillocks which have rubber plantation, social forestry, and tree nurseries adjacent. One school and a temple are in the ROW. Tea plantations are also present in the PAI. Two ponds are present in the PAI. No groundwater sources identified. No tree cutting envisaged, only looping/trimming along rubber plantation. Roads are moderately dusty and broken. Noise levels are low. Traffic management needed along road and at sharp bends.
3	Electrical Division 2	11kV Golchakar to Dashamighat via Joypur	3.6	Agaratal Sadar in West Tripura (underground)	Dashamighat, Joypur,	Route is along urban and congested road in flat terrain. International check post for commercial vehicles between India and Bangladesh is about 190m from the Golchakkar start point. This section is on a busy intersection and main road. High traffic volume and ongoing sewage lines nearing completion. Air pollution and noise levels are high

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
						due to traffic movements and frequent traffic congestions. One intersection is present in the middle stretch. About 1.3km towards the end, the route passes along a road on an embankment with sloping sides. No footpath is available. Slope stability / property condition studies will be required along the end sections as some shops are located on wooden pillars over the slopes. The existing line passes over shops/markets/small businesses. One school and one temple are present along the road. Haora River is 10m at the nearest point, although it is not crossed. No ponds present in PAI/ROW. Handpumps in houses within PAI. No tree loss is envisaged. The route passes on main road, so traffic management is required during HDD activities.
4	Bisalgarh	Dayarampur Feeder to bifurcate the existing Golaghati Feeder 99 km	46	New line on covered conductor, Golaghati feeder to Dayarampara	Dayarampara, Golaghati, Asharampur, Mohantopara, Jogendrapara, Balurampara, Hirapur, Devendrapara	ROW passes complex terrain, although mostly flat along the rural, unmetalled roads. It is also passing over cropland and private properties and houses. Some of the villages like Dayarampara are located on hillocks. Air quality is good and noise levels low. There are multiple road crossings. Crosses the Bijoy River. Hand pumps present in PAI. Tree cutting may be required, along with trimming/lopping along the route. Passes 1.3 km from Sipahijila WLS but outside the ESZ – higher possibly to encounter critical habitat species but as it avoids plantation/forest provided a primate/bird sensitive design adopted and EMP followed, critical habitat requirements can be met. Traffic management will be required along the main road.
5	(ED) Santir-bazar/ Belonia sub-division	11 kV Bagfa feeder to bifurcate the existing	15	New line on covered conductor,	Jolaibari, Muhuripur	ROW will pass through rural settings with densely vegetated rubber plantation and social forestry adjacent to road. Houses are only found at the start with the ROW crossing the garden of one house at

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
		Santirbazar New Feeder 88 km		Belonia in North Tripura District		the start point requiring attention to safety clearances. Topography is flat. No surface or ground water sources in ROW and PAI. Low noise levels and some dusty road stretches (rural village, unmetalled road throughout) but overall good condition. Minimal damage to trees and plantation envisaged, but tree looping especially in the rubber plantation area is required. No road, river, or railway crossings present. Traffic management required at start and end points as both on main road.
6	Electrical Division Belonia	Chittamura Feeder to bifurcate the existing Monaicherra Feeder 110 km	12	New line on covered conductor, Belonia SS to Chittamura Feeder, Belonia in South Tripura	Belonia, SBC Nagar, West Kalobaria, Sarasima, Chittamura	ROW is in flat topography along main road with short sections passing over cropland and one section from cropland to main road via a brick field. Noise levels are low although dusty road sections observed. Major portion of route lacks houses but it has intermittent settlements along the end section. Muhuri River crossing present. About 12 ponds found in PAI. No groundwater sources observed in ROW/PAI. Around 11 brick field are in PAI. No tree feeling is envisaged. Passes within 10km Trishna WLS but outside the ESZ – higher possibly to encounter critical habitat species but provided route follows road alignment, a primate/bird sensitive design adopted and EMP followed, critical habitat requirements can be met. The route passes on main road and hence traffic management required during construction.

D. Low Tenstion Distribution Line Settings

117. The 900 ckm of proposed low tension (0.4 kV) distribution line which shall be converted to ABC lines are spread across the state and pass through modified habitat which varies from flat to hilly/complex terrain. These lines are passing along the existing urban and rural roads and highways; besides also passing through agricultural lands and across settlements/houses in both semi-urban and rural areas. In comparison to the 33kV and 11kV lines, which are identified by start and end points, the low-tension lines start from distribution transformers and may move in various directions across different land uses. They are all existing lines and mostly pass along roads with some short diversions across croplands to avoid road bends/turns. Though only a quantum of low-tension lines to be converted to ABC in each electrical subdivision (ESD) has been provided (Table 4-4) and that quantum of reconductoring has not been mapped, it has been confirmed by TSECL none of the low-tension lines taken up will pass through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972. Rudrasagar Lake is also avoided. TSECL also indicated no distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300m from) ASI or Government of Tripura protected monuments would be reconductored.

118. Table 4-3 shows the setting of the sample Electrical Subdivisions with low-tension lines that might be reconductored visited, as seen by this there are some low-tension lines that pass along roads routed within notified forest areas and run near protected monuments in ESD Mandwi and ESD Boxarnagar in which case once the low-tension lines have been mapped, if such lines need to be involved in the scope of works, site-specific assessment and management planning must be undertaken by a professional ecologist or archaeologist with rerouting outside the area of concern or undergrounding rather than reconductoring preferred, followed by full time ecological and/or archaeological supervision during works. Table 4-4 flags the Electrical Subdivisions with internationally and nationally important biodiversity and physical cultural resource sensitivities that EPC contractors will need to have cognizance of when route planning in these electrical subdivisions – in addition to these there will be locally important resources to which attention will be required.

119. The conversion of the low-tension lines should not require felling of trees as unless minor rerouting to meet safety clearances is needed only poles that are damaged are proposed to be replaced in the existing pole location, but lopping / trimming of branches may be involved. There are some lines that are proposed in the TTAADC areas though no land acquisition is involved for the works.

Table 4.3 LT Distribution Lines Setting (Sample Lines Surveyed)

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
1	Division 2	ESD Sekherkote	15	Line starts from Motinagar distribution transformer (double distribution transformer – each connects to two different routes) and spreads across Sekherkote ESD in the West Tripura district	Motinagar, Bhoikhola, Mohinagar	Flat topography with a mix of semi-urban and rural settings. Minority communities present, local workers are preferred along with awareness of local community and culture. Lines pass along two schools and over private properties and houses which will require minor realignment. One branch runs parallel to the Bangladesh International border and gate; attention to be paid to the fact that construction site would be close to international border. Rural roads are broken. Four roads crossed with very low traffic. Dusty and noisy areas at start point. Most other areas have low air and noise pollution. No surface water bodies in ROW/PAI. Handpumps are present in most houses. No tree felling is envisaged, although trimming/looping is required as vegetation present along road.
2	Jirania	ESD Mandwi	20	Line passes from Baludhumpara to Khumpani and branches at multiples locations in West Tripura	Baludhumpara, Sarkimura, Twisarangchar, Iranikami, Para Kwitar, Nal Bagla, Diyari, Khumpani, Harbhang	Lines starting distribution transformer and branches in three directions. Although mostly flat terrain, some sections are in complex terrain. TTAADC area with history of communal violence; local employment to be preferred. Multiple churches in the area. A banyan tree is present in Harbhang village and is of local importance and during February every year about 2,500 visitors come to the site for nature worship. Air and noise pollution is low in the area. Dakdu River crossing present. Line passes over Tripura State Rifles (TSR) camp at start point and over houses, private properties (which will require minor realignment to meet safety clearances) and dense vegetation. Tree felling is not envisaged, although trimming would be required along much of the line. Part of Mandwi Forest Range; lines are routed along road. Even if notified forest land avoided

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
						and forest clearance not required there is a need to consult with the District Forest Officer and obtain written permission for the works from the Forest Department. No temporary construction facilities are permitted in notified forest land, sensitization of construction workers will be required. Traffic management needed along roads in complex terrain and at sharp bends.
3	Rabindranagar	ESD Boxarnagar	25	Line starts from Kulubari distribution transformer and moves to Ashabari, branches across routes in Sipahijila District	Rahimpur, Veluachar Bazar, Moynama, Manikyanagar, Ashabari, Boxarnagar Dakshinpara, Putia, Dayalpara, Adampur, Baramura, Thanemura, Motinagar	Topography is mostly flat with some sections of the line passing along elevated roads. Rural setting with lines passing along roads, croplands, over houses – requiring realignment, adjacent to dense vegetation, bamboo, rubber plantations. Section along Boxarnagar-Bisalgarh Road is passing through Boxarnagar Forest Range. Even if notified forest land avoided and forest clearance not required there is a need to consult with the District Forest Officer and obtain written permission for the works from the Forest Department. No temporary construction facilities are permitted in notified forest land, sensitization of construction workers will be required. Passes within 10km Sipahijila WLS but outside the ESZ – higher possibly to encounter critical habitat species but provided route follows road alignment, a primate/bird sensitive design is adopted and EMP followed, critical habitat requirements can be met. The route passes on main road and hence traffic management required during construction. Bangladesh Border is about 510m from the section passing along the ASI protected Boxarnagar Buddhist Stupa.[33]

[33] Roads run along and bisects the stupas that comprise the ASI protected monument and thus some of the low-tension lines in this Electrical Subdivision are within the prohibited zone of 100m. Construction is not allowed in a prohibited zone; repairs and renovation may be allowed but not reconstruction. Notified of the presence of the stupas TSECL has indicated that reconductoring works can be avoided within 300m. But if once mapped this section of line (or other sections of low-tension line within 300m of protected monuments) need to be involved in the scope of works, then site-specific assessment and management planning must first be undertaken by a professional archaeologist including consultation with ASI regarding the detailed design and construction method. No objection certificate must be obtained if works remain within 300m, https://nmanoc.nic.in/home/procedure_applying_noc#:~:text=Step%201%3A%20Any%20individual%20applicant,as%20provided%20in%20the%20website. In addition, there must be full time archaeological supervision by a third-party professional archaeologist and sensitization of workers for all works within 300m.

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
						  The area has 13 brickfields with 3000-4000 migrant workers from other states. Moderately polluted in terms of dusty roads, which is mix of rural-unpaved/broken and metaled. Noise level is mostly low, except in town areas/markets like Veluachar

Sl. No.	Electrical Division/ Administrative Sub-division	Distribution Line	ckm	Indicative Route and Location	Settlements	Design Considerations
						Bazar. About 14 main road crossings are present. About 8 small to medium sized ponds are present in PAI. Handpumps are present in individual houses in PAI. Traffic management is required along main roads and congested settlement/market stretches.
4	Sabroom	ESD Poangbari	20	Starts from Hrishyamukh substation and ends Poangbari distribution transformer in South Tripura	Hrishyamukh, Rojnagram, Krishnanagar, Srinagar, Poangbari, Madhavnagar	Mostly flat topography across rural settings and along main road. The Tekka Reserve Forest is about 1.2km from Hrishyamukh start point. The Bangladesh International Border runs parallel to the entire route and is about 130m at the nearest point. Sensitization of workers is required. Sections of line pass over cropland. Road condition is good with low air and noise pollution. Most of the line passes along agricultural fields with scattered houses/shops. Six road crossings are present. No tree felling is envisaged. Traffic management required along main roads.

Table 4.4 LT Distribution Lines Setting

Electrical Circle	Electrical Division	ckm (based on DPR)	Biodiversity Sensitivities	Physical Cultural Resources Sensitivities
Dharmanagar	Dharmanagar	25	Rowa WLS and ESZ Pachertal Reserve Forest Juri Reserve Forest Kumarghat Reserve Forest Jhampui Hills, Unclassified Government Forest In Kanchnagpur Subdivision: critically endangered, endemic *Cyrtodactylus montanus* if distribution lines pass along rocky roadside cuttings adjacent forest areas above 600 m asl	-
	Panisagar	40		
Unakoti	Kailashahar	30	Soteromiar Hawor – state prioritized wetland	ASI sculptures and rock-cut reliefs, Unakoti
	Kumarghat	50	-	-
Khowai	ED-Khowai	60	-	-
	ED-Teliamura	55	Teliamura Forest Range- Unclassified Government Forest	-
Ambassa	Ambassa	30	Gumti WLS and ESZ Ambassa Proposed Reserve Forest Damboor Lake	-
	Kamalpur	35	-	-
	Manu	40	-	-
Circle 1 – Agartala	ED-CCD	15	Batapara Lake, Agartala and College Tilla Lake – state prioritized wetlands Mandwi Forest Range	Ujjayanta Palace, Agartala (state protected)
	Division 2	15		
Circle 2 – Agartala	Jirania	75		
	Mohanpur	45		
Sipahijila	Bisalgarh	25	Sepahijala WLS including the Sipahijila Reservoir and ESZ Bisalgarh Forest Range	ASI Ancient Remains / Buddhist Stupa, Boxanagar
	Rabindranagar	95	Rudrasagar lake - Ramsar wetland	Neermahal Water Palace, Melaghar (State Protected)
	Jampuijala	65	-	-
Gomati	Udaipur	50	Trishna WLS and ESZ	ASI Gunavati Group of Temples, ASI Temple of Chaturdasha Devata,

Electrical Circle	Electrical Division	ckm (based on DPR)	Biodiversity Sensitivities	Physical Cultural Resources Sensitivities
				ASI Bhubaneswari Temple, Udaipur Tripureswari temple (state protected)
	Amarpur	50	Gumti WLS and ESZ Bampur Proposed Reserve Forest (PRF) Debbari PRF Rajkang PRF Part of Baramura-Deotamura Reserve Forest (RF)	-
Belonia	Sabroom	45	Part of Baramura-Deotamura RF, Tekka-Tulsi RF and Betaga Ludhua RF Amlighat PRF, Manubazar PRF, Jalafa PRF and Kalapania PRF	Mahamuni-Buddha Mandir – Manubankul village (state protected)
	Belonia	35	Trishna WLS and ESZ Tekka Reserve Forest	ASI Puja Khola in Pilak, ASI Thakurani Tilla ASI Shyamsundar Ashram Tilla Chandrapur Mosque – Rajnagar (state protected)
	Bagafa	20	Muhuri Reserve Forest	-
TOTAL		**900**		

ASI = Archaeological Survey of India, CCD: Central Civil Division, WLS = Wildlife Sanctuary
Source: ADB TA Consultant

E. Statewide Biological Setting

120. Tripura is in the bio-geographic zone of Northeast India, province 9B-North-East Hills. Situated in the Indian sub-region of the Oriental zoo-geographic region, local flora and fauna bear a very close affinity and resemblance with the floral and faunal components of the Indo-Malayan and Indo-Chinese sub-regions. Its unique zoo-geographical position means it rich in biodiversity falling on the edge of the Indo-Myanmar biodiversity hotspot. It supports mountain ecosystem with moderate hill ranges, forest ecosystem, and freshwater ecosystem comprising 10 major rivers and numerous wetlands.

6. Protected Areas

121. As per the forest department of Tripura, about 9.59% of the 6294.29 km^2 of declared forest area in Tripura are protected areas. The area roughly corresponds to 603.62 km^2. There are two National Parks (Bison National Park old name Rajabari National Park and Clouded Leopard National Park) and four wildlife sanctuaries (WLS) (Gumti WLS, Rowa WLS, Sepahijala WLS and Trishna WLS) in Tripura. Bison National Park is housed within the Trishna Wildlife Sanctuary, while Sepahijal WLS houses the Clouded Leopard National Park. These protected areas have been declared through gazette notifications under the Wildlife Protection Act, 1972. Rowa WLS is in North Tripura district, Bison NP is in South Tripura district but Trishna WLS encompasses South Tripura, Gomati and Sepahijala Districts. The Clouded Leopard NP and Sepahijala WLS are in Sepahijala district while Gumti WLS falls in Gomati and Dhalai districts. Gumti WLS is the largest protected area in the state.

122. The ecological sensitivity zones (ESZ) of all the national parks and the WLS in Tripura has been notified through gazette notifications issued by the MoEF&CC. The notified ESZ of Rowa WLS varies from 10-100 m (extends 10 m from WLS on the western side, 20 m on the southern and eastern side and the maximum of 100m in the northern side of the WLS). For Trishna WLS and Bison NP the ESZ varies from 0-500m where 0m is due to Indo-Bangladesh border in the southwestern part of the WLS. For Sepahijhala WLS and Clouded Leopard National Park the ESZ varies from 10-50 m (it extends 10m from the WLS on all sides except the eastern boundary where it extends 50 m), while for Gumti WLS the ESZ varies between 0-1.2 km (0m in the southern boundary of the WLS due to Indo-Bangladesh border), 500 m in the south eastern and south western side, 30 m-500 m on the north eastern side of the WLS and 1.2 km to the north and north western side of the WLS.

123. The next nearest Protected Areas to Tripura are in Bangladesh, these are Satchari National Park (approximately 70m away from the international border), Lawachara National Park (also a KBA and approximately 7.23 km away from the international border), Rema-Kalenga WLS (also a KBA which shares its boundary with the international border) and Pablakhali WLS (a KBA which is approximately 35 km from the international border). Rajkandi Reserve Forest which is a KBA also shares its boundary with the international border. No Substation under the distribution component it located within 10km radius of Satchari National Park, Lawachara National Park, Rema-Kalenga WLS or Pablakhali WLS. There are three substations under the project within 10km radius from Rajkandi Reserve Forest and these are Rangrung Substation (approximately 4.67 km), Kailasahar Substation (approximately 7.28 km) and Tilabazar Substation (approximately 8.97 km).

124. Dampa Tiger Reserve is the nearest Protected Area in India's neighbouring states, it is in Mizoram state. Its ESZ was notified in 2019 and varies from 3-6 km from the interstate border with Tripura. Vangmung Substation is approximately 24km away from this protected area in

Mizoram. The state of Tripura does not have any tiger reserves and there are no tigers reported in the state.[34] The state also does not have any elephant reserves nor are there any elephant corridors in the state.[35] As per records available only 59 wild elephants are said to be present in Tripura.[36] These elephants are part of two different elephant groups in Khowai and Gomati districts as per records of Forest Department Tripura. The wildlife section of the Forest Department has provided warning boards of elephant movements in Gomati and Khowai districts along roads which they cross. The state has three Important Bird Areas (Gumti Wildlife Sanctuary, Trishna Wildlife Sanctuary and Rudrasagar lake, which is also a Ramsar site).[37] The Sepahijala WLS, Trishna WLS and Gumti WLS have also been identified as Key Biodiversity Areas (KBA).[38, 39] Table 4.5 identifies which of these protected areas would be considered as a critical habitat.

Table 4.5 Summary of Protected Areas Triggering Critical Habitat in Tripura

Name	National Status	IUCN Protected Area Level/ Ramsar Criteria	IBA Criteria	KBA	Critical Habitat as a Protected Area
Bison National Park	Protected Areas as National Park	Not categorized yet but considered as Category II as per IUCN criteria	-	-	Yes, as this fulfils IUCN category II protected area criterion
Clouded Leopard National Park (within Sepahijala WLS)	Protected Areas as National Park	Not categorized yet but considered as Category II as per IUCN criteria	-	-	Yes, as this fulfils IUCN category II protected area criterion
Gumti WLS (IBA and KBA)	Protected Areas as WLS	Category IV as per IUCN criteria[40]	For globally threatened Lesser Adjutant (VU) For congregations but no	KBA due to IBA status KBA identified in Ecosystem Profile of the	No

[34] Jhala, Y.V., Qureshi, Q. and Nayak, A.K. (eds) 2020. Status of tigers, copredators and prey in India, 2018. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun.

[35] Right of Passage: Elephant Corridors of India. 2005, Menon, V.,Tiwari, S. K., Easa P. S. and Sukumar, R. (2005). (Eds.). Conservation Reference Series 3. Wildlife Trust of India, New Delhi.

[36] http://www.wiienvis.nic.in/Database/ElephantReserves_8226.aspx

[37] http://www.wiienvis.nic.in/Database/IBA_8463.aspx

[38] Key Biodiversity Areas (KBA) are sites contributing significantly to the global persistence of biodiversity in terrestrial, freshwater and marine ecosystems. Sites qualify as global KBAs if they meet one or more of 11 criteria, clustered into five categories: threatened biodiversity; geographically restricted biodiversity; ecological integrity; biological processes; and, irreplaceability. KBAs comprise an “umbrella” set of internationally recognized priority sites for biodiversity that includes Important Bird Areas (IBAs) and Alliance for Zero Extinction (AZE) sites. IBAs are priority sites for bird conservation because they regularly hold significant populations of one or more globally or regionally threatened, endemic or congregatory bird species, or highly representative bird assemblages.

[39] http://www.wiienvis.nic.in/Database/Key_Biodiversity_Areas_8647.aspx

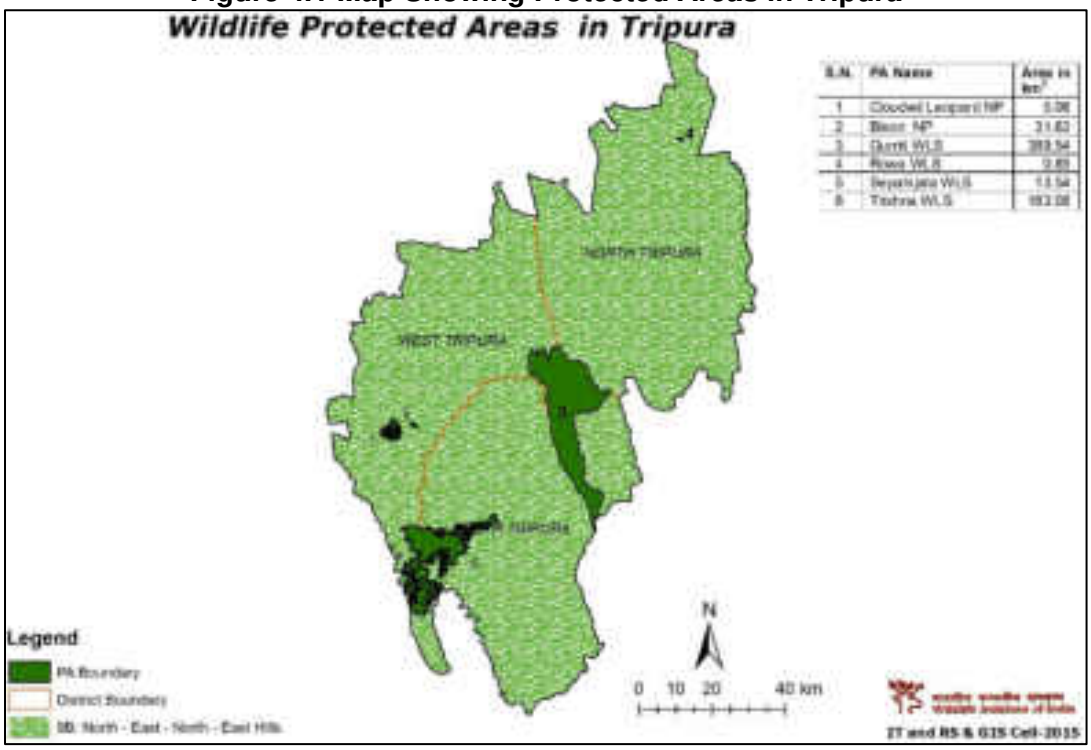
[40] IUCN. 1990. IUCN Directory of South Asian Protected Areas. IUCN, Gland, Switzerland and Cambridge, U.K. xxiv + 294 pp.
https://wedocs.unep.org/bitstream/handle/20.500.11822/8084/IUCN_directory_South_Asian_Protected_Areas.pdf?sequence=3&isAllowed=y

Name	National Status	IUCN Protected Area Level/ Ramsar Criteria	IBA Criteria	KBA	Critical Habitat as a Protected Area
			specific species are listed	Eastern Himalayas	
Rowa WLS	Protected Areas as WLS	Category IV as per IUCN criteria	-	-	No
Sepahijala WLS (KBA)	Protected Areas as WLS	Category IV as per IUCN criteria	-	No global criteria met but KBA identified in Ecosystem Profile of the Eastern Himalayas Hotspot (2005)	No
Trishna WLS (IBA and KBA)	PA as WLS	Category IV as per IUCN criteria	For biome restricted bird species but no specific species are listed	No global criteria met but KBA identified in Ecosystem Profile of the Eastern Himalayas Hotspot (2005) Supports western hoolock gibbon (EN) and capped langur (EN) plus guar (VU) and pig tailed macaque (VU)	No
Rudrasagar Lake (Ramsar and IBA)	Ramsar Site	Criteria 2, supports IUCN Red listed endangered Three-striped Roof Turtle (*Kachuga dhongka*) Criteria 3 important for supporting the biological diversity	For globally threatened Baer's Pochard (CR)	KBA due to IBA Status	Yes, as a Ramsar it is a wetland that provides key ecosystem services/fish breeding ground.

Name	National Status	IUCN Protected Area Level/ Ramsar Criteria	IBA Criteria	KBA	Critical Habitat as a Protected Area
		Criteria 8 natural safe breeding ground of majority of the indigenous valuable species of fishes of the state			

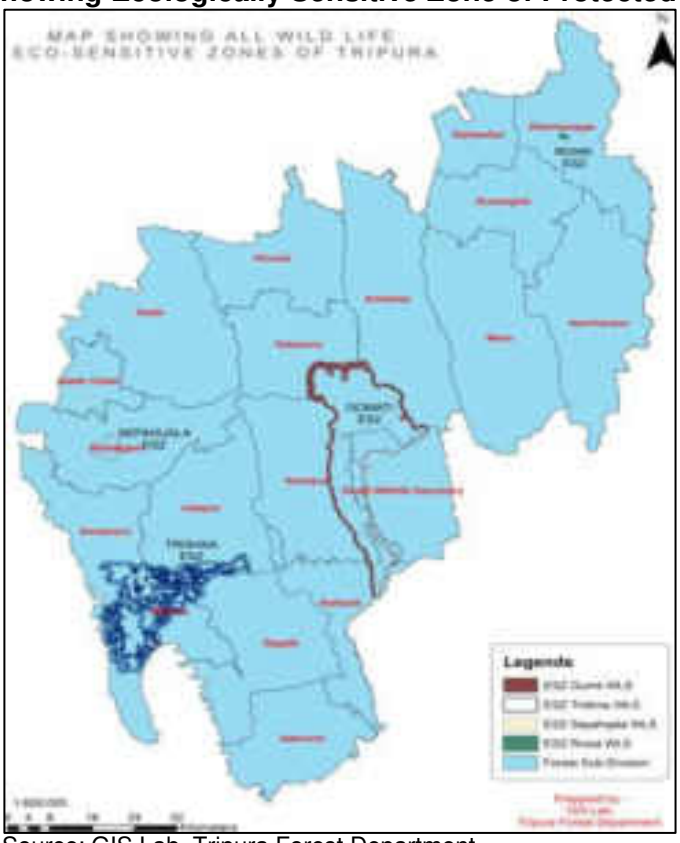
CR = Critically Endangered, EN = Endangered, IBA = important bird area, KBA = Key Biodiversity Areas, IUCN = International Union for Conservation of Nature, VU = vulnerable, WLS = wildlife sanctuary
Source: ADB TA Consultant

Figure 4.1 Map Showing Protected Areas in Tripura



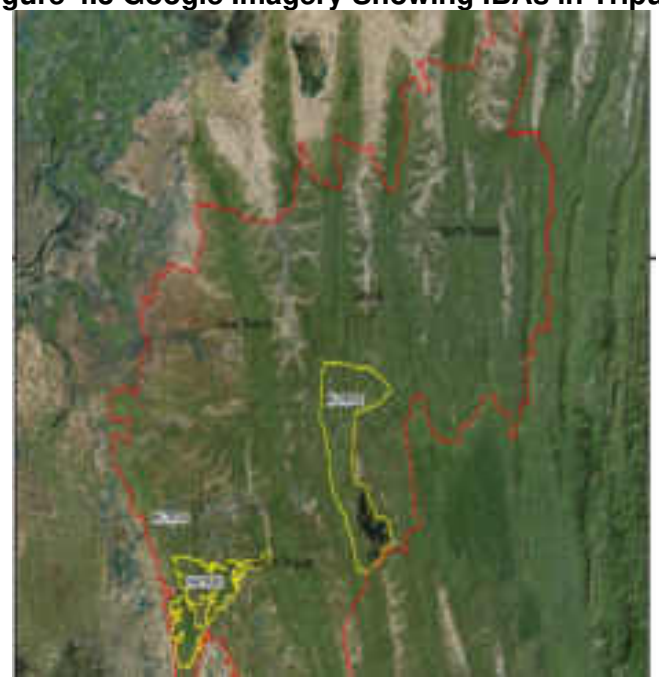
Source: Wildlife Institute of India

Figure 4.2 Map Showing Ecologically Sensitive Zone of Protected Areas in Tripura



Source: GIS Lab, Tripura Forest Department

Figure 4.3 Google Imagery Showing IBAs in Tripura



Source: Important Bird and Biodiversity Areas in India: Priority Sites for Conservation Second Edition: Revised and Updated Volume II, BNHS & BirdLife International

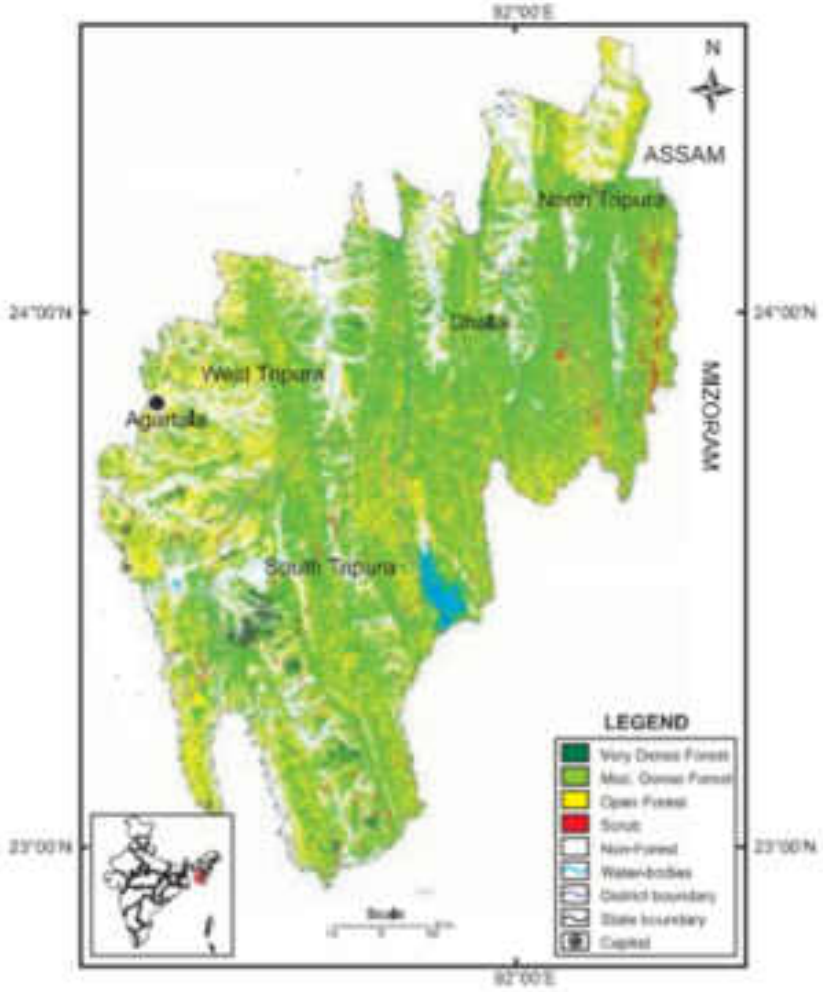
7. Forests

125. The official recorded forest area of the state of Tripura is 6,294 km^2 which constitutes 60.02% of its geographical area.[16] Of this 4,175 km^2 is reserved forest, 2 km^2 is protected forest and 2,117 km^2 is unclassed forest. However, 2017 satellite data interpretation shows there may be 7,725.59 km^2 of forest covering 73.68% of the geographical area with only 653.1 km^2 being very dense forest, 5,235.19 km^2 being moderately dense forest, and 1,835.89 km^2 being open forest. As per the IRS Resourcesat-2 LISS III satellite data of the period October 2017 to December 2017, Forest Cover in the State has decreased by 0.41 km^2 as compared to the previous assessment reported in ISFR 2017[41] (the last assessment was based on satellite data pertaining to October to December 2015). The main reasons as stated by Forest Survey of India (FSI) for the decrease in forest cover are shifting cultivation and development activities. As per the Forest Survey of India report of 2019,[42] the forests in Tripura belong to two forest type groups (tropical semi-evergreen forests and tropical moist deciduous forests) which are further divided into five forest types (as per the classification of Champion & Seth, 1968). A sizeable area of the state is covered with bamboo brakes which virtually form a sub climax resulting from shifting cultivation.

[41] India State of Forest Report 2019, Volume II, 2019, Forest Survey of India, Ministry of Environment, Forest & Climate Change, Government of India

[42] https://fsi.nic.in/forest-report-2019?pgID=forest-report-2019

Figure 4.4 Forest Cover Map of Tripura



Source: India State of Forest, 2019, Forest Survey of India

Table 4.6 Statement of Forest Land in Tripura

District	Civil Sub-division	Geographical Area km²	Forest Area	
			Total km²	% Total Forest Area in State
North	Kanchanpur	769.04	609.786	**9.7**
	Dharmanagar	301.33	55.453	**0.9**
	Panisagar	286.41	181.328	**2.9**
North Total		**1356.78**	**846.567**	**13.4**
Unakoti	Kailashahar	235.92	69.438	**1.1**
	Kumarghat	475.55	307.301	**4.9**
Unakoti Total		**711.47**	**376.739**	**6**
Dhalai	Longtdorai Valley	869.32	714.464	**11.4**
	Ambassa	549.09	517.004	**8.2**
	Gandachhara	451.18	425.636	**6.8**
	Kamalpur	387.08	202.264	**3.2**

District	Civil Sub-division	Geographical Area km²	Forest Area	
			Total km²	% Total Forest Area in State
Dhalai Total		**2256.67**	**1859.37**	**29.5**
Khowai	Khowai	508.03	233.777	**3.7**
	Teliamura	508.37	353.447	**5.6**
Khowai Total		**1016.4**	**587.224**	**9.3**
West	Sadar	196.85	1.587	**0**
	Mohanpur	397.09	73.869	**1.2**
	Jirania	239.74	139.126	**2.2**
West Total		**833.68**	**214.582**	**3.4**
Sepahijala	Bishalgarh	385.59	19.761	**0.3**
	Jampuijala	287.51	98.119	**1.6**
	Sonamura	481.68	226.176	**3.6**
Sepahijala Total		**1154.78**	**344.056**	**5.5**
Gomati	Udaipur	631.71	341.62	**5.4**
	Amarpur	766.92	572.159	**9.1**
	Karbook	298.37	211.354	**3.4**
Gomati Total		**1697**	**1125.13**	**17.9**
South	Santirbazar	235.16	379.442	**6**
	Belonia	780.95	299.397	**4.8**
	Sabroom	448.8	261.779	**4.2**
South Total		**1464.91**	**940.618**	**14.9**
Tripura Total		**10491.69**	**6294.29**	**100**

Source: https://forest.tripura.gov.in/forest-of-tripura

126. Maximum amount of forestland is in the district of Gomati (1,697 km^2) where two of the WLS (Gumti and Trishna) are partially located. This is followed by Sepahijala district which has 1,154.78 km^2 of forest land and houses the Clouded Leopard National Park and Sepahijala WLS. The lowest amount of forest land is in Unakoti (711.47 km^2) followed by West (833.68 km^2).

8. Wetlands

127. The state has three categories of lakes: oxbow lakes, tectonic lakes, and artificial reservoirs. Rudrasagar lake is the only existing Ramsar wetland in the state and was declared a Ramsar site in November 2005. The total area of the lake is 240 ha and is situated in Melaghar block of Sipahijala district. The lake is a natural lowland sedimentation reservoir and is fed by three perennial streams (Oacherra, Durlavnarayacherra and Kemtalicherra) before discharging in Gomti River through a connective channel namely Kachigang. The lake water is generally clean, with insignificant pollution and the depth varies from 2 m to 9 m. Owing to high rainfall (2500mm) and downstream topography, the wetland is regularly flooded assisting in groundwater recharge. Rudrasagar Lake fulfils the Ramsar Criteria 2 (wetland supports globally threatened ecological communities including the critically endangered three-striped roof turtle (*Batagur dhongk*a), Criteria 3 (wetland supports populations of animal / plant species important for maintaining biological diversity), and Criteria 8 (lake has the perennial connection with one of the major rivers of the state facilitating the natural safe breeding ground of majority of the indigenous valuable

species of fishes of the state). The site is classified as Ramsar Wetland Type O (permanent freshwater lake) and Type 6 (water storage area). The lands are owned by the state with perennial water areas leased out to the subsistent fisher's cooperative while the surrounding seasonal waterbodies are cultivated for paddy. The main threats to the wetland are increasing silt loads due to deforestation, expansion of agricultural land and intensive farming, and land conversion for population pressure. The largest artificial lake in the state is the Dumbur / Damboor Lake or Gumti Reservoir (41 km^2) which was formed due to the construction of a hydroelectric dam in 1974 across the Gumti river, near the confluence of the Raima and Sarma rivers. The reservoir is part of the Gumti WLS. The lake has already been suggested in 2008 by a national NGO to be declared as a Type 6 Ramsar Site (water storage reservoir) as it qualifies under the Ramsar Criteria 2 (wetland supports threatened ecological communities like the critically endangered Baer's pochard (*Aythya baeri*) and Criteria 6 (wetland regularly supports 1% of the individuals in a population of one species or subspecies).[43] Presently about half of the reservoir has been silted due to the deforestation in the catchment area and has created shallow zones, which are very attractive to waders and ducks. The oxbow lakes (*beel*) are mostly small and scattered in the plains. Many wetlands are found inside the forest areas and FSI has overlayed the spatial layer of wetlands as made available from the Space Application Centre, Ahmedabad, ISRO over the forest areas. The spatial data of the wetland corresponds to the National Wetland Atlas, 2011 published by MoEF&CC of India. As per the records of FSI, wetlands (both natural and manmade) form 0.66% of the total forest areas in Tripura. There are small wetlands within the Trishna WLS that were created as water sources for wildlife and now attracts many species of waterfowl like the IUCN Near Threatened Grey-headed Fish Eagle (*Icthyophaga ichthyaetus*), the IUCN Near Threatened Black-headed Ibis (*Threskiornis melanocephalus*) and nationally schedule IV species and the IUCN Nationally Threatened Oriental Darter (*Anhinga melanogaster*). Soteromiar Hawor is a marshy area located approximately 9 km from Kailashahar which is fed by water of two streams namely, Jarail Cherra and Bagua Cherra, the confluence of which has created marshland. The name of the area comes from a legend that 17 Muslims (Mia in local dialect) drowned while crossing this area. The marsh area has mostly eutrophied and is now more of a field with buffaloes and cattle found grazing. The marsh area earlier was full of aquatic trees and was reported to be visited by migratory birds in winter. This and Batapara Lake, Agartala and College Tilla Lake are state prioritized wetlands.

[43] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

Table 4.7 Wetlands Inside the Recorded Forest Area in Tripura

Wetland Category	No. of Wetlands	Total Wetland Area (hectares)
Inland Wetlands - Natural		
Ox-bow Lake / Cut-off meander	23	55
Riverine wetland	17	25
Waterlogged	115	343
River/Stream	12	1,260
Sub - Total	**167**	**1,683**
Inland Wetlands -Man-made		
Reservoir/Barrage	8	1,661
Sub - Total	8	1,661
Wetlands (<2.25 ha)	535	535
Total	**710**	**3,879**

Source: India State of Forest, 2019, Forest Survey of India

Figure 4.5 Photographs of Damboor Lake

Source: ADB TA Consultant

Figure 4.6 Ramsar Map of Rudrasagar Lake

Note: Map not to Scale
Source: https://rsis.ramsar.org/RISapp/files/49321025/pictures/IN1572map.pdf

Figure 4.7 Photographs of Rudrasagar Lake

Source: ADB TA Consultant

Figure 4.8 Photograph of Soteromiar Hawor

Source: https://unakoti.nic.in/tourist-place/soteromiar-hawor/

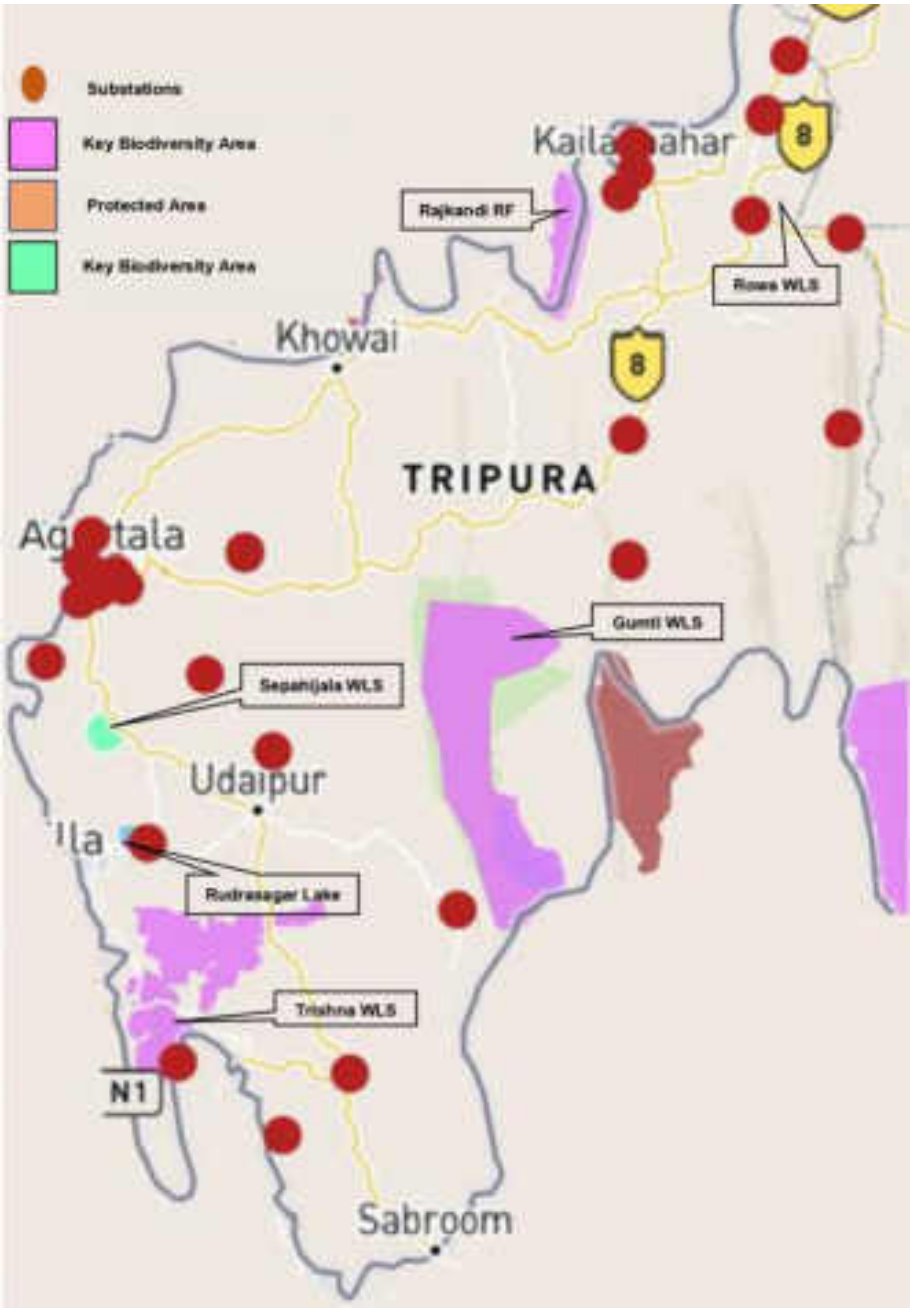
128. None of the distribution lines proposed under the project shall be passing through any of the wetlands discussed above including Ramsar wetland. Melaghar Substation is 2.3 km away from the Rudrasagar lake (Ramsar) while Jatanbari Substation is 6.75 km away from Damboor lake. But there may be crossings of locally important ponds, rivers, streams, and other waterbodies.

IBAT Screening Assessment

129. The ADB TA consultants had visited 27 substations, the test laboratory site at Gokulnagar and sample distribution lines spanning the entire state (**Annexure 5** shows the flora and fauna photolog). IBAT analysis was undertaken for each of the substations and the test laboratory besides undertaking a survey of the flora and fauna within these sites.[44] The summary of the IBAT analysis is given below with further details and the critical habitat screening tables provided in **Annexure 6**. IBAT has recorded the presence of 1 CR, 1 EN and 8 VU floral species and 15 CR, 28 EN and 43 VU faunal species in the 50 km radius of the substations and sample distribution lines. Some of the species listed by the IBAT assessment are also protected and covered under the schedules of Indian Wildlife Act. IBAT analysis has captured the floral and faunal species potentially found within a 50 km radius of the substations and sample distribution lines. Hence, some of the endemic species found in the two neighbouring states of Mizoram and Assam and in Bangladesh or species not normally observed in the state may also have been recorded. Thus, the data cannot be presumed to be entirely correct, and the species found within the radius may not be implied to be found within the state.

[44] IBAT is a multi-institutional programme of work involving BirdLife International, Conservation International, IUCN and UNEP-WCMC. IBAT provides a basic risk screening on biodiversity. It draws together information on globally recognised biodiversity information drawn from a number of IUCN's Knowledge Products: IUCN Red List of Threatened Species, Key Biodiversity Areas (priority sites for conservation) and Protected Planet / The World Database on Protected Areas (covering nationally and internationally recognised sites, including IUCN management categories I–VI, Ramsar Wetlands of International Importance and World Heritage sites).

Figure 4.9 IBAT Screening Map of Protected Areas and Key Biodiversity Areas with Substations



Source: ADB TA Consultant (analyzed from IBAT)

9. Flora

130. Tripura has a very high floral diversity with approximately 1546 floral species including 1463 Angiosperms, 13 Gymnosperm and 70 Pteridophytes. There are only 15 floral species that have been considered as rare and endangered nationally in the Red Data Book on Indian Plants published by Botanical Survey of India. These are *Begonia surculigera, Colona flagrocarpa, Ophiorrhiza viillosa, orenia mucronulata, Tournefortia roxburghii, Jasminum listeri, Wallichia caryotoides, Cycas pectinate, Podocarpus neriifolius, Gnetum montanum, Gnetum oblongum, Mangifera sylvatica, Dischidia benghalensis NE, Dischidia nummularia* and *Dischidia major.* All

these species are classified as Not Evaluated (NE) as per IUCN except *Podocarpus neriifolius, Gnetum montanum* and *Mangifera sylvatica* which are Least Concern (LC) as per IUCN and *Gnetum oblongum* which is a Not Threatened (NT) species as per IUCN.

131. **Protected Species.** The Wildlife (Protection) Act 1972 prohibits picking, uprooting, damaging, destroying, acquiring, or collecting six species of plants from forest land and any area specified, by notification, by the Central Government [Clause 17A of Chapter IIIA (Protection of Specified Plants), page 346 of Handbook Vol. 1]. The six species are: Beddome's cycad (Cycas beddomei), Blue Vanda (Vanda coerulea), Kuth (Sassurea lappa), Ladies slipper orchids (*Paphiopedilum* spp.), Pitcher plant (*Nepenthes khasiana*), Red Vanda (*Rananthera imshootiana*). None of the six species are recorded / reported from Tripura.

132. **Species of Socioeconomic Value**. Approximately 15 timber producing species have been recorded to be found in the state. Besides timber, wood from 29 floral species is used for manufacturing of packing boxes, 14 species for tea chests, approximately 30 species for plywood and match boxes and another 13 species for musical instrument. Tripura also has approximately 13 bamboo species and six cane species that are used for making furniture. Besides these timber and other wood producing species another 27 species have been recorded that contribute towards Non-Timber Forest Products (NTFP) besides utilization of 107 species for fodder, 60 species as human food and 65 fruit producing species. Agarwood (*Aquilaria malaccensis)* a globally critically endangered species is an important social and economic species.

133. Tripura has one of the oldest, richest, and most diverse cultural traditions associated with use of medical plants. There are large number of village-based herbal medicines practitioners who have traditional knowledge of herbal home remedies of ailments and nutrition. Forest Department of Tripura reported documentation and identification of around 266 species of medicinal plants (68 species trees, 38 species shrubs, 71 species of herbs and 81 species of climbers) although herbal medicines used by rural people including tribal have not yet been documented.[45] Most species used for social and economic purposes are either NE or LC species.

134. All the substations and the test laboratory support and are located within modified habitat, similarly the distribution lines run through modified habitat. Floral survey in the substations and the sample distribution lines have found 30 species of shrubs, herbs and grasses besides 25 tree species (Table 4-8). All the floral species found are either of least concern (LC) or not evaluated (NE) as per International Union for Conservation of Nature (IUCN) global data and none are in the Indian red data book list/nationally endangered. Out of the 55 species there are 12 invasive species (3 having native range, 8 are alien and 1 without range data). None of these species are endemic to Tripura. As none of the species are critically endangered, endangered, or vulnerable as per the IUCN red list, nor endemic, these shall not trigger critical habitat (CH).

[45] Envis Centre: Tripura Pollution Control Board. http://trpenvis.nic.in/test/biodiversity.html

Table 4.8 Floral Species in Substations and Along Sample Distribution Lines Visited (Including Survey of Distribution Lines Subsequently Dropped)

Sl. No.	Botanical Name	Common Name	Class	IUCN Status	Invasive	Range (in reference to India, if endemic or invasive)
1	*Accacia* sp	-	Tree	-	-	-
2	*Albizia lebbeck*	Indian Siris	Tree	LC	Yes	Native
3	*Albizzia procera*	White siris	Tree	LC	No	-
4	*Alocassia macrorrhizos*	Giant Taro, Upright elephant ear	Herb	NE	No	-
5	*Andrographis paniculate*	Green Chiretta	Herb	NE	No	-
6	*Annona squamosa*	Custard Apple	Tree	LC	Yes	-
7	*Areca catechu*	Areca Nut	Tree	NE	No	-
8	*Artocarpus heterophyllus*	Jackfruit	Tree	NE	No	-
9	*Bacopa moneieri*	Brahmi	Herb	LC	Yes	Native
10	*Bahunia* spp.	Purple Orchid Tree / Kanchan	Tree	LC	No	-
11	*Bidens biternara*	-	Herb	NE	No	-
12	*Cassia tora / Senna tora*	Sickle Pod	Shrub	NE	No	-
13	*Catharanthus roseus*	Pink Periwinkle	Herb	NE	No	-
14	*Chromolaena odorata / Euphatorium odoratum*	Siam Weed	Herb	NE	Yes	Alien
15	*Citrus limon*	Lemon	Tree	NE	No	-
16	*Citrus maxima*	Pomelo	Tree	LC	No	-
17	*Clerodendrum infortunatum*	Bhat / Hill glory bower	Shrub	NE	No	-
18	*Colocassia esculenta*	Taro	Herb	LC	No	-
19	*Cynodon dactylon*	Bermuda grass	Herb	NE	Yes	Alien
20	*Delonix regia*	Gulmohar	Tree	LC	No	-
21	*Dendrocalamus hamiltonii*	Tama Bamboo	Grass	NE	No	-
22	*Diplazium esculentum*	Fiddlehead / Edible Fern	Herb	LC	No	-
23	*Eclipta alba*	False Daisy	Herb	NE	No	-
24	*Eichhornia crassipes*	Water Hyacinth	Herb	NE	Yes	Alien
25	*Ficus racemose*	Cluster Fig	Tree	NE	No	-
26	*Ficus religiosa*	Pipal	Tree	NE	No	-
27	*Flaveria trinervia*	yellowtops	Herb	NE	No	-
28	*Gmelina arborea*	Gamhar	Tree	LC	No	-
29	*Hevea brasiliensis*	Rubber tree	Tree	LC	No	-
30	*Hibiscus rosa sinensis*	Chinese hibiscus	Shrub	NE	No	-
31	*Lagenaria siceraria*	Bottle Gourd	Climber	NE	No	-
32	*Lagerstroemia speciosa*	Pride of India	Tree	NE	No	-
33	*Lantana camera*	Lantana	Herb	NE	Yes	Alien
34	*Leucas aspera*	Common Leucas	Herb	NE	No	-
35	*Magnifera indica*	Mango	Tree	NE	No	-

Sl. No.	Botanical Name	Common Name	Class	IUCN Status	Invasive	Range (in reference to India, if endemic or invasive)
36	*Melastoma malabathricum*	Malabar Melastome	Herb	NE	No	-
37	*Michelia champaca / Magnolia champaca*	Champak	Tree	LC	No	-
38	*Mikania micrantha*	Chinese creeper	Climber	NE	Yes	Alien
39	*Mimosa pudica*	Touch me not	Herb	LC	Yes	Alien
40	*Musa paradisiaca*	Banana	Tree	NE	No	-
41	Palm	-	Tree	-	-	-
42	*Peltophorum pterocarpum*	Copper pod / Radhachurra	Tree	NE	No	-
43	*Polyalthia longifolia*	False Ashoka / Debdaru	Tree	NE	No	-
44	*Psidium guajava*	Guava	Tree	LC	Yes	Alien
45	*Setaria glauca*	Yellow Foxtail	Grass	NE	No	-
46	*Solanum nigrum*	Nightshade	Herb	NE	No	-
47	*Spermacoce verticillate*	False Button Weed	Herb	NE	No	-
48	*Synedrella nodiflora*	Node weed	Herb	NE	No	-
49	*Syzygium cumini*	Jamun	Tree	LC	Yes	Native
50	*Tabernaemontana divaricata*	Crape Jasmine	Herb	LC	No	-
51	*Tectona grandis*	Teak	Tree	NE	No	-
52	*Thevetia peruviana*	Yellow Oleander	Shrub	NE	Yes	Alien
53	*Ziziphus* spp.	Ber	Tree	LC	No	-
54	*Thysanolaena latifolia*	Broom Grass	Grass	NE	No	-
55	*Ocimum tenuiflorum*	Tulsi / Holy Basil	Herb	NE	No	-

IUCN = International Union for Conservation of Nature, LC = Least Concern, NE = not evaluated
Source: ADB TA Consultant

10. Fauna (Avian, Terrestrial, Aquatic)

135. The state of Tripura is also quite diverse in terms of its faunal diversity with the richness being attributed to its unique bio-geographical location and zoo-geographical position. As per Wildlife Protection Act, 1972, Schedule I and II (part II) species are provided the highest degree of protection and any harm to these species are severely dealt with. These species are threatened and normally are keystone species and national parks, sanctuaries reserves (Protected Areas) are declared for the conservation and protection of these species. The levels of punishment for causing harm to Schedule III and IV species are much lower but these species are also protected under the act.

11. Fishes

136. Approximately 129 species of fishes including 10 nationally endangered, 28 nationally vulnerable, and four rarely found species of fishes of India have been recorded in the state. The

state also contains four endemic species (only one endemic to Tripura) to India.[46] Majority of the species are common to both Indo-Gangetic drainages and Southeast Asian fish fauna and are found in the various rivers in the state including Gomti, Howrah, and Deo; Damboor and Rudrasagar Lakes; ponds and other waterbodies.

12. Reptile and Amphibian

137. There are 32 species of reptiles including three species of freshwater turtles and tortoises, and 16 species of snakes (both venomous and nonvenomous) with three species of water snakes recorded in the state.[47, 48] There are also 13 species of lizards including two species of monitor lizards, *Varanus bengalensis* and *Varanus salvator* both of which are Schedule 1 species under Wildlife Protection Act, 1972 but are classed as Least Concern under the IUCN red list. There are 11 species amphibians out of 203 species so far reported from India.[49] Out of the 11 species 1 species is very rarely found and 3 are rarely found in Tripura while the other 7 species are commonly found. All the species are of LC except 1 which a NE species as per IUCN. None of these species is listed in the Wildlife Protection Act, 1972 schedules.

138. During the site visits to the substations presence of various snakes was intimated by the staff. Presence of holes used by snakes were also seen in a couple of substations. The common snakes that were encountered by the staff in the substations were Monocled Cobra (*Naja kouthia*) a Schedule 2 Wildlife Protection Act, 1972 and Appendix II CITES species, Branded Krait (*Bungarus fasciatus*) a Schedule IV Wildlife Protection Act, 1972 species, Viper (Schedule IV of Wildlife Protection Act, 1972), Short-nosed Vine Snake / Oriental Vine Snake *(Ahaetulla prasina*), Indian Rat snake (*Ptyas mucosa*), Chequered Keelback (*Fowlea piscator*), Red-necked Keelback (*Rhabdophis subminiatus*) and Striped Keelback (*Amphiesma stolatum)*. A case of snake bite by non-venomous snake has been recorded within the control room of Rangrung Substation a couple of years back.

139. Various species of gecko, toads, and frogs have been observed by the staff in the substations mainly during the monsoon period. All the named species that have been reported are either NE or LC as per IUCN red list and are not endemic species. As none of the species are critically endangered, endangered, or vulnerable as per the IUCN red list, nor endemic, these shall not trigger CH.

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[46] Barman, R. P. 2004. Threatened and endemic fishes of Tripura with comments on their conservation, *Rec. zool. Surv. India:* 103 (Part 1-2): 75-81, 2004

[47] ENVIS Centre: Tripura State Pollution Control Board. http://trpenvis.nic.in/test/biodiversity.html

[48] Sanyal, D. P., Duttagupta, B. & Gayen, N. C. 2002. Reptilia. Fauna of Tripura, State Fauna Series, 7(1): 159-177. Zoological Survey of India, Calcutta

[49] Sarkar A. K., Das S. and Ray S. 2002. Reptilia. Fauna of Tripura, State Fauna Series, 7(1): 179-190. Zoological Survey of India, Calcutta

Table 4.9 Reptilian Species Reported in Substations

Sl. No.	Scientific Name	Common Name	Class	IUCN Status	Wildlife Protection Act Status	Invasive
1	*Naja kouthia*	Monocled Cobra	Reptilia	NE	Schedule II (Part II)	No
2	*Bungarus fasciatus*	Branded Krait	Reptilia	LC	Schedule IV	No
3	-	Viper	Reptilia	-	Schedule IV	-
4	*Ahaetulla prasina*	Short-nosed Vine Snake / Oriental Vine Snake	Reptilia	LC	Schedule IV	No
5	*Ptyas mucosa*	Indian Rat snake	Reptilia	LC	Schedule II (Part II)	No
6	*Fowlea piscator*	Chequered Keelback	Reptilia	LC	Schedule II (Part II)	No
7	*Rhabdophis subminiatus*	Red-necked Keelback	Reptilia	LC	Schedule IV	No
8	*Amphiesma stolatum*	Striped Keelback	Reptilia	LC	Schedule IV	No

IUCN = International Union for Conservation of Nature, LC = Least Concern, NE = not evaluated
Source: ADB TA Consultant

13. Birds

140. In total there are approximately 518 species of birds that have been recorded in the state.[50] There are three Important Bird Areas (IBA) in the state (i) Gumti Wildlife Sanctuary (WLS) that fulfils IBA criterion A1, A4i, (ii) Trishna WLS that fulfils IBA criteria A2 and A3 and (iii) Rudrasagar lake (IBA criteria A1).[51] These IBAs have recorded the presence of Baer's Pochard (*Aythya baeri)* a critically endangered species found in Rudrasagar Lake and Gumti WLS, Lesser Adjutant (*Leptoptilos javanicus*) a VU species in Gumti WLS and numerous other NT (near threatened) species. The presence of the CR Baer's Pochard in Rudrasagar lake and Gumti WLS (including Dumbur / Damboor Lake or Gumti Reservoir) potentially triggers Critical Habitat. No distribution lines are proposed to be located within these IBAs thus they will not be impacted.

141. Eight critically endangered, nine endangered, and 16 vulnerable species have been reported in the state as per secondary data and the presence of these species in sufficient numbers in the Area of Analysis (state) may trigger critical habitat. However, none of the CR, EN and VU bird species were evidenced during the site visits.

142. Tripura lies in the Endemic Bird Area (EBA) of Eastern Himalaya (EBA 130) where Subtropical Hill Forest and Temperate Forest bird species could be found in winter.[52, 53] Twenty-

[50] Avibase - Bird Checklists of the World, Tripura. https://avibase.bsc-eoc.org/checklist.jsp?lang=EN&p2=1&list=avibase&synlang=&region=INnetr&version=text&lifelist=&highlight=0

[51] ENVIS Centre on Wildlife & Protected Areas, Hosted by Wildlife Institute of India, Dehradun. http://wiienvis.nic.in/Database/IBA_8463.aspx and Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[52] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[53] BirdLife International (2022) Endemic Bird Areas factsheet: Eastern Himalayas (http://datazone.birdlife.org/eba/factsheet/129)

one bird species have been listed in Eastern Himalaya EBA as restricted range species.[54] Out of the 21 species, 15 (including 2 endemic to India) are reported in India. Only *Phylloscopus cantator* (yellow-vented warbler) a LC species has been reported in Tripura as a native nonbreeding species. Forest officials reported that it is regularly reported/observed. As this is a LC species and a non-breeding one reported to be found in 3 countries, this does not trigger critical habitat.

143. 466[55] species of migratory birds from the Central Asian flyway, East Asian Australasian Flyway (covering parts of eastern and northeastern India including the state of Tripura) and Asian East African Flyway covering parts of western India are reported to visit the Indian subcontinent. The research paper of Palm *et al* (2015) was consulted to inform the avian baseline for migratory species for the study area.[56] Tripura falls within the outer edges of two flyways. The Central Asian Flyway (CAF) links northern most breeding grounds in Russia (Siberia) to southernmost non-breeding (wintering) grounds in West and South Asia, the Maldives, and the British Indian Ocean Territory. India has a strategic role in this flyway as it provides critical stopover sites to over 90% of the bird species known to use this migratory route. The East Asian - Australasian Flyway (EAAF) stretches from the Russian Far East and Alaska, southwards through East Asia and South-east Asia, to Australia and New Zealand. India is on the edge of this flyway which extends into Bangladesh. Based on a Palm *et al.* study stopovers sites, core movement areas, and flight corridors for the species studied are not found in Tripura, although the state may still fall within the flight corridors for species that were not studied.

144. As there are deficiency in the data availability, it is difficult to state as to how many of the 466 migratory bird species are present in or visit the state. However, an analysis of the secondary data (IBAT analysis, which captures species within a 50km radius, of all the substations and the sample distribution lines) and cross referenced with data from Birdlife and other secondary sources[57] reveals that there are approximately 238 species of migratory birds that are reported to likely to visit or be present in the state. The wetlands in the state (including Rudrasagar lake, Dumboor lake, and wetlands within the Trishna WLS) provide excellent habitat for the migratory birds. Out of these 238 species, four are CR, four EN and four VU species (Table 4-5) per the IUCN red list with Bengal Florican also a Wildlife Protection Act Schedule 1 species. The rest are LC species as per IUCN. The majority of these 12 species are mainly winter migrants in the state though *Houbaropsis bengalensis* (CR) is possibly extinct in the state while *Leptoptilos dubius* (EN) is reported to be extinct within the state by Birdlife International. The presence of these migratory species in sufficient numbers in the Area of Analysis (state) shall trigger CH. However, none of the CR, EN and VU species were evidenced during the site visits – the site visits were conducted during December 2020, March 2021, October 2021, and April-May 2022 so they included the winter migration period when these birds would be present.

Table 4.10 International Union for Conservation of Nature Red-Listed Migratory Avian Species Reported at Tripura

Sl. No.	Scientific Name	Common Name	IUCN Status	Wildlife Act Status	Movement pattern	Remarks
1	*Aythya baeri*	Baer's Pochard	CR	Schedule IV	Full Migrant	Winter migration

[54] Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

[55] BirdLife International (2022) Country profile: India. Available from http://www.birdlife.org/datazone/country/india

[56] Mapping migratory flyways in Asia using dynamic Brownian bridge movement models (biomedcentral.com)

[57] Tripura, India - eBird and Choudhury_Tripura.pdf (indianbirds.in)

Sl. No.	Scientific Name	Common Name	IUCN Status	Wildlife Act Status	Movement pattern	Remarks
2	*Calidris pygmaea*	Spoon-billed Sandpiper	CR	Schedule IV	Full Migrant	Winter migration
3	*Emberiza aureola*	Yellow-breasted Bunting	CR	Schedule IV	Full Migrant	Native nonbreeding
4	*Houbaropsis bengalensis*	Bengal Florican	CR	Schedule I	Full Migrant	Possibly extinct in Tripura[58]
5	*Aquila nipalensis*	Steppe Eagle	EN	Schedule IV	Full Migrant	Winter migration
6	*Calidris tenuirostris*	Great Knot	EN	Schedule IV	Full Migrant	Winter migration
7	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	EN	Schedule I	Full Migrant	Not migrant
8	*Leptoptilos dubius*	Greater Adjutant	EN	Schedule IV	Full Migrant	Extinct in Tripura[59]
9	*Aythya ferina*	Common Pochard	VU	Schedule IV	Full Migrant	Winter migration
10	*Clanga clanga*	Greater Spotted Eagle	VU	Schedule I	Full Migrant	Winter migration
11	*Gallinago nemoricola*	Wood Snipe	VU	Schedule IV	Full Migrant	Native nonbreeding
12	*Leptoptilos javanicus*	Lesser Adjutant	VU	Schedule IV	Full Migrant	Native nonbreeding

CE = Critically Endangered, EN = endangered, IUCN = International Union for Conservation of Nature, LC = Least Concern, VU = vulnerable
Source: ADB TA Consultant (analyzed from IBAT, Birdlife International and IBA reports in India)

145. There are 21 bird species (all waterbirds) which are reported to be of congregatory nature. Only Baer's Pochard (*Aythya baeri*) is a CR species while the others are either NT (4 species) or LC (16 species). The presence of these congregatory species in sufficient numbers in the Area of Analysis (state) shall trigger CH. However, none of the CR, EN and VU species were evidenced during the site visits.

Table 4.11 Congregatory Avian Species Reported at Tripura

Sl. No.	Scientific Name	Common Name	IUCN Status	Wildlife Act Status
1	*Anas acuta*	Northern Pintail	LC	Schedule IV
2	*Anas strepera / Mareca strepera*	Gadwall	LC	Schedule IV
3	*Anastomus oscitans*	Asian Openbill	LC	Schedule IV
4	*Anhinga melanogaster*	Oriental Darter	NT	Schedule IV
5	*Anser anser*	Greylag Goose	LC	Schedule IV

[58] BirdLife International (2022) Species factsheet: *Houbaropsis bengalensis*. http://datazone.birdlife.org/species/factsheet/bengal-florican-houbaropsis-bengalensis
[59] BirdLife International (2022) Species factsheet: *Leptoptilos dubius*. http://datazone.birdlife.org/species/factsheet/greater-adjutant-leptoptilos-dubius

Sl. No.	Scientific Name	Common Name	IUCN Status	Wildlife Act Status
6	*Anser indicus*	Bar-headed Goose	LC	Schedule IV
7	*Aythya baeri*	Baer's Pochard	CR	Schedule IV
8	*Aythya fuligula*	Tufted Duck	LC	Schedule IV
9	*Aythya nyroca*	Ferruginous Duck	NT	Schedule IV
10	*Dendrocygna bicolor*	Fulvous Whistling-duck	LC	Schedule I
11	*Dendrocygna javanica*	Lesser Whistling-duck	LC	Schedule IV
12	*Gallinula chloropus*	Common Moorhen	LC	Schedule IV
13	*Larus brunnicephalus*	Brown-headed Gull	LC	Schedule IV
14	*Limosa limosa*	Black-tailed Godwit	NT	Schedule IV
15	*Nettapus coromandelianus*	Cotton Pygmy Goose	LC	Schedule IV
16	*Pelecanus philippensis*	Spot-billed Pelican	NT	Schedule IV
17	*Phalacrocorax carbo*	Great Cormorant	LC	Schedule IV
18	*Porphyrio porphyrio*	Purple Swamphen	LC	Schedule IV
19	*Tadorna ferruginea*	Ruddy Shelduck	LC	Schedule IV
20	*Vanellus cinereus*	Grey-headed Lapwing	LC	Schedule IV
21	*Sarkidiornis melanotos*	African Comb Duck	LC	Schedule IV

CR = critically endangered, IUCN = International Union for Conservation of Nature, LC = Least Concern, NT = Near Threatened
Source: ADB TA Consultant (analyzed from IBAT, Birdlife International and IBA reports in India)

146. Common or Indian myna (*Acroditheres tristus*), Cattle egret (*Bubulcus ibis*), sparrow (*Passer* domesticus), pigeon (*Libia columbia*) and common crow (*Corvus splendens*) were observed in the substations during site visits. Calls of Brown-headed barbet (*Psilopogon zeylanicus*) and Blue-throated Barbet (*Psilopogon asiaticus)* were heard in areas adjoining the substations. Eurasian Collared-Dove *(*Streptopelia decaocto*)*, black drango (*Dicrurus macrocercus*) and long tailed shrike (*Lanius schach)* were observed perching on the distribution lines during the site visits.

147. Remains of *Acroditheres tristus* a not evaluated species was found to be electrocuted near a 11 kV line (not under the distribution components), while Eurasian collared dove (*Streptopelia decaocto*) a LC species were reported to have been electrocuted on a 11 kV bare conductor line (not the distribution components) under the Stadium Substation by the TSECL staff. TSECL do not have any records of birds that have been electrocuted while roosting or perching on the electrical lines, neither are there any secondary information on the details (numbers and species wise data) of electrocuted birds in Tripura. The earlier World Bank funded North Eastern Region Power System Improvement Project (NERPSIP) identified the wing spans of the birds (ranging from 19-155 cm) that may get impacted due to their proposed project and provided mitigation measures for bird electrocutions but has not reported details of any electroction incidences.[60]

[60] India - North Eastern Region Power System Improvement Project: environmental assessment (Vol. 13): Initial environment assessment report: T and D network in West Tripura, South Tripura, Khowai and Sepahijala District, 2015.
https://documents1.worldbank.org/curated/en/228041468041065761/pdf/SFG1014-v13-EA-P127974-PUBLIC-Disclosed-7-23-2015-Box393169B.pdf

14. Mammals

148. The Tripura Forest Department has recorded 90 mammalian species that represents approximately 33% of the total mammalian fauna known in India. 7 out of the 15 known species of primates have been recorded in Tripura. Phayre's Leaf Monkey (*Presbytis phayrei*), an endangered species as per IUCN red list is the most dominant species and has been accorded the position of State Animal of Tripura. The other primate species includes Slow Loris (*Nycticebus coucang*) an endangered species under the IUCN red list, Pigtail Macaque (*Macaca nemestrina*) another endangered species, Hoolock Gibbon (*Hoolock hoolock*) an endangered species, Capped langur (*Presbytis pileatus*) a vulnerable species as per the IUCN red list and the only tailless ape in India, Stumped-tail Macaque (*Macaca arctoides*) a vulnerable species, and, Rhesus macaque (*Macaca mulatta*) which is a least concern species under the IUCN red list.

149. The mammalian fauna of Tripura that are nationally endangered and thus accorded protection under the various schedules of the Wildlife Protection Act, 1972 includes Leopard (*Panthera pardus*), Marbled Cat (*Felis* marmorata), Leopard Cat (*Felis bengalensis*), Golden Cat (*Felis temmincki*), Common Otter (*Lutra lutra*), Indian Elephant (*Elephas maximus*), Indian Bison (*Bos gaurus*), Chinese Pangolin (*Manis pentadactyla*), Slow Loris (*Nycticebus coucang*), Phayre's Leaf Monkey (*Presbytis phayrei*), Capped langur (*Presbytis pileatus*) and Hoolock Gibbon (*Hoolock hoolock*) which is reported by the District Forest Officer in the Baramura forest range.

150. TSECL does not have any records of any mammals that have been electrocuted, neither are there any secondary information on the details (numbers and species wise data) of electrocuted species in Tripura. However, the forest officer for North Tripura reported many primates including Phayre's Leaf Monkey had been electrocuted in the past 2-3 years. Case of mortality due to electrocutions of Indian flying fox (*Pteropus medius*) a LC species on the IUCN red list was reported by TSECL staff at Govindtilla Substation (not included in the distribution components) from a 11 kV line at Chellagangmukh village in Gomoti district. A case of mortality of the same species was also reported from one existing bare conductor line (not included in the distribution components) under Madhupur Substation. A case of mortality due to electrocution of a domesticated elephant by a falling live wire of TSECL was reported on December 2018 in North Tripura during a road widening project.[61] There have been no reported cases of electrocution of wild animals from 2016-17 till 2020-21 in the last 5 years as per records shared by Wildlife Officials with TSECL (**Annexure 7**).

151. During consultations with the Chief Wildlife Warden (CWLW) and PCCF (Head of the Forest Force) he shared his apprehension about mammals, notably bison and elephant, disturbing power line poles and them getting injured in the process. Bisons are present in Trishna WLS, bison attacks are reported by Forest Officers, but no distribution lines are passing through either the WLS or its ESZ. As per records available only 59 wild elephants are said to be present in Tripura. These elephants are part of two different elephant groups in Khowai and Gomati

India - North Eastern Region Power System Improvement Project: environmental assessment (Vol. 16): Initial environment assessment report for T and D network in Gumti and South Tripura district under Nerpsip tranche-1, Tripura, 2015. https://documents1.worldbank.org/curated/en/324411468033589948/pdf/SFG1014-v16-EA-P127974-PUBLIC-Disclosed-8-11-2015-Box393182B.pdf

India - North Eastern Region Power System Improvement Project: environmental assessment (Vol. 9): Initial environment assessment report for transmission network in Gumti and South Tripura district, 2015. https://documents1.worldbank.org/curated/en/416931468035940259/pdf/E47420V90P127900Box391434B00PUBLIC0.pdf

[61] https://indianexpress.com/article/north-east-india/tripura/elephant-electrocuted-at-tripura-highway-site-5514103/

districts as per records of Forest Department Tripura. Regular elephant conflicts are reported such as around Gandharo, Maharani, Aambasa, Laxmipur, Uttar Maharanipur, Madhya Maharanipur, Tulsigarh, Khomi, and Jhumbai. The South Tripura District Forest Officer also reported elephant conflict around Debipur beat. Other Forest Officials reported human-wildlife conflicts with the globally vulnerable Himalayan (Asiatic) Black Bear (*Ursus thibetanus*) notably around the Rowa WLS and Sepahijala WLS.

15. Critical Habitat Screening

152. The Area of Analysis for screening critical habitat has been taken as the state given that the distribution components are statewide, although impacts will be restricted to within the PAI. In addition to the protected areas and IBA which support critical habitat as per Table 4-5, the tables in Annexure 6 summarize the findings of critical habitat screening with respect to species supported considering IFC Performance Standard 6 thresholds for triggers 1-4. It is concluded that critical habitat for two species and possible critical habitat for seven species is supported by the state.

153. The presence of *Aquilaria malaccensis* (Agarwood) which is the only flora triggering critical habitat will need to be reconfirmed through route surveys, but it was not observed during site visits.

154. Most of the faunal species are generally restricted to the protected areas and their immediate surroundings rather than being found within the PAI although they are not just restricted to the protected areas and ESZ. The avoidance of forest areas by new distribution lines means many of these species are unlikely to be found within the PAI but care will need to be taken when distribution lines are adjacent plantation/social forestry/dense vegetation especially within 10km of the WLS. Critical habitat for *Nilssonia nigricans* (Black Softshell Turtle) is supported in the temple ponds especially in Tripureswari Temple pond in Matabari, Udaipur. Critical habitat for *Cyrtodactylus montanus* a reptilian species endemic to Jampui Hills in North Tripura district is also supported near Vangmung Substation. However, the species is reported in the forested habitats only while Vangmung Substation is a modified habitat and thus the critical habitat shall not extend to the substation footprint. No distribution line works are proposed in its area of occurrence. Critical habitat for *Aythya baeri* (Baer's Pochard) is supported in Gumti WLS where it reportedly supports ≥ 0.5% of the global population, however, the species has not been reported post 2012. Critical habitat for *Gyps bengalensis* (White-rumped Vulture) is also supported in Gumti WLS. *Manis pentadactyla* (Chinese Pangolin) is supported in Sepahijala WLS. *Trachypithecus phayrei* (Phayre's Leaf Monkey) is supported but that this is mainly associated with Sepahijala WLS and Trishna WLS. *Nycticebus bengalensis* (Bengal Slow Loris) is associated with Sepahijala, Trishna and Gumti WLS. Critical habitat for *Macaca leonina* (Northern Pig Tailed Macaque) is supported in Trishna WLS. The findings are summarized in Table 4.12 with the detailed critical habitat screening results provided in Annexure 6.

Table 4.12 Summary of Species for which Critical Habitat Found in Tripura

Sl. No.	Critical Habitat Feature (Species)	Qualifying Reason	Species Present in PAI
1	*Aquilaria malaccensis* (Agarwood)	Possible Critical Habitat due to state population of CR species	Not recorded but probable so to be reconfirmed through route surveys where trees present

Sl. No.	Critical Habitat Feature (Species)	Qualifying Reason	Species Present in PAI
2	*Nilssonia nigricans* (Black Softshell Turtle)	Possible Critical Habitat due to state population of CR species	Not recorded, but reported in Tripureswari Temple pond in Matabari, Udaipur and possible in other big temple ponds
3	*Cyrtodactylus montanus*	Definite Critical Habitat due to state population of CR and endemic species	Not recorded, but probable in forest areas though reports were from outside footprint of Vangmung Substation
4	*Aythya baeri* (Baer's Pochard)	Possible Critical Habitat due to state population of CR species which is also migratory and congregatory	No (no records in state post 2012)
5	*Gyps bengalensis* (White-rumped Vulture)	Possible Critical Habitat due to state population of CR species	Not recorded but possible rare occurrence
6	*Manis pentadactyla* (Chinese Pangolin)	Possible Critical Habitat due to state population of CR species	Not recorded but possible; absence will need to be confirmed during route surveys of distribution line in rural areas
7	*Trachypithecus phayrei* (Phayre's Leaf Monkey)	Definite Critical Habitat due to state population of EN species which is also the state animal	Not recorded but District Forest Officers have reported possible occurrence outside of WLS; absence will need to be confirmed during route surveys of distribution line in rural areas especially plantation/social forestry/dense vegetation within about 10km of WLS
8	*Nycticebus bengalensis* (Bengal Slow Loris)	Possible Critical Habitat due to state population of EN species	No (forest habitat)

Sl. No.	Critical Habitat Feature (Species)	Qualifying Reason	Species Present in PAI
9	*Macaca leonina* (Northern Pig Tailed Macaque)	Possible Critical Habitat due to state population of VU species	Not recorded but District Forest Officers have reported possible occurrence outside of WLS; absence will need to be confirmed during route surveys of distribution line in rural areas especially plantation/social forestry/dense vegetation within about 10km of WLS

CH = critical habitat, CR = Critically Endangered, EN = Endangered, NE = not evaluated, PAI = project area of influence, VU = vulnerable, WLS = wildlife sanctuary
Source: ADB TA Consultant

Table 4.13 Critical Habitat Screening

Critical Habitat Trigger	Thresholds Adopted	Trigger Present	Rationale
Areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	Yes, definite critical habitat for 2 species and possible critical habitat for 7 species as per Table 4-12	Rationale provided in Table 4-12 for species that potentially trigger critical habitat. Though many individuals of other CR/EN/VU species may be present, except for the named species, concentrations are unlikely to exceed the thresholds for critical habitat as per Annexure 6.
Areas having special significance for endemic or	Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	Yes, definite critical habitat for 1 species *(Cyrtodactylus montanus)*	This CR reptilian species is endemic to Jampui Hills in North Tripura district and reported near Vangmung. It is endemic to this

Critical Habitat Trigger	Thresholds Adopted	Trigger Present	Rationale
restricted-range species			small area which holds the entire global population.
Sites that are critical for the survival of migratory species Areas supporting globally significant concentrations or numbers of individuals of congregatory species	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	Yes, possible critical habitat for 1 species (Baer's Pochard)	Migratory and congregatory species found in Tripura, but no IBA reported to be supporting globally significant concentrations; there are old reports Gumti WLS/Dumboor Lake might support congregations of Baer's Pochard with 13 individuals were reported in 2008 which is less than 1.3% of the global population. However, as per IUCN, visitors post 2012 have not been recorded.
Areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services	-	Yes, Rudrasagar Lake Ramsar Site	Ecosystems services are provided by Rudrasagar Lake wetland (Ramsar)
Areas having biodiversity of significant social, economic, or cultural importance to local communities	-	Yes, possible for Phayre's Leaf Monkey and Agarwood	Biodiversity associated with natural forest habitat is of social, economic, and cultural importance to local communities including indigenous peoples; ADB TA social safeguard specialist has confirmed that this biodiversity is not of "significant" importance to local communities. However, Phayre's Leaf Monkey is the state animal so is considered of "significant" importance at the state level whilst agarwood is an important social and economic species.

ADB = Asian Development Bank, CR = Critically Endangered, EN = Endangered, IBA = important bird area, IUCN = International Union for Conservation of Nature, PAI = project area of influence, VU = vulnerable, WLS = wildlife sanctuary
Source: ADB TA Consultant

16. Key Biological Aspects

Summary of the key biological aspects in the PAI are given in Table 4-14.

Table 4.14 Summary of Biological Setting of the Project Area of Influence

Component	Subproject	Location	Key environmental features in Project Area of Influence
Substations and Test Laboratory	27 Substations Test Laboratory	Tripura	• Habitat type: modified habitat • Protected Areas in 10 km: None situated within protected areas. Three substations (Panisagar, Rajnagar, and Jatanbari) and test laboratory within 10 km but all are outside of the ESZ. Melaghar within 10 km of Rudrasagar Lake Ramsar • Key biodiversity area and IBA in 10km: Trishna WLS, both IBA and KBA (633m from Rajnagar Substation), Gumti WLS both IBA and KBA (approximately 6 km from Jatanbari WLS), Sepahijala WLS a KBA 6.5 km from test laboratory, Rudrasagar lake an IBA (2.3 km from Melaghar Substation) • Forest land: None within forest area. Substations that are sited within 2km to forest areas are Rajnagar, Panisagar and Jatanbari Substation • Wetlands: Melaghar Substation approximately 2.3 km from Rudrasagar Lake (Ramsar site) • Surface water bodies: ponds are found within 500 m of 23 Substations and rivers/streams within 500 m of four Substation. Eight substations have borewells in the compound. • Vegetation supported: mainly shrubs, herbs, and grasses with some trees in the substation area • Trees to be lost: None • Critical habitat: in addition to protected areas (Bison and Clouded Leopard National Parks and Rudrasagar Lake) the state supports critical habitat for two species and possible critical habitat for seven species but none of these were seen during survey work or are likely to be encountered in modified habitat found at the substations and test laboratory thus the individual Areas of Analysis do not support critical habitat • No wildlife conflicts recorded at any of the substations, although snakes are observed
2667.46 ckm of 33 kV, 11 kV, and low-tension	• New 33kV Line (underground): 163 km • New 33kV Line (covered	Tripura	• Habitat type: modified habitats (roads/highways passing settlements, agricultural fields, plantations, social forest etc.) -- to be reconfirmed following final route surveys

Component	Subproject	Location	Key environmental features in Project Area of Influence
distribution lines	conductor): 107 km • New 11 kV Line (underground): 4.2 km • New 11 kV Line (covered conductor): 1270 km • Conversion of 11 kV Line to covered conductor: 134 km • Conversion of 11 kV Line to underground cable: 89.26 km • Conversion of low tension (0.4 KV) Line to aerial bunched cable: 900 km		• Protected Areas: outside of protected areas including the ESZ, to be reconfirmed following final route surveys but some distribution lines are within 10km • Key biodiversity area and Important Bird Area: None, to be reconfirmed following final route surveys but some distribution lines are within 10km • Forest land: None for new distribution lines, to be reconfirmed following final route surveys; some existing low-tension lines may be found along roads in forest range areas • Wetland: distribution lines do not pass through Rudrasagar lake, Damboor lake, lakes within Trishna WLS, or state protected wetlands; to be reconfirmed following final route surveys • Surface water: sample lines cross or are in the ROW of ponds/rivers/streams, surface water crossings are to be confirmed during route surveys • Vegetation supported: shrubs, herbs, grasses, and plantation trees • Trees lost: based on discussion with TSECL it is estimated total 2,775 trees may be felled for laying poles of new lines (2,540 trees for 11 kV and 235 trees for 33 kV) for the entire distribution component based on the expectation that 10% of total new poles (about 27,754 poles) that will be placed may require felling of trees. It is a standard practice of TSECL to realign lines to minimize the number of trees to be felled and this good practice will be followed by the project. The total actual number of trees to be felled will be reconfirmed by the EPC contractors for the final alignment during route surveys but the total number is not expected to exceed this estimate by more than 10%. • Critical habitat: in addition to protected areas (Bison and Clouded Leopard NPs and Rudrasagar Lake) the state supports critical habitat for two species and possible critical habitat for seven species. Only the following likely to be encountered in modified habitat along distribution lines, their presence or absence to be confirmed during route surveys: *Aquilaria malaccensis* (Agarwood) where trees present especially in plantation, *Nilssonia nigricans* (Black Softshell Turtle) if temple ponds crossed, *Gyps bengalensis* (White-rumped Vulture), *Manis pentadactyla*

Component	Subproject	Location	Key environmental features in Project Area of Influence
			(Chinese pangolin) in rural areas, and *Trachypithecus phayrei* (Phayre's Leaf Monkey) and *Macaca leonina* (Northern Pig Tailed Macaque) in rural areas/plantation especially within 10km of the WLS. In Kanchanpur subdivision of North Tripura district, particular attention will also be paid to the critically endangered, endemic *Cyrtodactylus montanus* if distribution lines pass along rocky roadside cuttings adjacent forest areas above 600 m asl although no works are proposed here.

AOA = area of analysis, ESZ = ecologically sensitive zone, IBA = important bird area, KBA = Key Biodiversity Areas, PAI = project area of influence, WLS = wildlife sanctuary
Source: ADB TA Consultant

F. Statewide Physical Setting

1. Introduction

155. The State of Tripura, with a geographical area of 10,491 km^2 is landlocked. It is surrounded by the deltaic basin of Bangladesh except for in the North-East which adjoins Cachar district of Assam and Mizoram. The state has five anticlinal ranges of hills running north to south, from Boromura in the west, through Atharamura, Longtharai and Shakhan, to the Jampui Hills in the east. Small, isolated hillocks interspersed throughout the state are known as tillas, and the narrow fertile alluvial valleys, mostly present in the west, are called lungas. The Tropic of Cancer passes through it, and strong seasonal rhythms are observed with a warm humid tropical climate. Tripura state is well endowed with surface water resources.

156. The specific objectives of the baseline analysis for the physical environment were to:

(i) Gather information on the existing topography, geology, soil types and quality, climate, air quality, noise, surface and ground water resources, and water quality of the study area as likely to be impacted by the distribution works.

(ii) Characterize the ability of the physical environment to absorb changes because of the proposed distribution works.

157. The physical baseline assessment methodology adopted included:

(i) Desktop Review of Secondary Data: a desktop review of existing published materials and documents was conducted to help determine the topography, geology, soil resources, climate, and water resources in the study area, and to identify any existing baseline data for soil quality, air quality, noise, and water quality.

(ii) Site Visit: site visits to sample distribution line and substations to identify sensitive receptors

(iii) Baseline data monitoring surveys: one season surveys for air quality, noise, and water quality as well as soil quality surveys were conducted by MITCON (sampling photos in Annexure 8, detailed baseline data for air quality is provided in Annexure 9, whereas noise data is provided in Annexure 10), supervised by ADB TA environment consultants.

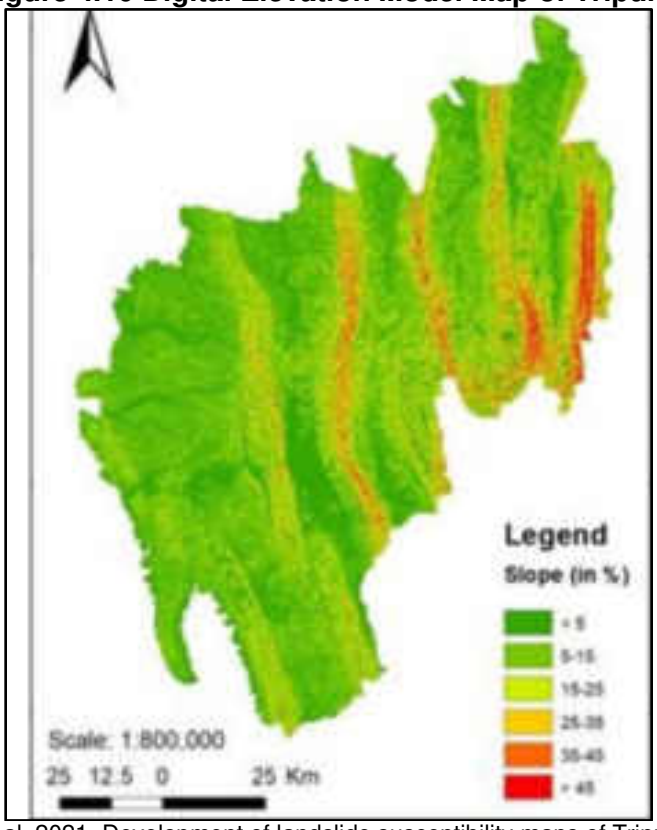
(iv) Consultation: discussions were held with local community during substation audits and sample distribution line site visits, which included consultation among other aspects on physical environmental quality of area, like air, noise, water quality etc.

2. Elevation and Topography

158. Tripura is predominantly a hilly region. It is characterized by hill ranges, valleys, and plains with three distinct physiographic zones (i) hill ranges, (ii) undulating plateau land, and (iii) low-lying alluvial land. About 60% of its land is hilly covered by north-south trending hill ranges while the remaining 40% is flat land. Geomorphologically, the terrain of Tripura is immature and represents first order topography. Five major anticlinal hill ranges traverse the state in roughly north-south direction from the plains of Sylhet in Bangladesh and Baramura in the west, through Atharamura, Lontharai and Shakhan, to the Jampui Hills in the east and continue southward into Chittagong Hill Tract. The intervening synclines are the Agartala–Udaipur, Khowai–Teliamura, Kamalpur–Ambasa, Kailasahar–Manu and Dharmanagar–Kanchanpur valleys. There are several small, isolated hillocks (locally known as tillas) interspersed throughout the state along with narrow fertile alluvial valleys (known as lungas) mostly present in the west.

159. The general altitude of the state varies between 16 m to 600 m ASL. The elevation of hills gradually increases in the east. The eastern range of the Jampui is situated at an elevation of 914 m ASL and the western range of the Baramura, Deotamura with its elevation of 244 m ASL is the lowest. The highest peak lies at Bethliangchhip (Thaidawar, Shib-rangkhung) 975.36 m ASL. Narrow valleys generally 20 km wide running southeast to northwest separate these hill ranges, they are broad and flat being separated from the adjacent highs with domes and conical peaks.

Figure 4.10 Digital Elevation Model Map of Tripura



Source: Source: Nath et al. 2021. Development of landslide susceptibility maps of Tripura, India using GIS and analytical hierarchy process

3. Geology, Soils, and Geological Hazards

160. **Geology.** The state of Tripura is characteristically underlain by a wide range of sedimentary rocks that has origin in marine-mixed fluvial type laid down in a range of environmental conditions primarily governed by tectonic movement.[62]https://word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en%2DUS&rs=en%2DUS&wopisrc=https%3A%2F%2Fasiandevbank-my.sharepoint.com%2Fpersonal%2Femarsden_adb_org%2F_vti_bin%2Fwopi.ashx%2Ffiles%2Fd3621e127a284b9f8a58e04fd17f36f4&wdenableroaming=1&mscc=0&wdodb=1&hid=7A3434A0-1045-0000-FCC0-350AA64BDF04&wdorigin=Outlook-Body&wdhostclicktime=1650091273727&jsapi=1&jsapiver=v1&newsession=1&corrid=74a7fb0b-d26c-4b0b-9e4a-737d5d7c8a61&usid=74a7fb0b-d26c-4b0b-9e4a-737d5d7c8a61&sftc=1&mtf=1&sfp=1&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush&rct=Medium&ctp=LeastProtected - _ftn1 The age ranges from upper most Oligocene (38 million years) to Holocene (recent period). Tectonically it now comprises a series of sub-parallel arcuate, elongated doubly plunging folds arranged in north-south direction. The anticline[63] folds are separated by wide flat synclines. Geomorphologically, the state of Tripura represents the western fringe of typical “ridge and valley” province of the late Tertiary fold mountain belt, commonly known as Indo-Myanmar ranges (Purbanchal range). Five prominent roughly north south trending anticlinal strike ridges traverse the state from east to west; these are

[62] State of Environment Report of Tripura for the year of 2002: Geomorphology, Geology and Mineral Resources
[63] An anticline is a fold that is convex upward, and a syncline is a fold that is concave upward

Jampui, Sakhantlang, Longtarai, Athramura and Baramura. These strike ridges form the watershed of the Meghna basin of Bangladesh fed by Khowai, Haora, Juri, Manu, Dhalai, Deo, Longai, Muhuri, Feni and Gomoti rivers. Ten physiographic units have been identified by the Geological of India (1999) in the State of Tripura.[64] The physiography of Tripura is shown as Table 4-15 and the group of sediments during different geological ages are shown in Table 4-16 on litho-stratigraphy.

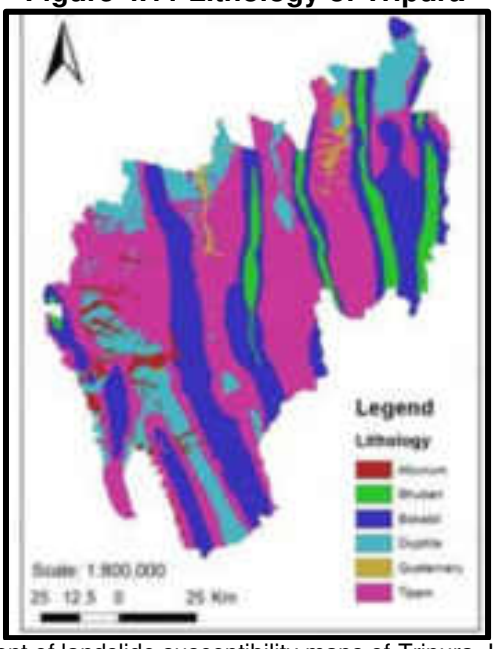
Table 4.15 Physiographic Unit of Tripura

1.	Steeping slopping and slightly dissected high relief structural hills and ridges exemplified by areas like Kailashahar, Panisagar, Baramura, Teliamura, etc.
2.	Moderately slopping with moderately dissected medium relief parallel ridges present in north and northeastern part of Tripura.
3.	Moderately slopping and highly dissected, low relief structural hills and ridges found in the north-west and southern part of the state.
4.	Moderately to gently sloping and moderately dissected flat topped denuded hill occurring in western, central and southern part of Tripura.
5.	Low lying residual hill with valley represented by Gonda charra area of southeastern part of Tripura.
6.	Undulatory plain with low mounds and gently sloping valley situated mostly in the western and southern part of Tripura.
7.	Moderately to gently sloping inter-hill valley with upland mostly occurring on the northern- eastern and southern part of the state.
8.	Moderately to gently slopping inter-hill valleys with alluvial upland plains, represented by Kumarghat-Chailengta area as alluvial deposit of river Manu.
9.	Rolling upland common in some pockets of the west and north-western part of Tripura.
10.	Flood plain constitutes an important area rornled by rivers of Tripura. Studied area Krishnakishore nagar and Jampuri fall under this group.

Source: Tripura ENVIS

[64] State of Environment Report, Tripura, 2020

Figure 4.11 Lithology of Tripura



Source: Nath et al. 2021 Development of landslide susceptibility maps of Tripura, India using GIS and analytical hierarchy process

Table 4.16 Stratigraphy of Tripura

Age	Group	Sub-Group	Formation	Rock Type
Holocene	Recent	-	Khowai Formation Ghilatoli Formation Teliamura Formation Kalyanpur Formation	Unconsolidated silt, and clay with decomposed vegetable matter and gravels
Quaternary	Dupitila	-	Dupitila Formation	Sandy clays, clayey sandstone, ferruginous sandstone with pockets of plastic clay, silica and laterite.
Upper Pliocene to Pleistocene Pliocene	Tipam	Tipam	Upper Tipam Formation Lower Tipam Formation	Sandstone, occasional sandy shale and abundant lumps of fossil wood Sandstone with laminated layers and lenses of sandy shale, siltstone and mudstone.
Micocene- Lr. Pliocene Upper most Oligocene	Surma	Bokabill Bhuban	Bokabil Formation 1. Upper Bhuban Formation 2. Middle Bhuban Formation 3. Lower Bhuban Formation (Not exposed in Tripura)	Thinly bedded repetition of sandstone, siltstone/shale, mudstone and ferruginous sandstone. Hard compact sandstone, olive shale, sandy shale and siltstone repetitions

Source: Tripura ENVIS

161. In Tripura, the mineral resources are mainly glass sands, limestone, plastic clay, and hard rock; all these materials are being used to a variable degree. However, the single most important resource in the state is oil and natural gas. ONGC or Oil and Natural Gas Commission has initiated massive exploration programme in the State. Of the total geographical area of Tripura, 76% can be marked as of “Tertiary” origin and 24% belong to Quaternary period; none of these contain any major mineral resource. A GSI Report of 1982 provide a list of non-metallic and metallic mineral vis-a-vis their location or otherwise in Tripura indicating the poor profile.

162. **Soils.** The soil types of Tripura can be classified under five major groups classified as per USDA Soil Taxonomy into four orders viz. Entisols, Inceptisols, Alfisols and Ultisols:

(i) Red loam and sandy loam soil (43.07% of the total area), normally associated with forest ecosystems and rich in nutrient but prone to erosion due to heavy rainfall

(ii) Reddish yellow brown sandy soils (33.06%), mostly distributed along north south axis and poor in nutrient

(iii) Older alluvial soils (9.71%), located in river terraces and high plains, the soil is rich in organic nutrient and suitable for arable farming but is predominantly under tropical forest cover

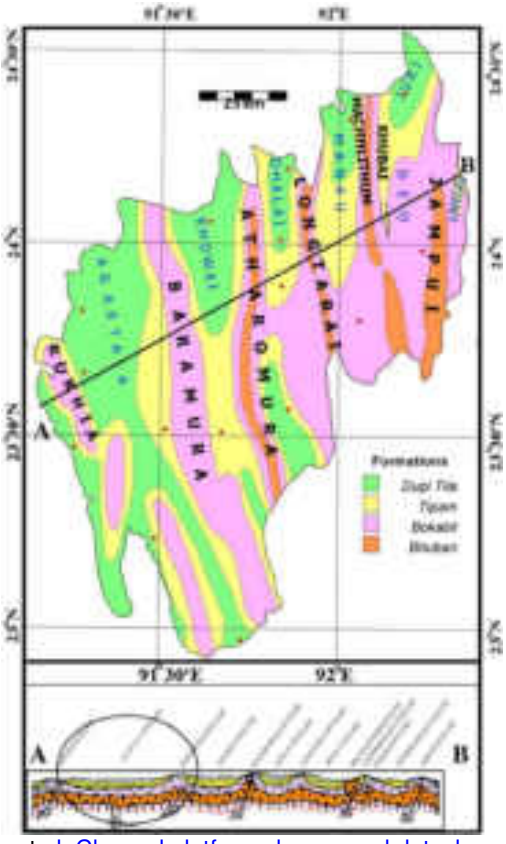
(iv) Younger alluvial soils (9.34%), mainly in the floodplains of rivers is composed of clay loam and loam, it is extremely rich and fertile due to impact of annual flooding

(v) Lateritic soils (4.86%), located in along the western boundary in the uplands, it is coarse in texture and has very poor in nutrients and supports scrubland and wild bushes.

Figure 4.12 Soil Map of Tripura Showing Distribution of Loam and Clay

Source: Nath et al. 202' Development of landslide susceptibility maps of Tripura, India using GIS and analytical hierarchy process

Figure 4.13 Geology of Tripura (Anticline and Syncline) Map



Source: July 2013, Bandopadhyay et al; Channel platform change and detachment of tributary: A study on the Haora and Kotakhal Rivers, Tripura, India

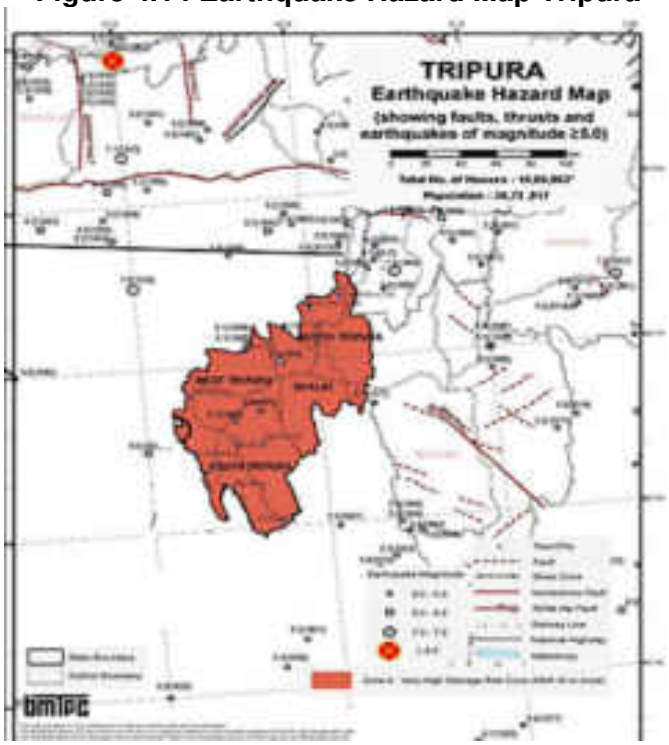
163. **Seismic Hazard.** Tripura is situated in north-eastern India, adjacent to the Himalayan belt that is seismically very active due to the convergent boundary of the Indian plate with the Eurasian plate. The Indian plate is currently moving towards the northeast at 5 cm per year. The fault line is a reverse fault, due to which subduction and over-thrust occur. Earthquakes of small to moderate magnitude therefore occur quite often, on average it has more than seven earthquakes a year that are greater than magnitude 5 on the Richter scale. The varying geology at different locations in India implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map was required to identify these regions. The seismic zone maps were prepared and revised from time to time as more understanding is gained on the geology, the seismotectonic and the seismic activity in the country. The latest map was published in 2002, and has only four seismic zones – II, III, IV and V.[65] The zonation is as per the estimated seismic intensity risk (Zone Factor). The zone factor is defined as maximum horizontal acceleration experienced by structure in that zone. For example, a seismic factor of 0.10 is the maximum horizontal acceleration experienced by a structure in this zone is 10%. The entire state of Tripura including the project site, falls in the seismic zone V (magnitude 7.0 to 7.5) as per Indian Standard Code (IS 1893 2002)[66] with a zone factor of 0.36 (36% horizontal acceleration), which signifies high risk severity of earthquake hazards in the region. This is considered Very High Damage Risk Zone (MSK IX or more) as shown in Figure 4-14. There is a history of numerous earthquakes occurring in the state, following being the prominent:

[65] http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf
[66] Revised IS Code for Earthquake Resistant Design of Structures IS 1893 (Part 1): 2002

(i) An earthquake occurred in 1918 with 7.6 magnitude on Richter scale.
(ii) A 5.7 magnitude earthquake occurred at Ambassa, Tripura on January 3, 2017, with a maximum observed intensity of 6-7. It struck at 2:39 pm and the estimated depth was 32 km.

164. The PAI is thus susceptible to high frequency of earthquakes. Earthquakes are quite frequent. Existing substation buildings are normally designed to be earthquake proof. However, cracks have been noted in some control buildings during the environmental audit. Poles of the distribution lines are also designed as per IS conditions, however, earthquakes can uproot poles and hence cause disturbances in the distribution line network. Since the PAI is in a seismic zone V new equipment and buildings will need to be installed on foundations that have proper seismic design.

Figure 4.14 Earthquake Hazard Map Tripura



Source: BMTPC Vulnerability Maps (3rd Edition), Government of India

1. **Landslides**. Tripura is in a seismically active zone; because of the inherent character of sediments of these areas even the minor shock during earthquake may cause devastating particularly landslides.[67] Some distribution components are in hilly and rolling terrain such as Vangmung Substation. Landslides in the hilly areas are quite common in the state. The landslide susceptibility of the state is classified as medium to low according to the information published by Global Facility for Disaster Risk Reduction. This means that Tripura has rainfall patterns, terrain slope, geology, soil, land cover and (potentially) earthquakes that make localized landslides an infrequent hazard phenomenon. Climate change is likely to alter slope and bedrock stability through changes in precipitation and / or temperature. It is difficult to determine future locations

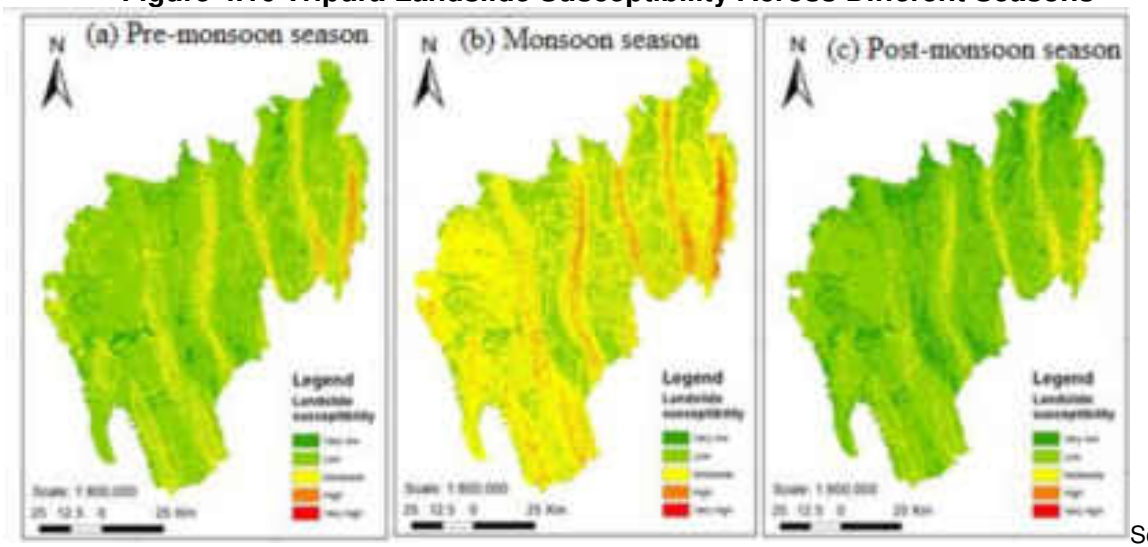
[67] http://trpenvis.nic.in/test/demography.html

and timing of large rock avalanches, as these depend on local geological conditions and other non-climatic factors. Landslide hazard risk profile of Tripura is shown in Figure 4-15.

Figure 4.15 Landslide Hazard Risk Profile of Tripura

Source: https://thinkhazard.org/en/report/1509-india-tripura/LS

Figure 4.16 Tripura Landslide Susceptibility Across Different Seasons



Source: Nath et al. 2021. Development of landslide susceptibility maps of Tripura, India using GIS and analytical hierarchy process

4. Climate and Climate Hazards

165. The climate of Tripura is characterized by a warm and humid tropical climate with five distinct seasons, namely, spring, summer, monsoon, autumn, and winter. Spring starts from late mid-February and continues till mid-March. Summer season starts from mid-March and reaches its peak in April–May and brings thunderstorms accompanied with rain to the state. Pre-monsoon rain is always experienced after Jhum harvesting (slash and burn agricultural practice) in the hills in March–April, these thunderstorms are known as 'Norwesters' or 'Kalbaisakhi' in local language. They generally move from northwest to southeast direction. Their duration may be from a few minutes to a few hours. This is the secondary rainy season of the state with nearly 30% of the annual rainfall. On average, thunderstorms occur more than 30 days in Tripura during this season. Sometimes thunderstorms are accompanied with squalls, with wind speed of more than 150 km per hour or hail. The south-west monsoon when the wind direction changes from northerly/north-westerly to southerly bringing humid air from the Bay of Bengal to the state generally breaks in the later part of May or first week of June and lasts until September. Occasionally there is no gap between the pre-monsoon and monsoon rain. Severe thunderstorm activity decreases but rainfall increases during this season. It is the main rainy season for the state with an average of more than 1300mm. It is about 60% of the annual rainfall. June is the rainiest month of the year with more than 400mm of average rainfall. The south-west monsoon is normally withdrawn from the state during mid-October. Rainfall decreases in the state from October. The temperatures also start decreasing. Winter sets in from November and is it coldest in the month of January. From November itself the weather becomes dry and light northerly surface winds are observed, but sometimes one or two cyclonic circulations in the Bay of Bengal bring some rainfall for 2–3 days during this season. Humidity is generally high throughout the year. In the summer season, due to the presence of Bay of Bengal to its south, the relative humidity varies from 50% to 74% whereas in the monsoon season it is over 85%.

166. In terms of Agro Climatic Profile, Tripura being a hilly and mountainous region, due to change in topographical features of the region, causes change in climatic conditions in the state. The state influences a monsoonal climate with the well demarcated sub-tropical and temperate zones. The climate along with the other factors of the terrain and the soil are suitable conditions for horticulture in the state of Tripura. The horticultural sector is dependent on the seasonal rainfall that dominates the seasons of Tripura. The longest season of the state is the monsoon season that continues between the months of May to mid October. Based on the variability in rainfall (P), Potential evapotranspiration (PE), actual evapotranspiration (AE), relation between P and PE, AE and PE and length of growing period (LGP) for normal cropping system, the entire terrain of Tripura has been divided into agro-ecological zones shown in Table 4-17.

Table 4.17 Agro-Climatic Zones of Tripura

Name of the ACZ	Area (ha)	Major Soils	Rainfall	Major Crops	Region
Mild Tropical plain zone	2,11,300	Inceptisols, Entisol, Ultisols	2,427 mm	Rice (Aus & Aman), Vegetable (Kharif & Rabi), pineapple, banana, arecanut	North
Mild Tropical plain zone	231,569	Inceptisols, Entisol, Ultisols	2,232 mm	Rice (Aus & Aman), Vegetable (Kharif & Rabi), pineapple, banana	Dhalia

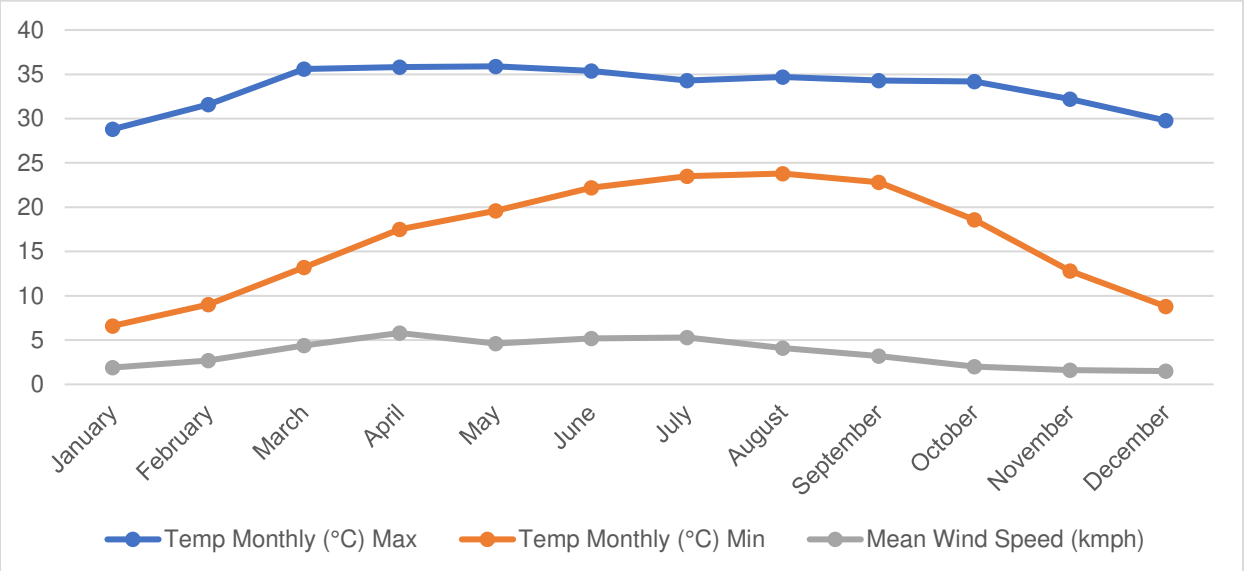
Name of the ACZ	Area (ha)	Major Soils	Rainfall	Major Crops	Region
Mild Tropical plain zone	305,000	Inceptisols, Ultisols, Alfisols	2,065 mm	Rice (Aman & Boro), vegetable (Kharif & Rabi), pineapple, mango, banana, coconut	West
Mild Tropical plain zone	301,300	Inceptisols, Entisol, Ultisols	2,678 mm	Rice (Aman & Boro), vegetable (Kharif & Rabi), pineapple, mango, banana, cashew nut, coconut	South

ACZ = Agro-Climatic Zones
Source: Dept. Of Agriculture, Government of Tripura, 2019

167. Overall Tripura observes moderately warm temperatures during summer and moderately cold temperatures during winter. January is the coldest month of the year, average minimum temperatures are around 10 degrees Celsius in this month. Temperatures start rising from March. The average maximum temperatures are around 32-33 degrees Celsius during this season with April being the warmest month of the year. The average maximum temperatures during the monsoon are around 31-32 degrees and minimum temperatures are around 24-25 degrees Celsius. With the withdrawl of the south-west monsoon and onset of winter the average maximum and minimum temperatures fall from 31 and 22 degrees in October to 26 and 11 degrees Celsius respectively in December.

168. IMD has two full time meteorological observatories in Tripura. One Meteorological Centre (MC) located at the state capital Agartala (23° 53´ N, 91° 15´ E) in West Tripura district and one Meteorological Observatory (MO) located at Kailashahar (24° 19´ N, 92° 00´ E) in Unakoti District. Besides, it also has part-time observatories across the state from which daily rainfall data are obtained.

Figure 4.17 Max/Min Temperature and Wind Speed Variation at Agartala (1981-2010)



Source: India Meteorological Department, Government of India

Table 4.18 Long-Term Climatologically Data-Agartala IMD Observatory (1915-2020)

Meteorological Centre: IMD Agartala
Location: near Maharaja Bir Bikram Airport, Agartala
Latitude: 23°53'N, Longitude: 91°15'E
Relative location: about 30 Km NNE of project site
Elevation: 15 m above MSL

Month	Temperature (° C)				Relative Humidity (%)		Rainfall (mm)		Mean Wind Speed (m/s)	Wind Direction: Predominant
	Daily Min. Mean	Daily Max. Mean	Lowest in Month	Highest in Month	Min	Max	Monthly mm	No. of Rainy Days		
January	10.5	25.2	6.6	28.8	71	83	7.6	0.8	0.5	N
February	13.9	28.2	9.0	31.6	60	75	22.1	2.1	0.8	N-S
March	18.9	31.7	13.2	35.6	57	70	69.4	3.3	1.2	S-SW
April	22.4	32.9	17.5	35.8	67	74	180.4	7.9	1.6	SE-S
May	23.4	32.6	19.6	35.8	74	78	362.9	13.3	1.3	SE-S
June	25.2	32.3	22.2	35.4	81	82	373.0	14.9	1.5	SE-S
July	25.2	31.6	23.5	34.3	82	83	344.0	15.8	1.5	SE-S
August	25.2	32.2	23.8	34.7	82	82	258.2	14.9	1.2	SE-S
September	24.6	31.8	22.8	34.4	83	84	225.1	12.2	0.9	SE-S
October	22.4	31.4	18.6	34.2	81	83	167.7	7.1	0.6	N-NE, S
November	17.1	29.6	12.8	32.2	79	81	36.2	1.2	0.5	N
December	12.1	26.6	8.8	29.8	78	82	11.0	0.7	0.4	N
Annual Mean or Total	**20.1**	**30.5**	**6.5**	**36.8**	**75**	**79**	**2057.5**	**94.3**	**3.5**	**SE-S**

Source: IMD, Agartala

Table 4.19 Annual Variations in Long-Term Meteorological Data 2015-2020

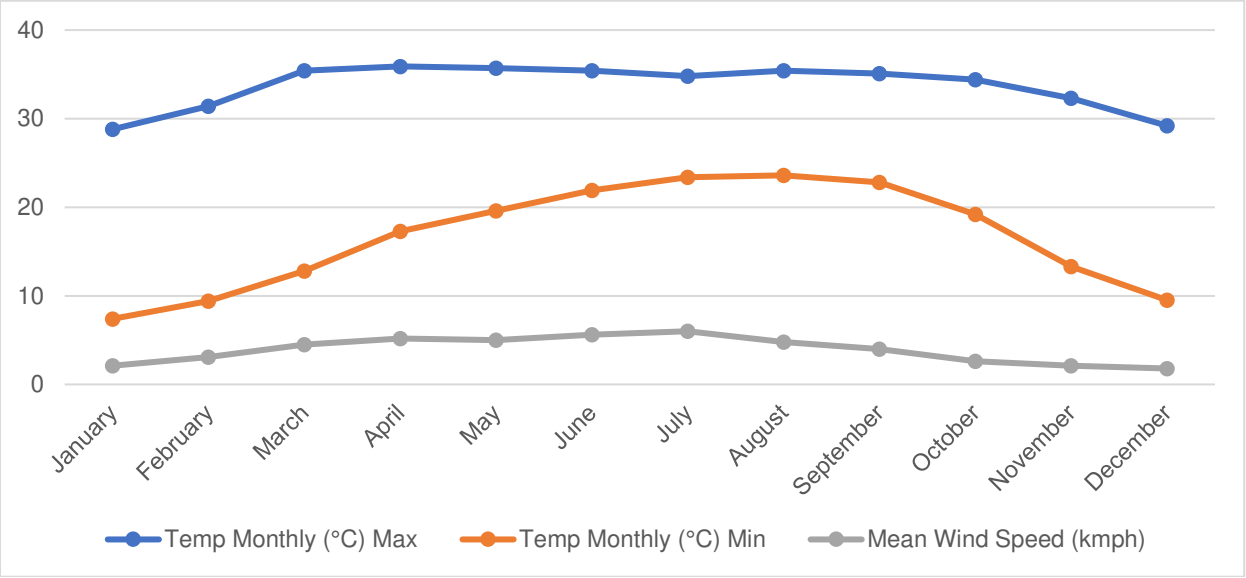
Meteorological Centre: IMD Agartala
Location: near Maharaja Bir Bikram Airport, Agartala
Latitude: 23°53'N, Longitude: 91°15'E
Relative location: about 30 Km NNE of project site
Elevation: 15 m above MSL

Year	Values	Temperature ^{0}C	Relative Humidity%	Wind Speed (km/h)	Wind Dir. (deg)	Precipi-tation (mm)	Atmos. Pressure	Cloud cover, octa	Mixing height, m
2015	Max	36.2	100.0	36.0	337.5	86.6	40.3	2.0	6000.0
	Mean	25.1	80.3	2.8	81.5	0.9	26.0	0.6	4507.6
	Min	8.2	0.0	0.0	0.0	0.0	8.1	0.0	1500.0
2016	Max	37.4	100.0	22.0	337.5	68.4	38.9	2.0	6600.0
	Mean	25.8	81.6	2.8	85.6	0.7	27.4	0.7	3284.9
	Min	7.6	0.0	0.0	0.0	0.0	9.8	0.0	1000.0
2017	Max	37.0	100.0	114.0	337.5	97.2	39.4	2.0	7500.0
	Mean	25.4	82.9	2.8	78.5	1.5	27.2	0.7	4400.7
	Min	6.6	24.0	0.0	0.0	0.0	8.7	0.0	0.0
2018	Max	39.4	100.0	20.0	337.5	236.2	46.9	2.0	6000.0
	Mean	25.0	81.1	1.9	71.2	1.1	26.0	0.6	4201.9
	Min	7.2	29.0	0.0	0.0	0.0	9.5	0.0	0.0
2019	Max	37.0	100.0	200.0	337.5	158.6	40.7	2.0	7500.0
	Mean	25.4	81.6	2.0	71.5	1.1	27.1	0.6	4580.0
	Min	9.0	28.0	0.0	0.0	0.0	10.5	0.0	0.0
2020 (up to May)*	Max	37.0	100.0	44.0	315.0	30.5	38.2	2.0	7500.0
	Mean	23.4	78.5	1.5	56.6	0.3	22.3	0.5	4371.5
	Min	8.2	17.0	0.0	0.0	0.0	8.9	0.0	1000.0

* Not used for assessment as complete year data not available
Source: MITCON Baseline Report for Rokhia power plant, 2021

169. Agartala generally experiences hot climatic conditions during summer and chilled weather during winter with mercury reducing to 6.6°C. SE and S were the predominant wind direction in Agartala Observatory. The total average annual rainfall at the observatory was about 2,057.5 mm.

Figure 4.18 Max/Min Temperature and Wind Speed Variation at Kailasahar (1981-2000)



Source: India Meteorological Department, Government of India

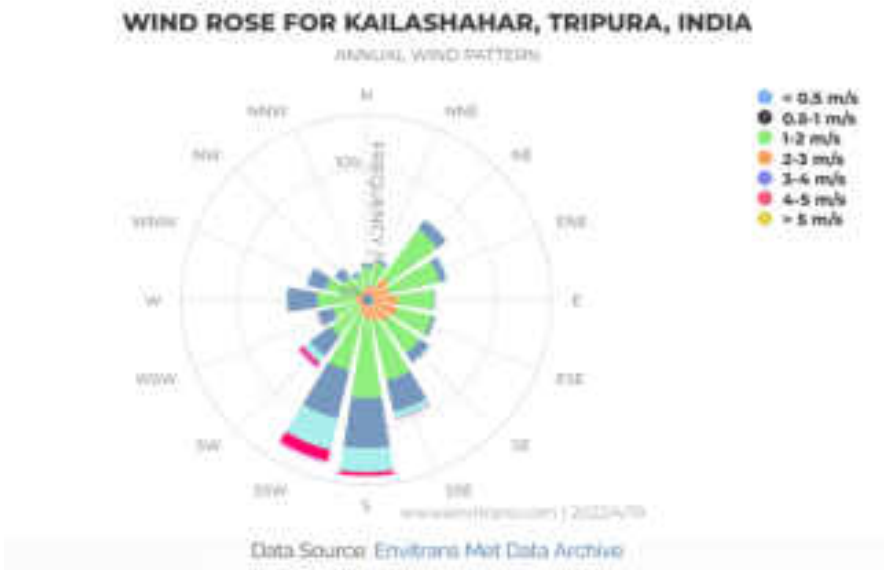
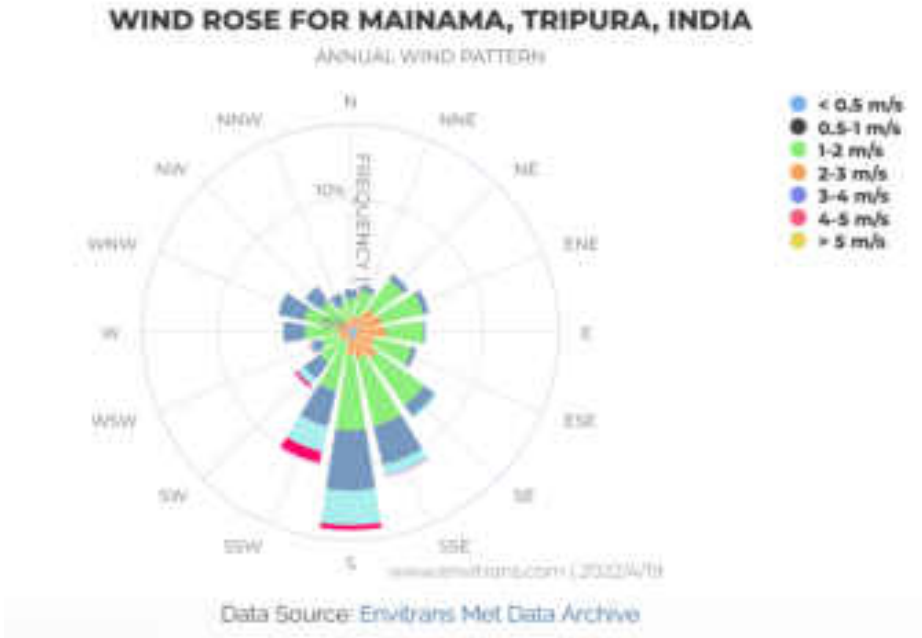
Table 4.20 Long-Term Climatologically Data–Kailasahar IMD Observatory (1981-2010)

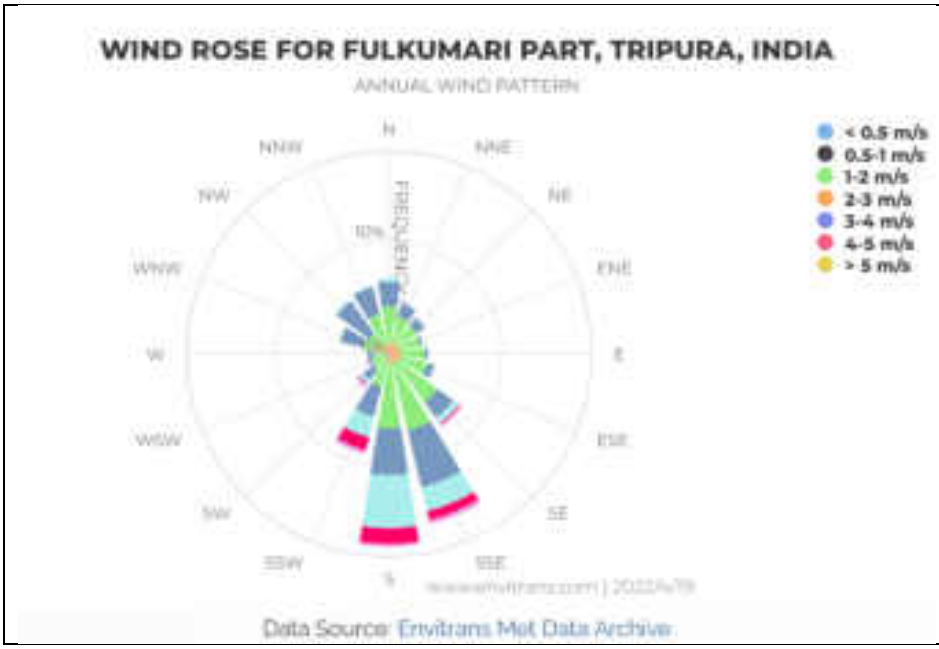
Month	Temp Monthly (°C)		Humidity (%)		Mean Wind Speed (kmph)	Dominant Direction (from)	Average Rainfall (mm)
	Max	Min	AM	PM			
January	28.8	7.4	87	69	2.1	S	8.3
February	31.4	9.4	81	59	3.1	S	41.9
March	35.4	12.8	75	57	4.5	S	109.3
April	35.9	17.3	78	69	5.2	S, SE	277.5
May	35.7	19.6	81	75	5	S, SE	455.9
June	35.4	21.9	84	83	5.6	S, SE	465.9
July	34.8	23.4	84	84	6	S, SE	380.2
August	35.4	23.6	85	83	4.8	S, SE	357.1
September	35.1	22.8	86	85	4	S, SE	306.9
October	34.4	19.2	86	83	2.6	S	166.7
November	32.3	13.3	85	80	2.1	S	29.7
December	29.2	9.5	86	76	1.8	S	16.8
Total / Average	36.8	7.5	**83**	**75**	**3.9**	**S**	2616.2

Source: Climatological Normals, 1981-2010, India Meteorological Dept., Govt. of India

170. Kailasahar generally experiences hot climatic conditions during summer and chilled weather during winter with mercury reducing to 7.4°C.SE and S were the predominant wind direction in Kailasahar Observatory. The total average annual rainfall at the observatory was about 2616.2 mm.

Figure 4.19 Wind Flow Pattern–Annual

	Kailashahar, Unnakoti District
	Manu, Dhalai District

	Udaipur, South Tripura District

5. Climatic Hazards[68]

171. **Temperature.** The highest ever temperature recorded at Agartala is 42^{0}C on 1 May 1960. Tripura is generally moderately cold, but on one occasion, the temperature recorded as 2^{0}C on 30 December 1972. the average annual mean maximum temperature time series has shown no trends in Tripura during 1951-2010. Averaged annual mean minimum temperatures have shown significantly increasing trends of +0.02 ºC/year during the same period. Annual mean diurnal temperature range (DTR) trends have significantly decreased at -0.02 ºC/year.

172. **Rainfall.** The highest one-day rainfall recorded was 257.2 mm on 22 May 1993.[69] State averaged annual rainfall trend, winter season rainfall trend and summer season rainfall trend have increased over Tripura while decreasing trends have been observed over Tripura in monsoon and post monsoon rainfall. Figures 4-20 and Figure 4-21 show the trends in district rainfall over Tripura. There is no significant trend in any districts for any of the southwest monsoon months or the southwest monsoon season. A significant decreasing trend is seen only in Dhalai district for annual.

173. **Wind Hazard and Cyclones.** The state is categorized as cyclonic as it experiences cyclonic winds at speeds up to 198 km/hour. The seasonal cyclone occurs during April and May and during October and November. Sometimes the cyclonic winds pass the state after originating from the Bay of Bengal and after crossing Bangladesh. Because Tripura state is surrounded by Bangladesh and aerial distance to Bay of Bengal is less than 100 km, the entire landmass of the State is also prone to high wind and cyclone zone-A which is very high-risk zone as shown in Figure 4-22.[70] Even though the intensity of the cyclones decreases after making landfall from the sea, it is sufficient to wreak havoc in the state especially disrupting the power sector. Historically cyclones have impacted the state in 2005 (Kailashahar), 1997 (Udaipur, Amarpur, Belonia,

[68] ADB Climate Risk and Vulnerability Assessment, 2021
[69] https://agartala.imd.gov.in/Tripura-Climatology/#:~:text=Month%20wise%20extreme%20temperature%20and,mm%20on%2022nd%20May%201993.
[70] Tripura State Action Plan on Climate Change, Government of Tripura

Shantirbazar and Sabroom), 2002 -2003 (Teliamura and Sonamura), 1994, 1997, 1998 1998, 1999, 2001, 2002 & 2003 (Dhalai district, Manu and Chawmanu areas were impacted). A large part of the state was impacted due to seasonal cyclonic rainstorms in April 2015 wherein outages caused areas to be in the dark as power transmission lines snapped for many hours due to heavy rains coupled with strong winds. Orange alerts were issued by IMD, Agartala in the recent past on 30th June 2021 regarding heavy storms and rainfall.' IMD had also issued bulletins for Cyclone Amphan in May 2020 for Sabroom area in South Tripura though not much impact has been recorded.

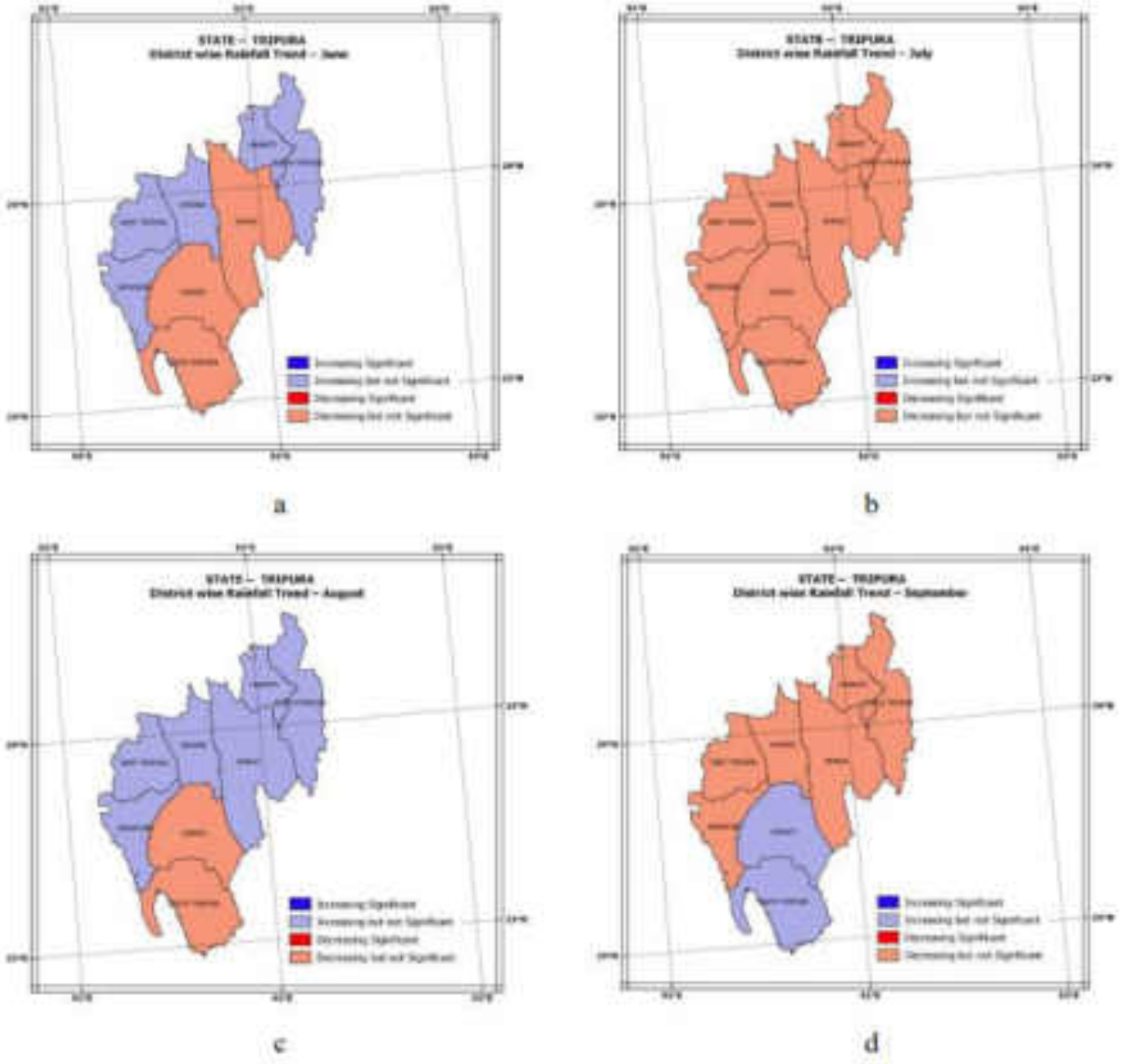
174. **Drought.** Although drought is not a periodic calamity in the state, it does occur at times such as the dry spell of 1988-99. Caused by extremely low rainfall, the drought of December 1988-April 1999 resulted in extensive damage to crops. The rainfall during this period was as low as 54.6mm while the usual average for the corresponding period is 286.6mm. Summer vegetables, paddy, sesamum, and maize were among the crops damaged. The damage of Rs 1397.3 million caused by debilitating drought seriously affected the state's economy, the agricultural sector.

175. **Flood**. 750 km^2 of land area of Tripura is flood prone. Nearly all the rivers are rain-fed and are prone to flood. North, South, Dhalia and West Tripua district faces flash floods annually during the monsoon season i.e., June to September accompanied with other hazards like landslide. During the past twenty-five years, two massive floods occurred in 1999 and 2004 causing huge economic cost. The 1999 floods followed incessant rain that was almost double the normal rainfall and it was extremely heavy during 8-12 of July resulting in the floods. The damage was particularly severe in South Tripura and West Tripura districts. Gumti River turned immensely destructive, and the total damage caused by this flood was estimated at Rs 498.5 million. Two episodes of devastating floods also occurred in June/July and September 2004, following unprecedented rainfall. While the usual average rainfall in North District during the month of July is 700.9 mm, in 2004 it was 2,102.8 mm; whereas the usual average for South Tripura in the month of September is 298.4 mm, in 2004 it was as high as 1,491.8 mm.[71] In the recent past, frequent flooding has been observed, August and November 2002, May and June 2003, June 2004, September 2005, June to November 2007, March and April 2010, May 2011, May 2013.[72]

[71] Tripura State Pollution Control Board, http://trpenvis.nic.in/test/disaster.html

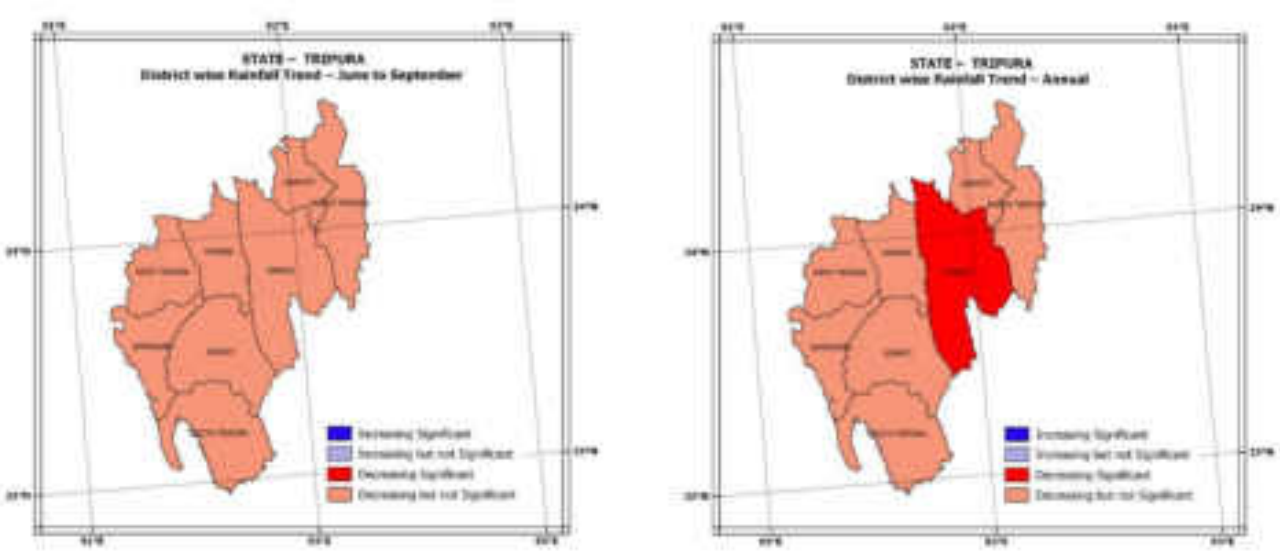
[72] https://www.rkvy.nic.in/static/SAP/TR/For%20this%20Period(2017-18%20to%202019-20)/SAP%20Tripura%20Report_LD.pdf

Figure 4.20 Rainfall Trends in Tripura for the Monsoon Months



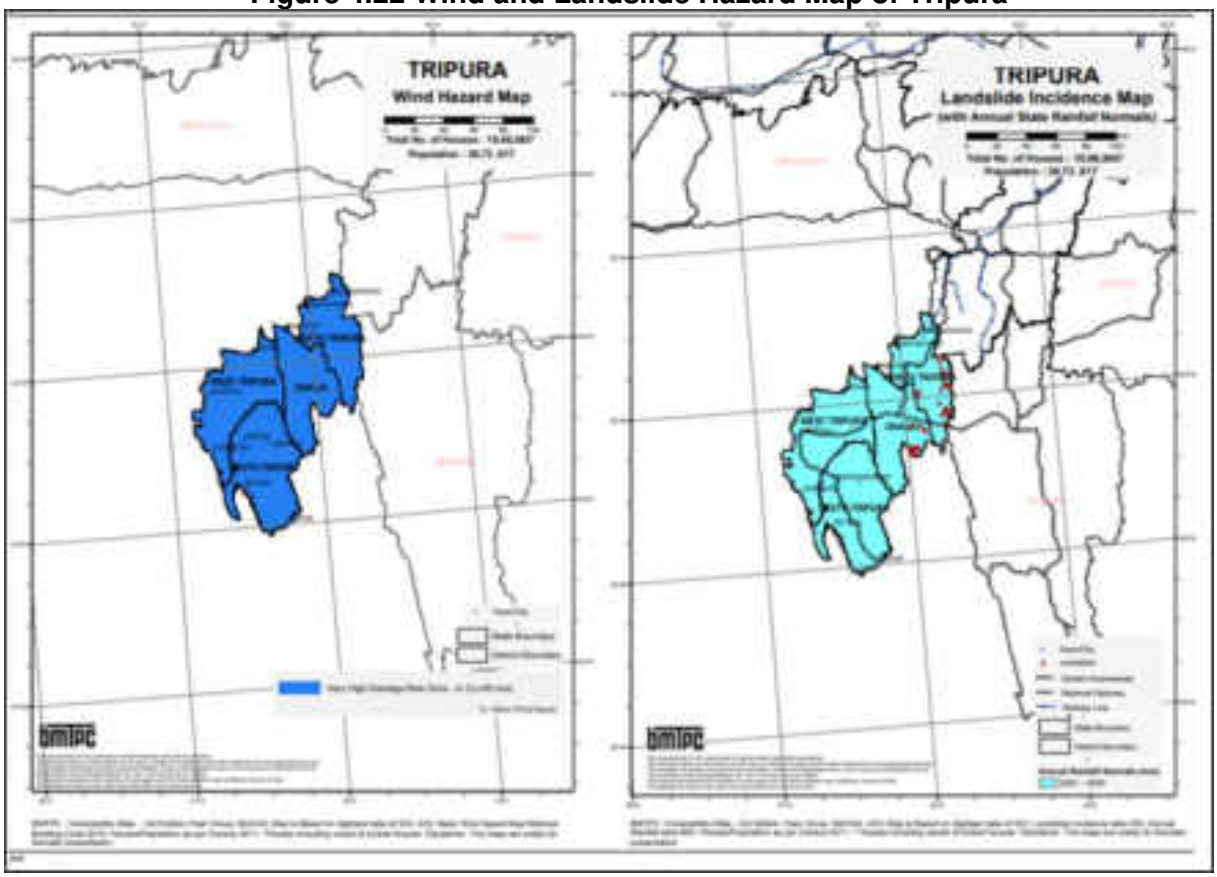
Source: https://imdpune.gov.in/hydrology/rainfall%20variability%20page/tripura_final.pdf

Figure 4.21 Rainfall Trend in Tripura–Total Monsoon Period (June–September) and Annual



Source: https://imdpune.gov.in/hydrology/rainfall%20variability%20page/tripura_final.pdf

Figure 4.22 Wind and Landslide Hazard Map of Tripura



Source: BMTPC https://bmtpc.org/DataFiles/CMS/file/Publication/VAI_3rd2019.pdf

Hydrology and Water Resources

1. Hydrology

176. The State of Tripura is well endowed with surface water resources. As many as ten major rivers is reported to generate an annual flow of 793 million cubic meter of water. The total volumes of surface water generated in Tripura largely depend on rainfall. All rivers are rainfed and ephemeral in nature. All major rivers originate from hill ranges and show a typical drainage pattern called trellis, except a few instances of dendrite pattern, and flow either in a northerly or westerly direction through narrow valleys towards Bangladesh. The north flowing rivers are Khowai, Dhalai, Manu with Deo as its tributary, Juri and Longtrai while the Gumti and Haora flow to the west and the rivers Muhuri and Feni flow to the southwest. Each valley is drained by a river with several perennial and ephemeral streams joining to produce a dendritic drainage pattern. Table 4-21 provides a synopsis of the rivers. Collectively the basin area of these ten major rivers and other minor streams covers nearly 10,500 square km. In terms of percentage of the basin of individual rivers vis-a-vis, total basin area, Gumti (22.66%) is followed by Manu-Deo (18.36%) and Khowai (13.13%).

177. During the dry season all the major rivers are fed by ground water and maintain certain base flow. Run-off essentially depends on various factors like intensity and duration of rainfall, its distribution, extent of the catchment area, vegetative cover, relief and slope. Figure 4-18 shows the drainage density map of Tripura. More than 67.5% of the total flow is carried by Gumti (249 mcm), Manu (170 mcm) and Khowai (115 mcm) rivers. While other rivers carry 32.5% of the total surface flow. The highest flow rate of surface water is recorded for Gumti (1.05 lakh cubic meter) and the lowest being on Burima river (0.2 lakh cubic meter). The available data indicates that all the rivers originating in the hill ranges can cause floods in heavy rainfall. Flood levels from at least five of the major rivers show that the danger may vary from 1.48 m for Haora River near Agartala to 31.50 m for Dhalai river near Kamalpur.[73]

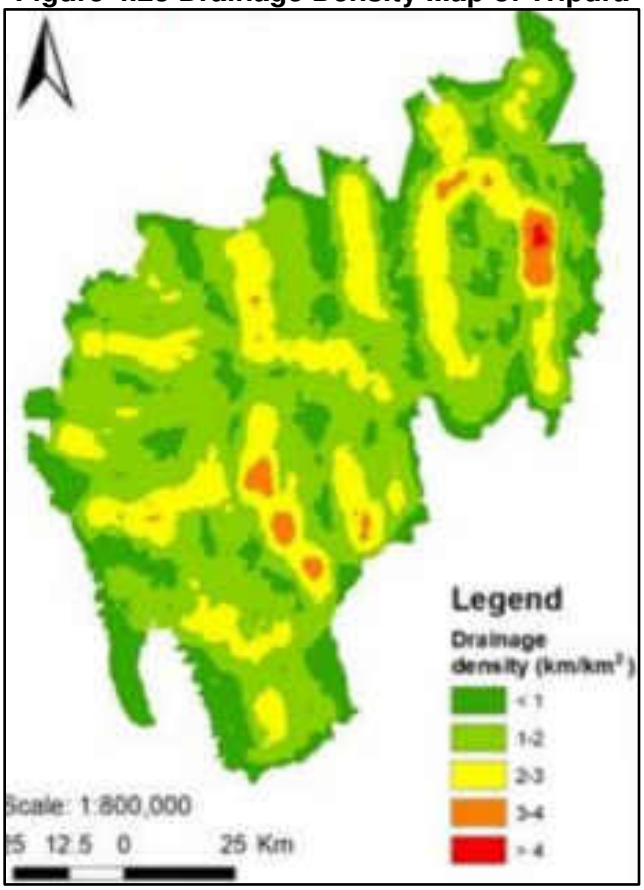
Table 4.21 Rivers of Tripura

River	Origin and Flow
Longai	Jampui Hill Northerly flow 98 km long
Juri	Jampui Hill Northerly flow through Dharmangar valley
Deo	Jampui Hill Northerly flow through Kanchanpur valley, meets Manu river 98 km long
Manu	Sakhan range Northerly flow via Kailasahar to Bangladesh 167 km long
Dhalai	Longtharai range Northerly flow via Kamalpur to Bangladesh 117km long
Khowai	Longtharai range North-west flow and then northerly via Khowai town to Bangladesh 70km long
Haroa	Baramura range Westward flow via Agartala to Bangladesh 53 km long
Gumti	Longtharai and Atharamura range Flow westward via Amarpur, Sonamura to Bangladesh
Muhuri	Deotamura range Westward flow via Belonia to Bangladesh 64 km long
Fenni	Originate at the border by confluence of three streams, of which Asalong is the main channel

Source: State of the Environment, Tripura, 2020

[73] http://trpenvis.nic.in/test/surface_water.html

Figure 4.23 Drainage Density Map of Tripura



Source: Nath et al. 2021. Development of landslide susceptibility maps of Tripura, India using GIS and analytical hierarchy process

2. Hydrogeology and Ground Water Resources

178. The existence of tappable aquifers is the combined effect of the topography, lithology, and soil types. Aquifers in the study area are generally of two types: shallow aquifers (upto 30m) and deep aquifers (> 30m). Shallow aquifers are unconfined or semi-confined. Shallow aquifers can be contaminated by the seepage of polluted water and leaching of waste. Deep aquifers are under confined conditions and are tapped by deep bore wells for domestic and industrial purposes like brick fields. Water tables are sub-parallel to land surface and follow the topographic slopes.

179. Physiographically the northeastern region can be subdivided into several units each with distinctive characteristics. Hydrological condition is correlated with geomorphic units, which in turn can provide reliable data on groundwater. Of the various groups of rocks found, Tipam sandstones are considered the main producer aquifer. This formation consists of sub-rounded, fine to medium grained, friable sandstone with intercalated clay. The permeability of this sandstone is much higher than that of Dupitila sandstone or Surma sandstone. Tipam formation is found in most of the valleys. Extensive hydrological surveys carried out by the Central Groundwater Board in almost all the valleys of Tripura revealed three to four major aquifers within 259m in depth. Such thickness varies from valley to valley but decreases considerably in the synclinal valleys of Kamalpur, Kailashsahar and Dharmanagar. The anticlinal hills intervening the synclinal valley not only act as ground water divides but the sandy formations exposed therein act as recharge zone. Since the recharge area lies in the anticlinal hills, favorable artesian

conditions occur whenever good thickness of impermeable clay beds underline and overlie the saturated granular zones. Ground water occurs under semi-confined to confined conditions.

180. This sandstone is developed by deep tubewells and shallow tubewells. Flowing conditions with auto-flow of 100 to 3000 liters per hour are found mainly in the central part of most of the synclinal valley of Tripura. High auto-flow discharge of 54 m^3/hr is observed in Khowai valley.

3. Water Resources

181. Groundwater in the state of Tripura is primarily used for agriculture, drinking and other domestic purposes. No groundwater exploitation is being reported by Water Resource Investigation Department at state level (Table 4-22). There are no notified areas for regulation of ground water development as per Central Ground Water Authority. The water stress map of the state as per water risk atlas prepared by World Resource Institute shows that the water stress is less than 10%.

(i) Water Stress which measures total water withdrawals to available renewable surface and groundwater supplies – Low (<10%)

(ii) Water Depletion, which measures the baseline water depletion, ratio of total water consumption to available renewable water supplies – Low (<5%)

(iii) Seasonal Variability which measures the average within-year variability of available water supply, including both renewable surface and groundwater supplies. Higher values indicate wider variations of available supply within a year – Medium High (0.66-1.00)

(iv) Drought risk measures where droughts are likely to occur, the population and assets exposed, and the vulnerability of the population and assets to adverse effects. Higher values indicate higher risk of drought – Medium High (0.6-0.8)

Table 4.22 Ground Water Resources of Tripura (2018)

Parameter	
Annual Replenishable Ground Water Resource	2.19 BCM
Net Annual Ground Water Availability	1.97 BCM
Annual Ground Water Draft	0.17 BCM
Stage of Ground Water Development	9 %
Ground Water Development and Management	
Over Exploited	NIL
Critical	NIL
Semi- critical	NIL
Ground water User Maps	4
Artificial Recharge to Ground Water (AR)	Feasible AR structures: 300 check dams, 500 weirs, 1000 gabion structures, 240 roof top harvesting, 100 developments of springs
Ground Water Quality Problems	
Iron (>1.0 mg/l)	Districts affected (in part) = Dhalai, North Tripura, South Tripura, West Tripura.

BCM: Billion cubic metres
Source: CGWB, Government of India http://cgwb.gov.in/AQM/NAQUIM_REPORT/Tripura/NAQUIM%20Report-West%20Tripura.pdf

182. The entire surface water from the state can be categorized as class 'C' (drinking water source with conventional treatment followed by disinfection) as per classification of Inland Surface Water Standards of CPCB as per a report prepared by National Environmental Engineering Research Institute in December 2014 which was sponsored by TPCB wherein samples from a total of 43 surface water locations were collected. The locations included 4 in Unakoti district including Deo River, 4 locations in North Tripura district including Longai river, 6 locations in Dhalai district including Dhalai and Manu rivers, 5 locations in Khowai district including Khowai river, 7 locations including Dhalai river in West Tripura district, 7 locations in Gomti district including Gomati River, 4 locations in Sepahijala District and 6 locations in South Tripura District. Overall, the pH varied between neutral to alkaline, total dissolved solids varied from 28- 179 mg/l, the values dissolved oxygen (DO) were in the range of 4.1-5 mg/l and presence of coliform was noted. Almost all the districts are affected with iron contamination in the ground water.

Figure 4.24 Water Stress Map of Tripura and Surrounding Region

Source: WRI Aqueduct 2019

183. To obtain a baseline localized to the PAI samples for ground water quality (10 samples) and surface water quality (seven samples) water quality assessment were collected from/near selected substations and analyzed. Location of water sampling are provided in Table 4-23 and Figure 4-25.

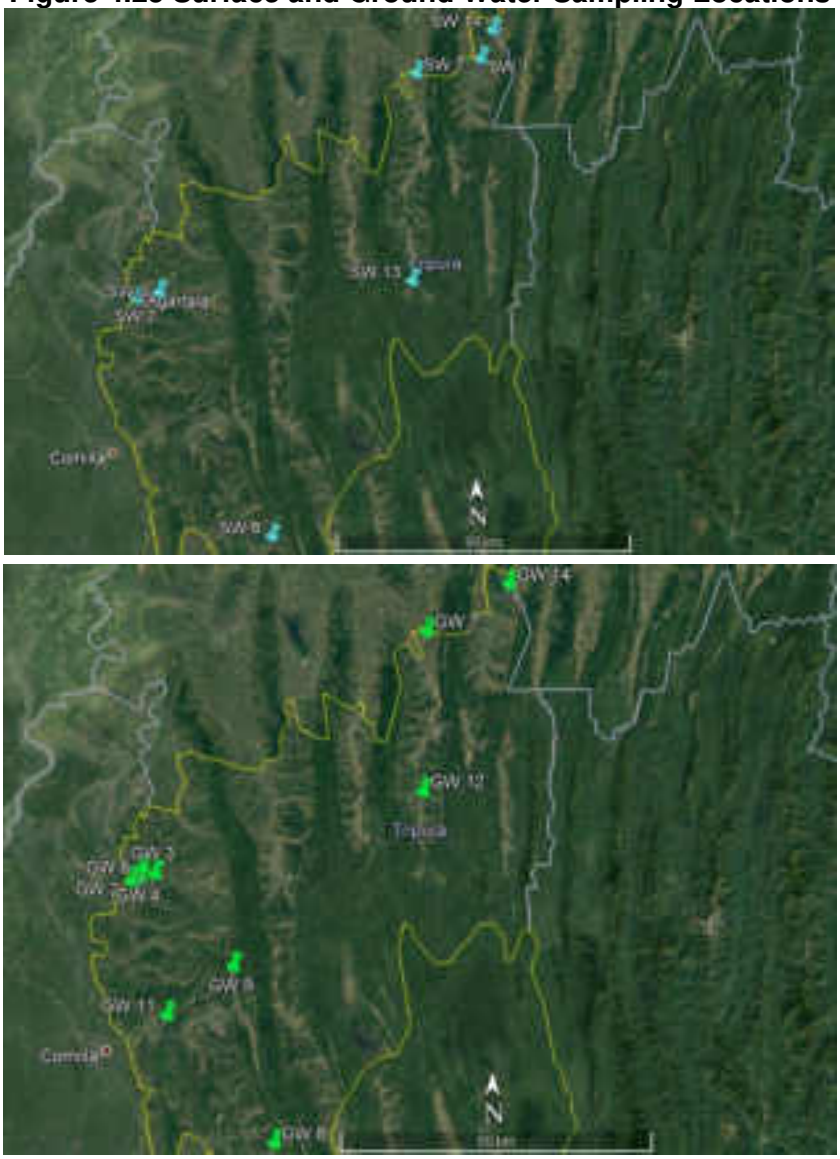
Table 4.23 Surface and Ground Water Sample Site Details

Sample Code	Sampling Location (Substation)	Latitude	Longitude	Type	Justification
Surface water					
SW.1	Digalbagh	24°23'12.33"N	92°10'29.14"E	Pond	• Civil work for bay extension and R&M, cable trench for R&M • End point for new 33kV underground
SW.2	Charipara	23°47'57.26"N	91°15'7.18"E	Pond	• Civil work for bay extension to new substation • End point for new 33kV underground
SW.3	Adharsha Colony	23°48'53.99"N	91°18'44.71"E	Pond	• Civil work for bay extension • End point for new 33kV underground
SW.7	Tillabazar	24°21'5.24"N	92° 0'3.03"E	Pond	• New substation; civil work for bay extension • End point for new 33kV underground
SW.8	Jolaibari	23°13'8.91"N	91°36'57.74"E	Pond	• Pond immediately adjacent to substation boundary • Sample site in South Tripura
SW.13	Chhawmanu	23°50'40.87"N	91°59'26.14"E	Pond	• Civil work / cable trench for R&M • Sample site in Dhalai District
SW.14	Kadamtala	24°27'28.27"N	92°12'21.98"E	Pond	• Civil work / cable trench for R&M
Ground water					
GW.2	Charipara	23°47'55.10"N	91°15'6.86"E	Hand-pump	• New substation; civil work for bay extension • End point for new 33kV underground • Handpump within substation • Nearest houses use ground water
GW.3	Adharsha Colony	23°48'52.03"N	91°18'43.80"E	Hand-pump	• Civil work for bay extension • End point for new 33kV underground • Nearest residence uses handpumps
GW.4	Stadium, Agartala	23°48'31.45"N	91°16'31.93"E	Hand-pump	• Civil work for bay extension • Residents use handpumps located in house compounds
GW.6	NSRCC, Agartala	23°49'37.56"N	91°16'45.38"E	Hand-pump	• Civil work for bay extension • End point for new 33kV underground • Nearest house handpump
GW.7	Tillabazar	24°21'7.20"N	92° 0'1.03"E	Hand-pump	• New substation; civil work for bay extension • End point for new 33kV underground • Handpumps in residences within 50m
GW.8	Jolaibari	23°13'8.50"N	91°36'57.10"E	Hand-pump	• Handpump within substation • Nearest residences use hand pumps • Sample site in South Tripura
GW.9	Killa	23°36'40.70"N	91°30'42.72"E	Open-well	• Handpump at nearest houses
GW.11	Melaghar	23°30'6.01"N	91°20'40.10"E	Hand-pump	• Civil work / cable trench for R&M • Handpump in nearest houses
GW.12	Manu	23°59'55.28"N	91°59'25.48"E	Hand-pump	• Civil work / cable trench for R&M • Handpump located in 50m from substation

Sample Code	Sampling Location (Substation)	Latitude	Longitude	Type	Justification
					• Sample site in Dhalai District
GW.14	Kadamtala	24°27'28.12"N	92°12'29.56"E	Hand-pump	• Civil work / cable trench for R&M. • Nearby residents use handpumps

Source: ADB TA Consultant

Figure 4.25 Surface and Ground Water Sampling Locations



Source: MITCON

184. The water samples were collected by MITCON (consultants for TSECL) an MOEF&CC accredited organization and were analyzed in their laboratory. The result was compared against IS 10500: 2012 for drinking water standards and results are provided as Table 4-24 and Table 4-25. The above water samples are not complying with the required limits of all the parameters as per IS 10500:2012. The surface water and groundwater are contaminated with coliform and so

is not suitable for drinking without undergoing adequate treatment. Otherwise, the parameters are complied with including iron and with no oil or PCB pollution in groundwater.

Table 4.24 Surface Water Quality

Sr. No.	Parameters	Units	Wildlife and Fish*	IS: 10500:2012 Acceptable (Permissible) Limits	SW.1 Digalbagh	SW.2 Charipara	SW.3 Adharsha Colony	SW.7 Tillabazar	SW.8 Jolaibari	SW.13 Chhaw-manu	SW.14 Kadamtala
CHEMICAL POTABILITY											
1	pH at 25°C	-	6.5-8.5	6.5 to 8.5	6.98	7.02	6.97	7.05	7.07	7.15	7.37
2	Electrical Conductivity at 25°C	µS/cm	-	-	168.5	175.4	43.01	72.51	200.7	166.3	55.59
3	Temperature	^{0}C	-	-	25.6	25.6	25.6	25.6	25.6	25.6	25.6
4	Total Dissolved Solids	mg/l	-	500 (200)	124	143	34	57	165	138	30
5	Turbidity	NTU	-	1(5)	1.5	1.7	1.4	1.6	1.8	1.2	1.1
6	Dissolved Oxygen	mg/l	>4	-	4.9	4.7	5.0	4.4	4.1	4.3	4.2
7	Oil & Grease	mg/l	-	-.	< 5	< 5	< 5	< 5	< 5	< 5	< 5
8	Total Solids	mg/l	-	-	132	152	40	64	174	143	35
9	Color	Hazen	-	5 (15)	< 5	< 5	< 5	< 5	< 5	< 5	< 5
BACTERIOLOGICAL POTABILITY											
1	Total Coliforms	MPN./100 ml	-	Shall not be detectable in any 100ml sample	80	60	70	90	80	80	50
2	Fecal coliform	MPN./100 ml	-	Shall not be detectable in any 100ml sample	40	30	30	40	30	50	30

* https://cpcb.nic.in/wqm/Designated_Best_Use_Water_Quality_Criteria.pdf
NTU = Nephalo Turbidity Unit
Source: MITCON

Table 4.25 Ground Water Quality

Sr. No.	Parameters	Unit	IS: 10500:2012 Required	GW.2 Charipara	GW.3 Adharsha Colony	GW.4 Stadium	GW.6 NSRCC	GW.7 Tillabazar	GW.8 Jolaibari	GW.9 Killa	GW.11 Melaghar	GW.12 Manu	GW.14 Kadamtala
ORGANOLEPTIC & PHYSICAL PARAMETERS													
1	Colour	Hazen	≤ 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	pH at 250C	-	6.5 to 8.5	6.88	6.74	6.65	6.68	6.71	6.68	6.75	6.69	6.89	7.04
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	NTU	≤ 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
6	Total Dissolved Solids	mg/l	≤ 500	68	72	80	91	86	50	112	54	66	118
GENERAL PARAMETERS CONCERNING SUBSTANCES UNDESIRABLE IN EXCESS AMOUNTS													
7	Aluminium (as Al)	mg/l	≤ 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
8	Ammonical Nitrogen (as N)	mg/l	≤ 0.5	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
9	Anionic detergents (as MBAS)	mg/l	≤ 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
10	Barium (as Ba)	mg/l	≤ 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
11	Boron (as B)	mg/l	≤ 0.5	< 0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
12	Calcium (as Ca)	mg/l	≤ 75	5.66	< 5	8.09	< 5	12.14	5.66	8.09	3.23	6.47	9.71

Sr. No.	Parameters	Unit	IS: 10500:2012 Required	GW.2 Charipara	GW.3 Adharsha Colony	GW.4 Stadium	GW.6 NSRCC	GW.7 Tillabazar	GW.8 Jolaibari	GW.9 Killa	GW.11 Melaghar	GW.12 Manu	GW.14 Kadamtala
13	Chloramines (as Cl2)	mg/l	≤ 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
14	Chloride (as Cl)	mg/l	≤ 250	12.99	13.99	14.99	15.99	10.99	7.49	24.49	9.99	13.49	25.99
15	Copper (as Cu)	mg/l	≤ 0.05	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
16	Fluoride (as F)	mg/l	≤ 1.0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
17	Residual Chlorine as Cl	mg/l	≤ 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
18	Iron as Fe)	mg/l	≤ 0.3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
19	Magnesium (as Mg)	mg/l	≤ 30	3.43	2.94	2.45	5.40	<1	1.47	5.89	1.96	2.45	6.38
20	Manganese (as Mn)	mg/l	≤ 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
21	Mineral Oil	mg/l	≤ 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
22	Nitrate (as NO3)	mg/l	≤ 45	1.08	1.19	1.27	1.39	1.47	<1	<1	<1	<1	<1
23	Phenolic Compounds (as C6H5OH)	mg/l	≤ 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
24	Selenium (as Se)	mg/l	≤ 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
25	Silver (as Ag)	mg/l	≤ 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
GENERAL PARAMETERS CONCERNING SUBSTANCES UNDESIRABLE IN EXCESS AMOUNTS													
26	Sulphate (as SO4)	mg/l	≤ 200	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
27	Sulphide (as H2S)	mg/l	≤ 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
28	Total Alkalinity (as CaCO3)	mg/l	≤ 200	18.09	20.1	16.08	24.12	26.13	22.11	40.2	15.07	19.09	46.23
29	Total Hardness (as CaCO3)	mg/l	≤200	28.30	24.25	30.32	32.34	34.36	20.21	44.47	16.17	26.28	50.54
30	Zinc (as Zn)	mg/l	≤ 5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Sr. No.	Parameters	Unit	IS: 10500:2012 Required	GW.2 Charipara	GW.3 Adharsha Colony	GW.4 Stadium	GW.6 NSRCC	GW.7 Tillabazar	GW.8 Jolaibari	GW.9 Killa	GW.11 Melaghar	GW.12 Manu	GW.14 Kadamtala
PARAMETERS CONTAINING TOXIC SUBSTANCES													
31	Cadmium (as Cd)	mg/l	≤ 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
32	Cyanide (as CN)	mg/l	≤ 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
33	Lead (as Pb)	mg/l	≤ 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
34	Mercury (as Hg)	mg/l	≤ 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
35	Molybdenum (as Mo)	mg/l	≤ 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
36	Nickel (as Ni)	mg/l	≤ 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
37	Poly Chlorinated Biphenyls (PCBs)	mg/l	≤ 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
38	Poly Nuclear Aromatic Hydrocarbon (as PAH)	mg/l	≤ 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
39	Total Arsenic (as As)	mg/l	≤ 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
40	Total Chromium (as Cr)	mg/l	≤ 0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
41	Thrihalomethanes:												
a)	Bromoform	mg/l	≤ 0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
b)	Dibromochloro methane	mg/l	≤ 0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
c)	Bromodichloro methane	mg/l	≤ 0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Sr. No.	Parameters	Unit	IS: 10500:2012 Required	GW.2 Charipara	GW.3 Adharsha Colony	GW.4 Stadium	GW.6 NSRCC	GW.7 Tillabazar	GW.8 Jolaibari	GW.9 Killa	GW.11 Melaghar	GW.12 Manu	GW.14 Kadamtala
d)	Chloroform	mg/l	≤ 0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
42	Parameters Concerning Radioactive Substances												
i)	Alpha emitter	Bq/l	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ii)	Beta emitter	Bq/l	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDE RESIDUES LIMITS AND TEST METHOD													
43	Alachor	µg/l	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44	Atrazine	µg/l	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
45	Aldrin/Diedrin	µg/l	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
46	Alpha HCH	µg/l	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
47	Beta HCH	µg/l	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
48	Butachlor	µg/l	125	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
49	Chlorpyriphos	µg/l	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
50	delta HCH	µg/l	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
51	2,4-Dichlorophenoxyacetic acid	µg/l	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
52	DDT (o, p and pp-Isomers of DDT and DDE and DDD)	µg/l	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
53	Endosulphan (alpha, beta, and Sulphate)	µg/l	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54	Ethion	µg/l	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
55	Gamma-HCH-Lindane	µg/l	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
56	Isoproturon	µg/l	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
57	Malathion	µg/l	190	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
58	Methyl parathion	µg/l	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
59	Monocrotophos	µg/l	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Sr. No.	Parameters	Unit	IS: 10500:2012 Required [illegible]	GW.2 Charipara	GW.3 Adharsha Colony	GW.4 Stadium	GW.6 NSRCC	GW.7 Tillabazar	GW.8 Jolaibari	GW.9 Killa	GW.11 Melaghar	GW.12 Manu	GW.14 Kadamtala
60	Phorate	µg/l	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BACTERIOLOGICAL POTABILITY													
61	Total Coliform	MPN. / 100ml	Absent	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
62	E. coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

DDD = dichlorodiphenyldichloroethane, DDE = dichlorodiphenyldichloroethylene, DDT = dichlorodiphenyltrichloroethane, HCH = hexachlorocyclohexane, ND = not detected, PAH = Poly Nuclear Aromatic Hydrocarbon

Source: MITCON

4. Air Quality

185. Tripura State Pollution Control Board regularly monitors the air quality all throughout the state but mainly during the Durga puja and Diwali wherein air gets polluted due to bursting of firecrackers. The extant air quality was therefore studied to assess the status of the PAI vis-à-vis the air quality standards prescribed by the Central Pollution Control Board. The urban areas in the State have witnessed a significant increase in the number of small and medium scale industries along with vehicles resulting in change in air quality.

186. Ambient air quality sampling stations has been selected in 14 substations for assessment of the existing status of air environment. The selection of monitoring locations has been distributed throughout the state to get representative baseline. Measurement techniques used for air quality analysis are presented in Table 4-16 and sampling locations with sampling dates are given in Table 4-27. Air quality sampling locations marked on Google imagery are shown in Figure 4-26, and photographs taken during sampling are shown in Annexure 8.

187. The sampling and analysis of ambient air quality parameters was carried out as per the procedures detailed in relevant Parts of IS-5182 (Indian Standards for Ambient Air Quality Parameters). 24-hourly samples were collected once from each location. The following air pollution parameters were monitored and measured by sampling:

(i) Particulate Matter less than 10µm (PM_{10})
(ii) Particulate Matter less than 2.5µm (PM2.5)
(iii) Sulphur dioxide (SO2)
(iv) Oxides of nitrogen (NO_X)

Table 4.26 Air Quality Measurement Techniques

Parameter	Monitoring Equipment	Analytical Method	Minimum Detectable limit	Technical Protocol
$PM_{2.5}$	Fine Dust sampler	CPCB Guidelines for the measurement of Ambient Air pollutant Vol. I, 2011	10 µg/m^3	Gravimetric method
PM_{10}	Fine Dust sampler	IS 5182 (Part 23) :2006, RA-2012	10 µg/m^3	Gravimetric method
SO_2	Gaseous sampler	IS 5182 (Part II): 2001, RA-2012	5 µg/m^3	Improved West and Geake method
NO_x	Gaseous sampler	IS 5182 (Part VI): 2006, RA-2012	5 µg/m^3	Modified Jacob and Hochheiser method

CPCB = Central Pollution Control Board
Source: ADB TA Consultant

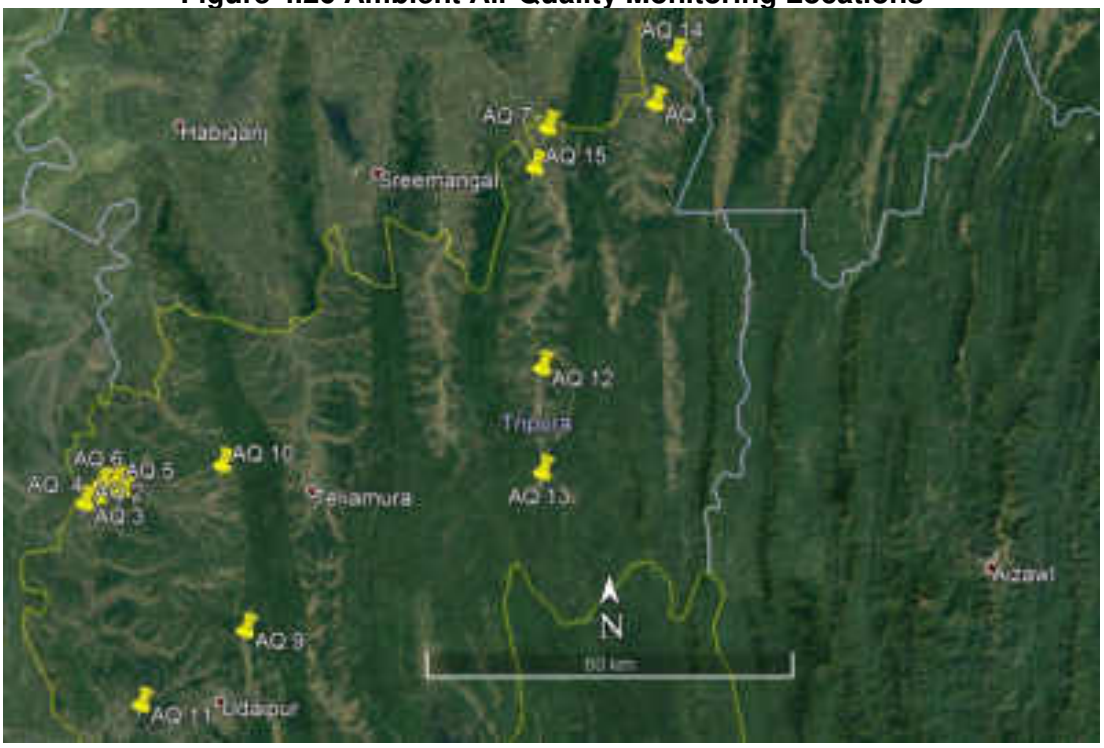
Table 4.27 Ambient Air Quality Stations at the 33/11 kV Substation locations

Substation	Station Code	GPS Coordinates	Justification for Sampling Location
Digalbagh	AQ1	24°23'11.27"N 92°10'28.61"E	• Civil work for bay extension and R&M, cable trench for R&M • End point for new 33kV underground • Residential within 500m
Charipara	AQ2	23°47'53.71"N 91°15'6.90"E	• Civil work for bay extension • End point for new 33kV underground
Adharsha Colony	AQ3	23°48'52.16"N 91°18'47.21"E	• Civil work for bay extension • End point for new 33 kV underground

Substation	Station Code	GPS Coordinates	Justification for Sampling Location
			• Residential within 500 m
Stadium	AQ4	23°48'31.27"N 91°16'32.09"E	• Civil work for bay extension • End point for new 33 kV underground • Properties in 50 m, Sports Complex, College, Residential within 500 m
College Tilla	AQ5	23°49'46.05"N 91°18'5.26"E	• Civil work for bay extension • End point for new 33kV underground • In University Campus, NCC Commando Barrack, Residential within 500 m
NSRCC	AQ6	23°49'38.27"N 91°16'44.05"E	• Civil work for bay extension • End point for new 33 kV underground • In urban area, Residential within 10 m
Tillabazar	AQ7	24°21'6.45"N /92° 0'2.20"E	• New substation; civil work for bay extension • End point for new 33 kV underground • Open area; residents across road
Killa	AQ9	23°36'41.58"N 91°30'44.12"E	• Civil work / cable trench for R&M
Mandai	AQ10	23°51'18.49"N 91°28'29.38"E	• Civil work / cable trench for R&M
Melaghar	AQ11	23°30'3.18"N 91°20'37.21"E	• Civil work / cable trench for R&M • Outskirts of Melaghar Town within semi urban settings. • Residential houses scattered within 50 m
Manu	AQ12	23°59'53.74"N 91°59'25.99"E	• Civil work / cable trench for R&M • Semi urban setting within residential areas. • Presence of primary school within 50m and high school within 70 m
Chamanu	AQ13	23°50'43.95"N 91°59'26.39"E	• Civil work / cable trench for R&M.
Kadamtalla	AQ14	24°27'28.78"N 92°12'25.43"E	• Civil work / cable trench for R&M • Residential, crematory, common road
Rangrung	AQ15	24°17'35.47"N 91°58'48.12"E	• Civil work / cable trench for R&M located within tea garden area opposite to a high school which does not have any boundary

Source: MITCON

Figure 4.26 Ambient Air Quality Monitoring Locations



Source: MITCON

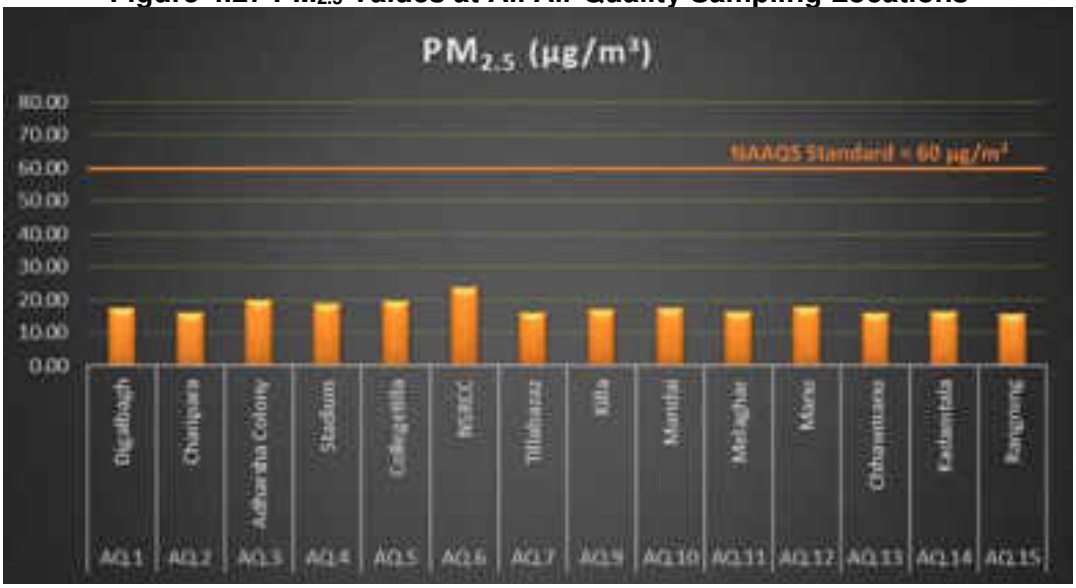
188. The summary of ambient air quality results is presented in Table 4-18. 24-hour average $PM_{2.5}$ concentrations recorded at all the sampling locations are well below the prescribed Government of India standards of 60 µg/m^3 and earlier WHO AQG but exceeds the more stringent WHO AGQ 2021 at all locations. It may be noted that the latest WHO standards are very stringent and very few places can meet them. The minimum value recorded was 15.62 µg/m^3 at Rangrung (AQ.15) and the maximum recorded value was 23.87µg/m^3 at NSRCC, Agartala (AQ.6). The PM_{10} concentrations, recorded at all the sampling locations, are well below the prescribed NAAQ standards of 100µg/m^3 and in most cases the earlier WHO AQG, but exceeds the more stringent WHO AQG 2021 at all locations except Chawmanu (AQ13) and Rangrung (AQ15). The minimum value recorded was 43.7µg/m^3 at Chawmanu (AQ.13), while the maximum value recorded was 56.4µg/m^3 at NSRCC, Agartala (AQ.6). The air quality in the PAI is therefore slightly degraded with respect to PM2.5 and PM10 and attention will need to be paid to minimizing dust generation. The average SO_2 concentrations, recorded at all the sampling locations, are well below the prescribed CPCB limits of 80 µg/m^3 as well as the WHO AQG 2021 guidelines. The minimum value recorded was 7.67 µg/m^3 at Chawmanu (AQ.13) and the maximum value recorded was 18.74 µg/m^3 at NSRCC (AQ.6). The average NO_X concentrations, recorded at all the sampling locations, are well below the prescribed NAAQ standard of 80 µg/m^3 as well as the WHO AQG 2021 guidelines. The minimum value recorded was 10.17 µg/m^3 at Killa (AQ.9) and the maximum value recorded was 20.14 µg/m^3 at Mandai (AQ.10). The air quality in the PAI is considered non degraded with respect to SO2 and NOx. A graphical plot of the pollutants across sampling locations are shown in Figure 4-27 to Figure 4-30.

Table 4.28 24-Hour Average Ambient Air Quality

Sl. No	Station	Sampling date	PM2.5 (µg/m³)	PM10 (µg/m³)	SO_2 (µg/m³)	NOx (µg/m³)
1	AQ1	29/08/2021	17.55	48.5	7.89	14.73
2	AQ2	26/08/2021	16.12	48.6	8.64	13.56
3	AQ3	25/08/2021	19.96	52.4	13.81	10.86
4	AQ4	25/08/2021	18.75	53.4	10.08	13.64
5	AQ5	24/08/2021	19.65	50.1	11.83	13.84
6	AQ6	24/08/2021	23.87	56.4	18.74	12.41
7	AQ7	31/08/2021	16.01	49.9	9.76	15.73
8	AQ9	23/08/2021	17.07	46.3	9.55	10.17
9	AQ10	26/08/2021	17.28	46.4	9.10	20.84
10	AQ11	22/08/2021	16.32	45.7	10.51	11.20
11	AQ12	27/08/2021	17.87	47.7	8.37	12.57
12	AQ13	27/08/2021	15.89	43.7	7.67	13.27
13	AQ14	29/08/2021	16.54	46.2	9.06	19.19
14	AQ15	31/08/2021	15.62	44.6	9.88	12.18
Government of India			**60**	**100**	**80**	**80**
IFC EHS (WHO AQG)			**25**	**50**	**20**	**-**
WHO AQG 2021			**15**	**45**	**40**	**25**

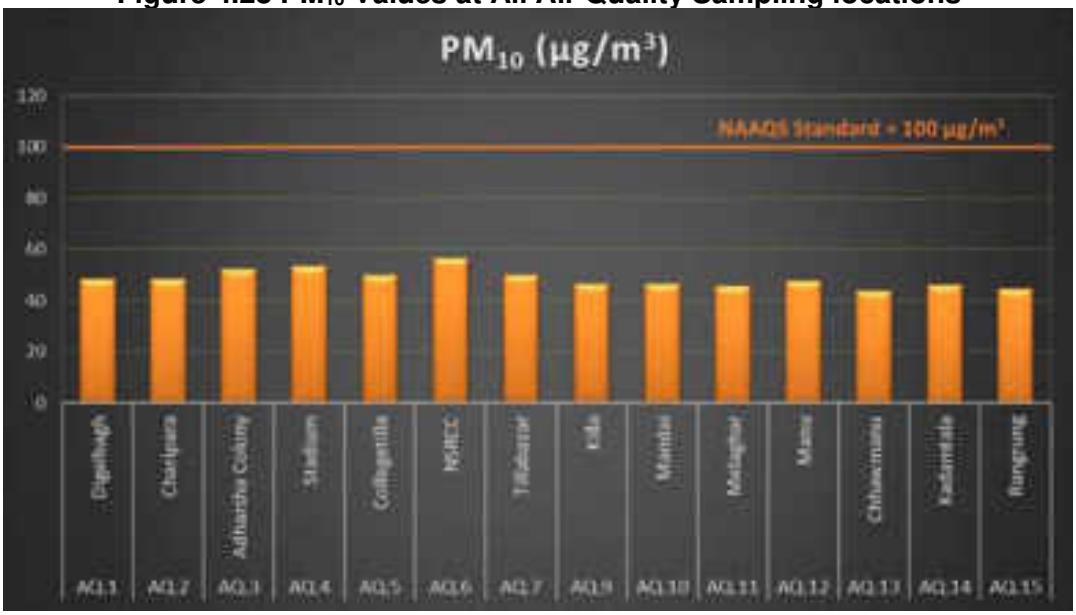
AQG= , EHS = environmental, health and safety, IFC = International Finance Corporation, WHO = World Health Organization
Source: ADB TA Consultant

Figure 4.27 $PM_{2.5}$ Values at All Air Quality Sampling Locations



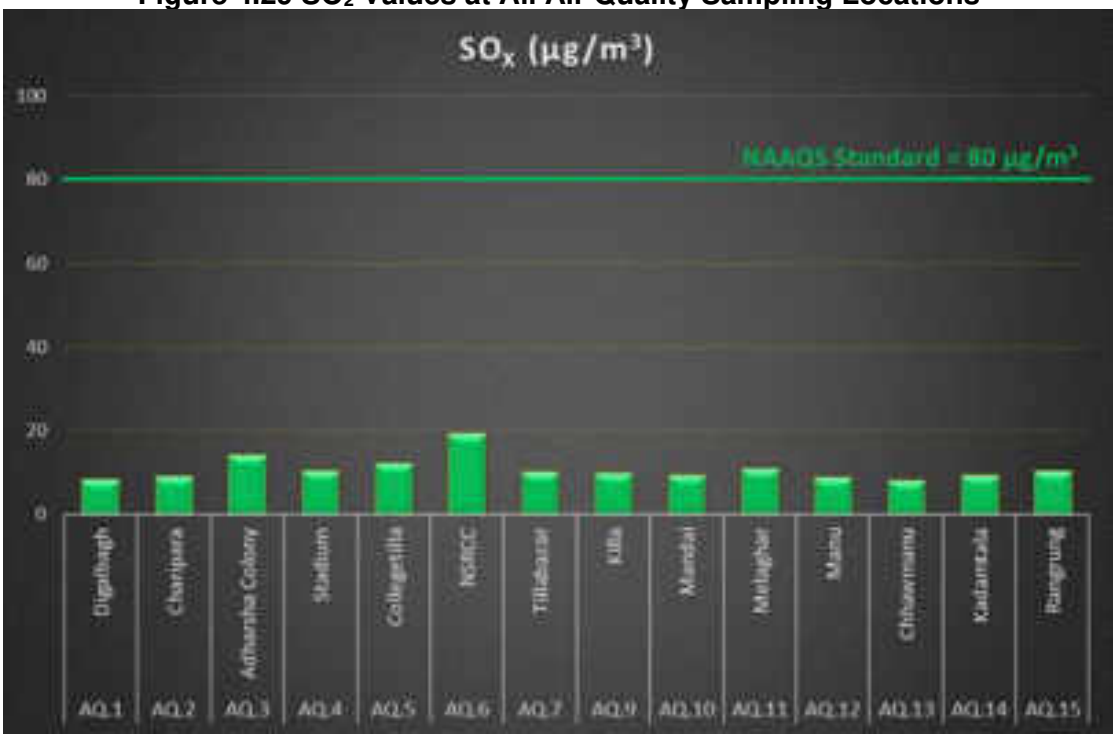
Source: MITCON

Figure 4.28 PM_{10} Values at All Air Quality Sampling locations



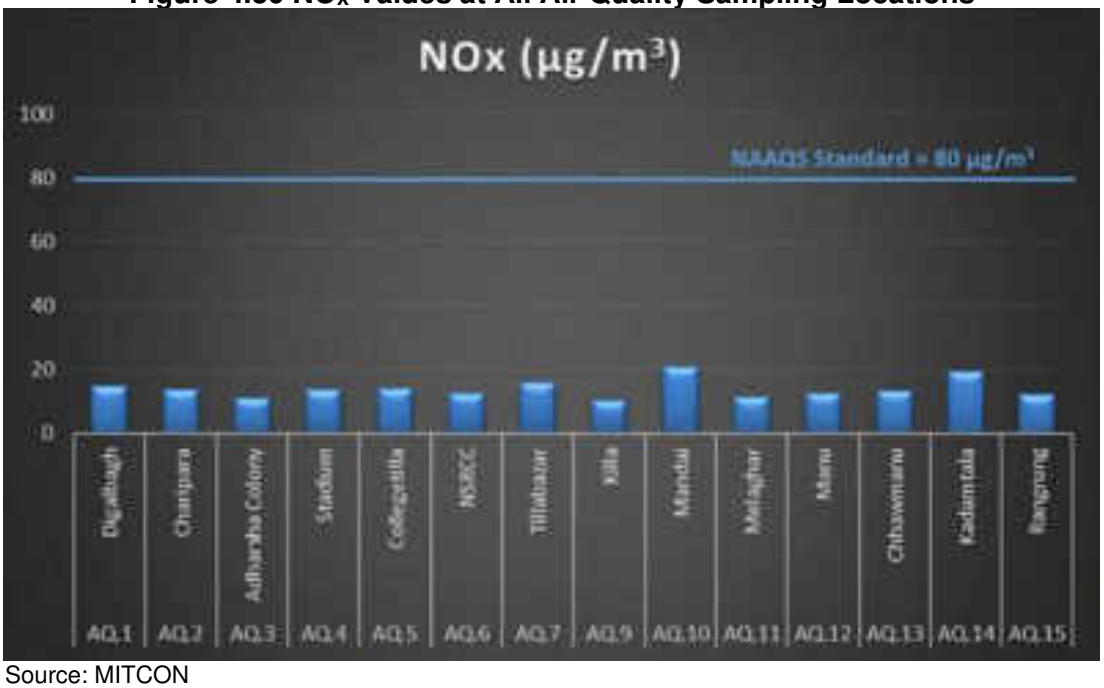
Source: MITCON

Figure 4.29 SO_2 Values at All Air Quality Sampling Locations



Source: MITCON

Figure 4.30 NO_X Values at All Air Quality Sampling Locations



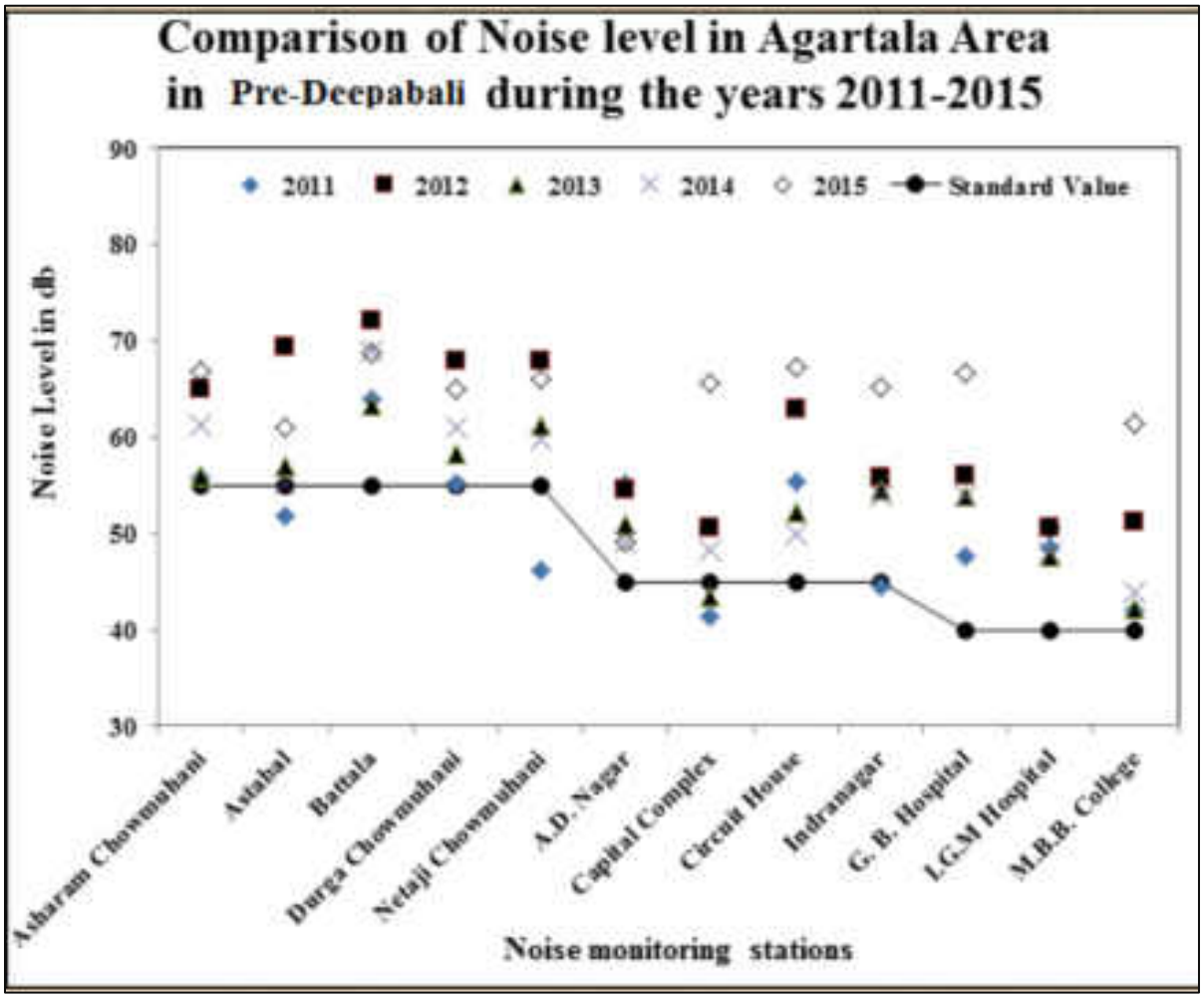
Source: MITCON

5. Noise

189. Noise and vibration in the form of undesirable and unwanted sounds can have an adverse effect on human beings and their environment, including structures, and domestic animals. It can also disturb wildlife and ecological systems. MoEF&CC has notified permissible noise levels for different zones in India vide gazette notification dated February 14, 2000 under the Environment Protection Act (1986) wherein standard limits are provided in respect of time (day 6.00am to 10.00pm and night 10.00pm to 6.00am) and land use – Industrial, Commercial, Residential, Silence and Mixed area. As per notification, the Silence zone is defined as an area up to 100m around premises of hospitals, educational institutions, and courts. Rule 3(4) states that while planning developmental activity consideration will be taken of all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise. It does not provide guidance on the exceedance of ambient noise due to such developmental activities. In terms of ADB's SPS 2009 requirement, the IFC EHS Guidelines 2007 which in turn refer to the WHO Community Noise Guidelines are referred to along with the Government of India standards and assessment is undertaken based on a more stringent threshold.

190. Noise is not monitored across the state on a regular basis. Most noise monitoring and studies are based in the Agartala Municipal Area, including those by TPCB and CPCB, especially during festive occasions. Around Agartala city 12 stations were identified and selected for noise level monitoring as these stations are most interrupted by public influences. All the collected data during the years 2011-2015 has been analyzed and graphically represented in Figure 4-31. The noise levels of all the years were higher than corresponding standard values of those areas.

Figure 4.31 Noise Level Trend Analysis in The Agartala City During the Years 2011-2015



Source: TPCB-ENVIS

191. Continuous 24-hour noise level sampling was carried out once near the sub-station boundary or at a suitable location near the sub-station. Noise levels were measured by noise meter, and half hourly readings were collected from each location. The methodology adopted for Noise Monitoring is:

(i) Site visit and identification of sources of noise at each sub-station location
(ii) Carrying out noise monitoring by placing handheld noise meter on a tripod (approx. height 1.5 m agl) for 24 hours to get 24 1-hourly readings or 48 half-hourly readings
(iii) Calculating various noise values like Leq, L90, L10, Lmax, Lmin for Day time (06:00 hrs. to 22:00 hrs.) and Night-time (22:00 hrs. to 06:00 hrs.) separately

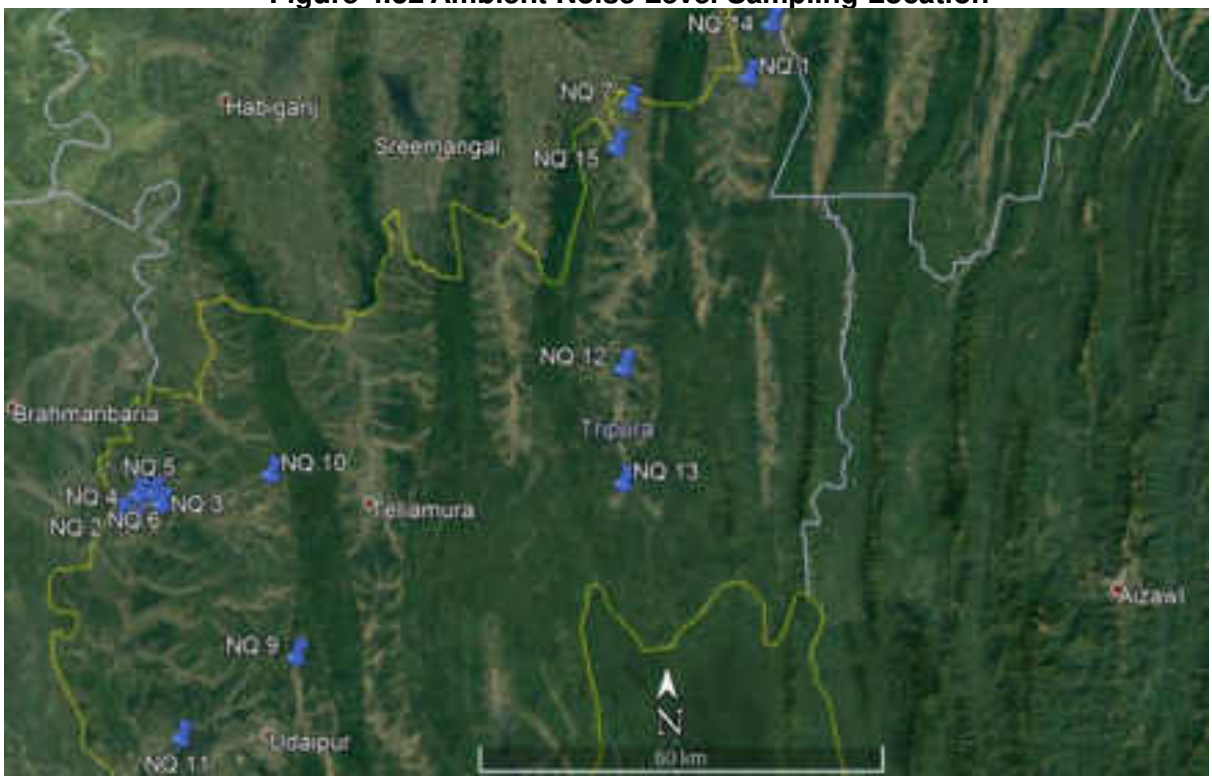
192. Ambient noise-sampling conducted at 14 substations are detailed in Table 4-29 and Figure 4-32. Summary of the results of noise monitoring carried out at the sub-station locations is given below in Table 4-30. Raw data of the noise monitoring is provided in Annexure 9.

Table 4.29 Noise Monitoring Locations

Substation	Station Code	GPS Coordinates	Justification / Major LULC
Digalbagh	N1	24°23'11.27"N 92°10'28.61"E	• Civil work for bay extension and R&M, cable trench for R&M • End point for new 33 kV underground • Residential within 500 m
Charipara	N2	23°47'53.71"N 91°15'6.90"E	• Civil work for bay extension • End point for new 33 kV underground
Adharsha Colony	N3	23°48'52.16"N 91°18'47.21"E	• Civil work for bay extension • End point for new 33 kV underground • Residential within 500 m
Stadium	N4	23°48'31.27"N 91°16'32.09"E	• Civil work for bay extension • End point for new 33 kV underground • Properties in 50 m, Sports Complex, College, Residential within 500 m
College Tilla	N5	23°49'46.05"N 91°18'5.26"E	• Civil work for bay extension • End point for new 33 kV underground • In University Campus, NCC Commando Barrack, Residential within 500 m
NSRCC	N6	23°49'38.27"N 91°16'44.05"E	• Civil work for bay extension • End point for new 33 kV underground • In urban area, residential within 500m
Tillabazar	N7	24°21'6.45"N /92° 0'2.20"E	• New substation; Civil work for bay extension • End point for new 33 kV underground • Open area; residents across road
Killa	N9	23°36'41.58"N 91°30'44.12"E	• Civil work / cable trench for R&M
Mandai	N10	23°51'18.49"N 91°28'29.38"E	• Civil work / cable trench for R&M
Melaghar	N11	23°30'3.18"N 91°20'37.21"E	• Civil work / cable trench for R&M • Outskirts of Melaghar Town within semi urban setting • Residential houses scattered within 50m
Manu	N12	23°59'53.74"N 91°59'25.99"E	• Civil work / cable trench for R&M • Semi urban setting within residential areas. • Presence of primary school within 50m and high school within 70m
Chamanu	N13	23°50'43.95"N 91°59'26.39"E	• Civil work / cable trench for R&M
Kadamtalla	N14	24°27'28.78"N 92°12'25.43"E	• Civil work / cable trench for R&M • Residential, Crematory, common road
Rangrung	N15	24°17'35.47"N 91°58'48.12"E	• Civil work / cable trench for R&M • Located within tea garden area opposite to a high school which does not have any boundary

Source: MITCON

Figure 4.32 Ambient Noise Level Sampling Location



Source: MITCON

Table 4.30 Noise Levels, Laeq T at Monitored Substations

Sample No.	Location	Sampling Date	Day	Day Standard	Night Standard	Day Time, LAeq T (06:00 hrs. to 22:00 hrs.)						Nighttime LAeq T (22:00 hrs. to 06:00 hrs.)					
				L_{eq}	L_{eq}	L_{eq}	L_{90}	L_{50}	L_{10}	L_{max}	L_{min}	L_{eq}	L_{90}	L_{50}	L_{10}	L_{max}	L_{min}
NQ.1	Digalbagh	29/08/2021	Sunday	55	45	47.3	42.8	47.5	50.3	51.9	41.1	41.7	39.4	40.9	44.3	45.6	39.1
NQ.2	Charipara	26/08/2021	Thursday	55	45	48.8	42.3	48.8	52.9	53.8	41.3	43.2	40.5	41.9	46.3	47.3	39.8
NQ.3	Adarsha Colony	25/08/2021	Wednesday	55	45	50.3	43.4	51.1	54.8	55.4	41.9	45.1	42.6	43.7	47.9	49.4	42.4
NQ.4	Stadium			50	40	50.3	44.5	50.0	54.6	55.4	42.7	45.5	42.7	45.4	48.1	49.1	42.5
NQ.5	College Tilla	24/08/2021	Tuesday	50	40	49.6	44.3	49.3	53.7	54.4	42.4	43.7	41.6	43.1	46.3	47.7	41.1
NQ.6	NRSCC			55	45	51.5	45.7	51.9	55.6	56.8	43.9	45.3	43.0	43.6	48.7	49.6	42.6
NQ.7	Tillabazar	31/08/2021	Tuesday	50	40	45.1	41.5	45.7	47.6	48.7	38.9	39.4	37.7	39.4	40.9	41.2	37.4
NQ.9	Killa	23/08/2021	Monday	55	45	47.1	42.1	47.0	50.2	51.8	40.2	41.8	40.4	41.3	43.6	44.8	39.7
NQ.10	Mandai	26/08/2021	Thursday	55	45	47.9	42.3	47.9	51.6	53.4	40.6	42.1	40.0	41.2	45.2	46.3	39.6
NQ.11	Melaghar	22/08/2021	Sunday	55	45	48.8	43.6	49.0	52.6	53.6	41.6	44.3	42.1	43.3	46.9	47.9	41.8
NQ.12	Manu	27/08/2021	Friday	50	40	48.5	41.3	48.9	52.8	54.7	39.9	41.4	38.9	40.4	44.1	46.1	38.3
NQ.13	Chawmanu			50	40	46.1	41.1	46.4	49.6	50.2	39.6	40.3	37.7	39.2	43.5	44.2	37.2
NQ.14	Kadamtala	29/08/2021	Sunday	50	40	45.0	40.4	45.3	48.2	48.7	38.6	38.6	36.7	38.0	40.7	42.8	36.5
NQ.15	Rangrung	31/08/2021	Tuesday	50	40	46.3	41.7	46.4	49.6	50.7	40.3	38.2	36.6	37.8	39.8	40.9	36.1

Exceeds daytime 55 dB(A) guideline; Exceeds night-time 45 dB(A) guideline for residential.
Exceeds daytime 50dB(A) guideline; Exceeds night-time 40 dB(A) guideline for silent zone buffer due to presence of school or hospital in 100m.
Assessment criteria Government of India vs IFC EHS most stringent for residential, commercial or silent zone.
NRSCC = Netaji Subhas Regional Coaching Centre
Source: ADB TA Consultant

193. 24-hour continuous levels, recorded at all the sampling locations, are within assessment criteria for residential area of 55 dB(A). However, for silent zone where a more stringent Government of India noise level applies the assessment criteria are exceeded at Stadium substation during the day. Nighttime noise is within 45 dB(A) for all substations except Adarsha Colony Substation and for silent zones Stadium Substation, College Tilla Substation, NRSCC Substation – although most of the surrounding is commercial there are shops/houses identified to be present, and Chawmanu Substation, at Manu Substation in silent zone noise at night exceeds 40 dB(A). At these 2 locations, which are all within Agartala city limits the exceedance is marginal being most significant (3.7dBA) at College Tilla Substation. The Government of India standard for noise is more stringent against the IFC guidelines and was used as assessment criteria.

6. Key Physical Aspects

194. Summary of the key physical aspects in the PAI are given in Table 4-31.

Table 4.31 Summary of Physical Setting of the Project Area of Influence

Component	Subproject	Location	Key environmental features in PAI
General	General	Tripura	• Physiography of Tripura is characterized by hill ranges, valleys, and plains. • Seismic hazards: Zone-V and Very High Damage Risk Zone • Surface Water Flooding–Medium Risk • Landslides-Medium Risk area • Storms and cyclones–High Risk area • Daily maximum temperature and minimum mean temperatures are 30.7°C and 19.5°C respectively during summer months. January is the coldest month when minimum mean minimum temperature is only 8.9°C and maximum mean temperature is 25.2°C. Temperature shows a declining trend from west to east. • Annual rainfall ranges from 1,922 mm to 2,855 mm. Rainfall generally increases from south-west to north-east. The north-eastern part of the state around Dharamnagar gets maximum rainfall. • Humidity is generally high throughout the year. In the summer season the relative humidity is between 50 to 74% whereas in the rainy season it is over 85%. • Mean wind speed is 7.1 km per hour, with maximum of 13.1 km per hour in May.
Substations and Test Laboratory	Total 27 Substations, Test Laboratory	Tripura	• Land use of substations and test laboratory sites comprising buildings, electrical equipment, and open areas with grass, shrubs, and occasional trees; the available open space within substations varies from 5% to 60%

Component	Subproject	Location	Key environmental features in PAI
			• Substations are spread across the state at various elevations with 25 substations and the test laboratory located on flat/plain land, two located on elevated land compared to their surroundings, including one located on a ridge (Vangmung Substation 375 m) and the Chawmanu Substation on elevated land • 25 substations have evidence of oil leaks inside the compound/switch yard and soil contamination of various degrees especially in and around the transformers. • Standing water was not observed in the substations but 23 have ponds and four have rivers, or streams within 500 m. Ponds are located close (<25 m) to Jolaibari and Rampur Substations with the closest rivers being Manu River at 185 m from Manu Substation and Haora River, 200m College Tilla Substation. • Bore wells are located within the substation compound of eight substations • Monitored surface and ground water parameters are within range, except coliform, which indicates organic waste loading in the water bodies/bore wells. • Although monitored ground water parameters are within permissible limits of ISO 10500 for drinking water, groundwater in Tripura, especially Sipahijila District may have a high iron content. • PM2.5 ranged between 15.62 µg/m^3 at Rangrung Sunstation to 23.87µg/m^3 at NSRCC Substation, Agartala. 24-hour average PM2.5 are all within Government of India standards and the IFC EHS guideline but exceeds WHO AGQ 2021 at all substations. • PM10 varies between 43.7 ug/m^3 (Chawmanu Substation) to 56.4ug/m^3 (NSRCC Substation, Agartala). PM10 concentrations at all Substations are below the Government of India standards. Except Chawmanu and Rangrung Substation, all other substations exceed the WHO AQG 2021 guidelines whereas the IFC EHS guideline is exceed at Adarsha Colony, College Tilla, NSRCC and Stadium Substation . • SO_2 values are all within the most stringent IFC EHS guidelines. SO_2 value

Component	Subproject	Location	Key environmental features in PAI
			varies between 7.67 µg/m^3 (Chawmanu Substation) and 18.74 µg/m^3 (NSRCC Substation). • NOx values are all within the most stringent WHO AQG 2021. NOx values vary between 10.17 µg/m^3 (Killa Substation) and 20.84 µg/m^3 (Mandai Substation). • Low magnitude of dust suspension observed on access roads in rural areas mainly due to low traffic flows. In the urban areas, dust and vehicle emissions were observed to be high along access roads to substations in Agartala city. • Ambient noise levels were observed to be low at most of the substations which are not exposed to traffic or other noise sources. Monitored noise levels during daytime (LAeq-Day) varied between 45 dB(A) in Kadamtala Substation to 50.3 dB(A) in Stadium Substation. Noise exceeded the noise limits (most stringent of Government of India vs IFC EHS) at Adarsha Colony, Stadium, College Tilla, NSRCC and Chawmanu Substation • Transformer hum was audible in some cases from nearly 5 meters and ranged between 48 dB(A) to 59 dB(A).
2667.46 ckm of 33 kV, 11 kV, and low tension distribution lines	• New 33kV Line (UG): 163 km • New 33kV Line (CC): 107 km • New 11 kV Line (UG): 4.2 km • New 11 kV Line (CC): 1270 km • Conversion of 11 kV Line to CC: 134 km • Conversion of 11 kV Line to UG cable: 89.26 km • Conversion of low tension (0.4 KV) Line to Aerial bunched cable: 900 km	Tripura	• Based on sample distribution line site visits elevation ranges between < 20m in the Agartala city routes to 196m in the Damcherra-Panisagar-Pechartal line. • Topography varies between plain/flat in Agartala to complex terrain in Damcherra-Panisagar, Pechertal, Mandwi, Dayarampara lines. • Surface water bodies: river/stream crossings were observed in the urban and rural alignments; Haora River passing parallel to Golchakkar-Dashamighat line in Agartala for major portion (on river embankment) of the alignment • No ponds are found within the ROWs although ponds are found within the PAI. • Ground water features like bore wells, hand pumps, wells are within the PAI of all sample routes, but none were in the ROWs. • On some route alignments dusty conditions were observed due to ongoing road expansion and/or power line

Component	Subproject	Location	Key environmental features in PAI
			maintenance works; for these stretches noise levels are also higher. • Observed distribution transformer were not maintained with broken fences, no caution signages, grass undergrowth, oil leak and contamination in Sipahijila districts – being close to road and private property are cause of community health and safety risk.

AQG = air quality guideline, EHS = environmental, health and safety, IFC = International Finance Corporation, NSRCC = Netaji Subhas Regional Coaching Centre, PAI = project area of influence, WHO = World Health Organization
Source: ADB TA Consultant

G. Statewide Socio-economic Setting

195. The socio-economic study adopted a desk-based methodology with review and analysis of published secondary data sources without any primary data collection. Secondary data was collected from District Census statistics of 2011. Census 2011: the District Census Handbook (DCHB) is an important publication of the Indian Census Organization[74] since 1951. It contains both Census and non-Census data of urban and rural areas for each District. The Census data provides information on demographic and socio-economic characteristics of population at the lowest administrative unit i.e., town/village ward of the district. The non-Census data presented in the DCHB is in the form of a Town Directory and Village Directory containing information on various infrastructure facilities available in the village or town including education, medical, drinking water, communication and transport, post and telegraph, electricity, banking, and other miscellaneous facilities. Review and analysis of the available secondary data helped to identify key socio-economic parameters and trends.

1. Administrative Set Up

196. Tripura state is located in the northeastern region of India. Tripura, erstwhile princely state, merged with the Indian Union after independence on 15 October 1949 and became a Union Territory without a legislature with effect from 1 November 1956 and a popular ministry was installed in Tripura on 1 July 1963. Tripura became a fully fledged State on the 21 January 1972 and is the third smallest State of the Country, located in the North Eastern Region. Tripura is connected with the rest of the Country by National Highway-44, which runs through the hilly terrains of Cachar District in Assam followed by zigzag roads of hilly regions of Meghalaya and then to Guwahati, the capital city of Assam, via Shillong, the capital city of Meghalaya.

197. The state lies approximately between latitude 220 56'N and 240 32'N and longitude 91009'E and 92010'E and covers an area of about 10492 km^2. It is bordered by Bangladesh on the north, west, south and southeast, by Assam and Mizoram on the northeast. Tripura State has eight Districts, which are divided into Sub-divisions and further into Blocks. Blocks have administrative units like Tehsils (group of villages) and Panchayats (village council). Tripura was Divided into Four Districts when it gained full Statehood on 21 January 1972. The Old Districts were – Dhalai, North Tripura, South Tripura and West Tripura. The Government of Tripura has reorganised the administrative units in 2012 by creating 4-new Districts, 6-new Sub-Divisions and 5-new Blocks in-order to further decentralise the administration. The State now has 8-Districts

[74] Office of the Registrar General and Census Commissioner, India under Ministry of Home Affairs, Government of India.

(Dhalia, Gomati, Khowai, North Tripura, Sipahijila, South Tripura, Unakoti and West Tripura (Figure 4-25), 23-SubDivisions, 58-Blocks and 1-Tripura Tribal Areas Autonomous District Council (TTAADC). With a view to fulfil the aspirations of the tribal population to have autonomy to administer themselves, the TTAADC was set up in January 1982 under the Seventh Schedule of the Constitution of India. Later, the council was brought under the provisions of the Sixth Schedule of Indian Constitution to entrust more responsibilities and power from 1 April 1985.

Figure 4.33 Map Showing Districts and Sub-Divions

Source: mapsofindia

2. Land Cover and Land Use

198. Tripura has an area of 10,491 km^2 and the forest area is approximately 60% while the net area cropped is 24%. The land use data has been derived from the latest 2015-16 data from Bhuvan-Thematic Services provided by National Remote Sensing Centre, ISRO. The 2019-20 data as extracted from Agriculture Department of Tripura is given in Table 4-32.

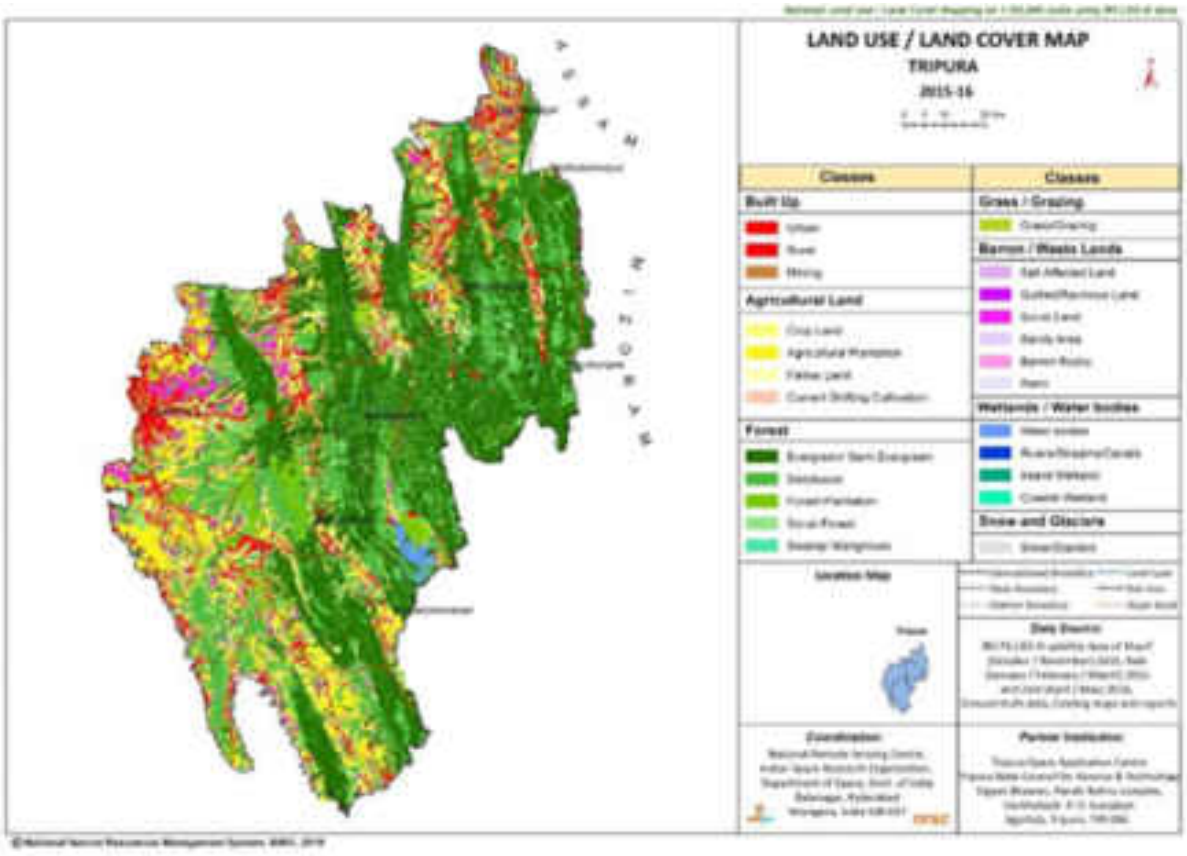
Table 4.32 District Land Use / Land Cover in Tripura (2015-16)

Category	Sub-category	Dhalai	Gomati	Khowai	North Tripura	Sepahijala	South Tripura	Unakoti
		Square kilometers						
Agriculture	Crop land	164.71	214.04	186.95	121.93	198.44	227.56	109.14
	Current Shifting cultivation	15.11	3.39	3.14	6.49	0.07	1.96	0.07
	Fallow	0.13	3.66	1.38	0.96	5.08	13.90	1.12
	Plantation	47.29	94.62	35.15	31.03	203.64	206.99	34.67
	Gullied / Ravenous	0.34	0.14	-	-	-	-	-
	Sandy area	1.02	0.03	0.66	0.03	0.38	0.18	1.10
	Scrub land	20.57	19.33	35.67	22.97	51.63	45.68	12.65
Built up	Mining	0.26	0.28	0.28	1.11	1.54	0.75	0.68
	Rural	75.60	56.96	56.94	96.66	92.43	48.74	74.50
	Urban	12.26	39.37	37.51	23.79	29.71	24.27	19.15
Forest	Deciduous	447.58	453.44	169.24	339.46	352.30	449.72	140.77
	Evergreen / Semi Evergreen	1204.78	515.79	451.72	638.47	38.30	433.51	230.80
	Forest Plantation	88.21	131.10	3.53	4.95	35.92	16.13	3.16
	Scrub Forest	186.51	59.35	24.55	61.78	26.17	34.75	22.78
Wetlands / Water bodies	Inland wetland	0.05	3.02	0.08	-	1.06	0.12	0.30
	River / Stream / Canals	10.82	9.93	5.99	6.92	3.53	5.35	4.72
	Waterbodies	38.75	11.55	0.22	0.45	2.79	1.39	0.37

(above statistics are provisional)

Source: https://bhuvan-app1.nrsc.gov.in/2dresources/thematic/LULC503/MAP/TR.pdf

Figure 4.34 Land Use (Land Cover) Map of Tripura



Source: https://bhuvan-app1.nrsc.gov.in/2dresources/thematic/LULC503/MAP/TR.jpg

Table 4.33 Land Use-Land Cover Pattern in Tripura

Sl. No.	Indicator	In Hectare	In km^2	Percentage
1	Total area	1,049,169	10,491.69	100.00
2	Forest Area	629,426	6,294.26	59.99
3	Land Not Available for Agricultural Use	148,691	1,486.91	14.17
4	Land under Miscellaneous tree crops and groves not included in net area sown	10,037	100.37	0.96
5	Permanent pasture and other grazing land	925	9.25	0.09
6	Culturable waste land	2,578	25.78	0.25
7	Current Fallow	955	9.55	0.09
8	Fallow Land other than current fallow	1189	11.89	0.11
9	Net cropped area	255,368	2,553.68	24.34
10	Gross cropped area	487,000	4870	46.42
11	Area sown more than once	231,632	2,316.32	22.08
12	Cultivable Land	271,052	2,710.52	25.83

Source: Agriculture Department, Tripura, Economic Review 2019-20.

3. Population Characteristics

199. Tripura is the second most populous State in the North-Eastern Region after Assam. The data of Census-2011 shows that Tripura ranks 18th in terms of density of population at all India level. Among the North-Eastern States, in terms of density, Tripura remained the second highest populous State after Assam. The population of Tripura has increased by 474,714 during the decade 2001-2011. The population of Tripura in 2011 was 3,673,917 and per demographic trends it was estimated that the population projection of Tripura would be 4,051,000 in 2020 (two years ago, pre COVID-19 pandemic). Out of this 2020 population, male population is 2,061,000 and female population is 1,990,000.[75] Among the districts West Tripura has the highest population of 918,200 mainly due to the presence of the capital city of Agartala. According to the census of 2011 the lowest population lives in the district of Unakoti in Tripura.

200. **Population Density.** The population density of Tripura in 2011 was 350 persons per square kilometer and the population density for all India was 382 in 2011. The estimated density of population in the State in 2020 has increased to 386 per square kilometer. The State ranks 18th in terms of density of population at national level although, it is the third smallest State in terms of area in the country after Goa and Sikkim as per last Census 2011. Among the North-Eastern States, Tripura remained the second highest Population State after Assam. The detail on population density by district is given in Table 4-34.

Table 4.34 District-wise Population Density in Tripura

District	Total Population	Density
West Tripura	9,18,200	973
Khowai	3,27,564	326
Sepahijala	4,83,687	463
Gomati	4,41,538	287
South Tripura	4,30,751	283
Unakoti	2,76,506	469
North Tripura	4,17,441	288
Dhalai	3,78,230	157
Total	**36,73,917**	**350**

Source: Census of India, 2011

201. **Sex Ratio:** The Census- 2011 data reveals that the sex ratio was 960 females per 1000 males. There is a steady positive improvement in sex ratio in the State as it rose from 945 (females per 1000 males) in 1991 to 948 (females per 1000 males) in 2001 and further to 960 in 2011. The all-India sex ratio in 2011 was of 943 (females per 1000 males). Among the district the highest sex ratio is of West Tripura (970 females for 1000 males) and lowest sex ratio is seen in Dhalai district at 944. The detail on sex ratio by district is given in Table 4-35.

Table 4.35 District-wise Sex Ratio in Tripura

District	Total Population	Male Population	Female Population	Sex ratio
West Tripura	9,18,200	4,66,152	4,52,048	970
Khowai	3,27,564	1,67,401	1,60,163	957
Sepahijala	4,83,687	2,47,829	2,35,858	952
Gomati	4,41,538	2,25,428	2,16,110	959
South Tripura	4,30,751	2,20,162	2,10,589	957
Unakoti	2,76,506	1,40,210	1,36,296	972

[75] Economic Review of Tripura 2019-20

District	Total Population	Male Population	Female Population	Sex ratio
North Tripura	4,17,441	2,12,650	2,04,791	963
Dhalai	3,78,230	1,94,544	1,83,686	944
Total	**36,73,917**	**18,74,376**	**17,99,541**	**960**

Source: Census of India, 2011

202. **Religious Composition:** Among the population of Tripura, Hindu comprises of 83.4%, Muslims 8.6%, followed by 4.4% Christians, 3.4% of Buddhists followed by other minority religions.

Table 4.36 Population by Religion

Religion	Number	Percentage
Hindu	3,063,903	83.40
Muslim	316,042	8.60
Christians	159,882	4.35
Buddhists	125,385	3.41
Sikhs	1070	0.03
Jains	860	0.02
Others	1514	0.04
Religion not stated	5261	0.14
Total	**3673917**	**100.00**

Source: Census of India, 2011

203. **Rural and Urban Population:** The present rural population forms about 73.8 percent of the population in 2011 against 82.9 percent in 2001 and 84.7 percent in 1991 in the State. This demonstrates an urbanizing trend. Total rural population was 2,712,464 in 2011, out of which male and female population were 1,387,173 and 1,325,291 respectively, as per result of Census-2011. The sex ratio for rural area is 955 females per 1000 males according to the 2011 census. Similarly in 2011, 26.2 percent of the State's population was in urban areas as against about 17.1 percent in 2001 and 15.30 percent in 1991. Total urban population was 961,453 in 2011, out of which male and female population were 487,203 and 474,250 respectively, as per data of Census-2011. The sex ratio for urban area was 973 females per 1000 males according to the 2011 census.

Table 4.37 Rural and Urban Population in Tripura

Sex	Rural		Urban	
	Number	Percentage	Number	Percentage
Male	13,87,173	74.01	4,87,203	25.99
Female	13,25,291	73.65	4,74,250	26.35
Total	**27,12,464**	**73.83**	**9,61,453**	**26.17**

Source: Census of India, 2011

204. Among the districts the urban population is more in west Tripura at 64.1 %. In the rest of the 7 districts the rural population is significantly high where more than 80 % stays in rural areas. The details of the rural and urban population in different districts of Tripura are given in Table 4-38.

Table 4.38 District-wise Rural Population in Tripura

Districts	Rural		Urban		Total
	Number	Percentage	Number	Percentage	
West Tripura	329,466	35.88	588,734	64.12	918,200
Khowai	288,006	87.92	39,558	12.08	327,564

Districts	Rural		Urban		Total
	Number	Percentage	Number	Percentage	
Sepahijala	434,341	89.80	49,346	10.20	483,687
Gomati	357,566	80.98	83,972	19.02	441,538
South Tripura	391,692	90.93	39,059	9.07	430,751
Unakoti	235,676	85.23	40,830	14.77	276,506
North Tripura	337,986	80.97	79,455	19.03	417,441
Dhalai	337,731	89.29	40,499	10.71	378,230
Total	**2,712,464**	**73.83**	**961,453**	**26.17**	**3,673,917**

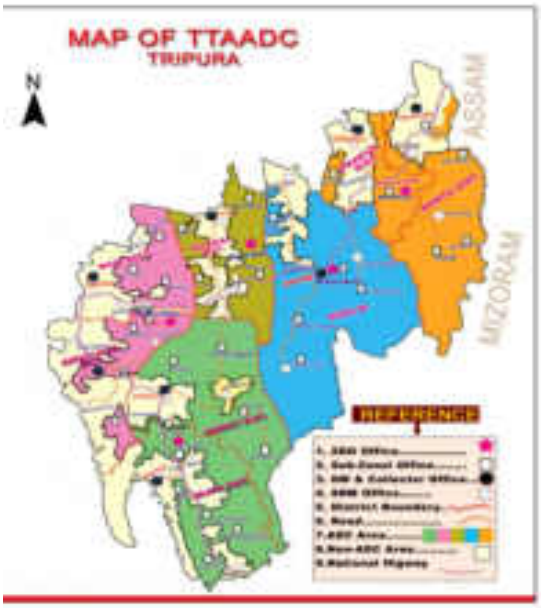
Source: Census of India, 2011

4. Vulnerable Groups

205. **Below Poverty Line**. The final poverty line for Tripura was Rs. 450.49 for rural areas and Rs. 555.79 for urban areas as against Rs. 446.68 for rural areas and Rs.578.8 for all India in 2004-05.

206. **Tripura Tribal Area Autonomous District Council Area.** The activities of the TTAADC range from primary education to maintenance of roads and bridges etc. The rehabilitation of the landless tribal, creation of employment opportunities, agricultural development, soil conservation, flood control, supply of drinking water, education, transport and communication, setting up of village industries are some of the important tasks undertaken. Special drive to bring highlands under horticultural crops, establishment of small farms to supply inputs of agriculture, horticulture, pisciculture, and animal husbandry to the tribal families, extension of medical facilities in interior areas through mobile unit, supply of safe drinking water will also be geared up and arranged for the Scheduled Tribe villages in TTAADC. The total area of the TTAADC (Figure 4-35) is 7,132.56 km^2, which covers about 68% of the total area (10,491 km^2) of the state. About 70% of land under TTAADC is covered by hilly forest, whereas all the plain cultivable land including all the districts and sub-divisional headquarters are outside the purview of TTAADC. The population of the TTAADC area is 1,216,465 out of which the Scheduled Tribes are 1,021,560, i.e., 83.4% of the population in the TTAADC area. In the total population of 3,673,917 of Tripura (as per 2011 census) the total population of Scheduled Tribes is 1,166,813 (31.76%). Therefore, the number of Scheduled Tribes of the state who reside in the TTAADC area is 87.55% of the total indigenous population of Tripura.

Figure 4.35 TTAADC Area



Source: TTAADC Council Website, Government of Tripura

207. **Scheduled Tribes.** The population of Tripura is characterized by diversity. There are 19-scheduled tribes in the State with their own cultural identity. The people of the Scheduled Tribes comprise of about one-third of the total population of the State. As per Census-2011, Scheduled Tribes population of the State was 1,166,893 which is 31.8 percent of the total population of the State. The composition of Scheduled Tribes population is maximum in Dhalai district (55.7%), followed by erstwhile South Tripura district that also included the present Gomati district. In south Tripura district Scheduled Tribes population comprises of 39.36% of the total population. The children population is highest in West Tripura district which also includes the present-day districts of Khowai and Sepahijala in both the 0-6 years and 7-12 years age group while North Tripura including present day Unakoti district has the least child population amongst the Scheduled Tribes category.

Table 4.39 Scheduled Tribe Population in Tripura

Districts	Total Population	Scheduled Tribes Population					% Scheduled Tribes Population
		0-6 years	7-12 years	Total Male	Total Female	Total population	
West Tripura (includes present Khowai & Sepahijala district)	1,725,739	53,265	51,018	217,278	214,666	431,944	25.03
South Tripura (includes present Gomti district)	876,001	54,878	51,279	173,174	171,661	344,835	39.36

Districts	Total Population	Scheduled Tribes Population					% Scheduled Tribes Population
		0-6 years	7-12 years	Total Male	Total Female	Total population	
North Tripura (includes present Unakoti district)	693,947	31,090	26,228	91,116	88,310	179,426	25.86
Dhalai	378,230	36,153	32,727	106,759	103,849	210,688	55.70
Total	**3,673,917**	**175,386**	**161,252**	**588,327**	**578,486**	**1,166,893**	**31.76**

Source: Census of India, 2011 https://censusindia.gov.in/2011census/C-series/c-13/DDW-1600C-13ST.xls

Table 4.40 Scheduled Tribes Communities in Tripura and their Detailed Demography

#	Name of the tribes	Population (Census Years)			
		1981	1991	2001	2011
1	Tripuri / Tripura	330,872	461,531	543,848	592,255
2	Reang	84,003	111,606	165,103	188,220
3	Jamatia	44,501	60,824	74,949	83,347
4	Noatia	7,182	4,158	6,655	14,298
5	Uchai	1,306	1,637	2,103	2,447
6	Kuki	5,501	10,628	11,674	10,965
7	Halam	28,969	36,499	47,245	57,210
8	Lushai	3,734	4,910	4,777	5,384
9	Bhutia	22	47	29	28
10	Lepcha	106	111	105	157
11	Khashia	457	358	630	366
12	Chakma	34,797	96,096	64,293	79,813
13	Mog	18,231	31,612	30,385	37,893
14	Garo	7,297	9,360	11,180	12,952
15	Munda / Kaur	7,993	11,547	12,416	14,544
16	Santhal	2,726	2,736	2,151	2,913
17	Orang	5,217	6,751	6,223	12,011
18	Bhil	838	1,754	2,336	3,105
19	Chamal	18	26	226	549
20	Generic	0	0	7,098	48,356
	Total	**583,770**	**852,191**	**993,426**	**1,166,813**

Source: Census of India Report 2011

208. The Scheduled Tribes and Other Traditional Forest Dwellers (ROFR) Act, 2006 has been successfully implemented in the state. Under this act, so far 130,903 forest dwellers have been vested with forest rights out of 200,696 applications filed by the Forest Dwellers. Details of implementation of ROFR Act, 2006 are given in Table 4-41 (as on 30 April 2020).

Table 4.41 Recognition of Different Forest Rights

Particulars	Number
Total no. of forest rights so far vested	130,903
Total no. of forest rights so far vested to ST families	130,901
Total no of forest rights so far vested to OFD	2
Quantum of land involved (ha.)	186,229.50
Quantum of land involved (for ST families) (ha)	186,229.02
Quantum of land involved for OFD (ha)	0.48
Demarcation of land completed through GPS (Nos.)	124,985
Pillaring completed (Nos.)	122,422

Source: Tribal Welfare Department, Tripura

209. **Scheduled Caste Population.** The Census-2011 data shows that Scheduled Caste population of the State was 654,918 (17.8%). The total Scheduled Caste male was 334,370 and Scheduled Caste female was 320,548. The demography of Scheduled Castes in the State is not confined to any particular location, *'paras'*, or '*bastis'* instead, it is scattered in all regions of the State.

Table 4.42 Scheduled Caste Population in Tripura

Districts	Total Population	Scheduled Caste Population					% Scheduled Caste Population
		0-6 years	7-12 years	Total Male	Total Female	Total population	
West Tripura (includes present Khowai & Sepahijala district)	17,25,739	38,310	36,079	1,72,522	1,65,572	3,38,094	**19.59**
South Tripura (includes present Gomti district)	8,76,001	15,149	14,816	72,012	68,156	1,40,168	**16.00**
North Tripura (includes present Unakoti district)	6,93,947	8,040	7,090	31,461	30,227	61,688	**8.89**
Dhalai	3,78,230	15,575	13,918	58,375	56,593	1,14,968	**30.40**
Total	**36,73,917**	**1,75,386**	**1,61,252**	**5,88,327**	**5,78,486**	**11,66,893**	**17.83**

Source: Census of India, 2011https://censusindia.gov.in/2011census/C-series/c-13/DDW-1600C-13SC.xls

210. **Children Population.** The Census 2011 data shows that the total children in Tripura in the age group of 0-6 years was 449,165 and 7-12 years was 429,970. The highest population of children is in West Tripura while the lowest is in Dhalai district.

Table 4.43 Children Population in Tripura

Districts	Total Population	0-6 years			7-12 years			Total Children			% Population
		Male	Female	Total	Male	Female	Total	Male	Female	Total	
West Tripura (includes present Khowai & Sepahijala district)	1,725,739	97,787	93,063	**190,850**	91,775	87,959	**179,734**	189,562	181,022	**370,584**	0.21
South Tripura (includes present Gomti district)	876,001	57,382	54,567	**111,949**	53,702	51,152	**104,854**	111,084	105,719	**216,803**	0.25
North Tripura (includes present Unakoti district)	693,947	50,379	48,825	**99,204**	43,852	42,221	**86,073**	94,231	91,046	**185,277**	0.27
Dhalai	378,230	28,460	27,551	**56,011**	25,828	24,632	**50,460**	54,288	52,183	**106,471**	0.28
Total	**3,673,917**	**234,008**	**224,006**	**458,014**	**215,157**	**205,964**	**421,121**	**449,165**	**429,970**	**879,135**	**0.24**

Source: Census of India, 2011 https://censusindia.gov.in/2011census/C-series/c-13/DDW-1600C-13.xls

5. Health and Sanitation

211. Major communicable diseases in Tripura include dengue, malaria, and Japanese encephalitis. Data on vector borne diseases in given in Table 4-44, whereas for malaria is shown in Figure 4-36.

212. In 2014, the number of reported malarial cases was approximately 51 thousand. Since then, there has been a gradual decline in the number of cases. In 2017 for instance, there were only about seven thousand cases which is a seven-fold decrease compared to 2014. As of June 2020, the number of reported cases stood at over 1.3 thousand. Dhalai District is the most malaria prone district in Tripura. As per the Annual Parasite Incidence, the endemic areas of Dhalai are Manikpur, Ganganagar, Chawmanu, Chailengta, Jagabandu Para, Ambassa and Manu. For elimination of malaria, various activities have been taken such as increased of awareness generation, fever screening programme, special health camps, formation of District level Malaria Elimination Committee, training of the Nursing Assistant of Paramilitary Forces, involvement of Paramilitary Forces, training of the Male Volunteers etc.

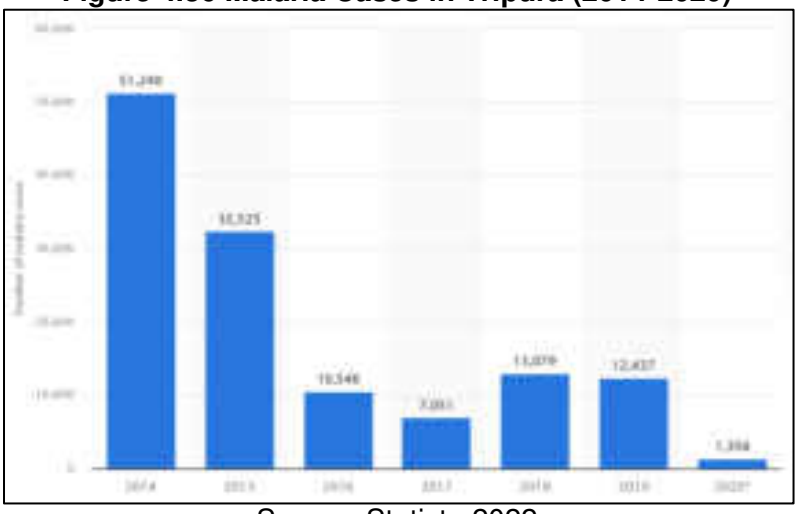
213. In case of Dengue, as per Tripura Health and Family Welfare Department in November 2021, Tripura reported 127 cases of dengue in the year 2017 which was reduced to 100 cases in 2018 and 109 cases in 2019. In 2020, only 24 cases of dengue were reported in the state. 95% of cases were witnessed among people who work as tappers in the state's rubber plantations.

Table 4.44 Tripura Vector Borne Diseases (2018)

Name of Vector Borne Disease	Parameter	2018
Malaria:	No. cases	13,079
	No. death	13
Dengue	No. cases	100
	No. death	0
Chikungunya	No. cases	75
	No. death	0
Japanese Encephalitis	No. cases	59
	No. death	0

Source: National Vector Borne Diseases Control Programme

Figure 4.36 Malaria Cases in Tripura (2014-2020)



Source: Statista 2022

214. **Health Services.** The health care infrastructure is divided into three tiers – the primary health care network, a secondary care system comprising district and sub-divisional hospitals and tertiary hospitals providing specialty and super specialty care. As on 31 December 2020 the position of Health Institutions is:

(i) State Hospital: 6 (Allopathic:4, Homeopathic:1, Ayurvedic:1)
(ii) District Hospital: 6 (Allopathic)
(iii) Sub-divisional Hospital:12 (Allopathic)
(iv) Community Health Centre (CHC): 23 (Allopathic)
(v) Primary Health Centre (PHC):115 (Allopathic including 7 Urban PHC)
(vi) Health Sub Centre (HSC):1001 (Allopathic)
(vii) Ayurvedic Dispensary: 39 (Ayurvedic Dispensary-36, Satellite Dispensary-2 and Rajbhawan Ayurvedic Clinic-1)
(viii) Homeopathic Dispensary:73

215. There are approximately 144 health care establishments with 2,366 beds in the state as per the data available. The data available though seems to be quite old as it is prior to the district reorganisation. The Tripura Health Assurance Scheme for Poor (THASP) offers financial support to the poor in the case of hospitalisation, to cover the cost of treatment of surgeries, therapies, critical illnesses and so on. Through it each family is granted a health cover up to Rs.1.15 lakh p.a. HIV/AIDS cases are monitored in the state (Tables 4-47 to 4-49). As per https://covid19.tripura.gov.in/ data, there are two active cases of COVID-19 as of 29 March 2022 in the state with 95,964 recovered cases and 881 death cases. There are 50 COVID-19 hospitals / safe houses spread across the state having a total of 3,485 beds available.[76]

Table 4.45 District Wise Inventory of Health Care Establishment in Tripura

Health Care Establishment	West Tripura	South Tripura	North Tripura	Dhalai	Total
Govt Hospitals & Dispensaries					
State Hospitals	4	-	-	-	**4**
District Hospitals	-	1	1	-	**2**
Sub-Division Hospitals	3	3	2	3	**11**

[76] https://covid19.tripura.gov.in/Bed_Availability_Status.html

Health Care Establishment	West Tripura	South Tripura	North Tripura	Dhalai	Total
Rural Hospitals	4	3	2	-	**9**
Primary Health Centers	15	18	18	11	**62**
BSF Hospitals	1	-	-	-	**1**
Army Hospitals	1	-	-	-	**1**
Police Hospitals	1	-	-	-	**1**
Dispensaries of Army, Assam Rifles, TSR, CRPF, BSF	28	7	5	3	**43**
Private Nursing Homes	10	-	-	-	**10**
Total	**67**	**32**	**28**	**17**	**144**

Source: http://trpenvis.nic.in/test/waste_management.html

Table 4.46 Bed Capacity of Different Health Care Establishments in Tripura

Health Care Establishment	West Tripura	South Tripura	North Tripura	Dhalai	Total
State hospitals	1054	-	-	-	1054
District hospitals	-	150	150	-	300
Sub-division hospitals	205	150	60	100	515
Rural hospitals	120	80	60	-	260
Defense/Police hospitals	87	-	-	-	87
Homoeopathic hospitals	20	-	-	-	20
Private nursing homes	130	-	-	-	130
Total	**1616**	**380**	**270**	**100**	**2366**

Source: http://trpenvis.nic.in/test/waste_management.html

Table 4.47 Year-wise Distribution of Testing for HIV and Found HIV Positive to October 2021

Year	Total No. of Testing for HIV	Total No. of HIV Positive	Positivity Rate (%)
2018-19	148046	338	0.23
2019-20	1,59,946	442	0.27
2020-21	1,26,629	487	0.38
2021-22 (April-October)	81258	560	0.68

Source: https://health.tripura.gov.in/

Table 4.48 District-wise Data for People Living with HIV in Tripura to October 2021

District	Total
West	564
Khowai	188
Sepahijala	137
Gomati	183
South	109
Dhalai	408
Unakoti	261
North	594
Other State	15
Total	2459

Source: https://health.tripura.gov.in/

Table 4.49 Migrant Labor STD/HIV Data up to October 2021

Indicator	2018-19	2019-20	2020-21	2021-22 (April-October)
Treated for STI/STD	342	330	170	113
Tested for HIV	6452	6455	5910	3066
HIV Positive	10	13	8	2

Source: https://health.tripura.gov.in/

216. **Water and Santitation.** In Tripura tap water is accessible by 33% of the households; ranging from about 54 % in urban areas to 25 % in rural areas. This is significantly less than the national average of 43.5 % of households. Wells and hand pumps are also important sources of water for 89% of the households in Tripura, more in rural areas than in urban areas. The other sources of water are as shown in Table 4-50.

Table 4.50 Number and Percentage of Source of Water by Different Types

House list Item	India	Tripura					
		Absolute Number			Percentage		
		Total	Rural	Urban	Total	Rural	Urban
Tap water	43.5	279,789	152,888	126,901	33.20	25.2	54
Tap water from treated source	32.0	171,167	69,003	102,164	20.30	11.4	43.5
Tap water from un-treated source	11.6	108,622	83,885	24,737	12.90	13.8	10.5
Well	11.0	230,576	215,219	15,357	27.40	35.4	6.5
Covered well	1.6	24,343	21,196	3,147	2.90	3.5	1.3
Uncovered well	9.4	206,233	194,023	12,210	24.50	31.9	5.2
Hand pump	33.5	152,365	102,071	50,294	18.10	16.8	21.4
Tube-well / Borehole	8.5	136,980	98,270	38,710	16.30	16.2	16.5
Spring	0.5	15,960	15,769	191	1.90	2.6	0.1
River / Canal	0.6	15,414	14,954	460	1.80	2.5	0.2
Tank / Pond /Lake	0.8	4,075	3,772	303	0.50	0.6	0.1
Other sources	1.5	7,622	4,836	2,786	0.90	0.8	1.2

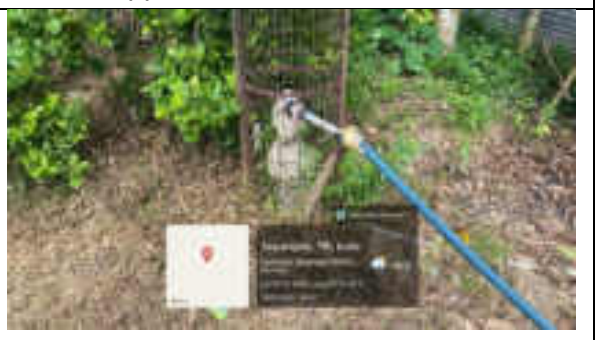
Source: Census of India Report, 2011

Figure 4.37 Photolog of Drinking Water Sources

Handpump: ESD Boxarnagar

Water storage at ESD Mandwi - ONGC tanker supplied

Water storage built by Mandwi Forest Range in ESD Mandwi



Bore well with pump in Manikyanagar village, ESD Boxarnagar

Supplied water at Kadamtala Substation

Handpump along 33kV Adarsha Nagar to College Tilla Distribution Line

Source: ADB TA Consultant

217. Drinking water and sanitation is provided in the state by the a dedicated wing under the Public Works Department. This wing was created on 1 April, 2008 and is responsible for implementation of all drinking water supply schemes and rural sanitation works for the entire State of Tripura. A total of 8,723 habitations in the state including those under the TTAADC is served by the wing. A range of schemes to tap both surface, ground and rain water are under implementation which include surface water treatment plants, deep tube wells, small bore tube wells etc. More than 88% of the population of the state and its capital city has access to safe water but issues include (i) insufficient water supply (a current level of 85 liters per capita per day against a target of 135 liters per capita per day); (ii) the excessive iron content in ground water, which poses a major challenge to the water supply system; and (iii) intermittent supply of about 2 hours a day.

218. Access to sanitation in Agartala is high (98% with individual toilets) but only 20% of the population is covered by sewage network. As per the Tripura Urban Development Department, around 74% of the total urban households have access to adequate sanitation facilities, while around 23% use unimproved facilities. Government of Tripura has taken extensive activities for bringing behavioral change along with construction of Individual House Hold Latrines for achieving Open Defecation Free (ODF) Status of all Gram Panchayats and Village Councils of the State. On 02.03.2019, the entire state of Tripura attained ODF status. As per the Swachh Bharat Mission[77] a total of 1,178 villages (Gram Panchayats) are Declared ODF of which 743 are verified ODF villages. Use of unsanitary toilets is common even after prohibition of dry latrines and drain discharge directly in to nearing water bodies. Private sewage treatment in the form of septic tanks is often used.

6. Literacy

219. The literacy and education are reasonably good indicators of development in a society. As per Census 2011, the literacy rate of Tripura was 87.22 percent against the population group consisting of 7 years and above, which were 73.20 percent in 2001 and 60.44 percent in 1991. The corresponding figures in 2011 for males and females were 91.5 percent and 82.7 percent, respectively. At the State level, gap in male-female ratio with respect to literacy has been reduced to 8.8 percent in 2011 as against 17.01 percent in 2001.

[77] https://sbm.gov.in/sbmdashboard/ODF.aspx

220. Tripura has achieved a high level of literacy at all India level and ranked third among the States after Kerala and Mizoram in 2011. As per report of 71st National Sample Survey (State Sector), the literacy rate of the State is 91.1 percent in 2014. Among the districts, west Tripura leads in the overall literacy which is 91 % and highest for both the sexes. Five out of the 8 districts are having more than 90 % of literacy rate. The detail on district wise literacy is given in Table 4-51.

Table 4.51 District and Gender Wise Literacy Level in Tripura

Districts	Male	Female	Total
West Tripura	94.04	88.01	91.07
Khowai	92.17	83.17	87.78
Sepahijala	89.8	79.49	84.78
Gomati	89.94	78.9	84.53
South Tripura	89.96	79.16	84.68
Unakoti	90.92	82.79	86.91
North Tripura	91.27	84.39	87.9
Dhalai	91.31	79.79	85.72
Total	**91.5**	**82.7**	**87.2**

Source: Census of India, 2011

221. **Scheduled Tribe Literacy.** The Census-2011 data reveals that the overall Schedule Tribe literacy rate reached to 79.05 percent from earlier 56.5 percent in 2001. The Schedule Tribe literacy rate has significantly increased during intra census period of 2001-2011 in the State, i.e., about 22.55 percent.

222. **Scheduled Caste Literacy.** The Scheduled Caste literacy rate has increased to 89.45 percent in 2011 from earlier level of 74.68 percent in 2001. During intra census period of 2001-2011 and increase of 14.77 percent is noticed for Scheduled Caste literacy.

223. **Language.** Bengali is the dominant language with 2,330,452 speakers (63.48%) followed by Kokborok or Tripuri with 950,875 speakers (25.9%). The Kokborok is spoken by the indigenous Tripuri people. Other languages include Chakma (2.17%), Hindi (2.11%), Mogh / Marma (0.97%), Manipuri (0.64%), Falam (0.62%), Bishnupriya Manipuri (0.6%), Garo (0.35%) & Others (3.04%). In the areas where other languages are spoken information dissemination will need to be provided in these local languages in addition to Bengali information.

7. Employment and Livelihoods

224. The main source of employment in the state is agriculture and contributes about 64% of total employment in the state and about 48% of the State Domestic Product (SDP). About 42% of the population is depending on agriculture and allied activities. The economy is characterized by high rate of poverty, low per-capita income, low capital formation, inadequate infrastructural facilities, geographical isolation, communication bottleneck, inadequate exploitation, inadequate use of forest and mineral resources, low progress in industrial field and high unemployment problem. Inadequate economic development of Tripura has a natural fall-out in terms of its capacity to generate employment opportunities. The organized private sector employment is practically missing. The Industry Sector has remained undeveloped so far, despite the vast potential.

225. Tripura is industrially backward and main reason for its backwardness is geographical isolation. Low availability of infrastructure has made the process of economic development and

decentralization extremely difficult. The provisional report of 7th Economic Census 2019 shows that about 783,694 persons are engaged in 511,127 establishments. The secondary sector contributes only about 5% of total employment and about 7% of the total income (SDP) of the state at present.[78]

226. **Agriculture.** Only about 26% of the land is cultivable, rest being hilly and forested. The cropping pattern in Tripura is characterized by two distinct farming systems i.e., settled cultivation in the plains and shifting cultivation in the hills. A section of the indigenous population practices jhum (slash and burn) method of cultivation. Paddy (rice) is grown in 55% of gross cropped area in three seasons viz. *Aush* (pre-Kharif), *Aman* (Kharif) and *Boro* (summer) whereas pulses and oilseeds cover about 5% of area. Kharif is the autumn crops sown at the beginning of the monsoon season. Fruits and vegetables are grown in 21% of gross cropped area, 10% area is under rubber cultivation and 9% under other miscellaneous crops like tea, medicinal plants etc. The major Kharif crops are rice, maize, pigeon pea, black gram, green gram, cowpea, ground nut, sesame, jute, Mesta, cotton, and Kharif vegetables. Different crops taken during Rabi season (crops sown around mid-November, preferably after monsoon rains) are rice, wheat, pea, green gram, lentil, rapeseed-mustard, potato, and Rabi vegetables. The state has favorable climatic conditions for cultivating various fruit and horticultural crops including rice, jackfruit, pineapple, potato, sugarcane, chili, and natural rubber. The major crops grown in plantations are tea, rubber, cashew, orange, and pineapple whilst jackfruit, banana, lemon, coconut, and areca nut are largely grown on the homestead. Tripura Forest Department had introduced rubber trees as early as 1963 in the form of trial plantations in localities like Patichhari and Manu. The State is the second largest producer of Natural Rubber in the country.

227. **Forest Produce.** Tripura has one of the oldest, richest, and most diverse cultural traditions associated with use of medical plants. There are large number of villages based herbal medicines practitioners who have traditional knowledge of herbal home remedies of ailments and nutrition. Besides the above registered medical practitioners of modified system of Indian Medicine (such as Ayurveda) use medical plants. The herbal medicines used by rural people including tribal have not yet been documented. Compiling an exhaustive inventory of medicinal plants in the State is the need of the hour. So far about 266 species of medicinal plants (68 trees, 39 shrubs, 71 herbs and 88 climbers) have been identified and documented. Bamboo plays a very vital role in the economy of the State as it serves the artisan and non-artisan users of the state. The productivity of bamboo at present is only 0.70 MT per ha/year.[79] Research studies in various forest divisions show that the productivity of bamboo can be increased to 5MT per ha/year in natural conditions with timely plantation and protection measures.

[78] https://tripura.gov.in/demographic-features
[79] https://forest.tripura.gov.in/forest-of-tripura#:~:text=Tripura%20has%20one%20of%20the,home%20remedies%20of%20ailments%20%26%20nutrition.

Figure 4.38 Medicinal plant *Cassius quadrangularis* (Hadjor) used by locals for joint pain and broken bone treatment in ESD Mandwi

Source: ADB TA Consultant

Table 4.52 Recorded/Unrecorded Removal/Use of Five Categories of Forest Produce

Produce	Recorded removal (million units)	Unrecorded removal (million units)	Actual removal (million units)	Value per unit (Rs.)	Value (in Rs. Lakhs)
Timber	0.012	0.034	0.046	2,000/m^3	680
Fuelwood	0.043	2.194	2.236	200/m^3	4,388
Thatch	0.13	0.213	0.343	80/ton	170
Fodder		1.53	1.53	500/ton	7650
Bamboo	109.76	75.50	184.26	50,000/million	38
Total					12,926

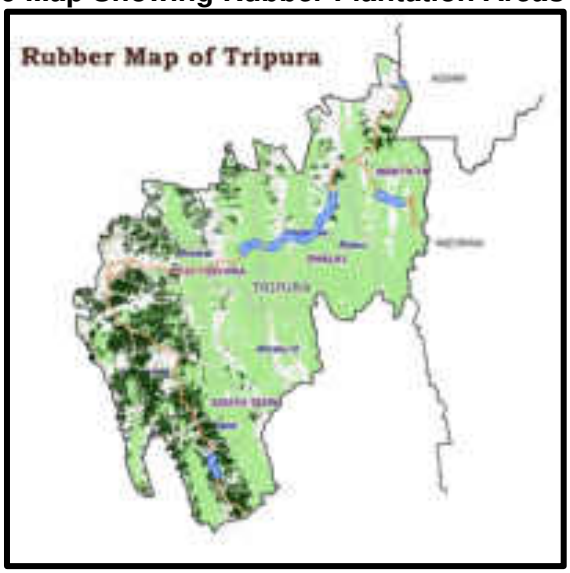
Source: MITCON

Table 4.53 Supply-Demand Timber

Forest produce	Average demand/ capita	Total users (in million)	Extraction/ annum (million units)	Sustainable yield (million units)	Gap (million units)
Timber	0.022 m^3	2.76	0.061	0.041	0.02
Fuelwood	0.806 m^3	2.57	2.07	1.485	0.585
Bamboo	42.76 No.	2.57	109.82	142.60	-
Thatch	0.124 ton	2.57	0.32	0.0127	0.32

Source: MITCON

Figure 4.39 Map Showing Rubber Plantation Areas of Tripura



Source: Tripura ENVIS

228. **Industry.** There are four medium scale industries (Bowry Plywood and Neramac Fruit Juice Concentrate Plant in North Tripura, Tea Factories and Jute Mills in West Tripura) besides the Baramora and Rokhia Gas Thermal Power Plants. There are five designated industrial estates in the state (Arundhutinagar Industrial Estates, Badarghat Industrial Estates, Dhajanagar Industrial Estates, Kumarghat Industrial Estates and Dharmanagar Industrial Estates). Most of the small-scale units are randomly located and no information is available about the actual number of operating industrial units in Tripura.

Table 4.54 List of Industrial Areas Under Various Categories

Name of Industrial Area	Location	Area (in Acres)
Arundhutinagar Industrial Estate	Arundhutinagar, Tripura West	9.39
Badarghat Industrial Estate	Badarghat, Tripura West	20.32
Dukli Industrial Estate	Dukli, Tripura West	37.50
Bodhjungnagar Growth Centre	Bodhjungnagar, Tripura West	238.53
Bodhjungnagar Export Promotion Industrial Park	Bodhjungnagar, Tripura West	123.20
Food Processing Technology Park	Bodhjungnagar, Tripura West	25.00
Kumarghat Industrial Estate	Kumarghat, Tripura North	45.66
Dharmanagar Industrial Estate	Dharmanagar, Tripura North	5.00
Dewanpassa Integrated Infrastructure Dev. Centre	Dewanpassa, Tripura North	45.00
Dhajnagar Industrial Estate	Dhajnagar, Tripura South	18.79
Integrated Infrastructure Development Centre	Tripura South	Site under selection
Integrated Infrastructure Development Centre	Dhalai	Site under selection

Source: Tripura ENVIS

229. **Work Force.** Census-2011 classified workers in two categories: main workers who worked for 183 or more days, and marginal workers who worked for less than 183 days in a year. The workforce data based on Census-2011 has been released by the Registrar General of India, New Delhi shows that the total number of workers (main and marginal) in the State was 14,69,521. Out of these total workers, 1,077,091 were the main workers and 3,92,502 were the marginal workers in 2011. The total male workers (main and marginal) were 1,045,326 and remaining 424,195 were the female workers in 2011. Out of the total worker (main and marginal), 1,116,076 (75.95 percent) were in rural areas and 353,445 (24.05 percent) were in the urban area in 2011, respectively. The proportion of total workers (main and marginal) in total population of the State was 40 percent in 2011, compared to 36.24 percent in 2001. The total main workers were 1,077,019 in 2011, out of which 887,881 (83.44 percent) were male main workers and 189,138 (17.56 percent) were female main workers.

Table 4.55 Details on Main and Marginal Workers

Items	Numbers	Main workers		Marginal workers		Main +Marginal workers	
		Numbers	%	Numbers	%	Numbers	%
Total population	3,673,917	1,077,019	29.32	392,502	10.68	1,469,521	40.00
Male	1,874,376	887,881	47.37	157,445	8.40	1,045,326	55.77
Female	1,799,541	189,138	10.51	235,057	13.06	424,195	23.57
Total population Rural	2,712,464	776,583	28.63	339,493	12.52	1,116,076	41.15
Male (R)	1,387,173	637,023	45.92	130,744	9.43	767,767	55.35
Female (R)	1,325,291	139,560	10.53	208,749	15.75	348,309	26.28
Total population Urban	961,453	300,436	31.25	53,009	5.51	353,445	36.76
Male (U)	487,203	250,858	51.49	26,701	5.48	277,559	56.97
Female (U)	474,250	49,578	10.45	26,308	5.55	75,886	16.00

Source: Census of India, 2011

230. **Work Participation Rate.** The work participation rate (WPR) stood at 39.99 percent in 2011 which were 36.2 percent in 2001 and 31.1 percent in 1991, respectively. The work participation rate among the rural population of the State was 41.15 percent in 2011. The similar work participation rate among the urban population was 36.76 percent in 2011. Male work participation rate for the State increased from 47.6 percent in 1991 to 50.6 percent in 2001 Census and further to 55.77 percent in 2011. Female work participation rate increased from only 13.8 percent to 21.1 percent in 2001 and further to 23.57 percent in 2011. Among the workers about 20% are cultivators and 24% are working as agricultural laborer. Thus 44.2% are directly engaged in agriculture and allied activities. Similarly, 2.8% are household industrial workers and majority about 53% are classified as other workers.

Table 4.56 Economic Classification of Workers–2011

Classifications	In Numbers			In Percentage		
	Total	Male	Female	Total	Male	Female
Cultivators	295,947	228,868	67,079	20.14	21.89	15.81
Agricultural labourers	353,618	214,106	139,512	24.06	20.48	32.89
Household industrial workers	41,496	17,458	24,011	2.82	1.67	5.66
Other workers	778,460	584,869	193,593	52.97	55.95	45.64
Total workers	**1,469,521**	**1,045,326**	**424,195**	**100.00**	**100.00**	**100.00**

Source: Census of India, 2011

231. **Per Capita Income**. The per capita income of the state was Rs. 47,155 in 2011-12 and it increased to Rs. 125,191 by 2019-20. The state stands at 21st position among the 33 states in term of per-capita income. The state per-capita income is less than the national average of Rs. 134,226 according to the Economic Review of Tripura for 2019-20. The Per Capita Income (PCI) is derived by dividing the Net State Domestic Product at current prices by the mid-year's total population of the State. The Per Capita Income (PCI) is a pointer for standard of living and the well-being of people.

Table 4.57 Per Capita Income of Tripura and All India (Base: 2011-2012)

Year	Tripura		All India
	Per Capita Income	Variation over previous year (%)	
2011-12	47,155		63,462
2012-13	52,574	11.49	70,983
2013-14	61,815	17.58	79,118
2014-15	69,857	13.01	86,647
2015-16	84,267	20.63	94,797
2016-17	91,596	8.7	1,03,870
2017-18(2nd RE)	1,00,444	9.66	1,15,293
2018-19(1st RE)	1,12,849	12.35	1,26,521
2019-20 (Advance)	1,25,191	10.94	1,34,226
2020-21 (Quick)	1,31,128	4.74	1,26,968

The expected growth in Per Capita Income is affected due to lockdown and slowdown of the economy in COVID-19 pandemic during 2020-21.
Source: Economic Review of Tripura 2019-20

8. Basic Amenities, Infrastructure, and Accessibility

232. **Energy Use and Electrification**. For cooking majority about 80.5% of the households in Tripura use firewood which is significantly higher than the national average of 49% according to the 2011 census. Besides firewood, about 18% uses LPG/PNG as cooking fuel. About 68 % of the households uses electricity for lighting and this comparable the national average of 67 %. As usual the urban areas are more electrified than the rural areas according to the 2011 census. Kerosene oil is used as another major source of light for the households in Tripura. The use of solar energy is higher in the rural area of Tripura which is higher than the national average. The details of sources of lighting are given in Table 4-59.

Table 4.58 Fuel Used for Cooking

Households by fuel used for cooking	India	Tripura					
		Absolute Number			Percentage		
	%	Total	Rural	Urban	Total	Rural	Urban
Firewood	49	6,78,178	5,66,977	1,11,201	80.5	93.3	47.3
Crop residue	8.9	6,573	5,105	1,468	0.8	0.8	0.6
Cowdung cake	7.9	1,173	763	410	0.1	0.1	0.2
Coal, Lignite, Charcoal	1.4	694	528	166	0.1	0.1	0.1
Kerosene	2.9	5,294	1,100	4,194	0.6	0.2	1.8
LPG / PNG	28.5	148,637	31,920	119,717	17.6	5.3	50.9
Electricity	0.1	299	223	76	0.0	0.0	0.0
Biogas	0.4	589	264	325	0.1	0.0	0.1
Any other	0.5	705	559	146	0.1	0.1	0.1
No cooking	0.3	639	340	299	0.1	0.1	0.1
Total number of households	246,692,667	842,781	607,779	235,002	100.0	100.0	100.0

Source: Census of India Report, 2011

Table 4.59 Number and Percentage of Household by Main Source of Lighting

Household by main source of lighting	India	Tripura					
		Absolute Number			Percentage		
	%	Total	Rural	Urban	Total	Rural	Urban
Electricity	67.2	576,787	361,573	215,214	68.44	59.49	91.58
Kerosene	31.4	245,373	2,28,953	16,420	29.11	37.67	6.99
Solar	0.4	15,868	13,368	2,500	1.88	2.20	1.06
Other oil	0.2	1,798	1,470	328	0.21	0.24	0.14
Any other	0.2	349	268	81	0.04	0.04	0.03
No lighting	0.5	2,606	2,147	459	0.31	0.35	0.20
Total number of households	246,692,667	842,781	607,779	235,002	100.00	100.00	100.00

Source: Census of India Report 2011

233. The transmission system is primarily fed through Power Grid Corporation of India Ltd. 400 KV Palatana–Silchar double circuit lines. In addition to the state level network, Tripura is also interconnected with other states and Bangladesh to facilitate power export. There are a total of 70 substations of various capacities. Although, based on government records, Tripura is 100% electrified, there are pockets of rural communities and individuals not having legal/metered electric power installed in the premises, as was observed in Manikyanagar village in Sipahijila District. Total consumers (including domestic, commercial, industrial, public lighting, mobile towers etc.) connected to power distribution in the state is 825,938 as of March 2019. Domestic consumers form 55% of the total consumers. The distribution network in the state is maintained by TSECL and there are a total of 46 substations (33/11 kV) and has 29,389 ckm of low tension lines, 14,819 ckm of 11 kV and 891 ckm of 33 kV lines for a total of 45,099 ckm lines. There are also 15,403 distribution transformers in the state.

234. A number of incidents related to Operational Health & Safety (OHS) of TSECL frontline staff and community health and safety (CHS) regarding electrcial supply issues have been noted

in the past and reported in newspapers.[80] At times these issues have led to conflict with the local communities. Many of these incidences primarily are a result of poor health and safety for workers and poor awareness amongst the general public on the risks of live electricity.

235. **Household Assets and Communication.** According to the 2011 census only about 45% of the households possesses a television significantly more households in urban areas than the rural areas. This is comparable to all India average of 47% in 2011. Only 7% possesses a computer in Tripura against the national average of 19%. About 94% were having either a landline or a mobile in the state which is higher than the national average of 82%. Four wheelers were there with only 2% of the households and 8% were having a two wheelers. The detail on assets possessed by households is given in Table 4-60.

Table 4.60 Possession of Household Assets Tripura

Assets	Numbers			Percentage		
	Total	Rural	Urban	Total	Rural	Urban
Radio/Transistor	1,07,995	80,746	27,249	12.8	13.3	11.6
Television	3,77,988	2,05,683	1,72,305	44.9	33.8	73.3
Computer/Laptop with internet	8,612	2,489	6,123	1	0.4	2.6
Computer / Laptop without internet	53,344	1,989	21,355	6.3	5.3	9.1
Landline only	4,05,115	2,33,957	1,71,158	48.1	38.5	72.8
Mobile only	3,60,143	2,14,022	1,46,121	42.7	35.2	62.2
Both	27,481	9,956	17,525	3.3	1.6	7.5
Bi-cycle	3,31,560	2,23,872	1,07,688	39.3	36.8	45.8
Scooter/ Motorcycle / Moped	69,463	28,451	41,012	8.2	4.7	17.5
Car/Jeep/Van	18,443	7,839	10,604	2.2	1.3	4.5
Total number of households	8,42,781	6,07,779	2,35,002	100	100	100

Source: Census of India Report 2011

236. **Education Facilities.** Tripua has all levels of eduation facilities, including schhols, colleges, universities and technical institutes. Although primary and high schools are found across the state in rural and urban areas, the colleges and universities are concentrated in the major town and cities including Agartala. 4,350 teaching-learning centers have been opened in all the Gram Panchayats, Village committees, Blocks, Nagar Panchayat areas of Tripura and 3,056 literacy workers have been engaged to cover 70,425 identified neo-literates. In all Panchayats, monitoring committees have been formed to encourage as well as to supervise the regular attendance of the learners.

Table 4.61 List of Higher Education Infrastructures in Tripura

University Name	University Type
Maharaja Bir Bikram University, Agartala	State Public University
National Institute of Technology, Agartala	Institute of National Importance
The ICFAI University, Kamalghat	State Private University
Tripura University, Suryamaninagar	Central University

Source: https://highereducation.tripura.gov.in/content/other-colleges-tripura

[80] https://nenow.in/north-east-news/tripura/power-crisis-hits-tripura-residents-vandalize-power-stations-in-agartala.html

Table 4.62 School Eduction in Tripura (2021)

Parameters	Status
Type-wise total no. of Schools (including Madrassa[81])	
J.B.	2547
S.B.	1230
High	688
H.S.(+2 stage)	469
Total	**4934**
Stage-wise Enrolment in Schools (including Madrassa)	
Pre-Primary	28,474
Primary	31,8457
Upper Primary	18,4264
Secondary	107,950
Higher Secondary	66,858
Total	**706,003**
Facility-wise no. of schools (including Madrassa)	
Water	4352
Boys Toilet	4813
Girls Toilet	4830
Electricity	1366
Playground	3002
Rumps	2407
Library	2094
Computer	758

UDISE: Unified District Information System for Education; JB: Junior Bpard; SB: Senior Board; HS: Higher Secondary; GIA: Grant in Aid; SPQEM: Scheme for Providing Quality Education in Madrasas
Source: https://schooleducation.tripura.gov.in/at_a_glance

237. **Transport and Communication.** For a total of 962 Gram Panchayat and 16 towns/ notified area, the state has 333 km of National Highway, 454 km of major district roads and 1463 km of other district roads and 3,652 km of village roads. Besides road communication, the railway line is currently confined to only 44.72 km in this land locked State of North East India. Considering the entire network of road, the total road length stands at 15,177 km. Of these, 3523 km are black topped, 2,589 km are brick soled and 9,065 km are earthen. state has 6 National Highways with total length of 853.81 km and 4 in-Principal declared National Highways for a length of 229.25 km. The state also has 1,057 km of State Highways and 454 km of Major District Roads roads, 1,463 km of other district roads, and 3,652 km of village roads.[82] Agartala, the capital city of Tripura is connected with railway link with the rest of the country through broad gauge and the railway route is connected upto Garji of Gomati district of the State. The state is also connected through the rest of the country by the Agartala Airport. Communication network is maintained through mobile and telephone service providers. There are some areas in the state especially in the forested and hilly areas and border areas where mobile networks is very poor. The number of vehicles in public transport system is only 1,349 vehicles for 3.1 million people (2000-2001).

[81] Madarsa: a Muslim school, college, or university that is often part of a mosque.
[82] http://trpenvis.nic.in/test/doc_files/TripuraAtAGlance.pdf

Figure 4.40 Road Network Map of Tripura

Source: https://pwd.tripura.gov.in/index.php/2021-01-14-09-28-05/road-maps

9. Solid and Hazardous Waste and Management

238. **Solid Waste**. Tripura has no masterplan for solid waste management even in major urban centers including the capital city of Agartala. According to the Agartala Municipal Council:

(i) Waste Generated from door-to-door collection 20 MT/Day
(ii) Waste Generated by Vegetable Markets, Fish Markets, Mandis etc. 60 MT/Day
(iii) Waste generated by workshops/garages/electronic waste 4.5 MT/Day
(iv) Commercial waste (hotels/shops/institutions) 30 MT
(v) Dead Animals/Carcasses 0.5 MT
(vi) Waste thrown collected by Sweeping and construction debris 125 MT
(vii) Drain silt 10 MT
(viii) Total daily Solid Waste Generation 250 MT/Day[83]

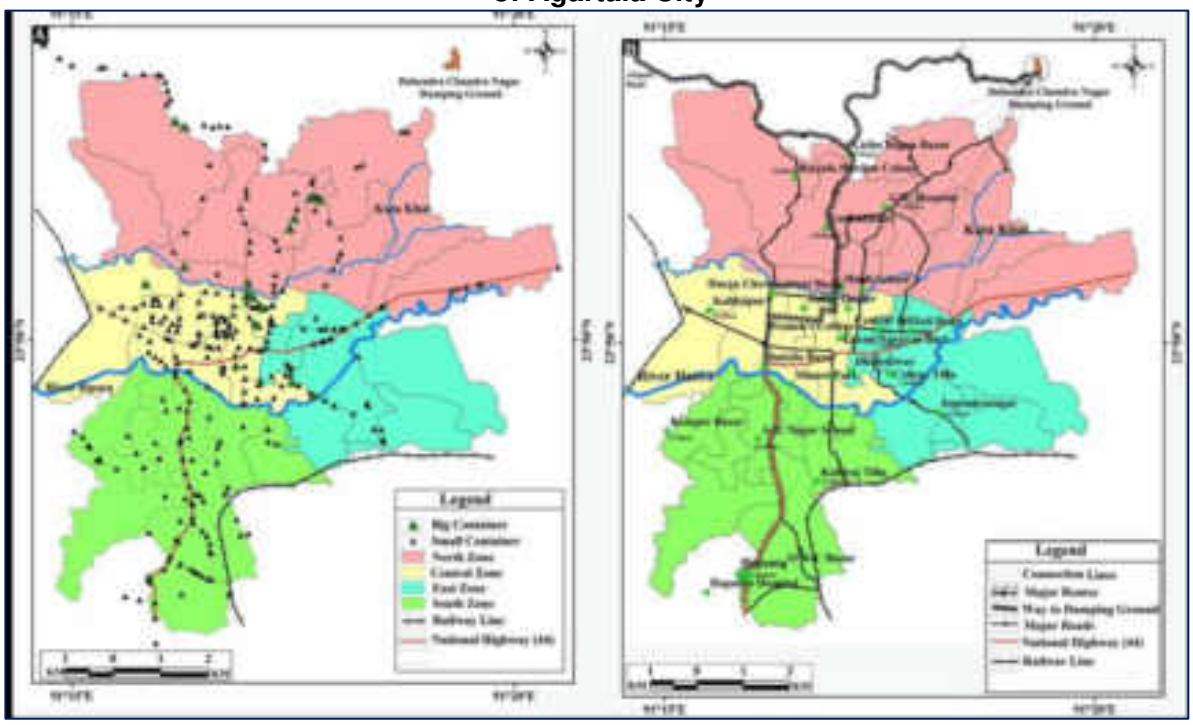
239. House to house garbage collection under some wards of Agartala (coverage of 30 to 40%) is being done by NGOs using tricycles and auto rickshaw. Agartala Municipal Council has also placed more than 500 number of medium (1.1 cubic meter) and large size (4.5 cubic meter) bins/containers by the side of major roads and in market and commercial areas. Daily more than 400 sweeping staff sweep the roads and market areas, and garbage is collected in above said bins.

240. Solid waste is transported to the dump yard of Agartala Municipal Council which is about 15 km away from the main city of Agartala. On an average 25 vehicles of Agartala Municipal Council move daily twice or thrice for this purpose. As per the standard calculation about 40

[83] Agartala MC

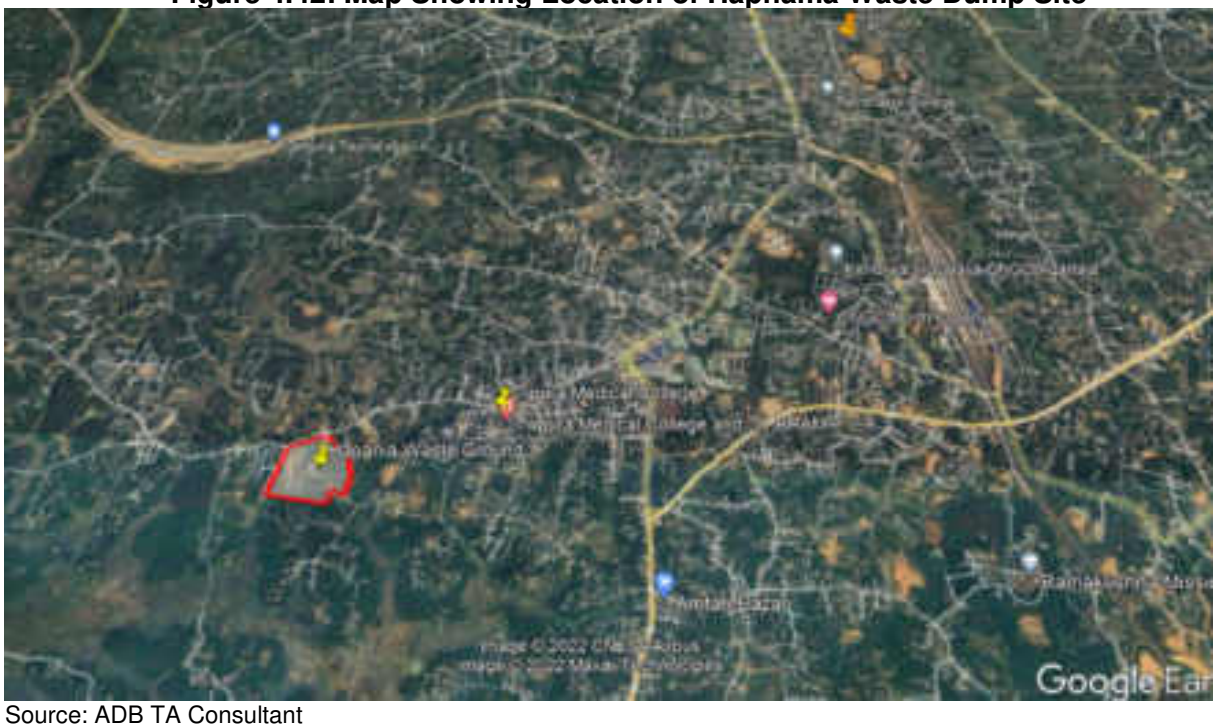
vehicles make three trips. For this 280-300 laborer are engaged, lifting the garbage from the roadside and from the drains and also from various dustbins/containers. All the garbage thus collected from the city is disposed in two open dump yards by way of landfill without proper processing. There is some facility for processing of garbage at Debendra Chandra Nagar dump yard, but it is not so scientific and sufficient. Hence most of the garbage is dumped without processing. The other is Haphama Dumping Ground–it is an open dump and not an engineered sanitary landfill.

Figure 4.41: Zone-Wise Distribution of Solid Waste Containers (Small and Big Size) (A) and Waste Disposal Flow Map (B) (Showing Debendra Chandra Nagar Dump Site) of Agartala City



Source: ResearchGate; Santra et al, 2017

Figure 4.42: Map Showing Location of Haphama Waste Dump Site



Source: ADB TA Consultant

Figure 4.43: Waste Dump in Agartala Outskirts

Source: CN NEWS

Figure 4.44: Municipal waste dumping along with electrical cables, e-waste on roadside (Bodhgangnagar-Adarsha Colony distribution line route)

Source: ADB TA Consultant

Figure 4.45: Open Municipal Solid Waste Dump near ground/tea plantation, adjacent to Gokulnagar Test Laboratory site

Source: ADB TA Consultant

241. **Hazardous Waste.** As majority of the production units in Tripura are small-scale units, Material Safety Data Sheet (MSDS) are not generally available, thus limiting the inventory of hazardous waste to medium-scale and large-scale industrial units only. Based on the available information an inventory of hazardous waste generating units has been prepared by the National Productivity Council in 2001, Delhi to the State Pollution Control Board, Tripura. Highest quantum of hazardous waste is generated from processing of latex (88,000 m^3/year) with approximately 67% generated from West district and balance 33 % is spread in remaining three districts. About 0.8 MT/year of waste is generated from photo printing units in Tripura and the majority is drained to the municipal drains. 240 MT / year of spent acid is generated from lead acid battery reconditioning which is again drained into municipal drains while 1200 MT of lead scrap is sold out to traders for reclamation of lead outside Tripura. Automobile servicing centers generate 198 MT of oil sludge and about 13.2 MT of waste cloth contaminated with oil a year. The oil containing sludge is sold out while the waste cloth is generally burnt. The wastewater containing spent azo-dyes generated from dyeing of cotton yarns and printing of textile is being discharged into ground water without any treatment through digging the wells right up to aquifer. Presently there is a tannery unit in West district of Tripura which does not have a wastewater treatment plant. Remaining hazardous wastes are in very small quantity. In summary, it is apparent that at present no proper systems of hazardous waste management exist in Tripura. A summary of hazardous waste generation are provided in in Table 4-63 and Table 4-64. There is virtually non-existent system of biomedical waste and no hazardous waste management facilities in Tripura. Thus, no waste management system can be utilized for the distribution components.

242. Currently all old and defunct transformers are either stored within the TSECL's premises (substations and other site offices) until repair or if major maintenance issues occur sent to TSECL's workshop at Agartala (79 Tilla). A suitable facility for transport is not available and they are dispatched in open trucks. Drained oils are stored in drums and recycled within the transformers brought in for repair and sometimes sold to other small-scale industries/end users. The old batteries are mainly stored within TSECL's premises. Used oils are also kept in barrels within the premises of TSECL's substations and workshops. These are auctioned or sold to approved vendors from time to time. The existing workshop cum store caters to initial repairs to broken transformers, spare part repair/changes, storage of scrap and end of life transformers and other distribution line electricals and systems. The photographs of the workshop are given in Figure 4-46. Presently, TSECL is in the process of appointing a vendor to dispose all the defunct transformers and batteries and wastes that may emerge from these.

Table 4.63 District wise distribution of Hazardous Waste Generating Units in Tripura

Industrial Sectors	West Tripura	South Tripura	North Tripura	Dhalai	Total no. of units	Waste Type
Drug intermediate producing units	1	-	-	-	1	Different process residues
Pharmaceuticals	5	-	-	-	5	Different process residues
Latex producing units	12	7	8	4	31	Non-emulsified latex residue & wastewater
Lead acid batteries reconditioning	60	25	10	5	100	Spent H_2SO_4, exhausted lead plates with PVC separators
Small printing press	60	14	13	6	93	Paper cloth containing printing ink residue, Lead letters
Government printing press	1	-	-	-	1	

Industrial Sectors	West Tripura	South Tripura	North Tripura	Dhalai	Total no. of units	Waste Type
Newsprint (Letter printing)	29	-	-	-	29	
Newspaper print (offset)	9	-	-	-	9	
Photo printing	15	10	5	5	40	Different photochemical
Leather tanning	1	-	-	-	1	ETP sludge contaminated with Chromium
Textile and handloom dying and printing	7	-	-	-	7	ETP sludge from wastewater treatment
Aluminium product with melting facility	2	-	-	-	2	Aluminum slag
Timber processing	1	-	-	-	1	Spent wood preservatives
Repairing and servicing of automobiles	80	19	33	10	142	Spent oil, oil emulsion, cloths contaminated with oil
Total					**462**	

ETP = effluent treatment plant, PVC = polyvinyl chloride
Source: http://trpenvis.nic.in/test/waste_management.html

Table 4.64 District Quantification of Hazardous Waste Generation in Tripura

Industrial sector	Waste type	Quantity in MT/year				
		West	South	North	Dhalai	Total
Lead acid battery reconditioning	Spent acid	144	60	24	12	240
	Lead scrape	720	300	120	60	1200
Printing press	Paper cloth containing printing ink residue	9	2	1	0.9	14.1
	Lead letter	0.42	0.09	0.09	0.04	0.06
Newspaper print	Developer residue	0.5	-	-	-	0.5
	Fixer residue	0.5	-	-	-	0.5
Photo printing	Developer residue	0.18	0.12	0.06	0.06	0.42
	Fixer residue	0.18	0.12	0.06	0.06	0.42
Leather tanning	ETP sludge contaminated with chromium	159	-	-	-	159
Textile and handloom dying	ETP sludge from wastewater treatment	4.3	-	-	-	4.3
Aluminum product with melting facility	Aluminum sludge	18	-	-	-	18
Pharmaceuticals	Process residue	0.04	-	-	-	0.04
Use and production of latex	Latex emulsion residue (wastewater)	52800	13200	13200	8800	88000
Timber treatment	Residue from the use of the wood preservatives	0.024	-	-	-	0.024
Drugs intermediate production	Distillation residue	0.05	-	-	-	0.05
Repairing and servicing of automobiles	Oil containing sludge and oil emulsion	112	26	46	14	198
	Cloths contaminated with oil	7.4	1.7	3	0.9	13.2

ETP = effluent treatment plant
Source: http://trpenvis.nic.in/test/waste_management.html

Figure 4.46: Photographs of The Existing Repair Workshop Near 79 Tilla

	Faulty material/scrap storage area inside workshop.
	Faulty material/scrap storage near entrance due to lack of space inside workshop. Workshop in densely built-up area, on a busy road and locals can easily assess scraps (community H&S risk).
	Entrance showing rails for receiving transformers inside workshop. Floor is impermeable but damaged, top layer scraped and oil is smudged from dripping/leaking equipment.

	Transformer holding zone before repair
	Defunct transformer storage
	Workshop arrangements

	Used oil storage
	New oil drums with rusting
 	Transformer storage in the 79 Tilla TSECL Workshop

Source: ADB TA Consultant

10. Key Socioeconomic Aspects

243. Summary of the key socioeconomic aspects in the PAI are given in Table 4-65.

Table 4.65 Summary of Socioeconomic Setting of the Project Area of Interest

Component	Subproject	Location	Key environmental features in PAI
Substations, RMU and Test Laboratory	Total 27 Substations, Test Laboratory	Tripura	• Vangmung and Damcharra Substations close to border with Mizoram state, these areas have a high percentage of tribal population. • Killa, Mandai, Takarjala, Manu, Chawmanu and Vangmung are located within the Tripura Tribal Areas Autonomous District Council (TTAADC) Areas. • Land belongs to TSECL, no private land or property involved. • Land adjacent includes habitation, distance to nearest properties varies between 0-5m (Damchara Substation), 5-10 m (Durjanagar, Mandwi, NSRCC, Chawmanu Substation) to >50m up to 150 m (Adarsha Nagar, College Tilla Substation). • Sensitive receptors including schools / educational institutes and hospitals within the PAI of the substations and test laboratory especially Substations at Rangrung, Tilabazar, Kailashahar, Adasah Nagar, and College Tilla substations • No surface water within the sites (see physical environment) with adjacent surface water use limited to limited to cleaning and washing • Groundwater is used by local communities (drinking water) • Existing road network available but entry to the Chawmanu Substation needs to be repaired and connected to the access road in front for entry of vehicles. • Humans or animals can easily access the substation area, control room, as well as the switch yards. Cattle and livestock were observed to be inside the substation areas in some cases. • Conflicts reported by TSECL staff in Kadamtala Substation where public agitation is due to frequent power failure and a lack of timely restoration (maintenance)
2667.46 ckm of 33 kV, 11 kV, and low tension distribution lines	• New 33 kV Line (UG): 163 km	Tripura	• Some routes pass through tribal areas/TTDAC area. • Land use in the PAI include settlements, roads, rubber plantations, commercial land, and cultivations.

Component	Subproject	Location	Key environmental features in PAI
	• New 33 kV Line (CC): 107 km • New 11 kV Line (UG): 4.2 km • New 11 kV Line (CC): 1270 km • Conversion of 11 kV Line to CC: 134 km • Conversion of 11 kV Line to UG cable: 89.26 km • Conversion of low tension (0.4 KV) Line to Aerial bunched cable: 900 km		• Sample route alignments visited were mostly along roads but also crossing rubber plantation, agricultural croplands, houses and private properties where safety clearances need attention. • Along the roads in the urban/semi urban areas are entrances to private properties; houses, shops, business such as garage/car repairs, welding and fabrication. • Individual properties were recorded encroaching into the RoW and safety clearances in the tribal areas and Agartala city area. • Road and rail crossings were present, for rail crossings they will need to be underground or passing through pipes in rail over bridges. • No ponds were observed in the ROW. Human use of surface water is mostly limited to cleaning and washing whilst ground water is used for drinking purposes across most of the PAI • Sensitive land use like schools and hospitals were recorded in both rural and urban alignments mostly outside the ROWs.

MRSS = main receiving substation, NRSCC = Netaji Subhas Regional Coaching Centre, PAI = project area of influence, ROW = right of way, TSECL = Tripura State Electricity Corporation Limited, TTAADC = Tripura Tribal Areas Autonomous District Council
Source: ADB TA Consultant

H. Statewide Physical Cultural Resources

244. Tripura is home to various important physical cultural resources as discussed in this section.

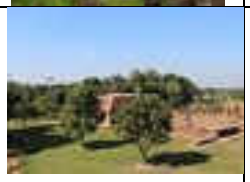
1. World Heritage Sites

245. There are no UNESCO world heritage sites in Tripura.

2. National and Other Designated Cultural Heritage Sites

246. There are 8 monuments of national importance in Tripura that has been recognised by Archaeological Survey of India as per Table 4-66.

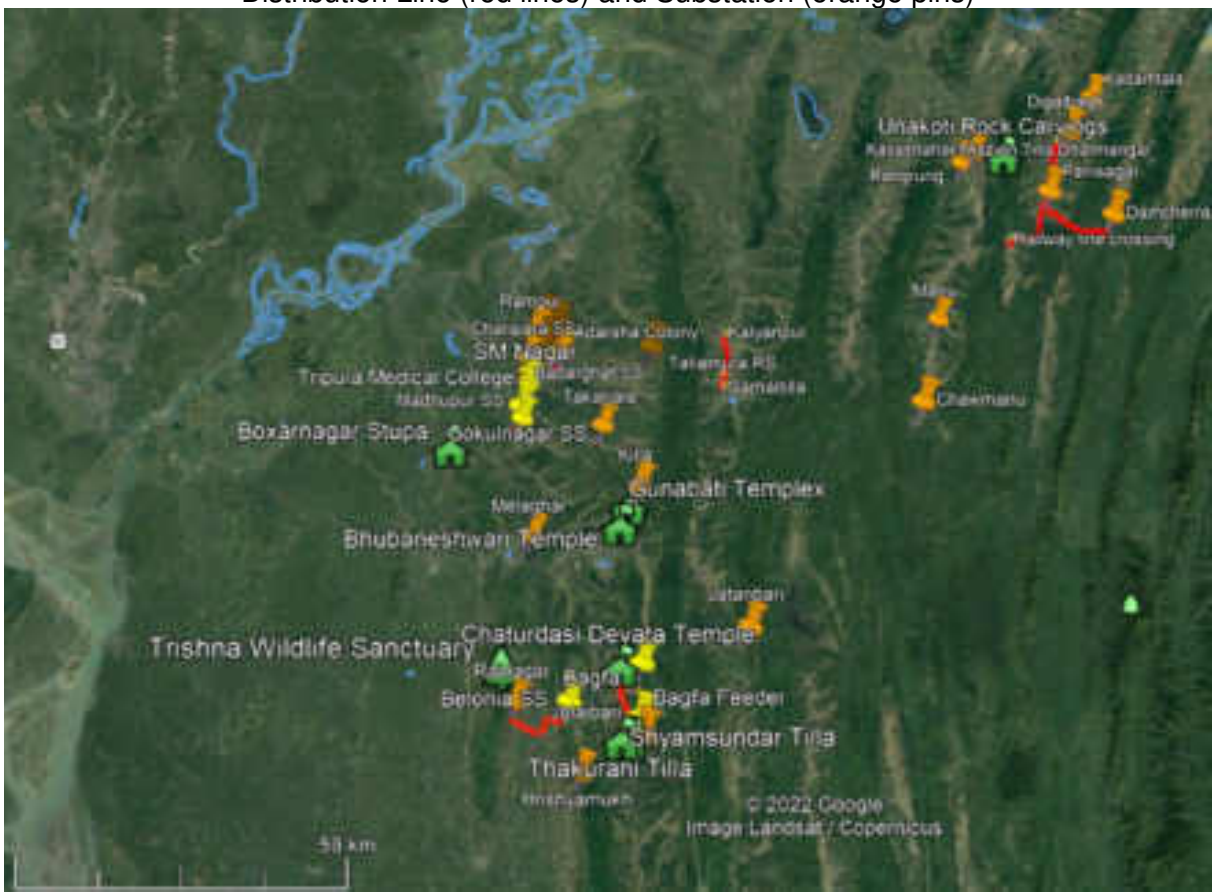
Table 4.66 Physical/Cultural Resources in Tripura

ASI Monument ID	Image	Name/ Description	Nearest Distribution Line/ Substation*	Distance (km)	District	Coordinate location
N-TR-1		Sculptures and rock reliefs of Unakoti	Kailashahar Substation	6.85	Unakoti district	24°19'0.91"N; 92° 4'0.80"E
N-TR-2		Ancient remains in Baxanagar (Buddhist monument)	Conversion of low tension line under Boxanagar Electrical Sub Division (ESD)	Road passing through the ASI protected monument, in prohibited zone (see footnote 33).	Sipahijila district	23°36'58.15"N; 91° 9'59.25"E
N-TR-3		Gunavati Group of Temples, Radha Kishorpur (ancient temples)	New 33 kV Line on Covered Conductor from 33 KV Bagma Substation to 33 KV Udaipur Power House Substation New 33 kV Line on Covered Conductor from 132 kV Bandwar Substation to 33KV Killa Substation	4.4 km	Gomtai district	23°34'36.75"N' 91°30'41.20"E
N-TR-4		Temple of Chaturdasa Devata, Radha Kishorpur (group of temples)	Killa Substation	8km	Udaipur district	23°32'24.00"N; 91°29'58.78"E

ASI Monument ID	Image	Name/ Description	Nearest Distribution Line/ Substation*	Distance (km)	District	Coordinate location
N-TR-5		Bhubanes-wari Temple, Rajnagar,	New 33 kV Line on Covered Conductor from 33 kV Bagma Substation to 33 kV Udaipur Power House Substation	603m	Gomtai district	23°32'29.42"N; 91°30'15.57"E
N-TR-6		Thakurani Tilla, Paschim Pillak, Jolaibari (rock sculpture)	Jolaibari Substation New 33 kV Line on Covered Conductor from 66 kV Bagafa Substation to 33 kV Jolaibari Substation Conversion of low tension (0.4 kV) Line to Aerial buched cable under Jolaibari ESD	2.97 km from Jolaibari Substation Distance for low tension lines to be confirmed during site survey (if in 300m see footnote 33)	South Tripura district	23°12'14.45"N; 91°35'31.65"E
N-TR-7		Ancient Mound called Shyam-sundar Ashram Tilla, Baikhora Jolaibari		3km from Jolaibari Substation Distance for low tension lines to be confirmed during site survey (if in 300m see footnote 33)	South Tripura district	23°12'23.22"N; 91°36'13.87"E
N-TR-8		Ancient Mound known Puja Khola, Paschim Pillak, Jolaibari		1.5km from Jolaibari Substation Distance for low tension lines to be confirmed during site survey (if in 300m see footnote 33)	South Tripura district	Lat. 23° 37' N; Long.91 36' E

*Nearest components and distances subject to reconfirmation following route alignments and mapping of low tension lines by the EPC contractor
ASI = Archaeological Survey of India, ESD = Electrical Sub Division
Source: ADB TA Consultant

Figure 4.47 Map Showing ASI Monument Sites
Distribution Line (red lines) and Substation (orange pins)



Source: ADB TA Consultant

247. Other than the above national monuments protected under ASI, Ujjayanta Palace at Agartala (within 893m from NSRCC Substations in Agartala), Neermahal Water Palace at Melaghar (2.9 km from Melaghar Substation), Tripureswari temple in Udaipur, Chandrapur Mosque, Rajpur and Mahamuni Buddha Mandir at Manu Bankul village are state protected monuments in Tripura.

Table 4.67 State Protected Monuments in Tripura

Image	Name/Description	Nearest Distribution Line / Substation*	Distance (km)	District	Coordinate location
 Source: ADB TA Consultant	Ujjayanta Palace, Agartala: example of neoclassical style of early 20th century designed by Sir Alexander Martin for Maharaja Radha Kishore Manikya. The complex of site area 800 acres comprises of the two storied Palace building with central dome, symmetrically landscaped grand entrance promenade in between two ponds, Chhatris, rear garden, north gate and Astabal. The palace has historical association to the Manikya dynasty, the rulers of Tripura before merger into India. Ujjayanta palace presently accommodates the State Museum of Tripura.	New 33kV underground Badarghat to Rampur Substation NRSCC Substation	800m 823m	West Tripura	23°50'12.94"N 91°16'57.82"E
 Source: Gosahin	Neermahal Water Palace, Rudrasagar: Neermahal literally means Water Palace. The place is a picturesque fairytale Royal mansion located in the middle of the Rudrasagar Lake which is 53 km South of Agartala. Maharaja Bir Bikram Kishore Manikya built the palace in 1930 A.D as his summer residence being inspired by Mughal Style of Architecture.	Melaghar Substation	2.9km	Sipahijila	23°30'23.04"N 91°18'53.88"E
 Source: ADB TA Consultant	Tripureswari temple located in Udaipur. King Dhanya Manikya founded the Tripura Sundari Temple in the year 1501. The temple consists of a square type of sanctum of the typical Bengali hut type structure with a conical dome. Though the influence of medieval Bengal “Char Chaala“(four slanted roof) temple architecture is clearly visible, such a blend is unique to this place and Tripura could distinctly claim this as its own architectural style. The tortoise present in the lake in huge numbers specially worshipped by the locals.	ESD Matabari	1km (low tension line route to be mapped)	Gomati District	23°30'32.53"N 91°29'53.61"E

Image	Name/Description	Nearest Distribution Line / Substation*	Distance (km)	District	Coordinate location
 Source: IGNCA	Chandrapur Mosque, Rajnagar overlooking the plains of Bangladesh and Tripura from a hillock was restored in 1992. Experts attribute the construction of Rajnagar Maszid to the commander of the Mughal army which invaded Tripura in the year 1618 during the reign of king Yashodhar Manikya.	ESD Rajnagar	11km	South Tripura	23°08'9.79"N 91°20'46.98"E
 Source: tripuratourism	Mahamuni Buddha Temple, Belonia. It is famous for its ancient Buddhist monastery. The monastery bears the Buddhist idioms of expressions in religious architecture and was constructed under the leadership of Mathu Mog and others a long time ago. A beautiful pagoda was also built at Mahamuni. A famous weeklong fair is held every year in the month of March-April. The Temple attracts thousands of Buddhists and non-Buddhist pilgrims from every corner of the state as well as from neighbouring countries like, Myanmar, Thailand, Sri Lanka and Bangladesh.	ESD Sabroom	8-10km, low tension line routes not mapped	South Tripura	23°07'2.42"N 91°42'4.83"E

Nearest components and distances subject to reconfirmation following route alignments and mapping of low-tension lines by the EPC contractor
Source: ADB TA Consultant

3. Locally Important Physical Cutural Resources and Festivals

248. Agartala city has a lot of temples, churches, mosques and monastery, some of which are over 150 to 200 years old. Some of the famous religious institutions include Buddha Mandir, Mother Theresa Ashram, Ramkrishan Ashram Vidyamandir among many others. The city has a Universal Prayer Hall, where people can come and pray.

249. Since Hinduism is predominant in this region, common festivals of Hindus like Holi, Rath yatra, Durga puja, Kali puja, Diwali are quite common to be celebrated. Main festival for the Muslim population is Eid which is celebrated during April-May every year. Apart from these, many tribal festivals such as Kharchi Puja, Ker Festival, Garia Puja, Ganga Puja are celebrated. In the TTAADC Goria festival is an important annual celebration, which is celebrated in the months of March/April.

250. Folk culture of the tribal and non-tribal people of the state forms the backbone of Tripura's cultural tradition. This is reflected as much in the delicately rhythmic physical movement of the 'Hoza Giri' dance of the Reang tribesmen as in the collective musical recitation of 'Manasa Mangal'

or 'Kirtan' (devotional songs in chorus) of the non-tribals. Apart from this, the 'Garia' dance of the tribals, organized on New Year festivities and worship of 'Garia', and 'Dhamail' dance of the non-tribals, organized on familial occasions like wedding ceremony in rural areas as well as musical duels (Kabi Gaan) between two rival rhyme-makers on public platforms form the staple of Tripura's folk culture enriched by myths and legends of tribal society over the past half a millennium.

Table 4.68 Main Festivals in Tripura

Festival	Photo
Rudrasagar Lake - also known as Rudijala is a famous lake which is situated in the Melaghar Block under Sonamura Sub-Division in the West Tripura District in Tripura, India. An annual boat festival is organized in July/August.	 Source: deccanchronicles.com
Kharchi is one of the most popular festivals of Tripura. However, given the participation of people transcending the communities, it has gained a universal character. It is also said to have been influenced by the Brahmanical Hindus. The festival associated with the indigenous tribal deities is held in June-July at old Agartala. The ceremonial worship starts a day before the festival. Buffalo, richha, he-goats, eggs, bamboo poles and pipes, umbrella, earthen pot, duck, pigeon, bamboo stick, thread, cotton, turmeric, vermilion, wine, banana leaves and rice are some of the important ingredients for the worship. “Chantai” or the chief priest chants mantras and his assistant sacrifices the animals. A grand colorful fair held on this occasion continues for seven days. The uniqueness of the festival lies in the fact that this becomes a symbol of peace, harmony, and fraternity as people irrespective of cast, creed, and religious flock to the place to the celebrate the festival.	 Source: hellotravel.com
Diwali festival is observed in Tripura Sundari Temple, Matabari, Udaipur, Gomati district. This is one of the fifty-one Hindu pithas of India which is recognised as a holy and sacred place in Tripura. Devotees from both tribals and non-tribals observe this festival with great enthusiasm and take bath in the lake of the temple paying their homage to Mother Kali. A grand fair is also organized during this festival for two days at the festive month October/ November.	 Source: telegraphindia

Festival	Photo
Both tribal and non-tribal people assemble every year on the Uttarayan Sankranti for a holy dip in the river Gomati at its place of origination, known as Tirthamukh. The devotees take a holy dip in the river on the day which marks the commencement of the Sun's northern course- the last day of the month of Pousa (middle of the month January). Surrounded by high hills, Tirthamukh in South Tripura district is a unique place of belief frequented specially by the Tripuries to realise their own pledges throughout the year. But on the day of 'Poush Sankranti' this place becomes a confluence of thousands of people. Since ancient days Tirthamukh had been a holy place of the Hindu Tripuri tribals. On the specific day people flock to the place to shave their head in the name of their ancestors or worship deities and perform individual sacrifices and ritual to propitiating the souls of departed ancestors. Based on this occasion a two-day long fair is also held.	 Source: Rupa The Wanderer

Source: ADB TA Consultant

Table 4.69 Festival Locations and Dates in Tripura

Name of the Festival	Venue	Tentative Schedule
Garia Puja	All over the state	Seventh day of the Bengali month of Baisakh (3rd week of April) for seven days
Asokastami Festival	Unakoti Archaeological Sites, Kailashahar, Unakoti District	Every year in the month of February
Pilak Festival	Pilak Archaeological Site, Jolaibari, South Tripura District	Every year in the month of February/March.
Kharchi Festival	Khayerpur, Old Agartala, West Tripura	Every year in the month of July
Neermahal Festival	At Rudrasagar Lake, Rajghat, Melaghar, Sepahijala District	Every year in the month of August and December
Diwali Festival	At Tripura Sundari Temple, Matabari, Gomati District and all over the state	Every year in October/November
Pous Sankranti Fair	Tirthamukh, Gomati District	Every year in the month of January

Source: TripuraFestivals

4. Archeological Value of the Terrain

228. Other than the above mentioned monuments there are some stone age sites that have been discovered in Quarternary fluvial sediments within 45km of Agartala. These findings demonstrate the existence of multiple dispersed colonies of stone age people on the stabilized river terraces. The discovery of some stray celts and pebbel-tools and stratified pottery sites were

first made in the Khowai and Haora valleys during the course of Quaternary mapping in 1981-82.[84]

d. Key Physical Cultural Resources Aspects

229. Summary of the key physical cultural resources aspects in the PAI are given in Table 4-70.

Table 4.70 Summary of Physical Cultural Resources Setting of the Project Area of Influence

Component	Subproject	Location	Key Environmental Features in Project Area of Influence
Substations, RMU and Test Laboratory	27 Substations, Test Laboratory	Tripura	• No ASI monuments are located within 500m of any substation or the test laboratory site; nearest is an Ancient Mound (Shyamsundar Ashram Tilla) at Jolaibari (1.5 km from Jolaibari substation) • State protected monument Ujjjayanta Palace is 823m from NSRCC Substation and 1.97km from College Tilla Substation • Locally important cultural and religious places within 500m: Hindu crematorium site is attached to the south boundary of Kadamtala substation etc. • Potential for chance finds exists where there is undisturbed land • Paleontological stone age sites are recorded in the state, but no substations are within 3km of the known find locations
2667.46 ckm of 33 kV, 11 kV, and low tension distribution lines	• New 33kV Line (underground): 163 km • New 33kV Line (covered conductor): 107 km • New 11 kV Line (underground): 4.2 km • New 11 kV Line (covered conductor): 1270 km • Conversion of 11 kV Line to covered conductor: 134 km • Conversion of 11 kV Line to	Tripura	• Low tension Boxarnagar ESD lines pass adjacent to the ASI protected Boxarnagar Buddhist Stupa in Sepahijila District, other low tension electrical subdivisions also support protected monuments and distances will need to be confirmed during mapping (if within 300m see footnote 33) • No ASI or state protected monuments are within 300m 33kV and 11kV distribution lines • New 33kV line on Covered Conductor from 33 KV Bagma Substation to 33 KV Udaipur Power House Substation passes 603m from ASI Bhubaneswari Temple, in Gomati District • New 33kV underground Badarghat to Rampur Substation line runs 800m from the state protected Ujjayanta Palace • Locally important cultural and religious places like temples, churches and mosques are located throughout – especially in the urban alignment routes

[84] https://gsmpubl.files.wordpress.com/2014/09/bgsm1986b16.pdf

Component	Subproject	Location	Key Environmental Features in Project Area of Influence
	underground cable: 89.26 km • Conversion of low tension (0.4 KV) Line to Aerial bunched cable: 900 km		e.g., new 33kV underground Bodhgangnagar-Adarsha Colony Substation line passes 90m from Chaturdashi Temple, a locally important temple in West Tripura • Potential for chance finds exists where there is undisturbed land, paleontological stone age sites are recorded in the state

ASI = Archaeological Survey of India, NRSCC = Netaji Subhas Regional Coaching Centre, RMU = ring main unit
Source: ADB TA Consultant

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

251. This section identifies and assesses the potential and perceived environmental impacts and risks that can be expected from the distribution component. Environmental impacts and risks on the physical, biological and socioeconomic (including occupational and community health and safety, vulnerable groups, gender inclusion, impacts on livelihood) and physical cultural resources (PCR) in the project's area of influence (PAI) were considered in terms of nature of impact (i.e., direct, or indirect), spatial nature (i.e., within ROW or further), temporal nature (i.e., long/medium/short term), severity, likelihood as well as frequency and cumulative nature of their occurrence. The distribution component which involves (i) renovation and modernization of 27 existing 33/11 kilovolts (kV) substations; (ii) installation of 150 auto-reclosers, 350 sectionalizers, and 2,000 fault passage indicators at 11 kV and 33 kV lines, supply of cable fault locator and test van; (iii) installation and upgrade of 2,667 km of 11 kV, 33 kV and low tension distribution lines including the supply and installation of 100 ring main units associated with underground cabling and a high voltage distribution system (HVDS) pilot, (iv) set up of a modern test laboratory for testing and maintenance of distribution equipment and to act as a training center for TSECL staff and engineers; and (v) replacement of 100,000 household meters with smart meters and advanced metering infrastructure for smart metering systems establishment will have a diverse range of impacts and risks on the environment across two distinct phases (i) pre-construction and construction, including preparatory works, detailed design, survey, site or ROW clearance, construction and installation, and (d) Operation, including maintenance (O&M) as described in Chapter III.

252. The focus of the assessment is on the substation, test laboratory and 33kV, 11kV and low-tension distribution line components (especially the new distribution lines) with other components having minimal environmental impact, although works regardless of scope will be required to follow the project level EMP for the distribution component. Potential impacts that will occur are site-specific, short duration, not significant and few if any of them are irreversible. The activity – impact/risk interaction matrix to identify the potential impacts and risks of these components that may occur across different phases is presented in Table 5-4. The pre-construction phase will influence the impacts of the subsequent phases, but it is evaluated along with construction, as it will have minimal impact being mostly desk based with some site investigation. Mitigation for construction and operation, including for substations/test laboratory and distribution lines, will, however, needs to be considered upfront during the pre-construction phase.

253. The potential impacts and risks from the distribution component were assessed based on available design information, but as detailed design will be undertaken by the EPC Contractor and distribution line routings are only indicative, the assessment will need to be revisited once the detailed design is complete and the IEE/EMP updated as needed prior to construction. Preparations for construction include establishing the EPC contractor's environment, health and safety management arrangements (including preparing a contractor's environmental management plan (CEMP)) to ensure mitigation of construction related impacts in accordance with the EMP.

254. The significance of the potential impacts and risks identified was determined (scoping) using the criteria and methodology described below and if necessary scoped into further assessment based on professional judgement following review of project documents (including TSECL's DPR, November 2020), environmental audits of substations and site visits to a sample of distribution lines which were conducted in December 2020, March 2021, October 2021, and

April-May 2022, meaningful consultations undertaken during site visits, reference to international good practice guidance and primary and secondary baseline data analysis. For the selection of a sample distribution lines for site visits these were selected based on environmental sensitivity of the indicative routings, a district sensitively matrix was used to identify environmentally sensitive routing in terms of settlements, agricultural fields, rubber plantation**,** biodiversity areas/physical cultural resources and other land uses that may be impacted. Environmental audit and survey checklists and consultation formats were agreed with ADB before taking up the site visits.

255. This section summarizes the potential impacts and risks identified (Table 5-5), mitigation measures to address those impacts, which are incorporated into the project level Environmental Management Plan (EMP), and the residual impacts of the distribution component which will remain post-mitigation.

B. Scoping and Impact Assessment Methodology

256. Environmental impacts and risks will result from both the location (routing) of the substations, test laboratory and distribution lines and the design of these components. Prediction of impacts and risks is essentially a process in which the interactions between the components and the existing baseline environment are identified. Prediction methods used include quantitative, semi-quantitative and qualitative techniques. The significance of potential impacts and risks is then arrived at using the criteria and methodology given in this section. The impact assessment is structured by the two distinct phases (pre-construction-construction; and O&M) and this structure is carried forward and used to develop the EMP.

257. Considering the nature and footprint of the activities, the project area of influence is generally considered as a 500m radius around the substations and the test laboratory and 50m along the distribution lines. Environmental impacts were evaluated considering baseline information (Chapter IV) and consultation feedback (Chapter VI) with respect to the nature of impact (i.e., positive, negative, direct, or indirect, cumulative, or induced), spatial nature (i.e., site-specific, localized, or widespread), temporal nature and reversibility (i.e., temporary during construction, permanent, short term, or long term), and likelihood amongst other factors that influence significance.

258. In the first instance the severity of the impacts and risks has been considered in terms of the predicted magnitude of change (or for risks, the consequences) that will be experienced. The importance or sensitivity of receptors (Table 5-3) including workers, local communities, and the surrounding environment has also been considered, and the initial significance determined as a function of severity and importance using the impact significance matrix shown in Table 5-1. The maps for locations such as protected areas, physical cultural resources, geology, land use, and primary and secondary data on the environmental (air, water, soil, noise) and socio-economic settings in the PAI were analyzed to help determine the magnitude and sensitivity of the impact.

259. The matrix applies universally to all resources/receptors, and for all impacts and risks to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/importance designations that enter the matrix. However, significance also considers the likelihood, frequency or duration of the impact and parameters such as: (i) spatial extent; (ii) reversibility; (iii) opportunities for mitigation; and (vi) legal standards and established international good practice guidelines – i.e., the eventual significance (Figure 5-2) may not directly correspond to a function of severity and importance in all cases.

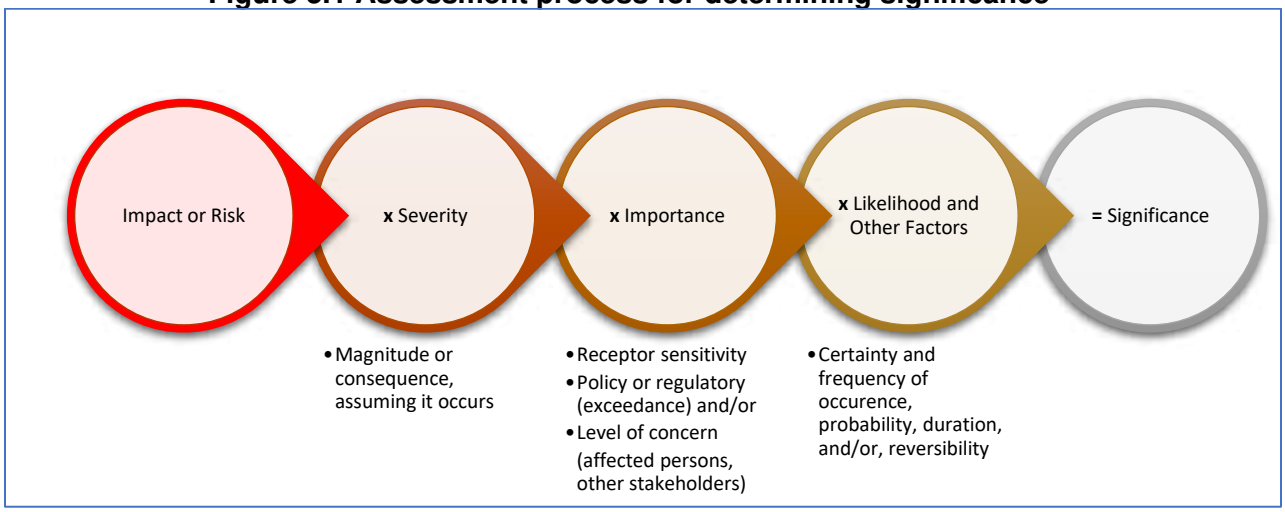
260. For scoping the assessment, potential and perceived environmental impacts and risks that would occur pre-mitigation but including the standard design features that would be incorporated by TSECL in accordance with national environment, health and safety requirements and have been identified, qualitatively assessed, and are summarized in Table 5.5. These impacts and risks have been categorized as being of Maximum, High, Medium, Low or Minimal significance based on the assessment process shown Figure 5-1, Tables 5-1 and 5-2. Impacts of Maximum or High significance are those which require detailed assessment and/or quantification. Impacts of Medium significance also require a thorough understanding to define suitable mitigation measures. However, mitigation is required for all the potential impacts and to ensure residual significance is reduced to the greatest extent possible.

261. While the importance factors cannot be influenced, mitigation measures can be put in place to decrease the severity or likelihood of impacts to decrease the overall significance of the risk. For the purposes of this IEE, the following mitigation hierarchy is adopted, the priority being to first avoid or reduce the source of impacts and then to address the impacts that do occur via mitigation to reduce the significance of the impact, and then as a last resort using compensatory or offset measures. Mitigation measures required are summarized in this chapter but are set out in full within the EMP mitigation plan in **Annexure 14.**

(i) Avoid or Reduce at Source: avoiding or reducing the source of impacts through the design, construction, and operation of the distribution line component.
(ii) Abate on Site: if the source cannot be removed, adding something to the design or into the construction method to abate the impact.
(iii) Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site.
(iv) Repair or Restore: some impacts involve unavoidable damage to a resource (e.g., use of agricultural land for temporary construction activities) and these impacts can be addressed once they have occurred through use of repair or restoration measures.
(v) Compensate or Offset: where other mitigation approaches are not possible or fully effective, then compensation of offset for loss, damage and disturbance might be appropriate (e.g., the planting of trees off-site to offset for loss of vegetation on-site).

240. Considering the mitigation measures proposed in the following sections to manage potential environmental impacts and risks, these have then been re-categorized to reflect their expected post-mitigation levels and estimate residual environmental risks and impacts (Table 5-5).

Figure 5.1 Assessment process for determining significance



Source: ADB TA Consultant

Table 5.1 Parameters for Determining Significance Factors

Category	Maximum	High	Medium	Low	Minimal
Severity Factors:					
Magnitude Change (quantified amount)	Very Large	Large	Medium	Small	Very Small (negligible)
Consequence	Critical (catastrophic)	Major	Moderate	Minor	Minimal (negligible)
Importance Factors:					
Receptor Sensitivity	International	National/State	District	Local / Community	Individual
Receptor Resilience and Adaptability	No capacity to absorb proposed changes	Minimal capacity to absorb changes	Some capacity to absorb changes	Good capacity to absorb changes	Very good capacity to absorb changes
Receptor Vulnerability	Far above average vulnerability	Above average vulnerability	Average vulnerability	Below average vulnerability	Far below average vulnerability
Policy or Regulatory (exceedance)	Large	Medium	Small	None	Not Regulated
Level of Concern	Global / National	Regional/State	Division/District	Community / Block	Individual
Likelihood Factors:					
Frequency of Occurrence	Continuous	Frequent	Occasional	Infrequent	Rare
Probability	Certain	Likely	Possible	Unlikely	Improbable
Duration	Very long term, > 3 years	Long term, > 1 year	Medium term, < 1 year	Short term, < 1 month	Very short term, < 1 week
Other Factors:					
Spatial extent	Far beyond project site boundaries (>500m)	Beyond project site boundaries (<500m)	Immediately adjacent to project site (<50m)	In project site	Confined location in project site

Category	Maximum	High	Medium	Low	Minimal
Reversibility	Irreversible	Reversible with effort in long term	Reversible with ease in long term	Reversible with effort in short term	Reversible with ease in short term
Opportunities for mitigation	No or minimal opportunities for mitigation	Few opportunities for mitigation	Some opportunities for mitigation	Several opportunities for mitigation	Numerous opportunities for full mitigation
Legal standards	Breaches national standards and international good practice guidelines	Complies with international good practice guidelines but breaches more stringent national standards	Complies with national standards but breaches more stringent international good practice guidelines	Meets national standards and international good practice guidelines	Not applicable

Source: ADB TA Consultant

Table 5.2 Risk Matrix for Significance Determination

Importance \ Severity	Maximum	High	Medium	Low	Minimal
Maximum	Maximum	Maximum	High	Medium	Medium
High	Maximum	High	Medium	Medium	Low
Medium	High	High	Medium	Low	Low
Low	High	Medium	Low	Low	Minimal
Minimal	Medium	Medium	Low	Minimal	Minimal

Source: ADB TA Consultant

C. Cumulative and Induced Impacts

241. Cumulative impacts[85] are defined as the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project.

242. Substation and test laboratory activities will take place on TSECL land but distribution line activities, including construction, will mostly take place along existing roads. During the distribution line site visits it was observed that along some of the stretch's where distribution line works are proposed by TSECL, road works like expansion and maintenance are taking place. These activities are contributing to clearance of vegetation and trees, air pollution, especially dust, noise emission, soil erosion, and waste generation, with the storage of wastes, spoil from earthworks and construction materials along the road ROWs, thus decreasing the effective width of the road for use by pedestrians and traffic. It was also observed that no environmental management is being implemented by these contractors such as no allocated storage areas for waste, soil, or construction materials, no sprinkling of water on dusty roads, etc.

243. Cumulative impacts are anticipated in those distribution line route alignments where roads works are planned in the future and are ongoing in parallel with the distribution line works. Cumulative impacts are anticipated not only from road works, but works by other utility sectors

[85] ADB. 2012. *Environment Safeguards: A Good Practice Sourcebook Draft Working Document*. Manila

which run along the roads like water or sewage pipelines, gas lines, optic fiber line maintenance, etc. Impacts would mainly relate to construction works increasing the significance of those impacts predicted from the distribution lines alone: vegetation clearance, dust generation, noise emission, soil erosion, and occupational and community health risks from reducing the effective width of the road and affecting people's access and traffic flows. Possible conflicts among workers of the distribution component along with workers on the other works may also take place. To manage these impacts the EPC contractor will be required to coordinate with other utility sectors having planned works. O&M impacts may occur when the other works do not pay respect to the presence of the distribution line and damage it, this could expose their workers to electrocution risk as well as increasing risks to others from the damaged distribution line. TSECL can provide awareness raising to other utility sectors (contractors) regarding safe working practices around its distribution lines and undertake regular inspections and maintenance to identify any damage that has been caused.

Figure 5.2 Ongoing Works in Distribution Line Right of Way

	Ongoing road expansion works along highway near Pachertal Substation to Panisagar
	Ongoing road maintenance works along a TSECL ROW near SM Nagar-Charipara, Agartala. Pole base is covered with soil, this will weaken the foundation

	Ongoing Agaratal sewerage network project along busy road, Golchakkar intersection, leading to the International Checkpost. The photo is taken at the start point of the 11kV Golchakkar-Dashamighat line
 	Ongoing (National Highway 8) road works and drainage in ROW of 33kV Bodhgangnagar-Adarsha Colony Substation alignment The last photo shows nearly completed National Highway expansion work along this route and adjacent to the locally important Chatursadhi Temple. The temple pond is seen in this photograph.

ROW = right of way, TSECL = Tripura State Electricity Corporation Limited
Source: ADB TA Consultant

244. Induced impacts are the adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur later or at a different location. There may be some induced socioeconomic development because of implementation of the TSECL distribution component. During construction roadside eateries,

shops, accommodation may be able to provide services for construction workers. However, as the substations already exist, no major construction works are involved, and distribution line works are transient in nature, any such impacts are anticipated to be negligible (minimal). Improved quality of supply during operation may contribute to improved socioeconomic development in Tripura, however, given the distribution network already exists any such impacts are considered at most minor. Any such induced development due to improved supplies will need to be in accordance with the national laws and regulations of India. It should also be noted that any such future development is entirely independent of the distribution component.

Table 5.3 District Sensitivity Matrix for Sample Distribution Lines to Conduct Site Visits

District	Division	Subdivision	Number and area of Protected Areas	Number and area of KBA or IBA	Number of National protected monuments	Number of State protected monuments	Population (district totals)	Population density (district)	% Illiterate (district %)	Tribal area	% Urban (built up)[69]	% agricultural	% forest	% water	Elevation range	Topography	Other notable features	Sample Distribution Lines surveyed
North Tripura	Dharmanagar	Dharmanagar	Rowa WLS (0.858 km^2)	-	-	-	417441	289	87.9	28.05	13.64	7.20	17.70	6.59	68 m	Hills, rolling valleys and plains	-	33 kV Mission Tilla - Panisagar- Dhamchara Line 11 kV Deegalbagh Feeder
		Kanchanpur	-	-	-	-									198 m			-
		Panisagar	-	-	-	-									63 m			33 kV Pecharthal Substation to 33 KV Panisagar Substation
Unakoti	Kailashahar	Kumarghat	-	-	-	-	276506	467	86.91%	22.54%	10.59	6.50	6.73	4.82	43 m	Predominantly plains with some low hills, rolling and valleys	Wetland - Soteromiar Hawor	-
		Kailashahar	-	-	1 (ASI sculptures and rock-cut reliefs, Unakoti)	-									33 m		-	-
Dhalai	Ambassa	Kamalpur	-	-	-	-	378230	158	85.72%	55.68%	9.89	10.19	32.65	44.37	39 m	Hilly, rolling valleys and plains	-	-
		Ambassa	1, Gumti WLS (389.54 km^2)	1 KBA and IBA (Gumti WLS)	-	-									75 m		-	-
		Gandachera			-	-									111m		Dumbur lake – 40 km^2	-
		Longtarai Valley	-	-	-	-									127 m		-	-
Khowai	Khowai	Khowai	-	-	-	-	327564	326	87.78%	42.6%	10.63	10.17	11.00	5.62	34 m	Low hills, valleys and plains	-	132 kV Gamaitilla Substation to33kV Kalyanpur Substation
		Teliamura	-	-	-										54 m			-
West Tripura	Agartala	Sadar	-	-	-	Ujjayanta Palace, Agartala	918200	974	91.07%	19.23%	22.24	13.30	6.48	3.95	14 m	Predominantly plains	-	33 kV covered conductor line from Grid Substation to Durjoynagar Substation

District	Division	Subdivision	Number and area of Protected Areas	Number and area of KBA or IBA	Number of National protected monuments	Number of State protected monuments	Population (district totals)	Population density (district)	% Illiterate (district %)	Tribal area	% Urban (built up)[69]	% agricultural	% forest	% water	Elevation range	Topography	Other notable features	Sample Distribution Lines surveyed
																		33 kV covered conductor line from Badharghat to Rampur Substation 33 kV underground from Grid Sub Station to College Tilla Substation 33 kV underground Line from SM Nagar Substation to Charipara Substation 33 kV underground Line from Adarsha Colony Substation to College Tilla Substation 11 kV underground Milan Chakra Feeder from Badhaghat Substation to CNG Station 11 kV underground Raima Feeder Stadium Substation to Doordarshan 11kV underground Dashamighat to Golchakkar 33kV underground Bodhgangnagar-Adarsha Colony

District	Division	Subdivision	Number and area of Protected Areas	Number and area of KBA or IBA	Number of National protected monuments	Number of State protected monuments	Population (district totals)	Population density (district)	% Illiterate (district %)	Tribal area	% Urban (built up)[69]	% agricultural	% forest	% water	Elevation range	Topography	Other notable features	Sample Distribution Lines surveyed
																		11Kv to covered conductor, Ananda Nagar Feeder
		Mohanpur	-	-	-	-									36 m			-
		Jirania	-	-	-	-									35 m			Low tension ESD Mandwi
Sipahijala	Bishramganj	Bisalgarh	2, (Sepa-hijala WLS) 13.45 km^2 including Clouded Leopard National Park (5.08 km^2)	1 KBA (Sepa-hijala WLS) 13.45 km^2)	1, ASI Ancient Remains / Buddhist Stupa, Boxanagar	-	483687	463	84.78%	24.69%	13.88	18.27	7.67	6.60	21 m	Plains	-	66 kV Gokulnagar Substation to 33 kV Madhupur Substation Low tension ESD Boxanagar
		Sonamura	-	1 IBA (Rudra sagar lake)	-	Neermahal Water Palace, Melaghar									21 m			-
		Jampuijala	-	-	-	-									57 m			-
Gomati	Udaipur	Udaipur	1, Trishna WLS (Partial)	1 KBA and IBA, (Trishna WLS - partial)	3, ASI Gunabati Group of Temples, ASI Temple of Chatur-dasha Devata and ASI Bhubaneswari Temple, Udaipur	Tripureswari temple	441538	290	84.5 %	42.70%	10.84	14.16	19.65	21.91	28 m	Low hills and valleys but predominantly plains	-	-

District	Division	Subdivision	Number and area of Protected Areas	Number and area of KBA or IBA	Number of National protected monuments	Number of State protected monuments	Population (district totals)	Population density (district)	% Illiterate (district %)	Tribal area	% Urban (built up)[69]	% agricultural	% forest	% water	Elevation range	Topography	Other notable features	Sample Distribution Lines surveyed
		Amarpur	1, Gumti WLS (partial)	1 KBA and IBA (Gumti WLS)	-	-									33m			-
		Karbook	-	-	-	-									68 m			-
South Tripura	Belonia	Sabroom	-	-	-	Mahamuni-Buddha Mandir – Manubankul village	430751	281	84.68%	35.45%	8.28	20.21	15.82	6.13	27 m	Low hills, valleys and plains	-	-
		Belonia	2, Trishna WLS (163.08 km^2) including Bison National Park (31.63 km^2)	1 KBA and IBA (Trishna WLS along with Bison National Park)	-	Chand-rapur Mosque – Rajpur									27 m			33 kV line from 66 kV Belonia Substation to 33/11 kV Rajnagar Substation visited but dropped from scope as it passes through Trishna WLS 66kV Bagfa Substation to 33kV Jolaibari Substation 11 kV Bagfa feeder 11kV Chittamura Feeder Low tension ESD: Poangbari
		Santirbazar	-	-	3 ASI Ancient mound called Pujakhola,	-									30m			-

District	Division	Subdivision	Number and area of Protected Areas	Number and area of KBA or IBA	Number of National protected monuments	Number of State protected monuments	Population (district totals)	Population density (district)	% Illiterate (district %)	Tribal area	% Urban (built up)[69]	% agricultural	% forest	% water	Elevation range	Topography	Other notable features	Sample Distribution Lines surveyed
					Paschim Pilak, Ancient mound called Thakurani Tilla, Ancient mound called Shyam Sundar Ashram Tilla)													

ASI = Archaeological Survey of India, IBA = important bird area, KBA = Key Biodiversity Areas, WLS = wildlife sanctuary
Source: ADB TA Consultant

Table 5.4 Activity-Potential Impact/Risk Identification Matrix for Distribution Component

Project Activities	Environmental Impacts and Risks (IEC)												
	Biological		Physical							Socioeconomic			Physical Cultural Resources
	Vegetation/trees	Wildlife	Topography/ Terrain/ Drainage	Ambient air quality	Noise and vibration	Soil	Water Resources	Natural resources and waste generation	Climate change	Occupational Health & Safety including discrimination and SEAH in workforce	Community Health and Safety/Labour influx and conflicts	Land and Livelihoods including traffic congestion/ utilities	Physical Cultural Resources
Pre-Construction and Construction													
Detailed design survey work		√								√	√	√	
Labour Influx and establishment accommodations/facilities	√	√	√	√	√	√	√	√		√	√	√	√
Mobilization/transport of construction material and equipment, poles, wires, etc.		√		√	√		√	√		√	√	√	
Storage of materials etc.	√		√	√		√	√			√	√	√	√
Substation renovation/modernization no civil works					√	√	√	√		√	√		
Substation renovation/modernization including excavation, foundation, and construction works	√		√	√	√	√	√	√		√	√		√
Substation bay extension including excavation, foundation, and construction works	√		√	√	√	√	√	√		√	√		√
Construction of Test Laboratory including excavation, foundation, and construction works	√		√	√	√	√	√	√		√	√		√
Selective clearing of vegetation/trees in distribution line ROW	√	√						√		√	√	√	√
Foundations for and erection of poles (OHL)	√	√	√	√	√	√	√	√		√	√	√	√
Stringing activities and installation of accessories					√			√		√	√		
UG cables laying	√	√	√	√	√	√	√	√		√	√	√	√
RMU installation	√		√	√	√	√	√	√	√	√	√	√	√
Site restoration			√					√					

Project Activities	Environmental Impacts and Risks (IEC)													
	Biological		Physical							Socioeconomic			Physical Cultural Resources
	Vegetation/trees	Wildlife	Topography/ Terrain/ Drainage	Ambient air quality	Noise and vibration	Soil	Water Resources	Natural resources and waste generation	Climate change	Occupational Health & Safety including discrimination and SEAH in workforce	Community Health and Safety/Labour influx and conflicts	Land and Livelihoods including traffic congestion/ utilities	Physical Cultural Resources
Smart Metering								√		√	√		
Operation and Maintenance													
Power line presence including transformers		√				√	√			√	√		
Power line maintenance	√	√				√	√	√		√	√	√	√
Substation presence/O&M					√	√	√	√	√	√	√		
Test Laboratory presence/O&M						√	√	√		√	√		

Parameters that are likely to be influenced by distribution component activities are marked (√)
Source: ADB TA Consultant

Table 5.5 Impact and Risk Scoping Matrix for Distribution Component

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
BIOLOGICAL ENVIRONMENT							
Vegetation/ trees	Clearance of vegetation and lopping or felling of trees which is required along distribution line to install pole foundations and maintain safety clearances and in grounds of substations/test laboratory to create construction platform, including regular trimming of vegetation and trees during O&M. Whilst the number of trees to be lost cannot be determined until the route alignments are confirmed by the EPC contractor it has been estimated for the purpose of the IEE that 2,775 trees may be lost. Internationally or nationally important biodiversity areas including notified forest areas have been/will be avoided by new distribution lines, and no threatened flora species identified, although possible presence CR *Aquilaria malaccensis* (Agarwood) to be confirmed during distribution line route surveys.	Construction and to a lesser extent during distribution line O&M	**Low** Locally important receptor, modified habitat, average vulnerability, community concern **High** Notified forest area, potentially in respect of low-tension lines	**Low to Minimal** Small magnitude for new distribution lines as vegetation clearance is confined to the project footprint, new distribution line will mostly follow existing distribution line alignments with renovation. Minimal magnitude for reconductoring existing lines and modernization and bay extension works in the grounds of existing substations and the test laboratory in the grounds of an existing sub-divisional office. If the Critically Endangered *Aquilaria malaccensis* (Agarwood) were to be encountered during distribution line route surveys several opportunities for mitigation exist e.g., minor rerouting to avoid cutting of tree.	**Low Adverse**	Yes, including compensatory plantation for tree loss as per Forest Department requirements	**Low Adverse**
	Unintended disturbance to vegetation and trees outside the distribution line ROW due to construction works; risk of spread of invasive flora species	Construction and to a lesser extent during	**Low to Medium** Locally important receptor,	**Low** Minor consequence if occurred given modified habitat. Risk of impact beyond ROWs,	**Low Adverse (but potentially**	Yes	**Low Adverse (but potentially Medium Adverse for**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	within Tripura due to the transitory nature of distribution line works and multiple sites under each contract package with species transferred in / out of the PAI during vehicle movements; for all works some potential for accidental forest fire to be caused or for illegal cutting of trees or collection of non-timber forest products by workers venturing outside of the project footprint. Internationally or nationally important biodiversity areas including notified forest areas have been/will be avoided by new distribution lines, and no threatened flora species identified. These risks are already present due to the existing distribution network, although construction will bring an influx of activity to the PAI. No forest fire reported by TSECL to date, but once operational use of covered conductor and ABC will reduce the risk of accidental forest fire.	distribution line O&M	modified habitat in project footprint, but there may be natural habitat beyond the distribution line ROWs in which case there is above average vulnerability as minimal capacity to absorb changes, district importance **High** Notified forest area, potentially in respect of low-tension lines	unintended disturbance to internationally or nationally important or other natural habitat is unlikely to occur given the distances to substations and because new distribution line routings have/will avoid them. Several opportunities for mitigation e.g., though controls on worker behavior. Site specific assessment and management planning will be needed if low tension lines once mapped are identified in notified forest habitat, full time ecological supervision can ensure disturbance is minimized.	**Medium Adverse for low-tension lines)**		**low-tension lines)**
Wildlife	Habitat loss and fragmentation due to clearance of vegetation, including nesting birds during regular trimming of vegetation and trees during O&M, earthworks in respect of burrowing animals, presence of	Construction and to a lesser extent during distribution line O&M	**Low** Locally important receptor, no threatened species observed in	**Low** Small magnitude as habitat loss is confined to the project footprint, new distribution line will mostly follow existing distribution line	**Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	project workers, noise etc. Internationally or nationally important biodiversity areas including notified forest areas have been/will be avoided by new distribution line; they will mostly follow existing distribution line alignments with renovation, modernization and bay extension works in the grounds of existing substation and the test laboratory in the grounds of an existing sub-divisional office. Individuals of threatened species may occasionally be encountered in modified habitat along the distribution lines, but no threatened fauna species observed or reported by District Forest Officials whose population would be impacted by the extent of modified habitat loss and fragmentation required for the new distribution lines.		project footprint, average vulnerability, community concern, if threatened species were encountered above average vulnerability as minimal capacity to absorb changes, district importance	alignments with renovation, modernization, bay extension works in the grounds of existing substations and the test laboratory in the grounds of an existing sub-divisional office.			
	Potential human-wildlife conflicts during works for distribution line e.g., increased risk of road-related accident due to additional traffic, illegal hunting and poaching by workers venturing outside of the project footprint. Internationally or nationally important biodiversity areas including notified forest areas have been/will be avoided by new distribution lines, and no	Construction and to a lesser extent during distribution line O&M	**Low to Medium** Locally important receptor, no threatened species observed in project footprint, but there may be threatened	**Low** Minor consequence if occurred given no threatened species observed in PAI, given modified habitat at most a few individuals may occasionally be encountered. Risk of impact beyond ROWs, unintended disturbance to internationally or nationally important	**Low Adverse (but potentially Medium Adverse if critical habitat species or for low-tension lines)**	Yes	**Low Adverse (but potentially Medium Adverse if critical habitat species or for low-tension lines)**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	threatened fauna species identified during sample distribution line surveys although possible presence of *Nilssonia nigricans* (Black Softshell Turtle) if temple ponds crossed, *Gyps bengalensis* (White-rumped Vulture), *Manis pentadactyla* (Chinese pangolin) in rural areas, and *Trachypithecus phayrei* (Phayre's Leaf Monkey) and *Macaca leonina* (Northern Pig Tailed Macaque) in rural areas/plantation especially within 10km of Wildlife Sanctuaries to be confirmed during distribution line route surveys.		species using habitat beyond the distribution line ROWs in which case there is above average vulnerability as minimal capacity to absorb changes, district importance	biodiversity sites or other natural habitat is unlikely to occur given the distances to substations and because new distribution line routings have/will avoid them. If the critical habitat species were to be encountered potential for irreversible impact on individuals, but several opportunities for mitigation e.g., though controls on worker behavior and magnitude of loss unlikely to affect population. Site specific assessment and management planning will be needed if low tension lines once mapped are identified in notified forest habitat, full time ecological supervision can ensure disturbance is minimized.			
	Risks of damage to overground distribution line from human-wildlife conflicts e.g., destabilization of OHL poles by bison, elephant etc.	Operation	**Low to Medium** Locally important receptor, no threatened species observed in project	**Minimal** Unlikely to occur given the new distribution line routings have/will avoid important biodiversity areas including notified forest areas although migratory elephant may still be encountered.	**Minimal Adverse**	Yes	**Minimal Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	Electrocution and collision risk to wildlife especially avian fauna (birds, bats) primates and elephant due to overhead conductors of distribution line. Existing distribution line presents a high risk of electrocution for medium-sized and large birds. Electrocution risk will be significantly reduced with the use of covered conductors and ABC to replace uncovered conductors. underground cabling completely removes the electrocution risk. However, the steel pole/cross arm distribution design used by TSECL is not a primate or bird friendly design and so electrocutions may still occur.	Operation	footprint, but there may be threatened species using habitat beyond the distribution line RoWs in which case there is above average vulnerability as minimal capacity to absorb changes, district importance	**Low** Minor consequence in terms of population loss if occurred given no threatened species observed in PAI and all new 11 kV and 33 kV lines shall be either on covered conductor or underground besides conversion of existing 11 kV bare lines on covered conductor or underground and conversion of bare low-tension conductors to ABC which shall minimize electrocution risks. Risk of impact to migratory species usually found in habitat beyond ROWs. If the critical habitat species were to be encountered potential for irreversible impact on individuals, but several opportunities for mitigation e.g., adoption of bird sensitive design with adequate spacing and use of basic covers for standardized bushings and jumpers. Installation of anticlimbing devises for primates reported to be present by Forest	**Low Adverse**	Yes	**Minimal Adverse (Beneficial)**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
				Officials and which have been electrocuted on existing distribution lines. Site specific assessment and management planning will be needed if low tension lines once mapped are identified in notified forest habitat, existing risks will not increase but undergrounding or rerouting will enable them to be removed.			
PHYSICAL ENVIRONMENT							
Topography/ terrain and drainage	Potential change in topography and terrain during installation of foundations for OHL poles, substation equipment, test laboratory building and underground cables. Primarily at OHL and substation located in highly complex terrain due to cut and fill required to create a level construction platform.	Construction	**Low** Flat land. Good capacity to absorb changes, below average vulnerability **Medium** Highly complex terrain. Some capacity to absorb changes, above average	**Low to Minimal** Changes in topography and terrain will be of very small magnitude as new distribution line will mostly follow existing distribution line alignments with renovation, modernization, and bay extension of substations in the grounds of existing substation and a sub-divisional office already having a mostly level construction platform.	**Low to Minimal Adverse**	Yes	**Low to Minimal Adverse**
	No substations support surface water bodies and no distribution line are crossing over major rivers/streams or large water	Construction		**Low to Minimal** Changes in drainage flows will be of very small magnitude as new	**Low to Minimal Adverse**	Yes	**Low to Minimal Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	bodies/wetlands where flood risk may be a problem. However, natural drainage flow pattern will be altered by earthworks and the introduction of impermeable surfaces will alter the existing greenfield runoff. Substation bay extensions and test laboratory will result in the most increase in impermeable surface with potential to exacerbate waterlogging or flood risk on adjacent land.		vulnerability as in area of high landslide risk	distribution line will mostly follow existing distribution line alignments with renovation, modernization, and bay extension of substations in the grounds of existing substations and a sub-divisional office having existing drainage provision.			
Ambient air quality	Generation of dust during foundations for OHL poles and substation equipment and installation of underground cables; air pollution emissions from construction plant and vehicles travelling to/from project sites. Substation bay extensions and test laboratory will involve the most earthworks and have greatest dust impact. There will also be increased dust from installation of underground cables in urban areas although use of HDD minimizes earthworks and additional emissions from traffic congestion where roads are blocked.	Construction	**Medium** Locally sensitive receptors, some capacity to absorb change although vulnerability of school children and other groups may be above average, Existing baseline concentrations meet national standards but exceed	**Medium** Small magnitude of change mostly in relation to bay extensions, test laboratory and underground cables; any exceedance of national air quality standards would be very short term, impact restricted to within and immediately adjacent project footprint, some opportunities for mitigation, reversible with ease in short term	**Medium Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
			the latest WHO 2021 guidelines for PM10 and 2.5 and the airshed is degraded this respect, individual/local concern community concern				
Noise and vibration	Presence of construction workers generating noise, noise from operation of mechanical equipment and plant, material mobilization, and construction vehicles travelling to/from project sites etc. Substation bay extensions and test laboratory will involve the most earthworks and have greatest noise impact. There will be increased noise from drilling for installation of underground cables using HDD in urban areas and from the traffic congestion that results where roads are blocked	Construction	**Medium** Locally sensitive receptors, some capacity to absorb change although vulnerability of school children and other groups may be above average, community concern. Existing baseline noise levels mostly meet national	**Medium** Medium magnitude of change, mostly in relation to bay extensions, test laboratory and underground cables; any exceedance of noise standards would be very short term, impact restricted to within and immediately adjacent project footprint, some opportunities for mitigation, reversible with ease in short term	**Medium Adverse**	Yes	**Low Adverse**
	Changes in ambient noise levels–distribution line may produce corona and transformer hum from substations and distribution lines. Power distribution networks can generate a small amount of sound energy because of	Operation		**Low** Small magnitude of change; substation transformer hum recorded to be low and presence only within 3-5 m of switch yards	**Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	corona. Low level noise from corona becomes most noticeable at higher voltages (345 kV and higher) and in wet/humid conditions; under fair weather conditions corona is rarely noticed.		standards or only just exceed them.				
Soil	Excavation and compaction (change in structure) of topsoil and subsoil from installation of foundations for OHL poles, substation equipment, test laboratory building and underground cables as well as soil erosion due to clearance of vegetation and surface water runoff across bare ground especially during the monsoon season with risk of construction induced landslide	Construction	**Low to Medium** Soils along existing distribution line alignments and substations already disturbed, especially in urban areas, below average vulnerability except where crossing agricultural land where soils only have some capacity to absorb change or in areas of highly complex terrain area	**Low** Small magnitude as earthworks confined to the project footprint, new distribution line will mostly follow existing distribution line alignments with renovation, modernization and bay extension works in the grounds of existing substations and the test laboratory in the grounds of an existing sub-divisional office already having a mostly level construction platform.	**Low Adverse**	Yes	**Low Adverse**
	Storage of fuel, oil, chemicals during construction, operation, and maintenance works; potential for spills and leaks including transformer oils to result in soil contamination	Construction and to a lesser extent during O&M of distribution line Operation of distribution line, substations		**Medium** Moderate consequence due to volumes involved and unlikely to impact soils beyond immediate storage location, greatest additional risk from introduction of test laboratory at sub-divisional electricity office, reversible with	**Medium to Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
		and test laboratory	due to high landslide risk, community concern	effort in long term, several opportunities for mitigation			
Water resources	Alteration of surface water resources; no substations support surface water bodies and no distribution line are crossing over major rivers/streams or large water bodies/wetlands where poles would be needed in waterlogged area.	Construction	**Low** Some capacity to absorb changes, average vulnerability community concern	**Minimal** Very small magnitude of change; irreversible	**Minimal Adverse**	Yes	**Minimal Adverse**
	Use of water resources including potable water supply for construction and workers including water for HDD in urban areas; at some substations and the test laboratory new bore well will be sunk to provide potable water supply (following RO treatment)	Construction and Operation	**Low** In area of low water stress/medium drought risk, good capacity to absorb changes, community concern for others tapping same aquifer	**Low** Small magnitude as construction works require only a small crew at each project site and during operation there will be only a few staff present utilizing the water	**Low Adverse**	Yes	**Low Adverse**
	Sediment laden surface water runoff from installation of foundations for OHL poles, substation equipment, UG cables causing surface water pollution and affecting aquatic ecology	Construction	**Low to Medium** Some capacity to absorb changes,	**Low** Small magnitude of change, any exceedance of national water quality standards would be very short term, some opportunities	**Low Adverse**	No	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
			surface water of average vulnerability but groundwater above average where it is used for drinking water, community concern. Surface and groundwater quality meets national standards except for in respect of fecal coliform contamination.	for mitigation, reversible with ease in short term			
	Storage of fuel, oil, chemicals during construction, operation, and maintenance works; potential for spills and leaks including transformer oils to result in water pollution	Construction and to a lesser extent during O&M of distribution lines Operation of distribution lines, substations and test laboratory		**Medium** Moderate consequence due to volumes involved, impact may affect water resources beyond site boundaries, reversible with effort in long term, several opportunities for mitigation	**Medium to Low Adverse**	Yes	**Low Adverse**
	Open defecation or disposal of untreated sanitary effluent from workers sanitation (any septic tank) to surface or ground water causing water pollution. Existing substations already have sanitary facilities so additional wastewater in respect of operation only arises from test laboratory sanitary facilities.	Construction and to a lesser extent during O&M of distribution lines Operation of substations and test laboratory		**Low** Small magnitude as construction works require only a small crew at each project site and during operation there will be only a few staff present utilizing sanitary facilities and resulting in wastewater	**Low Adverse**	Yes	**Low Adverse**
Natural resources and waste generation	Use of raw materials from existing licensed sources: sand, fuel, oil, chemicals etc.	Construction and to a lesser extent during O&M	**Low** No policy or regulatory concerns as existing licensed sources will be used	**Low** Low magnitude in relation to construction materials: several opportunities for mitigation, impact may be beyond site boundaries	**Low Adverse**	Yes	**Low Adverse**
	Disposal of inert soil inappropriately on land or in nearby water bodies	Construction and to a	**Medium** Division/district level	**Minimal** Very low magnitude: several opportunities for	**Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
		lesser extent during O&M	concern since may be dumped outside the local community	mitigation, impact may be beyond site boundaries			
	Disposal of solid wastes inappropriately on land or in nearby water bodies	Construction and to a lesser extent during O&M	**High** State/National level concern as no engineered solid waste management facilities in Tripura	**Medium** Low magnitude in terms of volumes generated but minimal opportunities for mitigation, impact may be far beyond site boundaries	**Medium Adverse**	Yes	**Low Adverse**
	Disposal of hazardous wastes, including mineral oils from transformers especially test samples from the test laboratory inappropriately on land or in nearby water bodies	Construction and to a lesser extent during O&M	**High** State/National level concern as no hazardous waste management facilities in Tripura	**Medium** Low magnitude in terms of volumes generated but minimal opportunities for mitigation, impact may be far beyond site boundaries	**Medium Adverse**	Yes	**Low Adverse**
Climate Change	SF6 (a potent GHG) gas leakage from gas-insulated switch gear installed at substations and RMU	Operation and to a lesser extent during construction (installation)	**Maximum** Global/National level concern	**Minimal** Minimal magnitude at a global scale, leakage is unlikely and rare occurrence, some opportunities for mitigation	**Medium Adverse**	Yes	**Medium Adverse**
SOCIOECONOMIC ENVIRONMENT							

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
Occupational (workers) H&S including discrimination and SEAH in workforce	Unsanitary and unhealthy working conditions including at overnight accommodation provided by employer, leading to H&S incidents/accidents e.g., slips, trips, falls from height, interactions with equipment and machineries, electrocution, working along or within running road, snake bites, human health impacts from dust, noise, handling mineral oils, PCBs or asbestos in existing substations, ponding of water for mosquitos, spread of communicable diseases including malaria which is a major health problem in Tripura, HIV/AIDS and COVID-19 etc.	Construction and to a lesser extent during O&M of distribution lines, substations and test laboratory	**Medium** Individual receptors/concern, average vulnerability, although any under 18s and foreign migrant workers may be above average	**Medium** Major consequence for individual if fatality occurs, but only a small number of workers involved during construction and fewer during O&M, rare occurrence, in most cases moderate to low consequences will occur, and several opportunities for mitigation	**Medium Adverse but pay attention to vulnerable groups who may be at greater risk**	Yes	**Medium Adverse but less likely worst case will occur**
Community H&S/Labour Influx and Conflicts	Risks to community due to construction activities including construction traffic, storage of materials along roadside, inappropriate disposal of wastes, presence of open pits, inadequate warning signs dust, noise, live electricity etc.	Construction and to a lesser extent during O&M of distribution lines	**Medium to High** Community concern, average vulnerability although children of above average vulnerability especially where schools are located adjacent to substations or	**Medium** Major consequence for individual if fatality occurs, but impacts at individual not community level, rare occurrence, and several opportunities for mitigation	**Medium Adverse but pay attention to presence of schools/ vulnerable groups who may be at greater risk**	Yes	**Medium Adverse but less likely worst case will occur**
	Increased risk of traffic accidents involving pedestrians and vehicles due to underground cabling and OHL works along or within road			**Medium** Major consequence for individual if fatality occurs, but impacts at individual not community level, rare occurrence, in most	**Medium Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
			distribution lines	cases moderate to low consequences will occur, and several opportunities for mitigation			
	Spread of communicable diseases including COVID-19, HIV/AIDS, and other STDs from presence of migrant workers especially in rural area with risks increased due to transitory nature of the distribution line works. Most workers local to Tripura, although COVID-19 may still be rapidly spread by small number of workers at the community level.			**Medium** Major consequence for individual if fatality occurs, but only a small number of workers involved during construction and fewer during O&M, rare occurrence, in most cases moderate to low consequences will occur, and several opportunities for mitigation	**Medium Adverse**	Yes	**Low Adverse**
	Community interactions and conflict with project workers including sexual exploitation, abuse, and harassment from presence of migrant workers			**Medium** Only a small number of workers are involved, disruption to communities greatest in urban area but the presence of workers would be very short term, some opportunities for mitigation, reversible with ease in short term	**Medium Adverse**	Yes	**Low Adverse**
	Risks to community due to electrocution, fire risk, EMF exposure, cable break incidents etc.	Operation	**Medium to High** Community concern, average vulnerability although	**Medium** Major consequence for individual if fatality occurs, but impacts at individual not community level, rare occurrence, and several	**Medium Adverse but pay attention to presence of schools/**	Yes	**Medium Adverse but less likely worst case will occur**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
			children of above average vulnerability especially where schools are located adjacent to substations or distribution lines	opportunities for mitigation	**vulnerable groups who may be at greater risk**		
	Additional Community Health and Safety considerations when working in tribal (IP) areas, conflict when workers are from outside of the tribal area and many existing properties were observed to be encroaching on safety clearances/ROW of existing lines possibly due to extension of front porch, garage etc.	Construction and Operation	**Medium** IPs of above average vulnerability but distribution lines are already present in TTAADC and being maintained by TSECL, some capacity to absorb changes	**Low** Only a small number of workers involved, disruption would be very short term, some opportunities for mitigation, reversible with ease in short term	**Low Adverse**	Yes	**Low Adverse**
Land and livelihoods including traffic congestion/ utilities	Direct or indirect vibration damage to private property and road surfaces especially from drilling for underground cables and OHL crossing through rubber plantation and agricultural fields (crops)–see RIPP for	Construction and to a lesser extent O&M of distribution lines	**Low** Locally sensitive receptors, community level concern	**Medium** Moderate risk of private property damage due to urban location and property close to or encroaching in ROW of	**Low Adverse**	Yes, including compensation for damages in accordance with RIPP and contractor to	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	further assessment of temporary damages			existing distribution lines along roads/highways of narrow width etc. Impacts at individual not community level. Several opportunities for mitigation.		repair any damage caused	
	Temporary disturbance and loss of access to business property and temporary shifting of street vendors due to underground cable and OHL works affecting livelihoods along or within road			**Low** Minor consequence although greater impact in urban area, disruption would be very short term, some opportunities for mitigation, reversible with ease in short term	**Low Adverse**	Yes	**Low Adverse**
	Loss of land / restricted usage under distribution line poles and conductors (limitations on structures within safety clearance of ROW; etc.) some existing properties encroach into safety clearances/ROW of existing distribution lines which will require their minor rerouting to maintain vertical and horizontal safety clearances rather than relocation of properties involved -- see RIPP for further assessment	Operation	**Low** Locally sensitive receptors, individual level concern	**Low**	**Low Adverse**	N/A	**Low Adverse**
	Damage to other public utilities e.g., gas pipes, power lines, telephone lines, water pipelines or sewers especially from installation of underground cables	Construction and to a lesser extent O&M of distribution lines	**Low** Locally sensitive receptors, community	**Medium** Medium consequences if damage/breakage to utility occurs because of construction especially in urban area where	**Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
			level concern	many people are served, supply to local community hampered until supply restored, rare occurrence, several opportunities for mitigation			
	Temporary loss of power during works affecting existing distribution lines, impact on residences, business, and livelihoods	Construction and to a lesser extent O&M of distribution lines	**Low**	**Low** Minor consequence although greater impact in urban area, disruption would be very short term, some opportunities for mitigation, reversible with ease in short term	**Low Adverse**	Yes	**Low Adverse**
	Stress on use of community resources and services e.g., water supplies, hospitals	Construction and Operation	**Medium** Division/district level concern	**Low** Small magnitude as construction works require only a small crew at each project site and during operation there will be only a few staff present utilizing the water	**Low Adverse**	Yes	**Low Adverse**
	Traffic congestion including cumulative impacts if existing road works / other activities taking place in parallel with distribution line works adjacent to roads	Construction and to a lesser extent O&M of distribution lines	**Medium** Division/district level concern	**Low** Minor consequence although greater impact in urban area, disruption would be very short term, some opportunities for mitigation, reversible with ease in short term	**Low Adverse**	Yes	**Low Adverse**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	Employment and micro level economic development opportunities from provision of accommodation for workers etc.	Construction and to a lesser extent O&M	**Medium** Division/district level concern	**Minimal** Very small magnitude of change in relation to construction as only small number of workers involved	**Low Adverse**	Yes	**Low Adverse**
	Energy supply and security	Operation	**Medium**	**Beneficial**	**Beneficial**	n/a	**Beneficial**
	Additional considerations when operating distribution lines in tribal (IP) areas, in the tribal areas many properties were observed to be encroaching on safety clearances/ROW of existing lines and houses may be more sensitive to damage due to pucca construction etc.	Construction and Operation	**Medium** IPs of above average vulnerability but distribution lines are already present in TTAADC and being maintained by TSECL, some capacity to absorb changes	**Low** Rare occurrence, and several opportunities for mitigation	**Low Adverse**	Yes	**Low Adverse**
PHYSICAL CULTURAL RESOURCES							
Physical and Cultural resources	Potential risk of damage to physical cultural resources due to construction, especially during underground cable installation in urban areas. Internationally or nationally important physical cultural resources, ASI and	Construction and to a lesser extent O&M	**Low** Local/ community receptors, community concern	**Low** Risk of minor damage being caused to physical cultural resources immediately adjacent to project footprint, greatest likelihood in	**Low Adverse (but potentially Medium Adverse for**	Yes	**Low Adverse (but potentially Medium Adverse for low-tension lines)**

Receptor (IEC)	Rationale for Potential Environment Impacts/Risks	Phases	Importance	Severity	Significance Prior to Mitigation	Mitigation Incorporated into EMP	Significance Post Mitigation
	Government of Tripura protected monuments have been/will be avoided by new distribution lines. New distribution lines will mostly follow existing distribution line alignments with renovation, modernization and bay extension works in the grounds of existing substations and the test laboratory in the grounds of an existing sub-divisional office.		**High** ASI or state protected monuments potentially in respect of low-tension lines	urban area. Site specific assessment and management planning will be needed if low tension lines once mapped are identified in 300m of protected monuments, full time archaeological supervision can ensure disturbance is minimized.	**low-tension lines)**		
	Potential risk of damage to undiscovered physical cultural resources e.g., archaeological remains due to construction, especially during underground cable installation in urban areas	Construction	**Low** Unknown but likely if any encountered will be at most local/community receptor	**Low** If encountered risk of minor damage before work halted, some opportunities for mitigation but any damage would be irreversible, confined to project footprint, rare occurrence and unlikely to occur at project site	**Low Adverse**	Yes	**Low Adverse**

Note: impacts subject to reconfirmation following route surveys; some existing low-tension distribution lines may route alongside roads that pass through or adjacent to notified forest areas and protected monuments (e.g., Boxarnagar Electrical Sub-Division supports forest range and has low-tension lines adjacent to the Boxarnagar Stupa, an ASI protected monument) — in such locations once the low-tension lines have been mapped site-specific assessment and management planning will be required.

ABC = aerial bundled conductors, EMP = environmental management plan, EPC = engineering, procurement and construction, EMF = electromagnetic field, GHG = greenhouse gases, HDD = horizontal directional drilling, IEE = initial environmental examination, OHL = overhead line, PAI = project area of influence, RMU = ring main units, ROW = right of way, RIPP = resettlement and indigenous peoples plan SEAH = sexual exploitation, abuse and harassment, TSECL = Tripura State Electricity Corporation Limited, TTAADC = Tripura Tribal Areas Autonomous District Council, WHO = World Health Organization

Source: ADB TA Consultant

D. Pre-Construction Impacts and Mitigation Measures

245. Pre-construction activities will include establishing the contractor's environment, health, and safety (EHS) management arrangements to mitigate construction related impacts. This will include the development of a construction environmental management plan (CEMP) to provide details on how the contractor plans to implement the distribution component EMP and relevant parts of the IFC EHS Guidelines on Construction and Demolition. The CEMP will identify the temporary construction facilities required for the construction package be that for the substations, test laboratory or distribution lines e.g., laydown area, stores, temporary workers facilities etc. There will also be surveying of the route alignments and procurement of equipment and materials to transport to the site ready for their installation. No works including site establishment and vegetation clearance will commence on site until TSECL has approved the detailed designs (after having received ADB clearance of their IEE update in respect of final alignments) and CEMP because if not properly planned in the pre-construction stage, the construction phase will have potential significant impacts on the natural and human environment.

E. Potential Biological Impacts and Mitigation Measures

246. The construction works especially site establishment, vegetation clearance and earthworks required for the distribution component, notably upgrades to 27 existing substations, a new test laboratory, new and conversion of existing 33/11 kV covered conductor distribution lines from existing 33/11 kV substations involving stringing of overhead conductors and laying of underground cables including RMUs, existing low tension lines to be converted to ABC lines, and the installation of new distribution transformers on existing 11 kV/ low tension lines for the HVDS pilot could have impacts on the biological environment.

247. Modernization and bay extension work will take place in the grounds of existing substations and the test laboratory will be in the grounds of an existing sub-divisional office supporting modified habitat. No trees will need to be cut. New distribution lines will mostly follow existing distribution line alignments within the available right of way of road corridors or potentially crossing agricultural land, rubber plantation land, or other vegetated area. The new 33kV and 11kV distribution lines will not enter internationally or nationally important biodiversity areas including notified forest areas. Same applies to existing 11kV lines to be reconductored, but low-tension Electrical Subdivision lines to be included in the scope of works have not yet been mapped.

248. Representations of habitats adjacent to sample distribution line alignments are shown in Figure 5-3. Some trees will need to be cut or lopped to achieve the standard safety clearances for distribution power lines; felling of the trees can often be avoided through minor realignment of the distribution poles which is preferred by TSECL unless there are no alternatives available due to the presence of other constraints. Whilst the number of trees to be lost cannot be determined until the route alignments are confirmed by the EPC contractor it has been estimated for the purpose of the IEE that to 2,775 trees (235 trees for new 33 kV lines and 2,540 for new 11 kV) may be lost. No tree loss is envisaged for the low tension to ABC lines. Based on sample line walkovers, this estimation of tree felling is not expected to be exceeded by more than 10% but the actual number of trees to be cut or trimmed will be counted as part of the route alignment surveys by the EPC contractor who will undertake an inventory of trees to be cut prior to TSECL allowing any vegetation clearance. Public trees will be compensated by compensatory afforestation (planting at least 10 trees for each tree cut) as per forest department requirements and the requisite forest department approvals as well as any Department of Public Works approvals required for the tree cutting will be sought pre-construction.

249. As per the site visits, consultation, and secondary document review none of the 33kV or 11kV subprojects selected under the distribution component is within or passes through the protected areas or the notifed Ecologically Sensitive Zone (ESZ) of the protected areas. Rajnagar 33/11 kV substation is the closest to a legally protected area (Trishna Wildlife Sanctuary also a KBA and IBA) at 633 m, this is the distance to the ESZ with the protected area at 790 m. Panisagar 33/11 kV substation is 2.7 km away from Rowa Wildlife Sanctuary and its notified ESZ. Melaghar 33/11 kV) is 2.3 km from Rudrasagar Lake Important Bird Area and Ramsar Site, Jatanbari substation is about 6km from Gumti Wildlife Sanctuary (KBA and IBA) and about 6.5 km from Damboor Lake which is a proposed Ramsar Site, and the test laboratory is about 6.5 km from Sepahijala Wildlife Sanctuary, KBA and IBA, including Clouded Leopard National Park. For the distribution lines none of the new indicative route alignments are passing (or will pass) through the legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972. Rudrasagar Lake IBA and Ramsar site is also avoided. Further, based on indicative route alignments no new 33kV and 11kV distribution line passes through a notified forest area and hence no forest land shall be directly impacted by them. This will be reconfirmed during route surveys by the EPC contractor who will need to ensure that their final alignment maintains this position.

250. In ESD Mandwi and ESD Boxarnagar existing low tension lines were observed close to/passing through forest range but in modified habitat along existing roads; any reconductoring on these existing alignments (assuming no new poles) would have limited direct impact on the forest land. However, if any low-tension lines are identified to be passing through notified forest habitat, then site-specific assessment and management planning must be undertaken by a professional ecologist including consultation with Forest Officials regarding the detailed design and construction method with undergrounding (an acceptable along existing roads in forest lands) or rerouting outside the area rather than reconductoring adopted as the preferred option. The EPC Contractor must secure written permission for the works from Department of Forests even if clearances are not legally required. No low-tension lines will pass through other internationally or nationally important biodiversity sites including legally protected areas or their ESZ.

Figure 5.3 Photographs Showing Vegetation Scenario in Right of Way

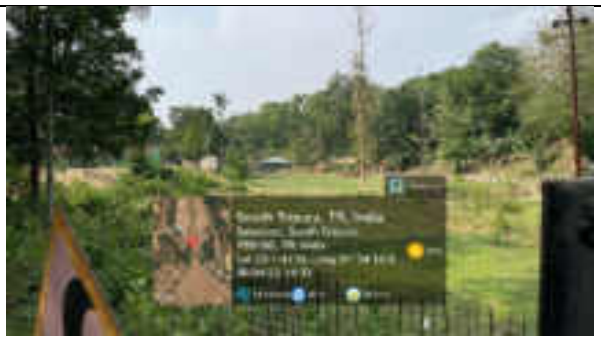
Panisagar to Pechartal Distribution Line

Panisagar to Pechartal Distribution Line

 Uunderground Line from Adarsha Colony Substation to College Tilla	 Mission Tilla - Panisagar- Dhamchara Line
 Gamaitila to Kalyanpur	 Bagfa Feeder Line
 Gokulnagar Substation to 33 kV Madhupur Substation	 ESD Sekherkote - Bangladesh Border

 Golchakkar-Dashamighat Line	 Chittamura Feeder
 Ananada Nagar Feeder	 Ananada Nagar Feeder
	Bodhgangnagar-Adarsha Colony

ESD Mandwi



ESD Poangbari

Source: ADB TA Consultant

251. In addition to the clearance of vegetation and lopping or felling of trees potential impacts on biodiversity during construction and to a less extent during O&M works on the distribution lines relate to disturbance of adjacent vegetation and trees which are not needing to be cleared and wildlife due to the presence of people and construction equipment, the spread of invasive species, and the potential for workers to be involved in illegal cutting of trees, unauthorized collection of non-timber forest products, hunting or poaching of scheduled fauna. These risks are already present due to the existing distribution network, although new distribution lines will increase disturbance and construction will bring an influx of activity to the PAI.

252. The state supports definite critical habitat for two species (*Cyrtodactylus montanus* and *Trachypithecus phayrei* (Phayre's Leaf Monkey)) and possible critical habitat for seven species (*Aquilaria malaccensis* (Agarwood), *Nilssonia nigricans* (Black Softshell Turtle), *Aythya baeri* (Baer's Pochard), *Gyps bengalensis* (White-rumped Vulture), *Manis pentadactyla* (Chinese Pangolin), *Nycticebus bengalensis* (Bengal Slow Loris) and *Macaca leonina* (Northern Pig Tailed Macaque)). No critical habitat species are likely to be encountered at the substations or test laboratory all of which are on modified habitat. The wildlife that will be disturbed will mostly be small fauna like snakes none of which are threatened species. No critical habitat species were encountered during site visits but the following may be encountered in modified habitat along the distribution lines. These seven critical habitat species including *Gyps bengalensis* (White-rumped

Vulture) are resident and can be surveyed for at any time of year, other threatened species will also be present year-round except for migrant birds which would need to be surveyed for during the winter months. Their presence or absence to be confirmed by a field ecologist searching for indicators of their presence as well as actual sightings during route surveys: *Aquilaria malaccensis* (Agarwood) where trees present especially in plantation, *Nilssonia nigricans* (Black Softshell Turtle) if temple ponds crossed, *Gyps bengalensis* (White-rumped Vulture), *Manis pentadactyla* (Chinese pangolin) in rural areas, and *Trachypithecus phayrei* (Phayre's Leaf Monkey) and *Macaca leonina* (Northern Pig Tailed Macaque) in rural areas/plantation especially within 10km of Wildlife Sanctuaries. In Kanchanpur subdivision of North Tripura district, definite critical habitat for the critically endangered, endemic gecko *Cyrtodactylus montanus* is found in a small area of occurrence with records including those from rocky roadside cuttings adjacent forest areas above 600 m asl. Ecology survey would be needed to confirm its presence or absence; but no distribution line works are proposed in its mapped area of occurrence in the Jampui Hills block, starting about 1.75km south of Vangmung substation. The check for presence and absence of species is included on a precautionary basis as individuals of these threatened species may occasionally be encountered in modified habitat along the distribution lines. Based on currently available information there are no threatened fauna species observed or reported by District Forest Officials whose population would be impacted by the extent of modified habitat loss and fragmentation required for the new distribution lines; but, if present, human-wildlife conflicts during works would need to be managed. For all distribution lines the District Forest Officers will be consulted on species occurrence and actively engaged by TSECL and the contractors throughout project implementation.

253. Once installed the substations, test laboratory and underground cables will have minimal impact. The main operational biodiversity impact is from overhead distribution lines relating to electrocution and collision risk to wildlife especially avian fauna (birds, bats) primates and elephant.

254. No elephant corridors are present in the state.[86] As per records available only 59 wild elephants are said to be present in Tripura.[87] These elephants are part of two different elephant groups in Khowai and Gomati districts as per records of the Forest Department, Tripura potentially also moving in South Tripura district from Gomati. There is a risk of elephants damaging / uprooting the poles of the distribution line leading to risk of electrocutions even though no electrocutions of wild elephants in the last 5 years (2016-17 till 2020-21) as per records shared by wildlife officials with TSECL. Based on the indicative route alignments no distribution line is crossing the elephant movement areas in Khowai and Gomati districts and so the risk to elephants from new distribution lines is minimal. However, the EPC contractor and TSECL in finalizing the alignments will ensure that the distribution lines do not cross the known elephant movement areas in these two districts. This will be reconfirmed during route surveys of distribution lines under the project in Khowai and Gomati districts by the EPC contractor who will need to ensure that their final alignment maintains this position of not crossing any elephant movement area.

255. The existing distribution lines present a high risk of electrocution for medium-sized and large birds. Metal crossarms are affixed to conductive poles; as a result, birds perching on the crossarms, or pole top are grounded, and electrocution is likely if birds contact an energized bare conductor. In a 33 kV/11 kV/low tension design the vertical clearances between grounded perches

[86] Right of Passage: Elephant Corridors of India. 2005, Menon, V.,Tiwari, S. K., Easa P. S. and Sukumar, R.(2005). (Eds.). Conservation Reference Series 3. Wildlife Trust of India, New Delhi.

[87] ENVIS Centre on Wildlife & Protected Areas, Hosted by Wildlife Institute of India, Dehradun. http://www.wiienvis.nic.in/Database/ElephantReserves_8226.aspx

and energized conductors are minimal increasing the risk of electrocution. Distribution lines also include pole-mounted equipment such as surge arresters, fuses, switches, transformers, reclosers, regulators, and capacitors. If unprotected, this equipment and associated bare jumper wires also pose an electrocution risk. Surveys of similar power lines in western Rajasthan found approximately one avian carcass per four poles.[88] Scavenging prevents the accurate identification of poles that have caused an electrocution, but it is reasonable to assume that the proportion of poles causing an electrocution is far greater. Avian electrocution is not only a worldwide conservation concern, it also negatively impacts system reliability because many avian electrocutions trigger system protection. In certain habitats, wildlife electrocutions are an important cause of wildfire ignitions. The replacement of existing uncovered conductors with covered conductors and ABC and the use of covered conductors for hew distribution lines significantly reduces the electrocution risk, whilst underground cabling completely removes it. However, the steel pole/cross arm distribution design with unprotected accessories is not a fully bird friendly design and so electrocutions may still occur to any birds that perch on the distribution poles. Primates like monkeys may also climb the poles and similarly get electrocuted, electrocution of Phayre's Leaf Monkey and Northern Pig Tailed Macaque (critical habitat species) as well as the globally vulnerable capped langur would be of particular concern.

256. The overall impact significance of the distribution component pre-mitigation is assessed as **Low Adverse** and **Not Significant** based on existing site conditions which are already modified habitat and the absence of threatened species; potentially increasing to **Medium Adverse** if critical habitat species are encountered or low-tension lines are in notified forest habitat. Mitigation measures will be adopted by TSECL and their EPC contractor to ensure no net loss of biodiversity is achieved including compensatory plantation of 10:1 for any public trees cut.

Mitigation

257. The EPC contractors will ensure during route surveys that the final alignments have no greater impact than predicted by the IEE, including ensuring that none pass through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972 and Rudrasagar Lake is also avoided. In conjunction with the detailed route surveys of the 33 kV / 11 kV / low tension distribution lines to confirm this is the case for all distribution lines a qualified terrestrial ecologist employed by the EPC Contractor will undertake an ecological walkover survey of the routings to map habitats and species encountered with a focus on the critical habitat species as well as confirming the absence of sensitive receptors. The results of the ecological walkover survey shall inform the completion of the site-specific assessment checklist to inform the updated IEE.

258. The following measures will be incorporated into the detailed design to minimize operational risks:

(i) No Agarwood permitted to be cut and if found along the route alignment an alternative routing must be taken.
(ii) In Kanchanpur sub-division of North Tripura district, any distribution lines in Jampui Hills block (near to Vangmung substation) must avoid passing adjacent to forest areas above 600 m asl since the endemic, CR *Cyrtodactylus montanus* may be found along rocky roadside cuttings adjacent forest areas; this includes undesignated forest areas.

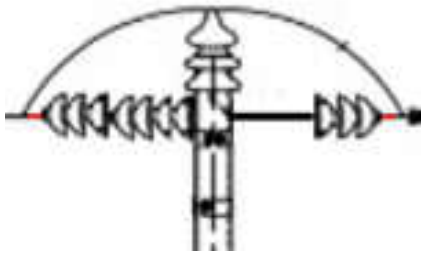
[88] Harness et al. (2013)

(iii) In areas where elephants are regularly found, such Khowai and Gomati districts, outside of the habitations, overhead cables should be installed with the clearance above ground of the lower conductor above the maximum trunk height of an elephant.

(iv) Use of anticlimbing devises on all distribution poles to prevent climbing of them by primates.

(v) On all overhead distribution lines in addition to using covered conductors or ABC bird/primate sensitive design is to be adopted for the distribution poles and accessories by the EPC contractor as per Table 5-6.

Table 5.6 Bird Sensitive Design Measures to be Integrated into Distribution Line Design

Measure	Covered Conductor	ABC	Photo
Ensure no insulation gaps at wire splices or place them >1m from pole (covered wire splice prevents insultation gaps)	**Yes**	**Yes**	
Use insulation-piercing connectors with non-energized exterior for taps and equipment	**Yes**	**Yes**	
Use covered jumpers for taps and equipment	**Yes**	**Yes**	
Cover all primary voltage bushings with insulating wildlife caps	**Yes**	**Yes**	
Extend wire-to-deadend connection >1m from pole with insulator or link	**-**	**Yes**	

Measure	Covered Conductor	ABC	Photo
Maintain integrity of wire cover at tangent insulators (no stripping) Regardless of traditional or clamp-top tangent insulators being used, there should be no gaps in wire cover.	-	**Yes**	
Use anchoring clamps to secure cable to pole without coverage gaps, to secure ABC to poles without any wire stripping	**Yes**	-	

ABC = aerial bundled conductors
Source: ADB TA Consultant

259. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required for biodiversity during construction elaborating on those included in this IEE and the distribution component EMP including the following measures:

(i) Conduct an inventory of trees to be cut prior to the start of vegetation clearance at the substation sites, test laboratory and along all new and existing distribution line routes. Special attention to be given to *Aquilaria malaccensis* (Agarwood) a CR species where trees present, especially in plantation.
(ii) Minimize the felling of the trees through route alignment.
(iii) No tree cutting or trimming during the bird breeding / nesting season.
(iv) Demarcation of mature trees and any *Aquilaria malaccensis* (Agarwood) to be avoided and retained.
(v) Ensure the requisite forest department approvals for any tree cutting are in place pre-construction.
(vi) Demarcation of the working area by the contractor and avoidance of encroachment outside the agreed corridor of impact.
(vii) No temporary or permanent project facilities shall be established within legally protected areas including national parks, wildlife sanctuaries, their ESZ, reserve forests, other notified forest areas, and, internationally and nationally recognized sites such as Key Biodiversity Areas and Important Bird Areas. Temporary construction camps for workers, maintenance yards, or storage areas for material and equipment shall be located at least 500m from the boundaries of internationally and nationally recognized sites.

(viii) Avoidance of construction works from one hour after dawn to one hour before dusk in areas where there is no existing human disturbance and within a 10km buffer of the WLS.
(ix) Removal of invasive plant species during site clearance and routine vegetation maintenance.
(x) Prompt revegetation of disturbed areas on the completion of works with native plant species to Tripura.

260. The PMU E&S Safeguards Officer will be delegated authority under the contract to be able to halt construction works if any wildlife of conservation value or which needs to be rescued is observed. For this purpose, a wildlife identification and rescue protocol will be adopted by the EPC Contractor. The following protocol will be further developed in consultation with forest/wildlife officials, as per site-specific requirements:

(i) Immediately stop all construction activities in the area in which the wildlife has been observed and cordon off the area to avoid any future human-animal conflict.
(ii) Intimate to TSECL (PIC) and the Forest/Wildlife Officer (Range Officer and District Forest Officer (DFO)) in whose territorial jurisdiction the wildlife has been identified. For this purpose, the contact numbers of the concerned officers will be available in the EPC Contractor's office (phone, email and other contact details of the DFOs are available in website of Tripura Forest Department).[89] The intimation message will include details of the location, name of the wildlife species (if identified), injury to humans or animal, if any, and the status of the present situation.[90]
(iii) If necessary, the concerned Forest/Wildlife Officer will mobilize the animal rescue team to undertake rescue operations as per their standard operating protocols. The EPC contractor will provide necessary support to the wildlife rescue team to carry out the wildlife rescue.
(iv) If necessary, the EPC contractor will also immediately intimate the local police station for support for crowd management and control besides cordoning off the area.

261. For the biodiversity offset, TSECL will provide funds to the forest department based on the number of public trees counted by the EPC Contractor to be cut rather than undertaking the compensatory plantation themselves. However, TSECL with support of the PIC will regularly 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 in the RoW would be based on their replacement cost, as defined in the RIPP. An estimated INR 8,852,250.00 has been budgeted towards the cost of compensatory plantation (per Tripura Forest Department cost of compensatory plantation is approximately INR 318.91 per tree including cost of sapling, labour and maintenance for 3 years period). The forest department will carry out the afforestation in degraded forest land and other areas as available with the forest department and officially intimate the locations to TSECL for ease of monitoring progress. The forest department will submit regular end user certificates to TSECL about the status of the saplings planted and the utilization of the fund for the compensatory afforestation. The progress of the compensatory afforestation will be regularly monitored at frequent intervals by TSECL/PIC during the construction and operation phases and reported in the environmental monitoring reports.

[89] https://forest.tripura.gov.in/whoiswho

[90] A training program related to identification of CR, EN, VU and Schedule I and II species that may be encountered is proposed to be undertaken.

F. Potential Physical Impacts and Mitigation Measures

262. The construction works especially site establishment, vegetation clearance and earthworks required for the distribution component, notably upgrades to 27 existing substations, a new test laboratory, new and conversion of existing 33/11kV CC distribution lines from existing 33/11kV substations involving stringing of overhead conductors and laying of UG cables including RMUs, existing low tension lines to be converted to ABC lines, and the installation of new distribution transformers on existing 11kV/low tension lines for the HVDS pilot could have impacts on the physical environment. The most significant impacts relate to ambient air quality due to construction works, noise and vibration due to construction works, storage of fuel/oil/chemicals affecting soil and water resources, and waste generation and climate change and are discussed in the following sections. Other impacts of the distribution component pre-mitigation are assessed as **Low Adverse** and **Not Significant** based on existing site conditions. However, mitigation measures will still be adopted by TSECL and their EPC contractor.

1. Ambient Air Quality

263. Stockpiling of stone and sand and earthworks may result in an increase in dust generation, in an airshed that is already degraded for PM10 and PM2.5 across the state comped to WHO AQG 2021. The substation bay extensions and test laboratory will involve the most earthworks and have greatest dust impact, especially those in the dense urban area. Earthwork at the substations will mostly be grading of the existing ground for paving of the switch yards and the compound, some foundation work for the new bays and cable trenches. This will generate dust, although the dispersion is anticipated to remain within the substation area. The test laboratory site will require more major earthworks in the form of building foundation works and this will generate dust in and around the site which is away from residences (130m closest) and beside the highway so is unlikely to have a significant impact on sensitive receptors. The distribution poles and UG cables will involve less earthworks for the installation of pole foundations and entry and exit pits; in rural areas any dust generated is unlikely to cause a nuisance outside of the settlements but in the settlements especially near residential areas poorly managed construction may result in dust nuisance to adjacent receptors. In the dense urban areas like Agartala there are many sensitive receivers that will experience the effects of additional dust such as households, schools, hospitals, temples etc. Transport of loose construction materials in uncovered trucks or on unsurfaced roads may also increase the levels of dust. On many rural main roads/highways in Tripura the road conditions are poor with exposed soils found along the road RoW instead of pavement. Road traffic congestion causing traffic to divert onto the unpaved edge may thus further increase the levels of dust as well as increasing vehicle emissions. In certain stretches road works for other utilities may be ongoing having a cumulative adverse impact. Overall pre-mitigation the impact of dust is **Medium Adverse** requiring mitigation but **Not Significant.** The use of diesel-powered equipment including diesel generator sets and HDD machine and construction vehicles may increase vehicular emissions although these impacts are assessed as **Low Adverse** and **Not Significant**. Ambient air quality impacts will be temporary during construction and for the distribution lines transient in nature for only a short period of time; following construction any ambient air quality impacts will be reversible and the baseline will quickly return to the pre-construction conditions.

Figure 5.4 Dusty Road Conditions in Study Area

Bodhgangnagar-Adarsha Colony Line

ESD Poangbari

Pachertal-Panisagar Line

Pachertal-Panisagar Line

2. Noise and Vibration

264. The use of construction equipment for earthworks, the use of HDD machinery for underground cable installation, and the use of construction vehicles may increase the noise levels experienced by adjacent receptors. No blasting or piling activities are currently planned.

265. Substation bay extensions and the test laboratory will involve the most earthworks and involve construction in a single location over a period of 12 months. In case of the substations, moderate earthwork for renovation and modernization will take place with replacement of old/defunct equipment, site paving and repairs the control buildings. Some existing substations to be renovated are located close to residential/sensitive receptors including Damchara and Killa with houses immediately adjacent, and Stadium, Kailashahar, Kadamtala, Panisagar, Digalbagh, Chawmanu, Jolaibari with houses at 10 m, and Melagarh with houses at 20m, Kadamtala has a crematorium area adjacent. Development of the test laboratory will be more involved and involve construction activities like earthworks, foundations, and construction of the buildings which will generate noise with the nearest property at 130m and a temple at a similar distance. Noise attenuates over distance but at these short distances the construction noise will be experienced

at the adjacent receptors and will need to be managed. The equipment and machinery used for construction activity will produce cumulative noise at the properties depending on the source type, sound power, number, weather condition, distance, and duration of working period.

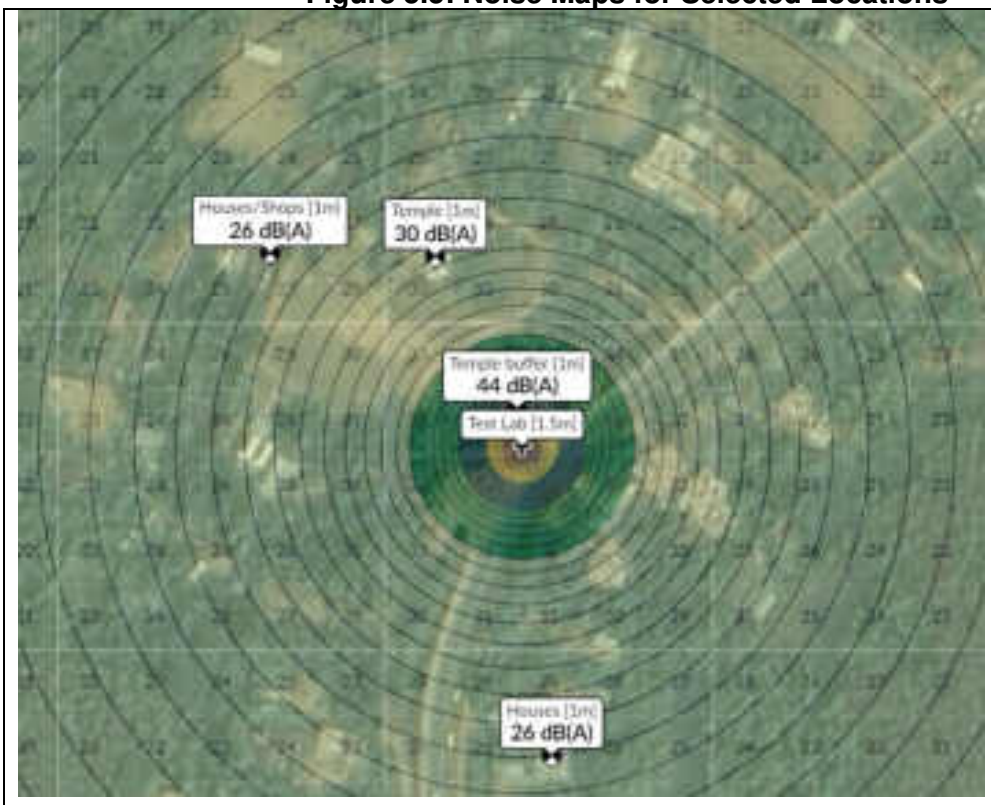
266. To assess the impacts noise modelling was conducted for selected substations and for the test laboratory based on proximity to sensitive receivers and adjacent land use. The model presents a 'worst-case scenario' as it does not consider factors like topography, ground absorption, large obstructions in the propagation path, e.g., barriers etc., refraction of noise, wind speed or direction effects and changing frequencies. Without any facility boundary or other barrier/obstructions, the noise level will propagate and attenuate significantly with distance. For modelling purpose, the cumulative source sound power (Lw) level from activities during construction was taken as 80 dB(A) but the impact will be greater if the contractor uses construction methods resulting in a greater sound power level than this, although piling and blasting are not currently anticipated.

Table 5.7: Day Time Construction Noise Assessment (pre-mitigation)

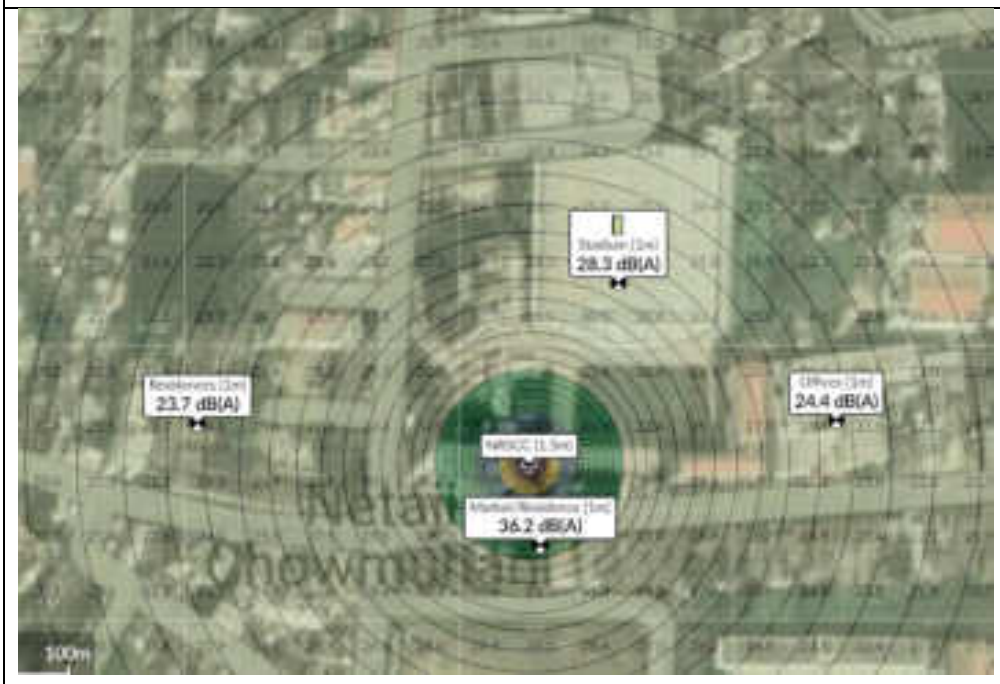
Site	Receptor	Baseline dB(A)	LAeq, T Calculated dB(A)	Assessment Criterion, dB(A)	Exceedance, dB(A)	Impact
Test Laboratory, Gokulnagar	Temple buffer at 100m	59.6	44	50	-6	Minimal
	Shops/houses near market		26	65/55	-29	Minimal
	Houses away from main road		26	55	-29	Minimal
NRSCC Substation	Stadium	51.5	28	65	-37	Minimal
	Front shop/ houses		36	65/55	-19	Minimal
	Office building		24	65	-41	Minimal
College Tilla Substation	University	49.6	28	50	-22	Minimal
	University ground		22	50	-28	Minimal
	NCC Barracks		30	55	-25	Minimal
Stadium Substation	Stadium	50.3	34	65	-31	Minimal
	Residence-side		35	55	-20	Minimal
	Residence-front		29	55	-26	Minimal
Dhamcharra Substation	Residence-back	55.0	41	55	-14	Minimal
	Residence-front		34	55	-21	Minimal
	Residence-side		40	55	-15	Minimal
Kadamtala Substation	Crematorium	45.0	35	50	-15	Minimal
	Residence -1		34	55	-21	Minimal
	Residence-2		39	55	-16	Minimal
Killa Substation	Residence -1	47.1	41	55	-14	Minimal
	Residence-2		36	55	-19	Minimal

Baseline noise levels for Test Laboratory site and Damcherra substation measured using IOS Mobile app 'Decibel X'.
Baseline for other substations monitored by MITCON.
Assessment criteria GoI vs IFC EHS most stringent for residential, commercial or silent zone.
Source: ADB TA Consultant

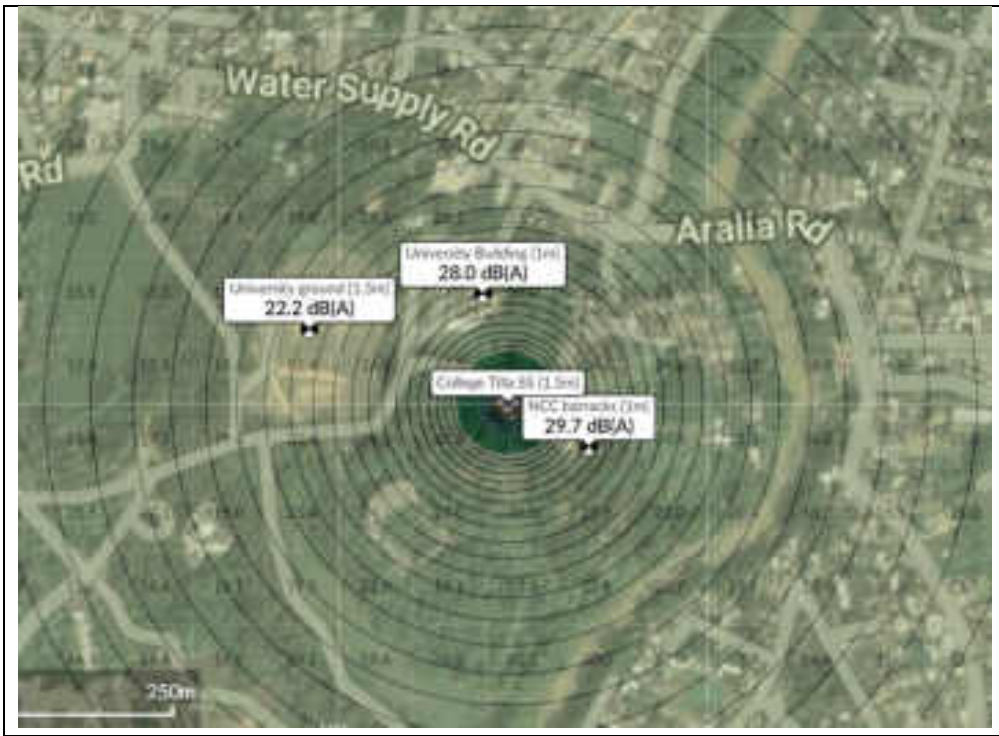
Figure 5.5: Noise Maps for Selected Locations

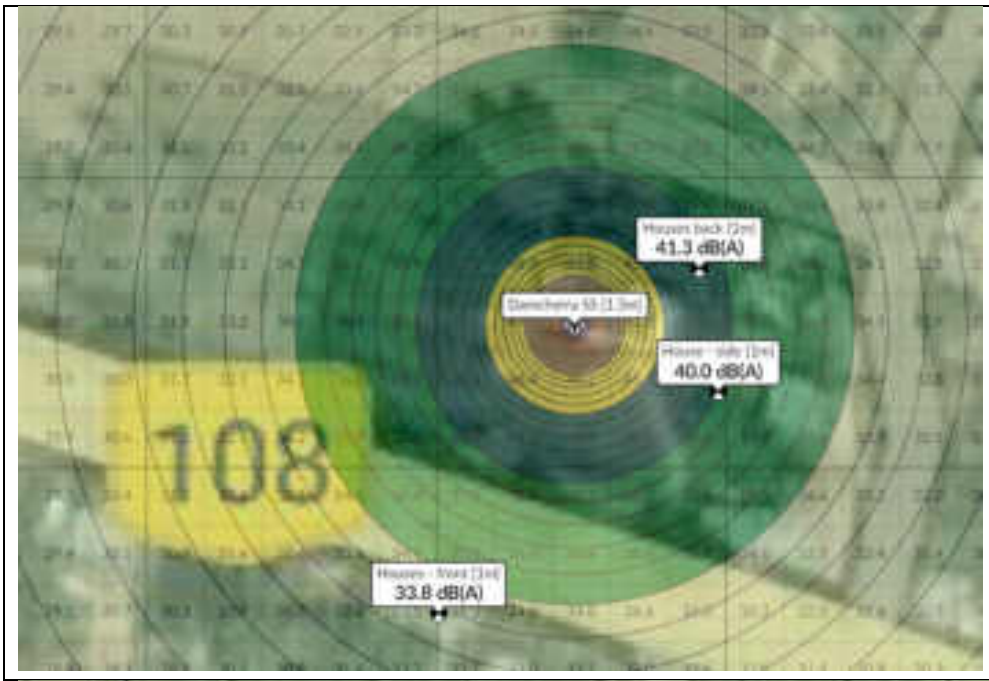
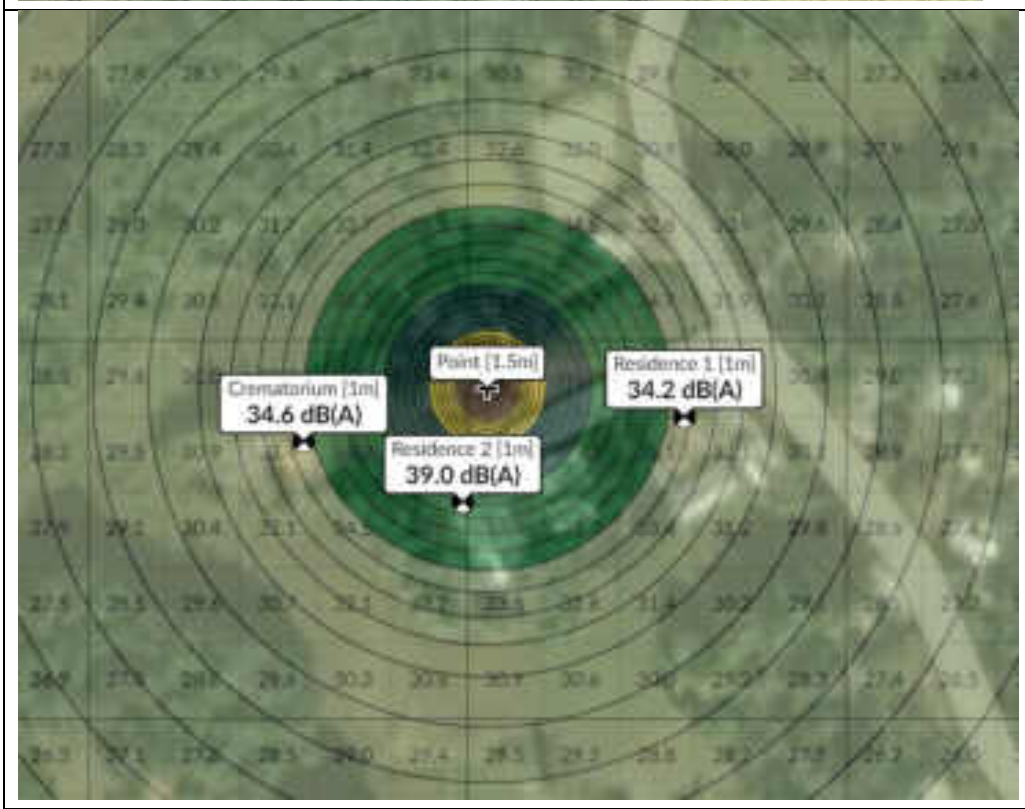


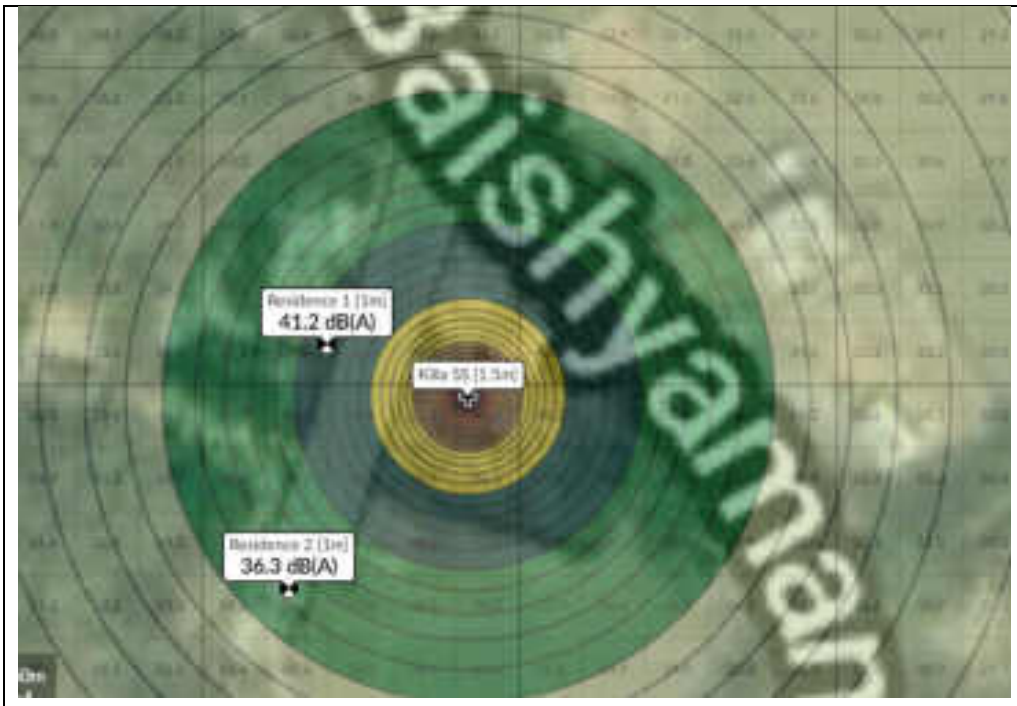
Test Laboratory site at Gokulnagar



NRSCC Substation

	College Tilla Ss
	Stadium SS

	Damcherra SS
	Kadamtala SS

	Killa SS

Source: ADB TA Consultant

267. The HDD machinery for underground cabling involves drilling (at 150m per section) with noise and vibration created around the entry and exit pits (1 x 1 x 1 meter each) where the drill and winch will be located. This activity will be undertaken in dense urban area like Agartala where there are many sensitive receivers that will experience the effects of additional noise such as households, schools, hospitals, temples etc. Road traffic congestion may further increase the levels of noise from vehicle engines and the honking of horns. However, cutting of the entry and exit pits should be for a maximum of 1 hour per section, and equipment operation will be for a maximum of 5 hours intermittent per section so any increase in noise levels will be of very short duration.

268. The overhead distribution lines will involve less earthworks for the installation of pole foundations and no drilling and in rural areas any noise generated by these activities is unlikely to cause a nuisance outside of the settlements; but in the settlements especially near residential areas poorly managed construction may still result in short-term noise nuisance to adjacent receptors.

269. Noise will most affect the sensitive receivers located within about 100m if they are not informed in advance of the works and the scheduling of installation is not properly organized. In certain stretches road works for other utilities may be ongoing having a cumulative adverse impact. Construction noise impacts will be temporary and for the distribution lines transient in nature for only a short period of time; following construction any noise impacts will be reversible and except for at the substations the baseline will quickly return to the pre-construction conditions.

270. For the substations there is also operational noise to be considered given the proximity of some to residential/sensitive receptors. The humming noise emitted from electric power transformers constitutes a serious environmental problem to nearby communities. Because of its tonal component it causes greater annoyance than other noise at the same level. However, at the existing substations transformer hum was recorded to be low and presence only within 3-5 m of

switch yards so it will only be an issue if transformers are within proximity to the adjacent receptors and not well maintained. Proximity of less than 50m to nearby residences/settlements is acceptable if internationally recognized EHS guidelines are applied during detailed design of the substation layout. This includes ensuring that noise levels generated from the substations do not exceed statutory limits for residential and silent areas at the site boundary as applicable to the substation site (Table 5-8).

Table 5.8: Noise Standards and Guidelines in dB(A)

Receptor	GoI Standard LAeq, 24 hr		IFC EHS LAeq, 1 hr		Prescribed Standard to be followed LAeq, 1 hr	
	Day	Night	Day	Night	Day	Night
Commercial	65	55	70	70	65	55
Residential	55	45	55	45	55	45
Silence (at 100m buffer)						
Educational	50	40	-	-	50	40
Health/Medical	50	40	-	-	50	40
Court	50	40	-	-	50	40
Religious Places	50	40	-	-	50	40
Authority Declared	50	40	-	-	50	40

For the operational standard, design to nighttime noise level as substations/test laboratory operate 24/7
Source: ADB TA Consultant

271. Overall pre-mitigation, the impact of noise is **Medium Adverse** requiring mitigation but **Not Significant.**

3. Soil and Water Resources

272. Earthworks will cause changes in soil structure whilst stockpiling of small quantities of loose materials for construction within the ROW and an increase in exposed soil especially during the monsoon season will increase sediment laden surface water runoff that may enter adjacent waterbodies. The amount of soil disturbance will be greatest for the substations/test laboratory, but all 27 substations compounds and the test laboratory are flat land and so no cut and fill is envisaged. Earthworks will be confined to soil movement to create a level platform for construction. Only small areas of a few meters square will need to be excavated for the distribution line pole foundations, underground cables entry and exit pits and RMU foundations. Excavation for the overhead lines will be limited to the foundation/auguring of a single hole in the RoW except when needing four holes for 33kV lattice tower concrete support bases for those distribution lines which are in complex/hilly terrain. Most of the distribution line alignments are along roads with already disturbed soil condition although some pass more fertile agricultural land, rubber plantation and other vegetated areas. For the underground cables there are in dense urban areas with already very disturbed soil condition. Construction works may also impact the existing drainage pattern although the substations/test laboratory are already modified and do not have any natural drainage or water bodies on them. These impacts are assessed as **Low Adverse** and **Not Significant**, although attention needs to be paid to distribution line installation in areas of highly complex terrain area like Damcherra, Panisagar, and Patherchal due to high landslide risk.

Figure 5.6: Erosion Issues Related to Existing Poles

Washed Away Foundation of Distribution Line Pole During Monsoon Season in Gomati District

Washed away pole foundation due to road cutting in Ananda Nagar feeder line, West Tripura

Unstable pole on eroded roadside along Chittamura Feeder line, South Tripura

Source: ADB TA Consultant

273. Additional water, including potable water requirement for borewells to be sunk at substations/test laboratory may impact the water allocation although the number of workers at each site will be limited.

274. Sanitary wastewater if not properly treated and disposed of has the potential to pollute adjacent waterbodies mostly adjacent ponds but also groundwater which can be used as a drinking water source, both of which already have high levels of coliform. However, the amount of sanitary wastewater generated would be limited as construction works and operation will involve only a few workers. There may also be wastewater from washing of construction equipment and vehicles.

275. During construction works fuel, oil and chemicals will be stored at the construction site from which there may be spills or leaks. Replacement of existing OHL will require the removal of poles and wires in some distribution line alignments and even if transformers are not being replaced, they may need to be taken down and reinstalled on the new lines. Oils from these transformers may leak or spill during removal and reinstallation. On the existing distribution network there are existing ground mounted transformers that are not well maintained, and which are already showing significant oil leakage and soil contamination. In the past transformers have contained PCB oil. PCB oil being non-biodegradable and carcinogenic is subject to international phase out of use under the Stockholm Convention.[91] Further once operational there will be fuel, oil and chemicals stored at the substations/test laboratory that may be spilt or leak, and new transformers at the substations and on the HVDS pilot distribution lines from which mineral oil may leak.

276. The main source of pollution will be from substation and distribution line transformers and there is a concern that those at the existing substations and on the distribution lines may contain PCBs. PCBs were not manufactured in India although transformers containing PCBs were made by a couple of companies up until 2004-2006 and their import was only banned in 2016. All old transformers must be considered at risk of containing PCBs. However, the risk is significantly lower for transformers manufactured post-2003 since by that time Indian regulations on the reprocessing and recycling of used oil limiting PCB content had been introduced reducing the likelihood of any cross-contamination.[92] Government of India regulations permit the use of existing PCB containing equipment up until 2025 provided it is within its certified lifetime and properly maintained without possibility of leakage or release of PCBs into the environment with disposal of waste PCBs or contaminated equipment by 2028 in accordance with the Stockholm Convention.[93] Under Government of India regulations TSECL should have an inventory of PCB containing transformers based on manufacturer information or testing of oil. The most suitable way to determine if PCB is present is for a suitably qualified institute to sample and analyze the oil following United Nations Environment Protection Agency (UNEP) Guidelines for the identification of PCB and materials containing PCB[94] and a health and safety risk assessment and plan referring to the measures in PCB transformers and capacitors: From Management to

[91] PCBs - Overview (pops.int)
[92] Hazardous Wastes (Management and Handling) Amendment Rules, 2003 (below detection limit); Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 (<2pmm).
[93] 2016, MOEF&CC: S.O. 1327(E) [06-04-2016] : Notification on Regulation of Polychlorinated Biphenyls(PCBs) Order, 2016 | The Official Website of Ministry of Environment, Forest and Climate Change, Government of India (moef.gov.in)
[94] 1999, UN: PCB_ID_1st_print-2.PDF (unep.org)

Reclassification and Disposal.[95] It is not recommended to take an oil sample for hermetically sealed oil distribution transformers since the transformer itself is fully closed to the environmental condition, but conservator type transformers can be tested. In the absence of Transformer Oil Test data, the date of manufacturing can be used to compare with the PCB risk matrix to ascertain risk. The Risk Matrix is provided in Table 5-9. It was identified that one of the transformers (Figure 5-8) in Damchara substation (located in North Tripura Electrical Division) houses a defunct PCB containing transformer (Eastern Transformer & Exporter Pvt Ltd make, manufactured in 1981) per the UNIDO list.

277. Given the 2025 deadline for removal which coincides with the date of the construction works TSECL will have the responsibility to replace any existing transformers which contain PCBs. Whilst no PCB oils will be used in new transformers, as per international good practice and in compliance with the ban by the Government of India on 6 April 2016, no PCB free test results were not available in any of the substations during audits. Once transformers have been found to contain PCBs they must be labelled as such, any PCB storage areas should also be marked to allow expeditious identification and response to a PCB accident. Similarly, transformers found to be PCB free should be marked as such for future reference of compliance with Government of India regulations and the log of test results to support this kept by TSECL.

278. Spills and leaks may result in pollutants being picked up by surface water runoff either directly or indirectly through the substation drainage system and entering surface waterbodies in or result in infiltration of pollutants to soils and groundwater. The risk of soil contamination or water pollution during construction or operation is assessed as **Medium Adverse** requiring mitigation but **Not Significant**.

Table 5.9 Risk of Existing Transformers Containing Polychlorinated Biphenyls

<table>
<tr><th>Risk of containing PCBs</th><th>Date of manufacture</th><th>Short-term corrective action pre-construction</th><th>Long-term corrective action by 2025</th></tr>
<tr><td>High Risk</td><td>No date, tampered rating plate, or dating pre-1994
(ceased global manufacture)</td><td rowspan="2">Obtain rating plate details, include in inventory – in absence of any documentary evidence PCB free, test transformers</td><td rowspan="4">For all transformers ensure well maintained and do not leak.
Comply with the Regulation of Use,
Handling and Disposal of Polychlorinated Biphenyls prohibition on PCB containing equipment by deadline of 31.12.2025.</td></tr>
<tr><td>High-Medium Risk</td><td>Pre-2004
(reuse of waste oils 20.5.03)</td></tr>
<tr><td>Medium-Low</td><td>Post-2003
(reuse of waste oils 20.5.03)</td><td rowspan="2">Obtain rating plate details and include in inventory – in absence documentary evidence PCB free, test transformers that
(i) are of brand listed by UNIDO in Table 5 of their 2014 Guidelines for PCB Waste Identification, Tracking and Recording[96]</td></tr>
<tr><td>Low Risk</td><td>Post-2016
(national ban import 6.4.16)</td></tr>
</table>

[95] 2002, UNEP: PCB Transformers and Capacitors: From Management to Reclassification and Disposal - First Issue (unep.org)

[96] 2014, UNIDO, GUIDELINES FOR PCBs WASTE IDENTIFICATION, TRACKING AND RECORD KEEPING: uidelines for PCBs, PCB–containing equipment and waste identification, tracking, and record keeping (unido.org)

		(ii) are poorly maintained and leaking and the project directly connects to; (iii) are at risk of being disturbed (moved) as a result of project works resulting in oil leakage; or (iv) are poorly maintained and leaking in high-risk locations e.g. adjacent to community water source.	

Source: ADB TA Consultant

Figure 5.7 Contaminated Soil in Jatanbari and Digalbagh Substation

Source: ADB TA Consultant

Figure 5.8 Polychlorinated Biphenyl High Risk Transformer in Damchara Substation

Source: ADB TA Consultant

4. Waste Generation

279. The distribution component will require procurement of raw materials for construction but more importantly will result in the generation of inert, solid, and hazardous waste that may be inappropriately disposed. This waste will likely pollute the neighborhood if not properly collected/stored/disposed of by the contractors and TSECL.

280. Construction wastes may include soil, concrete, and/or asphalt generated by excavation activity for foundation pits or the entry and exits pits for underground cables. Replacement of existing OHL will also require the removal of poles and wires in some distribution line alignments whilst replacement of electricity meters will result in e-waste (Figure 5-9). Unwanted cables, poles and meters are usually stored in TSECL existing stores and auctioned to authorized and approved bidders.

Figure 5.9 Existing Electric Meters

E-waste handling: Storage and handling of rejected and/or not usable/damaged smart meters in Mandai Substation

	Defunct smart-meter storage inside Digalbagh substation

Source: ADB TA Consultant

281. Some hazardous waste may be generated during both construction and operation such as waste oil, oily cloths, and lubricants. Oil spill clean-up materials (sorbent pads, loose sorbent material, etc.) should be stationed in/outside any oil/fuel/chemical storage building in clearly labelled containers. Although soil is usually inert existing substations were observed to have contaminated soil (Figure 5-3) in almost all cases and so some excavated soil may need to be treated as hazardous waste. If it were inappropriately dumped it could lead to soil and water pollution and be a community health hazard.

282. The risk from waste generation is assessed as **Medium Adverse** requiring mitigation but **Not Significant**.

5. Climate Change

283. Impacts on climate change are envisaged if SF6 gas (insulator) is used and leaked from circuit breakers in the substations or RMU associated with the underground cables. SF6 is a potent Green House Gas. It has a global warming potential 23,900 times greater than CO_2. Given low to medium voltage components and because substations are air not gas insulated only small volumes of SF6 may be used. However, SF6 can be found in gas insulated circuit breakers and RMUs. Although leakage of SF6 is rare and unlikely as climate change is a global issue the impact is assessed as **Medium Adverse** requiring mitigation but **Not Significant**.

Mitigation

284. The EPC contractors will ensure during substation/test laboratory detailed design and route surveys that the final layouts and alignments have not greater impact than predicted by the IEE by having cognizance of international good industry practice per the IFC EHS General Guidelines and Power Transmission and Distribution Sector Guidelines and the presence of adjacent ecological and human receptors. The following measures will be incorporated into the detailed design to minimize both construction and operational impact.

285. **Topography/terrain and drainage.** In all cases seismic design requirements will be followed. Overall, it may be said that about 50-60% of the scope of the distribution components fall under complex terrain. For the distribution lines in highly complex terrain slope stability measures shall be identified during detailed design to minimize the risk of pole uprooting and OHL fall, especially for pole foundations along steep roads, which have slope or embankment on one or both sides.

286. The detailed design for substations/test laboratory will include provision of effective drainage design to prevent possible flooding or waterlogging of the substation area whilst attenuating storm water runoff leaving the site to greenfield runoff rates such that there will be minimal changes to the natural flow rates and paths of storm water runoff across adjacent land. Drainage will be redesigned to route storm water runoff from the substation to existing watercourses or to infiltrate to ground to avoid flooding of access roads and nearby areas. The detailed design will consider climate change adaptation measures suggested by the separate Climate Risk Assessment (CRA).

287. **Noise.** The maximum allowable Government of India noise levels for residential areas in is 55 dB(A) during daytime (0600 – 2200hrs) and 45 dB(A) during night-time (2200- 0600hrs) which is aligned with WHO guideline noise levels given as 1-hour LAeqT per the IFC EHS guidelines but in silent areas the maximum allowable Government of India noise levels is 50 dB(A) during daytime (0600 – 2200hrs) and 40 dB(A) during night-time (2200-0600hrs) which is more stringent. The layout of the substations and test laboratory can be designed to keep both the construction works and transformers the furthest distance possible from the adjacent receptors to minimize noise generated from construction activities and their operation. If after detailed design the noise levels at the site boundary will exceed the required noise levels for either daytime (construction) or night-time (operation) then an acoustically designed noise barrier will need to be installed around the substation/test laboratory perimeter to bring the noise level down to the required noise level. This can be temporary for construction noise, but as operational noise is permanent the acoustic noise barrier will need to be a permanent installation as part of the detailed design.

288. **Soil and water resources.** New transformers (substation and HVDS pilot) will need to be certified PCB free.

289. For the test laboratory the contractor will either direct sanitary wastewater to an existing sewerage system where this exists (unlikely to be available) or include for provision of adequate on-site sanitation facilities including septic tanks and soak-away pits. Septic tank with a soak away to installed within the TSELC grounds but located at least 50m from any spring or well used for drinking water and 25m from any pond, river, or stream. Use of pit latrines will be prohibited.

290. To reduce the risk of leaks of spills causing soil or water pollution, and for emergency response, clean-up and contaminated soil remediation the General EHS Guidelines will be followed including the following measures:

(i) Substation/test laboratory surface water drainage system to be directed through an oil and grease separator before discharge outside the site.
(ii) Oil spill clean-up materials (sorbent pads, loose sorbent material, etc.) to be stationed in/outside any oil/fuel/chemical storage area in clearly labelled containers.
(iii) Substation/test laboratory operators will need to be trained in good housekeeping practices including how to clean up oil/fuel spills and dispose of contaminated sorbent material which would be treated as hazardous waste.

287. **Natural resource use and waste generation.** No asbestos containing materials must be used during the construction.

288. **Climate change.** Use of solid insulation in preference to SF6 insulated equipment. SF6 in fire extinguishers provided at substations should also be avoided. Any equipment containing SF6 will be enclosed hermetically to ensure leakage will be minimal during operation. To minimize leakages circuit breakers and RMU will need to be sealed pressure “sealed for life” units, tested and guaranteed by the supplier at less than 0.1% leakage rate. The RMUs will be designed and operated so that any leakage will trigger an alarm at the nearest concerned staffed substation requiring O&M staff to rectify the situation immediately.

289. During O&M TSECL will need to monitor leakage rates if such event take place and provide training to O&M staff on SF6 management. On end-of-life TSECL will need to ensure circuit breakers and RMUs are appropriately disposed by a certified industrial waste management company who will need to remove SF6 and treat the equipment prior to disposal in accordance with International Electrotechnical Commission (IEC) standard 61634 to ensure SF6 is not released to atmosphere.

290. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required to control impacts on the physical environment during construction elaborating on those included in this IEE and the distribution component EMP. The CEMP will include a pollution prevention sub-plan including an emergency response plan and solid and hazardous waste management sub-plan to be developed in accordance with national regulations, the project EMP and IFC EHS Guidelines and approved by TSECL prior to works. The CEMP and sub-plans will include the following measures:

6. Ambient Air Quality

(i) TSECL access roads to substations to be surfaced before any works at the substation commences
(ii) Minimizing removal of existing vegetation and topsoil, and, promptly revegetating with native species or surfacing any areas where excavation and other earthworks are done
(iii) Central covered warehouse for storage of construction materials will be provided while construction vehicles transporting stone, sand, and other dust generating materials will be covered with a canvas or tarpaulin.
(iv) Good housekeeping will be required with stockpiles of soil and other dust generating materials kept to a minimum and covered with a canvas or tarpaulin.

(v) Water to be sprayed using specialized water tankers to suppress dust during works in the vicinity of communities. The water should be sprayed at least twice a day at substations and on unpaved areas adjacent distribution lines but more often if needed during excavations, earthworks, and dry or windy conditions that enable dust to be easily mobilized.

(vi) Dust emissions will be further minimized by adopting a rolling construction method and immediately restoring the surface of excavated pavements once construction activities are completed.

(vii) Vehicles and construction equipment shall be regularly serviced and well maintained

(viii) Vehicles and construction equipment shall comply with statutory emission standards

(ix) Providing workers with N95 dust masks to be worn when dust generating activities take place

(x) Open burning of construction related waste will be strictly prohibited

7. Noise and Vibration

(i) Maximum allowable noise levels for residential areas is 55 dB(A) during daytime (0600–2200hrs) and 45 dB(A) during nighttime (2200–0600hrs) and in silent zones is 50 dB(A) during daytime (0600–2200hrs) and 40 dB(A) during nighttime (2200–0600hrs) and these are not to be exceeded. If noise levels cannot be met pre-mitigation, the contractor will utilize temporary acoustic barriers and enclosures to reduce the noise level. Monitoring as per EMoP to be conducted and report any exceedance to TSECL.

(ii) If works that exceed these noise levels or result in an increase of >3dB(A) compared to the baseline situation cannot be timed to avoid disturbing sensitive receptors temporary noise barriers will be placed around construction equipment. Temporary noise barriers are available that can theoretically reduce noise levels by up to 30dB(A) which would be sufficient to mitigate the noise impact of drilling at any sensitive receptors

(iii) No noisy works at night, on the weekends, public holidays, religious festivals, and for works in proximity to schools, during exam periods — any noisy works within these periods to only be undertaken with the agreement of local community and residents within 100m (in some locations such as the university area consultees have already indicated they prefer nighttime working to minimize daytime disturbance).

(iv) Use of low noise generating equipment e.g., less than 55dBA sound pressure level at 1m

(v) HDD equipment will use water as a drilling fluid to reduce noise level.

(vi) Drivers will be required to observe low speed wherever necessary and no blowing of horns.

(vii) Vehicles and construction equipment shall be regularly serviced and well maintained

(viii) Vehicles and construction equipment shall comply with statutory emission standards

(ix) Traffic management controls will be implemented to reduce noise from traffic congestion

(x) Construction workers exposure to noise should not exceed the levels set out in the General EHS Guidelines on Occupational Health and Safety otherwise the hearing protection is to be provided

8. Soil and Water Resources

(i) Slope stability measures identified during detailed design to be implemented during construction to minimize landslide risk.

(ii) Minimizing removal of existing vegetation and topsoil, and, promptly revegetating with native species or surfacing any areas where excavation and other earthworks are done

(iii) Excavation and other earthworks will be conducted during the dry season to minimize soil erosion and sedimentation of watercourses although this has potential to exacerbate dust impact.

(iv) Topsoil disturbed will be separately stored and used to restore the surface of the excavated area.

(v) Infertile and rocky material will where possible be reused as fill material, if it needs to be taken off site it will be disposed by licensed waste management operator at designated disposal area suitable for inert waste. It must be ensured that this inert waste is not contaminated with solid and hazardous waste (including oil spills) by maintaining good housekeeping for the waste segregation/storage/transport/disposal.

(vi) Excavated soil will be covered with canvas or tarpaulin when spoil heaps are not active and stored at least 10m from watercourses.

(vii) No wastewater will be discharged direct to surface waterbodies or groundwater without adequate treatment.

(viii) Use of pit latrines will be prohibited as will be open defecation and urination and uncivil use of roads or private premises by construction workers.

(ix) Provision of adequate on-site sanitation facilities including septic tanks and soak-away pits or alternative temporary sanitary facilities that do not allow untreated disposal of sewage to adjacent water bodies e.g., portable toilets where the wastewater generated is enclosed in a container and will later be taken offsite for wastewater treatment and disposal.

(x) For the transient works in urban areas access to alternative sanitary facilities (e.g., existing public toilets) that do not allow the untreated disposal of sewage to adjacent water bodies may be provided.

(xi) Sanitation facilities will include an adequate number of toilets (one per six workers) and sinks for the workers

(xii) Same requirement applies to any construction camps; the use of locally hired workers may eliminate the need for the establishment of temporary construction camps by contractors.

(xiii) Provision of designated hard standing areas for equipment servicing, refueling and wash down at least 50m from watercourses, springs, and wells, with drainage directed through oil and grease interceptors before being discharged into a settling pond prior to discharge offsite.

(xiv) Storage of oil, fuels and chemicals and mounting of equipment containing oil and diesel on drip trays to catch leaks.

(xv) Oil spill clean-up materials (sorbent pads, loose sorbent material, etc.) should be stationed at site.

9. Natural Resource Use and Waste Generation

(i) Provision of construction waste and domestic solid waste collection and disposal system.

(ii) Solid and hazardous waste generated during construction will be limited in volume but should be temporarily stored on site in segregated, labeled, sealed, and covered garbage bins.

(iii) Solid and hazardous waste will need to be handed over to authorized third-party vendors (Assam/West Bengal) for environmentally safe and sound disposal through approved reuses or recycling or disposal to licensed engineered waste management facilities. Based on the type of waste handled the third-party vendors will need to be approved by SPCB for the transport, storage, and disposal of solid or hazardous waste including transformer oil and PCBs.

(iv) Records of materials used, generated waste, and transfer records will be kept by the contractor.

(v) Any vegetation material that is not handed over to the landowner will be immediately disposed using appropriately licensed waste management operator on the completion of cutting and trimming activities.

(vi) Site surrounding soil contamination/exposed to oil leakage to be assessed for potential contamination and appropriate removal and/or remediation measures for any oil or PCB contamination implemented, as addressed in the section on contaminated soil in the General EHS Guidelines.

(vii) TSECL and contractors involved with decommissioning and disposal of old transformers will be required to follow the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 for transport, storage, and disposal of potentially PCB oil containing transformers. Disposal must involve facilities capable of safely transporting (closed trucks) and disposing of hazardous waste containing PCBs. In stores, the transformers will need to be stored on a bunded concrete pad or drip tray enough to contain 110% of the liquid contents should they spill or leak. The storage area should also ideally have a roof to prevent precipitation from collecting in the storage area.

291. Periodic noise monitoring (twice per year during the construction period) at substations/test laboratory will be undertaken. Monitoring points will be located at the façade of the nearest residence where the nearest residence is less than 100m from the site or access road. Should noise levels greater than the allowable standard be recorded during noise monitoring the contractor will be required to implement additional noise mitigation measures such as adjusting his working methods or placing of temporary noise barriers/fences to ensure that the noise standard is met.

G. Potential Socio-economic Impacts and Mitigation Measures

10. Occupational Health and Safety

292. If health and safety risks are not managed injuries are likely to occur during construction works for all the distribution components. Due to construction works for distribution lines being undertaken along railway crossings and roads including underground cabling on the busy urban roads of Agartala they may give rise to slow moving traffic and congestion increasing the risk of a traffic incident involving workers. River crossings also pose a risk. Other health and safety risks to construction workers include exposure to vector borne diseases such as malaria, snake bites, exposure to communicable diseases, such as COVID-19, exposure to hazardous chemicals including PCB exposure risk, unsanitary conditions at the work site and in overnight accommodation provided by their employer, toppling of poles and falls from height, working in complex terrain and slopes, electrocutions, dust, and noise exposure etc. The existing health

services in the parts of Tripura that are rural/remote may not be able to accommodate additional patients from the construction workforce during emergencies.

293. Another issue could be the straying of migrant workers near the Bangladesh Border as in some distribution line sections like ESD Sekherkote, ESD Chittamura, ESD Boxarnagar the border is very close to alignments. The border gate is present in the ESD Sekherkote adjacent to the distribution line. It is anticipated that no cross-border movement of workers will take place. ESD Sekherkote is also a minority area with high level of illegal power tapping. TSECL is of opinion that in such places there may be resistance/conflicts to re-conductor the low-tension distribution lines, as this would stop power theft. This is also true for other such areas also. ESD Mandwi, a TTAADC area, has a history of communal incidents which may be a potential safety issue/conflict.

294. The main occupational health and safety issues inherent to the operation of distribution lines include hazards due to exposure of workers to live power lines, working at heights, and potential exposure to electric and magnetic fields. Government of India has no limits of exposure to electric and magnetic fields.

295. In terms of operation, every year many electricity workers are killed or disabled in India due to electrical accidents due to accidental contact with live wire/equipment, violation/neglect of safety measures, defective equipment, lack of supervision etc. The quality of existing installations is cause of concern in terms of poor installation increasing exposure to OHS risks (Figure 5-11).

Figure 5.10: Photographs Showing Health and Safety Risks for Distribution Components

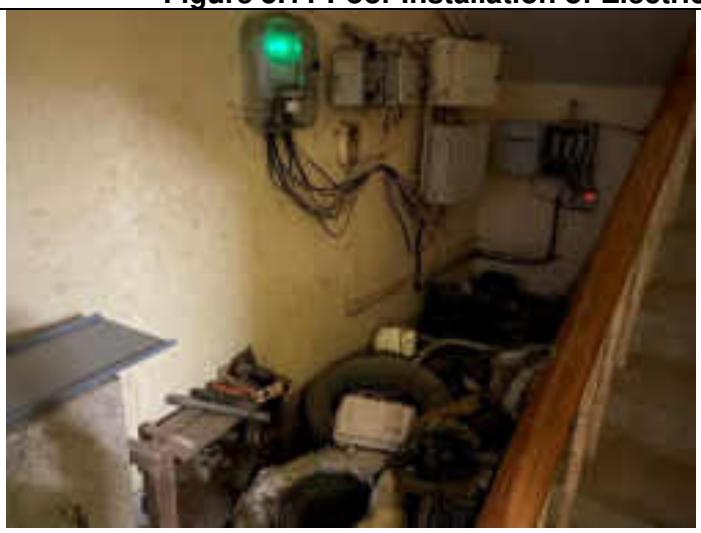
Border Gate and fence along ROW of ESD Sekherkote

Sloping ROW through which underground cable will be laid in Golchakkar-Dashamighat line

River Crossing: ESD Dayarampara	ESD Mandwi: line on elevation and complex terrain (photo showing line passing TSR barrack)
	
River bridge along Bodhgangnagar-Adarsha Colony 33kV Line	Congested and busy National Highway 8 along ROW of Bodhgangnagar-Adarsha Colony 33kV line

Source: ADB TA Consultant

Figure 5.11 Poor Installation of Electric Meter

	An electric meter in the Damchera substation

	An electric meter inside a shop in the Golchakkar-Dashamighat line
	An electric meter with faulty switch supported by a bamboo stem to prevent tripping in ESD Boxarnagar area

Source: ADB TA Consultant

296. Overall, pre-mitigation the distribution components a poses **Medium Adverse** risk which is **Not Significant** to the health and safety of workers. The probability of an incident resulting in fatality will be higher if appropriate health and safety measures are not enforced.

11. Mitigation

297. The EPC contractors will ensure during substation/test laboratory detailed design and route surveys that the final layouts and alignments have not greater risk to occupational health and safety than predicted by the IEE by having cognizance of international good industry practice per the IFC EHS General Guidelines and Power Transmission and Distribution Sector Guidelines.

298. There will be TSECL staff based at the existing substations/test laboratory during and upon operation and therefore the detailed design must ensure adequate sanitation and welfare

facilities are incorporated into the buildings at the site. Sanitation and welfare facilities should meet the requirements of the IFC EHS General Guidelines,[97] EBRD,[98] and ILO[99] including:

(i) Indoor toilets (one per six staff) with hand washing facilities and if overnight accommodation private bathing area, all connected to sewage system or septic tank with soak away,
(ii) Indoor food preparation and separate clean eating area, provision of sufficient fuel supply for cooking other than wood,
(iii) Garbage bins for disposal of waste generated by workers, as burning of waste will be prohibited, and
(iv) Potability testing before work commencement and drinking water supply for any TSECL staff stationed at the substation/test laboratory that meets Government of India drinking water standards must be provided.

299. The assessment of the transformer manufacturing date against the UNIDO guidance was conducted for the 27 substations and most are not at high risk of containing PCBs; but since PCBs are toxic and bio accumulative unless transformers have been certified PCB free all workers working with existing transformers must avoid all exposure to skin and eyes and avoid any potential for accidental ingestion by wearing suitable chemical and/or oil resistant gloves, goggles, and protective clothing during sampling processes and under normal working conditions. If PCBs meets the skin, immediately rinse the affected area with large amounts of running water. This may be done in a sink if the hands are the only portion of the body contacted or under a safety shower if the exposure area is more extensive. If large parts of the skin came in contact with PCBs, remove contaminated clothing while under the shower for a minimum of 15 minutes. Eyewash stations are required. Once equipment has been found to contain PCBs it must be labeled as such, any PCB storage areas should also be marked to allow expeditious identification and response to a PCB accident. Similarly, equipment found to be PCB free should be marked as such for future reference and log of test results to support this kept by TSECL.

300. There are no records of any asbestos survey conducted by TSECL, no asbestos materials were observed during audits in the substations but as some of the substation structures are old and because of the health risks associated with exposure to asbestos dust, which is carcinogenic, the potential presence of asbestos needs to be surveyed by the contractor as part of their occupational health and safety risk assessment using competent third party before any works disturbing existing substations are undertaken. If any asbestos is encountered at any of the existing substations and is at risk of being disturbed by construction work and exposing workers to asbestos dust it must be safely removed and treated as hazardous waste. There are no national acts or regulations banning the use of asbestos in construction but use of any asbestos containing materials by the contractor will be prohibited.

301. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required to manage occupational health and safety during construction elaborating on those included in this IEE and the distribution component EMP. The CEMP will include an occupational health and safety risk assessment and management plan including an emergency response plan to be developed in accordance with national regulations, the project EMP and IFC EHS Guidelines and approved by TSECL prior to works. The risk

[97] https://www.ifc.org/wps/wcm/connect/1d19c1ab-3ef8-42d4-bd6b-cb79648af3fe/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES&CVID=nPtgxyx
[98] https://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf
[99] https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R115#:~:text=The%20aim%20should%20be%20that,the%20purchase%20of%2C%20such%20accommodation .

assessment should be undertaken through a facilitated risk assessment workshop involving contractor, TSECL, and PIC. The occupational health and safety plan should follow the health and safety hierarchy including measures set out in the IFC EHS General Guidelines on Occupational Health and Safety and those on Electric Power Transmission and Distribution. The emergency response plan will be including emergency response and preparedness procedures, communication systems and protocols to report any emergency, including interaction with commune and provincial emergency and health authorities. Communication channels and protocols with local and regional emergency and health authorities will need to be established in case of an incident. CEMP H&S sub-plans will include the following measures:

(i) Provision of personal protective equipment (PPE) such as hard hats and safety gloves/boots for every worker (with use mandatory and subject to no work conditions if not compliant) as a last resort where risks cannot be avoided.
(ii) Provide readily available first-aid for workers as well as an ambulance for more serious cases.
(iii) Orientation regarding not to leave project footprint and potential risks of working close to international borders.
(iv) Hire local workers and staff as far as possible especially for works in TTAADC areas.
(v) Consider the use of security personnel to ensure workers comply with the code of conduct especially adjacent to the international border and in other areas with a higher conflict risk.
(vi) All workers will receive health and safety induction and those working with live electricity and at heights will attend specialist health and safety trainings and be certified to do so following medical check. Untrained workers will not be permitted to work with live electricity or at height.
(vii) Live lines will be deactivated and properly grounded before work is performed on, or in proximity, to the lines and this will be checked and certified in writing by the contractor's Health and Safety Officer in advance.
(viii) While working at heights personal safety measures such as harnesses, tool bags, ropes etc. will need to be provided.
(ix) Sufficient toilets (one per six workers) and hand washing facilities, clean eating area, and shaded rest area to accommodate the number of workers on site must be accessible at all construction sites.
(x) Drinking water that meets Government of India drinking water standards must be provided, if an authorized supplier of canned water is not used the source must be regularly tested to confirm it meets these standards.
(xi) If a construction camp is provided it must be similarly adequately equipped with sufficient toilets, hand washing facilities, showers or baths, food preparation and clean eating area, etc.

302. PMU E&S Safeguards Officer will be delegated authority under the contract to be able to halt construction works if occupational health and safety risk that poses a risk to life is present.

303. Given the operational occupational health and safety risks once handed over to TSECL they will need to adopt the following measures:

(i) TSECL to be guided by the "Environmental, Health, and Safety Guidelines – Electric Power Transmission and Distribution" (IFC 2007) when working with distribution components.

(ii) Risk assessment and occupational health and safety plan for the maintenance of substations and distribution lines will be developed and adhered to during their operation. Emergency situations considered will include fire and electrocution of workers.[100]

(iii) Training program for all workers on substation sites and responsible for maintenance of distribution lines to be provided.

(iv) O&M to be performed only by adequately and regularly trained and experienced staff of TSECL's various Division and Sub-division Offices under supervision of a Health and Safety Officer.

(v) Workers to observe guidelines to minimum approach distances for excavations, tools, vehicles, pruning, and other activities when working around power lines.

(vi) Restricting working at height only by workers who are trained and certified to do so.

(vii) Testing of structural integrity prior to proceeding with the work and the use of fall protection measures such as harnesses, tool bags, ropes etc.

(viii) Restricting access to electrical equipment only by workers who are trained and certified to work on electrical equipment.

(ix) Proper grounding and deactivation of live power lines during maintenance work or when working near the lines.

(x) Provision of PPE for workers, safety guidelines, personal safety devices such as harnesses, tool bags, ropes etc., and other precautions.

(xi) For O&M staff occupational health and safety measures include ensuring they are not exposed to excess EMF.

(xii) Sanitation and welfare facilities as per construction will also be required for maintenance workers.

12. Community Health and Safety

304. The substations/test laboratory are already within TSECL compounds which providing fencing is adequate before construction starts will not be accessible to the public. However, potential nuisance to nearby properties during construction includes dust, noise and vibration from construction equipment, and passage of heavy vehicles transporting materials to the sites.

305. Some of the distribution lines passes through agricultural and rubber plantation areas but in most cases the distribution lines will follow routes along road RoWs such that activities will mostly be performed in the road corridor, and in urban areas/settlement will be in very close proximity to residents, business, etc. The use of roadside and adjacent spaces during construction works will cause traffic congestion and increase the risk of a traffic incident. Sample photographs of ROW housing/commercial activities in the route alignments are shown in Figure 5-12. Since works are in the public domain impacts on the community during construction works may include health and safety incidents due to the presence of open pits, road blockages and congestion, exposure to pollution and wastes, conflicts with workers and staff of TSECL due to provocation, sexual exploitation, or harassment of locals by workers, spread of communicable diseases like STDs and COVID-19, and cultural conflicts in tribal areas.

[100] Including an emergency response plan with emergency response and preparedness procedures, communication systems and protocols to report any emergency, including interaction with commune and provincial emergency and health authorities

306. There could be occasional cases including in the tribal areas (as seen during site visits) where dilapidated distribution poles that need to be replaced or lines that do not comply with safety clearances are currently located on private property. In cases where there is conversion these poles and lines will be removed and stored temporarily on site/along the road. Existing line access will be used to undertake such activities to limit the work zone in private properties. But in such circumstances, there is increased potential for incidents or conflicts between the public and workers.

307. The risks from the distribution line subprojects are short term given the transient nature of distribution line works concentrated on each short section and activities being for a relatively short time. However, they will be greater if communities are not informed in advance about the works and appropriate health and safety measures (e.g., dust and noise management, community awareness, hazard warning boards for on-going construction activities, temporary works boundary fences, and traffic management controls) are not enforced at the construction sites.

Figure 5.12 Photographs Showing Potential Community H&S Risks Associated with Distribution Line Right of Way and Operation of Distribution Network

1. 11 kV Degalbagh Feeder to bifurcate existing Raghna Feeder route with poles stored along road – potential for vehicle/pedestrian accident

Storage of poles along roadside in Gamitila – Kalyanpur distribution line route

2. Temporary shops and workers on ROW of 33 kV Pechartal Substation to 33 KV Panisagar Substation route

3. Shops adjacent distribution transformer and within ROW (66KVGokulnagar Substation to 33kV Madhupur Substation) - potential risk from cable fault, transformer burst, fire etc.

4. Tribal hut below Distribution Line (132 kV Mission Tilla Substation to 33 kV Dhamchara via Panisagar Substation) with risk wire falling on roof and electrocution/fire

5. 11 kV Degalbagh Feeder to bifurcate existing Raghna Feeder route showing crossing with a hospital (white building) - during construction congestion, storage of material and pole dismantle/new may cause H&S risk to locals

6. 33 kV UG from Grid Sub Station to College Tilla Substation route showing potential health risk during construction, when road will become congested and students' movement (school gate shown)

7. 132 KV Gamaitilla Substation to 33KV Kalyanpur Substation route showing school entrance on ROW

8. 33 kV UG from Grid Sub Station to College Tilla Substation showing electrocution risk for people on rooftop. This line to be moved to UG

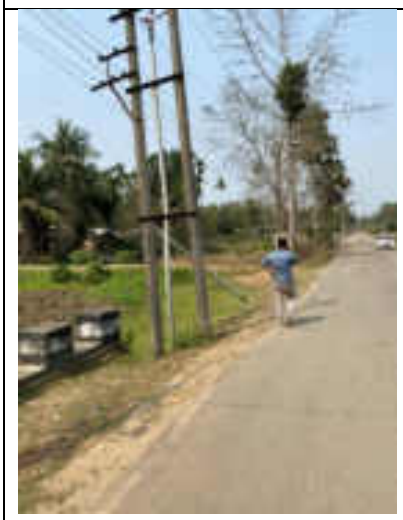
9. 33 kV UG from Grid Sub Station to College Tilla Substation route- potential pole topple/wire snapping on fields during monsoon.

10. 11 kV (UG) Milan Chakra Feeder from Badhaghat Substation to CNG Station, showing- UG ROW route

11. 11 kV (UG) Milan Chakra Feeder from Badhaghat Substation to CNG Station route showing- UG ROW route

12. Storage of distribution line transformers and other equipment outside the Kadamtala Substation compound and inside a public/community used crematorium.

Ground mounted transformer without fence on main road with shops adjacent near Gokulnagar Madhupur distribution line route, Sipahijila District



A hanging pole besides the Digalbag Substation and along the Digalbag to Rehna Feeder Bifurcation Line, Dharmanagar

	
Representative Image: Toppled TSECL Electric Pole in Agartala (Source: Tripua-infoway.com)	Representative Image: Shop engulfed in fire as Transformer catches fire due to short circuit. (Source: Times of India.com)
	
Representative Image: Udaipur, Tripura power outage due to transmission substation fire, 13th October 2021 (Source: Tripura- infoway.com)	Narrow road along Golchakkar-Dashamighat line with congestion and regular traffic jams Source: ADB TA Consultant
	
Shop on ROW on sloping roadside and supported on logs, through which underground will pass in the Golchakkar-Dashamighat line Source: ADB TA Consultant	End point of Golchakkar-Dashamighat line with transformer, bare conductors adjacent to shops in the ROW Source: ADB TA Consultant

	
LT line passing over house/yard of residences in ESD Dayarampara Source: ADB TA Consultant	Pole within private property and on unstable land in ESD Dayarampara Source: ADB TA Consultant
	
ESD Mandwi Low Tension Line pass over school compound Source: ADB TA Consultant	ESD Mandwi Low Tension line pass over Tripura State Rifles (TSR) Camp which is also built on complex terrain Source: ADB TA Consultant
	

ESD Mandwi Low Tension line passes over tribal houses Source: ADB TA Consultant	11kv Anandanagar Feeder line pass through school compound Source: ADB TA Consultant
	
ESD Poangbari Low Tension line passes over school in ROW Source: ADB TA Consultant	Storage of posts in ROW of Chittamura feeder line Source: ADB TA Consultant
	
Storage of posts in ROW of Poangbari LT line Source: ADB TA Consultant	Electric poles passing through brickfiled onto road - Chittamura feeder line Source: ADB TA Consultant
	

ESD Dayarampara low tension line pass along Main Hospital Source: ADB TA Consultant	Low tension line over houses in Dayarampara ESD Source: ADB TA Consultant

Source: ADB TA Consultant

308. The operation of the distribution lines near community areas may expose the locals to electrocution hazards because of direct contact with live conductors or flashover from the conductor to a pole, particularly if the person, tree, or structure is near a live line where the safe horizontal or vertical clearances are compromised. Indian Electricity Rules and Regulations provide for safety clearances to the ground, roads, railway lines and habitations to ensure safety of human beings and livestock moving, living, or working in the vicinity of distribution networks which is some instances are not currently met. Whilst minor rerouting where safety clearances are not current met and the use of covered conductor, ABC and underground cables especially where existing lines are reconductored reduces some of these health and safety risks because TSECL has decided to keep in situ the existing lines the benefits will not be as significant as if those lines were removed.

309. Presence of new overhead distribution lines in settlement areas may expose local communities to fire risks, EMF, cable break incidents and potential electrocution during storms if wires snap and poles fall on roads etc. Houses made of flammable material roofs like straw and bamboo, especially in the tribal areas, are at particular risk from fire hazards and such fires may easily result in fatalities. In terms of operation, every year many members of the public are killed or disabled in India due to electrical accidents due to snaping of conductors, accidental contact with live wire/equipment, violation/neglect of safety measures, defective equipment, inadequate maintenance, and unauthorized works. As with OHS the quality of existing installations in the public domain is cause of concern in terms of poor installation increasing exposure to risks. Ground mounted transformers, as observed during site visits, that are not maintained, not fenced and with oil leakages leading to soil contamination as shown in Figure 5-12 are a major risk.

310. To protect against EMF the International Commission for Non- Ionizing Radiation Protection (ICNIRP) for the public (up to 24 hours a day) will be adopted. The EMF from distribution networks in communities can vary widely depending upon the number of phases and whether the circuit is overhead or underground. A typical 11kV overhead distribution line with 300amps current can result in magnetic field of 22mG immediately below the line dropping to 15mG at 7.5m from the line and 8mG at 14m distance.[101] Further, EMF levels associated with distribution lines are significantly lower than those associated with overhead transmission lines. In the case of UG cable, the 3-core cables are covered by semi- conducting compound and wrapped with copper tape. As the copper tape is earthed, electric field only exists between the core and copper tape, and the electric field does not propagate outside the periphery of the cable. Therefore, the health impact of the electric field is negligible. Further, as the three cores for three different phases are installed closely in one cable, magnetic field generated by each core will be offset by the magnetic fields from two other cores. Therefore, almost no magnetic field is generated by the cable and the health impact by magnetic field is negligible. The impact of EMF is dependent on the duration of exposure but provided the ICNIRP guideline levels are complied with for community exposure to the distribution components no significant adverse impacts are envisaged.

311. Overall, pre-mitigation the distribution components a poses **Medium Adverse** risk which is **Not Significant** to the health and safety of local communities. The probability of an incident resulting in fatality will be higher if appropriate health and safety measures are not enforced by the EPC contractor and TSECL.

[101] https://www.adb.org/sites/default/files/project-documents/51395/51395-002-iee-en.pdf

13. Mitigation

312. The EPC contractors will ensure during substation/test laboratory detailed design and route surveys that the final layouts and alignments have not greater risk to community health and safety than predicted by the IEE by having cognizance of international good industry practice per the IFC EHS General Guidelines and Power Transmission and Distribution Sector Guidelines. Community health and safety measures e.g., fencing and signage will be incorporated into the detailed design:

(i) Lightning arresters to be provided along the line.
(ii) There should also be provision for ensuring security of the cable to avoid vandalism.
(iii) Each pole should also have installed a sign warning about the safety hazard from the power lines, for pole mounted transformers these should be fenced off with a locked gate.
(iv) To prevent against cable break incident of new UG cables markings will be installed to protect the safety of cables.

313. In all cases including conversion of distribution lines where safety clearances are currently encroached upon the minimum electrical clearance, as required by the Indian Electricity Rules and Regulations[102] are to be maintained with respect to the ground, roads, railway lines and habitations, to ensure safety of human beings and livestock in the vicinity of the distribution lines. If safety distances are found not to be complied with during reconductoring the distribution line will have a minor realignment to facilitate compliance. In addition to these safety clearances, given greater vulnerability of children to health and safety risk, the crossing of school compounds and playgrounds will be avoided by routing new distribution lines outside them and any other similar community facilities during survey work. For any lines within 5m of such facilities the arrangement plan will be included in the updated IEE, following detailed route surveys being completed during detailed design. Existing distribution lines being reconductored which cross school compounds or playgrounds and other similar community facilities will also be marginally realigned to ensure that the same requirements as for new lines are met. The arrangements plan for any such realignments will be included in the updated IEE following detailed route surveys being completed by the contractor.

314. Once operational, TSECL staff need to conduct regular inspections (at least monthly) on the distribution lines to ensure that the clearances are maintained. The inspection protocol should include possible conductor snapping and de-energizing of the line within three cycles to avoid the potential for electrocution from a breakage. The community is needing to be educated by the contractor and TSECL with respect to the importance of maintaining the horizontal clearance from buildings in order that they do not erect new buildings within this zone as has reportedly occurred in all the instances where safety clearances are breached.

315. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required to manage community health and safety during construction elaborating on those included in this IEE and the distribution component EMP. The CEMP will include a community health and safety risk assessment and management plan including an emergency response plan to be developed in accordance with national regulations, the project EMP and IFC EHS Guidelines and approved by TSECL prior to works. The risk

[102] DGMS, 1956: Microsoft Word - New Microsoft Word Document.doc (dgms.net)

assessment should be undertaken through a facilitated risk assessment workshop involving contractor, TSECL, and PIC. The community health and safety plan should follow the health and safety hierarchy including measures set out in the IFC EHS General Guidelines on Community Health and Safety and those on Electric Power Transmission and Distribution. The emergency response plan will be including emergency response and preparedness procedures, communication systems and protocols to report any emergency, including interaction with commune and provincial emergency and health authorities. Communication channels and protocols with local and regional emergency and health authorities will need to be established in case of an incident. CEMP H&S sub-plans will include the following measures:

(i) Measures for the physical environment will be adopted to reduce disturbance; notably construction works will be restricted to daytime, so the noise limit is 55dB(A) in residential areas and 50dB(A) in silent areas.
(ii) If works are not completed within the day the contractor must not leave any hazardous conditions (e.g., unsigned, unfenced, and unlit open excavations without means of escape and emergency contacts in case an accident occurs) overnight unless absolutely no access by public can be ensured.
(iii) Construction workers including subcontractors will be given awareness raising in HIV/AIDS, other communicable diseases including COVID-19, and sexual, exploitation, abuse, and harassment with strict penalties (e.g., immediate removal from site) for any. Contractors staff will also be given awareness raising in HIV/AIDS and sexual, exploitation, abuse, and harassment.
(iv) Contractor and TSECL with the support of CSOs as part of its regular health and safety practices to organize health and safety campaigns prior to construction regarding construction risks and from coming into contact with live electrical equipment prior to energizing the distribution lines as well as in relation to smart meters about how to avoid electrical incidents. Awareness programs will use distribution of posters, leaflets, and safety booklets to all households in Bengali language within 50m of the substations and along the RoW distribution lines as well as face-to-face orientation at the village/community level. Translations will also be available in local languages in the TTAADC area. These posters and safety booklets will be available within substations, local electrical offices of TSECL.

316. PMU E&S Safeguards Officer will be delegated authority under the contract to be able to halt construction works if community health and safety risk that poses a risk to life is present.

317. Given the operational community health and safety risks once handed over to TSECL they will need to adopt the following measures:

(i) Risk assessment and community health and safety plan for the maintenance of substations and distribution lines will be developed and adhered to during their operation. Emergency situations considered will include fire and electrocution of members of the public.[103]
(ii) TSECL with the support of CSOs as part of its regular health and safety practices to continue to organize health and safety campaigns.
(iii) In case of fire events, explosion, and other related situations, given the TSECL may not be available immediately in rural locations the community should be

[103] Including an emergency response plan communicated not only to staff of TSECL but also to the local communities living close to substations and distribution lines. Communities living close by should also be included in mock drills in addition to the awareness raising drives.

educated with respect to emergency response with 24/7 emergency contact numbers for TSECL included on signs; TSECL will need to ensure this is manned 24/7 to ensure that it is effective reporting route.

(iv) All RMU will be kept locked with warning signs as they are being installed on the public street. There is a risk of fire associated with RMU although use of solid or SF6 gas insulation minimizes this. All necessary precautions to ensure emergency procedures are to be posted and fire extinguishers available at the location of the RMUs in the event of a fire.

(v) TSECL will map on GIS and freely share the information of the routing of all underground cables to the relevant authorities so when underground works need to be done by others, the location of the cables would be known and can plan to be avoided by their contactors.

(vi) Regular inspections of the line and the facilities would help identify missing or corroded parts that need immediate replacement.

(vii) The community should be educated with respect to the hazards associated with meeting electrical equipment.

(viii) In the event of a cable break TSECL staff/community must immediately notify the nearest TSECL incident coordinator for handling measures: power cuts, technical O&M staffing to inspect and repair.

14. Land Use and Livelihoods

318. The substation/test laboratory locations are accessible from existing village roads, urban main roads and/or state highway paved roads at distance varying in the range of 25-50m. Some of the access roads are unpaved and/or in need of repair. Poor condition and unpaved access roads need to be surfaced to connect the substations with existing paved roads. Substations like Chawmanu (Figure 5-13) do not currently have provision for vehicle entry and a short level, surfaced access road needs to be constructed. Construction traffic to and from the sites will be minor and periodic in nature although large vehicles will be required for plant and equipment transport.

Figure 5.13 Inaccessible Vehicle Gate at Chawmanu Substation

Source: ADB TA Consultant

319. Impacts due to construction of the distribution lines include damage to private and public properties; interference with other utilities like power, water, gas, sewers especially due to underground cable laying works; traffic congestion and blockage of access ways to residences and business; and temporary power outages. Most roads are relatively narrow and in bad condition, and movement of large trucks along these roads carrying the electric poles and other materials might cause temporary blockage and nuisance to the locals. Some sections of distribution lines will traverse narrow single/two-lane roads which can cause interference to the normal flow of traffic. This is primarily troublesome in residential areas where roads are being used by vehicles such as bicycles, motorbikes, cars, and vans. As there may be limited space for the temporary storage of the poles and materials, the contractor may park trucks carrying these materials on the road further causing traffic congestion and hazards to pedestrian and vehicle commuters.

320. Overall, the construction of the distribution components will have **Low Adverse** impacts that are **Not Significant** to land use and livelihoods of the local community although these impacts will need to be well managed to avoid conflict situation with the local community.

Figure 5.14 Representative Photographs Showing Distribution Line Passing Through Agricultural Fields (Sepahijila 33 Tilla route/College Tilla)

Source: ADB TA Consultant

321. The impact of the distribution component on the socio-economic environment will be beneficial as improved access to uninterrupted electricity supply will help stimulate economic growth, particularly in rural areas of the state. During operation, benefits to local people can be maximized if TSECL recruits local persons for semi-skilled and unskilled positions at the substations/test laboratory.

322. Potential negative impacts include inconvenience during O&M works for the local community when there may be power outages for maintenance, which may affect business and residences although this impact would be short term and already being done for the existing system. The underground cables are armored by steel wires to protect the cores which are live. In case the armor is broken by a third party and the core is damaged, protection relays in the RMU/substation detect this and stop sending electricity to the feeder immediately by automatically opening switchgear in the RMU/substation to prevent a live shock to the person. Therefore, the consequences of a cable break incident are reduced.

15. Mitigation

323. The EPC contractors will ensure during route surveys that the final alignments have not greater impact than predicted by the IEE. Per national and Tripura regulations it is mandatory for TSECL to seek requisite clearances prior to construction from agencies like, departments of railways, roads, telecommunication, and wherever necessary, from aviation authorities that could be affected by the construction of power distribution infrastructure.

324. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required to manage land and livelihood related impacts during construction elaborating on those included in this IEE and the distribution component EMP. It will include a construction traffic management sub-plan, as to minimize adverse impacts of the project on traffic, the contractor will be required to properly plan and execute a traffic management plan in accordance with national regulations and the IFC General EHS Guidelines that is supported by good site supervision. The CEMP will be including the following measures:

(i) Ongoing consultation following the TSECL communication plan is to be implemented along with disclosure of distribution component impacts and activities. GRM to be operational, and all stakeholders to be aware of it, including how to register grievances.
(ii) Community awareness raising regarding the distribution component with concerned local government authorities and media dissemination for all communities living and working nearby so they know what to expect.
(iii) Conflict situations to be avoided by early consultation before the start of work and keeping open communication channels throughout.
(iv) In case there is a need for temporary storage, locations to be agreed and any impacts on private land and assets to be compensated in line with national requirements. Cut vegetation, excavated soil and poles will need to be stored away from the running road and habitation.
(v) Contractors will be required to ensure that safe access ways to public and private amenities are maintained throughout the construction period.
(vi) Traffic management will need to be done in consultation with the affected communities to ensure they are aware of likely disruption.
(vii) Post warning signs and manage traffic movements to protect the travelling public and its workers as necessary and ensure drivers obey road rules and travel at a safe speed given the nature of local roads and size of vehicles involved. Road

safety and warning signs must be posted at 500m, 100m, and immediately in advance of the distribution line works at least two weeks prior to the works commencing to inform the public of turning vehicles and the temporary blockage of one lane of the road during pole installation works.

(viii) For congested and narrow roads flagmen should be utilized to warn road users of the situation.

(ix) If stringing conductors presents a possible risk to traffic on roads, scaffolds will be constructed to protect pedestrians and vehicles (and the conductor itself) from potential injury/damage during conductor stringing.

(x) During construction, benefits to local people can be maximized if the contractor recruit's construction workers locally. However, precedence must be given to ensuring that all workers are appropriately skilled given the hazardous nature of distribution works and so local workers will be limited to few unskilled positions.

(xi) Wherever possible, the contractor should not discriminate and should proactively encourage the employment of suitably skilled women on the project.

H. Potential Physical Cultural Impacts and Mitigation Measures

325. The potential impacts on physical cultural resources include potential damage to existing structures and undiscovered underground resources during earthworks for foundations and underground cable installation. Presence of religious and cultural places is anticipated along distribution line routes which need to be inventoried with details after route alignments are surveyed and finalized. Based on the location of the work involving excavations in an already modified environment it is unlikely chance find will occur although a chance find procedure will still be adopted.

326. Based on the sample 33kV and 11kV distribution line route surveys a couple of locally important temples were observed beside the ROWs e.g., Pachertal to Panisagar Distribution Line route (Figure 5-15) which is visited by locals in large numbers. Although no potential damage is anticipated to such structures themself, movement of construction vehicles, dust and noise is anticipated disturbing users. The distribution lines could also have visual impact/create visual clutter in the vicinity of physical cultural resources. However, there are existing power lines and telecommunication lines in towns/villages and along the road RoW in most locations so the new and converted lines will not be a new component in the landscape. No 33kV or 11kV distribution lines will be within 300m of protected monuments. However, for the low-tension lines in ESD Boxarnagar existing low tension lines were observed within the 100m prohibited zone of an ASI monument. If any low-tension lines are identified to be passing within 300m of an ASI or state protected monument, then site-specific assessment and management planning must be undertaken by a professional archaeologist including consultation with ASI regarding the detailed design and construction method. No objection certificate must be obtained if works remain within 300m. Since the distribution lines are already present the risk relates to inadvertent damage and disturbance further than a visual impact on the setting of the protected monument.

327. Since any physical cultural resources that will be encountered by new lines are of local sensitivity the impact is assessed as **Low Adverse** and **Not Significant**. However, it may increase to Moderate Adverse in relation to low-tension lines if within 300m of protected monuments.

Figure 5.15 Physical Cultural and Religious Structures in Project Area of Influence

	
Hindu Temple and ashram along Pachertal to Panisagar route	Islamic religious Motinagar Eidgarh ground used for cultural events, adjacent to starting distribution transformer of ESD Sekherkote Low Tension line
	
Temple in PAI along Golchakkar-Dashamighat route	ESD Mandwi: Sacred Tree of local tribal importance used for annual festival of nature worshipping in PAI of the low-tension line

Temple in ROW of Ananda Nagar Feeder Line

A Temple, about 100m from test laboratory site

Low Tension Lines passing along access road to ASI Boxarnagar Stupa, ESD Boxarnagar

Source: ADB TA Consultant

Mitigation

328. The EPC contractors will ensure during route surveys that the final alignments have not greater impact than predicted by the IEE, including ensuring that none pass through ASI or Government of Tripura protected monuments or their regulated zone unless (in the case of low-tension lines) site specific assessment and management planning has been undertaken and a no objection certificate has been obtained. Such works would only be undertaken under the full time watch of an archaeologist. The detailed route surveys of the 33kV / 11kV / low tension distribution lines will need to confirm this in the case for all distribution lines with the completion of the site-specific assessment checklist to inform the updated IEE before any works commence.

329. The CEMP to prepared by the EPC contractors before construction commences will incorporate mitigation measures required for physical cultural resources during construction elaborating on those included in this IEE and the distribution component EMP including the following measures:

(i) Conduct an inventory of physical cultural resources in and adjacent to the RoW prior to the start of any works including site clearance along all new and existing distribution line routes.
(ii) Minimize visual impacts/amount of visual clutter through sensitive route alignment of overhead cables and RMU placement having cognizance of any physical cultural resources adjacent.
(iii) Demarcation of physical cultural resources such as trees or shrines to be avoided and retained.
(iv) Demarcation of the working area by the contractor and avoidance of encroachment outside the agreed corridor of impact.
(v) No temporary or permanent project facilities shall be established within ASI or Government of Tripura protected monuments or their regulated zone.
(vi) Follow agreed procedures for chance finds including stop work and inform TSECL who shall inform DOA.

330. PMU E&S Safeguards Officer will be delegated authority under the contract to be able to halt construction works if any damage to known physical cultural resources is caused or chance finds are encountered.

I. Residual Environmental Impact

331. The post mitigation impact significance is provided in Table 5-5, there are no significant residual impacts.

VI. CONSULTATIONS, PARTICIPATION, AND INFORMATION DISCLOSURE

A. Introduction

332. The purpose of the stakeholder consultation and public participation process is to ensure that interested or affected stakeholders as well as the public are informed about TSECL's plan for and to solicit their views and opinions about the distribution component. According to ADB's Safeguard Policy Statement (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.
(vi) Consultation will be carried out in a manner commensurate with the impacts on affected communities.
(vii) The consultation process and its results are to be documented and reflected in the environmental assessment report."

333. This chapter summarizes the outcome of public consultations conducted as part of the IEE for the distribution component of the Tripura Generation Upgradation and Distribution Reliability Improvement Project.

334. In the context of the distribution component, spread across 8 districts of Tripura, and its potential impacts and risks, there are three categories of project stakeholders:

(i) Affected Parties: individuals, groups, local communities, and others that may be directly or indirectly affected, positively or negatively (adjacent residents to substations and route alignments, consumers of electricity, owners of land through which a distribution line passes, farmers/rubber plantation owners who land route alignments pass, shop owners and small business along route alignments, educations establishments adjacent to route alignments, etc.)
(ii) Other interested parties: those interested because of the location of the distribution component, its proximity to natural or other resources these may be local government officials, community leaders, and those who work in or with impacted communities (elected municipal/village representatives, community/religious leaders, Tripura state pollution control board, wildlife/forest officers, local NGOs, CSOs, tribal Heads at village levels, etc.)
(iii) Disadvantaged / vulnerable individuals or groups: vulnerable individuals or groups who often do not have a voice to express their concerns or understand the potential impacts and risks (scheduled tribes, migrant workers, senior citizens, physically challenged, children, etc.)

Table 6.1 Approach and Methodology for Consultations

Stakeholders	Purpose	Method
Villagers/city residents along the distribution lines and adjacent to the substations and test laboratory in the distribution component	• For information sharing • Seeking their views on the impacts and risks, obtain suggestion on the possible mitigation (design inputs) • Discuss future plan of action such as project implementation and timeline • Discuss institutional setup and Grievance Redress Mechanism • Seeking their participation during the project implementation	Public consultations through focused group discussions (FGD) at various locations under the distribution component
Scheduled tribe/ indigenous people in the TTAADC village in the distribution component	• For information sharing • Discussing about the IP benefits and potential impacts and mitigation • To know about the local condition especially socio-cultural setup of scheduled tribes / indigenous peoples • Seeking their views on the impacts and risks, obtain suggestion on the possible mitigation (design inputs) • Discuss future plan of action such as project implementation and timeline • Discuss about institutional setup and Grievance Redress Mechanism • Seeking their participation during the project implementation	Public consultations at some TTAADC village through focused group discussions (FGD)
TTAADC official at the head quarter	• To discuss about the distribution component of TSECL and its benefits in general and to discuss about the potential environmental and social impacts along with mitigation measures and seeking further cooperation and involvement of TTAADC in project implementation	Meeting
PCCF cum Chief Wildlife Warden and HoFF Nodal Officer, Forest Conservation Act and Additional Principal Chief Conservator of Forest District Forest Officers (DFO)	• For information sharing • Identification of issues related to human-wildlife conflict, presence of elephant corridor and conflicts • Cases of electrocution of wild animals in the recent past • Thoughts on the project implementation, suggested mitigation measures	Meeting and Phone Calls
DGM TSECL Nodal Officer -in charge of forest and wildlife issues	• For information sharing • Identification of issues related to human-wildlife conflict, presence of elephant corridor and conflicts • Cases of electrocution of wild animals in the recent past • Response to feedbacks/comments from Wild Life Officials	Phone Call

Stakeholders	Purpose	Method
	• Wild Life clearance for ROW • Thoughts on the project implementation, suggested mitigation measures	

TTAADC: Tripura Tribal Areas Autonomous District Council; PCCF: Principal Chief Conservator of Forest; HoFF: Head of Forest Force
Source: ADB TA Consultant

B. Preliminary Consultations with Local Community

335. Consultations were held to inform the IEE with local communities at 19 locations in December 2020, March 2021, October 2021 and April-May 2022 based on the sample distribution lines surveyed. Keeping in mind the geography of the state and land use types through which distribution lines are proposed, a district sensitivity matrix was developed which included various situation risk-vulnerability scenarios and 19 sample distribution lines were selected for site-specific environmental assessment and consultations, including overhead and underground distribution lines passing through built-up areas, along village roads, adjacent shops/business, through agricultural fields, and in the tribal area. Additional consultations were held during the substation audits whereby residents within 50m of the SS were in invited for consultation. During audits locals were either interviewed in the substation, wherever present, or consulted outside the SS premises. Consultation was also held with nearest residences/small business owners to the test laboratory site on 2 May 2022.

336. Formal and informal discussions were held, and participants were informed about the details of the distribution component. The purpose of the discussions was to provide information to the public on the key features of the distribution component, including benefits, potential adverse impacts and risks, and how these will be managed by the TSECL, as well as to obtain the views and concerns of local communities with respect to environmental issues relating to the existing scenario including information on the physical, biological, cultural and socioeconomic environment and the distribution component and to ascertain general consensus of tribal and indigenous people on the acceptability of the distribution component, and make them aware about the project implementation schedule, mitigation measures, grievance redress mechanism, ongoing consultation etc.

337. Due to ongoing COVID-19 restrictions during 2020-2022 meaningful consultations were limited because of COVID-19 advisories and large gatherings not being permissible at the time of site visits. Town hall type public consultations were not possible on account of restrictions on mass gathering and lockdowns in place during the period. Further, for rural substations, being in more isolated locations away from village centres adjacent receptors were either absent or few in number, resulting in a lower rate of consultation participation. Since consultations were primarily based on on-the-spot discussions women participants were very rare, making female representation poor for the distribution component. FGD consultations were held within the tribal areas although no gender FGD in the tribal areas was possible.

338. The first round of consultations, conducted in December 2020, covered two distribution line alignments. In the second round, conducted in March 2021, consultations were held at 13 substations (out of 27 existing SS in scope) and on eight distribution line alignments. During the April-May 2022 site visits, consultations were conducted at ten sites along the distribution lines sampled. In total 20 villages/towns consulted were general revenue villages and non-TTAADC villages/areas along the distribution lines, substations and test laboratory site. A total of 112 participants attended the consultations of which 88 were male and 24 were female. Seven villages consulted were TTAADC villages. A total of 62 participants attended the consultations of which 38

were male and 24 were female. The total number of public consulted was 174 participants of which 126 were male and 48 were female. Locations and number of participants are described in Table 6-2, TTAADC in Table 6-3 and details on each consultation in non-TTAADC villages along with responses and list of participants are provided in **Annexure 12.**

339. The analysis of the consultations brought out that whilst impacts on the consumers of electricity distribution services as well as the safety of those along/adjacent to route alignment (including houses over which OHL to be realigned currently pass) will be positive, there are also likely to be negative impacts on other affected parties including shops and houses within/close to the RoWs over which OHL may pass, impacts on rubber plantation areas and farm lands along which route alignments will pass during construction and post construction stage, temporary impacts and inconvenience to communities residing along the distribution line alignments during construction, temporary economic impacts on businesses along the alignments, and temporary inconvenience for traffic where distribution alignments along narrow roads. The impacts on vulnerable groups, like tribal settlements in some distribution line alignment in the TTAADC areas, including where existing lines pass over houses, low tension poles are in private compounds, are related to disadvantages owing to exclusion from formal consultation processes, absence of voice in organized consultations or representation in resident associations or other collectives or owing to their location in slums or settlements that are already under/not served by electricity services.

340. These consultations are considered sufficient to inform the IEE which is based on trends in issues emerging from the consultees. However, the alignment of distribution lines consulted on was only indicative so the detailed impacts of the distribution lines on the local community were uncertain. Also keeping in mind the low turnout for the reasons stated above, further consultations will be conducted before construction and continue throughout the project implementation. The IEE will be updated when further consultations are conducted, and additional site-specific data become available.

341. Summary findings of the consultations are described in Table 6-4, Table 6-5 and Table 6-6 with records provided in **Annexure 12**.

Table 6.2 Locations and Participants in Non TTAADC Areas

#	Name of Village	Male Participants	Female Participants	Total Participants
1	Chaumanu	4	0	4
2	Khasrang para Mandwi	5	0	5
3	College Tilla, Agartala	6	0	6
4	Thakur Para Jolaibari	3	3	6
5	Kailasahar	6	0	6
6	Rangrung	6	0	0
7	East Chandigarh	3	0	3
8	Kadamtala	3	2	5
9	Jolaibari	1	3	4
10	Panisagar	2	0	2
11	Melaghar	3	0	3
12	Digalbag	0	2	2
13	Rajnagar	3	0	3
14	Sekherkote, Agartala	8	0	8
15	Dashamighat, Agartala	4	1	5
16	Ananda Nagar, Agartala	2	2	4
17	Chittamura	4	3	7

18	Kheyerpur, Agartala	4	4	8
19	Gokulnagar, Agartala	19	3	22
20	Badarghat, Agartala	2	1	3
Total		**88**	**24**	**112**

Source: ADB TA Consultant

Table 6.3 Locations and Participants in TTAADC Areas

#	Name of Village	Male Participants	Female Participants	Total Participants
1	Manu	5	1	6
2	Takarjala	3	0	3
3	Damcherra	12	1	13
4	Dayarampara	1	6	7
5	Boxarnagar	2	4	6
6	Mandwi	10	9	19
7	Poangbari	5	3	8
Total		38	**24**	**62**

Source: ADB TA Consultant

Table 6.4 Sample Distribution Line, Substation and Test Laboratory Wise Public Consultation Summary

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
Component: Distribution line alignment			
Distribution Line Route: **(66KVGokulnagar Substation to 33KV Madhupur Substation)** alignment along suburban road 18.12.2020 Shop within ROW	3 males (shop owners/workers)	• Flashes and fire in Distribution Line transformer located adjacent to shop • How the construction affects their livelihood. • Number of days they will have to shut shop as OHL is above shop • Regular power outages	• Consultation and disclosure before work starts • Updated distribution line and systems improves power outages
Distribution Line Route: Mission Tilla via Panisagar to Damchera North Tripura 12.03.2021 Tribal hut over which OHL is planned	1 male, 1 female – tribal family	• No power connection to house • How construction will impact their house	• Consultation and disclosure before work starts • Maintain safety clearances to properties • EMP implementation
Distribution Line Route: Raima Feeder Sadium Substation to Doordarshan, Agartala city, planned UG alignment,	2 males	• Power outage during UG cable laying • Issues with road blockage at entry/exit points • Power outage minimized	• Consultation and disclosure before work starts • EMP implementation

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
16.03.2021			
Distribution Line Route: 33kv (UG) Line from Badarghat to Rampur Substation, built-up area 16.03.2021	1 female	• Power lines over roofs can cause accidents • Expansion of the road • Reduced power tariff	• Consultation and disclosure before work starts • Maintain safety clearances to properties • EMP implementation
Distribution Line Route: Low Tension to ABC: ESD Sekherkote, multiple sub-lines, built up, minority area, adjacent to international boarder and gate 27.04.2022	8 male	• How will this mitigate power failures in the area • Lines over houses/compound is high risk	• Consultations and disclosure before work starts • ABC will mitigate electrocution risk, power failures • EMP implementation
Distribution Line Route: **11kV conversion to covered conductor from Golchakkar to Dashamighat**, built up, 40% of alignment passes along bund (flood control), narrow road 27.04.2022	4 male, 1 female	• Regular power outages affect shops • Fire flashes in the bigger distribution transformers • The route/road is on a bund (an embankment designed to control water) and the GoI is planning to resettle them elsewhere • Electric poles are broken and damaged and may risk falling	• EMP implementation • Upgradation will mitigate power failure and fire incidents • HDD laying would be done • Poles will be repaired/maintained • Consultations and disclosure before work starts
Distribution Line Route: **Low Tension line to ABC: ESD Dayarampara Feeder,** TTAADC area, some areas with complex terrain, houses clusters built on cut hillocks, lines over roofs, pole in compound, rural 28.04.2022	6 females, 1 male	• Distribution line passes over many of the houses in the area • Cover the wires • Electric pole is installed in one of the courtyards (Asharampara) • Regular power outages • Roads are bad and steep and water flow is high during monsoon	• Consultations and disclosure before work starts • Pole to be shifted near boundary of property • Overhead lines to be re-aligned along road with ABC • EMP implementation
Distribution Line Route: **Low Tension to ABC: ESD Boxarnagar**, rural, numerous brickfields, 3000-4000 migrant	2 male, 4 female	• Faulty meter and main switches • Bamboo planation hampers power lines. Power outages caused during rainy season.	• Project implementation will improve the faulty meter and line issues • Consultations and disclosure before work starts

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
workers mostly from state, some tribal villages covered, line passes adjacent to Boxarnagar Stupa (ASI) 28.04.2022		• Incidents of lines falling on houses during rainy season	
Distribution Line Route: **Low Tension to ABC: ESD Mandwi**, TTAADC area, rural, scattered huts, some routes in complex terrain, many churches, water stress, vegetation 29.04.2022	7 male, 9 female	• Power is cut when large vehicles of ONGC pass through. ONGC rig is in this area • Water stress in the area • ONGC supply water via tankers to the nearest cluster of houses • Regular power outages	• Consultations and disclosure before work starts • Conversion to ABC will help mitigate frequent power outages
Distribution Line Route: **11kV conversion to Covered Conductor: Anandanagar Feeder**, complex terrain in major portion, rural, scattered houses, lines over cropland, rubber plantation, hillock cut roads with vegetation in some portions 29.04.2022	2 male, 2 female	• Regular power failure	• Conversion to ABC will mitigate frequent power outages
Distribution Line Route: **Low Tension to ABC: ESD Poangbari**, TTAADC area, rural, social forestry in some stretches, passes over fields in some stretches, open areas, rubber plantation 30.04.2022	5 male, 3 female	• Regular power failure • Faulty meters • Sometimes excess billing	• Conversion to ABC will mitigate frequent power outages • Replacement of meters • Issues with billing system to be checked separate to project implementation by TSECL
Distribution Line Route: **New 11kV Line on Covered Conductor: Chittamura Feeder**,	4 male, 3 female	• Recurrent power outages • Faulty lines • Power lines snap during rainy seasons	• Conversion to ABC will mitigate frequent power outages • EMP implementation

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
rural, along main road, passes over cropland, brickfields, complex terrain in some portions, intermittent settlements 30.04.2022		• Line passing with 1m of structures/structures inside ROW	• Conversion will mitigate power outages/faults
Distribution Line Route: **New 33kV as underground from Bodgangnagar Substation to Adarsha Colony Substation**, urban, built-up, crosses highway, river railway line, along Chaturdash Devta temple, crosses congested market/traffic zone, ends in industrial area 02.05.2022	4 male, 4 female	• Regular power outages during rainy season • Impacts during construction in front of shop	• Conversion to ABC will mitigate frequent power outages • EMP implementation • HDD technology used
Distribution Line Route: Low Tension to ABC: ESD Sekherkote, multiple sub-lines, built up, minority area, adjacent to international border and gate 27.04.2022	8 male	• How will this mitigate power failures in the area? • Lines over houses/compound is high risk	• Consultations and disclosure before work starts • Realignment where lines over houses to meet safety clearances • ABC will mitigate electrocution risk, power failures • EMP implementation
Sample distribution lines where consultation was not conducted/possible	• Joloibari Substation to Bagafa Feeder • Gamaitilla to Kalyanpur • Adarsha Colony Substation to College Tilla Substation		
Component: Substations and Test Laboratory			
Dhamacherra Substation, North Tripura, nearest neighbors of Substation, 12.03.2021	2 males (both tribals)	• Traffic management during construction • High iron content in ground water • Issues related to solid wastes • Accidents from electricity to be avoided	• Consultation and disclosure before work starts • EMP implementation

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
Kadamtala Substation, family living adjacent to Substation, 13.03.2021	2 females	• There should be primary health center in the area	• To be forwarded to concerned authority (outside of TSECL scope) • Consultation and disclosure before work starts
Panisagar Substation, North Tripura, 13.03.2021	2 males	• Employment opportunities in the project construction is needed	• Consultation and disclosure before work starts • EMP implementation
Digalbagh Substation, family heads of residents adjacent to Substation, 13.03.2021	4 males	• There should be boundary wall around the substation • There should be a permanent road near the Substation	• Request for permanent road to be forwarded to concerned authority (outside of TSECL scope) • Consultation and disclosure before work starts • EMP implementation
College Tilla Substation, adjacent residents, 16.03.2021	3 males	• Electrical tariff is high • Covered cables are required and UG lines	• Electrical tariff be considered as per TSECL but outside of project scope • Consultation and disclosure before work starts • EMP implementation
Jolaibari Substation, locals living adjacent to Substation. 17.03.2021	1 male, 3 females	• Electrical tariff is high • Employment opportunities in the project construction is needed	• Electrical tariff be considered as per TSECL but outside of project scope • Consultation and disclosure before work starts • EMP implementation
Mandai Substation, locals 8.03.2021	3 males	• There should be streetlights on village residential areas • There should be primary health center in the area • There should be employment opportunities for villagers in project construction works	• Request for streetlights/health center to be forwarded to concerned authority (outside of TSECL scope)

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
			• Consultation and disclosure before work starts • EMP implementation
Kailasahar Substation, Unakoti District, local shop owners 13.03.2021	6 males (2 tribal)	• Substation within town area where there is presence of heavy traffic • Impact on present road infrastructure during construction period • Requirement of land acquisition for the project and displacement issues	• Request for permanent road to be forwarded to concerned authority (outside of TSECL scope) • Consultation and disclosure before work starts • EMP implementation
Rangrung Substation, Unakoti District Locals 13.03.2021	3 males	• Presence of school opposite the substation • Presence of poisonous snakes in the area • Lack of medical facilities in the area • Electric outage frequent but electrical bills are high	• Consultation and disclosure before work starts • EMP implementation
Manu Substation, Dhallai District, Locals 14.03.2021	1 female and 4 males (1 tribal)	• Poor quality and quantity of water • Issues related to solid wastes • Presence of primary school near the substation • Requirement of complete boundary wall along the substation	• Consultation and disclosure before work starts • EMP implementation
Melaghar Substation, Sipahijala District family head of residents living adjacent to substation and locals 16.03.2021	3 males (1 tribal)	• Poor quality of ground water • Presence of poisonous snakes and beehives within the substation area • Heavy presence of traffic in the local area • Impact on present road infrastructure during construction period	• Consultation and disclosure before work starts • EMP implementation
Rajnagar Substation, South Tripura District family head of residents living adjacent to substation and locals 17.03.2021	3 males	• There should be boundary wall around the substation • Existing transformers and lines are very old leading to regular outages during summer and monsoon	• Consultation and disclosure before work starts • EMP implementation
Takarjala Substation, Sipahijala District locals living adjacent to substation 18.03.2021	3 males (all tribal)	• Positive views on the upgradation project as the existing transformers and other machinery are very old	• Consultation and disclosure before work starts • EMP implementation

Consultation Location/Date	Number of participants (male/female)	Issues Raised/ Concerns	Project Response/Inputs to project design
		• Regular outage of current in the evening especially during monsoon leading to disturbances to students and public	
Gokulnagar, Agartala for Test Laboratory site, urban area, tea plantation on two sides, main road onside, nearest habitation about 130m, market/small business and residences	16 male, 3 female	• Possibility to employ locals and reduce unemployment in the area • Project implementation will mean influx of workers and economic benefit from the food outlets • Water stress during summer • Regular power outages • Faulty electric meters	• Consultation and disclosure before work starts • Local employment by contractor will be encouraged • EMP implementation • Smart metering replacing faulty meters • Test laboratory means quicker installation/repair of faulty transformers and quicker turnaround time that may help reduce power outages
Substations where consultation were not conducted/possible	1. Jatanbari Substation 2. Killa Substation 3. Madhupur Substation 4. Stadium Substation 5. Chawmanu Substation 6. Adharsha Colony Substation 7. Capital Complex MR Substation 8. NSRCC Substation 9. Rampur Substation 10. Hrishmukh Substation 11. Charipara Substation 12. Durjanagar Substation 13. Vangmung Substation 14. Tilabazar Substation		
Male	126		
Female	48		
Total	174		

Source: ADB TA Consultant

Table 6.5 Summary Findings of Public Consultations in Non-Tribal Village/Areas

Issues Discussed	People's Views and Perception
Have you heard about the Project or do you have any information about the project	Some people are aware of the project very little and in a few locations, people are listening about it for the first time. In some areas people have heard about the project and according to them, it will be a good project for the area. But not aware of distribution line upgradation and proposed test laboratory.

Issues Discussed	People's Views and Perception
What is your opinion about this Project	Project is good for the area and nearby villages. Some held that after implementation it will increase the power supply. People in general will be benefitted from this project. Business will benefit due to workers eating in nearby outlets/shops where line passes through built-up/market areas like - Kheyerpara, Gokulnagar.
Do you support this Project	People have agreed voluntarily to support this project fully as it is beneficial for them.
Are all houses electrified and if yes then what is average hours of electricity per day for domestic consumption	Most of the houses are electrified. The average hours of electricity per day for domestic consumption is 15 to 18 hours.
Are there industrial units in the village and surrounding and if yes please mention the name	Yes, there are agro-based, Wood based, Rubber, Tea estate, Food processing, Plastic and petrol based industrial units in this area. They are mostly small and medium scale industries. This project will help such industries to expand, and new industry might come here to set up. Industrial areas and intermittent workshops/factories along some distribution line routes like Bodhgangnagar to Adarsha Colony.
What are the general economic activities in the area	General economic activities are Service, Daily Labour, Business, agriculture, forest products, carpentry, small household products for markets etc.
What are the major crops and how many crops you cultivate in a year	Major crop is Paddy. It is cultivated once or twice in a year depending upon the weather, soil, and irrigation facility. Also, seasonal vegetables.
Do you face any problem regarding current electric supply as far as home connection is concerned	Yes, people have issues with current electric supply, as the supply is not regular and there are power cuts very often and it is worse during rainy season due to rain and storm. Power cuts affect shops/businesses.
Do you think that the project is necessary	Yes, project is necessary as the proposed project can help improve the power supply with developed and sustainable electricity supply even during rainy season.
What are your main concerns/issues about the project	The height of the electric pole should be more because its generally touch the trees. Tree cutting should be avoided to protect environmental losses, timely execution is needed as in some locations its closer to educational institutions, proper safety steps also important. Works in front of shops for new/existing line will affect business.
Can you suggest how best to address your concerns/issues	The height of the electric pole should be more than the existing poles and tree cutting should be avoided. Work may be done on night to avoid power cut during daytime. Safety measures should be followed during implementation to protect humans and animals from any accident.
The project is about rehabilitation of new substation without land acquisition and replacement of 33kv and 11kv distribution lines and test laboratory in TSECL area. While the project will not acquire any land some of the lines may pass through the agriculture field	Implementation of project should be done in such a way that it should avoid any loss of crops or acquisition of land. It should also avoid area where people are doing cultivation in forest and government land in some instances. In case of damage to such property, people should be paid cash compensation and some livelihood opportunity should be created for the affected people of the area.

Issues Discussed	People's Views and Perception
do you have any objection? if yes, then describe	
Do you expect any kind of compensation If there is loss of land or crops or trees (which is minimal)? In general, no such compensation is paid in Tripura for distribution project because it is for providing better electricity to the people, please suggest your views.	We are expecting cash compensation in case of damage of crops during construction. However, in case of no damage, compensation is not required
If you need compensation, what kind of compensation will you be expecting (cash or kind) in case of land acquisition	We are expecting cash compensation in case of land acquisition of common areas used by the villagers (cultivation in forest and govt land) as well as Livelihood for income generation for both men and women.
Specifically what concerns/issues do you have on the implementation of the project with respect to the following • Community health and safety • Land • Agricultural production • Cultural Heritage • Displacement • Loss of income and business • Other (Specify)	Work should be implemented with proper health and safety norms. Trees should not be cut, crops shouldn't be damaged, common areas used by the community should be avoided. Modern technology should be used at the time of execution of the project for speedy implementation.
What positive impacts and/or benefits do you think the project will have	People will get regular electricity supply due to the project which will help their children to get more time to study, will help existing small and medium scale industries to run business smoothly, can expand new opportunities. Also, some business opportunity may come up, irrigation system will improve etc. Power cut may not occur during rainy season etc.
What negative impacts do you think the project will have	As such no negative impact but may be environmental issues like tree cutting, noise and water pollution during construction stage.
Any criteria you would like to be considered for project design, construction and operation stage?	Safety during construction and operation. High poles, new wires, boundary walls for the sub stations, connecting roads, streetlight near the structure should be ensured. The activity should not be in residential area for safety of humans and animals.
Are there any local NGO or CBOs, if yes then mention the name and nature of work they do	The NGO "TRML" is working and they provide small loan to women. Also, Pushpraaj Club work for public welfare, during corona pandemic and they provide ambulance service to needful. Reliance Club provide medical help to the needful.

Issues Discussed	People's Views and Perception
Would you support and participate during the implementation of project	Yes, we will support and participate during the implementation. This should be implemented faster.
Any other suggestions if any	Old systems should be completely replaced, and good and quality materials should be used, and the work process implementation should be faster. Safety measures should be adopted seriously. Villagers should be informed from time to time on the progress. Poor tribals who cannot pay the electricity bills should be provided free supply.

Source: ADB TA Consultant

Table 6.6 Summary Findings of Public Consultations in Tribal Village/Area

Issues Discussed	People's Views and Perception
Have you heard about the Project or Do you have any information about the project	Few people of our locality have little information that a new Sub-Station with new transformer will be installed here. Not aware of distribution line upgradation.
What is your opinion about this Project	We believe that after the upgradation of substation, power supply will be improved and load shedding will decrease. That will ensure regular power supply.
Do you support this Project	Yes, most of the people in the village will support the project
What is the general economic activities in the area	General Economic activities are agriculture, daily labour, shops, selling bamboo for preparation of the handicrafts, and service
What are the major crops and how many crops you cultivate in a year	Major crop is Paddy and cultivated twice in a year. Vegetables are grown seasonally.
Do people use the state and forest land for their use and if yes then what kind of use	Yes, people use forest land for collection of firewood, bamboo and other non-timber products.
DO you depend on the forest for your basic livelihood and other needs	Yes, some villagers depend for their livelihood by selling firewood and other non-timber products.
Do you have access to forest	Yes
What are your main concerns/issues about the project regarding electricity	This will improve regular Power supply, stop load shedding, stop power cuts etc.
Can you suggest how best to address your concerns/issues	Capacity of the Transformers should be increased for better power supply. Electric poles height should be increased. Locals should get some work in this project. Reduce power outages.
Would you volunteer and provide consent to the project	Yes, we volunteer to provide consent to the project and will support the project. It's good for the locality.
Do you expect any kind of compensation If there is loss to crops which is temporary	Yes, we are expecting cash compensation if there is loss to crops, damage to any other assets, commonly used areas etc. Also, if livelihood opportunity can be supported, it will be helpful for poor tribals like us.
If you need compensation, what kind of compensation will you be expecting (cash or kind) in case of land restrictions	Cash compensation for both loss of crops and land. That will be better for us. For future, livelihood support required from the implementing agencies.

Issues Discussed	People's Views and Perception
Specifically what concerns/issues do you have on the implementation of the project with respect to the following: • Community health and safety • Land • Agricultural production • Cultural Heritage • Displacement • Loss of income and business • Cultural property • Other (Specify)	• Might affect our agricultural activities during the implementation of the project if not avoided • Safety for animals and children required • Protection of our commonly used area to be provided • Loss of trees if not avoided • Lines over huts/compounds during conversion may fall • Pole inside compound may fall (Dayarampara)
What positive impacts and/or benefits do you think the project will have	Regular power supply will help improve whatever irrigation facility we have; it will help students to give more time to study. Will encourage to set up small businesses.
What negative impacts do you think the project will have	We do not see any such negative impact, but there might be tree cutting which is not good for us.
Any criteria you would like to be considered for project design	Safety of human and animal should be taken into consideration while designing the project to minimize accidents. Tree cutting should be avoided.
Are there any local NGO or CBOs, if yes then mention the name and nature of work they do	NGOs such as Longthorai Foundation, Praghydhalai do help during natural calamity, NGO Radiant Club do social work. SHGs help in piggery, Goatry, Fishing and trading, CBOs are available in this area and women SHG group.
Access to the forest land and the use of the forest land (if any)	Yes, we access to forest land for wood and animal fodder, firewood collection, agricultural activities etc.
Shortage of water for human consumption, irrigation and how extensive are they?	Yes, there is a shortage of drinking water in our locality. Very few handpump and tube well available in the field. Water stress, especially during summer in most of the rural area affecting agriculture
Have you been consulted before	No, it is the first time the consultation held with the village people regarding upgradation of substation.
Is the consultation useful	Yes, people belief that these consultations help to understand what electric department is doing for the improvement of day-to-day life of village people.
Would you support the project	Yes, people do support the project
Other suggestions if any	Upgradation of substation and distribution line should be done on immediate basis which will improve the power supply in the area.

Source: ADB TA Consultant

Figure 6.1 Summary Consultation Photolog

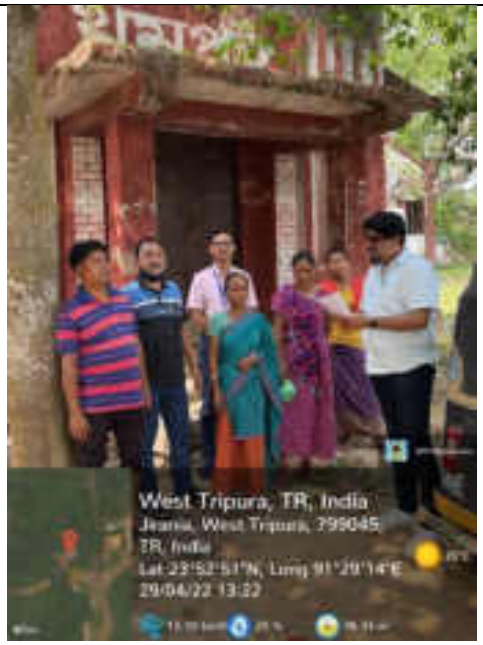
Consultation with shop owners/worker within ROW (Madhupur to Gokulnagar)		
Consultation with Tribal Family - Hut within ROW (Mission Tillla via Panisagar to Damchera)		
Consultation with nearest neighbor at Damchera Substation		
Consultation with nearest neighbor at Digalbagh Substation		

Consultation with nearest neighbor at Kadamtala Substation	
Consultation with nearest neighbor at College Tilla Substation	
Consultation with locals adjacent to UG alignment (Milan Chakra Feeder Stadium substation to CNG Station)	
Consultation with nearest neighbor of Jolaibari Substation	

Consultation with nearest neighbor of Mandai Substation	
Consultation with locals of Kailashahar Substation	
Consultation with locals of Rangrung Substation	
Consultation with neighbors and locals of Manu Substation	

Melaghar Substation, family head of residents living adjacent to substation and locals		
Consultation with neighbors and locals of Rajnagar Substation		
Consultation with tribal neighbors of Takarjala Substation		
Consultation in ESD Sekherkote – Low Tension line with locals		

Consultations in the Golchakkar to Dashamighat route		
Consultations in the ESD Dayarampara Low Tension line		
Consultations in the ESD Boxarnagar Low Tension Line		

Consultations in the ESD Mandwi Low Tension Line		
Consultations in the Anandanagar Feeder Line		
Consultations in the ESD Poangbari Low Tension line		

Consultations in the Chittamura Feeder Line		
Consultations in the Bodhgangnagar to Adarsha Colony Substation New 33kV Underground line		
Consultations near Test Laboratory site in Gokulnagar		
		

Source: ADB TA Consultant

C. Consultations with Other Stakeholders

342. Tribal Area Authority (TTAADC) stakeholders and Wildlife Officials were also consulted (Tables 6-7 and 6-8).

343. A formal consultation was carried out through conducting meeting with the TTAADC officials on 7 October 2021 at the headquarters of TTAADC office at Khumulwng. A total of 26 participants were present in the joint meeting held in the presence of TPGL and TSECL representatives and the TTAADC officials. A summary on the key elements of the Indigenous Peoples Plan was shared and discussed. Key issues discussed, response received, and clarification are summarized in Table 6-7.

Table 6.7 Summary Stakeholder Consultation with Tribal Area Authority Officials

Issues Discussed	Views and Opinion of TTAADC	Project Response
Distribution components and design	TTAADC does not have any such concern for the distribution components because there will be no land acquisition. However, it was suggested that trees and crop damage shall be avoided and any damage to other utilities shall be restored after construction work.	TSECL assured contractor will follow the EMP and RIPP requirements with respect to avoiding damage, compensation and restoration of any damages that are caused
Special focus on indigenous peoples and benefit sharing with the IPs and implementation of IPP	While discussing about the benefit sharing, TTAADC viewed those benefits shall be provided to the indigenous peoples to the best extent possible in terms of engaging them in temporary construction related work	Temporary local employment will be generated by engaging local people. TSECL will advise their contractors to engage locally available semi-skilled and unskilled labor force.
Requirement of obtaining any specific license by the contractor from TTAADC in implementing works in TTAADC area	TTAADC clarified that no such license is required to be obtained by the contractor from TTAADC to carry out any project related work. However, they expect that the contractor and TSECL shall continue consultation with the people in the TTAADC areas during construction to avoid any unanticipated impacts.	TSECL assured of continued consultations during implementation.
Support and Participation of TTAADC as key stakeholder in project planning and implementation	TTAADC is in full support of the project and viewed that their representatives at all levels will be informed to cooperate with TSECL team in case of any support is needed for further planning and implementation. They urged that the power supply shall be improved, and all	Distribution components and benefits have been explained.

Issues Discussed	Views and Opinion of TTAADC	Project Response
	the old lines and substations be modernized.	
Disclosure of project related documents especially the IPP	It was conveyed that TTAADC will remain as one of the key stakeholders and will be apprised of project related developments including disclosure of the IPP	TSECL will share a copy of the IPP with TTAADC.
Other Issues	TTAADC urged about some possible development related work to be done as part of the project	TSECL clarified that the project will bring overall development to the state of Tripura that includes the indigenous peoples. It was further clarified that its aim is to strengthen the energy generation and distribution in Tripura. However, it is conveyed that small scale development work will be carried out as part of the CSR work where feasible.

Source: ADB TA Consultant

Table 6.8 Summary Stakeholder Consultation for the Distribution Component

Consultation Location and Date	Name	Issues Raised	Project Response
Office of the TTAADC Khumulwng, West Tripura 07.10.2021	TTAADC officials include various representatives from various departments headed by the chief executive officer (CEO) with participation from all zonal officers, executive engineers, executive officer (Rural Development), executive officer (training), additional CEO, executive member (Public Works Department/Education-Elected representative) and Deputy CEO-II.	• Table 6.7	RIPP has been prepared
Office of the PCCF cum Chief Wildlife Warden (CWLW) and HoFF, Aranya Bhawan, Agartala, 16.03.2021	Dr. D,K,Sharma, IFS	• Issues related to human-wildlife conflict: CWLW intimated that data shall be officially sent to TSECL **(Annexure 7)** • Presence of elephant corridor and conflicts: CWLW intimated that there are no designated elephant corridors in Tripura and the same shall be officially communicated to TSECL • Cases of electrocution of wild animals in the recent past – CWLW intimated that data shall be officially sent to TSECL • Suggested mitigation measures: CWLW suggested to follow the general guidelines of MoEFCC and WII. He also intimated that the same shall be officially communicated to TSECL, if requested	Data received from wildlife department and used to inform the IEE Distribution lines identified as passing through internationally and nationally important biodiversity areas are dropped from the scope of the distribution component, some low-tension lines may route in notified forest land for which rerouting outside the area of concern or undergrounding will be preferred option

Phone Call with APCCF (Protection and NO FCA, Planning, Budget and Development) 2 May 2022	Shri V.G. Jenner, IFS	• TSECL Nominated Nodal officer wildlife/forest is responsible for all applications, permissions, process and procedures, filling reports and coordination. • Elephant conflicts mostly during crop harvesting season, which starts in June/July. They cross paddy fields - village to village • Trishna WLS- Bison attack reported recently. Bison was grazing in cropland. Bisons cause significant crop damage. • Elephants reported mostly in Khowai and Ghumti • No road and rail crossing accidents reported for elephants • Application for Wildlife Clearance is needed for any change/new ROW • It is possible that Wildlife Clearance not available for the older existing ROW /line • Suggestion - confirm ROW Wildlife Clearance status and act accordingly and follow all requirements.	ROW Wildlife Clearance status of final alignments to be confirmed and all requirements to be followed Distribution lines identified as passing through internationally and nationally important biodiversity areas are dropped from the scope of the distribution component, some low-tension lines may route in notified forest land for which rerouting outside the area of concern or undergrounding will be preferred option
Phone Call with Dhalai DFO 2 May 2022	Amit Debbarma, IFS	• Himalayan Black bear attack reported from some villages close to the Rowa WLS • Important species – Phayre's Leaf Monkey, Pig Tailed Macaque, Capped Langur • No elephant or other conflicts reported, other than black bear. • Suggestion – keep in touch with Wildlife Officials during implementation	Ongoing consultation and liaison with Wildlife Officials during project implementation

Phone Call with Gomati DFO 2 May 2022	Dr Neeraj Kumar Chanchal, IFS	• Regular elephant conflicts reported in Gandharo, Maharani and Aambasa • Endemic species – yes. List to be shared after details are submitted (to be followed up) • Suggestions: height increase of poles/lines, during construction – local volunteers from wildlife offices can be involved and constantly keep in touch during implementation	Ongoing consultation and liaison with Wildlife Officials during project implementation Implement EMP including wildlife measures
Phone Call with North Tripura DFO 2 May 2022	H. Vignesh, IFS	• Elephant conflicts reported • Electrocution – many primates killed including the Phayre's Leaf Monkey in last 2-3 years • Important species in area - barking deer • Share details in email and will be responded (to be followed up)	Ongoing consultation and liaison with Wildlife Officials during project implementation
Phone Call with Sepahijala DFO 2 May 2022	Pritam Bhattacharjee, IFS	• No large animals in district • Himalayan black bear reported near Sipahijila WLS • No conflicts reported • Death due to road accidents is the main issue – reptiles, langur, macaques, small mammals • Important species in area- Phayre's Leaf Monkey, capped langur, pig tail macaque • Endemic yellow vented warbler regularly reported/observed • Suggestions: no line in forest area, to ensure no forest land diversion envisaged	Ongoing consultation and liaison with Wildlife Officials during project implementation No new line in forest area Implement EMP including wildlife measures
Phone Call with South Tripura DFO 2 May 2022	Chaman Lal Negi,IFS	• Debipur beat-elephant and bear conflicts reported • No electrocution cases reported • No endemic spices in area • Suggestions: no labour camp in or near forest area, minimum destruction to vegetation, no new ROW in forest, no wood cutting by workers – to be regulated • Issue – usually government first sanctions project and then applies for diversion which delays project. Suggest applying in parallel if envisaged.	Ongoing consultation and liaison with Wildlife Officials during project implementation No new line in forest area Implement EMP including wildlife measures

Phone Call with Unakoti DFO 2 May 2022	Jayakrishnan V.K, IFS	• No wild or large animal • Minimum forest in area • No conflicts reported • Share details in email and will be responded (to be followed up)	Ongoing consultation and liaison with Wildlife Officials during project implementation
Phone Call with West Tripura DFO 2 May 2022	S. Soorya Narayan, IFS	• No protected area • No endemic species recorded • Suggestion to take up work as per forest conservation act, and regulations and no violations • Share details in email and will be responded (to be followed up)	Ongoing consultation and liaison with Wildlife Officials during project implementation
Phone Call with Khowai DFO 2 May 2022	Jeya Ragul Geshan B, IFS	• Elephant movement extensive in the area • Elephant conflicts reported in villages- Laxmipur, Uttar Maharanipur, Madhya Maharanipur, Tulsigarh, Khomi, Jhumbai • No casualties reported in the past, but recently, one month back – person killed in Tulsigarh village • Important species- Hoolock Gibbon mainly in Baramura range	Ongoing consultation and liaison with Wildlife Officials during project implementation

Phone Call with Nodal Wildlife Officer, DGM, TSECL 6 May 2022	Ratan Das, DGM, TSECL	• For all existing lines those that are passing through protected area may have been included in scope as they are already present • No workers camps for locals involved in any previous projects. They work and leave by evening • No incidents of elephant/wildlife attacks on workers reported • No elephant electrocutions reported • Cannot cut trees/collect wood in forest areas • If non-forest trees on road/in ROW is to be removed than Public Works Department needs to be involved • Many existing lines are quite old and previous to 1981 were not requiring Wild Life Clearance. • Wildlife Clearance through district for ROW takes 1-1.5 years and should be started in advance if any new ROW is involved. • Bird friendly design and anti-primate devices to be included • Pole heights taking in consideration elephant ruck height is welcomed in areas of Khowai and Gomati • For Low Tension lines the alignments will be existing ROW that have already been modified, but they may be in state protected forests, Reserve Forest and/or Proposed Reserve Forest, etc. • TSECL staff has not connected with Nodal Wildlife Officer on this project	Ongoing consultation and liaison with Nodal Officer during project implementation No new line in protected or forest area Implement EMP including wildlife measures
Phone call with Deputy Superintending Archaeologist, ASI Tripura 28 June 2022	N.K. Swain	• Disclosure of project • LT Line passing adjacent to Boxarnagar Buddhist Stupa, ASI protected • Per the Monuments Act this is passing through a no work/construction zone	TSECL has indicated that this LT line can be diverted

PCCF: Principal Chief Conservator of Forest; HoFF: Head of Forest Forces; IFS: Indian Forest Services; DFO: District Forest Officer, DGM: Deputy General Manager
Source: ADB TA Consultant

Figure 6.2 Stakeholder Consultation with TTAADC Official (top) and Wildlife Official (bottom)

Source: ADB TA Consultant

D. Meaningful Consultations During Project Implementation

344. During disribution component implementation, meaningful environmental consultations will be completed for subproject components involving the substations, test laboratory, new and existing distribution lines including placement of RMUs with underground cables prior to the commencement of any construction works. Consultations for each subproject must ensure a

representative percentage of the local community (10% of local population) are consulted, as well as gender balance (at minimum with 30% women) and representation of vulnerable groups.

345. For future consultations during the implementation, the following processes are envisaged:

(i) Identification of key stakeholders will be done by the contractors which will be finalized in due consultation with officials of TSECL and Tripura Tribal Areas Autonomous District Council (TTAADC).
(ii) The contractors concerned with guidance from the PIC will identify appropriate methods for consultation at each location and dissemination platforms for broader reach.
(iii) The contractors with guidance from PIC will develop appropriate communication materials in local language especially where affected people include scheduled tribes/indigenous peoples.
(iv) For disclosure purposes, the communication materials will include the positive and negative impacts, mitigation measures, grievance redress mechanism, construction schedule etc.
(v) The contractor will give advance notice about the consultations or other engagement and will disseminate properly for wider participation of beneficiaries or affected people especially women and the scheduled tribes/indigenous peoples.
(vi) Consultation process will be utilized to address the concerns and project implementation issues raised by the affected people during the consultation.
(vii) There will be budgetary provision to implement the future consultation and dissemination strategy.
(viii) Applicable COVID-19 guidelines of Government of India/Government of Tripura will be followed during the consultation, as well as the guidelines in Appendix 11.

346. For the consultations, the dates, attendees, male/female split, details of any participants vulnerabilities, topics covered, and, views and opinions raised should be recorded along with details of how the subproject has responded to them. Consultation meetings are to be attended by at least 10% of the village population and have at least 30% representation of women excluding TSECL and consultant/contractor representatives, if it is not possible at the public consultation a separate gender focus group must be held to ensure their concerns are heard. If public meetings are still not possible to convene due to COVID-19 restrictions, then the same representation should be achieved through door-to-door consultations within communities.

347. If the COVID-19 pandemic situation escaltes again in the future, in undertaking any additional face to face consultations it will need to be ensured by the TSECL and contractor/consultants that all guidilines[104] including national and Government of Tripura COVID-19 requirements and WHO hygiene guidelines are followed, including awareness raising activities for those undertaking consultations, minimizing travel requirements, undertaking screening health checks to confirm those going in the field are not symptomatic, providing adequate supplies of personal hand sanitizer and masks, ensuring social distancing of at least 1m, that masks are worn at all times during consultations, and that a register of all contacts is maintained. Consultations should also convey how the TSECL and contractor will ensure community health and safety during construction. If group meetings are not possible then individual one-on-one interviews will be

[104] https://www.mygov.in/covid-19
https://www.who.int/docs/default-source/coronaviruse/advice-for-workplace-clean-19-03-2020.pdf
https://www.who.int/infection-prevention/campaigns/clean-hands/WHO_HH-Community-Campaign_finalv3.pdf?ua=1

conducted. If travel within state is not possible due to COVID-19 then it will be for site-level representatives of TSECL and the contractors to facilitate the ongoing consultations.

E. Information Disclosure

348. Apart from meeting the requirements under ADB's Safeguard Policy Statement 2009, meaningful consultation is important for information disclosure under the Government of India, Right to Information Act of 2005. During the public consultation, information related to location of the substations, distribution alignments land requirements, potential environmental, health and safety impacts and risk of the distribution component both positive and negative, direct, and indirect, entitlement policies and frameworks for compensation for affected parties, and grievance redress procedures were shared with potentially affected persons by the ADB TA consultants and TSECL.

349. The draft IEE will be disclosed on ADB's website once cleared by ADB as well as on TSECL's website upon project approval. Once the draft IEE is updated following finalization of the route alignments for the distribution lines or upon any subsequent updates during project implementation the same procedure of disclosure of ADB and TSECL's website will be followed.

350. 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 Bengali and they will be made available/displayed for public scrutiny at places easily accessible to affected persons and other interested parties – including but not limited to the TSECL's Circle/Division/Subdivision offices, substations and construction sites – and if requested access to a printed copy of the full IEE will be provided and if required translated free of charge.

351. TSECL and the EPC contractors will continue communications with affected persons and other stakeholders as detailed above and disclose to them information such as the dates of contractor's route surveys and census of affected households, distribution component related impacts and measures included in the environmental management plan, specific entitlements of the affected persons, grievance redress procedures and dates of the commencement of civil works etc. The contractor will also undertake further consultations to inform the detailed design and subsequently disseminate information ahead of the start of civil works.

352. Six-monthly environmental-social monitoring reports during construction and annual environmental-social monitoring reports during implementation will also be timely disclosed on the ADB and TSECL websites.

VII. GRIEVANCE REDRESS MECHANISM

353. Grievances, within the context of IEE, are actual or perceived concerns about the implementation of the distribution component with respect to environment, health and safety. TSECL 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.

354. A grievance redress mechanism (GRM) will be set up upon loan effectiveness and be operationalized prior to the commencement of any civil works, including enabling works. TSECL will appoint a GRM (community liaison) focal for the distribution component. Their GRM (community liaison) focal may be a different person during the construction and operation period. Each contractor will appoint one full-time GRM (community liaison) focal under the contract. All staff of TSECL and the contractor, as well as local government and other entities directly involved in the GRM process will receive a training from the safeguard specialists under the project implementation consultant (PIC) prior to the start of works so that they fully grasp their roles and responsibilities within the GRM as well as approaches to constructively resolve any project-related grievances. Upon completion of works similar training will be provided to the TSECL O&M staff.

355. 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 project. For the distribution component, 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 distribution component will be as discussed in this chapter.

356. Recourse to the GRM does not impede access to the country's judicial or administrative remedies. A grievant can approach the court of law at any time and independently of the grievance redress process. They may (subject to eligibility criteria) also access ADB's Accountability Mechanism[105] whereby people adversely aggrieved 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.

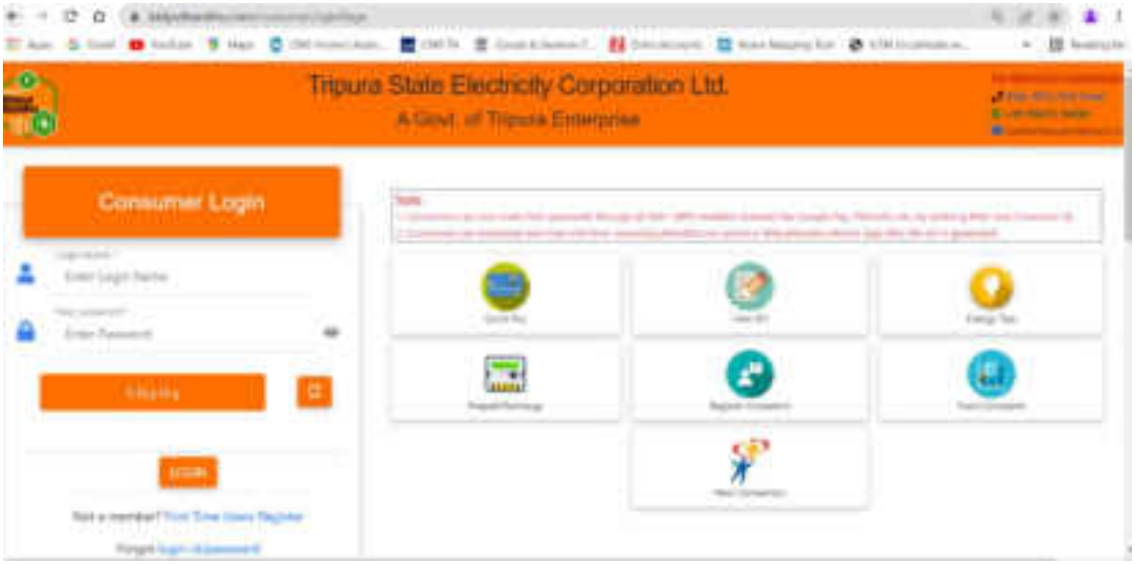
A. Grievance Uptake Points and Disclosure

357. There will be specified grievance uptake points where grievances can be lodged making use of TSECL's existing complaints resolution system. TSECL has an existing customer portal and complaint registration/tracking system which caters mostly to consumer issues like outage, maintenance, fire issues and billing. The distribution component GRM is to be integrated into this existing system in terms of registration and tracking whilst resolution will be undertaken off-offline for EHS issues raised by consumers/community/individuals and or any other stakeholders.

[105] 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.

Existing registration process/pick up points:

Consumers can now register their complaints 24x7 through the TSECL toll-free number: 1912, TSECL Web portal (**Error! Hyperlink reference not valid.**) and Tripura Power mobile app for billing complaints, power related complaints and queries for various applications.



Source: TSECL consumer portal

Contact details (see also Annexure 13):

- Registered Office/Postal Address: TSECL, Bidyut Bhaban, Banamalipur, Agartala, Tripura.
- Fax: 0381 2319427
- Phone Helpline/Contact No.: 1912 (Toll Free) / 0381- 235 3502
- Theft of Power Dy. Vigilance Officer: 9436472696, bjamatia10@gmail.com or 6033131670, tfagendra@gmail.com
- WhatsApp: 9863596081
- Contact Email: customer.care@tsecl.in
- Social media: Facebook front page with complaint registration information https://www.facebook.com/tsecl.in/
- TSECL Android based mobile app BidyutBandhu an initiative towards customer empowerment

Complaint escalation contacts in TSECL:

Mr. Debasish Sarkar	Managing Director	0381 2318001 / 2319427
Shri Sarvjit Singh Dogra	Director (Finance)	03812320896
Mr. Rajendra Debbarma	DGM (Corporate)	6033132107

Source: TSECL https://tsecl.in/irj/go/km/docs/internet/TRIPURA/New_Website1/Contact_Us.html#:~:text=Consumers%20can%20now%20register%20their,and%20queries%20for%20various%20applications.

Source: TSECL Facebook

Source: Google Play Store

358. TSECL and the contractor's GRM focals will actively engage with the adjacent communities and construction workers throughout pre-construction and construction, with TSECL's GRM focal doing the same at the onset of operation, providing an opportunity for members of the public or workers to approach them with any grievance. Any concerned person or group of people can also file a complaint through the GRM, at any time and at no cost. Affected persons and other stakeholders will have the flexibility of conveying grievances by sending them through the existing complaints resolution system, alternatively they may submit in writing, by email, through telephone call, mobile phone text, suggestion box kept on-site paper-based grievance form to the GRM focal persons who will ensure they are registered in the complaint registration/tracking system. All TSECL staff and the staff of its representatives, contractors, and subcontractors, must be made aware of the existence of the GRM and where to direct a grievant to if they are approached. Local government representatives will also be briefed by TSECL on the GRM and so be able to take up complaints and pass them onto TSECL or the contractor to be addressed.

359. 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.

360. Communities within 500m of the substations/test laboratory and 50m of the distribution line ROWs will be made aware of the GRM as well as how to access it, including communication channels/mode/reporting lines 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 works, in local languages, and maximizing use of graphics to convey messages for the illiterate, and (iii) notices on the radio, social media and/or local newspaper, as well as notice boards at all the entrances to the substations/test laboratory, at circle/division/subdivision offices, at the construction site offices, in local government offices, and on TSECL's website with details of the GRM together with details of the distribution component and where the IEE can be obtained to capture a wider audience.

361. Pre-construction and once operational, TSECL will be responsible to post clearly visible signboards at the substations/test laboratory 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, the contractor will be responsible for posting these signboards, including contact details with the names and phone numbers of both the TSECL and contractor's GRM focal persons as well as the suggestion box to be regularly checked at the construction site.

B. Record Keeping and Disclosure

362. Careful documentation of the name of the grievant, date of receipt of the complaint, address/contact details of the person, location of the area to which the grievance relates, dates of subsequent communications with the grievant, copies of investigation reports, minutes of deliberations, and how the grievance was resolved will be undertaken. TSECL's 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.

363. 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 TSECL and detailed in the quarterly project reports and environmental monitoring reports to be submitted by TSECL to ADB. TSECL 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.

364. The PIC safeguard specialists will monitor the operationalization of the GRM and the effectiveness of the grievance resolution process along with TSECL PMU and both will recommend any improvements to increase the efficiency, timeliness, and fairness of the process. During pre-construction and construction, the number of grievances registered and resolved, and summary outcomes will be disclosed on noticeboards at all the entrances to all substations/test laboratory, including substations connecting the distribution line, at the Circle/Division/Subdivision offices, at the construction site offices, in local government offices, and on TSECL's website.

C. Grievance Analysis and Resolution

365. 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 plant, and if it falls under the national and ADB policy and legal framework as described in Chapter II. This will enable ineligible grievances to be identified.[106] 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 proposed distribution line component, 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 TSECL or their contractor.[107]

366. Once a resolution has been reached, the grievant will be asked to sign a form/letter (Annexure 13) acknowledging receipt of the time bound grievance resolution action plan and providing their approval or refusal, as applicable.

367. Implementation of the actions must then be monitored by the TSECL 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 TSECL as promptly as is possible and ideally within 15 days of being agreed, though this will depend on the nature of grievances involved

D. Budget

368. TSECL and all contractors 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 training, support services, field inspections, meetings, documentation, supplies, etc.

[106] If the grievance is not eligible, the grievant should be informed of the reasons in writing and directed onto other appropriate mechanisms if applicable.

[107] https://www.adb.org/sites/default/files/institutional-document/180614/problem-solving-guidebook.pdf

E. Procedure for Grievance Resolution

369. Following an initial informal site level, the formal GRM will provide three-tiers for grievance redress as illustrated in Figure 7-4.

16. Informal Stage–Site Level/Electrical Subivision

370. Site level grievances may be informally redressed by the contractor staff during construction or TSECL operations staff under the Electrical Subdivision once operational. In such cases the grievance, however minor, will still be reported to the TSECL GRM focal concerned who will record the date, nature, and type of grievance and its resolution in the GRM register. A template for recording grievances is provided in **Annexure 13**. In case EHS grievances that are found to be immediate and urgent (e.g., dust, noise, spills, leaks, inappropriate behavior, worker conflict, community health and safety etc.) cannot be readily resolved at the contractor's level, then the on-site TSECL Electrical Subdivision field staff will provide the most easily accessible first level of contact. 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 on-site TSECL Electrical Division field staff.

371. It is anticipated that the TSECL will be able to respond to and resolve all informal, minor grievances received through this stage, in conjunction with the contractors if required, within three working days of the grievance first being raised. In case of a grievance relating to immediate risk to human life, or impending damage to structures, flora or fauna, or physical cultural resources, the contractor or TSECL Electrical Subdivision field staff will get in immediate contact with the PMU E&S Safeguard Officer who shall have the power to halt works until required corrective action is taken.

17. First Formal Stage–PIU Level/Electrical Division

372. If no resolution or understanding on the grievance is informally reached after three working days, the grievant chooses to direct their grievance directly to the formal GRM process, or an informal grievance is deemed more than minor, the grievance will be formally filed and taken up by the TSECL Electrical Division for it to be resolved within seven working days of being filed. The first formal level of the GRM will be headed by the TSECL Electrical Division DGM supported by the TSECL GRM focal. All grievances will be sorted by eligibility and level of urgency and by nature (suggestions or comments, complaints related to adverse impacts on an individual or group, violations of national law, etc.).

373. Just as for the information stage, all grievances will be recorded, and the grievant will be informed formally of receipt; timeline; and resolution. TSECL's GRM focal will send within 3 working days of the grievance being filed with the first stage a letter to the complainant acknowledging receipt, and what to do if they are unsatisfied with progress including contact details for raising it to the second stage; within seven working days the facts should have been established, a meeting held, and a time bound grievance resolution action plan agreed upon with the grievant.

18. Second Formal Stage–PMU Level/Circle Level

374. If no resolution or understanding on the grievance is reached at PIU level after 7 working days, or earlier if the PIU feel they are unable to resolve it themselves, the grievance will be formally filed with the second stage and taken up by the TSECL Electrical Circle/PMU for it to be

resolved within 15 working days of being filed. The second formal level of the GRM will be headed by the PMU Overall TSECL GM/Electrical Circle DGM in-charge who will be supported by the TSECL GRM focal. All grievances will be sorted by eligibility and level of urgency and by nature (suggestions or comments, complaints related to adverse impacts on an individual or group, violations of national law, etc.).

375. Just as for the first level, all grievances will be recorded, and the grievant will be informed formally of receipt; timeline; and resolution. TSECL's GRM focal will send within 3 working days of the grievance being field with the second stage a letter to the complainant acknowledging receipt, and what to do if they are unsatisfied with progress including contact details for raising it to the third stage; within 15 working days a meeting should have been held, and a time bound grievance resolution action plan agreed upon with the grievant.

19. Third Stage-Grievance Redressal Committee

376. The highest GRM level will be the GRC. The GRC will be constituted by the PMU Overall TSECL GM/DGM in-charge who will also convene and chair the GRC meetings during construction/operation. The GRC will be made up of the TSECL Electrical Circle DGM, Electrical Division DGM. safeguards staff, up to two representatives of the complainant including a female and/or indigenous peoples' representative if applicable[108] as well as, a representative of the contractor if applicable, and government representatives for environment or social issues as applicable to the matter being dealt with (such as, but not limited to, survey officials, forest officials, pollution control board officials, water department officials, municipality representatives etc.). The GRC will be convened and will meet at short intervals subject to the number of grievances to resolve.

377. Just as for the first level, all grievances will be recorded, and the grievant will be informed formally of receipt; timeline; and resolution. TSECL's GRM focal will send within 3 working days of the grievance being field with third stage (GRC) a letter to the complainant acknowledging receipt, and what to do if they are unsatisfied with progress including contact details of ADB's India Resident Mission. Within 15 days of filing with the third stage (GRC) the committee should have met, and a time bound grievance resolution action plan agreed upon with the grievant.

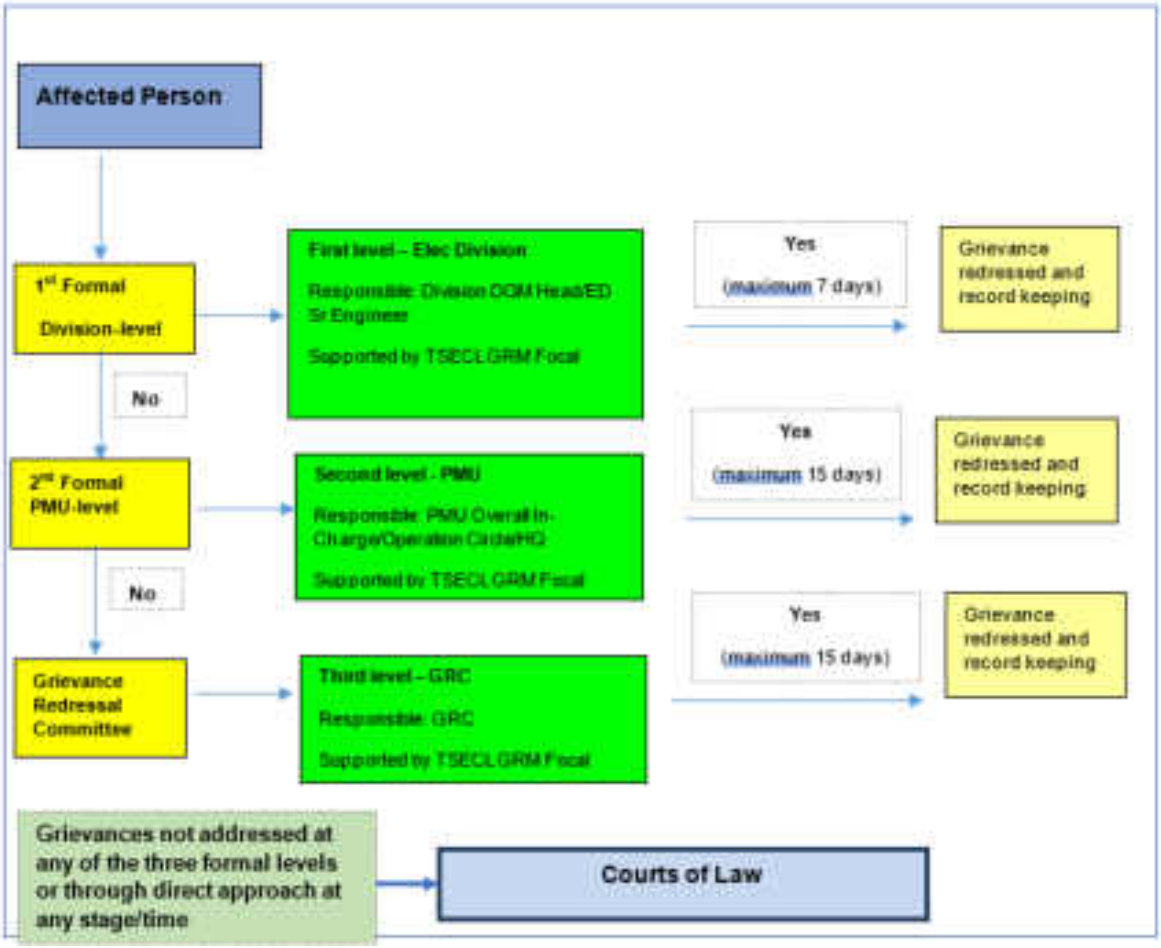
F. Unresolved Grievances

378. 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 ADB 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. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of disclosing the GRM.

379. 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.

[108] Representatives can include local government representatives or NGOs as requested by the grievant, the grievant may also choose to represent themselves during the GRC.

Figure 7.1 Structure of GRM for the TSECL Distribution Component



VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

380. ADB's Safeguard Policy Statement (SPS) 2009 requires that an Environmental Management Plan (EMP) be prepared to ensure construction and operation of the distribution component will be undertaken in accordance with its safeguard requirements. It is an overarching document that will guide environmental management implementation, supervision, and monitoring of TSECL and their contractor's activities under the distribution component. The EMP aims to (i) ensure project implementation by TSECL will comply with ADB's Safeguard Policy Statement 2009 requirements and international good practice as set out in the related IFC Environment, Health and Safety (EHS) general and sector guidelines, (ii) ensure project implementation will comply with applicable environmental, health and safety requirements of the Government of India and Government of Tripura, including international agreements it is a signatory too and (iii) ensure local ecological and human receptor sensitivities are taken into account.

381. It describes the anticipated adverse environmental impacts and risks of the distribution components, the measures required to avoid, reduce, mitigate, and compensate for the impacts and risks identified, and the monitoring requirements with respect to the following stages: (i) detailed design and pre-construction, (ii) construction, and (iii) operation and maintenance. The EMP focuses on potential impacts and risks to the physical, biological, and socioeconomic environment that have been identified as part of the IEE process. Detailed mitigation and monitoring plans are developed for the substation works, test laboratory construction and distribution lines components and will be implemented by the TSECL and their contractors during the project implementation. To ensure these mitigation and monitoring plans are implemented, TSECL will undertake a program of environmental supervision and monitoring during the project implementation.

382. The definitive version of the EMP cleared by ADB is the version disclosed on its website. The EMP is dynamic and can be updated as appropriate during the project implementation. However, any update to the EMP will first need to be cleared by ADB. In addition, any unanticipated impacts, or requirements for corrective action due to non-compliance identified during project implementation will be reported by TSECL to ADB, appropriate action will be agreed and taken by TSECL and their contractors to address them and bring the project implementation back on track.

383. The EMP contains a number of components crucial to effective environmental management within the project, these include:

(i) Corrective Action Plan for existing facilities (substations) to be implemented by TSECL pre-construction (Annexure 14, Table 1);
(ii) Mitigation plan including performance standards to be implemented during detailed design and pre-construction, construction, and operation and maintenance phases (Annexure 14 provides the general mitigation plan which is applicable to all components, and component specific plans for the substation works, test laboratory construction and distribution lines components);
(iii) Environmental, health and safety codes of practice (ECOP) elaborating on the mitigation measures to be implemented during the construction, and operation and maintenance phases (Annexure 15);

(iv) Safeguard checklist and consultation proformas to inform the IEE update prior construction (Annexure 16);
(v) Environmental monitoring plan (EMoP) including performance standards for quantitative monitoring to be undertaken during pre-construction, construction, and operation and maintenance phases (Annexure 17 provides the general monitoring plan which applicable to both the components, and component specific plans for the substation works, test laboratory construction and distribution lines components);
(vi) Implementation arrangements, including organizational roles and responsibilities for mitigation, supervision, monitoring and reporting, training requirements for TSECL and contractors on various aspects of EMP implementation, and preliminary cost estimates/budget for TSECL covering the various aspects of EMP implementation.
(vii) Grievance redress mechanism (GRM) – Chapter VII of the IEE report sets out the GRM with roles and responsibilities for TSECL and their contractors.

384. There are 6 contract packages and 10 lots (1 for substations including RMU, 2 packages each with 3 lots for distribution lines, and one package each for the test laboratory, smart meter, and HVDS pilot) that involve environmental impacts and risks. The EMP will form part of all bidding and contract documents for all these contract packages and during detailed design and pre-construction, and construction the contractors will be responsible for implementing all relevant measures for the subprojects in their contract package under the supervision of the TSECL. The contractors must always follow the definite version of the EMP which is the version disclosed on its website.

385. For operational risk management, TSECL will develop standard operating procedures (SOP) addressing the environment, health and safety impacts and risks of its substations, test laboratory and maintenance including recording of any occupational and community health and safety incidents.

B. Impacts, Mitigation, Monitoring, and Reporting

Potential Impacts to be Mitigated

386. The EMP has been prepared to cover all the distribution components with particular emphasis on substation works, test laboratory construction and distribution lines:

(i) Renovate and modernize of 27 33/11 kilovolts (kV) substations including control room equipment and protection systems (25 existing substations plus one under construction substation and 1 recently commissioned substation under separate funding arrangement, which will become part of distribution network being upgraded.
(ii) Install 150 auto-reclosers, 350 sectionalizers, and 2,000 fault passage indicators at 11 kV and 33 kV lines, supply of cable fault locator and test van.
(iii) Install and upgrade 2,667 ckm of 11 kV, 33 kV and low tension 0.4 kV distribution lines including 143.46 km of underground cables (new 33/11kv and existing 11kV overhead conversion), 1,624 km of covered conductor overhead lines (new 33/11kV and existing 11kV overhead conversion) and 900 km of low tension 0.4kV lines conversion to Aerial Bunched Cable (ABC) including the supply and installation of about 100 ring main units associated with underground cabling and

a high voltage distribution system (HVDS) pilot for agricultural feeders in one electricity subdivision.

(iv) Set up a modern test laboratory for testing and maintenance of distribution equipment (distribution transformers, other materials and equipment procured from suppliers prior to field use) within the grounds of an existing TSECL Sub-Division office at Gokulnagar.

(v) Replacement of 100,000 household meters with smart meters and advanced metering infrastructure for smart metering systems establishment.

387. The distribution component is unlikely to cause any significant irreversible, diverse or unprecedented environmental impacts due to the following facts: (i) overhead distribution components are mostly in semi-urban and rural areas which do not support high biodiversity values; no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; (ii) some distribution components are located in dense urban/city areas which will involve conversion from overhead to underground lines, again no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; and (iii) there will not be any major, large-scale civil or structural works involved in the distribution component, most works will be electrical and mechanical. Construction of a new building of up to 3 floors for the test laboratory will be the largest civil or structural works. Overall construction, operation and maintenance of the distribution components is likely to give rise to direct, indirect, and, induced environmental impacts that are mostly minor/low in magnitude, site-specific, generally reversible, temporary and of short duration primarily during construction works. Potential impacts and risks can be easily mitigated through the adoption of international good practices for environmental management as set out in the International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines including the General Guidelines and those on Electric Power Transmission and Distribution dated 30 April 2007. The selection and design of new equipment will comply with national requirements as well as considering international good practice per the IFC EHS Guidelines particularly with respect to avoiding the use of polychlorinated biphenyl (PCB) oil in the purchase of new transformers (already banned in India) and the use of all asbestos containing materials in the new construction.

388. All substation/test laboratory works are on modified habitat within the boundaries of existing substations and a sub-divisional office and no critical habitat species or chance finds are likely to be encountered.

389. The principles that have been (and will be) adopted by TSECL for the selection of route alignments of the various distribution lines are: (i) use existing alignments and/or the road Right of Ways (RoWs) wherever available; (ii) avoid legally protected areas including national parks, wildlife sanctuaries, protected ASI and Government of Tripura monuments; (iii) avoid other internationally and nationally recognized sites such as Key Biodiversity Areas, Important Bird Areas, ESZ, notified forest areas including protected forests, reserve forests and proposed reserved forests, and the regulated area associated with protected ASI and Government of Tripura monuments; and (iv) minimize damage to existing trees and properties encroaching into existing RoWs ensuring safety clearances are maintained. None of the new indicative or existing 33/11 kV route alignments are passing (or will pass) through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972 although some are within 10km and very near to the boundary of the ESZ. Rudrasagar Lake is also avoided. Neither are any new indicative or existing 33/11 kV distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300m from) ASI or Government of Tripura protected monuments. Some existing low-tension distribution lines may route alongside roads that pass through or adjacent to

notified forest areas and protected monuments — in such locations once the low-tension lines have been mapped site-specific assessment and management planning with full time ecological and/or archaeological supervision will be required with rerouting outside the area of concern or undergrounding rather than reconductoring the preferred option. Since the distribution routes assessed are only indicative and will not be finalized until the contractors are on board, during project implementation the IEE and EMP will need to be updated and cleared by ADB with any government clearances or permissions obtained before distribution routings are approved by TSECL and works commence.

390. The state supports critical habitat for two species and possible critical habitat for seven species mostly associated with habitat in and around the wildlife sanctuaries. No critical habitat species were encountered during site visits but District Forest Officials have reported sightings of the two primate species and the following may be encountered in modified habitat along the distribution lines for which mitigation measures include pre-construction ecological checks prior to tree cutting or earthwork, prohibiting poaching by construction workers, the adoption of bird and primate sensitive design etc. Their presence or absence to be confirmed by field ecologists during route surveys: *Aquilaria malaccensis* (Agarwood, a globally critically endangered species) where trees present especially in plantation, *Nilssonia nigricans* (Black Softshell Turtle, a globally critically endangered species) if temple ponds crossed, *Gyps bengalensis* (White-rumped Vulture, a globally critically endangered and Schedule I species under the Wild Life Act, 1972), *Manis pentadactyla* (Chinese pangolin, a globally critically endangered and Schedule I species under the Wild Life Act, 1972) in rural areas, and *Trachypithecus phayrei* (Phayre's Leaf Monkey, a globally endangered and Schedule I species under the Wild Life Act, 1972) and *Macaca leonina* (Northern Pig Tailed Macaque, a globally vulnerable and Schedule II Part 1 species under the Wild Life Act, 1972) in rural areas/plantation especially within 10km of Wildlife Sanctuaries. In Kanchanpur subdivision of North Tripura district, definite critical habitat for the critically endangered, endemic gecko *Cyrtodactylus montanus* is found with records including those from rocky roadside cuttings adjacent forest areas above 600 m asl. Ecology survey would be needed to confirm its presence or absence; but no distribution line works are proposed in its mapped area of occurrence in the Jampui Hills block, starting about 1.75km south of Vangmung substation. For all distribution lines the District Forest Officers will be actively engaged by TSECL and the contractors throughout project implementation. A wildlife identification and rescue protocol will be adopted, to be further developed in consultation with forest and wildlife officials as per site-specific requirements with all vegetation clearance and earthworks undertaken under ecological supervision. No physical cultural resources were identified along the sample distribution lines that would be directly impacted, but care will need to be taken to avoid damage to those adjacent to the route alignment. Many existing distribution lines to be reconducted especially low-tension lines were observed to be passing over houses with poles located in private compounds whilst some were seen to cross school compounds or playgrounds. To uphold safety clearances and minimize community health and safety risks during operation rerouting is required as part of reconductoring works with great care taken in dismantling the existing conductors.

391. The environmental impacts and risks of the distribution component have been assessed as described in the IEE report. Potential environmental impacts were identified in relation to the design, location, construction, operation and maintenance of the distribution infrastructure and mitigation measures have been developed in respect of all potentially negative impacts identified. Potential construction impacts relate to disturbance of land in the substation and test laboratory footprints and the ROW of distribution lines as well as adjacent communities with pollution, health and safety risks to workers and the community if the construction activities are not well managed by TSECL and their contractors. Pollution, health and safety risks to workers and the community will remain during operation and maintenance works. Environmental audit of the 27 existing

substations identified the presence of old equipment, particularly transformers that leak and which may contain PCB oil, depending on the date of manufacture and schedule of oil replacement. Based on assessment against United Nations Industrial Development Organization (UNIDO) guidance at least two substations were identified as being at higher risk of having transformers containing PCBs. Any removal, storage, and disposal of phased out transformers will be done in accordance with international good practice and the Government of India's regulations. Outside of the scope of the distribution component, Government of India regulations already require TSECL to complete the de-chlorination or the removal of all PCB-contaminated transformers before 31 December 2025.

C. Corrective Action Plan for Existing Substations

392. Since the substation component involves existing facilities (substations) that have been subject to environmental audit it is necessary for corrective action to be undertaken. The IEE (Annexure 2) provides summary details of all the existing substations and their audit findings. Annexure 14, Table 1 contains the corrective action plan; unless otherwise indicated, all actions are to be completed by TSECL prior to their contractors being given access to project sites involving existing facilities.

D. Environmental Mitigation Plans and EHS Codes of Practice

393. Tables 2 to 5 in Annexure 14 set out the mitigation plans for the distribution line (Table 3), substation (Table 4) and transformer lab (Table 5) components as well as a general plan (Table 2) which is applicable to all components even those with minimal impacts. The mitigation plans identify feasible and cost-effective mitigation and offset measures to be taken to reduce 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. Here, mitigation and offset measures are proposed for each potential impact and risk identified by the IEE, including details of responsible parties for implementation, budget source for supporting key activities, and the associated performance standards to be achieved.

394. The EHS Codes of Practice (Annexure 15) further elaborate on the pollution prevention, health, and safety measures to be adopted and are to be implemented as an integral part of the mitigation plans.

E. Environmental Monitoring Plans

395. The EMoP (Annexure 17) sets out the minimum provisions for quantitative environmental monitoring and performance standards to be achieved. Monitoring activities including laboratory analysis for air quality, noise, surface water and groundwater quality, and soil are to be carried out by NABL and/or MOEFCC accredited suitably qualified and experienced third-party monitoring experts. Quantitative monitoring activities may be modified during project 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 TSECL to help resolve any unsatisfactory performance.

396. 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. Following loan effectiveness, environmental monitoring reports (EMRs) (Annexure 18) (which will be combined with social monitoring report requirements) will be submitted to ADB on a semi-annual basis by TSECL up to the completion of construction reverting to an annual basis during operation up to the ADB project completion report with safeguards

inputs provided to quarterly progress reports. Following loan effectiveness, semi-annual 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. EMRs will be submitted until the ADB Project Completion Report is issued, or later if required therein. The EMRs will describe project implementation progress, any scope or design changes, compliance against safeguard requirements that are covenanted in the legal agreements, progress with environment mitigation and offset implementation, quantitative monitoring results in accordance with the EMoP, and grievances received.

397. 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 TSECL 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. EMRs, CAP if prepared by TSECL separately to their EMR submission, and updated IEE, if any, submitted by TSECL during project implementation will first be reviewed by ADB to ensure quality and acceptability and then, once cleared by ADB, are to be disclosed locally (in the same places as the IEE report was originally disclosed) by TSECL and on the ADB website upon receipt.

F. Environment Management Plan Implementation Arrangements

TSECL Environment Safeguards Capacity

398. TSECL's orgnisation structure is shown in Figure 8-1. TSECL presently do not have a dedicated environmental and/or social safeguards team in the organisation for monitoring and managing environmental and health and safety risks. Discussion with officers of TSECL shows that there is no other clearly defined institutional setup to supervise and manage environmental and health and safety risks. Thus there is no existing structure that can be called upon to provide EMP implementation support, supervision and monitoring during construction or operation. Currently the Electrical Division DGM, is responsible for EHS aspects and other issues with support from junior engineers or staff. However, the DGM and most of the staff at site / substation level have not been exposed to environment, health and safety compliance matters. This set-up has led to lapses in compliance with national laws and regulations in relation to the existing distribution network as evidenced by the environmental audit and site visits.

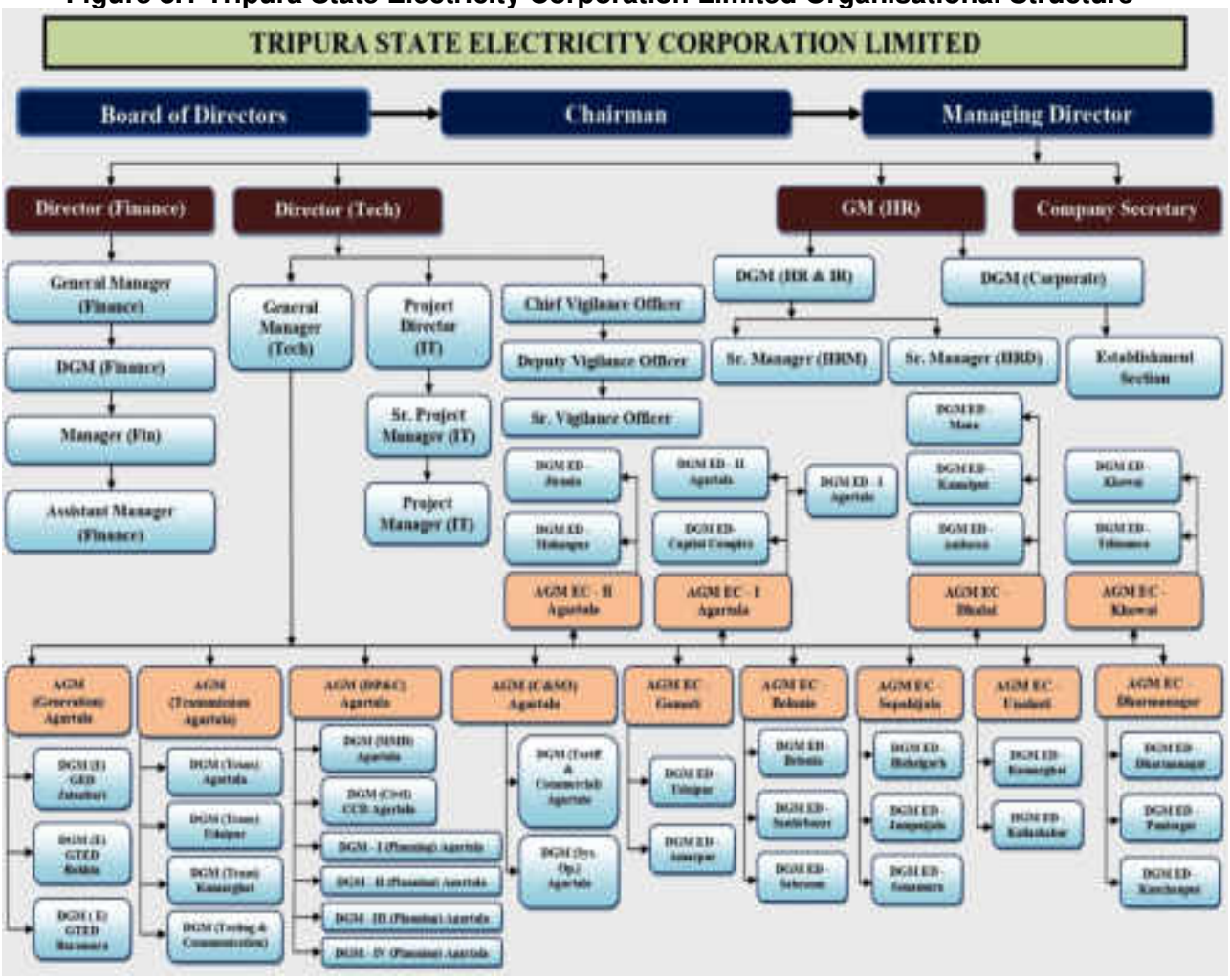
399. Therefore, TSECL must create a dedicated safeguards unit at headquarters (corporate) level to look after environment, health and safety risks (and any social impacts) of its activities staffed by a qualified and experienced Environment and Social Safeguards Officer and a qualified and experienced Health and Safety Officer with IOSH/NEBOSH certification, both with 12-15 years of experience. In the first instance the dedicated Environment and Social Safeguards Officer and dedicated Health and Safety Officer are to sit under the PMU but upon completion of contruction since EMP implementation is ongoing they will need to continue with their role into operation with the safeguards unit sitting within the TSECL organization structure (e.g., under the Director (Tech)) to provide corporate EHS support to all its activities and over time the staffing of the safeguards unit can be expanded. TSECL may decide to source the dedicated Environment and Social Safeguards Officer and H&S Officer either 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 EHS professionals presently employed in TSECL given the focus on electrical engineering making a direct hiring is the advised approach. This Environment and Social Safeguards Officer and H&S Officer will be responsible together with the PMU/PIU for EMP implementation, supervision and monitoring activities. They

will be tasked to obtain permissions, prepare the training plan, community liaison plan, consultations material, operationalize the GRM, update the IEE, prepare EMRs, and so on, in addition to undertaking day-to-day on-site/alignment supervision and monitoring activities for all contract packages. They will help strengthen the public images of TSECL in respect of safeguard aspects and maintain a good relationship with adjacent communities.

400. In addition, EHS site supervision needs to be assured at the PIU level for which the capacity of Electrical Divisions to take on responsibility for environment, health and safety compliance matters needs to be built. The staff nominated for support at PIU level will form the basis of EHS units which will be established at Electrical Division level and which will continue into operation of the distribution component.

401. Capacity building and training will be required especially for the PMU, PIU, and contractors implementing the distribution component. The training and capacity building will not only be project specific but will also target the development of long term EHS capacity at TSECL at corporate and Electrical Division level.

Figure 8.1 Tripura State Electricity Corporation Limited Organisational Structure



Source: https://tsecl.in/irj/go/km/docs/internet/TRIPURA/New_Website1/TSECL_Structure.html

G. Institutional Roles and Responsibilities

402. The main parties that will be involved in environmental management and monitoring activities for this project are as follows with their more detailed roles and responsibilities set out in Table 8-1:

(i) **Government of Tripura, Power Department**–the main project coordinating body on behalf of government.

(ii) **TSECL management–**as the executing and implementing agency for the distribution component, responsibility for environmental, health and safety management and compliance with Government of India and Government Tripura regulatory requirements, ADB's Safeguard Policy Statement 2009, the ADB project's loan covenants, and distribution component EMP requirements during all phases of implementation ultimately lies with TSECL's management.

(iii) **TSECL Project Management Unit (PMU)–**as the implementing agency the PMU to be set up at TSECL's head office in Agartala and headed by General Management Technical will be responsible for the overall day-to-day management of the technical, environmental, and social aspects of the project and thus

compliance with Government of India and Government of Tripura regulatory requirements, ADB's Safeguard Policy Statement 2009 and the project's loan covenants and EMP requirements, reporting to TSECL management. General Management Technical will be supported by an AGM and Senior Engineers. The E&S safeguard officer and H&S officer as part of the Safeguards Unit to be established to support EMP implementation, supervision and monitoring activities will sit under the PMU in the first instance.

The PMU will delegate relevant detailed design, preconstruction, and construction measures to their contractors through the contract.

(iv) **TSECL's Electrical Divisions as the Project Implementation Units (PIU)**– TSECL operates across the state by five location wise Electrical Circles which are subdivided into Electrical Divisions/Subdivisions. The Electrical Divisions will operate as the PIU for implementation of the distribution components in their division. Each Electrical Division is headed by a Deputy General Manager. The PIU will report to the PMU and be responsible for EMP implementation at site level during pre-construction and construction, day to day on-site management, and supervision and monitoring of the contractor with respect to the technical, environmental, and social aspects of implementation and thus compliance with all requirements.

On the completion of construction, Electrical Divisions/Subdivisions will take on responsibility for O&M of substations and distribution lines. For the test laboratory there will be a six-month handover period from the contractor during which the contractor and O&M staff will be jointly responsible for EMP implementation. Otherwise TSECL O&M staff will be fully responsible for EMP implementation during operation, overall day to day management of the technical, environmental, and social aspects.

The PIU will be supported during construction and operation by the E&S safeguard officer and H&S officer as part of the Safeguards Unit at PMU level. Each Electrical Division will need to nominate officers to fulfil the role of EHS site supervisor(s)[109] (monitoring contractor performance, undertaking regular site inspections, flagging the corrective actions required etc.) and GRM focals during both the construction and the O&M stages who will report directly to the E&S safeguard officer and who will receive EHS trainings as detailed in the capacity building section.

The Electrical Divisions will also need to nominate the electrical safety officers as per the regulatory requirements with respect to overseeing the design, installation, and O&M of electrical equipment.

(v) **Project Implementation Consultant (PIC)** — consulting firm to support PMU and PIUs in overseeing day-to-day implementation, including safeguards. PIC will contain an environment safeguard consultant (with ecological expertise) and a health and safety consultant, they will also be able to call upon subject-specific external experts to support these more generalist consultants to deliver the

[109] The number of EHS site supervisors required in an Electrical Division will depend on the number of packages and components being undertaken under their jurisdiction, there should be at least one EHS site supervisor nominated for each substation/transformer laboratory with separate EHS site supervisors overseeing the distribution line works

capacity building trainings with respect to ecology/archaeology issues, bird/primate sensitive design, PCBs management, SF6 etc. Both these consultants will have 12-15 years of experience and the H&S consultant will be IOSH/NEBOSH certified.

(vi) **Contractors for each of the 6 contract packages/10 lots and their subcontractors, if any** – through the contract, TSECL will delegate responsibility for implementing all relevant measures during detailed design, pre-construction, construction, and for the test laboratory the first six months of operation. The contractor will be required to comply with the EMP during the detailed design, preconstruction, and construction phases, closely supervised and monitored by TSECL. The contractor will be responsible for reporting environmental safeguards progress and performance at least monthly to TSECL including record data required by the EMoP and providing necessary inputs to the quarterly progress reports and semi-annual 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 as well as at any temporary workers camps or overnight accommodation provided by them. The main EPC contractor has the responsibility for EMP implementation. However, the contractor is required to ensure that the EMP requirements are cascaded down to all sub-contractors undertaking works relating to the distribution component, regardless they are formally or informally employed, and to be responsible for supervising and monitoring their sub-contractors in turn. The contractors are to employ the following suitably qualified and experienced EHS officers as their environment safeguards team for each contract package, if a contractor is awarded more than one contract package then separate EHS officers are to be employed for each of them:

(a) at least one dedicated environment manager with an environmental management bachelor's degree or similar qualification to be based full-time on-site for the duration of works under the contract package, in order to monitor and supervise the contractor's EMP implementation on a day-to-day basis reporting to their management: and
(b) at least one dedicated health and safety manager with NEBOSH/IOSH certification or similar qualification to be based full-time on-site for the duration of works under the contract package, in order to monitor and supervise the health and safety aspects of the contractor's EMP implementation on a day-to-day basis reporting to their management.

The contractor's environment safeguards team will act as their GRM focals for each contract package to keep affected persons informed of works and be available to receive and deal with any grievances at the project site level. They will also be responsible for reporting EHS progress and performance at least monthly to TSECL and providing necessary inputs to the quarterly progress reports and the semi-annual EMRs.

Further, each active construction site is to have adequate health and safety supervision to ensure the health and safety of all workers and local communities. This is to include a suitably qualified and experienced Senior Engineer having NEBOSH/IOSH certification or similar qualification who is based on-site full-time and nominated to the role of EHS Supervisor with responsibility for ensuring EMP implementation, acting on the advice of, and reporting to their environment

safeguards team. Each Senior Engineer nominated to the role of EHS Supervisor will be supported by full-time on-site Health and Safety steward(s) with at least one steward to each 50 persons.

Other safeguard experts such as field ecologists will also need to be employed on a part-time/intermittent basis by the contractor to meet the EMP requirements.

Construction contractors will preferably have a corporate EHS policy and environmental management certifications such as ISO 14001 (or equivalent) and EHS certification such as OHSAS 18001 or equivalent.

(vii) **Construction workers employed formally or informally by the contractors and their subcontractors**—these workers will need to abide, in their behaviour and work, to directives issued by their employer with regards to environmental, health and safety management.

(viii) **O&M workers employed formally or informally by TSECL, O&M contractors and their workers**—these workers/contractors will need to abide, in their behaviour and work, to directives issued by their employer with regards to environmental, health and safety management.

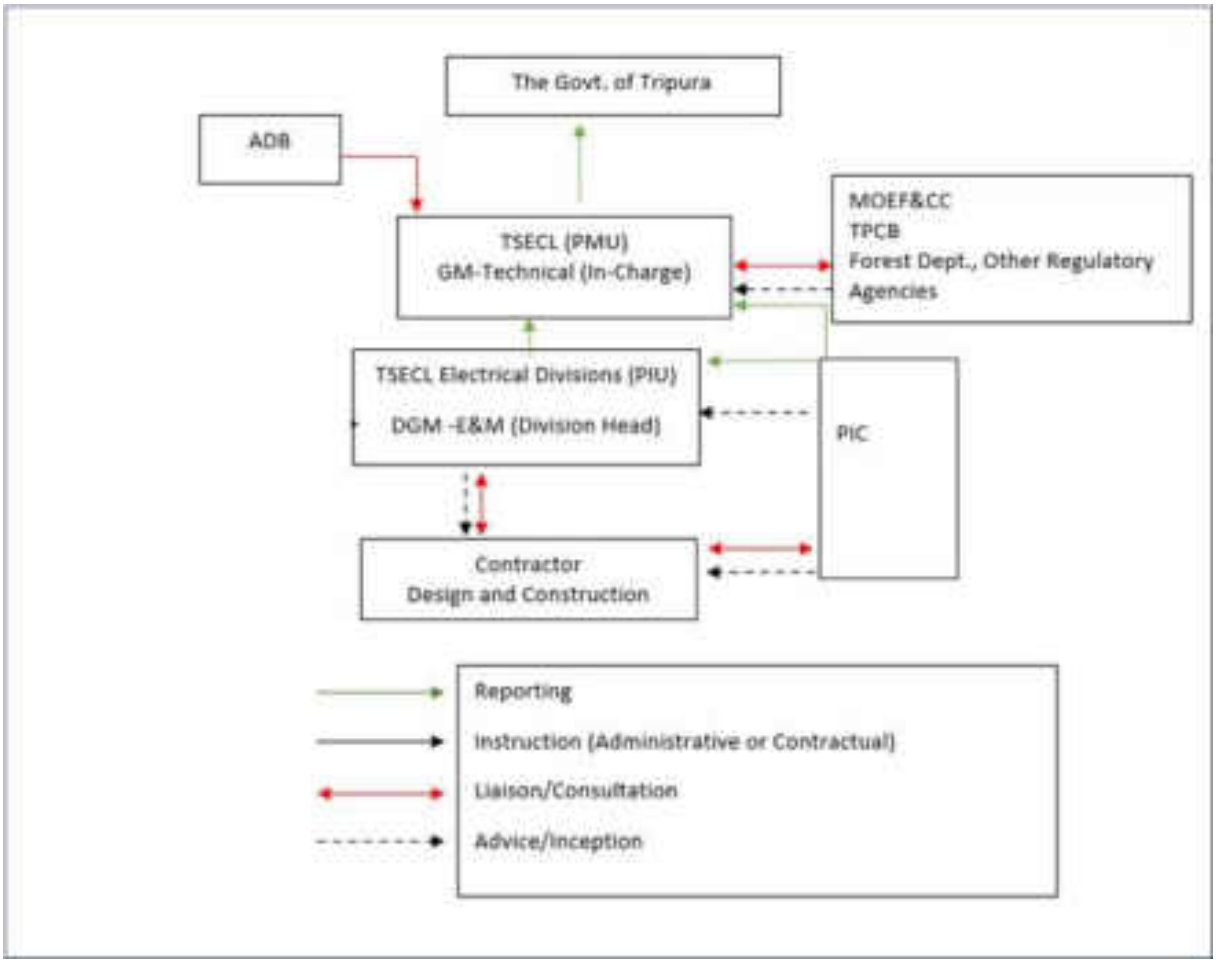
(ix) **Line agencies with regulatory responsibilities**–responsible for issuing and enforcing environment, forest and wildlife clearances, other permits, and licenses that may be required for the distribution component.

(x) **ADB–**project financer.

(xi) **ADB TA Consultants**–to provide environment safeguards capacity development support, in particular helping TSECL to develop standard operating procedures (SOP) addressing the environment, health and safety impacts and risks of its substations, test laboratory and maintenance including recording of any occupational and community health and safety incidents.

403. The proposed institutional arrangement relevant for EMP implementation is shown in Figure 8-2. The reporting, instructions, liaison/consultation, and advice/inspection channels are also shown.

Figure 8.2 TSECL Environment Safeguards Implementation Arrangement



Source: ADB TA Consultant

H. Implementation Responsibilities

404. During project implementation, detailed roles and responsibilities are listed in Table 9.1 (this is not an exclusive list).

Table 8.1 Detailed Implementation Roles and Responsibilities

Organization	Responsibility (not an exhaustive list)
TSECL PMU/ Safeguard Unit	• Ensuring adherence to all applicable national and state environment, health, safety, and labor laws and regulations in force at the time. • 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). • Ensuring adequate management support, budget, staff, and other resources are allocated to satisfactorily implement, supervise, and monitor implementation of the EMP during all phases. • Appointing suitably qualified and experienced E&S safeguard officer to the Safeguards Unit to support EMP implementation during construction and operation, as per the EMP capacity building requirements.

Organization	Responsibility (not an exhaustive list)
	• Preparing a detailed training plan, providing training venues, and providing with support of PIC a suite of training activities for TSECL staff and contractors in relation awareness raising on EMP implementation. • Ensuring that all PMU/PIU/O&M staff support and attend all capacity development and training activities provided for them. • Adopting a zero-tolerance approach to OHS and enforcing all TSECL staff to comply with OHS requirements of the EMP including wearing of appropriate PPE on site to set a good example to the contractor and their workers. • Implementing the EMP throughout all phases or, if responsibilities are delegated, supervising, and monitoring its implementation by the contractor. • Incorporating the EMP into the bidding and contract documents before issuing tenders and contract awards. • Reviewing bids to ensure they are in accordance with the EMP requirements prior to contract award. • Implementing the corrective action plan at the 27 existing substations prior to access being given to the contractor. • Ensuring that necessary compensation is paid to the forest department for cutting of trees before the commencement of related work. • Ensuring the contractor secures 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. • Ensuring the contractor provides 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. • Undertaking site specific assessment and management planning where required and updating the IEE/EMP as required in consultation with ADB prior to approval of the contractor's route alignments with respect to any changes from the indicative distribution line routes assessed. Obtaining ADB's clearance for the IEE/EMP update prior to the commencement of any work, including site establishment and vegetation clearance. Once cleared, ADB will disclose the updated IEE on its website whilst TSECL will locally disclose it. • Reviewing and approving the contractor's detailed designs as well as CEMP and EMP sub-plans to ensure they incorporate and are in accordance with the EMP requirements. • 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. • Locally disclosing the IEE and other environmental safeguards documents, including publication on TSECL's website. Help with translation of the IEE into local languages or an explanation of its content will be extended free of charge to affected persons on request. • Undertaking and documenting all ongoing consultation, details of consultations such as minutes of the meetings, photographs to be documented in the EMRs submitted to ADB. • Establishing and operationalizing the GRM for affected persons (construction workers and local community members) in line with Chapter VII of the IEE report, including appointing GRM Focals and establishing a GRC, disseminating contacts, recording and promptly resolving grievances received. All ongoing grievance-related information will be documented in the EMRs submitted to ADB.

Organization	Responsibility (not an exhaustive list)
	• Once operational, any contractors hired for maintenance works or decommissioning will be supervised and monitored by TSECL with roles and responsibilities the same as those of the contractor for construction • Developing and implementing SOP building on the EMP and reflecting operation and maintenance-related measures to be followed by TSECL O&M team addressing the environment, health and safety impacts and risks of its substations, test laboratory and maintenance including recording of any occupational and community health and safety incidents. • Undertaking 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. • Undertaking with the support of PIC monthly EHS meetings including site walkover inspection to determine the status of EMP implementation by the contractor during construction as well as random “spot check” site visits to audit their EMP implementation. Minutes of meetings and findings of site walkover inspections will be attached to the EMRs to be submitted to ADB. • Identifying areas for improvement, unsafe acts, and any non-compliances with the EMP by the contractor and/or TSECL staff and instructing for corrective actions to be taken by them to bring implementation back on track. • 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. • 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. • To agree the MOU for monitoring compensatory afforestation by Forest Department, as per the EMoP requirements. • Reporting any unanticipated impacts, accidents, and chance finds to ADB within 48 hours of them occurring along with a corrective action plan. • Reporting to ADB any grievances submitted to the third formal stage of the GRM upon receipt. • Further updating the IEE/EMP as necessary and locally disclosing any updates if any unanticipated impacts (including project scope or design changes) occur during implementation; any such updates must be submitted to ADB for clearance and disclosure on the ADB website before any related works commence or are cleared by TSECL to continue. • 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.
PIU at Substation and Distribution Line level (in addition to PMU responsibilities that cascade down to PIU)	• Ensuring that prior to acceptance of the construction works from the contractor all pre-construction and construction EMP measures have been fully closed out, and the works as constructed will enable TSECL to fully comply with all the operational EMP measures. • Following the formal systems and templates developed for supervision and monitoring undertake day-to-day supervision to ensure that contractors adhere to all the provisions in the EMP as well as their CEMPs and sub-plans as approved by TSECL. • Keep daily records and photo logs of site observations to inform preparation of the semiannual EMRs.

Organization	Responsibility (not an exhaustive list)
EPC Contractor	• Implementing all measures and responsibilities allocated to the contractor under the EMP for the full duration of the contractor's involvement. • Ensuring adherence to all applicable national and state environment, health, safety, and labor laws and regulations in force at the time. • 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). • Ensuring the detailed design reflects the EMP requirements; seeking to ensure it has the same or no worse impact than the indicative route alignments which were assessed in the IEE. • Liaising with the Forest Department and undertaking ecological surveys using experienced field ecologists for all the distribution lines during route survey for fixing alignments with focus on critical habitat species as well as confirming the absence of sensitive receptors. In case of confirmed presence of any critical habitat species either directly observed by the ecologist or as confirmed from other sources the field ecologists will conduct a species-specific survey to inform the final route alignment and design. • Supporting TSECL to update (as required) the IEE in respect of the detailed design by providing sufficient details to inform a revised project description and any subsequent reassessment of impacts and risks. • Undertaking and documenting a facilitated health and safety (H&S) risk assessment considering for all phases and including consideration of COVID-19 risks amongst others. • Preparing a Construction Environment Management Plan (CEMP) and sub-plans as specified in the EMP for review and approval by TSECL prior to the commencement of works including site establishment -- sub-plans will include a wildlife identification and rescue protocol, Pollution Prevention Plan, Construction Waste Management Plan, Occupational Health and Safety Plan, Community Health and Safety Plan, and Traffic Management Plan plus Emergency Response Plans etc. • 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 to protect the environment and ensure the health and safety of all workers and affected communities. • Ensuring suitably qualified and experienced environment, health and safety safeguard officers, as per the EMP requirements have been appointed to undertake regular on-site supervision and monitoring activities before the commencement of works. • Adopting a zero-tolerance approach to OHS on the project, enforce all workers to comply with the OHS requirements of the EMP including the wearing of appropriate PPE on the construction site. • Obtaining all necessary CTE, CTO and other permissions before the commencement of related work, share copies of all clearances, permits, licenses, and insurances obtained. • Providing – in part with the support from TSECL – and ensuring attendance at EHS trainings for formal and informal construction workers and other personnel as required. • Ensuring that all construction 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 and construction activities. • Supporting TSECL 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 project site level; all this information is to be included in the contractor's monthly reports to TSECL.

Organization	Responsibility (not an exhaustive list)
	• Undertaking environmental monitoring as set out in the EMoP (Annexure 17) during pre-construction and construction and documenting qualitative and quantitative monitoring results; for quantitative monitoring the contractor is to hire accredited, and quality assured, third party laboratories. • Submitting monthly environmental management reports to TSECL (monthly EMP 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 data including near misses and accidents, grievances received, and follow-up actions that were taken (or will be taken) to correct the problems. • Informing TSECL immediately in case of any approved detailed design changes or unanticipated environmental impacts occurring during implementation, and as required, provide any information needed to TSECL to enable them to promptly update the IEE/EMP for clearance by ADB before any changes are implemented. • Informing TSECL and forest/wildlife officials of any wild animals found within the work area. • Informing TSECL within 24 hours in case of chance find or accident on site and providing within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented. • Informing TSECL 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 TSECL to ensure the project remains in compliance with national and state regulatory requirements, ADB's SPS 2009, the project's loan covenants and EMP requirements.
PIC	• Support TSECL in preparing a detailed training plan. • Support delivery of safeguard training and capacity building activities and provide on-the-job guidance to TSECL safeguards staff and the contractors on ensuring compliance with the EMP requirements. • Guiding TSECL on the implementation of the EMP during the pre-construction and construction. • Reviewing the methodologies for ecological walkovers/surveys that are to be conducted by the EPC contractor during the route surveys; oversee the ecological surveys conducted by EPC contractor and review the ecological reports submitted. Support TSECL in decision making regarding the alignment of the distribution lines in the cases where any critical habitat or other threatened species presence is confirmed. • Supporting TSECL 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 contractor has valid labour licenses and insurances including provisions for community liability during the period of construction. • Supporting TSECL 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. • Supporting TSECL in reviewing the contractor's detailed designs, their CEMP and EMP subplans for compliance with the EMP to ensure these documents incorporate and are in accordance with EMP requirements. • Supporting TSECL in site specific assessment and management planning where required and updating the IEE/EMP as required in consultation with ADB prior to

Organization	Responsibility (not an exhaustive list)
	approval of the detailed designs to reflect any national environment clearance conditions and any changes from the indicative route alignments assessed by the IEE. • Supporting TSECL in preparing a community liaison plan. • Supporting TSECL to undertake ongoing meaningful consultation with affected communities to keep them informed of progress and with local disclosure of the findings of the IEE report and EMRs etc. • Supporting operationalization of the GRM and assist TSECL in resolving grievances received. • Developing formal systems and templates for TSECL staff, contractor, and PIC 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, third stage grievances etc. • Following the formal systems and templates developed for supervision and monitoring support TSECL safeguards staff to undertake day-to-day supervision to ensure that contractors adhere to all the provisions in the EMP as well as their CEMPs and sub-plans as approved by TSECL. • Keep daily records and photo logs of site observations to inform preparation of the semiannual EMRs. • Supporting monthly EHS meetings including site walkover inspection to determine the status of EMP implementation by the contractor during construction as well as random "spot check" site visits to audit their EMP implementation. • Supporting monitoring of the compensatory afforestation done by forest department. • Reporting any unanticipated impacts, grievances, unsafe acts, or EMP violations to TSECL, identifying areas for improvement, and assist them in implementing solutions and remedial measures. • Supporting TSECL in reporting on EMP implementation within the quarterly progress reports and preparing semi-annual EMRs for submission to ADB. • Supporting TSECL with updating of the EIA/EMP as necessary if any unanticipated impacts (including project scope or design changes) occur during implementation
ADB	• Review, clear and disclose updated IEE/EMP on ADB's website as required on the finalization of route alignments and in the event of any unanticipated impacts • Undertake supervision and monitoring of the EMP implementation by TSECL in accordance with ADB's Safeguard Policy Statement 2009. TSECL and their contractors will provide ADB with access to the site and all requested information, their contractors will provide all ADB staff/consultants with a site health and safety induction and adequate PPE.

Source: ADB TA Consultant

I. Supervision, Monitoring and Reporting Responsibilities

405. TSECL will carry out the following actions to supervise and monitor EMP implementation (not an exclusive list) and ensure intended environment safeguards outcomes are being achieved by the distribution component:

(i) E&S safeguard officer and H&S officer with support of PMU/PIC are to convene monthly EHS meetings with contractor/O&M team including site walkover inspections to determine the status of EMP implementation and random "spot check" site visits to audit in more depth EMP implementation by the contractors and upon operation the Electrical Division's O&M team.

(ii) Obtaining monthly reports from contractors and TSECL O&M team and reviewing qualitative and quantitative monitoring results to identify any issues of concern.

(iii) Identifying areas for improvement, unsafe acts, and any non-compliances with the EMP and instructing corrective action to be taken by them to bring implementation back on track.
(iv) Keeping records of all monthly reports, meetings, inspections, and audits and timebound corrective actions instructed.
(v) Supervising and monitoring the implementation of any corrective actions alongside EMP implementation to ensure they are implemented in a timely manner.

406. In addition to standard contract monitoring systems established by the PMU for the preconstruction and construction stages, the E&S safeguard officer and H&S officer with the support of PMU/PIC will introduce formal systems and templates for monitoring and reporting on EMP implementation, with the following reporting lines. The initial list of the different reporting formats is provided in Table 8-3, along with the frequency of submission. Those responsible shall ensure monitoring is well documented and the timely submissions of monitoring reports with an acceptable level of detail:

(i) Contractor will establish their own internal systems for monitoring and reporting their EMP implementation.
(ii) Contractor as the main executor of the EMP will formally submit monthly and quarterly summary environmental management reports per an agreed template to the PIU who will share the report with the E&S safeguard officer/H&S officer.
(iii) Once works commence on site the EHS site supervisors (PIU) under the direction of the E&S safeguard officer/H&S officer will keep daily records and photo logs of site observations reporting their findings in at least monthly reports to them with written quarterly summaries of progress submitted – their quarterly summary reports will be attached to the EMRs submitted to ADB.
(iv) Complete photographic records will be kept by both the contractor and EHS site supervisors (PIU) covering all activities on site as well as key locations such as the construction site, receptors adjacent to the substation and ROWs of distribution lines, off-site access roads, stores, sanitation and welfare facilities, temporary worker camps or overnight accommodation etc. Photographs of key areas will be taken prior to construction activities begin, to provide the environmental baseline. Copies of all geo-referenced photographs will be submitted to the PMU E&S Safeguards Officer along with the contractor's monthly report and EHS site supervisors (PIU) written monthly summaries.
(v) PMU E&S safeguard officer/H&S officer to convene monthly EHS meetings to be attended by PIU Head, EHS site supervisors (PIU), PIC safeguards specialists, and contractor's management and safeguard team to discuss progress; initially progress will be discussed in relation to detailed design actions and as the project progresses will move onto pre-construction and contraction actions.
(vi) 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 – minutes of monthly EHS meetings will be attached to EMRs submitted to ADB.
(vii) PMU E&S Safeguards Officer/H&S Officer will be able to instruct the PIU Head and be given delegated authority to instruct the contractor to take corrective action at any time in relation to EMP implementation.
(viii) PMU E&S Safeguards Officer/H&S Officer will maintain the time-bound corrective action plan, monitoring and reporting of corrective actions will be undertaken alongside monitoring and reporting of EMP implementation.

407. For the operational stages, TSECL will establish an internal system under the watch of the safeguards unit to monitor and report on EMP implementation along the same lines as that established for construction.

408. TSECL will be responsible for obtaining and maintaining documentation and ensuring document control with access by and distribution to relevant personnel. Documentation and records to be kept by all parties in hard copy as well as electronic format are as follows (not an exclusive list):

(i) Definitive IEE and EMP (as disclosed on the ADB website)
(ii) Legal register (of applicable national and state legislation)
(iii) CTE and CTO – for construction plant, and ancillary facilities like DG
(iv) Tree felling permits, vehicle emission test certificates etc.
(v) Training plan and training records
(vi) Community liaison plan and records of all consultations undertaken
(vii) Records of emergency preparedness and response drills
(viii) Document review and approval records
(ix) Contractor's CEMP and sub-plans and copies of approval records
(x) Contractor's certifications and insurances
(xi) Completed site checklists and photographic records
(xii) Corrective action instructions
(xiii) Contractor's and operational accident record and incident reports
(xiv) GRM register

409. TSECL will facilitate ADB to carry out the following monitoring actions to supervise project implementation:

(i) Conduct periodic site visits during the project implementation to confirm compliance with the EMP, loan covenants, ADB's Safeguard Policy Statement 2009 and IFC EHS General and Transmission and Distribution Guidelines.
(ii) If required, conduct supervision missions with detailed review by ADB's safeguard specialists/officers or consultants.
(iii) Review and comment on the periodic environmental monitoring reports submitted by TSECL to ensure that adverse impacts and risks are mitigated as was planned and agreed with ADB, that any corrective actions have been duly implemented, and that the GRM is fully functional.
(iv) Work with TSECL to rectify to the extent possible any failures to comply with their safeguard commitments, as covenanted in the loan agreement, and exercise remedies to re-establish compliance as appropriate.
(v) Prepare a project completion report that assesses whether the objective and desired outcomes of the EMP have been achieved, considering the baseline conditions, and monitoring results.

410. For this purpose, TSECL and their contractors will provide ADB with access to the site and all requested information on the project. For any ADB supervision missions to ongoing construction works TSECL and their contractors will provide all ADB staff with a project 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.

Table 8.2 Minimum Reporting Frequencies

Contractor	EHS Supervisor(s) in PIU		Safeguard Unit within PMU	
Reporting to PIU	**Supervision**	**Reporting to Safeguard Unit of PMU**	**Supervision**	**Report to ADB**
Pre-Construction and Construction Stage				
Monthly Report Quarterly Summary Report	Day to Day	Monthly Report Quarterly Summary Report	Monthly	Semi Annual
Operation Stage				
n/a	Day to Day	Quarterly Report Annual Summary Report	Quarterly	Annual until ADB PCR

Source: ADB TA Consultant

Table 8.3 Summary Details of Reporting Formats

Format No.	Item	Stage	Contractor	PIU with support PIC	
			Reporting to PIU	**Supervision**	**Reporting to Safeguard Unit**
RF 1	Site-Specific Checklist and Consultation Proforma to inform IEE update by TSECL	Pre-Construction	One Time	One Time	One Time
RF 2	Approval of Detailed Design of substation / Final Distribution Line Alignment / CEMP / CTE and CTO etc.	Pre-Construction	One Time	One Time	One Time
RF 3	Tree Inventory	Pre-Construction	One Time	One Time	One Time
RF 4	Environmental Quality Monitoring	Pre-Construction	One Time	One Time	One Time
		Construction	Per EMoP Requirement	Day to Day	Monthly
		Commissioning	One Time	One Time	One Time
RF 7	Deviations and Corrective Actions Plan	Construction	In case of Unanticipated Impact	Day to Day	Monthly
RF 5	Vehicles Used and Pollution Control	Construction	Monthly	Day to Day	Monthly
RF 6	Pollution Incident Reporting	Construction	Monthly	Day to Day	Monthly
RF 9	Work Force Management	Construction	Monthly	Day to Day	Monthly
RF 10	Details of PPE Stocks	Construction	Monthly	Day to Day	Monthly

Format No.	Item	Stage	Contractor	PIU with support PIC	
			Reporting to PIU	Supervision	Reporting to Safeguard Unit
RF 11	Occupational and Community Safety Measures	Construction	Monthly	Day to Day	Monthly
RF 12	H&S Incident Reporting	Construction	Monthly	Day to Day	Monthly
RF 13	Consultation Activities	Construction	Monthly	Day to Day	Monthly
RF 8	GRM during Construction	Construction	Monthly	Day to Day	Monthly

Source: ADB TA Consultant

J. Capacity Development

411. In addition to the hiring of an Environment and Safeguards Officer and nomination of EHS site supervision at PIU level capacity building and training will be required. To build capacity in the PMU/PIU and contractors for implementation of the EMP and other safeguard requirements, a training programme will be delivered. The training programme will be implemented as per training modules provided in Table 8-4, training needs will be further determined by TSECL and elaborated in a training plan. Training modules can be changed during construction phase based on requirements of PIU/PMU and 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. Delivery of the training program is part of the ADB project cost that includes institutional strengthening, capacity building and training whilst TSECL attendance will be from counterpart support, and the contractor will factor in their attendance within the contract amount. Key points for training to be given are:

(i) Upon the award of contracts to the contractor
(ii) Before the start of construction work
(iii) Refresher during construction
(iv) Before demobilization of contractor and commencement of O&M

Table 8.4 Training Modules

Training Session	Required Attendees/Recipients	Delivery Mode/Duration	Training Conducted by	Estimated Total Amount ($)	Budget Source
Pre-construction					
Introduction to ADB's Safeguard Policy Statement (2009), IFC EHS Guidelines, Government of India/Government of Tripura requirements, and Project EMP including EMOP	PMU, PIU Contractors' Management and Environment Safeguards Teams*	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	2000	PIC Budget

Training Session	Required Attendees/Recipients	Delivery Mode/Duration	Training Conducted by	Estimated Total Amount ($)	Budget Source
Corrective action plan for substations including O&M	Substation staff of TSECL PMU, PIU	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	2000	PIC Budget
EMP implementation for detailed design	PMU, PIU Contractors' Design Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	2000	PIC Budget
Identification of critical habitat/threatened and Schedule I and II species that may be encountered and survey requirements	PMU, PIU Contractors' Design Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. Online/ 0.5 day	E&S Officer of TSECL / Environment Expert of PIC	1000	PIC Budget
Bird and primate sensitive design for distribution lines (detailed design)	PMU, PIU Contractors' Design Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. Online/ 0.5 day	E&S Officer of TSECL / Environment Expert of PIC	1000	PIC Budget
PCB awareness raising and environmentally safe and sound transformer design	Substation staff of TSECL PMU, PIU Contractors' Management, Design Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. Online/ 0.5 day	E&S Officer of TSECL / Environment Expert of PIC	1000	PIC Budget
SF6 awareness raising	Substation staff of TSECL PMU, PIU Contractors' Management, Design Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. Online/ 0.5 day	E&S Officer of TSECL / Environment Expert of PIC	1000	PIC Budget
Facilitated H&S workshop (detailed design)	PMU, PIU, Contractors Management, Detailed Design, and Environment Safeguards Teams*	Facilitated workshop In Person/ 1 day	H&S Officer of TSECL/H&S Expert of PIC	1000	PIC Budget
GRM operation (initial run at start of project, and then again on handover to operational staff)	All GRM levels- GRM Focal Points, GRC, PMU, PIU, Contractors Management, Environment Safeguards Team, Local	Lecture session, presentation, and discussion. In Person/ 1 day	E&S Officer of TSECL / Environment Expert of PIC	4000	PIC

Training Session	Required Attendees/Recipients	Delivery Mode/Duration	Training Conducted by	Estimated Total Amount ($)	Budget Source
	Government Representatives* GRM Focal Points of Contractors*				
EMP implementation for pre-construction and construction, including workshop on CEMP preparation	PMU, PIU Contractors' Construction Teams and Environment Safeguards Teams*	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	2000	PIC Budget
Facilitated H&S workshop (construction stage)	PMU, PIU, Contractors Management, Construction, and Environment Safeguards Staff	Facilitated workshop In Person/ 1 day	H&S Officer of TSECL/H&S Expert of PIC	1000	PIC Budget
Environmental quality monitoring requirements; site supervision and monitoring including use of detailed monitoring framework (checklists) and preparing period Environmental Monitoring Reports	PMU, PIU, Contractors Management and Environment Safeguards Teams*	Lecture session, presentation, and discussion. In Person/ 2 days	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	4000	PIC Budget
Site restoration	PMU, PIU, Contractors Management, Construction, and Environment Safeguards Staff	Lecture session, presentation, and discussion. Online/ 0.5 day	E&S Officer of TSECL / Environment Expert of PIC	1000	PIC Budget
EMP implementation for O&M, including workshop on SOP preparation	PMU, PIU	Lecture session, presentation, and discussion. In Person/ 1 day	Safeguard Unit of TSECL / Environment and H&S Experts of PIC	2000	PIC Budget
Facilitated H&S Workshop (Operation Stage)	PMU, PIU	Facilitated workshop In Person/ 1 day	H&S Officer of TSECL/H&S Expert of PIC	1000	PIC Budget
			Sub-Total Training Budget	**26,000**	

*Cost of contractors' staff attendance at all formal trainings and capacity development activities will be included in contract price.
Source: ADB TA Consultant

K. Implementation Schedule

412. Strictly no contracts will be awarded before the EMP has been incorporated into the contract documentation. Further, no site establishment or construction activity is to take place before TSECL has received and approved the requisite contractor's CEMP including all EMP sub-plans. The duration of the distribution component including construction is of about 36 months. Tentative implementation schedule of the project is listed in Table 8-5. The contractors will submit a more detailed implementation schedule for the detailed design, pre-construction, and construction once the contract is awarded.

Table 8.5 Key EMP Milestones in Implementation Schedule

S. No	Description	Indicative Time Frame
1	**Project Implementation**	
A	Bidding Documents	May 2021
B	Procurement	October 2022
C	Construction commencement	December 2022
D	Construction Completion	November 2025
E	Defects Liability Period	October 2026
2	**Pre-Construction Phase - EMP**	
A	Implementation of mitigation measures and conduct environmental monitoring for which TSECL 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
C	Appointment of TSECL E&S safeguards officer (safeguards unit) and nomination of EHS supervisions at Electrical Division level	Latest within one month of loan effectiveness for the PMU safeguard support, before start of works on site including site establishment for the PIU safeguard support
D	Appointment of PIC	PIC must be appointed within three months of loan effectiveness and prior to the approval of detailed design, CEMP approval, site establishment, site preparation, 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 route alignments and obtaining ADB clearance of update	Prior to approval of the detailed design
G	Submission and approval of the Contractor's Construction Environmental Management Plan (CEMP)	One month before the start of works including any site establishment, site preparation, demolition, and earthworks
3	**Construction Phase – EMP**	
A	Implementation of mitigation measures and conduct of environmental effects monitoring following the EMP.	After award of the contract

S. No	Description	Indicative Time Frame
B	Monthly EMR for Project's Monthly Progress Report	10th day after effective month (covering the month prior)
C	Semi-Annual EMR during construction for submission to ADB	15th 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
D	Restoration of construction sites and Distribution Line ROW	Before demobilization of contractor
4	**Operation Phase**	
A	Implementation of mitigation measures and monitoring activities for operational period	Upon commissioning
B	Annual EMR during construction for submission to ADB	15th 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

Source: ADB TA Consultant

Table 8.6 Indicative Implementation Schedule Distribution Line component, Tripura

Activity	Timeline (Quarter)																	
	Construction Phase																	
	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
	2021		2022				2023-2024				2025				2026*			
Implementation of EMP and EMoP																		
Bidding Documents																		
Procurement																		
Construction commencement																		
Construction Completion																		
Defects Liability Period																		
EMR Reporting by Contractor																		
Submission of EMR by TSECL																		

*Project will be completed by December 2027

Operation Phase (2027)

	Timeline (Months)											
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Implementation of EMP and EMoP												
Submission of EMR by TSECL												

Source: ADB TA Consultant

L. Environment Management Plan Implementation Budget

413. Costs will be associated with implementation of the mitigation plan, EMoP and capacity building. Necessary budgetary provisions must be planned and allocated by TSECL for implementing the environmental measures of the distribution component as part of the EMP. The main EMP budget items have been identified for implementing the environmental management

and monitoring and capacity building activities required, and an indicative budget allocated for each. The budget in Table 8-6 will be refined during project implementation but enables preparedness for financial requirements. 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, whereas the operational EMoP will be the responsibility of TSECL O&M team.

414. If the construction period extends beyond 36 months, then the budget will need to be increased prorate. Operational cost is an annual cost, it will be incurred annually for each year the distribution components are in operation.

Table 8.7 EMP Budget for Distribution Component

Item	Quantity	Estimated Rate ($)	Estimated Total Amount ($)	Budget Source
CONSTRUCTION				
TSECL Safeguard Unit during construction			**81,000**	TSECL
Environment and Social	36 person months full time	1,125 pm	40,500	
Health and Safety	36 person months full time	1,125 pm	40,500	
PIC Safeguard Specialists			**128,000**	PIC Contract
Environment	8 person months over 36-month period (allowing one visit per month plus logistics)	8,000 pm	64,000	
Health and Safety	8 person months over 36-month period (allowing one visit per month plus logistics)	8,000 pm	64,000	
ADB TA Consultant Support for SOP etc.	1.5 person months input	Lump sum	**33,000**	ADB TA
Cost of implementing substation CAP	Renovation/upgradation	10,000 per substation	**270,000**	TSECL counterpart
Contractor's Environment Safeguards Team			**684,000**	Construction Contract/BOQ
Environment	36 person months full time x 9 lots	1,000 pm	*324,000*	
Health and Safety with NEBOSH / IOSH	36 person months full time x 10 lots	1,000 pm	*360,000*	
Contractor's EMP implementation cost (including PPE provision)	Estimated 2% of the contractor's civil works cost	2%	**319,723**	Construction Contract/BOQ
Bird Sensitive Design Measures in addition installation CC and ABC*	$12/pole/ One pole every 200m for 2,667km	Lump sum estimate	**160,020**	Construction Contract/BOQ
Pre-construction/construction environmental quality monitoring	36 months	Ref. Table 8-8	**124,400**	Construction Contract/BOQ

Item	Quantity	Estimated Rate ($)	Estimated Total Amount ($)	Budget Source
Commissioning environmental quality monitoring	Once at all 27 substations	Ref. Table 8-8	**19,400**	Construction Contract/BOQ
Tree Compensation	TBC	Lump sum estimate	**115,500**	TSECL counterpart
Training and capacity building	Ref. Table 8-4	Lump sum estimate	**26,000**	PIC Contract
Ongoing Consultation, GRM Implementation, including COVID- 19 Precautions for Consultation or GRC Meetings to cover ad hoc cost of printing leaflets, purchasing masks and hand sanitizers for consultees, hire of venue or food purchase etc.		Lump sum estimate	**9,500**	TSECL counterpart
Construction Sub-Total			**1,970,343**	
OPERATION				
TSECL Safeguard Unit during operation	12 person months full-time x 2 staff (annual cost repeats)	2,250 pm	**27,000**	TSECL Counterpart Cost
Operation Sub-Total			**27,000**	
Total Budget			**1,997,543**	
Contingency @ 10%			**199,754.30**	

*For distribution poles anticlimbing devises are already included in the contract scope but the design adopted will need to prevent climbing by both primates (especially Phayre's Leaf Monkey) as well as humans which may incur additional cost.
Source: ADB TA Consultant

Table 8.8 Environmental Quality Monitoring Budget

Parameters per Monitoring Plan	Sites	Rate in USD	Quantity/ location	No.	Total in $
Pre-Construction					
Noise	Test Laboratory Site	200	1	1	200
Air quality		400	1	1	400
Surface water quality		500	1	1	500
Ground water quality		500	1	1	500
Drinking water source for potability	All 27 substations and test laboratory	500	28	1	14,000
Polychlorinated biphenyl	Existing transformers	100	Substations: 2 Distribution: TBC	1	200 (TBC)
Construction					
Noise semi-annually	Per IEE baseline and test laboratory	200	15	90	18,000
Air quality semi-annually		400	14	84	33,600
Surface water quality semi-annually		500	8	48	24,000
Ground water quality semi-annually		500	11	66	33,000
	Pre-Construction/Construction Budget				**124,400**
Commissioning					
Noise	All 27 substations	200	27	1	5,400
Drinking water source for potability	All 27 substations and test laboratory	500	28	1	14,000
				O&M Budget	**19,400**
				Total Monitoring Budget	**143,800**

TBC = to be confirmed
Source: ADB TA Consultant

IX. CONCLUSION AND RECOMMENDATIONS

415. The distribution component is unlikely to cause any significant irreversible, diverse or unprecedented environmental impacts due to the following facts: (i) overhead distribution components are mostly in semi-urban and rural areas which do not support high biodiversity values; no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; (ii) some distribution components are located in dense urban/city areas which will involve conversion from overhead to underground lines, again no protected areas or internationally or nationally recognized biodiversity areas or physical cultural resources will be passed through by new distribution lines; and (iii) there will not be any major, large-scale civil or structural works involved in the distribution component, most works will be electrical and mechanical. Construction of a new building of up to 3 floors for the test laboratory will be the largest civil or structural works. Overall construction, operation and maintenance of the distribution components is likely to give rise to direct, indirect, and, induced environmental impacts that are mostly minor/low in magnitude, site-specific, generally reversible, temporary and of short duration primarily during construction works. Potential impacts and risks can be easily mitigated through the adoption of international good practices for environmental management as set out in the International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) Guidelines including the General Guidelines and those on Electric Power Transmission and Distribution dated 30 April 2007. The selection and design of new equipment will comply with national requirements as well as considering international good practice per the IFC EHS Guidelines particularly with respect to avoiding the use of polychlorinated biphenyl (PCB) oil in the purchase of new transformers (already banned in India) and the use of all asbestos containing materials in the new construction.

416. All substation/test laboratory works are on modified habitat within the boundaries of existing substations and a sub-divisional office and no critical habitat species or chance finds are likely to be encountered.

417. The principles that have been (and will be) adopted by TSECL for the selection of route alignments of the various distribution lines are: (i) use existing alignments and/or the road Right of Ways (RoWs) wherever available; (ii) avoid legally protected areas including national parks, wildlife sanctuaries, protected ASI and Government of Tripura monuments; (iii) avoid other internationally and nationally recognized sites such as Key Biodiversity Areas, Important Bird Areas, ESZ, notified forest areas including protected forests, reserve forests and proposed reserved forests, and the regulated area associated with protected ASI and Government of Tripura monuments; and (iv) minimize damage to existing trees and properties encroaching into existing RoWs ensuring safety clearances are maintained. Undergrounding and conversion of existing bare conductors to covered and aerial bundled conductors shall be helpful in reducing existing electrocution risks to wild animals. None of the new indicative or existing 33kV or 11kV route alignments are passing (or will pass) through legally protected areas or their ESZ notified under the Wildlife (Protection) Act, 1972. Rudrasagar Lake is also avoided. Neither are any new indicative or existing 33/11kV distribution lines passing through notified forest areas or impacting on the regulated zone (up to 300m from) ASI or Government of Tripura protected monuments. Some existing low-tension distribution lines may route alongside roads that pass through or adjacent to notified forest areas and protected monuments (e.g., Boxarnagar Electrical Sub-Division supports forest range and has low-tension lines adjacent to the Boxarnagar Stupa, an ASI protected monument) — in such locations once the low-tension lines have been mapped site-specific assessment and management planning with full time ecological and/or archaeological supervision will be required with rerouting outside the area of concern or undergrounding rather than reconductoring the preferred option. Since the distribution routes assessed are only

indicative and will not be finalized until the contractors are on board, during project implementation this IEE and EMP will need to be updated and cleared by ADB with any government clearances or permissions obtained before distribution routings are approved by TSECL and works commence.

418. The state supports critical habitat for two species and possible critical habitat for seven species mostly associated with habitat in and around the wildlife sanctuaries. No critical habitat species were encountered during site visits; but District Forest Officials have reported sightings of the two primate species and the following may occasionally be encountered in modified habitat along the distribution lines for which mitigation measures include pre-construction ecological checks prior to tree cutting or earthwork, prohibiting poaching and firewood collection by construction workers, the adoption of bird and primate sensitive design to minimize electrocution risk etc. Their presence or absence to be confirmed by field ecologists during route surveys. In Kanchanpur subdivision of North Tripura district, definite critical habitat for the critically endangered, endemic gecko *Cyrtodactylus montanus* is found with records including those from rocky roadside cuttings adjacent forest areas above 600 m asl. Ecology survey would be needed to confirm its presence or absence; but no distribution line works are proposed in its mapped area of occurrence in the Jampui Hills block, starting about 1.75km south of Vangmung substation. For all distribution lines the District Forest Officers will be actively engaged by TSECL and the contractors throughout project implementation. A wildlife identification and rescue protocol will be adopted, to be further developed in consultation with forest and wildlife officials as per site-specific requirements with all vegetation clearance and earthworks undertaken under ecological supervision. No physical cultural resources were identified along the sample distribution lines that would be directly impacted, but care will need to be taken to avoid damage to those adjacent to the route alignment. Many existing distribution lines to be reconducted especially low-tension lines were observed to be passing over houses with poles located in private compounds whilst some were seen to cross school compounds or playgrounds. To uphold safety clearances and minimize community health and safety risks during operation rerouting is required as part of reconductoring works with great care taken in dismantling the existing conductors.

419. The environmental impacts and risks of the distribution component have been assessed as described in the previous sections of this IEE report. Potential environmental impacts were identified in relation to the design, location, construction, operation and maintenance of the distribution infrastructure and mitigation measures have been developed in respect of all potentially negative impacts identified. Potential construction impacts relate to disturbance of land in the substation and test laboratory footprints and the ROW of distribution lines as well as adjacent communities with pollution, health and safety risks to workers and the community if the construction activities are not well managed by TSECL and their contractors. Pollution, health and safety risks to workers and the community will remain during operation and maintenance works.

420. Environmental audit of the 27 existing substations identified the presence of old equipment, particularly transformers that leak and which may contain PCB oil, depending on the date of manufacture and schedule of oil replacement. Based on assessment against United Nations Industrial Development Organization (UNIDO) guidance at least one substation was identified as being at higher risk of having transformers containing PCBs. Any removal, storage, and disposal of phased out transformers will be done in accordance with international good practice and the Government of India's regulations. Outside of the scope of the distribution component, Government of India regulations already require TSECL to complete the de-chlorination or the removal of all PCB-contaminated transformers before 31 December 2025.

421. An EMP has been prepared for the distribution component. The EMP includes (i) corrective action for existing facilities i.e. 27 existing substations; (ii) mitigation measures for environmental impacts during implementation, including ensuring detailed designs take into account biodiversity and physical cultural resource measures, the high seismic risk of the state, and climate change adaptation measures; upholding safety clearances especially where existing lines pass over houses rerouting as needed, and avoiding passing over school compounds or playgrounds; adhering to electromagnetic field (EMF) exposure, dust and noise guideline levels; drinking water quality for workers; approving contractor's pollution prevention, solid and hazardous waste management, and health and safety management plans prior to works; prohibiting PCB use in new transformers and asbestos containing materials in construction; and, community awareness raising activities by TSECL and the contractors on the health and safety risks of distribution infrastructure; and (iii) an environmental monitoring program, including monitoring of health and safety incidents. The responsible entity for mitigation, monitoring, and reporting is TSECL. Mitigation measures will be assured by a program of environmental supervision and monitoring to be conducted during the construction and operation stages. Any unanticipated impacts or requirements for corrective action during implementation of the distribution component will be reported by TSECL to ADB.

422. TSECL will establish a safeguard unit initially as part of the project management unit to support with EMP implementation, supervision, and monitoring during both construction and operation. This will be staffed with a suitably qualified and experienced Environmental and Social Safeguard Officer and a Health and Safety Officer (with professional certification) both with 12-15 years of experience. Project implementation consultants will include an Environment Consultant (with ecological expertise) and Health and Safety Consultant with professional certification to assist with site-specific assessment and provide on-site support, as well as capacity building and trainings. Further, the EPC Contractor will be required to have suitably qualified and experienced, dedicated on-site counterpart staff including an Environment Manager and Health and Safety Manager with professional certification supported by several health and safety stewards on-site. ADB TA consultants will help TSECL develop standard operating procedures (SOP) addressing the environment, health and safety impacts and risks of its substations, test laboratory and maintenance including recording of any occupational and community health and safety incidents.

423. This IEE including EMP are considered sufficient to meet the environmental assessment requirements of ADB for the distribution component. However, following selection of final route alignments but before the commencement of works, and, in case of any unanticipated scope or design changes occurring during project implementation, this IEE and EMP will be updated by TSECL and cleared by ADB.