

Draft Initial Environmental Examination

PUBLIC

February 2025

India: Tripura Industrial Infrastructure Development Project (Dukli Industrial Estate)

Prepared by the Department of Industries and Commerce (DoIC), Government of Tripura, for the Asian Development Bank (ADB).

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Initial Environmental Examination

Tripura Industrial Infrastructure Development Project

Project Number: 58021-001

**Infrastructure Development for Dukli Industrial Estate,
West Tripura District, Tripura**

**Prepared by the Department of Industries & Commerce (DoIC), Government of
Tripura**

February 2025

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ABBREVIATIONS

AC	: Assembly Coordinator
ACSR	: Aluminum Conductor Steel Reinforced
ADB	: Asian Development Bank
AEE	: Assistant Engineer Environment
AHU	: Air Handling Unit
AIDS	: Acquired Immune Deficiency Syndrome
AMC	: Agartala Municipal Commission
AQ	: Air Quality
ASI	: Archaeological Survey of India
BIS	: Bureau of Indian Standards
CAR	: Contractor All Risk
CCTV	: Closed-Circuit Television
CDRC	: Capacity Development Resource Centre
CEMP	: Contractor's Environmental Management Plan
CETP	: Common Effluent Treatment Plant
CFC	: Common Facility Centre
CGWA	: Central Ground Water Authority
CGWB	: Central Ground Water Board
CITES	: Convention on International Trade in Endangered Species
CoC	: Code of Conduct
CoI	: Corridor of Impact
CPCB	: Central Pollution Control Board
CPGRMS	: Centralized Public Grievance Redress Monitoring System
CPHEEO	: Central Public Health & Environmental Engineering Organization
CPWD	: Central Public Works Department
CRA	: Climate Risk and Adaptation
CRO	: Complaint Receiving Officer
CTE	: Consent to Establish
CTO	: Consent to Operate
CWR	: Clear Water Reservoir
DFO	: Divisional Forest Officer
DG	: Diesel Power Generating Set
DoIC	: Department of Industries & Commerce
DLP	: Defect Liability Period
DOT	: Department of Telecommunications
DTr	: Distribution Transformer
DTW	: Deep Tube Well
EA	: Executing Agency
EC	: Environment Clearance
EC	: Emergency Controller
EHS	: Environment, Health and Safety
EIA	: Environmental Impact Assessment
EMoP	: Environmental Monitoring Plan
EMP	: Environmental Management Plan
EMR	: Environment Monitoring Report
ERP	: Emergency Response Plan
ESGC	: Environmental, Social and Gender Cell
ETP	: Effluent Treatment Plant
FI	: Financial Intermediary
FRO	: Forest Range Officer

GBV	: Gender Based Violence
GHG	: Green House Gases
GIIP	: Good International Industry Practices
GoI	: Government of India
GoT	: Government of Tripura
GPS	: Global Positioning System
GPH	: Gallons Per Hour
GRC	: Grievance Redressal Committee
GRM	: Grievance Redressal Mechanism
GW	: Ground Water
Ha.	: Hectare
HDPE	: High-density Polyethylene
HIV	: Human Immunodeficiency Viruses
HSD	: High Speed Diesel
HT	: High Tension Line
IA	: Implementing Agency
IBAs	: Important Bird Areas
IBAT	: Integrated Biodiversity Assessment Tool
IC	: Incident Controller
ICCC	: Integrated Command and Control Centre
ICP	: Integrated Check Post
IE	: Industrial Estate
IEE	: Initial Environmental Examination
IFC	: International Finance Corporation
IMD	: Indian Metrological Department
INRM	: India Resident Mission
IRC	: Indian Road Congress
IRP	: Iron Removal Plan
IUCN	: International Union for Conservation of Nature
KLD	: Kilo Liter Per Day
KW	: Kilo Watt
LED	: Light Emitting Device
LT	: Low Tension Line
LULC	: Land Use Land Cover
MDPE	: Medium Density Polyethylene Pipe
MLD	: Million Liters Per Day
MoEF&CC	: Ministry of Environment, Forest and Climate Change
MPN	: Most Probable Number
MS	: Mild Steel
MSL	: Mean Sea Level
MSW	: Municipal Solid Waste
MT	: Metric Tonne(s)
MUD	: Multi Utility Duct
MVA	: Mega Volt Amp
MW	: Mega Watt
NAAQS	: National Ambient Air Quality Standards
NABET	: National Accreditation Board for Education and Training
NABL	: National Accreditation Board for Testing and Calibration Laboratories
NEEPCO	: Northeastern Electric Power Corporation Limited
NEP	: National Environment Policy
NG	: Natural Gas
NGO	: Non-Governmental Organization

NGT	: National Green Tribunal
NH	: National Highway
NOC	: No Objection Certificate
NQ	: Noise Quality
NRSC	: National Remote Sensing Centre
OFC	: Optical Fiber Cable
OHS	: Occupational Health and Safety
OH	: Over Head
OHT	: Over Head Tank
O&M	: Operation and Maintenance
OSD	: Officer on Special Duty
OSHA	: Occupational Safety and Health Administration
PCC	: Plain Cement Concrete
PCR	: Project Completion Report
PDMC	: Project Design and Management Consultant
PF	: Protected Forest
PIB	: Public Information Booklet
PIU	: Project Implementation Unit
PMSC	: Project Management and Supervision Consultant
PMU	: Project Management Unit
PNG	: Piped Natural Gas
POL	: Petroleum, Oil and Lubricants
PPE	: Personal Protective Equipment
PRF	: Project Readiness Financing
PRF	: Proposed Reserve Forest
PTr	: Power Transformer
PUC	: Pollution Under Control
PWD	: Public Works Department
QPR	: Quarterly Progress Report
REA	: Rapid Environmental Assessment
RET	: Rare, Endangered and Threatened
RF	: Reserve Forest
RFCTLARRA	: Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act
RoW	: Right of Way
RPD	: Rights of Persons with Disabilities
RWR	: Raw Water Reservoir
SCADA	: Supervisory Control and Data Acquisition
SCM	: Standard Cubic Meter
SEIAA	: State Environmental Impact Assessment Authority
SEMP	: Site Environmental Management Plan
SEMR	: Semi-annual Environment Monitoring Report
SEP	: Site Environmental Plan
SLD	: Single Line Diagram
SOP	: Standard Operating Procedures
SPS	: Safeguard Policy Statement
SQ	: Soil Quality
ST	: Scheduled Tribe
STP	: Sewage Treatment Plant
SW	: Surface Water
SWD	: Storm Water Drain
TIDCL	: Tripura Industrial Development Corporation Limited

TIIDP	:	Tripura Industrial Infrastructure Development Project
TSPCB	:	Tripura State Pollution Control Board
UG	:	Under Ground
UGSR	:	Under Ground Service Reservoir
ULB	:	Urban Local Body
UPVC	:	Unplasticized Polyvinyl Chloride
VCB	:	Vacuum Circuit Breaker
VdB	:	Vibration Decibels
WLS	:	Wildlife Sanctuary
WMM	:	Wet Mix Macadam
WTP	:	Water Treatment Plant
XLPE	:	Cross Link Polyethylene

CURRENCY EQUIVALENTS
(as of 12th December 2024)
Currency unit – Indian rupee (Rs)
Rs1.00 = \$0.012
\$1.00 = INR 84.82

NOTES

In this report, "\$" refers to US dollars.
"INR", ₹ and "Rs" refer to Indian rupees.

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EXECUTIVE SUMMARY

1. The DoIC is an executing agency (EA), and Tripura Industrial Development Corporation Limited (TIDCL) is designated as implementing agency (IA) for the PRF (Loan 6046-IND). The DoIC has engaged a Project Design and Management Consultant (PDMC) for preparation of the feasibility and detailed project reports, and other assigned deliverables for all prioritized industrial estates under PRF and to enable DoIC for seeking the ensuing loan (Project Number: 58021-001 - Tripura Industrial Infrastructure Development Project (TIIDP)) from ADB. Further, ADB has engaged a TA consultant (Environment) for compilation and finalization of all nine initial environmental examination (IEE) reports under the PRF.

2. The project will support Tripura's industrial infrastructure development. Industrial estates are critical drivers of industrialization. The state government has prioritized the development of nine industrial estates with ADB's support. The project builds on due diligence and preparation completed under a \$2.0 million PRF- loan to develop integrated, inclusive, climate-resilient, and sustainable infrastructure at the industrial estates. The project is aligned with the following impact: boost the manufacturing sector's competitiveness and create new and better job opportunities, including for women, and foster regional cooperation. This will be achieved through the following outcome: improved industrial infrastructure and business environment. The project will achieve this outcome by supporting the following outputs.

3. **Output 1: Institutional structures and mechanisms for industrial development strengthened, and business environment enhanced.** This output includes the establishment of a project management unit (PMU) and four project implementation units (PIUs) within TIDCL and a dedicated environment, social, and gender (ESG) cell to address ESG-related issues observed during implementation of infrastructure development within the nine industrial estates under the project. It also includes training programs in gender-responsive industrial estate management and climate change and safeguards. Output 1 also includes engaging Project Management and Supervision Consultants (PMSC) and individual experts to support TIDCL to strengthen institutional structures and mechanisms and to improve the business environment.

4. **Output 2: Climate resilient infrastructure and gender responsive and inclusive industrial environment built.** This output includes the development of (i) 34.16 km of climate-resilient road infrastructure and adjoining utility trenches built in nine industrial estates; (ii) about 66.55 km of stormwater drainage, 4 nos. minor bridges, 150 nos. box culverts built in nine industrial estates, and 70 rainwater harvesting systems, with 10 retention ponds built at seven industrial estates; and (iii) 13.30 MLD water supply system backed with 35.71 km of water supply distribution pipeline at six industrial estates. It also includes the construction of 2.1 km of geo-cell earth retaining wall for protection and erosion control. The project also includes the development of gender-responsive infrastructure at the industrial estates, including dedicated space for day care centers at all nine industrial estates, with at least three centers operational, and gender desks at six industrial estates to address the concerns of women workers. The Bodhjunnagar industrial estate will be promoted as a gender-responsive estate to serve as a model for other industrial estates. This also includes earmarking of at least 300 square meters of land in all industrial estates reserved exclusively for women-led enterprises. This output also includes at least five new women-led enterprises to receive incentives under the Tripura industrial investment promotion incentive scheme, promoting women ITI at Agartala as a state hub for skill training of women in emerging and non-traditional sectors and the "SHE Skills" program; and develop and adopt a five-year road

map for implementation of the Tripura State Policy for Empowerment of Women, 2022, aimed at increasing employment of women in state's industrial estates at TIDCL.

5. **Output 3: Industrial estates developed and upgraded.** This output is the major component of the project and includes activities to upgrade the nine industrial estates. To ensure adequate energy supply at the industrial estates, power distribution networks will be upgraded at all nine industrial estates, while 1255 streetlights and 37 high mast lights will be installed, and solar power facilities will be established in nine industrial estates. This output includes repairing and restoring the CETP at one industrial estate with 2 nos. clear water retention pond and building common multi-facility buildings at six industrial estates. At least 12 additional industrial pre-engineered sheds will be built at three industrial estates, and a parking area of 5 acres spread over six industrial estates will be developed. The transport systems of the industrial estates will be improved by introducing four compressed natural gas buses, 18 electrical vehicles, and nine electric vehicle charging stations. To improve safety and security at the industrial estates (i) one fire station will be proposed; (ii) seven weigh bridges will be built; (iii) 11 km of boundary walls will be built at eight industrial estates, and another 5.1 km of the existing wall will be upgraded; (iv) 14 watchtowers will be built; (v) 462 cameras with junction board as security and surveillance systems will be installed; and (vi) one integrated command and control center will be built to monitor two industrial estates in West Tripura. At least six industrial estates will have enabled accessible sanitation with ramps and grab rails in all toilets, and separate female toilets with menstrual hygiene facilities. All infrastructure will be inclusively managed, with women trained and provided employment opportunities in facility management services to the extent possible.

6. The project includes infrastructure development of nine IEs (namely Bodhjunnagar, R.K.Nagar, Kumarghat, Dhajanagar, Dharmanagar, Deewanpasa, Dukli, Sarasima and Nagicherra) spread across five districts in the state of Tripura. Dukli is one of the nine prioritized industrial estates, located in Dukli block of West Tripura district, established in the year 1982 and is spread over 16.30 ha. The Dukli IE is 0.5 km away from National Highway (NH-8), 2.5 km from Dukli Railway Station and 12 km from Agartala Integrated Check post, gateway to the adjoining country (Bangladesh). Currently, there are 23 industrial units in Dukli IE, out of which 12 are functional, six units are under implementation phase and five units are closed.

7. Based on the need analysis, infrastructure development components considered within the Dukli IE comprise of (i) development of vacant land into additional 10 industrial plots spread over 4.52 ha); (ii) improvement of 1.31 km of existing internal roads from single lane to intermediate along with improvement of junctions and lighting facilities; (iii) 2.4 kms of storm water drains with 7 culverts; (iv) augmentation of power system (HT/ LT/ SCADA cables/ OFC) with installation of additional seven distribution transformers, 4 high mast lights and 10 kw solar panels; (v) renovation/ upgradation of 1.15 km of existing boundary and construction of 1.71 km of new boundary wall with 4 entrance gates; and (vi) 1 no Weighbridge; and (vii) Two battery-operated small E-vehicles, along with the necessary charging infrastructure, have been proposed to be improving internal mobility within the Industrial Estate.

8. The proposed developments are spread over 7.57 ha. vacant land area (46.4% of total 16.30 ha), within the existing boundary of Dukli IE.

9. The objective of the IEE is to determine the applicable regulatory framework, assess the baseline environment surrounding the industrial estate (IE) along with the likely impacts due to the proposed infrastructure development works and suggest the mitigation measures

as required. The IEE includes a commensurate environmental management plan (EMP) along with institutional arrangements to mitigate the likely impacts under the project.

10. The IEE report has determined that the proposed development works at Dukli IE will not require prior environmental clearance (as per EIA notification 2006 and amendments thereof) either from the state or central levels. The proposed construction works within Dukli IE will require felling of 13 trees, which are commonly found in the region. TIDCL has already completed a joint verification survey with the forest department but has yet to receive permissions for felling of these trees from the State Forest Department. The cutting of 13 trees would be initiated only after obtaining the requisite tree cutting permission from the forest department.

11. The contractor will be required to obtain CTE and CTO for campsites, construction plants (hot-mix plants, concrete batch plants, crushers, wet mix macadam, etc.) from the Tripura State Pollution Control Board. Seeking such required permissions, consents following duly laid down procedures will not pose any regulatory risks.

12. The Dukli being a brown field industrial estate, it is proposed to 33 KV line from 132 / 33 KV SM Nagar S/s up to Dukli S/s at Dukli Industrial Estate (of length 10 km ref- Appendix-6), which qualify as “associated facility¹” under the Project. The associated environmental impacts and mitigation measures for proposed to 33 KV line from 132 / 33 KV SM Nagar S/s up to Dukli S/s at Dukli Industrial Estate (of length 10 km ref- Appendix-6) shall be carried out during implementation of the Project. The on-site assessment of the existing infrastructure/ facility² like roads, entrance gate, boundary wall, utility buildings like administration office, water supply (existing tube wells) and water distribution pipe network, power cables etc. did not identify any past and present concerns/ outstanding issues with respect to the existing infrastructure/ facilities, which warrant corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

13. Geologically, the core and buffer zones³ is occupied by upper tertiary and does not have geological reserves of rock/stone aggregates. The area has adequate groundwater resources with yield ranging between 100 to 150 cum. per hour and no area or block of the core/ buffer zones has been notified for restricted groundwater development by the CGWA.

14. The area falls within the Khowai river catchment under Barak sub-basin, which has a predominantly dendritic drainage pattern with first order followed by second order drains/streams, none of them are prone to floods even during the monsoon season or heavy rainfall years. The area does not have any surface water bodies or wetlands, although the state has 408 freshwater wetlands. Of these, Rudrasagar Lake is the only RAMSAR site, which is at about 31.02 km aerial distance from the Dukli IE.

¹ Associated Facility - that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project (Para 6, Appendix 1 of Safeguard Policy Statement, 2009).

² If a project involves an upgrade or expansion of existing facilities that has potential impacts on the environment, involuntary resettlement, and/or Indigenous Peoples, the requirements for environmental and social impact assessments and planning specified in Safeguard Requirements 1-3 will apply in addition to compliance audit. (Para 12, Appendix 4 of Safeguard Policy Statement, 2009).

³ IEE considers Dukli IE and a 500m wide strip all along its periphery as core zone area and entire West Tripura district as buffer zone for assessment of baseline environment.

15. The elevation of Dukli IE ranges between 31 to 51 meters above mean sea level (MSL) and is at a relatively higher level as compared to the surrounding region. Consequently, Dukli IE is not prone to submergence and/ or floods even during heavy rainfall periods. The soil types in the area are predominantly red loamy, red & yellow, light & red earth, which are generally acidic in nature and deficient in nutrients like nitrogen, phosphate calcium, magnesium and sulfur, whereas available potash levels are medium to high.

16. The climate of the area is characterized by moderate temperatures with high humidity throughout the year. Winter season starts in November and lasts till the end of February. Summer season starts from March and lasts up to May and is followed by Southwest monsoon lasting till October. Generally, maximum summer temperature ranges from 35°C to 40°C and average minimum temperature is in winter nights range between 6°C to 8°C.

17. The average annual rainfall received in the area between 2018 and 2022 is 1862 mm, most of which occurring between May to October months. The area has a visibility of 4 to 10 km for over 300 days in a year. The pre-dominant wind direction is South followed by Southeast both during morning and evening hours throughout the year. The wind speed in the area ranges between 1 to 19 km per hour for 247 days and calm days for nearly 117 days in normal years.

18. The baseline environmental monitoring (ambient air quality, ambient noise levels, surface and ground water, and soil quality) within the area indicates that all tested parameters at all sampling locations were within the respective standards or does not critically exceed the respective stipulated limits/standards. This can be attributed to the absence of any major emission sources related to industrial activities, except for vehicular emissions.

19. The core zone extending up to 500-metre beyond the boundary of the industrial estate does not have forest areas of any type/ category. The Sepahijala Wildlife Sanctuary (WLS) and its notified eco-sensitive zone is the nearest protected area, which is in the adjoining Trishna district, at 10.58 km from the Dukli IE.

20. Ecological investigations carried out through I-BAT has cataloged 76 flora and 133 fauna groups within 500m core zone, including Dukli IE, as compared to the 210 flora and 269 fauna groups in the buffer zone (beyond 500m and up to 20 kms). This abridgement in the flora and its richness in the core zone can be attributed to the hustle of industrial operations and consequent environmental stressors within the Dukli IE. None of the taxa identified during the investigation was found to be under the rare endangered and threatened (RET) category.

21. The proposed improvement works within Dukli IE will require 13 trees to be felled which are commonly found in the region and do not fall under the category of rare, endangered or threatened species. Consultations with the forest department officials as well as local community has not indicated presence/ sighting of any wildlife and/or any animal-human conflicts in the area during the past 10 years. The faunal surveys carried out within the core zone have not reported sighting of any reptilian fauna. However, the presence of reptilian fauna cannot be ruled out.

22. The core zone of Dukli IE have no physical and cultural resources or any protected archeological and/or historical monuments protected under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof.

23. Tripura state is vulnerable to earthquakes, floods, landslides, cyclones, extended dry spells and other natural and human induced disasters. Among these, the state is very highly vulnerable to earthquakes as it is situated in Seismic Zone-V and has a higher probability of occurrence of big earthquakes measuring 8 and above on Richter scale.

24. The IEE report has not identified any significant and irreversible environmental impacts and is not anticipated to have long term impacts on geology, hydrogeology, soil, flora, fauna etc. of the core and buffer zones pertaining to different environmental attributes under the Project. The proposed improvements will have localized, largely reversible short-term impacts, confined to the existing Dukli IE boundary.

25. Measures to minimize the impacts due to construction activities like vegetation clearance, dust and noise levels, air pollution due to vehicular emissions, worker's safety, construction site management, construction material management including debris disposal, on and off-site sanitation management are described under environmental management plan (EMP) for pre-construction, construction, and operations phase. The implementation of the EMP by the contractor(s) and PIU will be supervised and monitored by the environmental, social and gender (ESG) cell under the PMU. The EMP and environmental monitoring plan (EMP) will be included (sector-wise) in the bid document, to make it part of civil works contract and binding of awarded contractors for its implementation during construction phase.

26. Additionally, several environmental conservation measures like balancing the cut and fill quantities of earthwork (3127.28 cum), green area development, recharging/ percolation wells at 10 locations to offset the withdrawal of groundwater, plantation of 65 saplings (5 saplings for every tree felled) with 3 year maintenance and 70% survivability to enable to offset the net loss and ensure net gain from 3rd year onwards and periodical monitoring of ambient air quality, ambient noise levels, water and soil quality at construction sites throughout the construction stage have been considered along with necessary budgetary provisions (INR 17,71,000).

27. The stakeholders, i.e., owners of the existing industries as well as the workforce (within the IE) and residents in the nearby settlement areas have been consulted, and many of their suggestions have been included in the project design.

28. Alternative analysis has compared options like (i) no project scenario (ii) proposed development works with minimal impacts along with additional environment conservation measures. The IEE includes grievance redressal mechanism to resolve any complaints from aggrieved existing industries and/or their workforce, and any stake holders during pre-construction, construction, and operation stages of the project.

29. Based on the baseline environmental assessment of the core and buffer zone as well as the proposed infrastructure development works within Dukli IE, the IEE has not identified any significant and irreversible environmental impacts. The rapid environmental assessment (REA) checklist (ref. **Appendix-1**) has been prepared for the Dukli IE. The proposed improvements will have short-term and localized construction phase impacts confined to the existing boundary and is not anticipated to have long term impacts on environmental attributes such as geology, hydrogeology, soil, flora, fauna etc. of the core and buffer zones. The proposed 10 KW solar power generation component will lead to a 1% reduction in greenhouse gases (GHG) emissions by offsetting the energy demand from fossil fuel. Accordingly, as per ADB's SPS 2009, the Project (Dukli IE) is defined as "category B" for environment safeguards and the IEE report has been prepared.

1.0 INTRODUCTION

1.1 Background

30. The Department of Industries & Commerce (DoIC), Government of Tripura has initiated an ambitious program for the infrastructure development in nine prioritized industrial estates through a loan 6046-IND from the Asian Development Bank (ADB) to promote the industrial growth and economy of the state. The DoIC has received a Project Readiness Financing (PRF) facility from the ADB to prepare the prioritized industrial estates for the anticipated loan.

31. The DoIC is an executing agency (EA), and Tripura Industrial Development Corporation Limited (TIDCL) is designated as an implementing agency (IA) for the PRF (Loan 6046-IND). The DoIC has engaged a Project Design and Management Consultant (PDMC)⁸ for preparation of the feasibility and detailed project reports, and other assigned deliverables for all prioritized industrial estates under PRF and to enable DoIC for seeking the ensuing loan (Project Number: 58021-001 - Tripura Industrial Development Project) from ADB. Further, ADB has engaged a TA consultant (Environment) for compilation and finalization of all nine initial environmental examination (IEE) reports under the PRF.

32. The project will support Tripura's industrial infrastructure development. Industrial estates are critical drivers of industrialization. The state government has prioritized the development of nine industrial estates with ADB's support. The project builds on due diligence and preparation completed under a \$2.0 million PRF- loan to develop integrated, inclusive, climate-resilient, and sustainable infrastructure at the industrial estates. The project is aligned with the following impact: boost the manufacturing sector's competitiveness and create new and better job opportunities, including for women, and foster regional cooperation. This will be achieved through the following outcome: improved industrial infrastructure and business environment. The project will achieve this outcome by supporting the following outputs.

33. **Output 1: Institutional structures and mechanisms for industrial development strengthened, and business environment enhanced.** This output includes the establishment of a project management unit (PMU) and four project implementation units (PIUs) within TIDCL and a dedicated environment, social, and gender (ESG) cell to address ESG-related issues observed during implementation of infrastructure development within the nine industrial estates under the project. It also includes training programs in gender-responsive industrial estate management and climate change and safeguards. Output 1 also includes engaging Project Management and Supervision Consultants (PMSC) and individual experts to support TIDCL to strengthen institutional structures and mechanisms and to improve the business environment.

34. **Output 2: Climate-resilient infrastructure and gender-responsive and inclusive industrial environment built.** This output includes the development of (i) 34.16 km of climate-resilient road infrastructure and adjoining utility trenches built in nine industrial estates; (ii) about 66.55 km of stormwater drainage, 4 nos. minor bridges, 150 nos. box culverts built in nine industrial estates, and 70 rainwater harvesting systems, with 10 retention ponds built at seven industrial estates; and (iii) 13.30 MLD water supply system backed with 35.71 km of water supply distribution pipeline at six industrial estates. It also includes the construction of 2.1 km of geo-cell earth retaining wall for protection and erosion control. The project also includes the development of gender-responsive infrastructure at the industrial estates, including dedicated space for day care centers at all nine industrial estates, with at least three

centers operational, and gender desks at six industrial estates to address the concerns of women workers. The Bodhjunnagar industrial estate will be promoted as a gender-responsive estate to serve as a model for other industrial estates. This also includes earmarking of at least 300 square meters of land in all industrial estates reserved exclusively for women-led enterprises. This output also includes at least five new women-led enterprises to receive incentives under the Tripura industrial investment promotion incentive scheme, promoting women ITI at Agartala as a state hub for skill training of women in emerging and non-traditional sectors and the “SHE Skills” program; and develop and adopt a five-year road map for implementation of the Tripura State Policy for Empowerment of Women, 2022, aimed at increasing employment of women in state’s industrial estates at TIDCL.

35. **Output 3: Industrial estates developed and upgraded.** This output is the major component of the project and includes activities to upgrade the nine industrial estates. To ensure adequate energy supply at the industrial estates, power distribution networks will be upgraded at all nine industrial estates, while 1255 streetlights and 37 high mast lights will be installed, and solar power facilities will be established in nine industrial estates. This output includes repairing and restoring the CETP at one industrial estate with 2 nos. clear water retention pond and building common multi-facility buildings at six industrial estates. At least 12 additional industrial pre-engineered sheds will be built at three industrial estates, and a parking area of 5 acres spread over six industrial estates will be developed. The transport systems of the industrial estates will be improved by introducing four compressed natural gas buses, 18 electrical vehicles, and nine electric vehicle charging stations. To improve safety and security at the industrial estates (i) one fire station will be proposed; (ii) seven weigh bridges will be built; (iii) 11 km of boundary walls will be built at eight industrial estates, and another 5.1 km of the existing wall will be upgraded; (iv) 14 watchtowers will be built; (v) 462 cameras with junction board as security and surveillance systems will be installed; and (vi) one integrated command and control center will be built to monitor two industrial estates in West Tripura. At least six industrial estates will have enabled accessible sanitation with ramps and grab rails in all toilets, and separate female toilets with menstrual hygiene facilities All infrastructure will be inclusively managed, with women trained and provided employment opportunities in facility management services to the extent possible.

1.2 Prioritized Industrial Estates

36. In line with objectives and scope under PRF, DoIC has prioritized nine industrial estates spread across five districts in Tripura for ensuing ADB loan. The list of the prioritized industrial estates comprises eight existing (brownfield) and one new (greenfield) industrial estate are given in **Table 1-1**.

Table 1-1: Prioritized Industrial Estates under PRF

Sl. No.	Industrial Estate	Nearest Town	District	Present Status	Area (in Ha.)	Area (in acres)
1	Bodhjunnagar	Agartala	West Tripura	Existing/ Brownfield	207.6	512.87
2	R. K. Nagar	Agartala	West Tripura	Existing/ Brownfield	83.23	205.57
3	Kumarghat	Agartala	Unakoti	Existing/ Brownfield	14.60	36.05
4	Dharmanagar	Dharmanagar	North Tripura	Existing/ Brownfield	3.22	7.95
5	Nagicherra	Agartala	West Tripura	New/ Greenfield	12.56	31.02
6	Deewanpasa	Dharmanagar	North Tripura	Existing/ Brownfield	22.51	55.6
7	Dhajanagar	Udaipur	Gomati	Existing/ Brownfield	7.61	18.79
8	Sarasima	Belonia	South Tripura	Existing/ Brownfield	15.94	39.38
9	Dukli	Agartala	West Tripura	Existing/ Brownfield	16.30	40.27

1.3 Objectives and Methodology of IEE

37. Dukli is one of the nine prioritized industrial estates under PRF for which an initial environmental examination (IEE) report is prepared. The objective of the IEE report is to determine the applicable regulatory framework, assess the baseline environment surrounding the industrial estate (IE) along with the likely environmental impacts and associated mitigation measures due to the proposed development works. The IEE report includes evolving a commensurate environmental management plan (EMP) along with institutional arrangements to mitigate the likely impacts.

38. The entire Dukli IE as well as a 500-metre-wide strip all along the peripheral boundary has been considered as the core zone for assessment of present baseline environment. The core zone can be vulnerable to various construction activities during the project implementation stage. The West Tripura district has been considered as a buffer zone for assessment of the baseline environmental conditions within the region surrounding the Dukli IE.

39. The baseline environmental profile of the core and buffer zones have been assessed for key attributes like physical resources (viz. geology, hydrogeology, physiography, soil, drainage, land use, climate, ambient air quality, water quality, ambient noise levels, natural hazards and vulnerability status,), ecological resources (viz. flora, fauna, forest/vegetation cover, trees wetlands, critically endangered species protected monuments and social and cultural resources among others.

40. The baseline information on various environmental attributes for both core and buffer zones has been collected through field surveys and supplemented by secondary data sourced from authentic and verifiable sources.

1.4 Structure of IEE Report

41. This IEE report contains the following sections:

- Executive Summary
- 1.0. Introduction
- 2.0. Policy, Legal and Administrative Framework
- 3.0. Description of the Project
- 4.0. Description of the Environment
- 5.0. Anticipated Environmental Impacts and Mitigation Measures
- 6.0. Analysis of Alternatives
- 7.0. Public consultation and information disclosure
- 8.0. Grievance Redress Mechanism
- 9.0. Environmental Management Plan
- 10.0. Conclusions and Recommendations

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

42. A review of the policy, legal and regulatory framework related to the (a) Govt. of India (GoI)/Government of Tripura (GoT); and (b) ADB's Safeguard Policy Statement (SPS) 2009 pertaining to the environmental safeguards in terms of their relevance and applicability to the Dukli IE development is presented in this section.

2.1 Applicable Regulations of GoI/Government of Tripura

43. The GoI has laid out various policies, acts, regulations, and guidelines pertaining to environment safeguards requirements for various types of developmental projects. The implementation of the project will be governed by the national laws and state specific environmental rules, regulations, and standards. These regulations impose restrictions on activities to minimize/mitigate likely impacts on the environment. Compliance is required in all stages of the project's implementation including design, construction, and maintenance. All the relevant/ applicable GoI/ GoT regulations and their relevance to Dukli IE are given in **Table 2-1**.

Table 2-1: Summary of Applicable Environmental Regulations of GoI/Govt. of Tripura

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
1.	Environmental Protection Act, 1986 and subsequent amendments	The Act is an “umbrella” legislation that provides framework for the environmental regulation regime in India and the role and responsibilities of various central and state authorities established under other environment-related laws, such as the Water Act and the Air Act. The Act relates to the protection and improvement of the environment and the prevention of hazards to human beings, other living creatures, plants and property.	Yes Although, the development of Dukli IE does not fall under the EIA Notification, 2006, which require prior environmental clearances from central or state levels, CTE and CTO for construction plants (such as the hot-mix plants, ready mix concrete plants, crushers, DG sets, etc.) are to be obtained from the TSPCB under the relevant water and air acts.
2.	National Environment Policy (NEP), 2006	NEP is a comprehensive guiding document in India for all environmental conservation programs and legislations by Central, State and Local Government. The dominant theme of this policy is to promote betterment of livelihoods without compromising or degrading the environmental resources. The policy also advocates collaboration methods of different stakeholders to harness potential resources and strengthen environmental management.	Yes The DoIC, Government of Tripura should adhere to NEP principle of “enhancing and conservation of environmental resources and abatement of pollution” in all stages of project.
3.	Environmental Impact Assessment Notification-2006 notified on 14 th September 2006, as amended in 2009 and 2013	To regulate construction of new projects and/or expansion or modernization of existing projects and provide environmental clearance to new development activities following environmental impact assessment	No. The extent of land of Dukli industrial estate is less than 500 hectares. Also, the industrial estate does not have any industry of Category “A” or “B” as specified under the EIA Notification, 2006. Further, the development area as well as building and construction projects within the industrial estate is less than (i) 50 hectares area, (ii) 20,000 and 150,000 sqm of respectively (ref. 8a & 8b schedule of EIA Notification, 2006). (ref. Appendix-2) Therefore, infrastructure development within the Dukli IE will not require prior environmental clearance under the current EIA Notification, 2006 and its amendments thereof.
4.	MoEF&CC Notification for use	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	No

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
	of fly ash, 28 th April 2016.		There is no coal based thermal power plant within 300 km of the Dukli IE. The improvement of Dukli industrial estate does not involve construction of large-scale embankments or reclamation of low-lying areas, which can consume significant quantities of fly ash. Therefore, utilization of fly ash is not warranted for Dukli IE
5.	The Forest (Conservation) Act. 1980	To check deforestation by restricting diversion of forest areas into non- forest uses.	No The infrastructure development of Dukli IE is limited to the land owned by the DoIC, Govt. of Tripura and does not warrant diversion of forest land and therefore, no forest clearances are required under the Forest Conservation Act,1980.
6.	The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	It grants legal recognition to the rights of traditional forest dwelling communities.	NA This rule is applicable, if land acquisition of forest dwelling ST and other traditional forest dwelling communities may be required.
7.	MoEF&CC circular (1998) on linear Plantation on roadside, canals and railway lines modifying the applicability of provisions of forest (Conversations) Act, to linear Plantation	Protection / planting roadside strip as avenue/strip plantations as these are declared protected forest areas.	No Although, the infrastructure development of Dukli IE is limited to the land owned by DoIC, Govt. of Tripura. The development work will require the felling of 13 trees. Therefore, requisite permission for tree felling is required under Forest Conservation Act,1980.
8.	The Wildlife Protection Act, 1972	To protect wildlife such as National Parks and Sanctuaries	No, No Wildlife Sanctuary or National Park and/or their notified eco-sensitive zones are not located within 10 km of Dukli industrial

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
			estate. The nearest protected area is Sepahijala WLS which is at 10.58 km from the IE. The other protected areas are: Rowa WLS is located at 104.06km, Gomati WLS is at 41.78km, Trishna WLS is at 42.11km
9.	Biological Diversity Act, 2002 and Biological Diversity (Amendment) ACT, 2023	Conservation of biodiversity	No Dukli IE has been ecological investigations carried out during August-September 2023 has not reported presence of any rare, endangered, threatened flora/ faunal species within the industrial estate.
10.	Wetlands (Conservation and Management) Rules, 2017	Wetlands (Conservation and Management) Rules 2017 have enhanced the focus of management of wetlands from a central authority to state bodies. The rules provide for an advisory role for the National Wetland Committee, to guide the state bodies on the integrated management of wetlands based on wise-use principle and review the progress of integrated management of Ramsar Convention sites among other roles.	Not applicable as subprojects components are not located in or near to designated wetland area.
11.	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution Pollutants	Yes (during construction stage, contractor will have to obtain CTE and CTO) to regulate ambient air quality by use of construction plants along the construction sites within Dukli IE.
12.	Water (Prevention and Control of Pollution) Act, 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards	Yes (during construction phase, contractor will have to obtain CTE and CTO) to regulate the water quality by use of construction plants along the construction sites within Dukli IE.
13.	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEF&CC for various land uses.	Yes (during construction stage, contractor will have to obtain CTE and CTO) to regulate ambient noise levels by use of construction plants along the construction sites within Dukli IE.
14.	The Explosive Act 1884	Safe transportation, storage and use of explosive material	No (as explosives are prohibited to be used.)
15.	The Mines and Minerals (Development and	For opening a new quarry.	No Only licensed quarries will be used, and no new quarries will be developed for sourcing sand.

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
	Regulation) Act 1957		<p>The sand requirement can be met through existing licensed sand mining areas within the West Tripura and adjoining districts of the state. Further, if any project specific new sand quarries/ mining is warranted to be opened, contractors shall obtain clearances from State Pollution Control Board and other competent authorities as per environmental regulations.</p> <p>Dukli IE and the entire Tripura state does not have stone quarries. The stone aggregate requirement of the state is met through quarries in the adjacent Assam state, transported through road and rail network.</p>
16.	The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and The Tripura Ancient Monuments and Archaeological Sites and Remains Act, 1997	Conservation of cultural and historical remains found in India	<p>No</p> <p>The present regulations of Government of India prohibit any construction activity within 100 meters and regulate construction activity within 200m, beyond the first 100 meters of prohibited area of any protected monument under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof.</p> <p>Dukli industrial estate does not have any such protected monument and archaeological sites within 300 meters in all directions.</p> <p>In case of chance finding (below the ground levels), the contractor/ PIU will be required to follow a protocol as defined in the Environmental Management Plan (EMP) during implementation of the Project.</p>
17.	Municipal Solid Waste (Management & Handling) Rules, 2000 (MSW Rules)	Segregation, Handling & safe disposal of domestic solid waste	<p>Yes</p> <p>Solid waste generated at proposed facilities shall be managed and disposed in accordance with the Rules.</p> <p>The work force camp and camp site shall have facility for collecting the waste, and access controlled to prevent the entry of stray animals for scavenging of waste.</p>

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
18.	Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008.	Safe handling, storage, transportation & disposal of hazardous wastes	No Contractor shall obtain the requisite licenses for handling and disposal of hazardous waste generated during construction stage, if becomes applicable during construction stage.
19.	The Occupational Safety, Health and Working Conditions Code, 2020	Comprehensive Code on Occupational Safety, Health and Working Conditions, amalgamates 13 existing labour laws/acts relating to Safety, Health, working Conditions and Wages	Yes This shall be contractors' responsibility for compliance
20.	Batteries (Management and Handling) Rules, 2001	Safe recycling of lead acid batteries	Yes This shall be the contractors' responsibility for compliance during construction stage. Contractors shall adopt recycling of lead acid batteries of construction vehicles and equipment during construction stage.
21.	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989	To check vehicular air and noise pollution	Yes This shall be the contractors' responsibility for compliance during construction stage. The contractor shall obtain requisite Pollution Under Control certificates during construction stage for all vehicles deployed for construction activities.
22.	National Labour Act, 1970.	An Act to regulate the employment of contract labour in certain establishments and to provide for its abolition in certain circumstances and for matters connected therewith	Yes This shall be contractors' responsibility for compliance
23.	The Child Labour (Prohibition and Regulation) Amendment Act, 2016, The Child Labour (Prohibition	No child under 14 years of age will be employed or permitted to work in any of the occupations set forth in the Act's Part A of the Schedule or in any workshop wherein any of the processes set forth in Part B of the Schedule. Child can help his family or family enterprise, which is other than any hazardous occupations or processes set	Yes No children between the ages of 14 to 18 years will be engaged in hazardous working conditions. This shall be the contractors' responsibility for compliance.

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
	and Regulation) Act, 1986	forth in the Schedule, after his school hours or during vacations.	
24.	The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act 1979	The Act is applicable to an establishment which employs 5 or more interstate migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The interstate migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc.	Yes Contractors shall register with the Labour Department, if Interstate migrant construction workforce are engaged. Adequate and appropriate amenities and facilities to be provided to workers - housing, medical aid, traveling expenses.
25.	Public Liability and Insurance Act 1991	An Act to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by an accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.	No This shall be contractors' responsibility for compliance, if warranted
26.	Workmen Compensation Act, 1923	The Act provides for compensation in case of injury by accident arising out of and during employment.	Yes Compensation for workers in case of injury by accident. This shall be the contractor's responsibility for compliance. The main contractor (who has been awarded) will also be responsible if the subcontractors are engaged under the Project.
27.	The National Green Tribunal (NGT) Act, 2010	NGT provides an effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith. NGT has jurisdiction over matters related to the Water Act, 1974; Water Cess Act, 1977; Forest (Conservation) Act, 1980; Air Act, 1981; Environment (Protection) Act, 1986; Public Liability	Yes Stakeholders / affected persons may approach NGT to resolve project induced environmental issues. This shall be DoIC and contractors' responsibility for compliance.

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
		Insurance Act, 1991; and Biodiversity Act, 2002. Consequently, no other court will have jurisdiction over the matters related to the environment falling under the above referred Acts. Being a dedicated tribunal for environmental matters with the necessary expertise to handle environmental disputes.	
28.	Building and Other Construction Workers Act, 1998 and 2006	To regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto.	Yes This shall be contractors' responsibility for compliance
29.	The Tripura Building and Other Construction Workers (Regulation of Employment and Conditions of Service) (Seventh Amendment) Rules 2017	To regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto.	Yes This shall be contractors' responsibility for compliance
30.	The Petroleum Rules, 2002	Safe use and storage of petroleum products will need to be compiled by the contractors.	No Applicable only if the storage of petroleum product exceeds the stipulated threshold limits. As per the current regulations under Petroleum Rules, 2002, no license is required for transport or storage of limited quantities of petroleum Class B (HSD or Kerosene), if the total quantity at any one place does not exceed two thousand and five hundred liters and none of it is contained in a receptacle exceeding one thousand liters in capacity; however, the stipulations for storing such quantities shall be in accordance with the rules.

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
31.	The E-Waste (Management) Rules, 2016 & Solar Waste Treatment under E-Waste (Management) Rules, 2022	This provides for management of E-wastes (but not covering lead acid batteries and radio-active wastes) aiming to enable the recovery and/or reuse of useful material from e-waste, thereby reducing the hazardous wastes destined for disposal and to ensure the environmentally sound management of all types of waste of electrical and electronic equipment. The Ministry of Environment, Forest and Climate Change has also notified the E-Waste (Management) Rules, 2022 for. Management of solar PV modules panels/ cells in Chapter V of the rules for compliance by every manufacturer and producer of solar photo-voltaic modules or panels.	Yes The contractor shall obtain the requisite licenses for handling and disposal of E-waste generated (if becomes applicable) during the construction stage. Also, the contractor is responsible for safe keeping of damaged/ malfunctioning solar panels, for handing it over to manufacturer/ producer/ supplier during construction/ operation stage, to comply with Solar Waste Treatment under E-Waste (Management) Rules, 2022.
32.	Plastic waste Management Rules, 2016	This provides for control and management of the plastic waste generated from any activity.	No (Ordinarily not anticipated but it shall be contractors' responsibility for compliance during the construction stage)
33.	Central/ State Groundwater Acts and Rules for Ground Water Regulation, Development, control and Management	The Act provide for Regulation and Control of Development and Management of Ground water in any form	No No objection certificate (NOC) will be required only if new tube wells are constructed within the industrial estate in future. NOC shall be obtained in such cases, in accordance with the notification by the Ministry of Jal Shakti/ CGWA, vide GoI, gazette notification dated 24 th Sept. 2020.
34.	Construction & Demolition, Waste Management Rules, 2016	This rule shall be applicable to construction waste/debris resulting from construction activities	Not anticipated since the infrastructure within the existing Dukli IE is merely being upgraded and unlikely to generate demolition waste as per Rules. Applicable only, if the developmental activities within Dukli industrial estate are likely to generate more than 10 MT waste per day and/or 200 MT in a month, a project specific waste management plan will be required as per the stipulations under this rule.

Sl. No.	Act / Rules	Key Purpose	Applicability to Dukli industrial estate
			Project design considers balancing the cut and filling volumes and reusing the debris/muck generated for reclamation of low-lying areas within the industrial estate.
35.	Tripura Right to Information Rules, 2008	The Act provides for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, the constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto.	Yes This shall be DoIC/ TIDCL's responsibility for compliance
36.	The Rights of Persons with Disabilities Act, 2016	The Act ensures that persons with disabilities enjoy the right to equality and non-discrimination in all aspects of life. Every entity must comply with the accessibility standards relating to physical environment, transport and information and communication technology as per the standards prescribed in the RPD Act. These include barrier free built environment having elevators/ramps for the benefit of wheelchairs, including retrofitting old modes of transport, wherever technically feasible.	Yes Applicable to the Dukli IE infrastructure in terms of making it more accessible to person with disabilities/physically challenged and project design considers the same.

2.2 ADB's Safeguard Requirements

44. As per ADB's Safeguard Policy Statement (SPS 2009), all proposed developmental projects are to be screened and categorized at the earliest stage of project preparation, when sufficient information is available for this purpose. Screening and categorization are 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.

45. The process of determining a project's environment category is to prepare a rapid environmental assessment (REA) checklist, considering the type, size, and location of the proposed project. Based on ADB's SPS 2009, a project is classified as one of the four environmental categories (A, B, C, or FI) as follows:

Category A: A proposed project is classified as "category A" if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

Category B: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. 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.

Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

Category FI: Projects are classified as category FI, if they involve investment of funds in or through a financial intermediary. Where the FIs investment has minimal or no adverse environmental risks. The FI project will be treated as category C. All other FIs must establish and maintain an environmental and social management system and must comply with the environmental safeguards requirements specified in SPS 2009, if the FIs subprojects have the potential for significant adverse environmental impacts.

46. The rapid environmental impact assessment checklist (ref. Appendix-1) has been prepared for the Dukli IE development indicates that it is unlikely to cause irreversible and significant adverse impacts. Therefore, as per ADB's SPS 2009 the project is categorized as "category B" for environmental safeguards and the IEE report including EMP (component-wise) has been prepared under the Project.

2.3 Statutory Clearances and Permissions

47. The pre-construction and construction stage statutory clearances/ permissions required for the **Dukli IE** development are given in **Table 2-2**.

Table 2-2: Statutory Clearances/ Permissions Required for Dukli IE

Sl. No.	Clearances/ Permissions required	Competent Authority to Accord Clearances	Responsibility to Obtain Clearance
A. Pre-construction Stage			
1	Permission for felling of trees, which are within areas of development of Dukli industrial estate	Divisional Forest officer, West Tripura District, Department of Forests, Govt. of Tripura	TIDCL/ DoIC, Govt of Tripura

Sl. No.	Clearances/ Permissions required	Competent Authority to Accord Clearances	Responsibility to Obtain Clearance
B. Construction Stage			
1	Consent to establish and Consent to operate construction camp sites, crusher units, hot mix plants, concrete batch mix plants, Wet Mix Macadam (WMM) plant, work force camps etc.	Tripura State Pollution Control Board	Respective PIU/ Contractor
2	No Objection Certificate (NOC) for use of ground water for construction purposes from existing tube wells	Central Ground Water Authority, Govt. of India/ Designated/ Competent Department of the State Govt. of Tripura	Respective PIU/ Contractor
3	License to store HSD at Construction camp. A license will be required only if the storage capacity is beyond 1000 liters storage.	Regional office of Chief Controller of Explosives, Gol, Guwahati	Respective PIU/ Contractor
4	Permission to establish construction camps, only if require to be established outside of industrial estate	District Magistrate & Local Panchayat` (s), landowners in case of private land	Respective PIU/ Contractor
5	Sand mining license and/or opening of new quarry sites for stone aggregates	Principal Chief Conservator of Forests/ Director Department of Industries and Commerce, Govt. of Tripura	Respective PIU/ Contractor
6	Labour license/ permits for engaging construction workers (skilled & un-skilled)	Respective District Level Labour Officer under Directorate of Labour, Govt. of Tripura	Respective PIU/ Contractor

3.0 DESCRIPTION OF THE PROJECT

3.1 Dukli Industrial Estate

48. The Dukli Industrial Estate was established in the year 1982, situated in the Dukli block of West Tripura district. The Latitude and Longitude of the Dukli industrial estate is 23°46'54.11"N and 23°46'54.11"N. respectively.

49. Dukli is spread over an area of 16.30 ha and at present has 23 industrial units mainly belonging to medium and small enterprises. The salient features of Dukli Industrial estate are given in **Table 3-1**. The key map/ aerial view and regional connectivity is given in **Figures 3-1**.

Table 3-1: Salient Features of Dukli Industrial Estate

Particulars	Features
Location	Dukli, established in 1982, West Tripura district. Latitude - 23°46'54.11"N Longitude 23°46'54.11"N.
Total Area of Industrial Estate	16.30 hectares/40.27 acre (As per Revenue Records).
Ownership	Tripura Industrial Development Corporation Limited (TIDCL).
Topography	Undulating terrain
Connectivity	0.5 Km (NH 208 A)
	2.5 km (Dukli Railway Station)
	12 Km Agartala Integrated Check Post (ICP)
Major Industries	Bamboo Based Industries, Food & Beverage and Miscellaneous industries.
Area available for future development (Vacant Land)	7.57 ha
Existing and Associated facilities as per ADB, SPS 2009	"The Associated Facilities" are given in section 3.2 (and detail ref- Appendix-6)
Existing (Proposed to enhance the existing facilities and development of new Infrastructure)	Development of <ol style="list-style-type: none">1. Industrial area2. Transportation3. Common facilities4. Improvement of utilities

3.2 Associated and Existing Facility

50. Dukli IE, established in the year 1982 is spread over an area of 16.30 ha, out of which only 5.69 ha has been allocated for 23 industrial units (1 bamboo unit, 8 food and beverages mill and 14 misc.). The allocated areas for other facilities comprise 0.52 ha for roads, 0.37 ha for common facility/ utility areas, 2.15 ha for open areas and 7.57 ha available for future development (ref. Table 3-2 and 3-4).

51. The viability and existence of the existing 23 industrial units do not depend upon proposed improvement works and neither are these included under the ensuing ADB loan. The existing industrial units are regulated under the Air (Prevention and Control of Pollution) Act, 1981, Water (Prevention and Control of Pollution) Act, 1974 and have the valid CTE and

CTO from the Tripura State Pollution Control Board. 12. It is proposed to 33 KV line from 132 / 33 KV SM Nagar S/s up to Dukli S/s at Dukli Industrial Estate (of length 10 km ref- Appendix-6), which qualify as “associated facility” under the Project. The associated environmental impacts and mitigation measures for proposed to 33 KV line from 132 / 33 KV SM Nagar S/s up to Dukli S/s at Dukli Industrial Estate (of length 10 km ref- Appendix-6) shall be carried out during implementation of the Project. The on-site assessment of the existing infrastructure/ facility like roads, entrance gate, boundary wall, utility buildings like administration office, water supply (existing tube wells) and water distribution pipe network, power cables etc. did not identify any past and present concerns/ outstanding issues with respect to the existing infrastructure/ facilities, which warrant corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

52. An on-site assessment of all the existing infrastructure like roads, entrance gate, boundary wall and other utilities within the IE was undertaken to identify past or present concerns relating to the impact on the environment.

53. The on-site assessment⁴ did not identify any past and present concerns/ outstanding issues with respect to the existing infrastructure/ facilities, which warrant corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

⁴ On-site assessment of the existing infrastructure facilities within the IE was carried out as a pre-cursor to the IEE. The assessment included field inspection and interactions with the owner representative(s) of the industrial units within the IE. The field inspection indicated the industrial estate has no settlement areas, sensitive receptors like educational institutions/ hospitals/ religious structures, surface water bodies, lakes, forest/ ecologically sensitive areas, flood/ inundation/ drainage concerns within its boundary or surrounding 500m peripheral area. The IE does not have common effluent treatment plant (CETP).

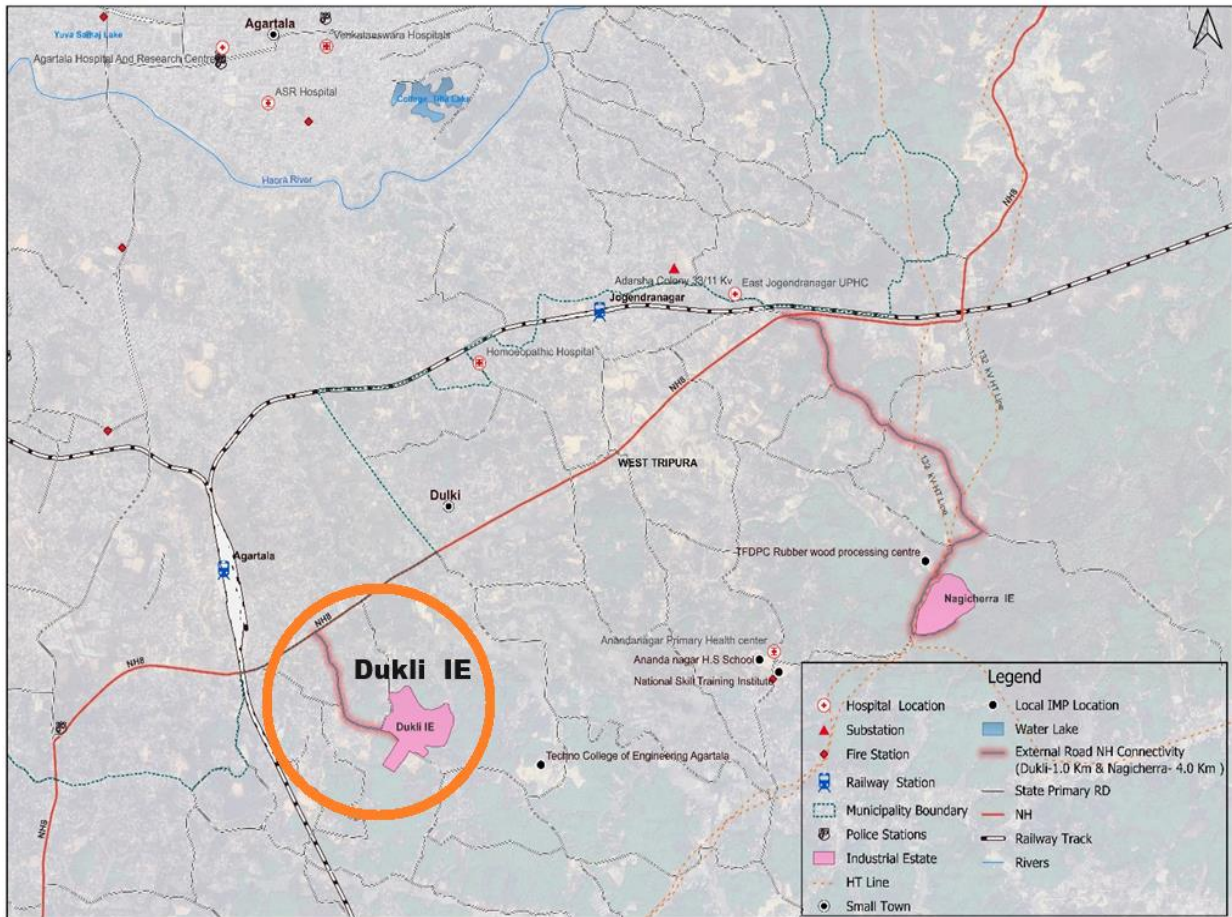


Figure 3-1: Regional Connectivity of Dukli IE

3.3 Existing Industries

54. Currently, there are 23 industrial units in Dukli Industrial Estate occupying an area of 5.69 ha. Out of these, 12 are functional, 5 units are currently closed and the remaining 6 are currently in the process of being established or yet to be set up. The existing industries and the workforce presently reported are given in **Table 3-2**.

Table 3-2: Existing Industries and Workforce within Dukli IE

Sl. No.	Type of Industries	No. of Industries	Land in ha	Workforce
1	Bamboo Based Industries	1	0.182	15
2	Food & Beverage Based Industries	8	1.20	106
3	Miscellaneous Industries	14	4.31	340
	Total	23	5.69	461

3.4 Proposed Development Works

55. Based on the need analysis, the infrastructure works considered within the Dukli IE comprise development of vacant land into 10 additional industrial plots, improvement of internal roads, storm water drainage, augmentation of power system, construction of boundary wall, entrance gates etc. The existing and proposed master plan development along with the

respective land use distribution is shown in **Figure 3-2**. The summary of development components considered within Dukli is given **Table 3-3**.

Table 3-3: Development Components of Dukli IE

Sl. No.	Development Components	Extent
1	Additional industrial plots	10 plots (including Industrial Shed), spread over 4.52 ha
2	Roads	Proposed and widening of 1.307 km existing roads within IE
3	Stormwater drains	2.4 km long stormwater drains along both sides of roads with 7 culverts.
4	Electrical and Power Supply	Augmentation of power system (HT/ LT/ SCADA cables/ OFC), Installation of additional 7 distribution transformers, 4 high mast lights and 10 kw solar panels.
5	Infrastructure and buildings for common and other facilities	A common facilities centre has recently been set up on the estate. Under the present proposal one weighbridge is proposed. Also, renovation/upgradation of 1.15 km of existing boundary wall and construction of 1.71 km of new boundary wall with 5 entrance gates. One plot is earmarked for common facility for future provision
6	Public Transport	Two battery-operated small E- vehicles along with the necessary charging infrastructure have been proposed

3.5 Development of Industrial Plots

56. At present, Dukli IE has got 7.57 ha of vacant land, which is available for the development of industrial plots and other amenities. In accordance with the need analysis, under the present proposal, the masterplan for infrastructure development has considered 4.52 ha of land for development of 10 industrial plots, constitute mere 46.4% area of the vacant land (7.57 ha) Dukli IE (ref. **Table 3-4**).

Table 3-4: Existing and Proposed Land Use for Masterplan Development

Sl. No	Land Use	Existing Area (ha)	In %	Proposed Area (ha)	In %	Net Area (ha)	In %
1	Industrial Area Plotted development, Industrial Sheds	5.69	34.0%	4.52	59.7%	10.21	61.6%
2	Transportation Roads, Junction, parking etc.	0.52	3.2%	0.84	11.1%	1.36	8.3%
3	Facilities Public and Semi-Public: health care centre, educational institutes, weigh bridge and administration etc. Utilities: Internal roads, stormwater drains, HT/LT and SCADA/ OFC, weigh bridge, high mast lights, solar power panels etc.	0.37	2.3%	0.03	0.4%	0.40	2.5%

Sl. No	Land Use	Existing Area (ha)	In %	Proposed Area (ha)	In %	Net Area (ha)	In %
4	Open Space Parks and open areas around it, steep slopes and low-lying lands	2.15	13.2%	2.18	28.8%	4.33	26.6%
5	Vacant Area Developable Area	7.57	46.4%		0.0%		0.0%
	Total	16.30	100%	7.57	100%	16.30	100%

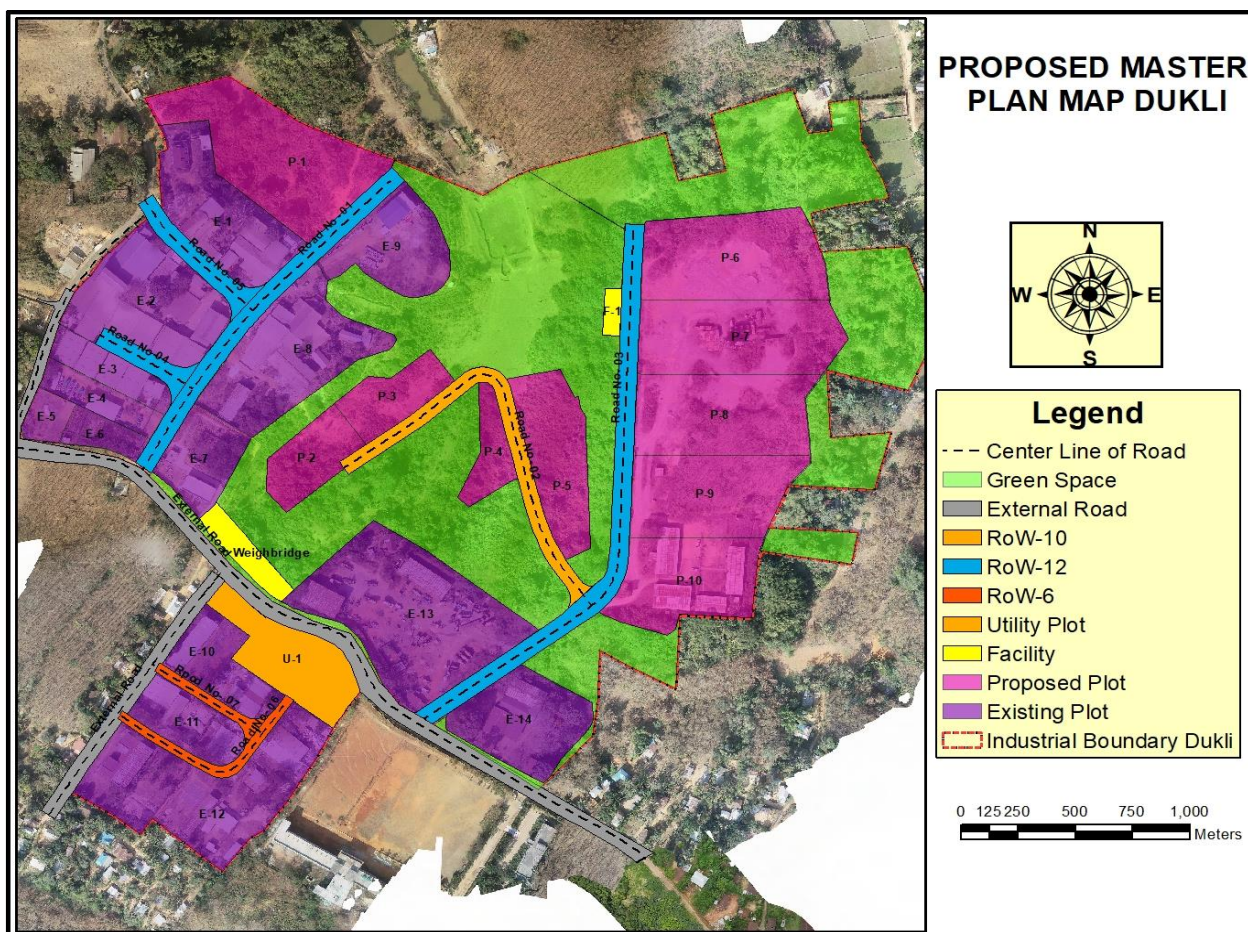


Figure 3-2: Proposed Master Plan Development

3.6 Infrastructure and Common Facilities

57. The existing infrastructure and common facilities, built more than two decades ago will need upgradation/ modification to meet the future needs of the industrial estate. Based on the need analysis, the proposed masterplan development for infrastructure and common facilities is spread over 0.40 ha as given in **Table 3-5** and **Figure 3-3**.

Table 3-5: Infrastructure and Common Facilities

Sl. No.	Type of Facilities	Provisions
1.	Infrastructure and Common Facilities	A common facilities centre has recently been set up in the estate. Under the present proposal one weighbridge is proposed. Also,

	for safety and security	renovation/upgradation of 1.15 km of existing boundary wall and construction of 1.71 km of new boundary wall with 5 entrance gates. One plot is earmarked for common facility for future provision
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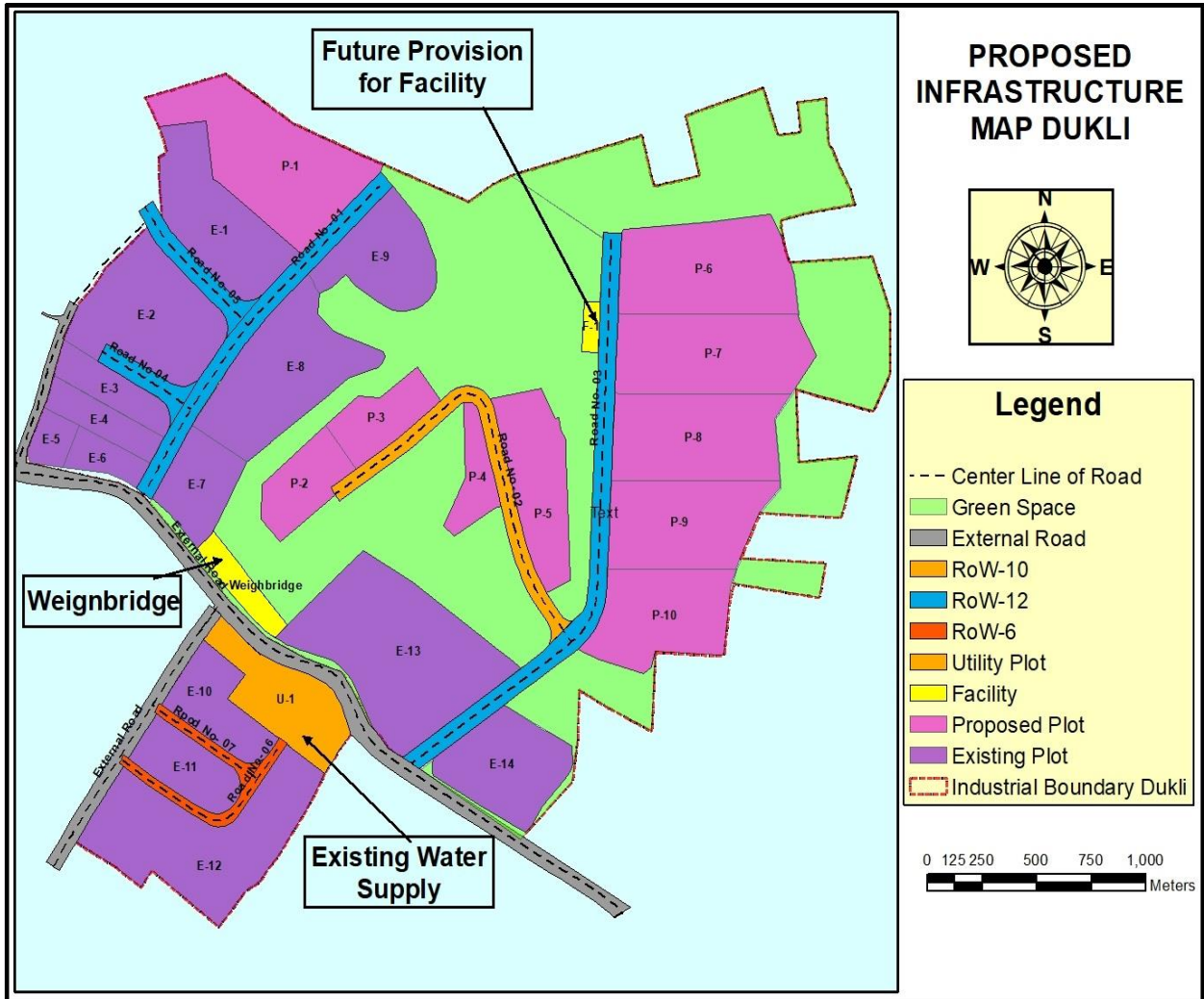


Figure 3-3: Proposed Industrial Plots and other Facilities

3.7 Widening/ Upgradation of Roads

58. Under the proposed development, widening and strengthening of the existing internal roads with a cumulative length of 1.307 km have been considered. All the major and minor intersections/ junctions along the roads are considered for upgradation along with adequate lighting facilities as per the IRC standards. The proposed road network as per the proposed masterplan development along with typical cross sections are given in **Figures 3-4 & 3-5** respectively.

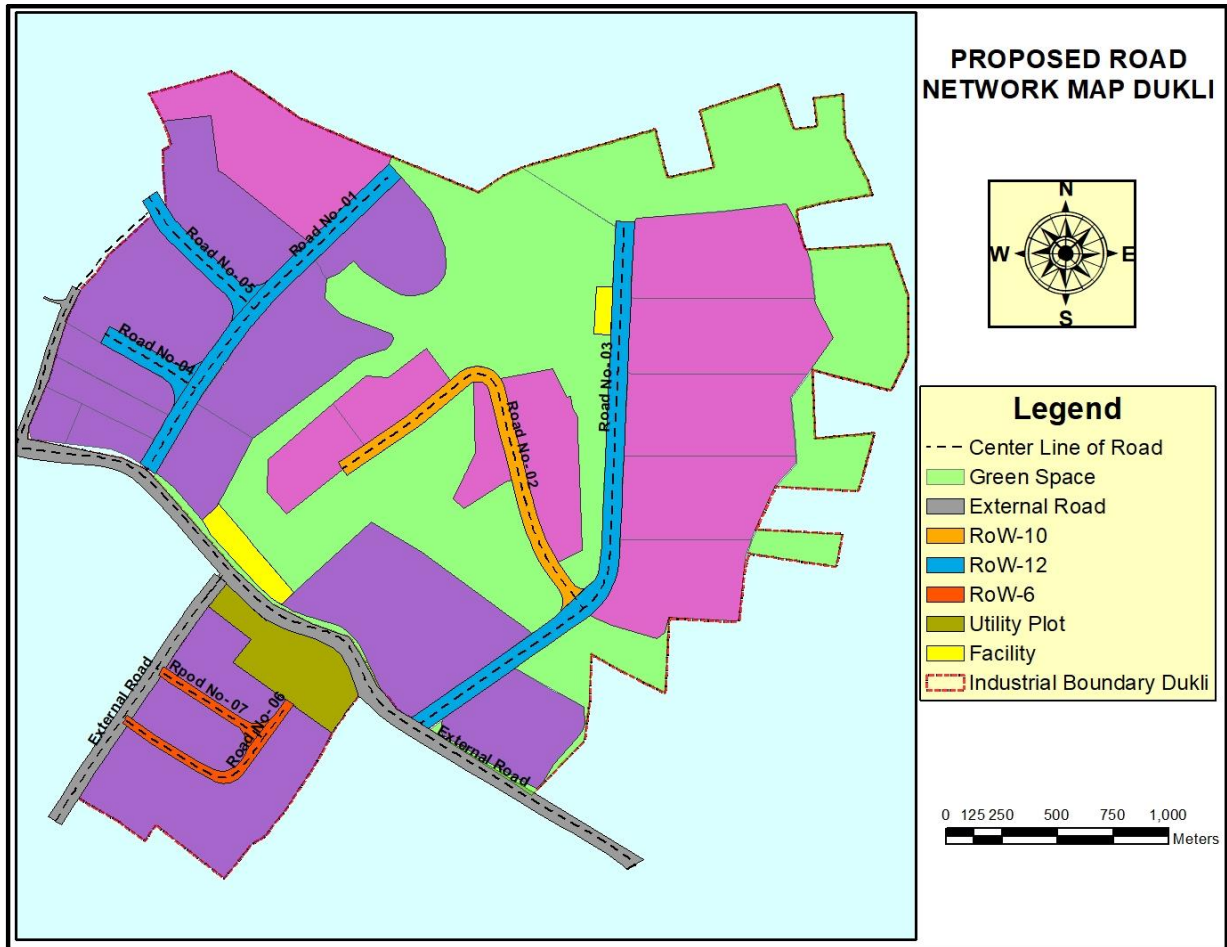
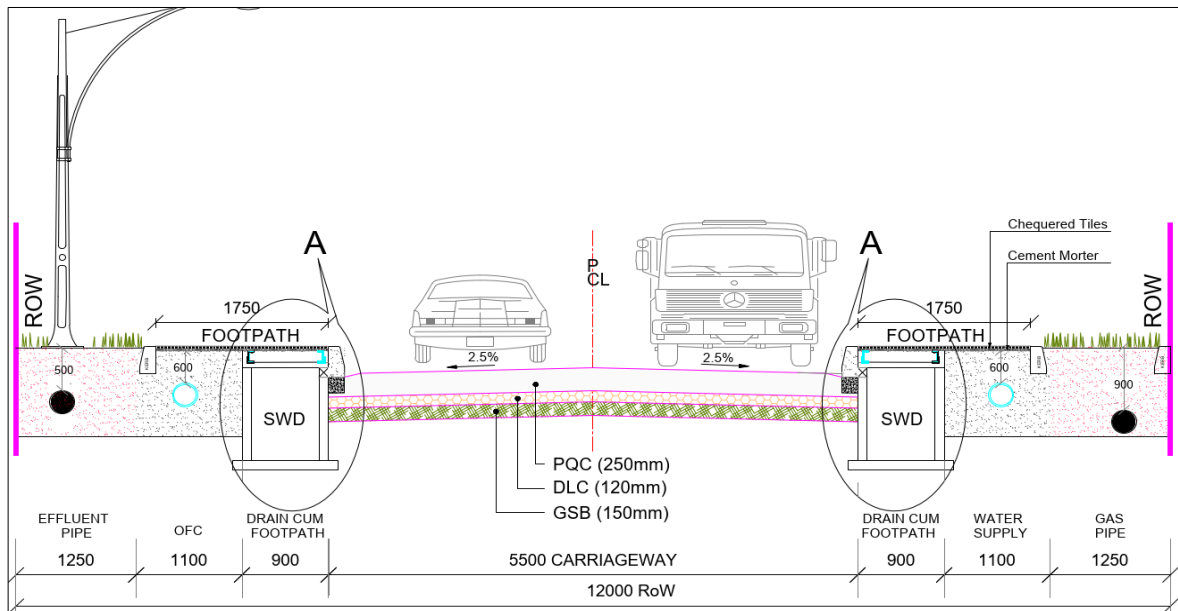
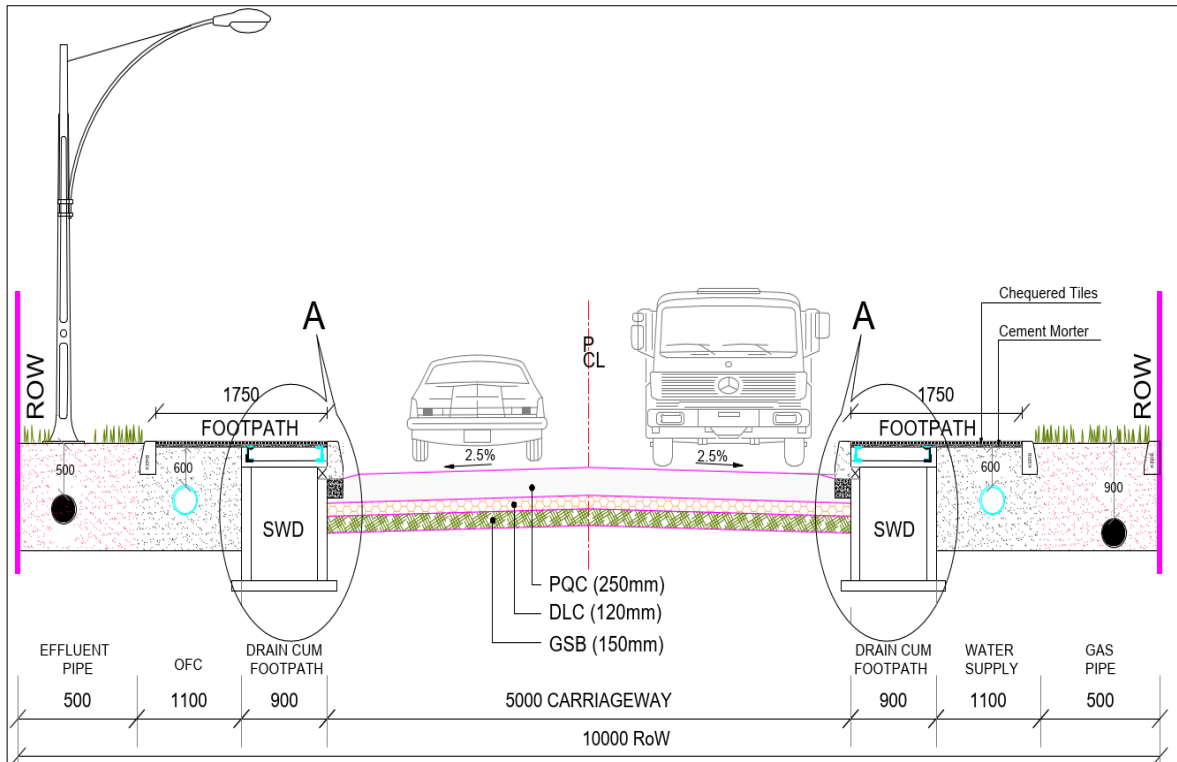


Figure 3-4: Proposed Road Network as per Master Plan Development

Typical Cross Section - Road No. 1, 3, 4 & 5



Typical Cross Section - Road No. 2



Typical Cross Section - Road No. 6 & 7

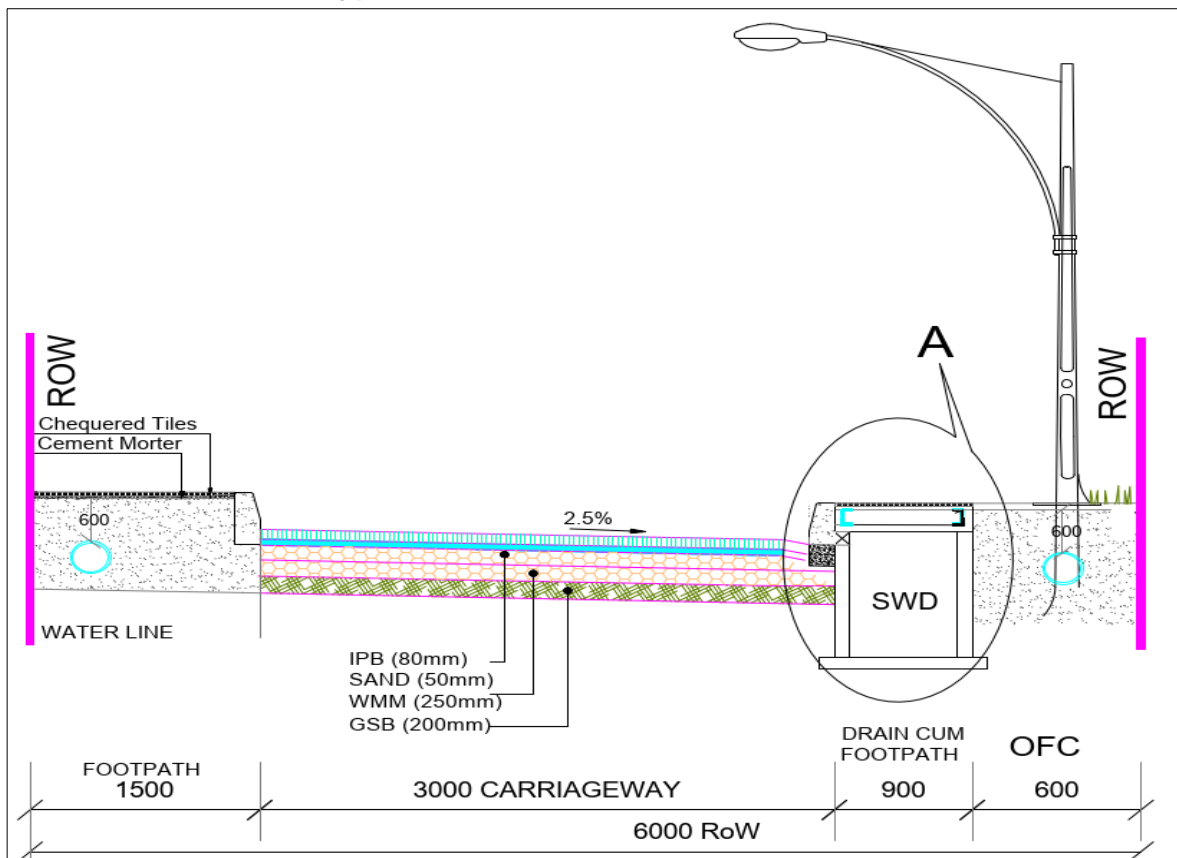


Figure 3-5: Typical Section of Proposed Road Network within Dukli IE

3.8 Augmentation of Water Supply & Treatment

59. The present water supply demand of Dukli IE is met through 1 existing deep tube well⁵ (DTW). The IE also has 1 iron removal plant, 300 KLD capacity overhead tank and 2 km of distribution pipelines. The projected water demand is 0.16 MLD.

60. The proposed improvement works do not consider any augmentation proposal and continue with the present system, which has been assessed to meet both present and projected demand.

3.9 Storm Water Management

61. Dukli IE at present does not have an adequate stormwater collection and disposal system. Therefore, the project design has considered rectangular covered storm water drains along all the roads with a cumulative length of 2.4 km with seven cross drainage structures.

62. The project design has considered a maximum of 24-hour rainfall intensity with 2-year return period for the design of storm water drains to facilitate drainage without overflowing even during the highest rainfall days/months.

3.10 Industrial Wastewater Management

63. Dukli IE is a brownfield site. However, there is no sewage system, sewage treatment plant (STP), effluent treatment plant (ETP) or common effluent treatment plant (CETP). The sewage and sanitary waste from individual buildings/ industries are treated in septic tank-soak pit combine. The septage from septic tanks are collected on bi-annual basis by sewer sucking & jetting trucks operated by (Agartala Municipal Corporation) and transported to their STP for further treatment and disposal.

64. The master plan development does not include any proposal for development of a centralized Industrial wastewater management facility at Dukli IE in the immediate future and continue with the present system.

3.11 Industrial Solid Waste Management System

65. Dukli IE, presently does not have any common facility for collection, treatment and disposal of solid waste generated within the industrial estate. The waste generated from various industrial units are being collected periodically by the waste collection trucks operated by the Agartala Municipal Corporation (AMC) and transported to their solid waste management facility for further treatment and disposal.

66. The master plan development does not include any proposal for development of a centralized integrated solid waste management facility at Dukli IE in the immediate future and continue with the present system.

67. The DoIC, through TIDCL, has plans to develop a common solid waste management facility for several industrial estates i.e. Dukli IE, R. K Nagar IE, Bodhjungnagar IE, AD Nagar, Nagicherra IE and Other IE at a suitable location in the next phase of development.

3.12 Electrical and Power Supply System

⁵ The surrounding region including the Dukli IE does not have dependable perineal surface water bodies and hence, ground water is the only source of water.

68. The Dukli IE is partially electrified, which is only in the developed area. The total installed capacity of DTrs is 2,056 KVA ~ 2 MVA. The 11kV network is on MS tubular/PCC Pole with ACSR Weasel conductor which is around 1 km. This conductor is old and worn out. There is LT Line Network inside the IE on Overhead conductors with configuration 3-ph 5 Wire, composite with 11 KV line. The streetlights are mounted over pole by clamp/cap fixed long arm bracket on composite line and on LT feeders.

69. The total electrical load of each load center is estimated as connected load. The estimation of the load is calculated for the next 10 years. The load projection has come up as 4.3 MVA.

70. It is proposed to lay a new 33kV Feeder from 66/33kV Badharghat S/s (which has spare 33kV bay complete with breaker and panel. The new 33kV line is proposed on 11m MS Tubular Poles with covered Dog Conductor for a route length of 5.0 Kms and it is also proposed 33/11 KV S/s at the entry gate of Dukli S/s, with 1x5 MVA, 33/11kV Power Transformer installed.

71. New 11 KV Feeders are proposed from 33/11kV Substation to various load centers inside IE. It shall be extended for road route length of 2.2 Kms. There are 7 Nos. additional DTrs of various capacity proposed for installation on 11kV Feeders. It is proposed to lay LT Feeders on all the road routes of IE along with a composite 11 KV Line. This would mean extension of new LT Network of around 2.2 Kms. LED streetlight shall be considered for illumination of the park estate including poles, lights, networking, transformers, and cables. A high mast is also proposed for installation inside IE.

72. The Dukli IE is partially electrified, only in the developed area. The existing installed DTrs are as given below:

- 500 KVA - 2 Nos.
- 315 KVA - 2 Nos
- 200 KVA - 1 No.
- 100 KVA - 1 No.
- 63 KVA - 2 Nos

73. **Streetlights and High Masts:** The streetlights are mounted over pole by clamp fixed or cap fixed long arm bracket on composite line and on LT feeders. There is no separate circuit for Street Light. There are no proper streetlights or area lighting that industry can arrange night shifting for working women. Under the present development, 75 streetlights, 6 nos. gate lights and 6 high masts are proposed.

74. The single line diagram (SLD) of Dukli from 66/33 KV & 132/11 KV Badharghat Substation is given in **Figure 3-6**.

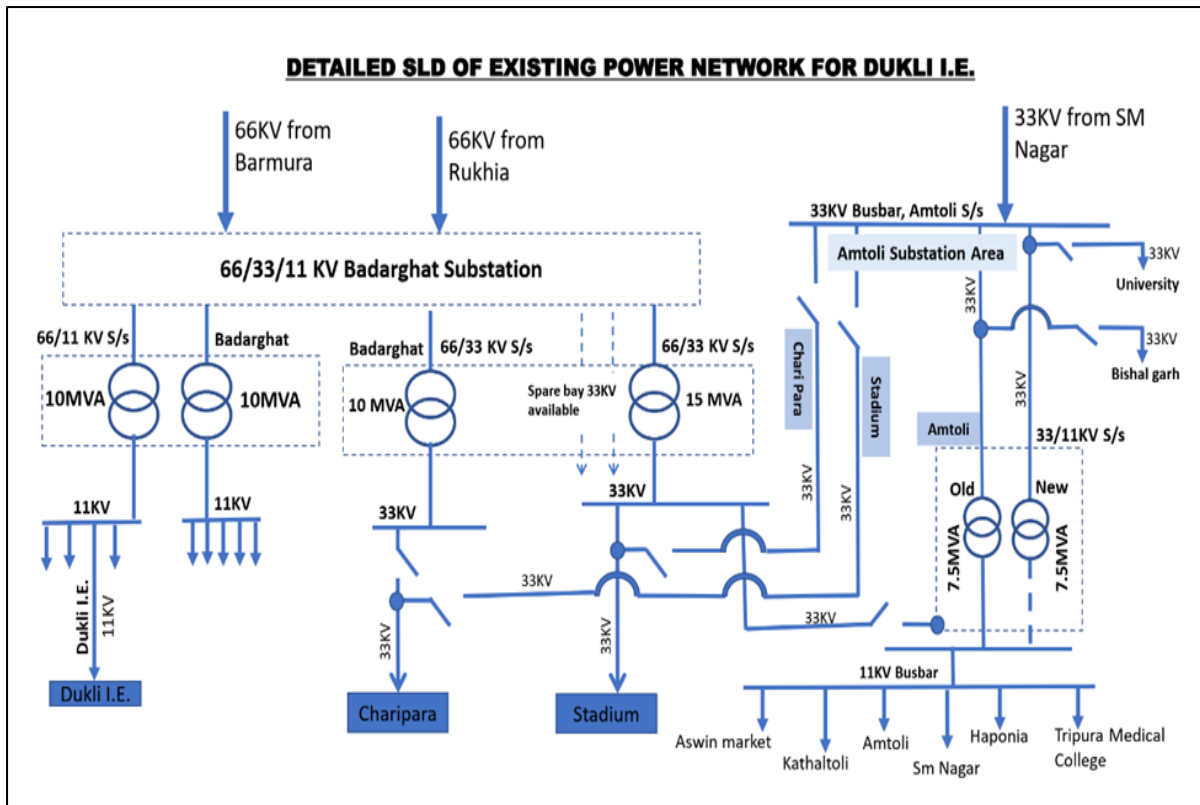


Figure 3-6: SLD of Dukli from 66/33/11 KV Badharghat substation.

3.13 Industrial Safety and Security

75. Safety and security provision are of utmost importance in an industrial estate to ensure safety of people, property, prevent theft and damage, early fire/threat detection, and quick response in case of emergencies.

76. Presently, safety and security infrastructure within Dukli IE is very limited with peripheral boundary wall (with barb wire fencing) which is dilapidated condition at many places and the entry gates are without any boom barriers.

77. In line with DoIC's envision to develop Dukli IE with the "Best in Class" infrastructure, project design considers providing most modern industrial safety and security infrastructure with provisions of 5 entry gates, a new boundary wall of 1.71 km long and 3 m height (2.4 wall and 0.6 concertina coil and barbed wire) and upgradation is 1.15 km long along with provision of concertina atop the walls is proposed to secure perimeter of Industrial estate.

78. Typical arrangements of the entrance gate, peripheral boundary wall with provision of concertina is given in **Figure 3-7**.

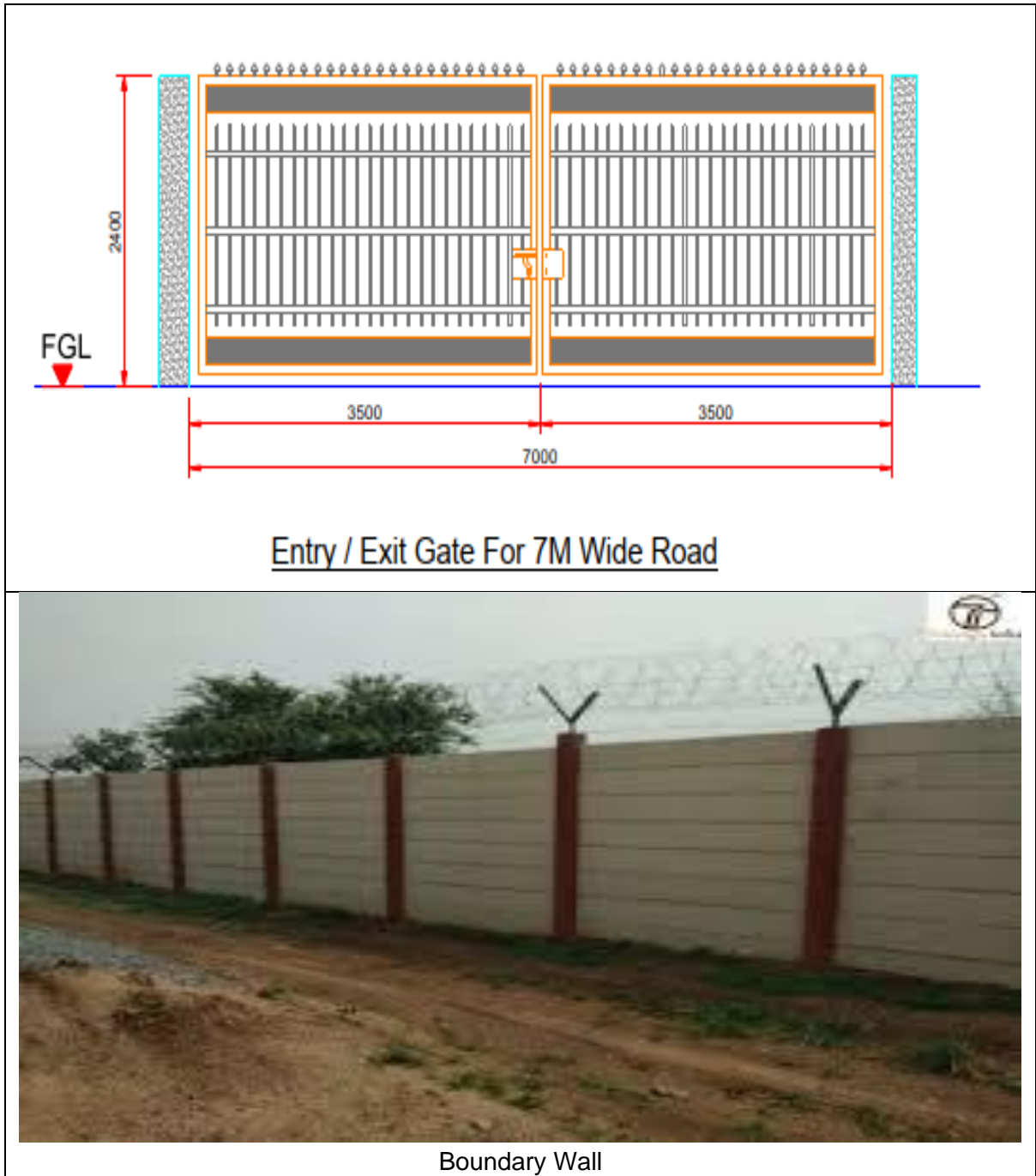


Figure 3-7: Provision for Safety and Security for Dukli IE

3.14 Solar Power Generation

79. As a green initiative and concern for reducing the carbon footprint, 1 module of ground mounted solar power generation unit with a cumulative capacity of 10 KW is proposed within the IE as given in **Table 3-6**.

Table 3-6: Proposed Solar Power Generation in Dukli IE

SI. No.	Location within IE	Capacity (Kw)	No. of Solar Modules	Total Capacity (KW)	Area Required (Sqm)
1	Proposed Utility Plot	10 KW	1	10	100
	Total	10 KW	1	10 KW	100

3.15 Public Transport

80. It is proposed to deploy two battery-operated small e-vehicles, along with the necessary charging infrastructure to improve internal mobility within the IE, which is eco-friendly and non-polluting. These vehicles offer a convenient and comfortable mode of transport for workers and visitors, reducing the physical strain of walking long distances. The e-vehicles can significantly cut down travel time from the main gate to individual workplaces within IE, thereby improving overall productivity and inclusive industrial environment. Being eco-friendly, these vehicles produce zero emissions, contributing to a cleaner environment within IE. The e-vehicles are designed to be accessible for people with disabilities and ensure inclusivity within IE.

3.16 Construction Workforce Requirement

81. The infrastructure development at Dukli will require an estimated 113 construction workforce at all levels. It is anticipated that nearly 70-75% of skilled and unskilled labour are likely to be migrant workers from other states and the rest are likely to be sourced from nearby villages and settlements areas (ref. **Table 3-7**).

Table 3-7: Estimated Construction Workers requirement at Dukli IE

Sl. No.	Labour/Staff Type/Designation	Manpower Involvement		Totals
		Civil Infra Works (Roads, SWD, Industrial shed, Industrial Safety and Security)	Electrical and Mechanical Works	
1	Project Manager	1	1	2
2	Deputy Project Manager	1	1	2
3	Section Engineer	1	1	2
4	Junior Engineer	2	2	4
5	Subcontractor	3	2	5
6	Skilled Labour	11	5	16
7	Unskilled Labour	69	13	82
	Total	88	25	113

3.17 Campsite and Workforce Camp Establishment

82. During the pre-construction stage, contractors will be required to establish workforce camp to accommodate all the migrant workforce, deployed for the construction works. Similarly, campsite establishments like hot-mix plants, concrete batch plants, crushers, wet mix macadam are also to be established by the contractor.

83. Both campsite and workforce camps will be established in the vacant plots within the boundary of IE with all the amenities like water, sanitation, medical facilities etc. (ref. Table 9-1 to 9-3 of EMP for more details).

3.18 Construction Material Requirement

84. The estimated construction material requirement of Dukli IE development as per the project design is given in **Table 3-8**.

Table 3-8: Estimated Construction Material Requirement at Dukli IE

Sl. No.	Item	Quantity	Unit
1	Excavated Earth	9577.8	cum
2	Backfilled Earth	6402.98	cum
3	Excess Earth	3174.83	cum

Sl. No.	Item	Quantity	Unit
4	Stone Aggregate	5056.05	cum
5	Sand	3679.85	cum
6	Cement	3395.16	cum
7	Steel	135437.91	ton
8	Shuttering	6365.94	sqm
9	Bricks	238,690	Nos.

3.19 Implementation Schedule

85. The construction works related to infrastructure development of Dukli IE is anticipated to be implemented in 36 months, including monsoon season, commencing from April 2025. The total implementation period including defect liability period (DLP) and the operation and maintenance phase would be till March 2032.

86. The infrastructure development works will be executed through the various state government departments having the domain expertise for components like roads, stormwater drains along with culverts, water, electrical works, others infrastructure. These state government departments will function as the respective project implementing units (PIUs) with a dedicated team and will be headed by the designated executive engineers (EE)/superintending engineers (SE) of the respective departments.

87. The DoIC will establish a PMU, comprising several domain experts and head by a Project Director. The DoIC will also appoint a project management and supervision consultant (PMSC), who will be responsible for the project management and work supervision at the field levels of all the prioritized industrial estates (including Dukli). The PMSC shall comprise several domain experts and headed by a team leader and reporting PMU (ref. Section 9.4 for implementation arrangements including environmental safeguards management).

4.0 DESCRIPTION OF THE ENVIRONMENT

4.1 General

88. The baseline environment of the core and buffer zones surrounding the Dukli IE is given in this section. The core zone considers the entire area within the Dukli IE as well as a 500-metre-wide strip all along its peripheral boundary. The core zone can be vulnerable to various construction activities during the project implementation phase. The West Tripura district has been considered as a buffer zone for assessment of the baseline environmental conditions prevailing in the region surrounding the Dukli IE.

89. The baseline information on various environmental attributes for both core and buffer zones has been collected through field surveys and supplemented by secondary data sourced from authentic and verifiable sources given in **Table 4-1**.

Table 4-1: Data Sources for Assessment of Baseline Environment

Environmental Attribute	Source of data / Information	Date and Year of the Data
Climate/Weather Parameters like Temperature, rainfall, wind speed and other similar climatological parameters	IMD (Indian Metrological Department), Agartala and New Delhi	Last 4 years data between 2018-2022
Soil & Geology	Central Ground Water Authority, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India	Aquifer Mapping and Management Plan of West Tripura District, 2017-18 published by the Central Ground Water Authority, North-Eastern Region, Guwahati.
Landslide locations/Slope stability	Primary investigations and field surveys	Primary investigations during 2022-23.
Drainage/ Flooding	Satellite Imagery/ Toposheet /Hydrology study/State Water Resource Department. Ground truth verification by Physical inspections of the IE.	Aquifer Mapping and Management Plan of West Tripura District, 2017-18 published by the Central Ground Water Authority, North-Eastern Region, Guwahati. Primary investigations during 2022-23.
Surface Water Bodies, Surface water quality and Ground water Quality	Topography sheets/field study. Hydrological data from the CGWB Reports followed by ground truth verification by Physical inspections of the project road. Also, Monitoring of the surface and ground water quality along the project road	Aquifer Mapping and Management Plan of West Tripura District, 2017-18 published by the Central Ground Water Authority, North-Eastern Region, Guwahati. Monitoring of the surface and ground water quality through NABL Accredited Laboratory during 2023.
Ambient Air Quality and Ambient Noise levels, surface water quality, soil quality	Monitoring of the ambient air quality and ambient noise level measurements along the project road was carried out.	Monitoring of the surface and ground water quality through NABL Accredited Laboratory during 2023.
Forest/Protected Areas, Endangered Plant and Animal, Ecological Sensitive	Department of Forest, Govt. of Tripura, Consultations with DFOs, Forest Range Officers	Forest area as of 2022-23, published by Tripura Forest Department and Primary investigations/ ecological assessment of

Environmental Attribute	Source of data / Information	Date and Year of the Data
Area, Wildlife Corridors /Migratory routes	of forest department and with local community.	the core and buffer zones during May-September 2023.
Trees and Vegetation Cover	Department of Forest, Govt. of Tripura, Consultations with DFOs, Forest Range Officers of forest department and with local community.	Primary investigations/ ecological assessment of the core and buffer zones during May-September 2023.
Cultural / Heritage and Ancient Structures.	Consultations with Archaeological Survey of India and Designated State Archaeological Officer under Education Department, Tripura and web-based data search.	Archaeological Survey of India and web-based data search for information on Cultural / Heritage and Ancient Structures within the core zone. Primary investigation of the core zone during May-September 2023.

4.2 Physical Resources

4.2.1 Geology

90. Geologically, both core and buffer zones are occupied by upper tertiary within the Dupitila group and formation consisting of earthy brown to buff sandy clay, mottled clay, clayey sandstone and coarse to gritty ferruginous sandstone overlies the Tipam Formation and are well developed in central portion of the synclinal valleys. These formations occur in the form of disconnected mounds with thickness of this formation varying from 10 – 30m. The core and buffer zones do not have geological reserves of rock/stone aggregates.

91. The geological succession of both core and buffer zones is given in **Table 4-2** and shown in **Figure 4-1**.

Table 4-2: Geological Succession of West Tripura District (Buffer Zone)

Age	Group	Formation	Lithology
Quaternary	Recent	Recent	Alluvium, represented by unconsolidated pale to dirty gray, silt, sand, clay, silty clay, sandy clay etc. and yellowish-brown coarse river sand, gravels & concretions.
			----- UNCONFORMITY-----
Upper Tertiary	Dupitila	Dupitila	Brown to buff sandy clay with grayish sandy loam, clayey sandstone with ferruginous materials & laterites.
	----- UNCONFORMITY-----		
	Tipam	Champaknagar Manubazar	Massive medium to coarse sandstone with sandy shale. Fairly bedded fine to medium sub-arkosic sandstone with sandy shale and siltstone.
	----- UNCONFORMITY-----		
	Surma	Bokabil Bhuban	Thinly laminated, bedded sandstone and silt (repetition) with ferruginous material, medium to coarse micaceous sandstone with mudstone. Intruded, hard compact, both massive & well-bedded sandstone, dark to olive shale repeated.

Source: CGWB, Ministry of Water Resources, Gol

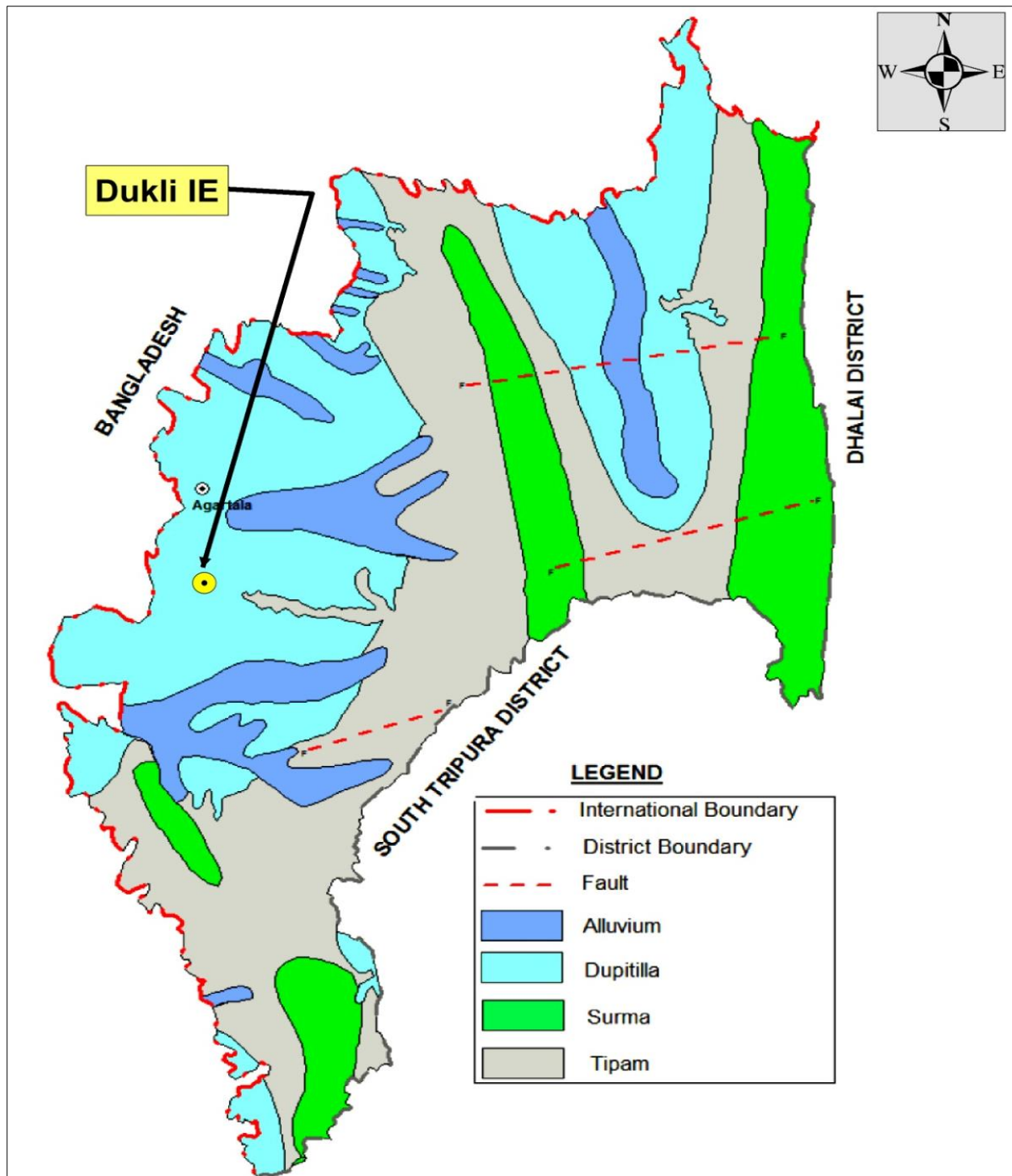


Figure 4-1: Geological Map of West Tripura District (Buffer Zone)

(Source: - Central Ground Water Board, Government of India Ministry of Water Resources)

4.2.2 Hydrogeology

92. Hydrogeological formations within the buffer zone i.e. West Tripura district largely comprising of Dupitilla, Tipam and Surma Formations of Upper Tertiary age and are considered as a single hydrogeological unit. The estimation of the ground water resources within the buffer zone i.e. West Tripura district carried out by the Central Ground Water Authority (CGWA) has indicated availability of adequate groundwater resources and suitable for deep tube well with discharges ranging between 100 to 150 cum. per hour within a drawdown of 15 meters.

93. The assessment has indicated that the entire buffer zone i.e. West Tripura district is under the safe category and therefore no area or block within the buffer zone has been notified for restricted groundwater development by Central Ground Water Authority (CGWA). The assessment also indicates that there is no saline/ brackish water aquifer or any other poor ground water quality in the region, except for the presence of the iron. The concentration of the iron in the groundwater exceeds the prescribed desirable and maximum permissible limit of 0.3 and 1 mg/l.

94. The ground water resources and iron levels within the buffer zone i.e. West Tripura district are shown in **Figures 4-2 & 4-3**.

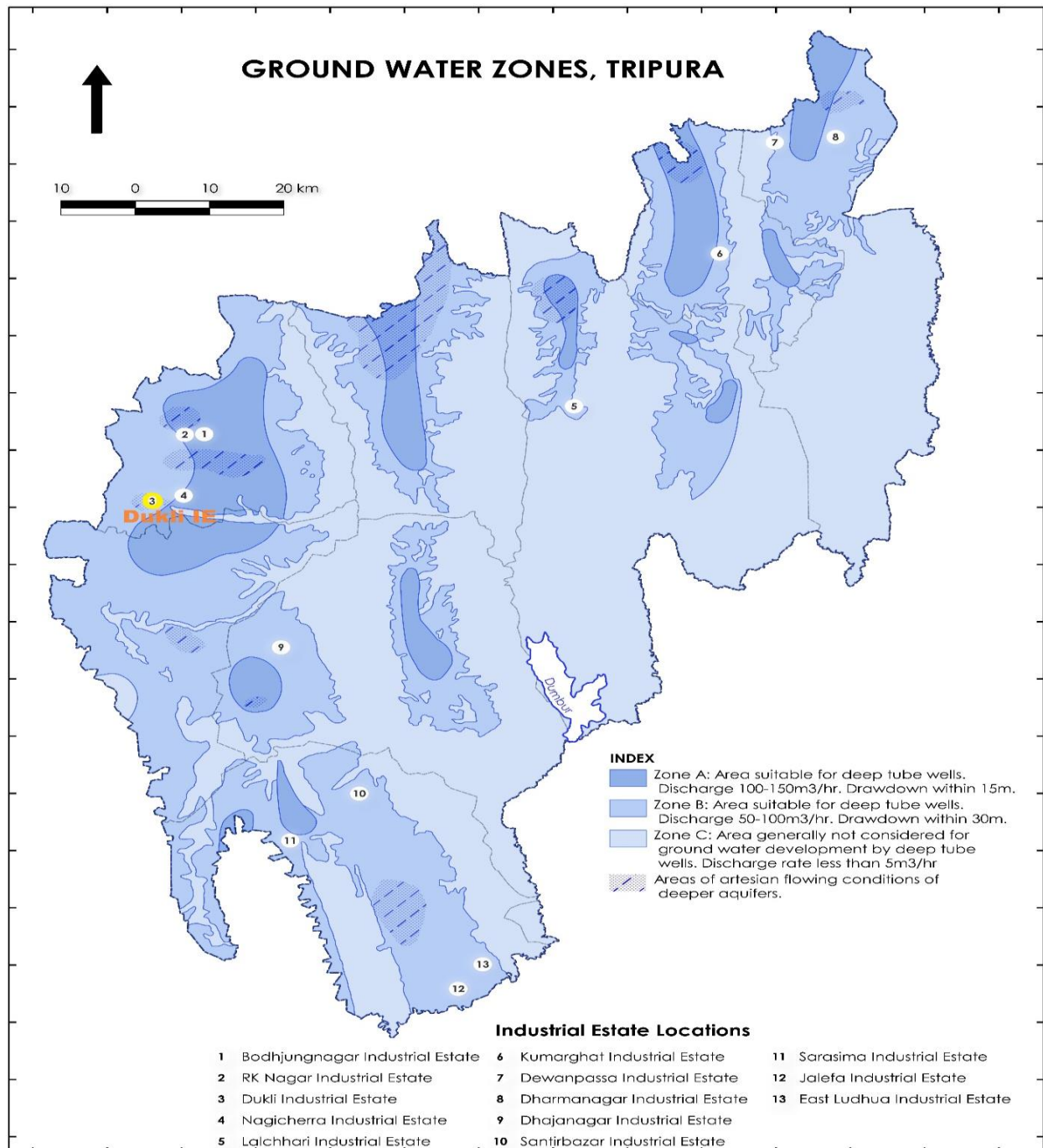


Figure 4-2: Ground Water Resources of Tripura Map

(Source: - Central Ground Water Board, Government of India Ministry of Water Resources)

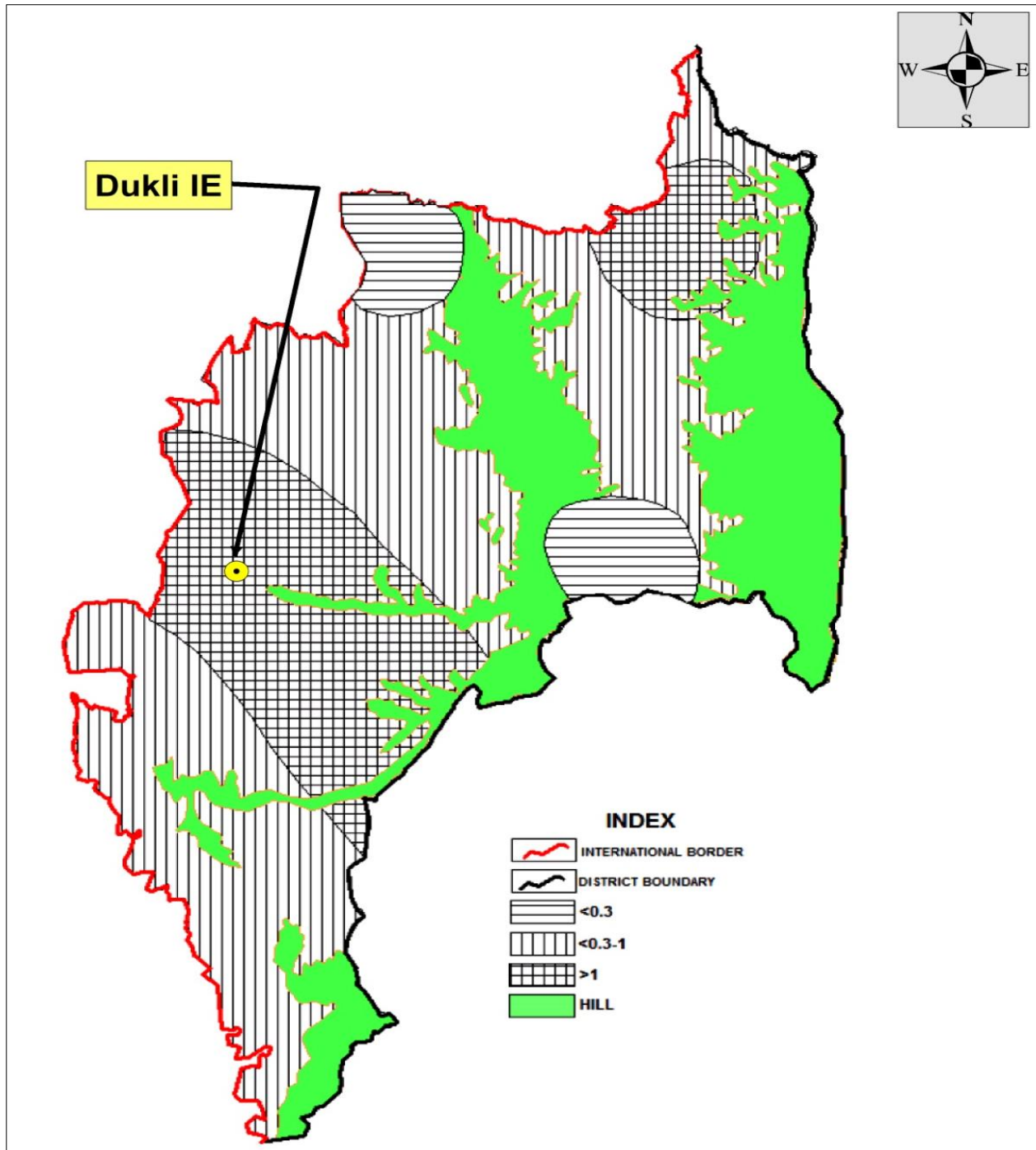


Figure 4-3: Distribution of Iron within West Tripura District (Buffer Zone)

(Source: - Central Ground Water Board, Government of India Ministry of Water Resources)

4.2.3 Physiography

95. Physiography of buffer zone i.e. West Tripura district can be divided into two parts i.e. Anticlinal Hill Ranges and Synclinal flat-bottomed valleys.

96. The core zone, which includes Dukli IE falls within the Agartala – Sonamura valley (or simply Agartala valley) of the synclinal flat-bottomed valleys. The master slope of the Agartala valley is generally towards west and gradually undulates with intermittent flood plains of small rivulets and streams. The undulations typically range between 10 – 30 m high mounds, with gullies in between them are locally called as “loonga”.

4.2.4 Hydrology and Drainage

97. Tripura state is drained by 9 rivers and falls within the Barak, Gomti and Fenny sub-basins of Meghna River basin (ref. **Table 4-3**).

98. The core zone, which includes Dukli IE falls within the Khowai river catchment under Barak sub-basin, which has a predominantly dendritic drainage pattern with first order followed by second order drains/streams. Most of these streams remain dry or carry meagre discharge during most of the year and none of them are prone to floods even during the monsoon season or heavy rainfall years.

99. The core and buffer zones do not have any major surface water bodies and/or wetlands (ref. **Figure 4-4 & 4-5**).

Table 4-3: Rivers of Tripura and its Catchment Area

Sl. No.	Rivers	Catchment Area (sq. km)	Up to
1	Gumti	2400	Sonamura
2	Manu	2278	Kailashahar
3	Deo	908	Kumarghat
4	Juri	482	Dharmanagar
5	Dhalai	630	Kawalpur
6	Khowai	1328	Khowai Town
7	Haora	488	Agartala
8	Buriganga	414	Bisalgarh
9	Muhuri	1014	Belonia

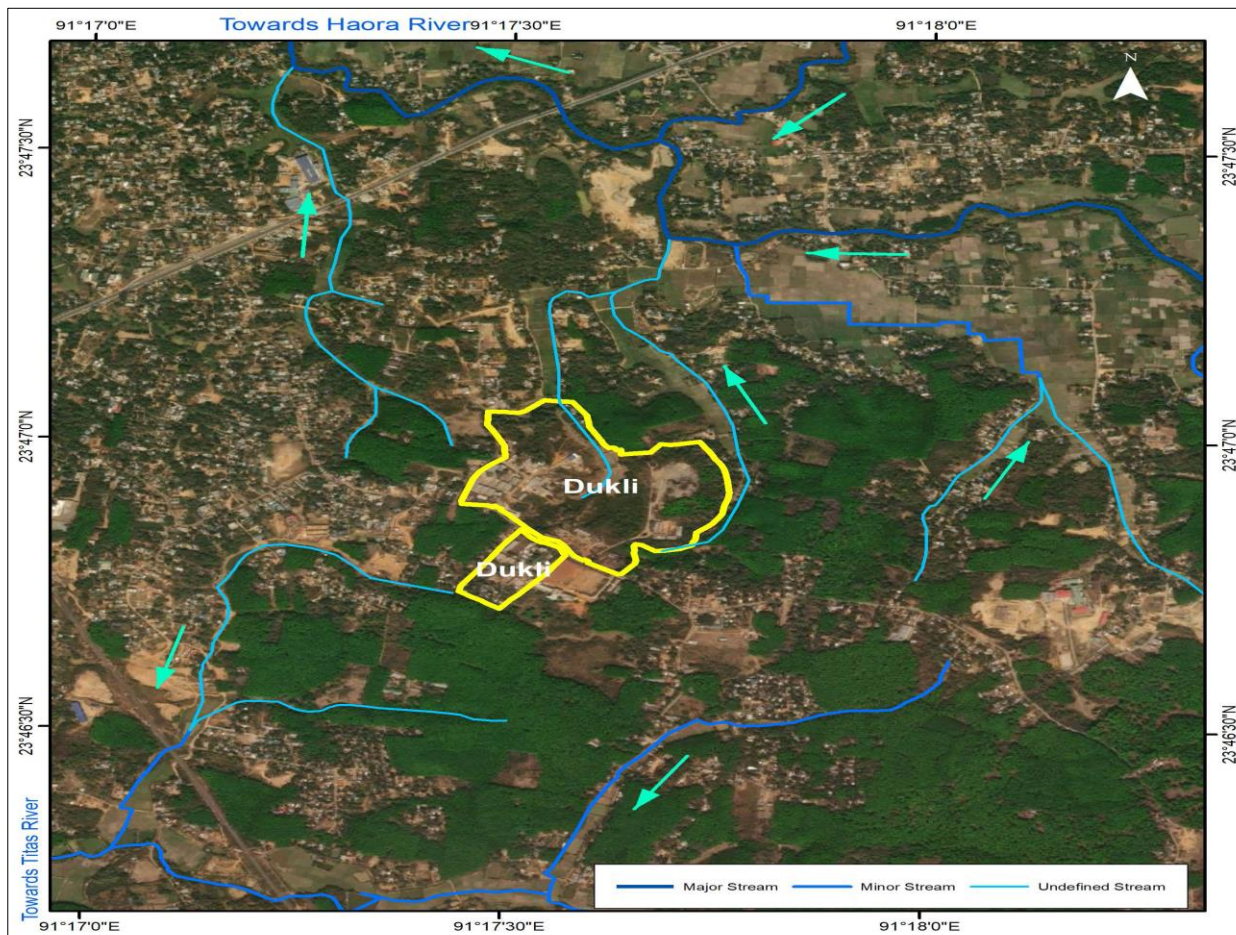


Figure 4-4: Drainage Pattern surrounding Dukli IE (Core Zone)

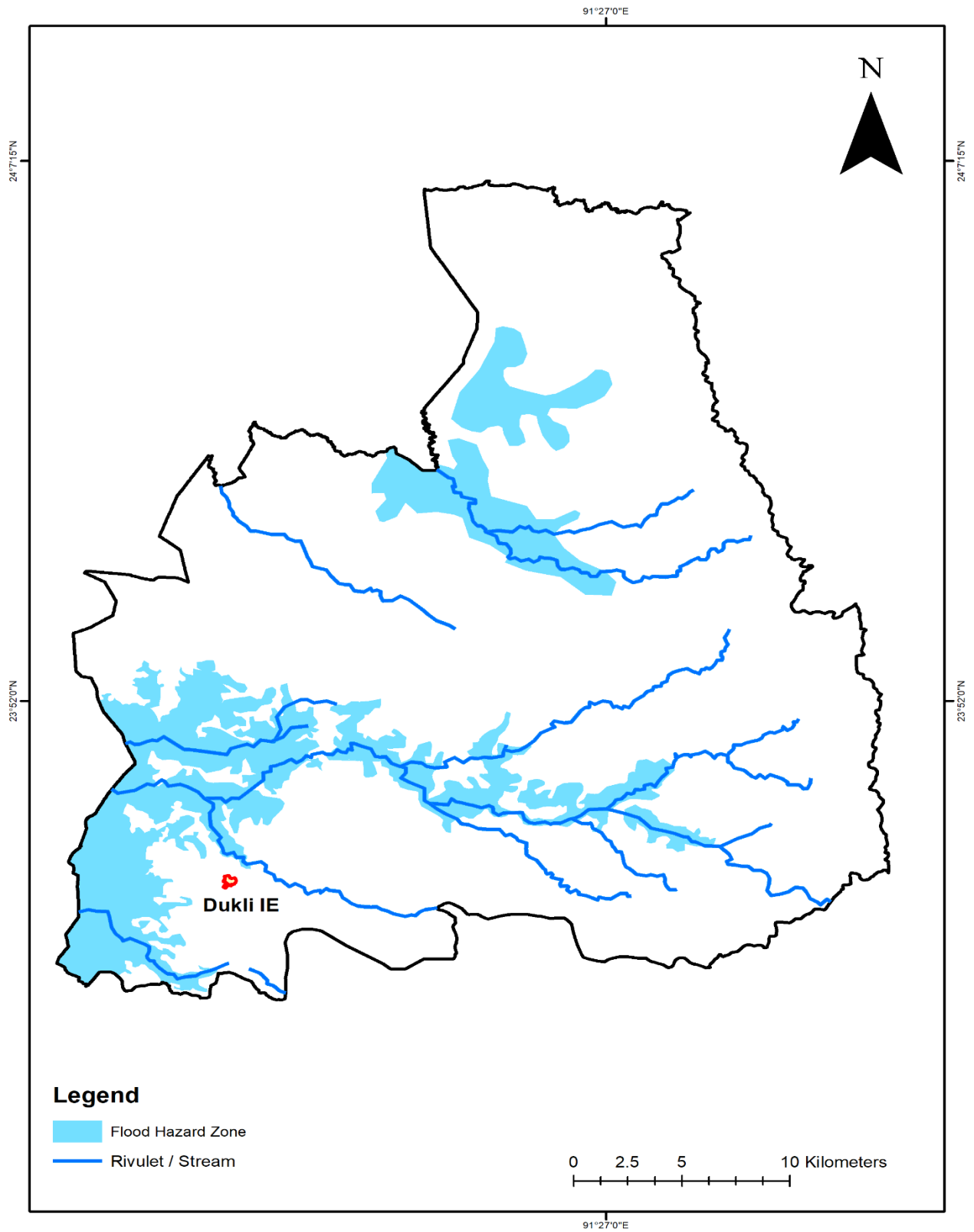


Figure 4-5: Drainage and Flood Prone Map of West Tripura District (Buffer Zone)

(Source: - Water Resources Department, Govt. of Tripura)

4.2.5 Topography and Elevation

100. The elevation of buffer zone i.e. West Tripura District ranges between 4 to 468 meters above mean sea level (MSL), whereas the elevation of the core zone i.e. Dukli IE and

peripheral areas up to 500m range between 31 to 51 meters above MSL. Since, the elevation within the Dukli IE is at a relatively higher level as compared to the surrounding region. Consequently, core zones including Dukli IE are not prone to submergence and/ or floods even during heavy rainfall days (ref. **Figure 4-6**).

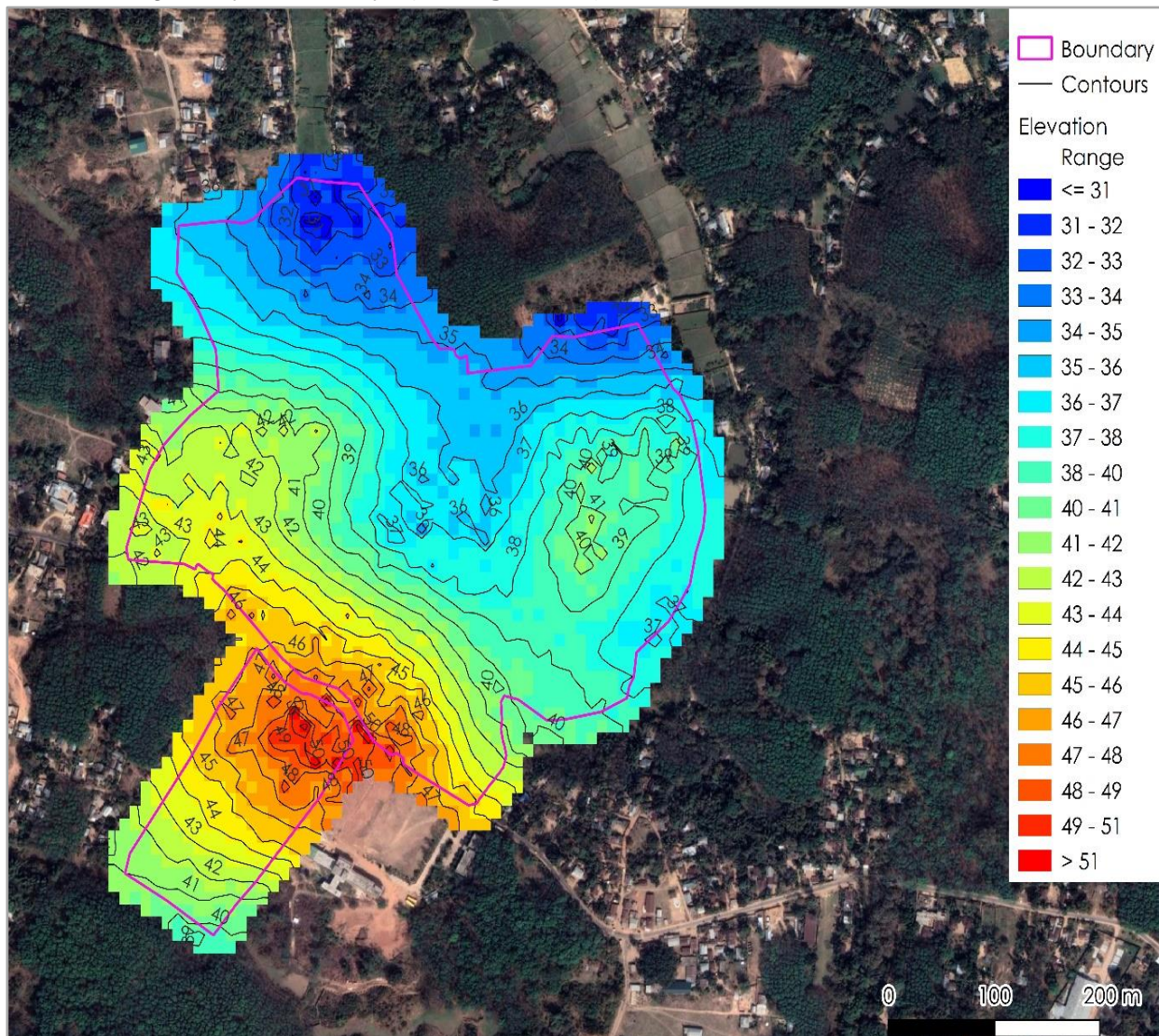


Figure 4-6: Elevation Profile of Dukli IE (Core Zone)

4.2.6 Geo-morphology and Soils

101. The soil types found within the core and buffer zones are predominantly red loamy, red & yellow, light & red earth (Haplustralfs, Paleustults, Rhodustalfs, Ocraquults, Rhodustults, Haplustults). These soil types are generally acidic in nature with pH ranging between 5.5 to 5.75 and deficient in nutrients like nitrogen, phosphate calcium, magnesium and sulfur, whereas available potash levels are medium to high.

102. The pH value of soil can be increased by applying calcium oxide or calcium carbonate which in turn increases the availability of nitrogen, phosphorus, calcium and magnesium in acidic soils and thus enables increased production of crops. Since the iron content in groundwater within the core and buffer zones is high, it inhibits the growth and decreases production of crops when used for irrigation.

4.2.7 Land Use

103. The land use land cover (LULC) map of buffer zone prepared using standard land use classification system followed by National Remote Sensing Centre (NRSC) is given in **Table 4-4**. Further, the land use/ land cover data was subjected to broad ground truth verification during August-September 2023.

Table 4-4: LULC of West Tripura District (Buffer Zone)

Sl. No.	Particulars	Area (ha.)	
		Dukli Block	West Tripura District
1	Geographical Area	19597	299681
2	Area under Forest	557	114580
3	Land not available for Agricultural use:		
4	Land put to non-agri cultural use	14164	66115
5	Barren uncultivable Land	228	1406
6	Permanent Pasture & other Grazing Land	0	196
7	Land under Misc. Tree crops & Groves (Not included in Net Sown Area)	387	2008
8	Cultivable Waste Land	95	697
9	Fallow Land other than Current Fallow	36	367
10	Current Fallow	58	371
11	Total Cropped Area	7867	211838
12	Total Cultivable Area	4623	114969
13	Cropping Intensity	194	190
	Total Area	27652	398157

104. The present land use of the core zone, particularly within the Dukli IE, spread over an area of 16.30 ha is given in **Table 4-5**, which shows that 7.57 ha is presently vacant and available for development of the plots and other infrastructure. The existing land use map of the core zone showing the Dukli IE is given in **Figure 4-7**.

Table 4-5: Existing Land Use within Dukli IE (Core Zone)

Sl. No	Land Use	Existing Area (ha)	In %
1	Industrial Area Plotted development, Industrial Sheds	5.69	34.0%
2	Transportation Roads, Junction, parking etc.	0.52	3.2%
3	Facilities Public and Semi-Public: health care centre, educational institutes, weigh bridge and administration etc. Utilities: Electric sub-Station, Pumping Stations, Underground Reservoirs / Fire Fighting Tanks and other utilities, etc.	0.37	2.3%
4	Open Space Parks and open areas around it, steep slopes and low-lying lands	2.15	13.2%
5	Vacant Area Developable Area	7.57	46.4%
	Total	16.30	100%

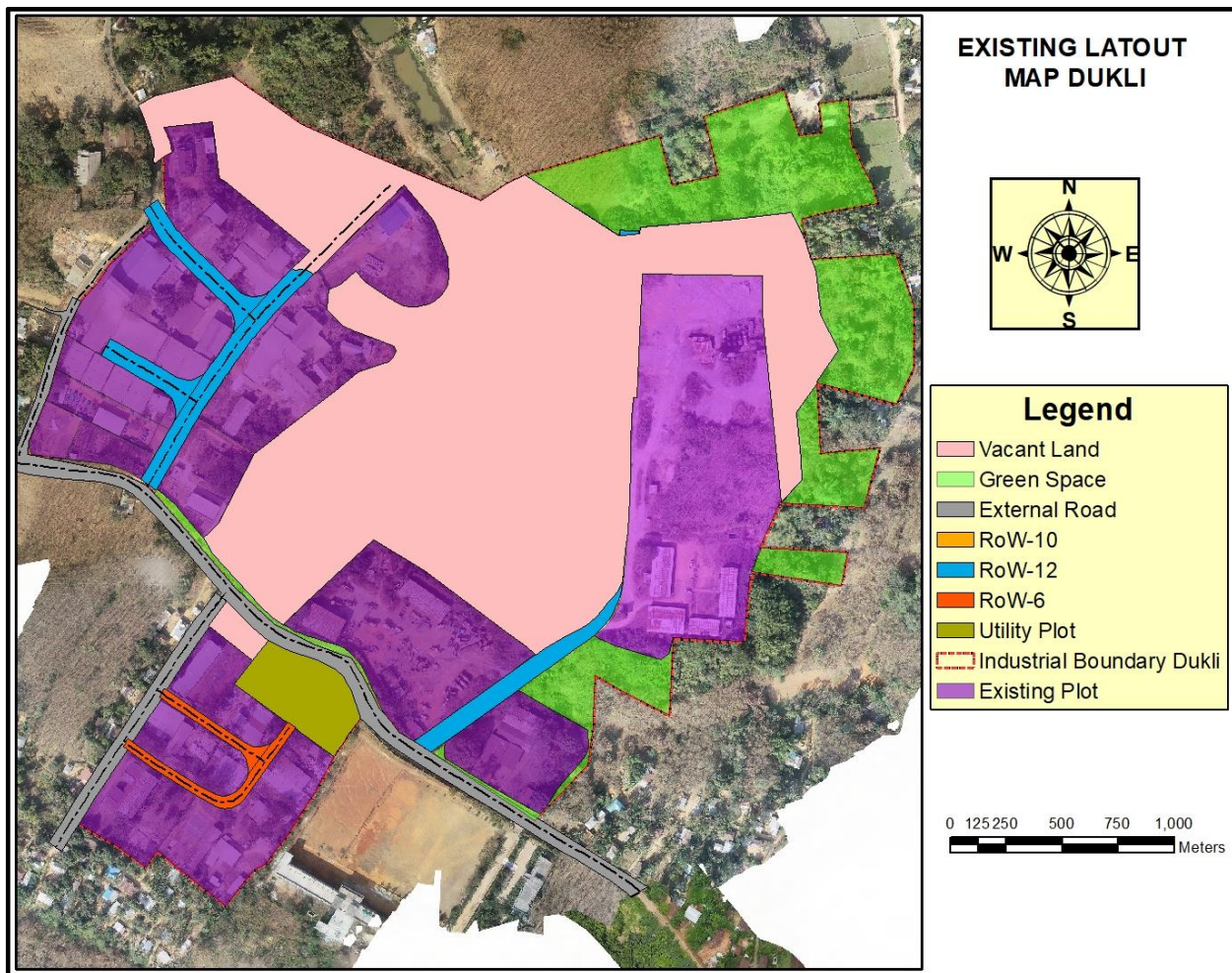


Figure 4-7: Existing Land Use of Dukli IE (Core Zone)

4.2.8 Agriculture

105. The predominant crops grown within the buffer zone i.e. West Tripura district mainly comprise paddy of three varieties namely (i) monsoon paddy (Aman), (ii) winter paddy (Boro) and (iii) summer paddy (Aush). Both monsoon and winter paddy are cultivated in large areas whereas summer paddy is cultivated in limited areas. In addition, different vegetables, viz. potato, cabbage, gourds etc., oil seeds and pulses are cultivated after the cultivation of monsoon paddy and before the cultivation of winter paddy. After winter paddy, jute is also grown on a limited scale.

106. In most of the cultivable land, only monsoon paddy is grown whereas in double-cropped areas, both monsoon and winter paddy along with vegetables are grown. Within the buffer zone, orchards of pineapples, jackfruits, mangoes, cashew nuts are also prevalent. Rubber plantations are grown on small mounds and foothills over a considerable area, which has shown an increasing trend in the last decade.

107. Being an industrial estate, since the year 1982, the core zone i.e. Dukli IE does not have any agricultural activities.

4.2.9 Climate and Rainfall

108. The climate of core and buffer zones is characterized by moderate temperature with high humidity. Winter season starts in November and lasts till the end of February. Summer

season starts from March and lasts up to May and is followed by Southwest monsoon lasting till October. Generally, maximum summer temperature ranges from 35°C to 40°C and average minimum temperature is in winter nights range between 6°C to 8°C.

109. The core and buffer zones receive rainfall mainly from Southwest Monsoon between May to October months. The average annual rainfall received between the years 2018 to 2022 is 1862 mm. The monthly rainfall and histograms of annual rainfall for the period between 2018 and 2022 are given in **Table 4-6** and depicted in **Figure 4-8**.

Table 4-6: Annual Average Rainfall (mm) in West Tripura State (Buffer Zone)

Year	Months												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
2018	2.5	10.1	35.8	200	596.1	402.3	210.7	148.4	94.5	43.5	18.2	22.1	1784
2019	0	62.9	44.4	166.9	216.3	263.6	568.6	195.6	190.3	121.2	37.6	6.2	1874
2020	20.8	0	6	141.4	302.1	480	376.7	208	320.7	207	16	0	2079
2021	3.2	0	19	22.7	209.1	301	458.2	247.4	244.1	138.8	11.8	150.7	1806
2022	9.1	14.2	32.7	52.4	512.5	438.1	121.6	121.3	264.4	195.6	0.5	3.4	1766

Source: India Meteorological Department, Gol, Agartala

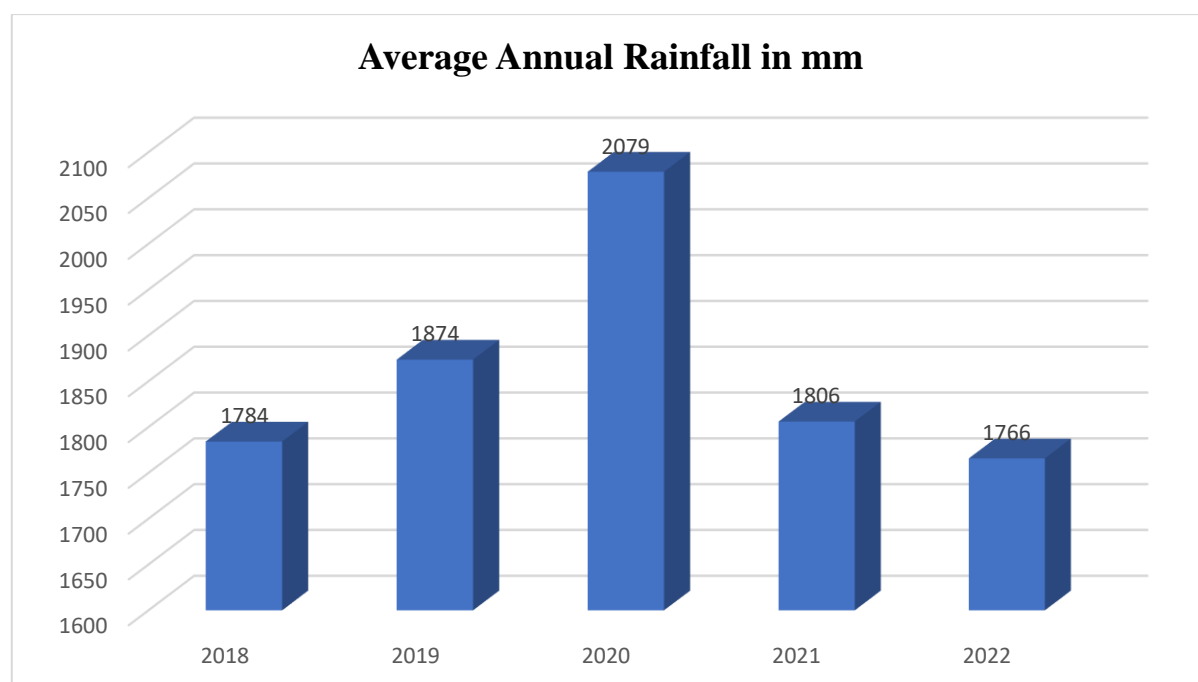


Figure 4-8: Annual Average Rainfall of West Tripura District (Buffer Zone)

4.2.10 Snowfall

110. The core and as well as buffer zones do not receive snowfall in normal years. As per the information sourced from the India Metrological Department, Agartala, no snowfall has been ever recorded within buffer or any part of the state in last decade.

4.2.11 Visibility

111. The core as well as buffer zones have a visibility of 4 to 10 km for over 300 days in a year both during morning and evening hours. The visibility reduces to less than 1 km for few days during both morning and evening hours in a year particularly winter month (Nov. to Feb.).

4.2.12 Dust & Thunderstorms

112. As per the information sourced from the India Metrological Department, Agartala, no severe dust and thunderstorms has been recorded within core and buffer zones in last decade.

113. The pre monsoon season starts from March which also brings thunderstorms accompanied with rain and wind speed 150 km per hour and these thunderstorm events are known as 'Nor 'westers' or 'Kalbaisakhi' in Tripura. The Kalbaisakhi begins in March and progressively increases with the advance of the season reaching its peak in May.

4.2.13 Wind Speed and Direction

114. The core and buffer zones experience calm days for nearly 100 days followed by wind speed with 4 to 9 km per hour for 250 days in a year. The pre-dominant wind direction is South followed by Southeast both during morning and evening hours throughout the year.

4.2.14 Baseline Environment Monitoring

115. The baseline environmental monitoring comprising ambient air quality, ambient noise levels, water quality and soil fertility was carried out through an NABET accredited laboratory at selected locations within the core zone i.e. Dukli IE in September 2023. The monitoring schedule, method of analysis, sampling locations along with its GPS coordinates are given in **Table 4-7** and **4-8**. The monitoring locations within the Dukli IE are shown in **Figure 4-9**. The laboratory test reports are given in **Appendix-3**. The baseline environmental monitoring findings are described in the following sections.

Table 4-7: Baseline Environmental Monitoring Schedule & Methods

Sl. No.	Parameters	Monitoring Schedule	Sampling Method
1	Ambient Air Quality Monitoring	24 hourly samples monitoring at each location	Respirable Sampler with arrangement for monitoring PM ₁₀ and PM _{2.5} carried out through NABL accredited Laboratory
2	Water Quality Monitoring	Grab samples from identified locations	Grab sampling, representing both surface and ground water samples and analyzed through NABL accredited Laboratory
3	Ambient Noise Level Monitoring	Hourly recording of noise levels for one full day (24 hours) at each location)	Handheld Integrated Noise Level Monitoring Instrument and measured through NABL accredited Laboratory
4	Soil Testing & Analysis	Grab Sample from each identified location	Grab samples drawn from 30 cm below existing ground level at each location, and analyzed through NABL accredited Laboratory

Table 4-8: Baseline Environmental Monitoring Stations at Dukli IE (Core Zone)

Sl. No.	Parameters	Monitoring Location/ Category	Monitoring Date	Latitude and Longitude
A	Ambient Air Quality			
1	AQ-01	Dukli -1/ Industrial	23.09.2023 & 25.09.2023	23° 46' 54.8328" N, 91° 17' 28.086" E
2	AQ-02	Dukli -2/ Industrial	23.09.2023 & 25.09.2023	23° 46' 56.5788" N 91° 17' 42.2808" E
3	AQ-03	Dukli -3/ Industrial	23.09.2023 & 25.09.2023	91° 17' 42.2808" E 91° 17' 33.7344" E
4	AQ-04	Dukli -4/ Industrial	23.09.2023 & 25.09.2023	23° 46' 48.6156" N 91° 17' 30.4044" E

Sl. No.	Parameters	Monitoring Location/ Category	Monitoring Date	Latitude and Longitude
B Ambient Noise Levels				
1	NQ-01	Dukli -1/ Industrial	23.09.2023	23° 46' 53.9292"N 91° 17' 29.5188"E
2	NQ-02	Dukli -2/ Industrial	23.09.2023	23° 46' 48.6012"N 91° 17' 35.8296"E
C-(i) Water Quality-Surface Water				
1	SW-1	Dukli -1	23.09.2023	Surface Water
C (ii) Water Quality-Ground Water				
1	WQ-01 (GW)	Dukli -1	23.09.2023	Ground Water
2	WQ-01 (GW)	Dukli -2	23.09.2023	Ground Water
D Soil				
1	SQ-01	Dukli -1	21.09.2023	Soil
2	SQ-02	Dukli -2	21.09.2023	Soil

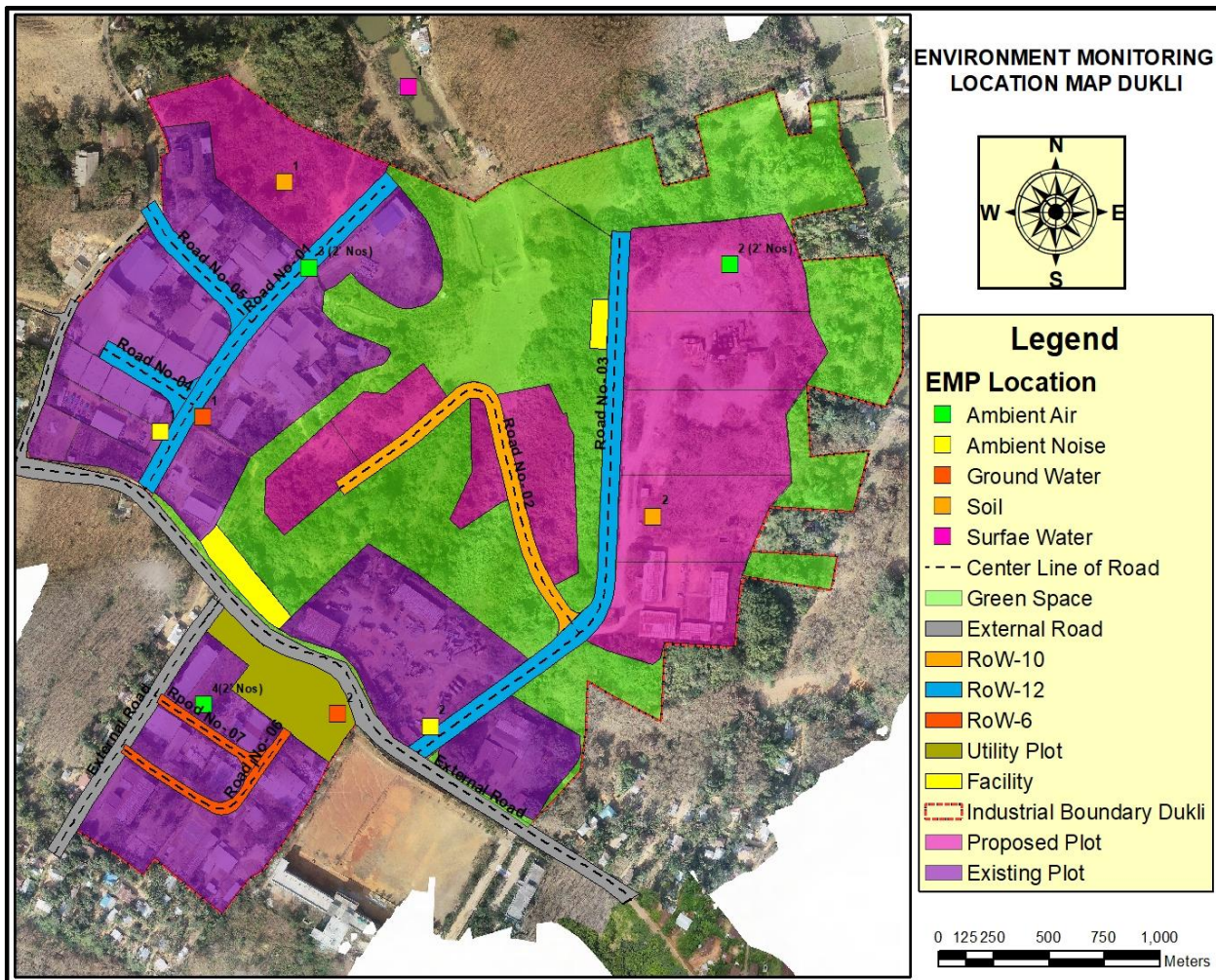


Figure 4-9: Environment Monitoring Locations at Dukli IE (Core Zone)

4.2.15 Ambient Air Quality

116. The ambient air quality was tested in 4 locations within core zone i.e. Dukli IE during September 2023. The monitoring test results along with the respective national standards are given in **Table 4-9**. The laboratory test reports are given in Appendix-3.

117. It may be seen that the ambient air quality (for all tested parameters) at monitored locations are well below the National Ambient Air Quality Standards, whereas PM₁₀ and PM_{2.5} exceed the IFC-EHS guidelines value (24 hours) (ref. Table 4-9).

Table 4-9: Ambient Air Quality within Dukli IE (Core Zone)

Sl. No.	Location	Date	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	CO (mg/m ³)
1	Dukli -1	26.09.2023	65.1	40.7	6.7	19.6	0.68
2	Dukli -2		72.8	40.4	7.4	21.3	0.74
3	Dukli -3		76.2	44.8	7.9	23.5	0.78
4	Dukli -4		69.3	36.5	6.5	20.7	0.66
5	Dukli -5	28.09.2023	81.7	40.9	8.3	25.1	0.82
6	Dukli -6		74.2	43.6	7.6	23.7	0.72
7	Dukli -7		65.1	31.0	6.8	20.3	0.68
8	Dukli -8		72.5	40.3	7.0	22.6	0.70
National Ambient Air Quality Standards, CPCB (NAAQS)			100	60	80	80	2
IFC- EHS Guideline Values (24 Hour values)			50	25	20	200	Not Specified (NS)

4.2.16 Ambient Noise Levels

118. The ambient noise levels within the core zone i.e. Dukli IE were measured at 2 locations during both day and night times. The measured noise levels are given in **Table 4-10**. The test reports are given in Appendix-3.

119. It may be seen that the ambient noise levels (for both day and night times) were below the National Ambient Noise levels for industrial category at all the monitored locations. The measured ambient noise levels could not be compared with IFC EHS Guidelines, as it does not specify the values for industrial category.

Table 4-10: Ambient Noise Levels within Dukli IE (Core Zone)

Sl. No.	Monitoring Location	Category	Ambient Noise Levels Leq dB (A)		
			Daytime	Night-time	
1	Dukli -1	Industrial	60.9	46.1	
2	Dukli -2	Industrial	68.1	47.7	
National Ambient Noise Levels Leq dB(A)			Industrial (I)	75	70
			Residential (R)	55	45
			Commercial (C)	65	55
IFC EHS Guideline Values (One Hour Leq dB(A))			Residential (R)	55	45

4.2.17 Surface and Ground Water Quality

120. The water quality within the core zone i.e. Dukli IE was tested at 3 locations covering both surface and ground water sources. The test results of physical, chemical and bacteriological parameters are given in **Table 4-11 & 4-12** and laboratory test reports are given in Appendix-3.

121. A comparison of tested water quality parameters with the respective acceptable and permissible limits indicates that the tested parameters for ground water sources does not critically exceed the respective limits for Drinking Water. Similarly, tested parameters for the surface water sources are within the criteria for Designated Best Use Water Quality for surface waters as well as primary water quality for outdoor bathing notified by CPCB, MoEF & CC (**Table 4-13 & 4-14**).

Table 4-11: Ground Water Quality within Dukli IE (Core Zone)

Sl. No.	Parameters	Unit	GW-1	GW-2	Drinking water Standards as per BIS 10500:2012	
					Acceptable Limit	Permissible Limit
1	Alkalinity (as CaCo3)	mg/l	60	56	-	-
2	Ammonia	mg/L	<0.1	<0.1	-	-
3	Arsenic (as As)	mg/L	<0.005	<0.005	0.01	0.05
4	Boron (as B)	mg/L	<0.5	<0.5	0.5	1
5	Cadmium Cd	mg/L	<0.001	<0.001	0.003	No Relaxation
6	Calcium as Ca	mg/L	19.01	18.22	75	200
7	Chlorides as Cl	mg/L	27	25	250	1000
8	Chromium as Cr	Mg/l	<0.01	<0.01	-	-
9	Colour	CU	<5.0	<5.0	5	16
10	Copper as Cu	mg/L	<0.02	<0.02	0.05	1.5
11	Dissolved Iron	mg/L	<0.05	<0.05	-	-
12	Electric conductivity	mg/L	230	215	-	-
13	Fluorides as F ⁻	mg/L	0.38	0.33	1	1.5
14	Lead as Pb	mg/L	<0.005	<0.005	0.01	No Relaxation
15	Magnesium as Mg	mg/L	9.50	9.03	30	100
16	Manganese as Mn	mg/L	<0.02	<0.02	0.1	0.3
17	Mercury	mg/L	<0.001	<0.001	0.001	No Relaxation
18	Nitrate as NO ₃	mg/L	<0.5	<0.5	45	No relaxation
19	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable
20	Phenol	mg/L	<0.001	<0.001	-	-
21	Phosphate as (PO ₄)	mg/L	<0.05	<0.05	-	-
22	Potassium as K	mg/L	2.6	2.3	-	-
23	Salinity	mg/L	0.12	0.11	-	-
24	Sodium as Na	mg/L	7.2	6.8	-	-
25	Sulphates as SO ₄ ²⁻	mg/L	13.4	12.6	200	400
26	Total Dissolved Solids	mg/L	138	129	500	2000
27	Total Hardness as CaCO ₃	mg/L	87.12	83.16	200	600
28	Turbidity	NTU	<1.0	<1.0	1	5
29	Zinc as Zn	mg/L	<0.02	<0.02	5	15
30	pH Value at 25°C	mg/L	7.29 at 25 Deg C	7.25 at 25 Deg C	-	-

Table 4-12: Surface Water Quality within Dukli IE (Core Zone)

Sl. No	Parameters	Unit	SW-1
1	Ammonia	mg/L	<0.1
2	Arsenic (as As)	mg/L	<0.005
3	Biochemical Oxygen Demand	mg/L	<2.0
4	Boron (as B)	mg/L	<0.5
5	Cadmium Cd	mg/L	<0.001
6	Calcium as Ca	mg/L	13
7	Chemical Oxygen Demand	mg/L	<4.0
8	Chlorides as Cl	mg/L	12
9	Chromium as Cr	Mg/l	<0.01
10	Colour	CU	<0.01
11	Copper as Cu	mg/L	<0.02
12	Dissolved Oxygen	mg/L	5.8
13	Dissolved Iron	mg/L	0.92
14	Electric conductivity	mg/L	298

Sl. No	Parameters	Unit	SW-1
15	Fluorides as F ⁻	mg/L	0.16
16	Lead as Pb	mg/L	<0.005
17	Magnesium as Mg	mg/L	5.2
18	Manganese as Mn	mg/L	<0.02
19	Mercury	mg/L	<0.001
20	Nitrate as NO ₃	mg/L	0.52
21	Odour	--	Unobjectionable
22	Phenol	mg/L	<0.001
23	Phosphate as (PO ₄)	mg/L	<0.05
24	Potassium as K	mg/L	1.9
25	Salinity	mg/L	0.15
26	Sodium as Na	mg/L	3.9
27	Sulphates as SO ₄ ⁻²	mg/L	9.7
28	Surfactants	mg/L	<0.02
29	Temperature	Deg.C	25
30	Total Alkalinity	mg/L	32
31	Total Dissolved Solids	mg/L	178
32	Total Hardness as CaCO ₃	mg/L	55
33	Total Suspended Solid	mg/L	<2.5
34	Turbidity	NTU	<1.0
35	Zinc as Zn	mg/L	<0.02
36	pH Value	mg/L	7.36 at 25 Deg C
37	Faecal coliform	mnp/100ml	<1.8
38	Phytoplankton	Per liter	Absent
39	Total coliform bacteria	mnp/100ml	<1.8

Table 4-13: Designated Best Use Water Quality Criteria

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C- 2mg/l or less
Outdoor bathing (organised)	B	Total Coliforms MPN/100ml shall be 500 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/1 or less
Drinking Water Source after conventional treatment and disinfection	C	Total Coliforms MPN/100 ml shall be 5000 or less
		pH between 6 to 9 Dissolved Oxygen 4mg/ 1 or more
		Dissolved Oxygen 4mg/ 1 or more
		Biochemical Oxygen Demand 5 days 20°C 3 mg/1 or less
Propagation of Wildlife and Fisheries	D	pH between 6.5 to 8.5
		Dissolved Oxygen 4 mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste Disposal	E	pH between 6.0 to 8.5
		Electrical Conductivity at 25°C micro mhos/cm Max 2250
		Sodium absorption ratio Max. 26
		Boron, Max. 2 mg/l

Source: - CPCB, MoEFCC

Table 4-14: Primary Water Quality Criteria for Bathing
(Water used for organized outdoor bathing)

Sl. No.	Criteria		Rationale
1.	Faecal Coliform MPN/100 ml	500 (desirable) 2500 (Maximum Permissible)	To ensure low sewage contamination Faecal coliform and faecal streptococci are considered as they reflect the bacterial pathogenicity
2.	Faecal Streptococci MPN/100 ml	100 (desirable) 500 (Maximum Permissible)	The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc.
3.	pH	Between 6.5 to 8.5	The range provides protection to the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing
4.	Dissolved Oxygen	5 mg/1 or more	The minimum dissolved oxygen concentration of 5 mg/1 ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment.
5.	Biochemical Oxygen Demand (3 days at 27°C)	3 mg/1 or less	The Biochemical Oxygen Demand of 3 mg/1 or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases

Source: - CPCB, MoEF&CC

4.2.18 Soil Quality

122. The soil quality within the core zone i.e. Dukli IE was tested at 2 locations and test values are given in **Table 4-15**. The laboratory test reports, and test methods following are given in Appendix-3.

Table 4-15: Soil Quality within Dukli IE (Core Zone)

Sl. No	Test Parameters	Units	SQ-01	SQ-02
1	Bulk Density	gm/cc	1.29	1.36
2	Electric Conductivity at 25°C	µS/cm	22	13
3	Iron (as Fe)	mg/kg	137 (1:2) at 25 deg C	115 (1:2) at 25 deg C
4	Lead (as Pb)	mg/kg	5.2	11
5	Moisture Retention Capacity	%	7.1	7.6
6	Organic Matter	%	35	31
7	Phosphorus	mg/kg	0.74	0.45
8	Porosity	%	Available Phosphorus (as P) =4.5	Available Phosphorus (as P) =3.4
9	Potassium	mg/kg	46	45
10	Clay	%	Available Potassium=44	Available Potassium=38
11	Sand	%	58	71
12	Silt	%	20	16
13	Texture	-	Sandy Clay Loam	Sandy Loam
14	Total Nitrogen as N	mg/kg	588	302
15	Total Organic Carbon	%	0.43	0.26
16	Infiltration Rate	Mm/hr.	15	22
17	pH Value	-	5.16 (1:2.5) at 25 deg C	4.60 (1:2.5) at 25 deg C

4.2.19 Hazard and Vulnerability

123. Tripura state is vulnerable to earthquakes, floods, landslides, cyclones, extended dry spells and other natural and human induced disasters. Among these, the state is very highly vulnerable to earthquakes as it is situated in Seismic Zone-V and has a higher probability of occurrence of big earthquakes measuring 8 and above on Richter scale.

124. The state witnessed the worst earthquakes in 1897 and 1950 measuring 8 and above on the Richter scale. In recent years, the state has witnessed a moderate earthquake of magnitude of 5.7 on the Richter Scale with epicenter in Dhalai district on 3rd Jan. 2017.

125. Floods are recurrent and have potential for disaster in the State. They occur every year during the normal monsoon season and cause temporary floods in valleys and plain land areas as well as urban flooding in Agartala and other towns. Due to the climate change risks in recent years, floods are occurring even during non-monsoon season. The last devastating floods occurred in the state was in 2018, wherein almost all districts were affected.

126. In case of cyclone vulnerability, wind speed in the state can go up to even 55m/s (198km/h) causing loss of lives and property. Tripura is vulnerable to landslides during monsoon season, particularly on heavy rainfall days. Tripura is also vulnerable to lightning, thunder strikes, and cloud burst occurrences, causing heavy loss of lives and property.

127. The core and buffer zones i.e. West Tripura district are also vulnerable to natural disasters on the same lines of the state. The hazard and vulnerability along with probable months of occurrence is given in **Table 4-16 & 4-17**. Among these, the core zone is least vulnerable to flood and cyclone due to its geographical location i.e. far away from known flood hazard areas (ref. **Figure 4-10**).

Table 4-16: Probability of Seasonal Hazards of West Tripura District (Buffer Zone)

Hazard	Probable Months											
	Jan	Feb	Mar	April	May	June	July	August	Sept	Oct	Nov	Dec
Flood												
Cyclone												
Drought												
Forest Fire												
Earthquake												

Source: Tripura District Disaster Management Plan

Table 4-17: Hazard and Vulnerability Status of West Tripura District (Buffer Zone)

Sub-division	Earthquake	Flood	Cyclone	Landslide	Fire	Dry Spell	Thunder
Sadar	Very high	Very high	High	High	Medium	Low	Low
Jirania	Very high	Very high	High	High	Medium	Low	Low
Mohanpur	Very high	Very high	High	High	Medium	Low	Low

Source: Tripura District Disaster Management Plan

The extent of the forest areas within the buffer zone i.e. West Tripura District is given in **Table 4-18** and mainly comprise tropical evergreen, semi-evergreen and moist deciduous type.

Table 4-18: Forest Cover of West Tripura District (Buffer Zone)

Forest Circle/ division	Geographical area	Forest area (in sq km)					
		RF	PRF	UGF	PF	Total	% Total
West Tripura District							
Sadar	196.85	1.587	0.000	0.000	0.000	1.587	0.0
Mohanpur	397.09	69.928	0.161	3.780	0.000	73.869	1.2
Jirania	239.74	86.016	0.369	52.741	0.000	139.126	2.2
District Total	833.68	157.531	0.530	56.521	0.000	214.582	3.4
State Total	10491.69	3588.183	587.633	2116.874	1.597	6294.287	100.0
* RF-Reserve Forest, PRF-Proposed Reserve Forest, UGF-Unclassified Govt. Forest, PF-Protected Forest							

Source; <https://forest.tripura.gov.in/forest-of-tripura>

4.3.2 Forest Areas within Core Zone

129. The entire land within the Dukli IE is owned by DoIC/ TIDCL and the proposed infrastructure construction works is limited to the existing boundary of the industrial estate, with no further land requirement or acquisition. The core zone extending up to 500-metre along peripheral boundary of the industrial estate does not have forest areas of any type/ category. The map prepared by Tripura Forest Department, confirming the absence of forest areas surrounding the Dukli IE is given in **Figure 4-11**.

4.3.3 Protected Areas within Buffer Zone

130. Tripura state has four wildlife sanctuaries and two national parks as given in **Table 4-19**. The buffer zone i.e. West Tripura District does not have any protected areas.

131. The Sepahijala Wildlife Sanctuary (WLS) and its notified eco-sensitive zone is the nearest protected area, which is in the adjoining Sepahijala district, at 10.58 km from the Dukli IE as shown in **Figure 4-12**. The eco-sensitive zone of Sepahijala WLS is limited to a mere 10m on the eastern side and a maximum of 50m on the western side (ref. **Figure 4-13**). Thus, Dukli IE is 10.58 km from the eco-sensitive zone of Sepahijala Wildlife Sanctuary.

Table 4-19: Protected Areas of Tripura State

Sl. No.	Name of Protected Area	Location/ District	Notification Date	Area in Km ²
1	Sepahijala WLS	Sepahijala District	02.02.1987	13.46
2	Trishna WLS	South Tripura District	19.11.1988	163.08
3	Gomati WLS	Dhalai District	01.12.1988	389.54
4	Rowa WLS	North Tripura District	07.05.2009	0.86
5	Clouded Leopard National Park and Sepahijala Zoological Park	Sepahijala WLS, Sepahijala District	24.01.2008	5.08
6	Bison National Park	Trishna WLS, South Tripura District	06.12.2007	31.63

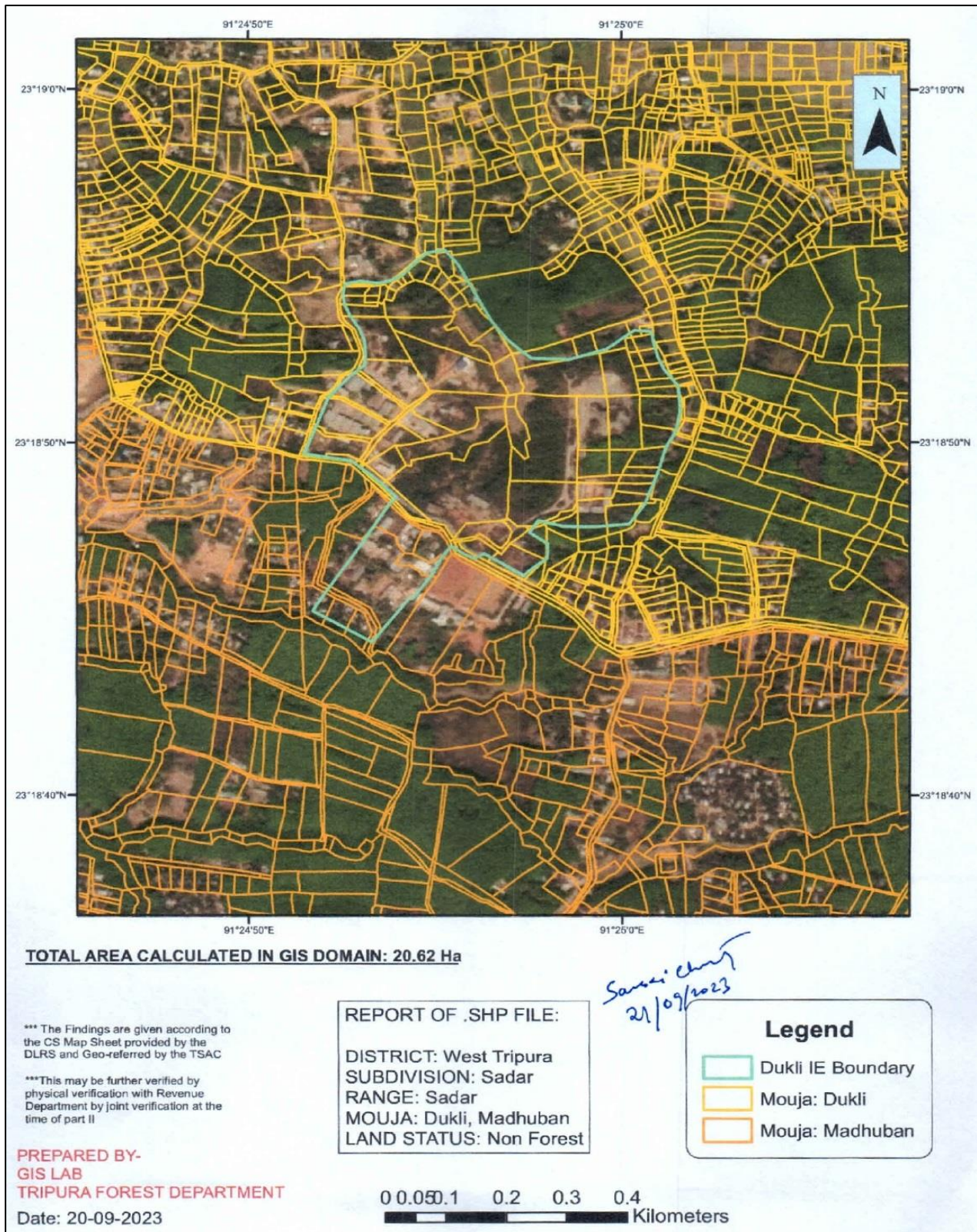


Figure 4-11: Map Confirming Non-Forest Areas with the Core Zone
 (Source: Forest Department of Tripura)



Figure 4-12: Distance of Protected Areas from Dukli IE (Core Zone)

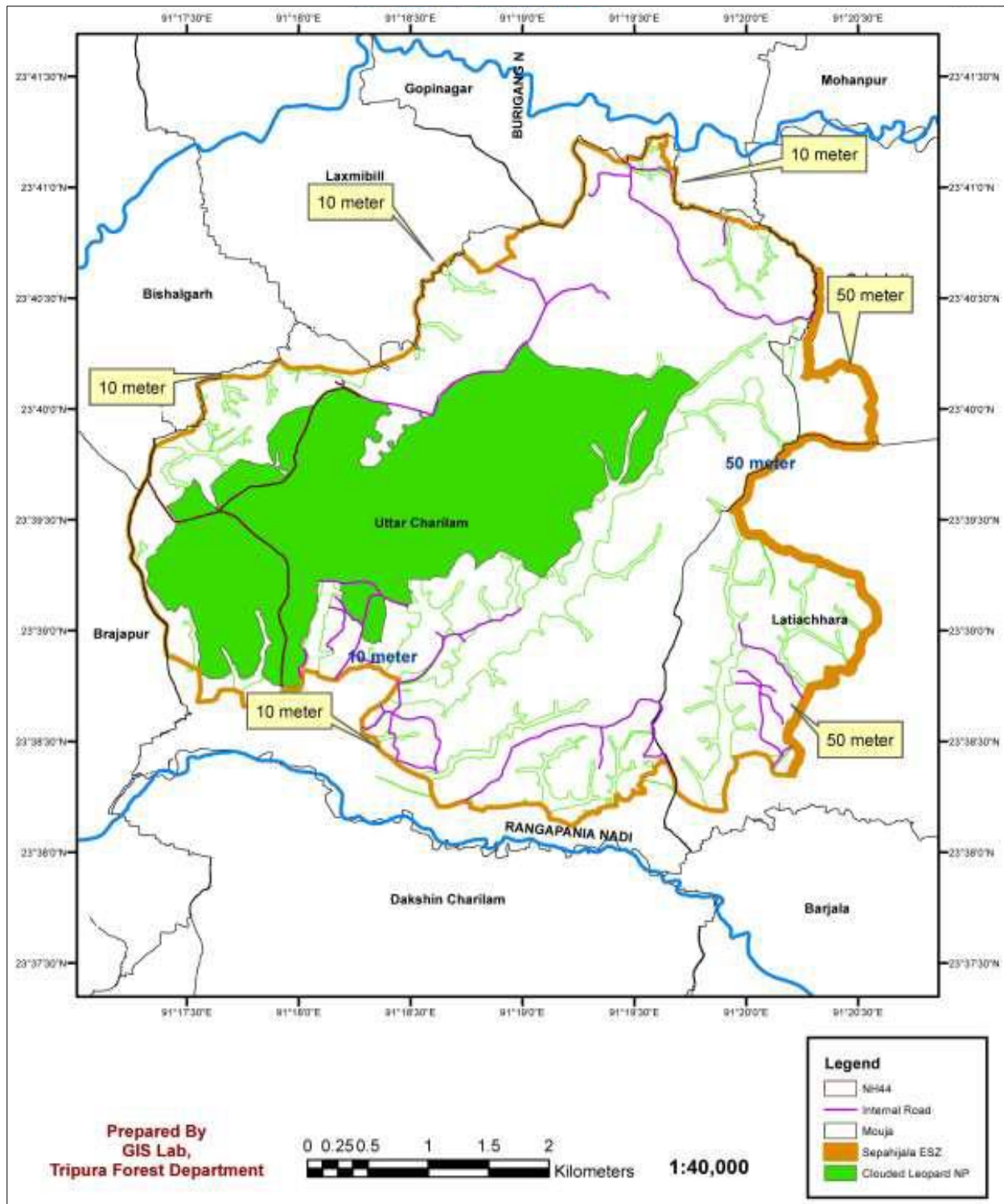


Figure 4-13: Eco-Sensitive Zone Boundary of Sepahijala WLS

4.3.4 Biodiversity

132. Tripura state is extremely rich in biodiversity⁶, situated within the Indian sub-region of Oriental Zoo-geographic region and flora & fauna of the state bear a very close affinity and

⁶ Source: <https://forest.tripura.gov.in/forest-of-tripura>

resemblance with floral and faunal components of Indo-Malayan and Indo-Chinese sub-regions.

Flora of State

133. The flora of the state comprises 379 species of trees, 320 shrubs, 581 herbs, 165 climbers, 16 climbing shrubs, 35 ferns, 45 epiphytes and 4 parasites. Out of these, 7 are endemic, 18 are rare and 50 species are restricted to Tripura and neighboring States. *Angiopteris evecta*, a fern and *Gnetum montanum*, a giant climber belonging to Gymnosperm are two rare species but occur abundantly in Trishna WLS in South District. Similarly, tree ferns (*Cyathia spp.*), which are also primitive and endangered, are found in South Tripura.

134. The state has 24 species of orchids, out of which *Dendrobium spp.* has the highest species diversity whereas, Blue vanda (*Vanda caerulea*) and Red vanda (*Renunthera imschootiana*) are in the endangered category. The state also has 266 species of medicinal plants (68 trees, 39 shrubs, 71 herbs and 88 climbers) with maximum value of *Shannon-Weiner* index of 5.23.

Flora of Core & Buffer Zones-IBAT

135. As part of the IEE, a comprehensive biodiversity studies were carried out through an Integrated Biodiversity Assessment Tool (I-BAT), which is a software tool that provide access to a wide range of global, national, regional and state level biodiversity & conservation information. The I-BAT is designed to support decision-making process and to aid in assessing baseline biodiversity information during project planning and development. The I-BAT has considered the 500-meter peripheral area surrounding the Dukli IE as the core zone (ref. **Figure 4-14**) and up to 20 km radius as the buffer zone. The objective of the study was to assess the major habitat types, critical species and evaluate threats and conservation opportunities.

136. The I-BAT has cataloged 76 flora and 133 fauna groups within 500m core zone, including Dukli IE, as compared to the 210 flora and 269 fauna groups in the buffer zone extending up to 20 km. This abridgement can be attributed to the hustle of industrial operations and consequent environmental stressors within IE. The flora and fauna groups and richness within the core and buffer zones assessed through IBAT are given in **Tables 4-20 & 4-21**.

137. Contrastingly, the buffer zone for IBAT i.e. up to 20 km beyond core zone, is characterized by forest patches with less intensive human activity, showcase more robust biodiversity with 479 identified species. The forested areas act as ecological buffers and corridors, facilitating gene flow and providing refuge for wildlife, thus enhancing species richness. Trees (88 species), shrubs (41 species), and herbs (70 species) in these forest patches contribute to ecological resilience, offering a spectrum of habitats and food sources. Aves (148 species) and butterflies (39 species) have been observed, indicating a healthier ecosystem with minimal human interference. The complete ecological investigation (I-BAT) report is given in **Appendix-4**.

138. Out of the 35 known biodiversity hotspots⁷ of the state, none are located within the core and buffer zones of the Dukli IE.

⁷ Source: Rapid assessment of Herpetofaunal and invertebrate diversity in Tripura state, September - November 2014 by National Centre for Biological Sciences and the Rufford Foundation.

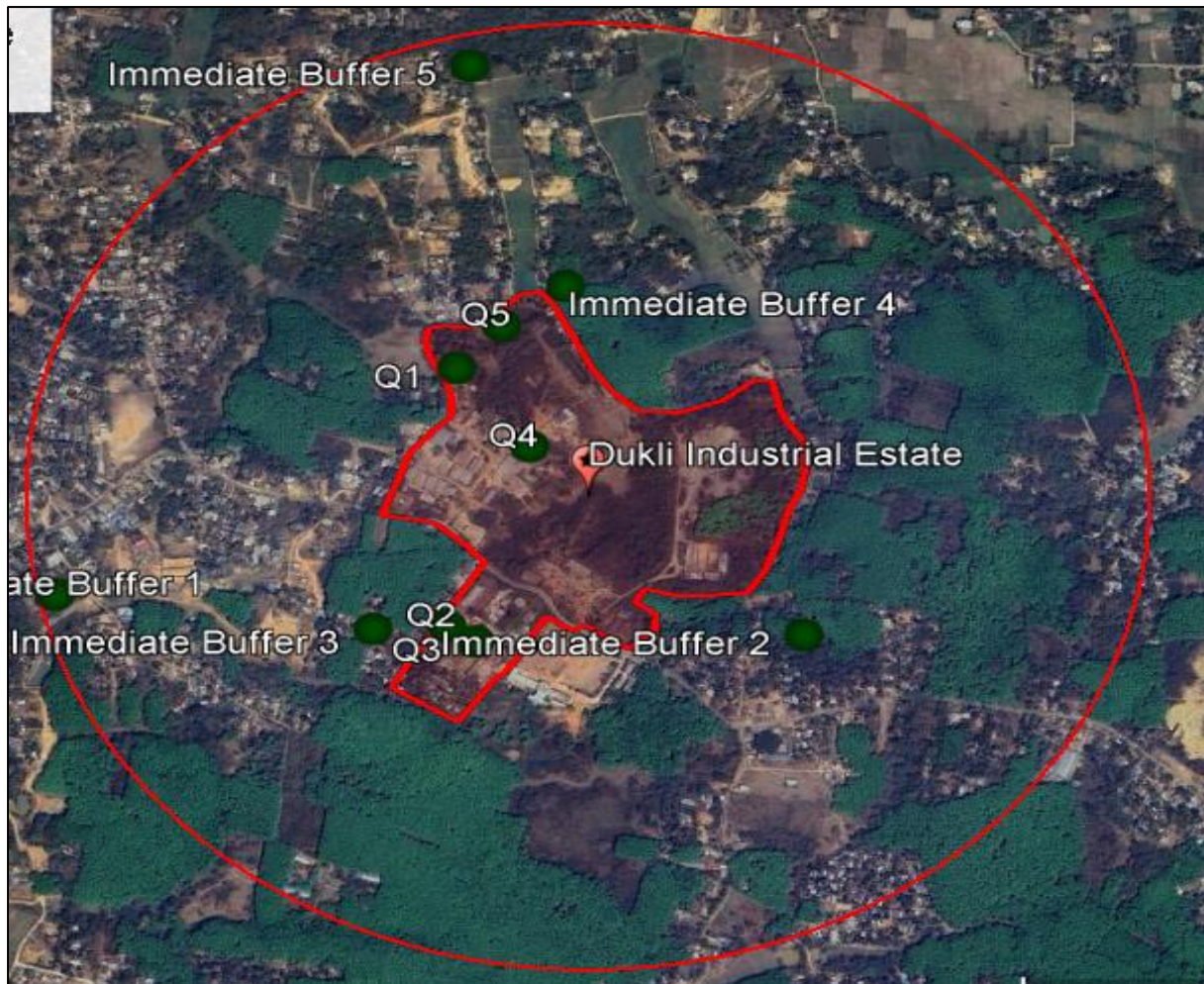


Figure 4-14: Core Zone for Biodiversity Studies using I-BAT Tool

Table 4-20: Flora and Fauna Groups Found in Core and Buffer Zones of I-BAT

Groups	Buffer Zone IBAT	Core Zone IBAT
Flora Total	210	76
Tree	88	31
Shrub	41	18
Herb	70	22
Climber	11	5
Fauna Total	269	133
Birds	148	75
Butterflies	39	28
Dragonflies	4	4
Other-Insects	29	17
Mammal	19	1
Reptile	24	6
Amphibian	4	3

Table 4-21: Species Richness in Core and Buffer Areas of I-BAT

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
0km	65	52	5	1	Core
500m	60	54	10	5	Dukli Immediate Buffer

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
5km	153	88	16	4	IC Nagar, Prabhapur, Jogendranagar, Nagicherra
10km	138	77	16	4	Dakshin champamura, Purba noagaon, Khayerpur, Ranjit nagar
15km	142	63	20	5	Madhupur, Paschim takarjala, Baidhya kobra, Oxygen Park, Sepahijala Wildlife Sanctuary
20km	188	96	16	4	Amtali, Jirania, Fatikcherra, Bamutia, Kathiram bari, Kandrai charra

4.3.5 Endemic & RET Species within Core Zone

139. The plant species identified during the biodiversity studies using I-BAT were assessed for their conservation status by cross checking with red data book of Indian plants (Nayar and Sastry, 1987-1990) for their rare, endangered and threatened (RET) status. None of the taxa identified during studies within the 500m core zone were found under RET category. The recorded plant species were also assessed for their endemism and none of the species was recorded as endemic to the core zone. The list of endangered and threatened with extinction flora within the state, listed by the Tripura Forest Department is given in **Table 4-22**.

Table 4-22: Endangered Flora within the State Listed by Tripura Forest Department

Sl. No.	Scientific Name	Local Name	Type
1	<i>Duabanga grandiflora</i>	Ramdala	Tree
2	<i>Adina sessifolia</i>	Haludehaki	Tree
3	<i>Michelia montana</i>	Champa sundi	Tree
4	<i>Magnolia pterocarpa</i>	Duli champa	Tree
5	<i>Lochio spermum</i>	Halde simul	Tree
6	<i>Canarium Stricum</i>	Dhup	Tree
7	<i>Aquilaria malaccensis</i>	Agar	Tree
8	<i>Pterocarpus santalinus</i>	Rakta chandan	Tree
9	<i>Santalum album</i>	Chandan	Tree
10	<i>Rauvolfia serpentina</i>	Sarpgandha	Herb
11	<i>Dischidia raflosiana</i>	Lantana kalasi	Climber
12	<i>Drosera burmanni</i>	Surja sisir	Herb
13	<i>Elaocarpus prunifolia</i>	Ban jalpai	Tree
14	<i>Mangifera sylvatica</i>	Laxmi aam	Tree
15	<i>Entada phaseolides</i>	Gila	Climber
16	<i>Angiopteris evecta</i>	Paku Gajah	Fern
17	<i>Cyathea gigantea</i>	-	Tree
18	<i>Holmiathostachys zeylanica</i>	Kamraj	Fern
19	<i>Podocarpus aerlifolius</i>	-	Tree
20	<i>Xantolis assamica</i>	-	Tree

Source: Tripura Forest Department

4.3.6 Tree Felling Requirement

140. The proposed improvement works within Dukli IE will require 13 trees to be felled as given in **Table 4-23**. All 13 trees, which are to be felled are commonly found in the region and do not fall under the category of rare, endangered or threatened species (ref. Table 4-22).

141. TIDCL has already completed a joint verification survey with the forest department but has yet to receive permissions for felling of these trees from the State Forest Department. The cutting

of 13 trees would be initiated only after obtaining the requisite tree cutting permission from the forest department (ref. **Appendix-5**).

142. In addition, the IE has about 65 trees within areas which are to be developed as industrial plots under the development scheme, but no such trees will be felled and all of them will be retained.

Table 4-23: List of trees to be felled within Dukli IE

Sl. No.	Local Species Name	Scientific Name	Measurement (in cm)	
			Girth at Breast Height	Height
1	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	80	1000
2	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	115	1000
3	Banyan/Bot	<i>Ficus religiosa</i>	70	500
4	Debdaru	<i>Polyalthia longifolia</i>	128	1600
5	Kathal	<i>Artocarpus heterophyllus</i>	190	180
6	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	80	900
7	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	70	800
8	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	65	600
9	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	80	700
10	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	75	800
11	Ordinary (Naicha)	<i>Trema orientalis (L) BL</i>	73	900
12	Khejur	<i>Phoenix dactylifera</i>	115	800
13	Khejur	<i>Phoenix dactylifera</i>	112	800

Source: Survey and Joint Verification with Sadar Forest Sub-Division, Tripura Forest Department

4.3.7 Fauna

143. Tripura reportedly has 90 mammal species⁸ from 65 genera and 10 orders. Seven primate species have been documented in Tripura, out of 15 found across India. Of these primates, slow loris and stumped tailed macaques have become rare species. Phayre's langur (locally known as 'Chashma Banar'), has a very restricted distribution in India, and is found in Tripura. Hoolock gibbon is the only ape and found in India and is also found in Tripura, though, its population is on decline in Tripura. The rare and threatened fauna of Tripura is given in **Table 4-24**.

144. The ecological investigations as well as consultations with the concerned forest department officials and local community within core zone has not indicated presence/sighting of any wildlife and/or any animal-human conflicts during the past 8-10 years.

Table 4-24: Rare and Threatened Fauna of Tripura

Sl. No.	Common Name	Scientific Name	Schedule-I of WL Protection Act	Appendix-I of CITES
1.	Slow Loris	<i>Nycticebus coucang</i>	+	-
2.	Phayre's Leaf Monkey	<i>Presbytis phayrei</i>	+	-
3.	Capped Langur	<i>Presbytis pileatus</i>	+	+
4.	Hoolock Gibbon	<i>Hylobates hoolock</i>	+	+
5.	Leopard	<i>Panthera pardus</i>	+	+
6.	Marbled Cat	<i>Felis marmorata</i>	+	+
7.	Leopard Cat	<i>Felis bengalensis</i>	+	+
8.	Golden Cat	<i>Felis temmincki</i>	+	+
9.	Common Otter	<i>Lutra lutra</i>	-	+

⁸ Source: <https://forest.tripura.gov.in/forest-of-tripura>

Sl. No.	Common Name	Scientific Name	Schedule-I of WL Protection Act	Appendix-I of CITES
10.	Indian Elephant	<i>Elephas maximus</i>	+	+
11.	Indian Bison	<i>Bos gaurus</i>	-	+
12.	Chinese Pangolin	<i>Manis pentadactyla</i>	+	-

Source: Tripura Forest Department

4.3.8 Avian Fauna

145. Tripura has reported 342 birds (Ornithofauna), of which about 58 are migratory species and one bird i.e. darter is reported to be nearly a threatened species. The state has high diversity of prey birds, frugivorous birds, marsh birds and flower peckers. The aquatic ecosystem of the state reportedly has 14 species of fish, of which 2 are endangered (*Anguilla bengalensis* and *Psuedatroptus alterinoides*) and 12 are in the vulnerable category. Some of the main reasons which are sighted decline in the marsh birds and fishes is due to silting of riverbeds and filling up of wetlands in various parts of the state.

146. Although, Tripura has important bird areas (IBAs) within Sepahijala WLS, Gumti WLS, Trishna WLS and Rowa WLS but these are at 10.58 kms, 41.78 kms, 42.11 kms and 104.06 km respectively from the core zone i.e. Dukli IE.

4.3.9 Reptilian Fauna

147. The reptilian fauna of Tripura comprises of 32 species under 28 genera and 11 families. These include 3 species of turtles and tortoise, 13 species of lizards, and 15 species of snakes. At least three species of reptiles are listed as endangered under Indian Wildlife (Protection) Act., 1972. (Sanyal, D.P. et.al. Reptilia, Fauna of Tripura, Vol.-1, Zoological Survey of India, In Press).

148. The faunal surveys carried out within the core zone i.e. Dukli IE did not sight any reptilian fauna. However, the presence of reptilian fauna within the core zone cannot be ruled out.

4.3.10 Aquatic Ecosystem of Core Zone

149. The core zone does not have any wetlands, although the state has 408 freshwater wetlands as given in **Table 4-25**. Of these, Rudrasagar Lake is the only RAMSAR site, which is at about 30 km aerial distance from the Dukli IE.

150. The core zone i.e. within 500m periphery of the Dukli IE does not have any surface water bodies or wetlands.

Table 4-25: Wetlands Areas of Tripura State

Sl. No.	Type of Wetland	No of wetlands	Area (Sq. Km.)
1	Lakes/ponds	74	25.04
2	Oxbow lakes	84	3.60
3	Waterlogged(seasonal)	222	15.43
4	Reservoirs	5	53.22
5	Tanks	19	1.36
6	Waterlogged	4	0.30
	Total	408	98.95

Source: Tripura Forest Department

4.4 Social and Cultural Resources

4.4.1 Demography

151. The buffer zone i.e. West Tripura district has its district headquarters at Agartala, which is also the capital of the State. The demographic features of the buffer zone are given in **Table 4-26**.

Table 4-26: Demographic Features of West Tripura District (Buffer Zone)

Sl. No	Particulars	Remarks		
1	Area	983.63 sq.km		
2	Number of Sub-divisions	3		
3	Number of Rural development Blocks	9		
4	Municipal Corporation	1		
5	Municipal Council & Nagar Panchayat	2 Nos Municipal Council and 1 Nagar Panchayat		
6	Gram Panchayat & ADC Villages	172 Nos		
7	Population (As per census 2011)	Male	Female	Total
		879,428	846,311	1,725,739
8	Density of Population	933 per sq.km		
9	Literacy rate (%)	88.69 overall	92.50 (Male)	84.75 (Female)
10	Sex ratio	962		
11	Colleges/Universities	13 Nos.		
12	Police Stations	16 Nos. (including 2 women PS)		
13	Fire Stations	10 Nos.		
14	Sub- Centre	176 nos.		
	Primary Health Centre	14 nos.		
	State Hospital	02 nos.		
	Army Hospital	01 nos.		
	Assam Rifles Hospital	01 nos.		
	BSF Hospital	01 nos.		
	CRPF Hospital	01 nos.		
15	Rail Stations	3 Nos.		

4.4.2 Agriculture and Land Use

152. The rural part of West Tripura District (buffer zone) is mainly dependent on agriculture and allied activities with paddy cultivation has the main agricultural activity. The district is ideal for diverse patterns of cultivation, for the cultivation of cereals, pulses and other food crops, of plantation crops, and of a rich range of agricultural and horticultural crops. The district has 19 tea estates which makes it the largest producer of tea in the state of Tripura.

4.4.3 Culture and Tourism

153. Likewise, the state, West Tripura (buffer zone) has several diverse ethno-linguistic groups, which has given rise to a composite culture. The dominant cultures are Bengali, Manipuri, Tripuris, Jamatia, Reang, Naitong, Koloj, Murasing, Chakma, Haram, Garo, Hajong, Kuki, Mizo, Mogh, Munda, Oraon, Santhal, and Uchoi.

154. In Tripura State, tourist attractions of the district are Ujjayanta Palace State Museum, Tribal Museum, Sukanta Academy, M.B.B. College, Laxminarayan Temple, Uma Maheswar Temple, Jagannath Temple, Benuban Vihar, Gedu Mian Mosque, Malancha Niwas, Rabindra Kanan, Heritage Park, Purbasha, Handicrafts Designing Centre, Fourteen Goddess Temple, Portuguese Church etc.

4.4.4 Commerce, Industry and Agriculture

155. Agriculture forms a primary sector of the economy of Tripura. More than 75% of the district's economic total workforce is dependent on agriculture for their subsistence. In fact, about 24.3 % of the state's net area is reserved for agricultural purposes of which, about 2.5 lakh hectares fall under the net cultivated area. Paddy is the principal crop that is reaped in Tripura. Besides paddy, jute, sugarcane, wheat, oil seeds, coconut and turmeric are also grown in plenitude in the northeast Indian state. The state takes elaborate measures to spruce up the agricultural infrastructure. New technologies, fertilizers, improved seeds and protective chemicals have been implemented to keep the state's agriculture in top shape.

156. The major flagship Industrial area is the Industrial Growth at Nagicherra at Dukli in West Tripura District. The industrial estates proposed has Rubber industries, Other Industries.

4.4.5 Health and Educational Facilities

157. 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 of 2013–14, there are 84 Primary Health Centers, 18 Community Health Centers, 13 Sub Divisional Hospitals, 3 District Hospitals, 6 State Hospitals.

158. The West Tripura District has 13 educational institutes viz. B.B. Evening College, Agartala, Government College of Education, Agartala, Tripura Government Law College, Agartala and other institutes.

4.4.6 Archaeological and Historical Monuments

159. Tripura has eight archeological and/or historical monuments protected under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof. However, there are no protected archaeological or historical monuments within the core zone of Dukli IE.

160. The present regulations of Government of India prohibit any construction activity within 100 meters and regulate construction activity within 200m, beyond the first 100 meters of prohibited area of any protected monument under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof.

4.4.7 Physical Cultural Resources

161. The core zone of Dukli IE including its surrounding 500m peripheral area has no movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Magnitude and Significance of Impacts

162. Based on the assessment of baseline environment of both core and buffer zones *vis-à-vis* the proposed infrastructure development works within Dukli industrial estate, the IEE has not identified any significant and irreversible environmental impacts.

163. The IEE has considered the environmental features within 15 meters on either side as corridor of direct impact (COI) for all linear components (roads, stormwater drainage, HT/LT cable etc.) and a 500m radius for all area-based components (building and common facilities) within the Dukli IE. The environmental sensitivity of all proposed components is documented and provided in **Appendix-6** and the anticipated impacts are summarized in **Table 5-1**. The environmental impacts and the respective risk level are given in **Table 5-2**.

164. The impacts due to the proposed infrastructure development works within the Dukli IE are short-term, confined to the respective corridor of direct impact and limited to the construction stage. The impacts are not anticipated to be long term on environmental attributes such as geology, hydrogeology, soil, flora, fauna etc. of the core and buffer zones.

Table 5-1: Anticipated Impacts due to Proposed Infrastructure Development Works

Sl. No.	Development Components	Corridor of Direct Impact	Likely Impacts
1	Additional 10 industrial plots spread over 4.52 ha	Respective plot and its 500m meters peripheral area	<ul style="list-style-type: none"> Demarcating plot boundary may have minimal impacts limited due to clearance of shrubs/ vegetation. No tree felling anticipated
2	Utility Corridors along both sides of roads, total length of utility corridor- 2168 meter with varying width of corridor (3250 m and 2500 m), total green area developed along with roads is 2296 Sqm.	15 meters on either side of the existing road alignment	<ul style="list-style-type: none"> Site clearance (shrubs/ vegetation), Felling of 13 trees and these trees are commonly found in the region and do not belong to RET category. Increase in air pollution (mainly dust) & noise levels due to excavation and road construction works.
3	Widening of existing internal roads – 1.31 km		<ul style="list-style-type: none"> Inconvenience to existing road users due to traffic diversions.
4	Construction of 2.4 km stormwater drains with 7 culverts		<ul style="list-style-type: none"> Workers/ community safety
5	Augmentation of power system 33 Kv line, 33/11 S/s, and 11 Kv feeder (HT/ LT/ SCADA cables/ OFC), Installation of additional 7 nos. DTR, 6 nos. high mast light and 10 kw solar power unit		<ul style="list-style-type: none"> On site drainage, disposal of construction debris
7	A common facilities center with 1 weighbridge, 4 nos. gates, 1.71 km of new boundary wall and upgradation 1.15 km of existing boundary wall.	Respective site and its 15-meter peripheral area	<p>Likely impacts are:</p> <ul style="list-style-type: none"> Site clearance (shrubs/ vegetation), No tree felling anticipated Increase in air pollution (mainly dust) & noise levels due to excavation and road construction works.

Sl. No.	Development Components	Corridor of Direct Impact	Likely Impacts
			<ul style="list-style-type: none"> • Inconvenience to existing road users due to traffic diversions. • Workers/ community safety • On site drainage, disposal of construction debris.

Table 5-2: Environmental Impacts and Risk Level for Dukli IE

Sl. No.	Environmental Attributes	Risk-Construction Phase		Risk-Operation Phase	
		Linear Components	Area Components	Linear Components	Area Components
1	Geology	Low	Low	Low	Low
2	Hydrogeology	Low to moderate	Low to moderate	Low	Low to moderate
3	Physiography	Low	Low	Low	Low
4	Topography	Low	Low	Low	Low
5	Drainage	Low	Low	Low	Low
6	Land Use	Low	Moderate	Low	Low
7	Surface Water Use	Low	Low	Low	Low
8	Ground Water Use	Moderate	Moderate	Low	Moderate
9	Agriculture & Soils	Low	Low	Low	Low
10	Climate & Rainfall	Low	Low	Low	Low
11	Dust & Visibility	Low to moderate	Low to moderate	Low	Low
12	Ambient Air Quality	Low to moderate	Low to moderate	Low	Moderate
13	Ambient Noise	Low to moderate	Low to moderate	Low	Low
14	Trees & Vegetation Clearance	Low	Low	Low	Low
15	Flora & Fauna	Low	Low	Low	Low
16	Flood Hazard	Low	Low	Low	Low
17	Earthquake	Very High	Very High	Very High	Very High
18	Wind Speed/ Cyclone	Low	Low	Low	Low
19	Thunderstorms	Low	Low	Low	Low
20	Landslide & Fire	Low	Low	Low	Low
21	Campsite/ Workforce Camps	Low to moderate	Low to moderate	Low	Low
22	Occupational Health & Safety	Low to moderate	Low to moderate	Low	Low
23	Community Health	Low	Low	Low	Low

Keynote: Impact of low or non-existent significance (rated as High, Moderate, Low to Moderate and Low)

165. The construction stage impacts like vegetation clearance, dust and noise levels, air pollution due to vehicular emissions, worker's health & safety, construction site management, construction material management including debris disposal, on and off-site sanitation management works are largely reversible, transitory in nature and confined to the existing IE boundary.

166. All such short-term impacts have been assessed and described in the following sections along with suitable mitigation measures. The construction stage impacts can be mitigated through generic measures, most of which are like Good International Industry Practices (GIIPs) and considered incidental to works.

167. The impacts arising due to laying of various utilities like electric cables (11/33 KV) and related components are governed by the respective regulations and code of practices which stipulates all technical and safety requirements during erection, testing and commissioning stages.

5.2 Geology

Impacts-Construction Phase

168. The construction works for the infrastructure development will not have any impact on geology, since the core and buffer zones do not have any reserves of rock/stone aggregates (ref. Section 4.2.1). Thus, no new project specific quarries/ crushers or sand mining are to be established for the development works. The existing quarries/crushers and sand mining operations at respective source locations are deemed to have all statutory/ regulatory compliances of state pollution control board(s) and regulated for prevention of air, noise and water pollution under the EPA Act (ref. Table 2-1). The estimated quantities of construction materials and lead distance are given in **Table 5-3**.

Table 5-3: Estimated Construction Materials and Lead Distances

Sl. No.	Material	Unit	Quantity	Location	Lead distance (km)
1	Sand	Cum	4051.51	Nearest River	10
2	Stone Aggregates	Cum	20582.68	Churaibari	178
3	Cement	MT	103810.72	Agartala	7.5
4	Steel	MT	539.57	Agartala	7.5
5	Bricks	Nos	297,780	Jhirania	23

169. The construction works within the Dukli IE will not warrant any deep excavation and maximum depth of excavation will not ordinarily exceed 3 meters from existing road/natural ground level (ref. Section 3 for proposed development components). All such excavated areas will be back filled and restored to their previous levels after construction works.

170. Therefore, the construction works for the proposed infrastructure development within Dukli IE are not anticipated to cause any long- or short-term impacts on geology of the area.

Mitigation Measures

- Project design has been considered to minimize the construction footprint as well as resource efficiency in all the proposed works, to conserve finite natural resources, which is under stress due to ever increasing demand.
- No specific mitigation measures are warranted to minimize the impacts on geology of the area. However, measures required for limiting the impacts during construction activities are described under the environmental management plan (EMP) (ref. Table 9-1 to 9-3).
- The EMP also specifies the responsibility for planning and execution of such measures along with mechanism for supervision & monitoring throughout the construction and operation stages.

Impacts-Operation Phase

171. The operation phase of the proposed infrastructure development works will not require construction materials and neither any deep excavation and related activity, akin to construction phase and therefore is not anticipated to cause any long or short term (cumulative/ residual) impacts on geology.

Mitigation Measures

- Operation phase does not warrant any mitigation measures to minimize impacts on geology of the core and buffer zones.

5.3 Hydrogeology

Impacts-Construction Phase

172. The proposed infrastructure development works at Dukli IE will require water for various construction activities including dust suppression measures during different stages of project implementation. In addition, water will also be required for providing sanitation facilities at the construction campsite and workforce camps. The daily construction water demand for development works is estimated at 5.73 KL, which is intended to be met through existing tube well (ref. **Table 5-4**). The core and buffer zones do not have any surface water bodies/ sources (ref. Section 4.2.4).

173. At present, there is 1 existing tube well, with an average yield of 125 cum/hr., which will be adequate to meet the construction water demand. As per the assessment carried out by the CGWB, core and buffer zones of Dukli IE have adequate groundwater resources (ref. Section 4.2.2 for available groundwater resources).

Table 5-4: Construction Water Requirement for development works at Dukli IE

Sl. No	Activity	Water Requirement (KL)
1	Consolidation of Earth and Compaction	2399.04
2	Mixing and Curing of Concrete	55.02
3	Dust suppression and Camp site management	24.06
4	Sanitation & Drinking water at workforce camps	12.03
Water Requirement in Kilo Liters (KL)		2490.15
Add 15% for wastage and contingency		373.52
Total Water Requirement (KL)		2863.67
Avg. Daily Water Requirement for 500 workdays in Kilo Liters per Day (KLD)		5.73

Mitigation Measures

174. The following measures are considered to offset the impacts due to groundwater utilization at Dukli IE:

- Construction of rainwater percolation wells for recharging groundwater have been considered at 10 locations, selected based on in-situ percolation rate within the core zone i.e. Dukli IE. The percolation wells will be constructed as per the guidelines Central Ground Water Authority (CGWA) and/or Central Public Works Department, Govt. of India.
- 2.18 ha within Dukli IE is being developed as green belt area, which is also expected to replenish groundwater, which works out to 13.2% of total 16.30 ha, considered for the present development (ref. Section 4.2.9 for rainfall data in West Tripura district).
- DoIC/ TIDCL will encourage all industrial units (upcoming) within the Dukli IE, to install roof water harvesting and groundwater recharging structures within individual industrial plots, to promote replenishment of groundwater resources.

Impacts-Operation Phase

175. The projected water demand for the operation phase will be met through the existing tube well, which will be adequate to meet operation phase demand as well, given the prevailing groundwater resources of the core and buffer zones (ref. Section 4.2.2).

176. Thus, the operation phase of the Dukli IE is not likely to cause any long- or short-term impacts on hydrogeology/ groundwater resources of the region.

Mitigation Measures

177. The following measures are required to further offset the residual impacts during the operation phase:

- Routine maintenance and cleaning of all the rainwater percolation wells for recharging groundwater during pre and post monsoon seasons and ensure its effective functional status.
- Routine maintenance and upkeep of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater.
- DoIC/ TIDCL shall continue to encourage and promote all industrial units (both existing and upcoming) within the Dukli IE, to install roof water harvesting and groundwater recharging structures within their respective individual industrial plots for replenishment of groundwater resources.

5.4 Physiography and Elevation

Impacts-Construction Phase

178. The proposed infrastructure development works at Dukli IE do not involve any major construction or deep excavation works, which alters the existing physiography and elevation profile of the area. The proposed works like development of additional industrial plots, widening of roads, stormwater drains etc. follow the existing physiography and terrain (ref. 4.2.3 and 4.2.5 under Section 4).

179. Therefore, no significant or long-term impacts are foreseen on the alteration of physiography and terrain due to proposed works. On the contrary, the proposed works will augment industrial growth and consequently socio-economic benefits to the state.

Mitigation Measures

180. No specific mitigation measures are required for managing the impacts on physiography. However, several GIIPs (good international industry practices) for mitigating incidental impacts arising due to construction activities like establishment of camp sites/ work force camps, removal of topsoil, contamination of ground water/ soil due to leakage/ spillage during handling of fuels/ lubes are included in the environmental management plan (EMP).

Impacts-Operation Phase

181. The establishment of new industries will be limited to the allocated plots within the Dukli IE, which is not likely to alter the physiography and elevation profile/ topography within the core zone.

182. Thus, the operation phase of the Dukli IE is not likely to cause any long- or short-term impacts (cumulative/ residual) on physiography and elevation profile/ topography of the core zone.

Mitigation Measures

183. No specific mitigation measures are required for managing the impacts on physiography and elevation profile/ topography during operation phase.

5.5 Hydrology and Drainage

Impacts-Construction Phase

184. The project design considers 2.4 km long stormwater drains along with 7 culverts to drain the runoff from the core zone i.e. entire IE. The stormwater outfalls will connect to the nearest natural drainage channels within the core zone. In addition, the project design has validated the discharge capacity of the stormwater drains considering the maximum/ peak daily intensity of rainfall reported in the last 50 years (or as available) and accounting for additional discharge capacity due to the excess rainfall/ change in the weather pattern induced by climate change⁹.

185. Thus, the construction works will not impact the natural drainage system within the core zone i.e. Dukli IE and its peripheral area.

186. Since, core zone i.e. Dukli IE and surrounding areas do not have any natural surface water bodies (ref. Section 4.2.4), there will be no impact on surface water resources of core and buffer zones because of this project construction.

Mitigation Measures

187. In addition, specific mitigation measures, which are required to minimize the impacts on hydrology and drainage area during construction stage are described in the EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

188. No specific mitigation measures are required for managing the impacts on hydrology and drainage, except for the routine maintenance and cleaning of all the stormwater drains as well as outfalls connecting to the natural drainage channels within core zone during pre and post monsoon seasons.

189. Thus, the operation phase of the Dukli IE is not likely to cause any long- or short-term impacts on hydrology and drainage of the core and buffer zones.

Mitigation Measures

190. The measures which are required to further offset the residual impacts, if any on hydrology and drainage during the operation phase, are already described under Section 5.3 and the same shall apply.

5.6 Geomorphology and Soils

Impacts-Construction Phase

191. The project design has evaluated alternatives and considered measures to limit the excavation quantities as well as to reuse of excavated materials in the construction works, particularly leveling and re-grading of the industrial plots, to minimize or avoid disposal of

⁹ Climate Risk and Adaptation Assessment (CRA) and Climate Resilience Framework Report, prepared as part of the detailed project report.

excess excavated earth. The estimated excavation and reuse of excavated earth for the development works is given in **Table 5-5**.

192. Therefore, the construction phase will not have any significant or long-term impacts on the geomorphology and soils of the core zone.

Table 5-5: Estimated Earth Work Excavation and Reuse Quantities

Sl. No	Item	Unit	Quantity in cum
A	Quantity from excavation		
1	Earth Work Excavation for roads, Stormwater drains, culverts and all other utility buildings, and trench for SWD, OFC cable, Electrical Cable etc.	Cum	9577.8
	Total A		9577.8
B	Reuse of excavated materials		
1	Back filling of earth works in, Stormwater drains, all utility buildings, and trench for WS, OFC cable, Electrical Cable etc.	Cum	6402.98
2	Leveling and Re-grading the industrial plots	Cum	3127.28
	Total B		9577.8

Mitigation Measures

193. Specific mitigation measures required for segregated collection and preservation of topsoil (up to 30cm depth), prior to site clearance of any construction activities are described in the EMP (ref. Table 9-1 to 9-3).

194. The reuse of the excavated earth for landscaping and green belt development will however require correction of pH by addition of calcium oxide or calcium carbonate, which in turn increases the availability of nitrogen, phosphorus, calcium and magnesium in acidic soils and thus enables growth of vegetation (ref. Section 4.2.6). The EMP (ref. Table 9-1 to 9-3) specifies reuse of preserved topsoil for land escaping and green belt development, within the IE.

Impacts-Operation Phase

195. The operation phase of the proposed infrastructure development works will not involve any deep excavation and related activities, which has potential to generate excavated earth and/or construction debris. Thus, operation phase is not anticipated to cause any long- or short-term impacts (cumulative/ residual) on geomorphology and soils.

Mitigation Measures

196. No specific mitigation measures are required for managing the impacts on geomorphology and soils during operation phase.

5.7 Land Use

Impacts-Construction Phase

197. The proposed works within Dukli IE is limited to 7.57 ha. i.e., nearly 45.7% of 16.56 ha of total area. The works comprise plot development and other allied infrastructure to meet the future demand as given in **Table 5-6** (ref. Table 3-4 for more details).

198. All the proposed development works are within the industrial estate, existing since 1982, and no fresh land is being acquired or diverted for industrial use. Thus, the impacts of the construction phase are short term and will be limited to the boundary of the industrial estate.

Table 5-6: Land Use of Proposed Development at Dukli IE

Sl. No	Land Use	Proposed Area (ha)	In %
1	Industrial Area Plotted development, Industrial Sheds	4.52	59.7%
2	Transportation Roads, Junction, parking etc.	0.84	11.1%
4	Facilities Public and Semi-Public: health care center, educational institutes, weigh bridge and administration etc. Utilities: Electric sub-Station, Pumping Stations, Underground Reservoirs / Fire Fighting Tanks and other utilities, etc.	0.03	0.4%
6	Open Space Parks and open areas around it, steep slopes and low-lying lands	2.18	28.8%
Total		7.57	100%

Mitigation Measures

199. The following measures are considered to further minimize the impacts due to change in land use.

- 2.18 ha (28.8% of 7.57ha) within Dukli IE is being allocated for the development of parks and open areas, to offset the impacts due to change in the land use viz. industrial plot and infrastructure development.
- Topsoil from site clearance activity shall be preserved and reused in green belt and landscaped area development. The reuse of the topsoil/ excavated earth will require correction of pH and soil nutrients (N, P & K) to enable vegetation growth (ref. Section 4.2.6).
- Further, contractor's campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps are to be established in vacant industrial plots within Dukli IE. No fresh land outside the IE shall be considered for any of these establishments.
- Measures to minimize the impacts due to construction activities like vegetation clearance, dust and noise levels, air pollution due to vehicular emissions, worker's safety, construction site management, construction material management including debris disposal, on and off-site sanitation management are described in the EMP (ref. Table 9-1 to 9-3).
- The EMP also specifies the responsibility for planning and execution of such measures along with mechanism for supervision & monitoring throughout the construction stage.

Impacts-Operation Phase

200. The operation phase of the Dukli IE will not involve any changes in the land use and all developable vacant land has been considered/ utilized in the presently proposed works (ref. Table 3-4).

201. Thus, the operation phase is not anticipated to cause any long- or short-term impacts on land use.

Mitigation Measures

202. Upon demobilization of the contractor, all the campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps etc. are to be restored to their previous stage. All the construction remanent materials/ debris shall be cleared and disposed of at approved disposal sites.

203. Other than this, no specific mitigation measures are required for managing the impacts on land use during operation phase.

5.8 Agriculture

Impacts-Construction Phase

204. The development works within Dukli IE will not have any direct impact on the present agriculture or cropping pattern either in core or buffer zones.

Mitigation Measures

205. No specific mitigation measures are required to minimize the impacts on agriculture.

206. In the unlikely event of supplying excess excavated earth from private agriculture lands, care shall be taken to inform the beneficiaries about the requirement for pH correction and addition of soil nutrients to improve the crop yield (ref. Section 4.2.6).

Impacts-Operation Phase

207. The operation phase will also not have any direct impact (short or long term) on the agriculture or cropping pattern either in core or buffer zones.

208. On the contrary, development works may attract more agriculture-based industries to Dukli IE, which in turn can promote certain agriculture/ cropping patterns in the region (ref. Section 4.2.8).

Mitigation Measures

209. No specific mitigation measures are required to minimize the impacts on agriculture/ cropping pattern.

5.9 Forest and Protected Areas

Impacts-Construction Phase

210. The construction works at Dukli IE does not warrant/ involve diversion of forest land. Further, no forest areas are within the core zone i.e. 500m peripheral area of the IE. Therefore, no impacts are foreseen on the forest areas (ref. Section 4.3.1 & 4.3.2).

211. Similarly, the construction works at Dukli IE will not have any impact (short or long term) on the protected areas (wildlife sanctuaries and national parks). The nearest wildlife sanctuary and or its notified eco-sensitive zone is 10.58 km from the IE (ref. Section 4.3.3).

Mitigation Measures

212. Since there is no impact on forest and protected areas, no specific mitigation measures are warranted.

Impacts-Operation Phase

213. The operation phase also will not have any direct impact on the forest and protected areas in the core or buffer zones.

Mitigation Measures

214. Since there is no impact on forest and protected areas, no specific mitigation measures are warranted during the operation phase.

5.10 Flora

Impacts-Construction Phase

215. The site clearance activity for infrastructure development components (linear and area based) will involve clearance of vegetation clearance as well as felling of 13 trees and these trees are commonly found in the region and does not belong to rare, endangered and threatened category.

216. The ecological investigations have also reported that none of the flora and/or trees within Dukli IE belong to rare, endangered and threatened as notified by the Tripura state Forest Department (ref. Section 4.3.4 to 4.3.6).

Mitigation Measures

217. The following measures are considered to minimize or reclaim the impacts on flora due to construction works.

- The loss due to tree felling for construction works within the IE will be recovered through compensatory tree plantation (1:5). The Tripura Forest Department has laid down procedures for issuing tree felling permissions.
- TIDCL has already completed a joint verification survey with the forest department but has yet to receive permissions for felling of these trees from the State Forest Department. The cutting of 13 trees would be initiated only after obtaining the requisite tree cutting permission from the forest department (ref. Appendix-5).
- The selection of species for compensatory plantation will be done in consultation with the Tripura Forest Department and locally prevalent species including those which have been felled will be given preference and/ or duly considered.
- To compensate the trees felled for the construction works, about 65 saplings (5 saplings for every tree felled) will be planted along the roads, and other open areas within the IE.
- The planted saplings will be provided with bamboo guards and will be maintained for 3 years and ensure a minimum survivability of 70%. The EMP includes specific budgetary provision for the compensatory plantation.
- Compensatory plantation including maintenance up to 3 years with 70% survivability will enable to offset the net loss and ensure net gain from 3rd year onwards.
- In addition, specific mitigation measures required to minimize the impacts on flora of the area during construction activities as well as to ensure survivability of the saplings are described under EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

218. The operation phase also will not have any direct impact on the flora of the core or buffer zones. On the contrary, the development of the green belt area and mitigation measures like compensatory tree plantation (1:5) are likely to offset the short term impacts due to construction activities like site/ vegetation clearance and tree felling, among others.

Mitigation Measures

219. The following measures are to be considered to minimize or reclaim the impacts on flora during the operation phase.

- Ensure routine maintenance and upkeep of all the compensatory saplings with minimum survivability of 70% including replanting the dead saplings and replacement

of damaged tree guards, if any for a minimum period of 3 years. The EMP provides budgetary provisions for 3-year maintenance period.

5.11 Fauna

Impacts-Construction Phase

220. The ecological investigations as well as consultations with the local community have not indicated presence or sighting of any wildlife and/or any animal-human conflicts during the past 10 years within the core zone of Dukli IE (ref. 4.3.7 under Section 4).

221. The nearest protected area and its notified eco-sensitive zone (Sepahijala WLS) is at 10.58 km. Therefore, the infrastructure development works from the Dukli IE are not likely to have any impacts on fauna within the core or buffer zones.

Mitigation Measures

222. No specific mitigation measures are required to avoid impacts on fauna of the core and buffer zones. However, instructions which are to be followed by the construction workforce in the unlikely event of sighting of any wildlife fauna during construction activities are given under EMP (Table 9-1 to 9-3).

Impacts-Operation Phase

223. Likewise, the operation phase also will not have any impact on the fauna of the core or buffer zones.

Mitigation Measures

224. No specific mitigation measures are required to avoid impacts on fauna of the core or buffer zones during the operation phase.

5.12 Weather and Climate

Impacts-Construction Phase

225. The construction works within Dukli IE, will not cause any emissions that can impact local weather and climate in the long term. The baseline air, noise and water quality are within the stipulated national standards and do not critically exceed the respective acceptable and permissible limits (ref. Section 4.2.9 to 4.2.13).

Mitigation Measures

226. Measures to minimize the impacts during construction activities like dust suppression, regulating noise levels, restricting vehicular emissions, ensuring worker's health & safety are described under EMP (Table 9-1 to 9-3).

Impacts-Operation Phase

227. No major industries are likely to come up within the Dukli IE, which can release significant gaseous emissions due to its small size. In any case, all the upcoming industries during the operation phase will be regulated for emissions through consent management (CTE and CTO) under the air, noise and water (Prevention and Control of Pollution) Acts (ref. Table 2-1 under Section 2).

228. Thus, no short and/ or long-term impacts are foreseen on the weather and climate during the operation phase.

Mitigation Measures

229. No specific mitigation measures are required to avoid impacts on air quality of the core zone during the operation phase.

5.13 Ancient Monuments/Archaeological Sites

Impacts-Construction Phase

230. The core zone i.e. Dukli IE and surrounding peripheral area up to 500m does not have any ancient monuments and/or archaeological site(s) protected under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and The Tripura Ancient Monuments and Archaeological Sites and Remains Act, 1997 (ref. Section 4.4.6).

231. The present regulations of Government of India prohibit any construction activity within 100 meters and regulate construction activity within 200m, beyond the first 100 meters of prohibited area of any protected monument under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof.

232. Therefore, there will be no impacts on ancient monuments and archaeological sites due to the construction works at Dukli IE.

Mitigation Measures

233. No specific mitigation measures are required to avoid impacts on any ancient monuments and/or archaeological site(s).

234. However, in the unlikely event or scenario of sighting of “remnants” or “chance finds” of archaeological or historical importance, the instructions/ management measures which are to be followed by the construction workforce are given in the EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

235. Likewise, the operation phase also will not have any impact on the ancient monuments and archaeological sites of the core or buffer zones.

Mitigation Measures

236. No specific mitigation measures are required during the operation phase to avoid impacts on any ancient monuments and/or archaeological site(s).

5.14 Physical Cultural Resources

Impacts-Construction Phase

237. The core zone i.e. Dukli IE and its surrounding 500m peripheral area has no movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance (ref. Section 4.4.7).

238. Therefore, there will be no impacts on physical cultural resources due to the construction works within core zone i.e. Dukli IE.

Mitigation Measures

239. No specific mitigation measures are required to avoid impacts on physical cultural resources.

240. However, in the unlikely event or scenario of sighting of “remnants” or “chance finds” of physical cultural resources during the construction phase, instructions/ management measures which are to be followed by the construction workforce are given in EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

241. The operation phase will also not have any impact on physical cultural resources within core zone i.e. Dukli IE

Mitigation Measures

242. No specific mitigation measures are required during the operation phase to avoid impacts on any physical cultural resource(s).

5.15 Surface & Ground Water Pollution

Impacts-Construction Phase

243. The estimated daily generation of sewage and sullage/ sanitary waste at camps site offices and work force camps during the construction stage is given in **Table 5-7**. The untreated sullage/ sewerage from such areas will have potential to cause surface and groundwater pollution.

Table 5-7: Estimated Daily Sanitary waste generation during Construction Stage

Sl. No.	Category	User Nos	LPD ¹⁰	Quantity in Liters Per Day
1	Supervision staff at camp site office	8	90	720
2	Non-local /migrant labor at workforce camps	45	90	4,050
			Sub-total	4,770
			Add 15% for wastage and Contingency	716
			Daily Water Requirement for Sanitation and Ablution (rounded off to)	5,486
			Estimated Quantity of Sewage generation @ 80% of Water Consumption as per Govt. of India Norms	4,388

Mitigation Measures

244. The construction stage impacts on surface and groundwater pollution can be mitigated through provision of septic tank along with soak pit arrangements of adequate capacity at all toilets and wash areas within camp site and work force camps. The sizes of the septic tank and soak pits for different user capacity in accordance with the guidelines of CPHEEO, Ministry of Housing and Urban Affairs, Govt. of India as well as typical details of oil interceptors are given in EMP (ref. Table 9-1 to 9-3).

245. The EMP also includes provision for oil interceptors with separate drainage systems at all vehicle servicing and oil/lube/fuel storage areas (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

246. The operation phase of the Dukli IE is not likely to cause any long- or short-term impacts on surface and ground water pollution.

¹⁰ LPD refers to liters per day consumption or discharge as per the Government of India Norms

Mitigation Measures

247. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within Dukli IE and disposed of at approved municipal sites. Other than this, no specific mitigation measures are required for managing the impacts on surface and ground water pollution during the operation phase.

5.16 Air Quality

Impacts-Construction Phase

248. The baseline ambient air quality for all monitored parameters (PM₁₀, PM_{2.5}, SO₂, NO₂, CO) within Dukli IE (ref. Table 4-9 of 4.2.15 under Section 4) were below the NAAQS, which can be attributed to present low vehicular traffic and absence of major industrial emission sources.

249. The construction works within Dukli IE may contribute to increase dust levels due to activities like site clearance/preparation, earth work excavation, back filling, construction material handling, among others. Similarly, gaseous emissions can be due to operation of vehicles and construction machinery like compactors, rollers, concrete batching plant, hot mix plant and wet mix macadam plants, which may emit carbon monoxide, Sulphur dioxide, and oxides of nitrogen. Thus, impact on the air quality is transitory in nature and limited to construction stage.

Mitigation Measures

250. Key avoidance and mitigation measures, which can avoid or reduce dust levels and vehicular emissions during construction stage are included in the EMP (Table 9-1 to 9-3).

251. Periodical environmental monitoring through an NABET accredited agency/ laboratory will be carried out during the construction phase to ensure the effective implementation of EMP measures. Adequate budgetary provisions are included in the EMP for periodical environmental monitoring.

Impacts-Operation Phase

252. No major industries are likely to come up within the Dukli IE, which can release gaseous emissions due to its small size. Thus, the operation phase will not have any impact on air quality.

Mitigation Measures

253. All the upcoming industries during the operation phase will be regulated for emissions through consent management (CTE and CTO) under the air, noise and water (Prevention and Control of Pollution) Acts (ref. Table 2-1 under Section 2).

254. No specific mitigation measures are required for managing the impacts on air quality during the operation phase.

255. Periodical environmental monitoring through an NABET accredited agency/ laboratory will be carried out during the first year of the operation phase. Adequate budgetary provisions are included in the EMP for the same.

5.17 GHG Emissions and Climate Change Concerns

Impacts-Construction Phase

256. Installation of solar power generation of 10 KW capacity is one of the components included in the proposed works at Dukli IE, to offset the energy demand from fossil fuel. The solar power

generation initiative is a small step towards reduction of GHG emissions/ carbon footprint by nearly 1% and address climate change concern (ref. 3.14 under Section 3).

257. The solar panels are proposed to be installed at open and vacant places, which will involve very minimum construction activities for the foundation and anchoring support for the panels on ground and does not warrant any significant levelling and/or major excavation works. Thus, the impacts are very limited and short term in nature.

Mitigation Measures

258. No specific mitigation measures are required for managing the GHG emission and climate change concerns, except for routine maintenance and cleaning of all solar panels to ensure optimum green power generation within Dukli IE.

Impacts-Operation Phase

259. The operation phase of the Dukli IE is not likely to have any long- or short-term impacts on GHG emissions. However, it is anticipated that the Dukli IE may be provided with a natural gas pipe connectivity soon (depending upon the industries need and viability), which can offset the energy demand from fossil fuel and enable reduction of GHG emissions/ carbon footprint and address climate change concern.

Mitigation Measures

260. Ensure routine cleaning of all solar panels to ensure optimum green power generation within Dukli IE, to ensure optimum power generation and to offset GHG emissions.

261. All the damaged and dysfunctional solar panels, if any, are to be disposed of in accordance with Solar E-waste Management Rules (ref. Table 2-1).

5.18 Noise & Vibration

Impacts-Noise-Construction Phase

262. The baseline ambient noise levels within Dukli IE were below the standards, which can be attributed to rural expense, present low vehicular traffic and absence of major noise emitting industrial activities. The principal source of noise during construction works would be from operation of equipment, machinery and vehicles deployed for construction activities (ref. Table 4-10 of 4.2.16 under Section 4).

263. The earth-moving machinery e.g., excavators, graders and vibratory rollers has potential to generate high noise levels of more than 70 dB (A) and can cause disturbance to the settlements, adjacent areas up to 100 m from the worksite. The noise levels of construction machinery typically used in construction works and permissible noise exposure levels as per OSHA (Occupational Safety and Health Administration), USA is given in **Tables 5-8** and **5-9**.

Table 5-8: Typical Machinery used in Construction Works

Sl. No.	Equipment Type and Capacity	Noise Level (dBA)	Sl. No.	Equipment Type and Capacity	Noise Level (dBA)
1	Dozer 200 Cum/hr Cap.	85	13	Backhoe and Front-end loader	80-85
2	Motor Grader – output above 150 KW Cap.	85-94	14	Bulldozer	85
3	Long arm Hydraulic Excavator	85	15	Compactor	82

Sl. No.	Equipment Type and Capacity	Noise Level (dBA)	Sl. No.	Equipment Type and Capacity	Noise Level (dBA)
4	Vibratory Roller (2 Tandem + 1 Vibro) – Minimum 8-10T static Weight	94	16	Compressor	81
5	Pneumatic Road Roller (200-300KN Cap.)	85	17	Concrete Mixer	85
6	Smooth Wheeled Roller – 8-10T Cap.	85	18	Concrete Pump	82
7	Tipper Truck – 5.5 Cum Cap.	85-88	19	Crane, Derrick/ Mobile	83
8	Rock Excavator – 60 Cum/hr Cap.	95	20	Pavement Breaker	88
9	Paver Finisher Hydrostatic with sensor control – 100 TPH Cap.	89	21	Paver	89
10	Paver Finisher Mechanical for WMM Work – 100 TPH Cap.	89	22	Pile Driver, Impact	101
11	Transit Mixer – 3-4.5 cum per hr Cap.	81	23	Pneumatic chip hammer/ Jackhammer	102-113
12	Cranes 60-80 T – capacities, with telescopic arm of Min 25 m length	85	24	Hammer	87-95

Table 5-9: Permissible Noise Exposures (OSHA Standards)

Sl. No.	Duration per day, hours	Sound Level dBA slow response
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	1 ½	102
7	1	105
8	½	110
9	¼ or less	115

Source: OSHA (Occupational Safety and Health Administration), USA

264. The noise generated during the construction would cause short term inconvenience to the population in nearby areas (up to 100m), beyond which it would get drastically attenuated to acceptable levels. Since the areas within the Dukli IE are not densely populated, the severity of the impact due to increased noise levels is not expected to be significant and transitory in nature.

Mitigation Measures

265. The mitigation measures to limit the ambient noise levels by the construction vehicles, equipment and machinery are given in the EMP (Table 9-1 to 9-3).

266. In addition, periodical environmental monitoring through an NABET accredited agency/ laboratory will be carried out during the construction phase to ensure the effective implementation of EMP measures. Adequate budgetary provisions are included in the EMP for periodical environmental monitoring.

Impacts – Noise-Operation Phase

267. No major industries are likely to come up within the Dukli IE, which can contribute to increased ambient noise levels due to its small size. In any case, all the upcoming industries during the operation phase will be regulated for noise levels under the Noise Pollution (Regulation and Control Act), 1990 (ref. Table 2-1 under Section 2). Thus, the operation phase is not anticipated to have any impact on ambient noise levels.

Mitigation Measures

268. No specific mitigation measures to limit the ambient noise levels are required during the operation phase. Periodical noise level monitoring through an NABET accredited agency/ laboratory will be carried out during the first year of operation phase. Adequate budgetary provisions are included in the EMP for environmental monitoring during the operational phase.

Impacts–Vibration-Construction Phase

269. Vibrations arising from construction activities like earth work excavation, compaction, paving and movement of construction vehicles/machinery are generally ground-borne.

270. The vibration velocity levels in rural settlement areas or low-density settings like Dukli IE is usually 50 VdB (vibration decibels) or even lower, which is well below the threshold of perception for humans, deemed to be around 65 VdB¹¹.

271. Typical outdoor sources of perceptible ground-borne vibrations like earth work excavation, compaction, paving and movement of construction vehicles/machinery, buses and trucks rarely create vibration that exceed 70 VdB, unless the riding surface/condition of pavement is very poor. If the pavement/road conditions are reasonably satisfactory, ground borne vibration from traffic is rarely perceptible.

272. Most perceptible indoor vibrations due to ground-borne vibration include perceivable movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception even by a small margin, although the vibration levels that cause annoyance will be well below the damage threshold for normal buildings.

Mitigation Measures

273. The roads within the IE, even during the construction stage will be paved and maintained¹² by the contractor to ensure smooth traffic movement and hence riding quality of pavement is expected to be satisfactory, thus not likely to contribute to ground borne vibration, beyond threshold levels.

274. The residual impacts of vibration during construction stage, although short term in nature, is not likely to be significant and can be further controlled by measures like regulating construction activities to limited day hours, ensuring normal pace of construction activity with frequent breaks. Such measures can reduce impacts of ground borne vibrations due to project construction activities.

Impact-Operation Phase

275. The operation phase of the Dukli IE is not likely to cause any long- or short-term vibration impacts.

Mitigation Measures

276. During operation phase, ensure that all the upcoming industries with major machineries have appropriate/ suitable isolated machine foundations and control measures, to limit vibration

¹¹ Source: Guidelines for Noise and Vibrations for Metro Rail Transit System by Research Designs and Standards Organization, Ministry of Railways, Government of India

¹² Contractors will be obligated to maintain the present road even during the construction phase through periodic pavement renewals and ensure riding quality and smooth traffic movement for present road users.

beyond threshold levels. In addition, also ensure routine maintenance and upkeep of the internal roads.

277. Such measures can reduce impacts of ground borne vibrations during the operation phase.

5.19 Hazardous and Non-Hazardous Wastes

Impacts-Hazardous Wastes-Construction Phase

278. The construction works at Dukli IE are not anticipated to generate hazardous waste and therefore, no impacts are foreseen.

Impacts-Non-Hazardous Wastes-Construction Phase

279. Large construction works related pollution risks include accidental spill of fuel, used oil or and contamination from poor waste management practices that can affect soil, surface and groundwater at operational sites and/ or establishment camp sites like concrete batching plants, hot mix plants, vehicle parking/ service area, oil/ lube storage areas among others.

280. The construction within Dukli IE activities will generate non-hazardous waste throughout the construction phase. The anticipated non-hazardous waste types include excavated surplus material, construction debris, municipal solid waste, sanitary sullage and sewage generation from construction camp sites and workforce camps. While, hazardous waste may include used oil, lube/grease/cotton waste materials from service areas of construction machinery, empty drums or dis-used/replaced spares of vehicles/machinery, used batteries, not used chemicals for concreting like admixtures etc.

281. Thus, the impacts due to the hazardous waste generation during project construction can be mitigated through safe handling and disposal of waste by adoption of good international industrial practices (GIIP). Also, the site specific EMP will be prepared by the contractor, which will cover the mitigation measures in storage and handling of hazardous waste during implementation of the Project.

282. During the construction stage, the municipal solid waste generation from construction camp site offices and workforce camps is estimated as 13.65 kg per day as shown in **Table 5-10**, which is to be safely handled and stored prior to its disposal at approved places by district administration.

Table 5-10: Estimated Municipal Solid Waste Generation during Construction Stage

Category	Nos	Kg per day	Total Quantity of Solid Waste (kg/ day)
Supervision staff at camp site office	08	0.3	2.4
Non-local /migrant labor at workforce camps	45	0.25	11.25
Total Municipal Solid Waste generation in Kg/day			13.65
Organic Waste Generation @ 40%			5.46
In organic Waste Generation @ 60%			8.19

Mitigation Measures-Hazardous & Non-Hazardous Wastes

283. The site specific EMP (C-EMP) will be prepared by the contractor, which will cover the mitigation measures for storage and handling of both hazardous and non-hazardous waste, as may be required/ warranted during the implementation of the project.

284. No specific mitigation measures are required for handling the hazardous waste during the construction phase.

285. The impacts due to the municipal solid waste during construction phase can be mitigated through safe handling and disposal of waste at district administration approved sites.

286. The used oil/ lubes generated at camp sites is to be collected in HDPE drums and placed under segregated roofed area for periodic disposal at approved waste disposal facilities by the Tripura State Pollution Control Board.

287. The organic waste generated can be composted at respective campsites/work force camps through construction of compost pits for treating organic waste and provision of color-coded separate bins for collecting the organic and inorganic waste.

288. The solid waste management from all campsites, workforce camps and all other operational sites shall be collected periodically and disposed of through the waste collection trucks operated by the Dharmanagar Municipal Council (DMC) and transported to their solid waste management facility for further treatment and disposal.

289. The sanitary/ sullage/ sewage generated at campsites, work force camps and other operational sites are to be disposed of through septic tanks and soak pit disposal arrangements, details of which are given in EMP (ref. Table 9-1 to 9-3).

290. Key avoidance and mitigation measures for waste minimization and management/handling of non-hazardous waste during the construction stage are given in the EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase-Hazardous/ Non-hazardous Waste

291. The operation phase of the Dukli IE is not likely to cause any long or short term hazardous and non-hazardous impacts.

Mitigation Measures

292. All the upcoming industries, which may generate both hazardous and non-hazardous waste during the operation phase is deemed to be covered under respective regulations for waste management and disposal (ref. Table 2-1).

293. Other than this, no specific mitigation measures are required for handling the hazardous and non-hazardous waste during the operation phase.

5.20 Work Zone Safety and Community Safety Risks

Impacts-Construction Phase

294. The construction works within Dukli IE will have potential work zone safety risks for the deployed workforce as well as community safety risks i.e. for workers of the existing industries.

Mitigation measures

295. The work zone safety arrangements for deployed workforce, measures for ensuring community safety during construction activities and traffic diversion arrangements among others are given in the EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

296. The operation phase is not likely to cause any work zone safety and community safety risks within Dukli IE.

Mitigation measures

297. All the upcoming industries within the IE are deemed to be covered under The Occupational Safety, Health and Working Conditions Code, 2020 (ref. Table 2-1) which covers work zone safety arrangements for their deployed workforce within the industrial premises.

298. Other than this no specific measures are required for ensuring work zone and community safety during operation phase.

5.21 Natural Disasters/ Calamity and Hazard Vulnerability

Impacts-Construction Phase

299. Given the fact that the Dukli IE is in earthquake Zone V, which carries highest risk, construction work poses risk and safety hazard to workforce and community, in the event of natural disasters like earthquake and/or landslides triggered during tremors of high intensity earthquake.

300. Such events may strand the workforce or even worse, they may get trapped at project construction and establishment camp sites.

Mitigation Measures

301. The construction sites shall have a “onsite emergency response plan (ERP) (prepared by the contractor)” in an event of natural disasters and/or any other natural calamities in line with the district disaster management plan and same shall be cleared by the PMSC/PIU working under the Project. Further, the onsite emergency response plan will be updated (if required) covering the implementation challenges encountered/not covered in the plan during execution of the Project.

302. As part of the emergency response plan, the construction site in charge shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity.

303. All work force, irrespective of levels, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations.

304. All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily.

305. At project level, the construction site in charge shall designate an Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP.

306. A template for Disaster Management and Emergency Response Plan for the construction phase at Dukli IE has been given in **Appendix-7** to dovetail with the West Tripura district disaster management plan and suiting to requirements of contractor’s scale of establishment after the mobilization.

Impacts-Operation Phase

307. The operation phase, likewise, also carries the highest risk due to earthquake for the workforce engaged within the Dukli IE.

Mitigation Measures

308. The mitigation measures for addressing natural disasters/ calamity and hazard vulnerability during the operation phase shall comprise:

- The IE shall have a “onsite emergency response plan (ERP) in an event of natural disasters and/or any other natural calamities in line with the district disaster management plan.
- As part of the emergency response plan, the IE in charge shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity.
- All work force irrespective of levels and various industries within IE, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations.
- All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily.
- IE shall have designated Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel, drawn from various industries for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP.
- A template for Disaster Management and Emergency Response Plan has been given in Appendix-7, which is to be dovetailed with the West Tripura district disaster management plan and suiting to requirements of the operation phase.

5.22 Labour and Working Conditions

Impacts-Construction Phase

309. The infrastructure development at Dukli IE will require an estimated 113 construction workforce at all levels (98 skilled and unskilled labour and 15 supervisory and managerial staff). It is anticipated that nearly 70-75% of skilled and unskilled labour (approx. 83) are likely to be migrant workers from other states and the rest are likely to be sourced from nearby villages and settlements areas (ref. Section 3.15).

310. Potential labor risks associated with construction workers/labors are:

- Lack of training/awareness/ orientation amongst workforce and sensitization for safety at work, Safe working at heights/ depths and working around moving equipment/machineries
- Lack/Inadequate or inappropriate personnel protective gear and or safety accessories for workforce.
- Injuries/fatalities leading to disability and/or even death, while at work during normal course, either due to negligence at work and/or inadequate experience/training or accidents

- Inadequate first-aid facilities at work sites and lack of emergency response mechanism for shifting injured to hospitals and care thereof.
- Inadequate accommodation, sanitation, and health facilities at work force camps,
- Non-payment, disparity of wages and/ or denial of benefits (compensation, bonus, maternity benefits etc.)
- Discrimination in employment (e.g., abrupt termination of employment, working conditions, wages or benefits etc.)
- Engagement of child labour and trafficking of labour.
- Safety, security of women workforce at work sites and within workforce camps
- Inadequate facilities for pregnant women and lactating mothers and children at camp sites
- Sexual harassment and Gender based violence issues within workforce camps or at work sites.
- Health risks of labour relating to HIV/AIDS and other sexually transmitted diseases
- Conflicts with local community at Potential Gender Based Violence (GBV) hotspots.
- Absence of a grievance mechanism for labor to seek redressal of their grievances/issues.
- Absence or inadequate or non-responsive emergency response mechanism for rescue of workforce, during caving in/mud slips, disasters due to earthquake etc. at operational sites

Mitigation Measures

311. The workforce management plan including guidelines to avoid or handle risks associated with the labor/ workforce during the construction stage are given in the EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

312. The operation phase is not likely to cause any risk related to labour and working conditions within Dukli IE.

Mitigation Measures

313. All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under National Labour Act, 1970, The Child Labour (Prohibition and Regulation) Amendment Act, 2016, The Child Labour (Prohibition And Regulation) Act, 1986 and The Occupational Safety, Health and Working Conditions Code, 2020 (ref. Table 2-1).

314. Other than these no specific mitigation measures are required to avoid or handle risks associated with the labor/ workforce during the operation phase.

5.23 Gender Based Violence (GBV) Risks

Impacts-Construction Phase

315. The presence of construction workers (migrant and local) at construction sites and the women workforce of the existing industries may trigger issues arising out of eve-teasing, stalking, harassment at potential GBV hotspots either within or outside the IE.

316. Also, migrant women workforce may also be vulnerable, if adequate safety and security measures are not available at work sites and/or workforce camps established within Dukli IE. Suitable working environment for women's participation include gender-equal wage

rates, safety & security issues, childcare facilities, health and sanitary requirements, separate toilets for women, temporary housing for families of workforce during the construction work with adequate water and sanitation facilities, among others.

Mitigation Measures

317. The GBV risk mitigation plan to avoid or handle GBV and related issues during the construction stage is given in EMP (ref. Table 9-1 to 9-3).

Impacts-Operation Phase

318. The operation phase is not likely to cause any risk related to gender-based violence for the industrial workforce.

Mitigation Measures

319. All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under the Prevention of Sexual Harassment (POSH) Act, 2013, which address risks related gender-based violence, in the unlikely event.

6.0 ANALYSIS OF ALTERNATIVES

6.1 Considerations for Alternatives

320. Conducting analysis of alternative at the early stages of project design as well as IEE helps to minimize, reduce, or mitigate potential negative impacts and enables to enhance positive impacts, sustainability and development benefits. This section summarizes the various alternatives evaluated through mitigation hierarchy for management of risks. The analysis of alternatives has enabled additional enhancement measures to the project design from the environmental perspective as well.

6.2 Alternative Analysis Option – No project scenario

321. The Department of Industries & Commerce (DoIC), Government of Tripura has embarked upon an ambitious program for industrial promotion, entrepreneurship development, and overall employment generation, which concurrently can promote the industrial growth and economy of the state. Dukli IE is one of the nine prioritized industrial estates identified for development with Best-in-Class Infrastructure development.

322. Dukli IE, spread over 16.30 ha, presently requires an immediate replacement of the worn-out infrastructure and its upgradation for the industrial growth of the state. Unless the infrastructure development works are taken up, it will not attract prospective industrialists for establishing their industries and contribute to the state industrial growth and economy and rather discourage any further investments.

323. Therefore, the infrastructure development works at Dukli IE are essential to sustain the industrial growth and economy of the state. The proposed works include development of vacant land within the IE into additional industrial plots for setting of new industries, improvement of internal roads, storm water drainage, augmentation of power system, social infrastructure amenities and others. Moreover, while planning, care has been taken to follow existing alignments and avoid opening of new areas for laying the infrastructure works, for minimization of impacts.

324. Thus, 'no project scenario' is not a desirable alternative option, which can be exercised for the industrial growth and economy of the state.

6.3 Alternative Analysis Option

325. Project design considered several alternatives through mitigation hierarchy for management of risks, while finalizing the infrastructure at the Dukli IE.

326. Some of the important considerations are summarized hereunder:

- Utilization of all vacant lands and avoiding diversion of fresh land for the development works
- Assessing and retaining the existing infrastructure, which can serve the design period of proposed development.
- Considering the risks associated with climate change for the next 50 years in the design of the project components.
- Balancing of cut and fill quantities has enabled to reuse excess earth excavated (3127.28 cum) for development of industrial plot within the IE boundary. Thus, avoiding opening of new areas for debris disposal.

- Promote use of solar power for streetlights and encourage units to maximize generation of renewable (solar) within their premises, rooftop, etc. to meet captive demand.
- Construction of recharging/ percolation wells at 10 locations to offset the withdrawal of groundwater for industrial purposes of the IE
- To compensate the trees felled for the construction works, about 65 saplings (5 saplings for every tree felled) will be planted along the roads, and other open areas within the IE. The selection of species for compensatory plantation will be done in consultation with the Tripura Forest Department and locally prevalent species will be given preference.
- The planted saplings will be provided with bamboo guards and will be maintained for 3 years and ensure a minimum survivability of 70%, which will enable to offset the net loss and ensure net gain from 3rd year onwards.
- The EMP includes specific budgetary provision for the compensatory plantation. In addition, specific mitigation measures required to minimize the impacts on flora of the area during construction activities as well as to ensure survivability of the saplings are described under EMP (ref. Table 9-1 to 9-3).

7.0 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1 Public Consultations

327. The public consultations were carried out within the core zone i.e. Dukli IE and its peripheral area of 500 meters. The general issues, which surfaced during the consultations and their consideration in the project design are summarized in this section.

328. The key stakeholders consulted during IEE as well as project design include:

- Officials of TIDCL at Dukli IE
- Representatives of the existing industries
- Workforce of the existing industries
- Officials of Tripura State Pollution Control Board having jurisdiction of Dukli IE
- Civil society organizations active in buffer zone

329. During the consultation, the following information was disseminated to participants:

- Objectives of DoIC/ TIDCL for developing the industrial estates in Tripura
- Features/ components of the infrastructure development works considered for Dukli IE
- Likely beneficial impacts arising due to development like increased employment and business opportunities.

330. The consultations were carried out during December 2022 and January, March, April 2023 to elicit viewpoints and/or suggestions of the participants were captured as an input to the project design to the extent feasible and /or warranted. The summary/ generic outcome of the consultations along with suggestion considered in project design are given in **Table 7-1**. The photographs taken during consultations are given in **Table 7-2**.

Table 7-1: Summary of Issues & Generic Outcome of Public Consultations

Summary and Generic Outcome of Consultations	Outcome of Consultations in Project Design
<ul style="list-style-type: none">• Participants were happy to know that development of IE is being taken up by DoIC/ TIDCL, Govt. of Tripura.• Participants have suggested & raised issues that;<ul style="list-style-type: none">• provision of widening of roads with footpaths for pedestrian safety.• stagnation of stormwater and drainage issue along some roads within IE during rainy season.• proper outlet system for the drainage of water in that area.• construction of proper culverts and covered drains to avoid smell wherever required.• improving streetlights along the roads within IE and surrounding areas• Request for employment opportunities within IE.	<ul style="list-style-type: none">• The project design has considered 2.4 km of stormwater drains for the entire IE. 07 CD structures/ culverts along the roads are being reconstructed to improve cross drainage and avoid water stagnation.• Footpaths and streetlights have been considered for pedestrian safety.• The project design considers widening of about 1.31 km of roads from single lane to intermediate along with improvement of major and minor intersections/ junctions with adequate lighting facilities as per requirement.• Project design considers public toilets at selected locations within IE.• Project design considers development of green areas including parks and open areas, including site remediation works of presently inundated ponds emanating bad smell.

Table 7-2: Photographs taken during Public Consultations





7.2 Gender Based Violence (GBV) Consultations

331. The influx or presence of migrant construction workers during the project construction stage has a potential to aggravate Gender Based Violence (GBV) risks within the communities surrounding the IE. Some of the hotspots for the GBV could be nearby settlements areas, rented accommodation for workforce in the nearby areas, liquor shops, market areas among others. Some of the probable GBV risks are:

- Adolescent girls are vulnerable to the incidents of harassment, stalking and eve-teasing while commuting to schools, colleges, and vocational centers.

- Women are vulnerable for GBV risks near marketplaces and liquor vends(hotspots), although no such known presently hotspots exist in and around Dukli IE.
- Women workforce of the existing industries of Dukli IE are at potential risk for eve teasing, stalking, harassment including sexual exploitation and abuse by the migrant construction workers.

332. Migrant women laborers may also be vulnerable, if adequate safety and security measures are not undertaken at work sites and within workforce camps. Suitable work conditions for women's participation includes gender-equal wage rates, safety & security issues with GRM mechanism, childcare facilities, health and sanitary requirements, separate toilets for women, temporary housing for families of workforce during the construction work with adequate water and sanitation facilities. Strict adherence to welfare of women workforce and compliance to child labor norms should be followed during construction stage (ref. EMP for details on GBV risk mitigation actions by contractor).

7.3 Information Disclosure

333. The TIDCL, DoIC, Govt, of Tripura and ADB will disclose the IEE report on their website. Further, the executive summary of IEE report in English and translated version (in local language) shall be disclosure (after mobilization of the contractor and before commencement of works) by the TIDCL to accessible place (such as PMU, PIUs, and construction site) for all the stakeholders including local community within Project area. The IEE report needs to be updated by the TIDCL (covering the associated environmental impact and mitigation measures), if there is any change of location, alignment, design, addition of new component/sub-components and shall be submitted to ADB for review and clearance. The TIDCL needs to ensure that works are not commenced for any change of location, alignment, design, addition of new component/sub-components identified during implementation under the Project, unless the updated/addendum to IEE report is cleared by ADB. Further, the ADB-cleared updated/addendum to IEE report shall be disclosed on TIDCL and ADB website.

334. In addition to providing safeguard updates in the quarterly progress report (QPR) from loan effectiveness, the PMU must submit semi-annual environment monitoring reports (EMR) to ADB for review, clearance, and disclosure, since the loan effectiveness. These EMRs are to be submitted semi-annually during construction phase reverting to annually during operation phase, until the issuance of the project completion report (PCR) by ADB. The EMRs will be due within 15 days of the reporting period's end i.e., 15 July and 15 January each year. The PMU will be responsible for responding to ADB's comments on their EMRs and resubmitting an updated version if required in a timely manner. Once the EMRs have been cleared by ADB, the PMU and ADB will disclose each EMR on their websites. In the event of any breaches of performance standards or other non-compliances recorded by ADB, PMU, PIUs, PMSC and/or their contractors, a time bound, and budgeted, corrective action plan will be provided and followed up for its timely implementation.

335. For each reporting period, SEMR will document covering all sectors/components: (i) all planning and management activities related to environmental safeguards; (ii) progress on EMP implementation (environmental performance) based on PMU and PMSC's respective supervision activities, including any feedback provided to the contractor and action taken; (iii) the results of quantitative monitoring required by the EMP; (iv) records of training activities, emergency drills, awareness raising activities, etc.; (v) details of ongoing consultations with

project beneficiaries and affected persons, as and when needed; (vi) project-related environmental grievances received during reporting period and their resolution including for grievances received in previous reporting periods; (vii) compliance with the EMP and progress towards the desired outcomes with compliance statements supported with evidence; and (viii) the identification of corrective and preventative actions with time-bound, budgeted corrective action plans, as applicable, for any breaches of performance standards or other non-compliances recorded.

8.0 GRIEVANCE REDRESSAL MECHANISM

336. The project will have a common grievance redress mechanism (GRM) to receive, evaluate, and facilitate the resolution of social, environmental, or any other relevant project-related grievances. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the Project. The GRM has been developed in consultation with stakeholders. The public awareness campaign will generate awareness of the Project and its grievance redress procedures. The campaign will ensure that the poor, vulnerable, and others know about the GRM.

337. The GRM will provide an accessible, inclusive, gender-sensitive, and culturally appropriate platform for receiving and facilitating the resolution of affected persons grievances related to the Project. The multi-channel and multi-tier GRM for the Project is outlined below, with each tier having time-bound schedules and responsible persons identified to facilitate and address grievances at each stage.

338. Affected persons will have the flexibility of conveying grievances and/or suggestions by dropping grievance redress/suggestion forms in complaint/suggestion boxes that will be installed by project implementation units (PIU) or by e-mail, by post, or by writing in complaints register or by sending a WhatsApp message on the dedicated number, e-mail to the PIU or telephonically contacting the project management unit (PMU)/PIU.

339. Besides the project's grievance redress mechanism, the Government of Tripura (GOT) has a centralized public grievance redress monitoring system (CPGRMS) where the public can file grievances through a dedicated web portal (grievance.tripura.gov.in). The General Administrative (Administrative Reforms) department is the nodal agency, and an officer of the rank of Joint Secretary is responsible for its functioning. Each department of the state has nominated officers to receive the grievances. The Department of Industries and Commerce (DOIC) has nominated officers of the rank of Deputy Director as nodal officers, whose names and contact details are provided on its website. The affected persons can also lodge their complaints through this online portal. Moreover, a Grievance Box is in place at DOIC and TIDCL to convey grievances and/or suggestions.

340. **Information to the stakeholders about the GRM:** The stakeholders, including affected persons, beneficiaries and citizens, and workers engaged during construction activities under the loan, will be informed about the GRM under the project and of the state through public consultations, disclosures, and distribution of public information booklets (PIB). In the case of illiterate persons, the information will be provided verbally during meetings with them.

341. **Who can complain:** A complaint can be registered by stakeholders directly or indirectly affected by the project. A representative can register a complaint on behalf of the affected person or group, provided that the affected person or group identifies the representative and submits evidence of the authority to act on their behalf.

342. **What the Grievance/Complaint should contain:** Any comments, complaints, queries, and suggestions pertaining to safeguard compliance - environment, involuntary resettlement, indigenous people, design/construction-related issues, compensation, service delivery, or any other issues or concerns related to the Project. The complaint must contain the complainant's name, date, address/contact details, location of the problem area, and the problem. A sample grievance registration form is provided in **Appendix-8**.

343. **Where and how to file a Complaint:** The complaint can be filed online and offline. The people can submit their complaints at the contractor's site office or at the PIU/PMU office. In addition, they can also have grievances/suggestions/queries submitted through phone or e-mails or, the state grievance portal, or social media (on a dedicated WhatsApp number). The information about the GRM will also be displayed on the TIDCL website. Contact numbers and names of the staff and contractors concerned will be posted and displayed at all construction sites.

344. **Grievance redress /Problem solving through participatory Process:** The PMU and PIUs will make efforts to resolve the problems and conflicts amicably through a participatory process with the community. In case of immediate and urgent grievances in the complainant's perception, the contractor and supervision personnel from the PIU will provide the most easily accessible or first level of contact to resolve grievances quickly.

345. **Grievance Redressal Committee:** The GOT will establish the Grievance Redressal Committees (GRC) at the site, PIUs, and PMU levels to provide a mechanism to resolve conflict and disputes concerning compensation payments, environmental safeguards-related issues and cut down on lengthy litigation. The General Manager of the District Industries Centre under DOIC will head the GRC at the PIU level¹³. Similarly, the Director of DOIC will head the GRC at the PMU level. The following will be the composition of the GRCs. The composition of the GRCs at all three levels is provided in **Table 8-1**.

Table 8-1: Composition of Grievance Redressal Committees

Site Level GRC (Level 1)	District level GRC (Level 2)	PMU level GRC (Level 3)
1. Assistant Engineer of concerned Industrial Estate (IE)-TIDCL 2. Junior Engineer, TIDCL 3. Field Engineer of PMSC 4. Social, and gender support staff, PMSC 5. Environmental Safeguard Expert, PMSC/PIU level 6. Two entrepreneur members from the concerned Industrial Estate, with at least one of them a woman (if any) or and a representative from the affected community (as and when required) 7. Executive Engineer of the concerned PIU ¹⁴ .	1. General Manager (GM), District Industries Centre (DIC) 2. Safeguards Specialist (social and gender), TIDCL/ I&C 3. Environmental Safeguard Expert, TIDCL/ PMSC 4. Executive Engineer-TIDCL 5. Assistant Engineer-TIDCL. 6. Team Leader, PMSC 7. Social and/or Environment Safeguards Consultant, PMSC 8. Two entrepreneur members from industrial Estate, with at least one of them a woman (if any) or and a representative from the affected community (as and when required)	1. Director, DOIC, GoT 2. Joint Secretary, Revenue Department, GoT 3. Addl. Director (Projects), I&C, GoT 4. OSD/ GM, TIDCL 5. Superintending Engineer, TIDCL 6. Executive Engineer TIDCL 7. Safeguards Specialist (social and gender), TIDCL/ I&C 8. Environmental (Safeguard cum Climate Change) Expert, TIDCL/ PMSC 9. Nominated representatives from the line departments (ULB, PWD, or any other department, as required) 10. Two entrepreneur members from industrial Estate, with at least one of them a woman (if any)

¹³ DOIC, Government of Tripura (GOT) is the executing agency under the loan.

¹⁴ The Executive Engineer will be involved in case of grievances are not related to the contractor's scope/ work activities, but under the project within the industrial estate (IE).

346. **Site level GRC (First Level):** In case of grievances that are immediate and urgent in the perception of the complainant, the Assistant Engineer of the PIU, in coordination with the Junior Engineer of PIU and field engineer of PMSC and the Contractor's on-site personnel (concerned engineer and EHS cum social supervisor) will provide the most easily accessible or first level of contact for quick resolution of grievances. If the grievance is not under the contractor's scope, but under the project, the Executive Engineer of the concerned PIU will resolve this issue. All the grievances should be resolved within seven days of receipt of the complaint/grievance. Contact phone numbers and names of the concerned officers/representatives will be posted at all construction sites at visible locations. The designated persons will be responsible for seeing through the process of redressal of each grievance. The contractor's site engineer and EHS cum social supervisor will jointly support in meetings, consultations, and site-level grievance resolution. The effort will be made to resolve issues on-site, in consultation with each other, and within 7 days of receipt of a complaint/grievance.

347. **District level GRC (Second Level):** All grievances that cannot be redressed within 7 days at the first field level will be brought to the notice of the GRC headed by the General Manager (GM)- District Industries Centre (DIC). The Grievance Officer, i.e. GM DIC, may consult/seek the assistance of the District Level GRC consisting of the Environmental Safeguard Expert, TIDCL/ PMSC, Safeguards (Social and Gender), PMU TIDCL, Executive Engineer-TIDCL, Asst. Engineer-TIDCL, Team Leader-PMSC. Social and/or Environment Safeguards Consultant, PMSC, two entrepreneur members from industrial Estate, with at least one of them a woman (if any) or/and a representative from the affected community (as and when required). The GRC will review the grievance and act appropriately to resolve it within 10 days of receipt at this level. The committee may co-opt any other member to resolve grievances.

348. **PMU Level GRC (Third Level):** In case the grievances are not addressed at the district level within 10 days of receipt, the same shall be brought to the notice of the PMU-level GRC. The PMU-level GRC will comprise the Director, DOIC, GoT, who will be the chairperson, and the Joint Secretary of the Revenue Department, Addl. Director (Projects)- DOIC, OSD/GM-TIDCL, Superintending Engineer-TIDCL, Executive Engineer TIDCL, Environmental (Safeguard cum Climate Change) Expert, TIDCL/ PMSC, Safeguards (Social and Gender), PMU, TIDCL. A representative from the line department (ULB, PWD) and two members from the industrial estate, with at least one of them a woman. GRC will resolve grievances within 15 days. The committee may co-opt any other member to resolve grievances.

349. The project GRM, notwithstanding, an aggrieved person 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 negative/positive outcome of the GRM. In case of grievance related to land acquisition, the affected persons will have to approach a legal body/court specially proposed under the RFCTLARRA, 2013.¹⁵ GRM will continue to be in place throughout the duration of the project. The grievance redress process is shown in **Figure 8-1**.

¹⁵ The authority admits grievance only with reference to the land acquisition, resettlement and rehabilitation issues under the RFCTLARRA, 2013.

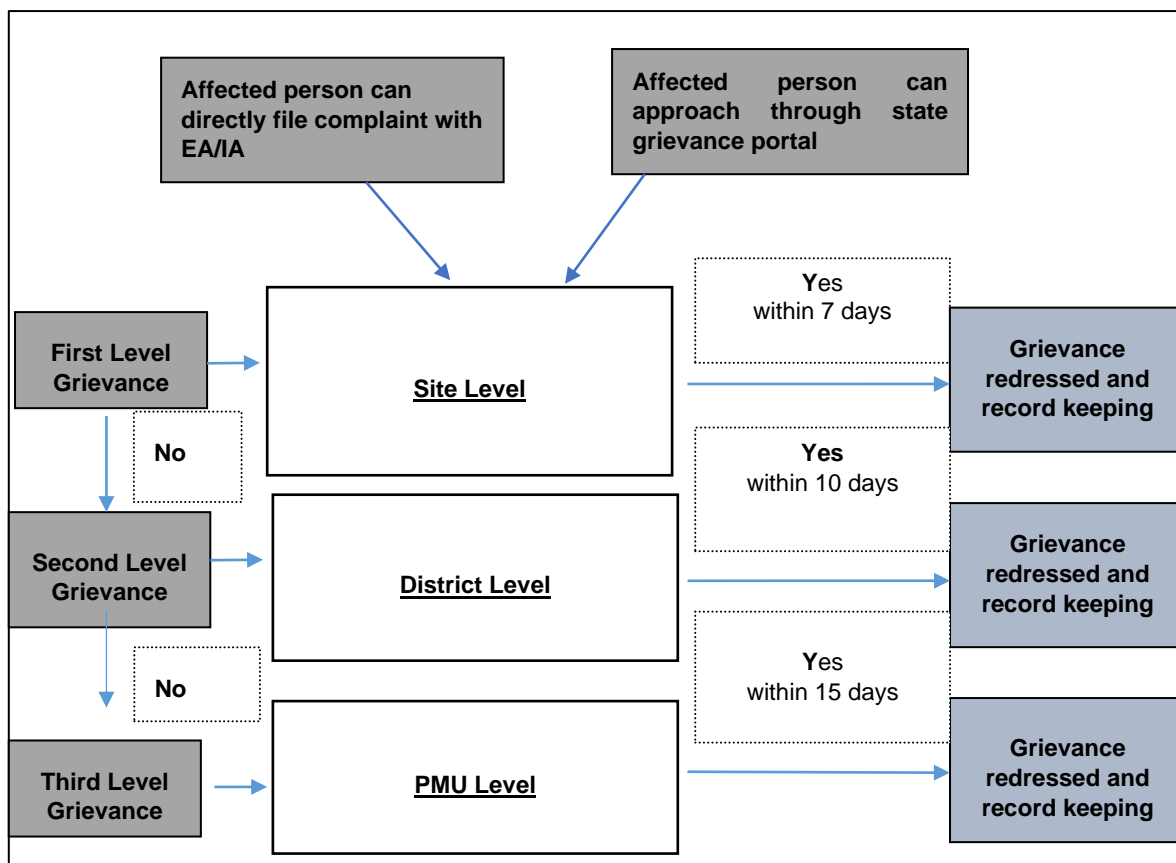


Figure 8-1: Grievance Redressal Mechanism

350. **ADB Accountability Mechanism:** The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB’s operational policies and procedures. If the established GRM is not able to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters. Before submitting a complaint to the Accountability Mechanism, affected people should try in good faith to solve their problems by working with the concerned ADB operations department (ADB India Resident Mission - INRM in this case). The complaint can be submitted in any of the official languages of ADB’s developing member countries. The ADB Accountability Mechanism information¹⁶ will be included in the project-relevant information to be distributed to the affected communities as part of the project GRM.

351. **Documentation:** PMU, with the support of PIUs, will be responsible for the timely registration of grievances, related disclosure, and communication with the aggrieved party. PMU will also ensure that all the details from submission to resolution are well recorded and documented. The environmental and social safeguard specialists of PMU will be responsible for maintaining the records and coordinating with the affected persons regarding complaints related to their respective domain areas. The chair of each GRC will be responsible for

¹⁶ <http://www.adb.org/Accountability-Mechanism/default.asp>

informing the complainant in writing about the resolution of their complaint or the decision of the GRC.

352. **Record keeping:** PIUs will keep records of grievances received, including contact details of the complainant, the date the complaint was received, the nature of the grievance, agreed corrective actions, the date these were affected, and the outcome. The number of grievances recorded and resolved, and the outcomes will be displayed/disclosed in the PMU and PIU offices and reported in monitoring reports submitted to ADB on a semi-annual basis.

353. **Perioding review and documentation of lessons learned:** The Project Coordinator, PMU, will periodically review the functioning of the GRM in each site and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address grievances.

354. **Cost:** All costs related to the resolution of grievances (meetings, consultations, communication, and reporting/ information dissemination, as well as costs incurred by affected persons to attend GRC meetings, if any) will be borne by PMU.

9.0 ENVIRONMENTAL MANAGEMENT PLAN

9.1 General

355. The proposed infrastructure development works are not anticipated to have long-term impacts on environmental attributes such as geology, hydrogeology, soil, flora, fauna etc. of the core and buffer zones of Dukli IE.

356. The construction stage impacts like vegetation clearance, dust and noise levels, air pollution due to vehicular emissions, worker's safety, construction site management, construction material management including debris disposal, on and off-site sanitation management works are largely reversible, transitory in nature and confined to the existing IE boundary. The impacts arising due to laying of various utilities like water and effluent pipelines, electric cables. Moreover, specialized works like laying of electrical cables are governed by the respective regulations and code of practices, which stipulates all technical and safety requirements during erection, testing and commissioning stages.

357. An Environmental Management Plan (EMP) - sector/ component wise has been developed to provide mitigation measures to reduce construction stage adverse impacts, wherever anticipated to an acceptable level are given in **Table 9-1 to 9-3**. Further, the site specific EMP will be prepared by the contractor (C-ESMP), which will cover the mitigation measures for the respective construction sites during implementation of the project. The institutional responsibilities for planning, implementation and monitoring of the EMP are also given in Table 9-1 to 9-3.

358. The purpose of the environmental management plan (EMP) is to ensure that the activities are undertaken in a responsible, non-detrimental manner with the core objective of undertaking all specific measures deemed necessary in mitigating the environmental impact(s) due to the proposed infrastructure development works and ensuring all safety considerations are adhered to.

359. The EMP shall be binding on all contractors operating on the site and will be included in the bid/contractor's contract agreement. The EMP largely includes mitigation management measures, most of which are akin to Good International Industry Practice (GIIP), considered incidental to works and deemed to be included in the quoted bid price(s) by the contractor. Non-compliance with, or any deviation from the conditions set out in this EMP constitutes a failure in compliance.

360. In addition, Environment, Health, and Safety (EHS) performance requirements by the contractor will be specified and incorporated as special conditions and performance requirements in the contract. The contractor will appoint a full-time qualified EHS officer from commencement to closure of the Project. The contractor is expected to be fully aware of the construction stage EMP and EHS performance requirements at the bidding stage itself and deemed to have priced requirements at the bidding stage itself.

Table 9-1: Environment Management Plan - Sector/ Component – Roads/ Stormwater Drainage (SWD)/Electrical Cable/OFC Cable with Utility Corridor etc.

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
Pre-Construction/Design Stage					
1.	Permission for Tree Felling	Loss of 13 numbers of trees due to proposed roads / electrical cable/OFC cable and storm water drainage etc.	<ul style="list-style-type: none"> The application for tree permissions shall be made well in advance and no site clearance or pre-construction activities shall be initiated in stretches/ areas, which involve tree felling. Requisite tree cutting permissions shall be obtained from Tripura Forest Department. Coordinate and ensure timely felling of trees through the Forest Department, including removal of all shrubs and clearance of site. Implement any stipulations imposed by the Department of Forests, while issuing the tree felling permissions including compensatory plantation among others Ensure the safety arrangements while cutting trees along roads /Electrical cable/OFC Cable and storm water drainage. Prioritize the stretches/ areas for handing over to the contractor for commencement of construction 	PDMC (Design Consultant) and TIDCL	DoIC/ TIDCL (Environmental Safeguards team)
Construction Stage					
2.	Consent to Establish (CTE) and Consent to Operate (CTO) from TSPCB	Non-compliance to regulatory requirements under Water and Air Pollution Acts and possibility for water and air pollution	<ul style="list-style-type: none"> Contractor has to prepare a SEMP including (i) proposed sites/locations for construction work camps, stack/ storage areas, workforce camps, hot mix plants, batch mix plants for WMM and Concrete, crushers (if required) and get it approved from PIU and ESG Cell under PMU. Contractor has to obtain CTE and CTO from TSPCB for establishing crushers (if required), construction camp site, material stack yards, hot mix plants, batch mix plants for WMM and Concrete, Workforce Camps Locations within IE No work shall commence without prior approval of SEMP from PIU and ESG Cell under PMU and consent from TSPCB. Copy of consents shall be submitted to the PIU and ESG Cell under PMU 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
3.	Permissions for using ground water (existing/new tube wells) for construction	Non-compliance to regulatory requirements and possibility for depletion of water resources	<ul style="list-style-type: none"> Contractors shall obtain prior permissions from designated department of state government and/ or from regional officer of central ground water authority. Copy of the permission shall be submitted to the PIU and ESG Cell under PMU same to ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
4.	Orientation of EMP for contractor	Orientation will sensitize contractor to minimize construction impacts and implement EMP requirements in a better way during project implementation phase	<p>The ESG Cell will orient the contractor with the EMP stipulations and EHS requirements under the contract. This shall include but not limited to the following.</p> <ul style="list-style-type: none"> Contractual Obligations of Contractor to submit Contractor's Site Environmental Management Plan (C-SEMP). C-SEMP prepared by Contractor shall be reviewed and approved by the ESG Cell, prior to commencement of construction works. Implementation of various plans required under C-SEMP related to Occupation Health & Safety (OHS), traffic diversion and road safety, hazardous and non-hazardous waste management plan, camp site management, water and waste management plan, workforce influx management plan, worker's camp management plan, emergency response plan (ERP) including conducting periodic mock drills, opening up of borrow area and muck disposal and including their restoration plan etc. Regulatory compliance requirements like obtaining CTE and CTO from State Pollution Control Board Workforce/Labour Management Procedures in line with Govt. of India and State Govt. norms Procedures for Worker's safety at all operational sites Implementation of GBV risk mitigation strategy plan at workforce camps, operational sites and at other hotspots likely to be frequented by workers after work hours/leisure and/or on weekly off days. Contractor to appoint one full time, qualified Environmental, Health and Safety Officer, who shall be solely responsible for implementation of all the SEMP stipulations and EHS requirements under the contract in close co-ordination/consultation with Environment Specialist under ESG Cell and TIDCL. Establishing GRM (Grievance Redress Mechanism) for Contractors' workforce as well as for existing industries/ workforce/ community for issues arising due to construction activities. Some of the GRM dissemination avenues for construction workers are. During Induction training for new workers and toolbox meet/briefings by work supervisors During periodic tail gate sessions, to review and refresh site protocols on safety procedures at work. Through pictorial illustrations and posters in local language installed at prominent places like entry/exit points, canteen, entertainment areas, health camps sites etc. During awareness campaigns for safety at work and response to Emergency Response Plans 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
5.	EHS Performance Requirements	Will sensitize contractor to understand the requirements and implement EHS requirements in a better way during project implementation phase	<ul style="list-style-type: none"> The EHS (Environment, Social, Health and Safety) performance requirements by the contractor under contract have been specified and incorporated as special conditions and performance requirements in bid documents of contract packages. The EHS performance requirements incorporated in the bid documents, obligate the contractor, upon mobilization, to prepare a Contractor's SEMP (C-SEMP), which shall include impacts mitigation and management plan, environmental enhancement plan, Occupational Health and Safety (OHS) Plan, labor management plan, workers' campsite management plan, grievance redressal mechanism (GRM) for workforce, traffic diversion and management plan, COVID-19 considerations, GBV risks mitigation and among others in accordance with the GoI, Govt. of Tripura and ADB requirements. The C-SEMP submitted by the contractor shall be reviewed and approved by the ESG Cell, prior to commencement of construction works. The approved C-SEMP also be reviewed periodically (as and when required but at least once in three (3) months) by ESG Cell and updated in a timely manner, to address changed requirements, if any during project implementation. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
6.	Disaster Management & Emergency Response Plan	Will enable contractor(s) preparedness and response to any emergency during project implementation phase	<ul style="list-style-type: none"> The overall vulnerability of West Tripura district including Dukli IE is categorized as High for earthquakes and thunderstorms. To ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Dukli IE must be prepared by contractor as part of C-SEMP, suiting to contractor's scale of establishment, which shall be approved by ESG Cell. Typical format is given under Appendix-7 to IEE. All work force, irrespective of levels, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations. All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily. At project level, contractor shall designate an Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP. As part of the ERP, the contractor shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity. West Tripura district has a Disaster Management Plan at district and subdivision levels, which provide the institutional arrangements, designated officers, emergency response systems, infrastructure facilities like hospitals, fire stations, police station at tehsil, sub-division and village levels. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
7.	Work Zone Safety Requirements	Will enable contractor to ensure safety requirements at work zones during project implementation phase	<ul style="list-style-type: none"> Prior to commencement of construction, the contractor will prepare and submit Contractor's SEMP (C-SEMP), which will include contractor's management plan for (i) Work Management; (ii) traffic and work zone safety management plan for the prioritized encumbrance free stretches/ areas, in accordance with approved implementation schedule. In addition, the contractor will be contractually obligated to implement work zone safety arrangements confirming to the requirements of IRC: 67 and IRC: SP: 55: 2014, which include provision of PPEs, fixed/ mobile barricades between work area and pedestrian/ traffic and required measures for ensuring community safety during construction activities. The requirements also include site specific traffic management plan for all types of work along with a work zone safety check list. The responsibility of the contractor to manage these risks is clearly reflected as the contractual obligations of the Civil Works Contractor with appropriate mechanisms for addressing non-compliance. Commencement of any activity by contractor without prior approval of these requirements will be treated as "non-compliance to contract obligations". 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
8.	COVID - 19 Requirements for Construction Workers	Will enable contractor to ensure preparedness and respond to any emergency situation arising due to eruption of Covid variants during project implementation phase	<ul style="list-style-type: none"> In respect of COVID situation, Standard Operating Procedures (SOPs) and Guidelines for Construction Sites for COVID-19 Outbreak issued by Central Public Works Department, Government of India, May 2020 and Tripura State Govt. as & when notified. Contractor shall mandatorily adhere to these Govt. of Tripura and GoI COVID-19 SOPs at all construction sites, which shall cover all contract workers, particularly migrant construction workers during the mobilization and subsequent phases of construction by the contractor: <ul style="list-style-type: none"> Induction of new batch of migrant workers, possibly some of them could be symptomatic or asymptomatic COVID carrier(s) Migrant workers returning to work after visiting native places and/or hometowns, possibly asymptomatic COVID carriers and could have got infected either on way home or on way back to project site. Any worker, who could have got infected from local community during visit to local market areas for purchase of some daily needs. Contractor shall adopt Labour Management Procedure and approved by ESG Cell, which shall include the following: <ol style="list-style-type: none"> Conducting pre-employment health checks Controlling entry and exit from site/workplace. General hygiene, cleaning, and waste disposal at all operational sites Maintaining social distance of minimum 1.5 meter at work sites as well as at workforce camps Provision of PPEs for covering of face with masks/cotton cloths, use of sanitizers, frequent washing of hands Creating awareness and prohibiting spitting in public, avoid use of chewing gum, tobacco in all forms, Instruct/encourage reporting of flu-like-illness symptoms and creation of isolation/quarantine rooms for any workers reporting/showing COVID symptoms until shifting to designated COVID hospitals. Adjusting work practices from COVID consideration <ol style="list-style-type: none"> reviewing accommodation arrangements maintain social distancing norms. reviewing accommodation arrangements, to see if they are adequate and designed to reduce contact with the community. reviewing contract durations, to reduce the frequency of workers entering/exiting the site. rearranging work tasks or reducing numbers on the worksite to allow social/physical distancing, or rotating workers through a 24-hour schedule. providing appropriate forms of personal protective equipment (PPE) putting in place alternatives to direct contact, like tele-medicine appointments and a live stream of instructions. Instances of spread of virus. Training and communication with workers Communication and contact with community. Provision of medical insurance covering treatment for COVID-19, sick pay for workers who either contract the virus or are required to self-isolate due to close contact with infected workers and compensation payment in the event of death. Designating/appointing a COVID-19 focal point officer with responsibility for monitoring and reporting on COVID-19 issues and liaising with competent authorities designated by district administration or the State Government. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> Contractor to convene regular meetings with the project health and safety specialists and medical staff (and where appropriate with local health authorities), and to take their advice in designing and implementing the agreed measures. Identify a senior person as a focal officer with responsibility for monitoring and reporting on COVID-19 issues and liaising with competent authorities designated by the district administration or State Government authorities point. Contractor's coordination arrangements, particularly at site where there are a few contractors and therefore (in effect) different work forces (ESG Cell could request the main contractor to put in place a protocol for regular meetings of the different contractors) Contractors to ensure regular checks on whether the workers are informed/encouraged to use the existing project grievance mechanism to report concerns relating to COVID-19 		
9.	Establishing Construction Camp Site, Material Stack Yards, Hot Mix Plants, Batch Mix Plants for WMM and Concrete, Workforce Camps Locations	Air, noise, water pollution and sanitation	<ul style="list-style-type: none"> All establishments/facilities by the contractor shall be set up at existing vacant plots within the IE and sufficiently away from existing industries and approved by ESG Cell. The Contractor shall submit a detailed layout plan for all such site establishments and prior approval of ESG Cell shall be necessary. Site specific protection measures required at such location are to be considered to minimize associated environmental risk, if the site selection is in rolling terrain. Arrangements to control dust pollution through provision of wind Screens, water sprinklers through pressurized fine spray nozzles shall be provided for dust suppression at all such operational sites, to ensure that there are no visible dust levels. The crushers, hot mix plants and batching plants shall conform the emission norms as well as noise level limits stipulated by CPCB and/or Tripura State Pollution Control Board (TSPCB) Consent to Establish (CTE) and Consent to Operate (CTO) shall be obtained from TSPCB by the Contractor prior to establishing or operation of any such facilities under this contract. A copy of permissions/consents should be submitted to ESG Cell. All stipulated consent conditions shall be strictly adhered to and complied with by the contractor. All establishment sites shall be access controlled with fixed entry and exit points. The contractor shall carry out periodical environmental monitoring at each of these locations/ operational sites as per Monitoring Program approved by ESG Cell and shall also carry out necessary servicing/ repair/ maintenance of machineries and equipment to comply with permissible emission standards for air and noise of GoI and TSPCB. The contractor shall be responsible to provide any mitigation and management measures to prevent induced impacts from such establishment sites due to wastewater, solid waste, landslide, erosion, clogging of streams, soil and water contamination, spoil dumping etc. Any impacts arising due to contractor actions shall be addressed in an amicable way at their own cost. The work camp sites shall mandatorily have designated paved areas with shades/roof for storage of used oils/lubes in plastic/HDPE drums, prior to their final disposal in TSPCB approved disposal locations. All construction sites shall have a provision of one mobile toilet of 2-seater capacity (1 men and 1 woman with separate entrances), stationed at a suitable place within 100 meters from each operational area. The mobile toilet shall have at least 1000 liters of overhead water storage, well always maintained and in usable condition. The bottom tanks shall be regularly cleaned, and the overhead tank replenished as per requirement. The work force shall be oriented to using mobile toilets and avoid using public toilets and/or nearby open places/parks. Every operational area shall be provided with one mobile drinking water kiosk having a storage of 300 liters and placed at a suitable place within 100 meters from work site. All work force shall be provided with suitable type of accommodation, if required and local labour or can return to their normal places of residence. Pooled transportation facilities, as may be required, shall be provided by the contractor. If establishing workforce camps becomes utmost necessary, then same shall be established at least 500m away from the settlement areas and away from bridge sites and or any other water body. The workforce camps shall be provided with all basic facilities like water supply, cooking gas facility, sanitation facilities including provision of mobile toilet (of adequate seating capacity for men and women separately) shall be stationed within the workforce camp. The mobile toilet shall be periodically replenished with fresh water for ablution purposes and wastewater shall be emptied through suction tankers and carried to the nearest municipal sewage treatment facilities. Alternatively, septic tank cum soak pit arrangements of adequate capacity shall be provided as per requirements. No wastewater from the camp/work force site shall be discharged directly without any treatment into any surface water channels or drain, which eventually join surface water bodies. The establishment sites shall be cleared from all remnants of construction and debris and restored to their previous state or as approved by PIU/ ESG Cell under PMU. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
10.	Management of Crusher sites and its operations	Air and noise pollution due to crusher operations and deployed vehicles, equipment and machinery	<ul style="list-style-type: none"> Since, West Tripura district does not have any stone aggregate resources which can be quarried, the contractor shall submit a due diligence/ safeguard compliance report of material sourcing locations with respect to applicable statutory requirements, identify and measures to offset risk to the project, if any required. The existing quarry or material sourcing locations shall have to conform to emission norms as well as noise level limits stipulated by CPCB and/or Tripura State Pollution Control Board (TSPCB). If the contractor chooses to establish crusher operations of the stone boulders sourced from elsewhere, the contractor in such cases shall obtain the Consent to Establish (CTE) and Consent to Operate (CTO) from TSPCB before establishment and operation of crushers, A copy of permissions should be submitted to the ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> The crushers shall have site specific management plan for dust/ noise control during transportation and at stock piling, waste management, wastewater and sanitary waster from workers camps, storage of fuel, stockpile management and any other anticipated risks. 		
11.	Arrangement for Construction Water	Reduction/ depletion of ground water resources	<ul style="list-style-type: none"> The contractor shall be responsible for arranging construction water demand in compliance with requisite statutory requirements. In doing so, the contractor shall assess water source availability and shall prepare a construction water demand and management plan for approval of ESG Cell. Construction water requirements are to be met from only existing tube wells, with prior approval of ESG Cell and competent authorities. Contractors shall preferably have more than one source to avoid over dependence on a single source and affecting pre-existing users. The contractor shall obtain prior approvals from the ground water department and/ or other designated department of state government, wherever required and submit a copy of the same to ESG Cell. West Tripura district is under the safe category and therefore contractors can even construct new tube wells specially for the construction water requirements, if required, with requisite prior permissions/ approvals from competent authorities. Contractor shall exercise all measures to minimize water consumption and wastage during all phase of construction works 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
12.	Labour/ Workforce Management	Protection of labour rights privileges including equal/ rightful wages	<ul style="list-style-type: none"> Contractor shall comply with all labour regulations of Govt. of Tripura, Government of India and The Occupational Safety, Health, and Working Conditions Code, 2020 Contractor shall prefer skilled/ unskilled local labour drawn from nearby places/ region wherever feasible/extent possible, to benefit local community. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
13.	Clearing, Grubbing, Stacking/ preservation and reuse of topsoil for green belt/ landscape areas	Loss of vegetation, topsoil and probable impacts on herpetofauna	<ul style="list-style-type: none"> All construction sites shall be clearly demarcated with hazard tapes or barricaded with access control as may be required at each specific site. All works shall be carried out such that the damage or disruption to vegetation/ flora other than those identified for minimum cutting/ clearing. All identified vegetation for clearing shall be removed from the construction zone before commencement of construction. The Contractor, under NO circumstances shall cut or damage trees. The topsoil from all areas shall be stripped off to a specified or a minimum depth of 150 mm and stored in stockpiles. The locations for stock piling shall be pre-identified in consultation and with approval ESG Cell. The reuse of the excavated earth for landscaping and green belt development will require correction of pH by addition of calcium oxide or calcium carbonate, which in turn increases the availability of nitrogen, phosphorus, calcium and magnesium in acidic soils and thus enables growth of vegetation. The contractor shall take measures to prevent generation of dust from such stockpile areas by covering them with jute cloth or tarpaulin. Such stockpiled topsoil shall be utilized for – <ul style="list-style-type: none"> To prepare surface for green belt development and landscape areas. To prepare surface for bioengineering measures. Covering all disturbed areas including low lying areas within IE Dressing of slopes of road embankment within IE 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
14.	Earth Excavation and handling of Excavated Earth/ Construction Debris	Loss of vegetation, topsoil and disposal of excess earth and construction waste as debris Air and noise pollution due to deployed vehicles, equipment and machinery	<ul style="list-style-type: none"> The site clearance and/or excavation activities shall be opened only in segments of 250 m stretch or specified zones at a time and no new stretches/ zones shall be opened unless the clearance and/or excavation activities in previous stretches or zones been satisfactorily completed and clearance given for the opening of next stretch or zone by ESG Cell. Prior to undertaking any site clearance and/or excavation activities, particularly hill side cut and excavation activities in any working stretch, the contractor shall mandatorily prepare an excavation plan with site specific measures/plans. The contractor shall submit 'excavation plan' to ESG Cell for approval in advance before opening of new work zone/ area. The blasting and use of explosives in any form shall not be used by the contractor under any circumstances. All excavation/ hill cutting operations shall be carried out using the rock driller/ hammer attachments with the excavators. Prior to commencement of any such excavation operations, contractors shall inspect the site to assess the potential for any disturbance to the adjoining industries and undertake the works in slow pace with prior intimation to such property owners. The contractor's handling and management of surplus excavation material shall be reviewed and approved by ESG Cell and shall be mandatory for opening and commencement of excavation at new work zone or stretch. Prior to disposal, the excavated material shall be screened/ scavenged for recovery of good soil, which can be used in the construction of sub grade, shoulders, back filling of retaining/breast/toe walls and or any other construction works. The use of recovered material is subject to conforming to technical specification and standards prescribed and approval by the ESG Cell. The noise levels during excavation shall be reduced/limited through deployment of well- maintained construction vehicles/equipment/machinery. All excavation activities shall be undertaken during daytime and at normal work pace, particularly in areas close to existing industries. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
15.	Planning for Traffic Diversions and Disruption in access and services to	Inconvenience to existing industries and other road users within IE	<ul style="list-style-type: none"> Traffic Control Plans shall be prepared by the Contractor and submitted to ESG Cell for approval prior to commencement of works on any section of road. Temporary diversions shall be constructed with the approval of the ESG Cell and local/ district admin authorities as required. The traffic control plans shall include details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures for night-time traffic with LED lighting facility and barricading as may be required, among others. The Contractor shall ensure that the diversion/detour is always maintained in good and easily usable condition, particularly during the monsoon to avoid disruption to traffic flow. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
	existing industries	Safety issues for road users particularly during nighttime Air and noise pollution due to deployed vehicles, equipment and machinery	<ul style="list-style-type: none"> The Contractor shall also inform all stakeholders/local community of changes to traffic routes, conditions and pedestrian access arrangements under intimation to ESG Cell. The temporary traffic detours shall be kept free of dust by sprinkling water as required under specific conditions. Ensure traffic diversions are in place, to minimize the inconvenience to the existing road users during the road construction phase. Wherever required, adequate number of uniformed traffic wardens with reflective batons shall be deployed to manage the traffic for the entire construction phase. Dust suppression measures like regular sprinkling of water through pressurized fine spray nozzles shall be carried out to ensure dust levels are kept to minimum. Normally 3-4 times of water sprinkling per day shall suffice). The Contractor shall provide, erect and maintain informatory /safety signs, hoardings written in English and local language, wherever required or approved by ESG Cell. All works shall be adequately planned and swiftly completed to minimize the inconvenience to the existing industries (inward and outward movement of vehicles and workforce) After completion of the work, disrupted/damaged diversion roads shall be restored by the Contractor. Advance information (7 days) wherever required, shall be served through poster and leaflet or through personal communication (as may be required) to the existing industries within the IE who may get affected due to temporary loss of access due to construction works. Make alternate arrangements for disrupted access if it is likely to be more than 4 hours. Restore the services with minimum down time and provide alternative source of supply for intervening period (if more than 2 hours). 		
16.	Transporting Construction Materials and Haul Road Management	Inconvenience and safety issues for existing road users Air and noise pollution due to movement of vehicles, clearance of spills during transportation	<ul style="list-style-type: none"> Contractor shall maintain all roads (within IE), which are used to be for transporting construction materials, equipment, and machinery. All vehicles delivering fine materials to the site shall be covered with tarpaulin to avoid spillage of materials. All roads used by vehicles of the Contractor or any of his sub-contractor or suppliers of materials and similarly roads, which are part of the project construction works, shall be kept clear of all dust/mud/spillage or extraneous materials dropped by such vehicles. The contractor shall arrange for regular water sprinkling through pressurized fine spray nozzles for dust suppression of all such roads and surfaces. If roads along existing industries are to be used as a haul road, then drivers and other involved workers shall be sensitized about "How to avoid conflicts". Existing industries shall be consulted by the Contractor to fix the timings of road usage and should avoid peak hours, if any to avoid/minimize inconvenience to existing industries/ local community. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
17.	Occupational Safety, Health, First Aid Facilities and Documenting Safety at all Construction and Operation sites	Will enable contractor to ensure safety requirements at work zones during project implementation phase	<ul style="list-style-type: none"> All workforce/ labour shall be provided with safety instructions daily, depending upon the work, for which they are likely to be deployed for the day/shift. Labour shall be provided with PPEs at no cost and ensure that the same is always being used by the workthe workforce, while at work. In case of damaged or lost PPEs, some shall be replaced without any cost to labour. All labour shall be instructed and encouraged to report, irrespective of small or major or fatal injury to the supervisory staff and all such incidents shall be documented, and ensure such incidents are not repeated by taking adequate precautions. All Supervisory staff shall be provided with mobile phones for better communication across all operational areas, in case of emergency or otherwise. The contractor shall establish a small first aid room/ mini clinic at the campsite and make available a standby vehicle for emergency purposes for transportation in case of accident with serious injuries at site. Any accident with fatalities shall be reported promptly to ESG Cell and shall take measures to compensate the affected person in accordance with existing regulation. First aid facilities and free emergency care shall be provided to all workforce, irrespective of their rank/level and no cost shall be recovered from them on this account. The contractor shall deploy a medical practitioner periodically at the camp site to attend to health issues/first aid and shall conduct regular health check-up of all staff and workers employed in the project. Further, no wages shall be cut for a period of absence because of injury – The contractor shall mandatorily have Contractor All Risk (CAR) policy to cover workers of main contractor and as well as all sub-contractors and third party. All work site(s) shall have first aid kits and details of major/nearby hospitals displayed prominently in local language, in case of emergency and/fatalities to work force and/or public, because of operations. The supervisory staff shall be provided with a wireless communication system (mobile telephones for better communication in the operational area and with other operational areas, in case of emergency or otherwise. The Contractor shall comply with all the precautions as required for ensuring the safety of the workmen as per the Government of India norms/regulations. All workforce deployed shall be governed by labour management procedures of TIDCL and Tripura Building and Other Construction Workers Welfare Board with regards to safety and welfare measures (including equal wages for men and women) for workers employed at building and other construction sites. The Contractor shall make sure that during the construction work all relevant provisions are adhered to. The Contractor shall not employ any person below the age of 18 years for any construction work and no woman shall be employed for hazardous work, unless and otherwise she is trained to carry put such work. The Contractor shall mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce compliance to use of PPE with zero tolerance. These shall be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and shall be approved by ESG Cell To promote and encourage a Safety culture, senior engineers in Contractors and consultants' teams shall wear helmets and safety jackets at all operational sites. Visitors/officials to work sites are to be provided with PPEs (hard hats and safety shoes) and shall be briefed on ongoing operations at that specific time and related safety requirement at work site including safe distances to keep during the site visit. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

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			<ul style="list-style-type: none"> The work force shall be subjected only to standard work shifts/hours. Overtime allowances, if applicable/warranted shall be paid with ceiling limits. Working beyond such ceiling limits shall be discouraged, even if, so desired workforce or contractor. 																																																						
18.	Water Pollution	Surface and ground water pollution at all operational sites, camp offices and workforce camps	<ul style="list-style-type: none"> The Contractor shall provide oil interceptor and take pre-cautionary measures to ensure that no water pollution occurs through surface runoff from construction vehicle parking areas, fuel/lubricants storage sites, vehicle, and machinery/equipment maintenance sites. The contractor shall ensure that all vehicle/machinery and equipment maintenance and refueling shall be carried out in such a manner that spillage of fuel and lubricants do not contaminate soil and groundwater. All other off-site operational areas like camp site, work force camp sites, which are likely to have potential for pollution, are to be provided with on-site mobile sanitary facilities, the effluents/waste discharges of which shall be transported to nearest sewage treatment plants through mobile tankers. The oil/lube storage shall be under roofed areas with impermeable cement concrete surfaces. Thus, the project operations shall not have any significant scope for soil or surface and/or ground water contamination. Thus, road construction projects shall not impact ground water sources. The water usage pattern within the construction camps can be minimized by adopting following best practices: <ul style="list-style-type: none"> Use buckets for washing purposes instead of using running water. Use of auto shut off taps (without sensors) in labour accommodation. Install water meters with main supply pipes/water tanks/bore well to assess quantity of consumed water. Create awareness among the camp site, work force camp sites at all levels. Areas used for handling of fuel and lubricants, wherever applicable shall be impermeable surfaces and under roof to prevent groundwater and soil contamination in the event of accidental spills. All other off-site operational areas like camp site, work force camp sites, which are likely to have potential for pollution, are to be provided with on-site mobile sanitary facilities, the effluents/waste discharges of which shall be transported to nearest sewage treatment plants through mobile tankers. The camp site and work force camp sites shall be provided with septic tank with soak pit arrangement of adequate capacity and numbers as required. All toilets and wash areas within the camp site and work force camps shall be provided with septic tanks and soak pit arrangements of adequate capacity. No wastewater from the camp/work force site shall be discharged directly into any surface water channels or drain, without any treatment, which eventually joins surface water bodies. Typically, each 5m Length, 2m Breadth and 1.5 m Clear depth with 0.3 free board with soak pit arrangement, which can serve up to 50 users at peak level as per CPWD specifications. CPHEEO, Ministry of Housing and Urban Affairs, GoI recommended sizes of septic tank (as per BIS 2470 part I) up to 300 users are given in the following table. The number of septic tanks required at the workforce camps and camp sites can developed demanding up to the number of locations and users. BIS 2470 part I may be referred for construction details of septic tanks and soak pit disposal arrangement. <p style="text-align: center;">CPHEEO Recommended size of septic tank up to 300 users.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">No. of Users</th> <th rowspan="2">Length (m)</th> <th rowspan="2">Breadth (m)</th> <th colspan="2">Liquid depth (m) (cleaning interval of)</th> </tr> <tr> <th>2 years</th> <th>3 years</th> </tr> </thead> <tbody> <tr><td>5</td><td>1.5</td><td>0.75</td><td>1.0</td><td>1.05</td></tr> <tr><td>10</td><td>2.0</td><td>0.90</td><td>1.0</td><td>1.40</td></tr> <tr><td>15</td><td>2.0</td><td>0.90</td><td>1.3</td><td>2.00</td></tr> <tr><td>20</td><td>2.3</td><td>1.10</td><td>1.3</td><td>1.80</td></tr> <tr><td>50</td><td>5.0</td><td>2.00</td><td>1.0</td><td>1.24</td></tr> <tr><td>100</td><td>7.5</td><td>2.65</td><td>1.0</td><td>1.24</td></tr> <tr><td>150</td><td>10.0</td><td>3.00</td><td>1.0</td><td>1.24</td></tr> <tr><td>200</td><td>12.0</td><td>3.30</td><td>1.0</td><td>1.24</td></tr> <tr><td>300</td><td>15.0</td><td>4.00</td><td>1.0</td><td>1.24</td></tr> </tbody> </table> <p>Notes:</p> <ul style="list-style-type: none"> Capacities are recommended on the assumption that discharge from only WC shall be treated in the septic tank. Provision of 300mm should be made for free board. Sizes of septic tank are based on certain assumption on peak discharges, as estimated in IS:2470 (part 1) and while choosing the size of septic tank exact calculations shall be made. For users over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning. 	No. of Users	Length (m)	Breadth (m)	Liquid depth (m) (cleaning interval of)		2 years	3 years	5	1.5	0.75	1.0	1.05	10	2.0	0.90	1.0	1.40	15	2.0	0.90	1.3	2.00	20	2.3	1.10	1.3	1.80	50	5.0	2.00	1.0	1.24	100	7.5	2.65	1.0	1.24	150	10.0	3.00	1.0	1.24	200	12.0	3.30	1.0	1.24	300	15.0	4.00	1.0	1.24	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
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19.	Air Pollution from Vehicles, Plants and Equipment	Air pollution due to deployed vehicles, equipment and machinery	<ul style="list-style-type: none"> The Contractor shall take every precaution to reduce dust levels at contractor's establishment sites and/or operational construction sites by sprinkling of water through pressurized fine spray nozzles. All tipper trucks carrying construction debris shall be covered with net cloth and wet prior to dispatch of every trip, to prevent en-route spills as well as airborne dust during transit. Tipper trucks shall not be overloaded beyond designated capacities and shall be provided with tail board, to avoid en-route spills. The dust levels during collection and loading operations of construction debris shall be controlled through periodical sprinkling of water through mobile water tankers of adequate capacity fitted with pressurized fine spray with hose reels and stationed at excavation areas. The Contractor shall procure the construction plants and machinery, which shall conform to the pollution control norms specified by the MoEF&CC/CPCB/TSPCB. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director																																																				

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				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> All vehicles, equipment and machinery deployed for construction are regularly maintained and maintain a record of Pollution Under Control (PUC) certificates for all vehicles and machinery used during the contract period which shall be submitted to ESG Cell for verification, whenever required. The contractor shall maintain records and conduct fitness tests of all vehicles and machinery at regular intervals of one year and the fitness certificate shall be submitted to ESG Cell. Only fit vehicles and machinery shall be deployed during construction. Environmental monitoring of all construction operational sites and contractor's establishment sites shall be conducted at least once in a month as agreed/ approved ESG Cell. 		
20.	Noise Pollution from Vehicles, Plants and Equipment	Noise pollution due to deployed vehicles, equipment and machinery	<p>The Contractor shall confirm to the following:</p> <ul style="list-style-type: none"> All Construction plant, machinery and equipment used in construction shall strictly conform to the MoEF&CC/CPCB requirements with respect to emissions and noise levels/standards. Servicing/routine maintenance of vehicles, equipment and machinery shall be undertaken periodically as per the approval of ESG Cell to keep emissions and noise levels as per norms/minimum. All construction works with high noise levels shall be stopped after sunset hours. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
21.	Non-hazardous Waste Management	Safe disposal of waste from construction camp sites	<ul style="list-style-type: none"> The Contractor's EMP shall include a Management Plan for Non-Hazardous waste and approved by ESG Cell. The camp site shall have compost pits for treating organic waste and separate bins for collecting the inorganic waste, which shall be disposed of at nearest municipal disposal sites. The nearest such sites are available at Agartala. The contractor shall collect, and store non-hazardous waste generated at camp sites in HDPE/steel drums and stored in a segregated roofed area and periodically disposed at approved waste disposal facilities by Tripura State Pollution Control Board. 		
22.	Bio-diversity Management (flora and fauna)	Loss of vegetation/ tree cover	<ul style="list-style-type: none"> To compensate for the vegetation cleared and trees felled due to construction works, compensatory plantation to be undertaken through planting of 65 saplings (@ 5 saplings for every tree felled- total 13 with 90% survival rate with three years maintenance. Only local species, approved by the forest department shall be used for both tree plantation and development of green/ landscaped areas. Normally, all such afforestation works are undertaken by Tripura Forest Department and maintained for three years as a deposit work to be borne by TIDCL. With these compensatory plantation measures, the tree cover lost could be regained in 2-3 years and thus the impacts could be mitigated. To limit the impacts on the fauna during construction, the following measures shall be followed: All work force shall be oriented to keep calm and walk away from the scene, in case, wild animals are sighted either during work hours at operational/work sites or at night hours at campsites. The construction work shall be restricted to day hours only. Work force shall be strictly instructed not to harm/kill and prohibited hunting of wild animals under any circumstances. The Construction camp and work force camp sites shall be established within IE. The camp sites and work force camps shall be access controlled and well-lit to avoid/prevent entry of wild animals. The work force shall be oriented not to feed monkeys and /or stray animals and to properly collect waste food in dustbins to prevent menace in camp area. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
23.	Ancient and Historical Monuments/ Physical & Cultural Resources and Chance Finds	Impact/ loss of cultural/ historical resources	<ul style="list-style-type: none"> Dukli IE and its surrounding areas do not have any protected Ancient and Historical Monuments and therefore no measures are warranted. All fossils, coins, articles of value of antiquity, structures and other remains or archaeological interest discovered on the site during excavation works (chance finds) shall be the property of the Government and shall be dealt with as per provisions of the relevant legislations/ Acts. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. The matter shall be immediately brought to the notice of ESG Cell and TIDCL upon discovery of any such articles thereof and carry out TIDCL's instructions for dealing with the same and till such time all work shall be stopped. ESG Cell shall report the matter to competent authorities at state or Archaeological Survey of India (ASI) through TIDCL and no further work shall be undertaken, until the location is cleared by competent authorities. The contractor shall recommend the work on the site only after the site is cleared and he gets instructions from TIDCL through ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
24.	GBV (gender-based violence)	Possibility of GBV arising due to influx of migrant labour/ construction workers and existing workforce of IE and community of nearby areas	<ul style="list-style-type: none"> A GBV risk mitigation strategy plan shall be implemented by the contractor under the supervision of ESG Cell and coordination by TIDCL. The plan shall comprise identifying potential risks; mitigation measures; prevention and responses strategy; key actions/SOPs to receive complaints, maintaining confidentiality, handling procedure of complaints, resolution of complaints with survivor centric approach, commensurate to different construction phases. Some of the generic measures, which shall be included in the GBV risk mitigation and key action plan are summarized hereunder: <ul style="list-style-type: none"> Creating awareness about GBV related issues among workers during engagement and/or during Induction of workforce Mandatory consent signing of Code of Conduct (CoC) by all workforce (all categories and levels) to the adhere to the Policy on Sexual Harassment of Women at Workplace prior to the acceptance of the employment/ appointment order. The Code of Conduct for GBV related issues shall include/ cover at workforce camps and or community hotspots like nearby market areas frequented by workers after work hours and/or weekly off days, schools, vocational training centers, liquor shops and, migrant workers residing in rented accommodations within the villages/settlement areas. Sensitization and orientation of workforce (all categories, all levels) during induction phase about GBV and associated risks and pep-talk to refresh subject matter in routine toolbox meetings. These shall also be at periodic intervals (at least once in quarter) through external specialized NGOs/ social workers about Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Acts, 2013" and consequences of violations. Integrate briefings on GBV into existing induction training, safety talks, toolbox meetings, tailgate sessions and regular training. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> ○ Create awareness to labor supply contractor about labour laws as well as GBV risks and mitigation strategy as part of contractor's labour management procedure. ○ Installation of Informatory messages/signboards about GBV awareness and grievance redress mechanism, complaints/ emergency contact numbers at all appropriate/prominent locations covering workforce camps, campsite offices, site establishment such as hot mix plant, ready mix cement concrete plants and site laboratories among others. ○ Provision of separate rest areas and toilets for both men and women with adequate privacy, lighting, water and sanitation facilities. ○ Provision of rest rooms with adequate privacy, lighting facility for pregnant women and lactating mothers at workforce camps, campsite offices, site establishment as may be warranted. ○ Nomination of a designated woman staff through external specialized NGOs/ social workers for regular surveillance of all potential women at workplaces and engaging women workforce in small pep talks for eliciting their views on victimization, discrimination, sexual harassment and GBV related issues at workplace on regular basis for creating a sense of confidence, privacy, security, and awareness of complaints mechanism and GRM thereof. ○ Sensitization of workforce to avoid any type of commercial transactions (money lending/ borrowing) with local community, particularly women headed households, widows, single women, and senior citizens. ○ Sensitization of workforce to avoid any type of potential conflicts with local communities, particularly women at market areas, settlement areas, grocery shops, liquor vends and eateries, community water source points etc. always during project implementation phase. ○ Sensitization of workforce about strict prohibition of eve-teasing, always stalking of women/adolescent girls near work sites/ educational institutions during project implementation phase. ○ Establishing a committee for grievance redressal mechanism specially for matters related to sexual harassment and GBV matters, which shall be headed by women member representing TIDCL, ESG Cell and contractor, apart from representatives drawn from local women elected members and external specialized NGOs/ social workers, having local presence. The GRM shall include prevention and responses strategy; key actions/SOPs to receive complaints, maintaining confidentiality, handling procedure of complaints, resolution of complaints with survivor centric approach, commensurate to different construction phases. 		
25.	Risk from Electrical Equipment(s)	Occupational safety of workers	<p>The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that -</p> <ul style="list-style-type: none"> • No material shall be so stacked or placed as to cause danger or inconvenience to any person or the public. • All necessary fencing and lights shall be provided to protect the public in construction zones. • All machines to be used in the construction shall conform to the relevant Indian Standards (IS) codes, shall be free from patent defect, shall be kept in good working order, shall be regularly inspected and properly maintained as per relevant BIS provision and to the approval of ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
26.	HIV/ AIDS	Likelihood of HIV/ AIDS among construction workers, existing workforce of IE and nearby area community	<ul style="list-style-type: none"> • Coordinate with State AIDS control society for dissemination materials amongst construction workers including creating awareness, education and Program convergence. • Make provisions for availability of condoms at convenient locations within the IE including installation of condom vending machines at labour camp, community-based meetings, consultations in camp, distribution of leaf let, IEC communication, posters, banners 		
27.	Clean-up Operations, Restoration and Rehabilitation during Contractor's Demobilization	Collection and safe disposal of construction debris from all work sites	<ul style="list-style-type: none"> • Contractor shall prepare 'Site Restoration Plans', which shall be approved by ESG Cell. The clean-up and restoration operations are to be implemented by the Contractor prior to demobilization. • The Contractor shall clear all temporary structures; dispose of all garbage, night soils and POL (Petroleum, Oil and Lubricants) wastes as approved by ESG Cell. • All establishments' sites like material stack yards, camp sites, workforce campsites, hot mix plants, batch mix plants concrete, crusher units, borrow areas, muck disposal sites have to be restored as per restoration plan approved by ESG Cell • All disposal pits or trenches shall be filled in and effectively sealed off. Residual topsoil, if any shall be distributed (in a layer of 30 mm) on restored sites, adjoining/ proximate barren land or areas identified by the Contractor and approved by the ESG Cell. • All construction zones and facilities including culverts, road-side areas, camps, Hot Mix plant sites, Crushers, batching plant sites and any other area used/affected due to the project operations shall be left clean and tidy, at the Contractor's expense and restored to previous state or to the entire satisfaction of ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
28.	Environmental Monitoring during both construction and maintenance phase	Monitoring air, noise, water and soil quality at project construction sites	<ul style="list-style-type: none"> • The Contractor shall undertake monitoring of air, water, noise and soil quality covering all construction sites as well as establishment sites such as material stack yards, workforce camps, camp sites, crusher unit, hot mix plant among others, through an NABL accredited laboratory (monthly during construction and quarterly during maintenance phase). • The contractor shall also monitor the performance of the various mitigation/ enhancement measures, which shall include survival rate and replanting of saplings, nature-based bio-engineering interventions, improved air quality, reduced noise levels, reuse of treated effluent, maintenance of drainage and waterbodies, landscape areas, groundwater recharging structure, among others. 		
Maintenance Phase/ Operation Stage					
	The following measures are required to further offset the residual impacts on various key environmental attributes like geology, hydrogeology, groundwater, air, noise, land use, waste management among others during the operation phase:			EHS Officer, Contractor and	Senior Environmental Specialist of ESG

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> Routine maintenance and cleaning of all the rainwater percolation wells for recharging groundwater during pre and post monsoon seasons and ensure its effective functional status. Routine maintenance and upkeep of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. DoIC/ TIDCL shall continue to encourage and promote all industrial units (both existing and upcoming) within the industrial estate, to install roof water harvesting and groundwater recharging structures within their respective individual industrial plots for replenishment of groundwater resources. Upon demobilization of the contractor, all the campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps etc. are to be restored to their previous stage. All the construction remanent materials/ debris shall be cleared and disposed of at approved disposal sites. Ensure a routine maintenance and upkeep of all the compensatory saplings with minimum survivability of 70% including replanting the dead saplings and replacement of damaged tree guards, if any for a minimum period of 3 years to offset the net loss and ensure net gain from 3rd year onwards. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed of at approved municipal sites, to mitigate the impacts on surface and ground water pollution during the operation phase. All the upcoming industries during the operation phase will be deemed to be regulated for emissions through consent management (CTE and CTO) under the air, noise and water (Prevention and Control of Pollution) Acts. TIDCL should regularly obtain such compliance reports from all the industries allocated within the industrial estate. Periodical environmental monitoring shall be conducted for ambient air, noise, surface and ground water and soils through an NABET accredited agency/ laboratory will be carried out during the operation phase. Ensure routine cleaning of all solar panels to ensure optimum green power generation within industrial estate, to ensure optimum power generation and to offset GHG emissions. All the damaged and dysfunctional solar panels, if any, are to be disposed of in accordance with Solar E-waste Management Rules. Ensure that all the upcoming industries with major machineries have appropriate/ suitable isolated machine foundations and control measures, to limit vibration beyond threshold levels. In addition, also ensure routine maintenance and upkeep of the internal roads. Such measures can reduce impacts of ground borne vibrations during the operation phase. All the upcoming industries, which may generate both hazardous and non-hazardous wastes during the operation phase are deemed to be covered under respective regulations for waste management and disposal All the upcoming industries within the IE are deemed to be covered under The Occupational Safety, Health and Working Conditions Code, 2020 (ref. Table 2-1) which covers work zone safety arrangements for their deployed workforce within the industrial premises. The industrial estate shall have a "onsite emergency response plan (ERP) for addressing natural disasters/ calamity and hazard vulnerability during the operation phase in line with the district disaster management plan comprising the following: <ul style="list-style-type: none"> As part of the emergency response plan, the IE in charge shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity. All work force irrespective of levels and various industries within IE, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations. All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily. IE shall have designated Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel, drawn from various industries for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP. A template for Disaster Management and Emergency Response Plan has been given in Appendix-7 to IEE, which is to be dovetailed with the district disaster management plan and suiting to requirements of the operation phase. All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under National Labour Act, 1970, The Child Labour (Prohibition and Regulation) Amendment Act, 2016, The Child Labour (Prohibition and Regulation) Act, 1986 and The Occupational Safety, Health and Working Conditions Code, 2020. All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under the Prevention of Sexual Harassment (POSH) Act, 2013, which address risks related to gender-based violence, in the unlikely event. 	Environmental Officers of PIU & PMU at IE Level	Cell, PMU under the overall guidance of Project Director

Table 9-2: Environment Management Plan - Sector/ Component – Laying, Testing and Commissioning of Electrical Feeder Cables and Communication Cables (SCADA/ OFC) within Utility Corridors

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
Pre-Construction/ Design Stage					
1.	Permissions for installation, testing and commissioning of electric feeder cables	None	<ul style="list-style-type: none"> Tripura State Electricity Corporation Limited (TSECL).is the designated and Nodal Agency for installation, testing and commissioning of electric feeder cables within Dukli IE. Hence, permission from any other agency is not required. The contractor designated for laying electrical feeder (33/11 KV) cables shall have a valid license and approved/ enlisted by the Tripura State Electricity Corporation Limited (TSECL). Copy of the valid license and approved/ enlistment by the Tripura State Electricity Corporation Limited (TSECL) shall be submitted to the PIU and ESG Cell under PMU same to ESG Cell. 	PDMC (Design Consultant) and TIDCL	DoIC/ TIDCL (Environmental Safeguards team)
Construction Stage Activities					
2.	Site inspection	None	<ul style="list-style-type: none"> The contractor shall inspect the cable corridor and check the readiness of trench for laying of electric feeder cables. Minor modifications or alterations, if any required shall be got done through the civil contractor and the respective PIU 		
3.	Laying, test and commissioning of electric feeder cables	None	<ul style="list-style-type: none"> All works during supply, erection, testing and commissioning shall be executed confirming to the technical and safety requirements stipulated under the Indian Electricity Rules, 1956 and BIS 1255;1983 and amendments thereof. All work shall be well planned, coordinated and swiftly completed, including providing connections to the existing industries and newly developed industrial plots. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
4.	Site clearance and abandoning/ disusing existing electric feeder cables	Waste disposal	<ul style="list-style-type: none"> The utility corridor shall be cleared of all debris/ remanent/ residual materials, after commissioning of the feeder cables. The feeder cables shall have line markers of approved type at regular intervals. All debris/ remanent materials shall be collected, scavenged for reusable materials and waste materials shall be disposed of as scrap or dumped at solid waste management facility of Agartala Municipal Corporation, Agartala. The existing overhead cables shall be dismantled, and underground feeder cables shall be abandoned/ disused, and no excavation shall be carried out to retrieve the existing underground feeder cables as scrap material. 		
5.	Orientation of EMP for contractor	Orientation will sensitize contractor to minimize impacts and implement EMP requirements in a better way during project implementation phase	<p>The ESG Cell will orient the contractor with the EMP and EHS requirements under the contract. This shall include but not limited to the following.</p> <ul style="list-style-type: none"> Contractual Obligations of Contractor to submit Contractor's Site Environmental Management Plan (C-SEMP). C-SEMP prepared by Contractor shall be reviewed and approved by the ESG Cell, prior to commencement of construction works. Implementation of various plans required under C-SEMP related to Occupation Health & Safety (OHS), material management plan, non-hazardous waste management plan, camp site management, workforce influx management plan, worker's camp management plan, emergency response plan (ERP) including conducting periodic mock drills, etc. Workforce/Labour Management Procedures in line with Govt. of India and State Govt. norms Procedures for Worker's safety at all operational sites Implementation of GBV risk mitigation strategy plan at workforce camps, operational sites and at other hotspots likely to be frequented by workers after work hours/leisure and/or on weekly off days. Contractor to designate/ appoint one full time, qualified Environmental, Health and Safety Officer, who shall be solely responsible for implementation of all the EMP stipulations and EHS requirements under the contract in close co-ordination/consultation with Environment Specialist under ESG Cell and TIDCL. Establishing GRM (Grievance Redress Mechanism) for Contractors' workforce as well as for existing industries/ workforce/ community for issues arising due to construction activities. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
6.	EHS Performance Requirements	Will sensitize contractor about EHS requirements in a better way during project implementation phase	<ul style="list-style-type: none"> The EHS (Environment, Social, Health and Safety) performance requirements by the contractor under contract have been specified and incorporated as special conditions and performance requirements in bid documents of contract packages. The EHS performance requirements incorporated in the bid documents, obligate the contractor, upon mobilization, to prepare a Contractor's SEMP (C-SEMP), which shall include Occupational Health and Safety (OHS) Plan, labor management plan, workers' campsite management plan, grievance redressal mechanism (GRM) for workforce, GBV risks mitigation and among others in accordance with the Gol, Govt. of Tripura and ADB requirements. The C-SEMP submitted by the contractor shall be reviewed and approved by the ESG Cell, prior to commencement of feeder laying works. The approved C-SEMP also be reviewed periodically (as and when required but at least once in three (3) months) by ESG Cell and updated in a timely manner, to address changed requirements, if any during project implementation. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
7.	Disaster Management & Emergency Response Plan	Will enable contractor(s) preparedness and response to any emergency situation during project implementation phase	<ul style="list-style-type: none"> The overall vulnerability of West Tripura district including Dukli IE is categorized as High for earthquakes and thunderstorms. To ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Dukli IE must be prepared by contractor as part of C-SEMP, suiting to contractor's scale of establishment, which shall be approved by ESG Cell. All work force, irrespective of levels, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations. All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily. At project level, contractor shall designate an Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> As part of the ERP, the contractor shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity. West Tripura district has a Disaster Management Plan at district and subdivision levels, which provide the institutional arrangements, designated officers, emergency response systems, infrastructure facilities like hospitals, fire stations, police station at tehsil, sub-division and village levels. 		
8.	Work Zone Safety Requirements	Will enable contractor to ensure safety requirements at work zones during project implementation phase	<ul style="list-style-type: none"> Prior to commencement of feeder cable laying works, contractor will prepare and submit Contractor's SEMP (C-SEMP), which will include contractor's management plan for (i) Work Management; (ii) work zone safety management plan for the prioritized stretches/ areas, in accordance with approved implementation schedule. Commencement of any activity by contractor without prior approval of these requirements will be treated as "non-compliance to contract obligations". All work force of the Contractor shall be subjected to an orientation program, which familiarize them with work requirements, safety practices at work, safe distances to keep from earth moving equipment, first aid facilities, emergency response, on-site sanitation facilities and practices to be adopted, rights and privileges of workforce among others. The orientation shall be carried out on Induction, at the start of the day for work through toolbox meetings and tailgate sessions. Orientation shall also include concern for community safety around operational sites/areas as well, Orientation shall also include first aid facilities, emergency care and emergency response plan available at operational sites and at workforce camps. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
9.	COVID - 19 Requirements for Construction Workers	Will enable contractor to respond due to eruption outbreak of Covid variants	<ul style="list-style-type: none"> In respect of COVID situation, Standard Operating Procedures (SOPs) and Guidelines for Construction Sites for COVID-19 Outbreak issued by Central Public Works Department, Government of India, May 2020 and Tripura State Govt. shall be followed as & when notified. Contractor shall mandatorily adhere to these Govt. of Tripura and Gol COVID-19 SOPs at all construction sites, which shall cover all contract workers, particularly migrant construction workers during the mobilization and subsequent phases of construction by the contractor: 		
10.	Labour/ Workforce Management	Protection of labour rights privileges including equal/ rightful wages	<ul style="list-style-type: none"> Contractor shall comply with all labour regulations of Govt. of Tripura, Government of India and The Occupational Safety, Health and Working Conditions Code, 2020 Contractor shall prefer skilled/ unskilled local labour drawn from nearby places/ region wherever feasible/extent possible, to benefit local community. 		
11.	Occupational Safety, Health, First Aid Facilities and Documenting Safety at all Construction and Operation sites	Will enable contractor to ensure safety requirements at work zones during project implementation phase	<ul style="list-style-type: none"> All workforce/ labour shall be provided with safety instructions daily, depending upon the work, for which they are likely to be deployed for the day/shift. Labour shall be provided with PPEs at no cost and ensure that the same is always being used by the the workforce, while at work. In case of damaged or lost PPEs, some shall be replaced without any cost to labour. All labour shall be instructed and encouraged to report, irrespective of small or major or fatal injury to the supervisory staff and all such incidents shall be documented, and ensure such incidents are not repeated by taking adequate precautions. All Supervisory staff shall be provided with mobile phones for better communication across all operational areas, in case of emergency or otherwise. The contractor shall establish a small first aid room/ mini clinic at the campsite and make available a standby vehicle for emergency purposes for transportation in case of accident with serious injuries at site. Any accident with fatalities shall be reported promptly to ESG Cell and shall take measures to compensate the affected person in accordance with existing regulation. First aid facilities and free emergency care shall be provided to all workforce, irrespective of their rank/level and no cost shall be recovered from them on this account. The contractor shall deploy a medical practitioner periodically at the camp site to attend to health issues/first aid and shall conduct regular health check-ups of all staff and workers employed in the project. Further, no wages shall be cut for a period of absence because of injury – The contractor shall mandatorily have Contractor All Risk (CAR) policy to cover workers of the main contractor as well as all sub-contractors and third party. All work site(s) shall have first aid kits and details of major/nearby hospitals displayed prominently in local language, in case of emergency and/fatalities to work force and/or public, because of operations. The supervisory staff shall be provided with a wireless communication system (mobile telephones for better communication in the operational area and with other operational areas, in case of emergency or otherwise. The Contractor shall comply with all the precautions as required for ensuring the safety of the workmen as per the Government of India norms/regulations All workforce deployed shall be governed by labour management procedures of TIDCL and Tripura Building and Other Construction Workers Welfare Board with regards to safety and welfare measures (including equal wages for men and women) for workers employed at building and other construction sites. The Contractor shall make sure that during the construction work all relevant provisions are adhered to. The Contractor shall not employ any person below the age of 18 years for any construction work and no woman shall be employed for hazardous work, unless and otherwise she is trained to carry put such work. The Contractor shall mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce compliance to use of PPE with zero tolerance. These shall be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and shall be approved by ESG Cell To promote and encourage a Safety culture, senior engineers in Contractors and consultants' teams shall wear helmets and safety jackets at all operational sites. Visitors/officials to work sites are to be provided with PPEs (hard hats and safety shoes) and shall be briefed on ongoing operations at that specific time and related safety requirement at work site including safe distances to keep during the site visit. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> The work force shall be subjected only to standard work shifts/hours. Overtime allowances, if applicable/warranted shall be paid with ceiling limits. Working beyond such ceiling limits shall be discouraged, even if, so desired workforce or contractor. 		
12.	Air Pollution from Vehicles, Plants and Equipment	Air pollution due to deployed vehicles, equipment and machinery	<ul style="list-style-type: none"> The Contractor shall take every precaution to reduce dust levels at contractor's establishment sites and/or operational construction sites by sprinkling of water through pressurized fine spray nozzles. All trucks, carrying electric feeder cables/ materials shall not be overloaded beyond designated capacities All vehicles, equipment and machinery deployed for construction are regularly maintained and maintain a record of Pollution Under Control (PUC) certificates for all vehicles and machinery used during the contract period which shall be submitted to ESG Cell for verification, whenever required. The contractor shall maintain records and conduct fitness tests of all vehicles and machinery at regular intervals of one year and the fitness certificate shall be submitted to ESG Cell. Only fit vehicles and machinery shall be deployed during construction. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
13.	Noise Pollution from Vehicles, Plants and Equipment	Noise pollution due to deployed vehicles, equipment and machinery	<p>The Contractor shall confirm to the following:</p> <ul style="list-style-type: none"> All machinery and equipment and vehicles used in construction shall strictly conform to the MoEF&CC/CPCB requirements with respect to emissions and noise levels/standards. Servicing/routine maintenance of vehicles, equipment and machinery shall be undertaken periodically as per the approval of ESG Cell to keep emissions and noise levels as per norms/minimum. All construction works with high noise levels shall be stopped after sunset hours. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
14.	Non-hazardous Waste Management	Safe disposal of waste from construction camp sites	<ul style="list-style-type: none"> The Contractor's EMP shall include a Management Plan for Non-Hazardous waste and approved by ESG Cell. The contractor shall collect, and store non-hazardous waste generated at camp sites in HDPE/steel drums and stored in a segregated roofed area and periodically disposed at approved waste disposal facilities by Tripura State Pollution Control Board. 		
15.	GBV (gender-based violence)	Possibility of GBV arising due to influx of migrant Labour/ construction workers and existing workforce of IE and community of nearby areas	<ul style="list-style-type: none"> A GBV risk mitigation strategy plan shall be implemented by the contractor under the supervision of ESG Cell and coordination by TIDCL. The plan shall comprise identifying potential risks; mitigation measures; prevention and responses strategy; key actions/SOPs to receive complaints, maintaining confidentiality, handling procedure of complaints, resolution of complaints with survivor centric approach, commensurate to different construction phases. Some of the generic measures, which shall be included in the GBV risk mitigation and key action plan are summarized hereunder: <ul style="list-style-type: none"> Creating awareness about GBV related issues among workers during engagement and/or during Induction of workforce Mandatory consent signing of Code of Conduct (CoC) by all workforce (all categories and levels) to the adhere to the Policy on Sexual Harassment of Women at Workplace prior to the acceptance of the employment/ appointment order. The Code of Conduct for GBV related issues shall include/ cover at workforce camps and or community hotspots like nearby market areas frequented by workers after work hours and/or weekly off days, schools, vocational training centers, liquor shops and, migrant workers residing in rented accommodations within the villages/settlement areas Sensitization and orientation of workforce (all categories, all levels) during induction phase about GBV and associated risks and pep-talk to refresh subject matter in routine toolbox meetings. These shall also be at periodic intervals (at least once in quarter) through external specialized NGOs/ social workers about Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Acts, 2013" and consequences of violations. Integrate briefings on GBV into existing induction training, safety talks, toolbox meetings, tailgate sessions and regular training. Create awareness to labor supply contractor about labour laws as well as GBV risks and mitigation strategy as part of contractor's labour management procedure. Installation of Informatory messages/signboards about GBV awareness and grievance redress mechanism, complaints/ emergency contact numbers at all appropriate/prominent locations covering workforce camps, campsite offices, site establishment such as hot mix plant, ready mix cement concrete plants and site laboratories among others. Provision of separate rest areas and toilets for both men and women with adequate privacy, lighting, water and sanitation facilities. Provision of rest rooms with adequate privacy, lighting facility for pregnant women and lactating mothers at workforce camps, campsite offices, site establishment as may be warranted. Nomination of a designated woman staff through external specialized NGOs/ social workers for regular surveillance of all potential women at workplaces and engaging women workforce in small pep talks for eliciting their views on victimization, discrimination, sexual harassment and GBV related issues at workplace on regular basis for creating a sense of confidence, privacy, security and awareness of complaints mechanism and GRM thereof. Sensitization of workforce to avoid any type of commercial transactions (money lending/ borrowing) with local community, particularly women headed households, widows, single women and senior citizens. Sensitization of workforce to avoid any type of potential conflicts with local communities, particularly women at market areas, settlement areas, grocery shops, liquor vends and eateries, community water source points etc. always during project implementation phase. Sensitization of workforce about strict prohibition of eve-teasing, always stalking of women/adolescent girls near work sites/ educational institutions during project implementation phase. Establishing a committee for grievance redressal mechanism specially for matters related to sexual harassment and GBV matters, which shall be headed by women member representing TIDCL, ESG Cell and contractor, apart from representatives drawn from local women elected members 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			and external specialized NGOs/ social workers, having local presence. The GRM shall include prevention and responses strategy; key actions/SOPs to receive complaints, maintaining confidentiality, handling procedure of complaints, resolution of complaints with survivor centric approach, commensurate to different construction phases.		
16.	Release of toxic pollutants, chemicals and gases to receptors (air, water, land) from transformers and other project equipment	Soil and water pollution & safe disposal of waste materials	<ul style="list-style-type: none"> Conduct training on PCB hazards related to old transformers and requirements of national laws and regulations for their phase out and environmentally sound disposal. PCBs will not be used in any transformers and any other project facilities or equipment. Equipment purchased by Contractor for use on the project to be accompanied by letter from the manufacturer that it is guaranteed PCB free and labelled as PCB free. Contractor to provide PIU/ PMU with material data sheets for insulating oil meeting technical specifications for use in new transformers. In the absence of test data all transformers at existing substations or which will be disturbed by the distribution works must be assumed by the Contractor to contain PCBs and the oil must be sampled and analyzed following UNEP Guidelines for the Identification of PCB and Materials Containing PCB36 and a health and safety risk assessment and plan referring to the measures in UNEP (2002) PCB Transformers and Capacitors: From Management to Reclassification and Disposal. Workers must wear suitable chemical and/or oil-resistant gloves, goggles, and protective clothing whilst sampling the transformer oils. Eye wash station and water supply to shower to be provided during sampling due to risk of PCB encountering skin. If PCBs are found in existing transformers and other project equipment it should be labelled as such and replaced with new equipment. Transformers containing PCBs may not be retained in-situ given the 2025 deadline which coincides with the date of the project completion. Equipment that is found to be PCB free is to be labelled as being PCB free for future reference. Contractor and PIU to ensure appropriate transport, storage, decontamination, and disposal of contaminated units; disposal should involve facilities capable of safely transporting and disposing of hazardous waste containing PCBs. In decommissioning and disposing of transformers (at existing substations) regardless of containing PCB oils, PIU and Contractor to follow Hazardous Waste Management and Handling Rules, 2008 and 2016 of India for transport, storage and disposal of potentially PCB oil containing transformers. The handling, transport, storage and disposal of old transformers by third party vendor will be subject to approval obtained from Tripura State Pollution Control Board and receiving State Pollution Control Board as vendors for disposal not available in Tripura. On reaching the stores Contractor/ PIU must ensure that old transformers are stored on drip trays and surrounding soil at existing substation locations exposed to oil leakage from equipment should be assessed by Contractor/ PIU and appropriate removal and / or remediation measures should be implemented in accordance with the General EHS Guidelines. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
17.	HIV/ AIDS	Likelihood of HIV/ AIDS among construction workers, existing workforce of IE and community of nearby areas	<ul style="list-style-type: none"> Coordinate with State AIDS control society for dissemination materials amongst construction workers including creating awareness, education and Program convergence. Make provisions for availability of condoms at convenient locations within the IE including installation of condom vending machines at labour camp, community-based meetings, consultations in camp, distribution of leaf let, IEC communication, posters, banners 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
18.	Clean-up Operations, Restoration and Rehabilitation during Contractor's Demobilization	Collection and safe disposal of construction debris from work sites	<ul style="list-style-type: none"> Contractor shall prepare 'Site Restoration Plans', which shall be approved by ESG Cell. The clean-up and restoration operations are to be implemented by the Contractor prior to demobilization. The Contractor shall clear all temporary structures; dispose of all garbage, night soils and POL (Petroleum, Oil and Lubricants) wastes as approved by ESG Cell. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
Maintenance Phase/ Operation Stage					
	<p>The following measures are required to further offset the residual impacts on various key environmental attributes like geology, hydrogeology, groundwater, air, noise, land use, waste management among others during the operation phase:</p> <ul style="list-style-type: none"> Routine maintenance and cleaning of all the rainwater percolation wells for recharging groundwater during pre and post monsoon seasons and ensure its effective functional status. Routine maintenance and upkeep of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. DoIC/ TIDCL shall continue to encourage and promote all industrial units (both existing and upcoming) within the industrial estate, to install roof water harvesting and groundwater recharging structures within their respective individual industrial plots for replenishment of groundwater resources. Upon demobilization of the contractor, all the campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps etc. are to be restored to their previous stage. All the construction remanent materials/ debris shall be cleared and disposed of at approved disposal sites. Ensure a routine maintenance and upkeep of all the compensatory saplings with minimum survivability of 70% including replanting the dead saplings and replacement of damaged tree guards, if any for a minimum period of 3 years to offset the net loss and ensure net gain from 3rd year onwards. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed of at approved municipal sites, to mitigate the impacts on surface and ground water pollution during the operation phase. All the upcoming industries during the operation phase will be deemed to be regulated for emissions through consent management (CTE and CTO) under the air, noise and water (Prevention and Control of Pollution) Acts. TIDCL should regularly obtain such compliance reports from all the industries allocated within the industrial estate. 			EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> • Periodical environmental monitoring shall be conducted for ambient air, noise, surface and ground water and soils through an NABET accredited agency/ laboratory will be carried out during the operation phase. • Ensure routine cleaning of all solar panels to ensure optimum green power generation within industrial estate, to ensure optimum power generation and to offset GHG emissions. All the damaged and dysfunctional solar panels, if any, are to be disposed of in accordance with Solar E-waste Management Rules. • Ensure that all the upcoming industries with major machineries have appropriate/ suitable isolated machine foundations and control measures, to limit vibration beyond threshold levels. In addition, also ensure routine maintenance and upkeep of the internal roads. Such measures can reduce impacts of ground borne vibrations during the operation phase. • All the upcoming industries, which may generate both hazardous and non-hazardous wastes during the operation phase are deemed to be covered under respective regulations for waste management and disposal • All the upcoming industries within the IE are deemed to be covered under The Occupational Safety, Health and Working Conditions Code, 2020 (ref. Table 2-1) which covers work zone safety arrangements for their deployed workforce within the industrial premises. • The industrial estate shall have a “onsite emergency response plan (ERP) for addressing natural disasters/ calamity and hazard vulnerability during the operation phase in line with the district disaster management plan comprising the following: <ul style="list-style-type: none"> ○ As part of the emergency response plan, the IE in charge shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity. ○ All work force irrespective of levels and various industries within IE, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations. ○ All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily. ○ IE shall have designated Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel, drawn from various industries for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP. ○ A template for Disaster Management and Emergency Response Plan has been given in Appendix-7 to IEE, which is to be dovetailed with the district disaster management plan and suiting to requirements of the operation phase. • All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under National Labour Act, 1970, The Child Labour (Prohibition and Regulation) Amendment Act, 2016, The Child Labour (Prohibition and Regulation) Act, 1986 and The Occupational Safety, Health and Working Conditions Code, 2020. • All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under the Prevention of Sexual Harassment (POSH) Act, 2013, which address risks related to gender-based violence, in the unlikely event. 		

Table 9-3: Environment Management Plan - Sector/ Component – Buildings under Industrial Sheds, Common facilities and Weighbridge etc.

Note: The guidelines mentioned hereunder are to be followed for building and construction projects, to ensure sustainable environmental management plan in pursuance of Notification No. S.O.3252 (E) of 22nd December 2014 under EIA Notification, 2006.

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
Pre-Construction/ Design Stage Activities				
1.	Environmental audits of proposed Building and Industrial Shed etc.	<ul style="list-style-type: none"> Building Construction Department of Public Works Department, Govt. of Tripura is the designated and Nodal Agency for construction of building infrastructure, industrial shed, facility center and utility center within Dukli. Hence, permission from any other agency is not required. Contractor designated for building & Infrastructure shall have valid license and approved/ enlisted by the BCD Wing of Public Works Department, Govt. of Tripura. Copy of the valid license and approved/ enlistment by the BCD Wing of Public Works Department, Govt. of Tripura shall be submitted to the PIU and ESG Cell under PMU 	PDMC (Design Consultant) and TIDCL	DoIC/ TIDCL (Environmental Safeguards team)
2.	Project planning and preparation	<ul style="list-style-type: none"> The building layout, set-back/side margin, podium, basement ventilation etc. is prepared based on local building bylaws and is approved by competent local authorities. The Project Proponent shall obtain all necessary clearance/ permission from all relevant agencies including the Town Planning Authority before commencing the work. Provisional fire NOC to be obtained from local CFO (Chief Fire Officer) "Consent-to-Establish and Consent-to-Operate" shall be obtained as required from State Pollution Control Board as provided in the Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution) Act, 1974 The project proponent shall put in place a credible enforcement mechanism for compliance of energy conservation measures with its allottees, as projected, in perpetuity. This would be monitored by the designated Energy Conservation/ efficiency Authority in the State. 	PDMC (Design Consultant) and TIDCL	DoIC/ TIDCL (Environmental Safeguards team)
Construction Stage Activities				
3.	Pre-requisites Environment Impacts on Project Land	<ul style="list-style-type: none"> Soil and ground water samples at the construction site shall be tested to ascertain that there is no threat to ground water quality by leaching heavy metals and other toxic contaminants. The top fertile soil to be preserved and to be later used in landscape. The excavation/demolition debris must be disposed of in designated landfill areas or to be used within site for levelling purposes. Under no circumstance, the debris will be disposed in riverbeds/ lakes etc. Undertaking to be given by project proponent that occupancy will be given only after drainage and water connections are in place. Dust/smoke prevention measures such as wheel washing, water sprinkler, screening, barricading and debris chute must be installed. This should comply with the provisions of eco-sensitive zone regulations, coastal zone regulations, heritage areas (identified in the master plan or issued separately as specific guidelines), water body zones (in such zones, no construction is permitted in the water-spread and buffer belt of 30 m minimum around the FTL [full tank level]), various hazard prone area regulations, and others if the site falls under any such area. The site planning should consider heat island effect, size and density of the built-up areas cause heat island effect; wherein higher air temperatures are created in the dense urban areas as against the low-rise surrounding built-up areas. The solar access in the morphology of clusters can be understood in terms of utilization of direct (and not reflected or diffused) solar radiation, mainly for day lighting and heat gain. This defines the minimal distances between the buildings and the relations between built-up volume and open spaces. The proportion of open spaces and built-up edges should be designed such that it ensures winter solar access and summer ventilation. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
4.	Water	<ul style="list-style-type: none"> Proponent shall obtain permission for ground water withdrawal from the State Ground Water Authority. Storm water control and its re-use as per CGWB and BIS standards for various applications The natural flow of existing storm water channel should not be altered or diverted. Keeping in view the use of large quantities of water in curing, measures for reducing water demand during construction should be followed. Curing water should be sprayed on concrete structures; free flow of water should not be allowed for curing. After liberal curing on the first day, all concrete structures should be painted with curing chemical to save water. Concrete structures should be covered with thick cloth/gunny bags and then water should be sprayed on them. This would avoid water rebound and will ensure sustained and complete curing. Ponds should be made using cement and sand mortar to avoid water flowing away from the flat surface while curing. The developer should ensure groundwater and municipal water meet the water quality norms as prescribed in the Indian Standards for various applications (Indian Standards for drinking [IS 10500-1991], irrigation applications [IS 11624-1986]). The use of potable water during construction should be minimized. Separation of grey and black water should be done using dual plumbing line for separation of grey and black water. Source of water to be identified. Water treatment measures such as filtration, softeners, RO etc. should be implemented. Low flow fixtures and sensors to be used to promote water conservation. Water meters to be installed to monitor consumption of water. Water balance table/chart should be prepared 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
5.	Wastewater Treatment	<ul style="list-style-type: none"> Sewage treatment plant of capacity capable of treating 100% wastewater off site of IE (Nearest urban local body (Agartala Municipal Corporation)). Tertiary treatment such as dual media filter, activated carbon filter and ozonation/ chlorination to be provided so that the treated water characteristics are as per Central Pollution Control Board (CPCB) norms. If STP and pump room are installed in basement, adequate ventilation as per NBC air changes norms should be provided. Treated wastewater to be recycled for flushing and gardening. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
6.	Drainage Pattern	<ul style="list-style-type: none"> Excess treated water disposal plan to be submitted. Total paved area of the site under parking, roads, paths or any other use should not exceed 25% of the site area or net imperviousness of the site not to exceed the imperviousness factor as prescribed by the NBC 2005 (BIS 2005b), whichever is more stringent. The final disposal point for excess treated water discharge will be municipal sewers for areas where sewage network is present. In areas where sewage network is absent, the excess treated water can be used for agriculture or can be disposed of as per CPCB rules. Storm water disposal plan to be submitted. The final disposal point for storm water will be municipal storm drain for areas where storm water network is present. In areas where storm water network is absent, the storm water surface runoff can be disposed of in nearby natural water streams/ nallas. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
7.	Ground Water	<ul style="list-style-type: none"> Hydro-geological survey for ground water analysis shall be submitted. Aquifer capacity and Ground water yield shall be determined. A rainwater harvesting plan shall be submitted indicating the number of recharge pits and bores and total rainwater to be harvested. Rainwater to be harvested and as a safety precaution, rainwater on-line filters be provided as per NBC norms. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
8.	Solid Waste Management	<p>During construction phase:</p> <ul style="list-style-type: none"> Disposal of muck during construction phase should not create any adverse effect on the neighboring communities and be disposed taking the necessary precautions for general safety and health aspects of people, only in approved sites with the approval of competent authority The Rules on the Solid Waste Management including Construction Waste issued by the MoEF&CC as amended will be applicable. Construction spoils, including bituminous material and other hazardous materials, must not be allowed to contaminate water courses and the dump sites for such material must be secured so that they should not leach into the ground water. Any hazardous waste generated during construction phase should be disposed of as per applicable rules and norms with necessary approvals of the State Pollution Control Board. Miscellaneous site debris such as broken tiles etc. shall be used on site for leveling /backfilling purposes. Packaged STP /mobile toilets shall be provided for labour camp. Polymer bags used for cement and gypsum shall be handed over to authorized recyclers. Cardboard boxes and other packaging material will be handed over to authorized recyclers. <p>Post construction phase:</p> <ul style="list-style-type: none"> Organic waste composter (OWC) or Vermiculture pits shall be installed on site for biodegradable waste treatment (capacity calculated at 0. 3kg/tenement/ day) The manure generated shall be used for landscaping. The non-biodegradable waste or e-waste shall be handed over to authorized recyclers. STP sludge shall be removed using filter press or centrifuge mechanism. The dried sludge cakes shall be used as manure in landscaping. Minimize waste generation; streamline waste segregation, storage, and disposal; and promote resource recovery from waste. Resource recovery from waste: Employ resource recovery systems for biodegradable waste as per the Solid Waste Management and Handling Rules, 2000 & 2016 of the MoEFCC. Plan for recycling of waste through local dealers. The use of covering sheets should be done for trucks to prevent dust dispersion from the trucks and washing of tyres when trucks with soil I debris coming on road. Hazardous Waste Management: Products, such as paints, cleaners, oils, batteries, and pesticides that contain potentially hazardous ingredients require special care when being disposed of. Improper disposal of household hazardous wastes can include pouring it down the drain, on the ground, into storm sewers, or in some cases putting them out with the trash. The hazardous wastes from construction and demolition activities are centering oil, formwork oil, tar and tar products (bitumen, felt, waterproofing compounds, etc.), wood dust from treated wood, lead containing products, chemical admixtures, sealants, adhesive solvents, Explosives and related products and equipment used in excavation, acrylics, and silica, etc. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
9.	Air Quality and Noise Levels	<p>A) During construction phase:</p> <ul style="list-style-type: none"> The diesel required for operating DG sets shall be stored in underground tanks and clearance from the Chief Controller of Explosives shall be taken, as applicable. Ambient noise levels should conform to residential standards both during day and night as per Noise Pollution (Control and Regulation) Rules, 2000. Incremental pollution loads on the ambient air and noise quality should be closely monitored during construction phase. Adequate measures should be made to reduce ambient air and noise level during construction phase, to conform to the stipulated standards by CPCB/ SPCB. Burning of waste to be banned. The construction site DG to be maintained regularly so that the smoke emission and noise levels are as per permissible norms. Regular P.U.C check for all construction machinery coming on site be done. 63 Noise cancellation and insulation devices such as mufflers, barricades etc. to be used to avoid noise propagation to adjoining areas. <p>B) Post construction phase:</p> <ul style="list-style-type: none"> DG to be regularly maintained so that the smoke emission and noise levels are as per permissible norms. It shall be at least 6 meters away from the boundary. Air quality monitoring to be done quarterly. STP and water pumps, air blowers etc. should be installed with noise cancellation devices or suitable acoustical enclosures to be given so that the noise levels as per NBC norms are maintained. <p>C) During Construction & Operation</p>	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
		<ul style="list-style-type: none"> The provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder be complied for control of noise pollution during construction and operation. Setting up the barriers: The National Building Code 2005 suggests that design solutions such as barrier blocks should be used to reduce external LA 10 noise levels to at least 60-70 dB (A) at any point 1.0 m from any inward looking facade. Green belts and landscaping could act as an effective means to control noise pollution. In the case of railway tracks, a minimum distance of 50m to 70m may be provided between the buildings and the tracks. 		
10.	Energy	<ul style="list-style-type: none"> Appropriate processes and material be used to encourage reduction in carbon footprint. Use of glass be reduced by up-to 40% to reduce the electricity consumption and load on air-conditioning. If necessary, use high quality double glass with special reflective coating in windows. Solar water heater to be provided adequately. Common area lighting should be Solar LED. Install energy meters to monitor overall consumption, and timer-switch for all common area lighting, and other consumption of measurable energy. Fly ash should be used as building material in the construction as per the provisions of the Fly Ash Notification of September 1999 and amended as on 27th August 2003 and 3rd November 2009. Wherever possible recycled materials having low embodied energy are used. Use of light colored, reflective roofs having an SRI (solar reflectance index) of 50% or more should be promoted. The dark colored, traditional roofing finishes have SRI varying from 5% to 20%. Optimize use of energy systems in buildings that should maintain a specified indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2007 of the Bureau of Energy Efficiency, Government of India. The energy systems include air conditioning systems, indoor lighting systems, water heaters, air heaters, and air circulation devices. Use the concept of passive solar design of buildings using architectural design approaches that minimize energy consumption in buildings by integrating conventional energy-efficient devices, such as mechanical and electrical pumps, fans, lighting fixtures, and other equipment, with the passive design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design, and thermal mass. The building should be oriented optimally based on Sun-path and engineering analysis to curtail excessive solar radiation. Lighting systems should comply with the ECBC 2007 and applicable to interior spaces of buildings, exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies, exterior building grounds etc. except emergency lighting and lighting in dwelling units. All the point light sources installed in the building for general lighting shall be LEDs or LEDs or equivalent. All the linear light sources installed in the building for general lighting shall be T-5 or at least 4 Star BEE rated TFLs or equivalent. The installed interior lighting power shall not exceed the LPD (Lighting Power Density) value as recommended by ECBC 2007 Automatic Lighting shutoff control be installed: Interior lighting/Exterior Lighting systems shall be equipped with an automatic control device in accordance with ECBC 2007. Occupancy sensors that shall turn the lighting off within 30 minutes of the occupant leaving the space. It should also have the option of manual turning on lights when the space is occupied. ECBC requires controls in day lit areas that can reduce the light output from luminaries by at least half and controlling of exterior lighting with photo- controls where lighting can be turned off after a fixed interval. The tapping of renewable sources of energy for lighting, heating, cooling, and ventilation needs deserve special attention. For captive solar power generation, a minimum of 15 percent of sanctioned load is the requirement. Solar photovoltaic (SPV) systems are direct energy conversion systems that convert solar radiation into electric energy. SPV systems should be installed to reduce use of conventional sources of energy. Roof tops of buildings as well as other exposed areas such as parking shades should be utilized for installation of SPV systems. Hot water requirements in buildings should be met through the use of various types of solar water heating systems, viz. flat plate collector single glazed double glazed; evacuated tube collectors; and Water heating with solar concentrators. The Project Proponent should ensure regular energy audit. <ul style="list-style-type: none"> To validate the predicted energy consumption, thermal comfort, and visual comfort criteria by an energy auditor approved by the BEE, Government of India. To ascertain continued safety in the operation of the electrical and mechanical systems of the building through proper maintenance by the owner or the occupants. This will be ensured in the contract document by providing for the commissioning of all electrical and mechanical systems by the respective supplier or builder. Moreover, the respective facility management group assigned by the owner or the occupants themselves, will carry out the maintenance facilities. Energy conservation measures like installation of CFLs/LEDs for the lighting in the areas outside the building should be an integral part of the project design and should be in place before project commissioning. Used CFLs and TFLs should be properly collected and disposed of /sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination. Use of solar panels may be done to the extent possible. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
11.	Traffic Movement System	<ul style="list-style-type: none"> Width of driveways, parking provision, ramp width and slope to be kept as per local by laws. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
12.	Provisions for Differently able	<ul style="list-style-type: none"> The Project Proponent should provide at least the minimum level of accessibility for persons with disabilities. <ul style="list-style-type: none"> Ensure accessibility and usability of the facilities in the building for employees, visitors and clients with disabilities. Ensure access to facilities and services by adopting appropriate site planning to eliminate barriers as per the recommended standards (NBC 2005 [BIS 2005n). Layout and designing of interior and exterior facilities as per principles of universal design such as prescribed by the National Building Code of India, building management policies and procedures, provision of auxiliary aids & appliances, and staff training in disability awareness. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
13.	Green Belt/Green Cover	<ul style="list-style-type: none"> Provide a minimum of 1 tree for every 80 sq.mt of plot area. 	EHS Officer, Contractor and	Senior Environmental

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
		<ul style="list-style-type: none"> Wherever trees are cut or transplanted, compensatory plantation in the ratio of 1:5 to be done in the premise. Native species of trees to be planted. Vegetation provides shading and promotes evaporative cooling. In hot and dry climates, evaporative cooling through appropriately sized wet surfaces or fountains has a desirable effect. It should be planned for maximum benefit. The project should have detailed proposals for tree plantation, landscaping, creation of open areas etc. along with a layout plan to an appropriate scale. 	Environmental Officers of PIU & PMU at IE Level	Specialist of ESG Cell, PMU under the overall guidance of Project Director
14.	Disaster/ Risk Assessment Plan	<ul style="list-style-type: none"> Fire tender movement plan to be submitted. Firefighting system to be provided as per the fire NOC. Turning radius to be kept as per Fire Noc or as prescribed in the local by- laws. A public address system to be installed as per the Fire Safety norms. Place of assembly to be indicated. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
15.	Socio Economic Impact and CSR	<ul style="list-style-type: none"> Biodegradable and non-bio-degradable waste bins to be provided for every household to promote waste segregation at source. Importance of environment and various environment drives to be initiated. 103 Importance of maintenance of environment infrastructure to be showcased. by issuing pamphlets etc. Provision for health care, medical kit, creche, First-Aid room shall be given during construction phase for the construction workers. Adequate shelter for resting hours, creche, clean and potable drinking water to be provided to construction workers. All local labour welfare laws must be complied with. Concerns of the communities being affected by the Project are to be responded to as a priority, and all possible CSR is to be rendered to make the responses effectively beneficial. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
16.	Environment Management Plan (EMP)	<ul style="list-style-type: none"> Detailed environment management plan comprising of estimated capital cost and O&M cost for the following environment infrastructure should be submitted: <ul style="list-style-type: none"> Sewage Treatment Plant Landscaping Rainwater Harvesting Power backup for environment infrastructure. Environment Monitoring Solid Waste Management Solar and Energy Conservation Environment Monitoring Cell with defined functions and responsibility shall be set up and its details be submitted. 	EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director
Maintenance Phase/ Operation Stage				
	<p>The following measures are required to further offset the residual impacts on various key environmental attributes like geology, hydrogeology, groundwater, air, noise, land use, waste management among others during the operation phase:</p> <ul style="list-style-type: none"> Routine maintenance and cleaning of all the rainwater percolation wells for recharging groundwater during pre and post monsoon seasons and ensure its effective functional status. Routine maintenance and upkeep of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. DoIC/ TIDCL shall continue to encourage and promote all industrial units (both existing and upcoming) within the industrial estate, to install roof water harvesting and groundwater recharging structures within their respective individual industrial plots for replenishment of groundwater resources. Upon demobilization of the contractor, all the campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps etc. are to be restored to their previous stage. All the construction remanent materials/ debris shall be cleared and disposed of at approved disposal sites. Ensure a routine maintenance and upkeep of all the compensatory saplings with minimum survivability of 70% including replanting the dead saplings and replacement of damaged tree guards, if any for a minimum period of 3 years to offset the net loss and ensure net gain from 3rd year onwards. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed of at approved municipal sites, to mitigate the impacts on surface and ground water pollution during the operation phase. All the upcoming industries during the operation phase will be deemed to be regulated for emissions through consent management (CTE and CTO) under the air, noise and water (Prevention and Control of Pollution) Acts. TIDCL should regularly obtain such compliance reports from all the industries allocated within the industrial estate. Periodical environmental monitoring shall be conducted for ambient air, noise, surface and ground water and soils through an NABET accredited agency/ laboratory will be carried out during the operation phase. Ensure routine cleaning of all solar panels to ensure optimum green power generation within industrial estate, to ensure optimum power generation and to offset GHG emissions. All the damaged and dysfunctional solar panels, if any, are to be disposed of in accordance with Solar E-waste Management Rules. Ensure that all the upcoming industries with major machineries have appropriate/ suitable isolated machine foundations and control measures, to limit vibration beyond threshold levels. In addition, also ensure routine maintenance and upkeep of the internal roads. Such measures can reduce impacts of ground borne vibrations during the operation phase. All the upcoming industries, which may generate both hazardous and non-hazardous wastes during the operation phase are deemed to be covered under respective regulations for waste management and disposal All the upcoming industries within the IE are deemed to be covered under The Occupational Safety, Health and Working Conditions Code, 2020 (ref. Table 2-1) which covers work zone safety arrangements for their deployed workforce within the industrial premises. The industrial estate shall have a "onsite emergency response plan (ERP) for addressing natural disasters/ calamity and hazard vulnerability during the operation phase in line with the district disaster management plan comprising the following: 		EHS Officer, Contractor and Environmental Officers of PIU & PMU at IE Level	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of Project Director

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
	<ul style="list-style-type: none"> ○ As part of the emergency response plan, the IE in charge shall establish and maintain regular coordination with the designated officers for Disaster Management at district/sub-division/ district levels. Maintaining regular coordination will enable us to seek quick response, in the event of natural disaster and/or any other natural calamity. ○ All work force irrespective of levels and various industries within IE, are to be provided with training to respond in an emergency and periodic mock drill shall be conducted to ensure the preparedness to respond any emergency situations. ○ All project operations shall be planned and coordinated in tandem with the daily/weekly weather predictions/alerts issued by competent authorities as relevant for the district and all such alerts shall be duly considered and review the scheduled work programs daily. ○ IE shall have designated Incident Controller (IC), Emergency Controller (EC), Assembly Coordinator (AC) and other required personnel, drawn from various industries for the emergency response mechanism in an event of natural disaster/ calamity in line with the ERP. ○ A template for Disaster Management and Emergency Response Plan has been given in Appendix-7 to IEE, which is to be dovetailed with the district disaster management plan and suiting to requirements of the operation phase. <ul style="list-style-type: none"> ● All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under National Labour Act, 1970, The Child Labour (Prohibition and Regulation) Amendment Act, 2016, The Child Labour (Prohibition and Regulation) Act, 1986 and The Occupational Safety, Health and Working Conditions Code, 2020. ● All industrial workforce who may be engaged by the upcoming industries are deemed to be covered under the Prevention of Sexual Harassment (POSH) Act, 2013, which address risks related to gender-based violence, in the unlikely event. 			

9.2 Budgetary Provision for Additional EMP Measures

361. The IEE has identified specific environmental enhancement measures which are to be implemented. The estimated budgetary provisions for such environmental enhancement measures are INR **17.71 lacs** and is given in **Table 9-4**.

Table 9-4: Budgetary Provisions for EMP Implementation

Sl. No.	Description	INR in lakhs
1	Civil Infra Works (Widening of Roads, SWD, Industrial Safety and Security)	
(a)	Provision for development of green belt area i.e. parks and open areas, spread over 4.59 ha.	Included in civil works cost
(b)	Provision for construction of rainwater percolation wells at 10 locations, selected based on in-situ percolation rate within the IE. The percolation wells shall be constructed as per the guidelines Central Ground Water Authority and/or Central Public Works Department, Govt. of India.	Included in civil works cost
(c)	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory (Ambient Air Quality Monitoring, Water quality Monitoring, Noise level Monitoring and Soil Quality Monitoring). Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard etc. (ref. Table 9-7 for parameters, monitoring locations, duration and frequency)	5.48 (ref. Appendix-10, Table-1 for detailed calculation)
(d)	Provision for construction of storm water drain within IE and discharge of excess/overflow. Provision includes necessary arrangements for pumping the water after requisite water treatment and connecting to the approved existing distribution network.	Included in civil works cost
(e)	Cost of tree felling/ extraction for 13 trees at Dukli IE (all-inclusive cost)	0.24 (ref. Appendix-10, Table-2 for detailed calculation)
(f)	Provision for Planting 65 nos. of saplings and their maintenance for 3 years with minimum 70% survival rate. Planting of sapling along the roadside (avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farmyard/sludge manure, planting the saplings, backfilling the trench, watering, fixing the bamboo tree guard and maintaining the plants for 3 years with minimum 70% survival rate (all-inclusive cost).	2.15 (ref. Appendix-10, Table-2 for detailed calculation)
2	Upgradation of electrical & power supply and Installation of solar plant and mechanical accessories works	
(a)	Provision for upgradation of electrical & power supply, distribution network, laying of underground cable & casting of pole foundation, installation of solar plant and mechanical accessories for industrial unit and utility & facility unit etc.	Included in electrical & power supply works cost. (Actual cost shall be borne by DoIC/ TIDCL as per the estimate of Tripura Forests Department)
(b)	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory (Ambient Air Quality Monitoring, Water quality Monitoring, Noise level Monitoring and Soil Quality Monitoring). Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard etc. (ref. Table 9-7 for parameters, monitoring locations, duration and frequency)	6.84 (ref. Appendix-10, Table-3 for detailed calculation)
3	Provision for Environmental Specialist (full time), Bio-Engineering Specialist (intermittent input) and Horticultural specialist (intermittent input)	Positions to be deployed by PMSC
4	Cost for institutional strengthening, capacity building and training	3.0 Training to be provided through

Sl. No.	Description	INR in lakhs
		PMSC Safeguard Specialists
	Total Rounded off (in Lakh)	17.71

362. The specific environmental enhancement measures will be included in the bid documents, to make it part of a civil works contract and thus to bind the contractor for implementation of the same. Thus, the contractor is deemed to have paid these requirements at the bidding stage itself.

9.3 Implementation of EMP under Civil Works Contract

363. The EMPs are to be included in bidding and contract documents and verified by the ESG Cell under PMU. The PIUs and their respective contractors will be required to deploy full-time qualified and dedicated Environment, Health and Safety (EHS) officers to ensure implementation of EMPs during construction and maintenance phase.

364. The contractor will be required to submit a site environmental management plan (SEMP) to the PIU/ESG Cell under PMU for review and approval. No work shall be commenced by the contractor prior to approval of SEMP by PIU and ESG Cell under PMU. The SEMP shall include (i) proposed sites/locations for establishing construction work camps, material stack/ storage areas, hauling roads, disposal areas for solid and hazardous wastes; (ii) specific requirements for mitigation measures as per approved EMP; (iii) monitoring program as per EMP; and (iv) budget for EMP implementation.

9.4 Institutional Arrangements for EMP Implementation & Monitoring

365. The DoIC, GoT will establish a dedicated Project Management Unit (PMU) and four 4 PIUs¹⁷ for implementation of all 9 industrial estates. The DoIC will also appoint a Project Management and Supervision Consultant (PMSC), who will be responsible for the project management and work supervision at the field levels of all the industrial estates. The PMSC shall comprise several domain experts and headed by a team leader.

366. The PMU will establish an environmental, social and gender (ESG) cell, to be headed by a designated officer of the DoIC/ TIDCL at Superintending or Executive Engineer level. The ESG Cell shall have (a) one Environmental (Safeguard cum Climate Change) Expert at PMU level with 25 months of intermittent input spread over construction phase of 36 months and 1 year DLP/O&M phase (b) One Environmental Safeguard Expert at PMU Level with 35 months of input during construction phase of 36 months and 1 year DLP/O&M phase (c) One Environmental Safeguard Expert at PIU Level with 25 months of input during construction phase of 36 months and 1 year DLP/O&M phase (c) one Bio-Diversity Expert will be designated from Tripura Forest Department to oversee and guide the bio-diversity aspects of the project and will be available for entire project implementation period and O&M/DLP phase and (d) One Landscape Architect cum Horticultural Expert with intermittent input of 4 months during construction phase of 36 months and 1 year DLP/O&M phase) for all Industrial Estates under the TIIDP. One more additional independent consultant (for Environmental Safeguard)

¹⁷ The project will have one PMU established at Agartala, whereas 4 PIUs to cover all 9 industrial estates i.e. 2 for West Tripura District, 1 for North Tripura and 1 for West Tripura district.

would be appointed for one year to provide handholding support to the TIDCL and ensure 5-6 month overlapping period with Project Management and Supervision Consultant (PMSC) under the Tripura Industrial Infrastructure Development Project (TIIDP). All experts will be appointed by the Tripura Industrial Development Corporation (TIDCL) through the Project Monitoring & Supervision Consultant (PMSC).

367. Further, PIU(s) at each IE will have one designated official of the respective department at Assistant Engineer level as Safeguards Officer. The contractor(s) of the respective packages will have one full time EHS officer for the day-to-day implementation of the EMP measures under the guidance of PIU and officers of ESG Cell from PMU. The staffing of the ESG Cell, PIU and the contractor(s) for implementation of EMP is given in **Table 9-5**. The qualification requirement for the positions to be provided by the PMSC for the ESG Cell, PIU and contractors are given in **Appendix-9**.

Table 9-5: Environmental Safeguards Staffing at PMU, PIUs, PMSC, and contractors for EMP Implementation

Sl. No.	Entity	Staff to be Deployed
1	PMU	<ul style="list-style-type: none"> One designated officer at Superintending or Executive Engineer level from, DoIC/TIDCL (as head of ESG Cell). He/ She will be supported by (a) one Environmental (Safeguard cum Climate Change) Expert at PMU level with 25 months of intermittent input spread over construction phase of 36 months and 1 year DLP/O&M phase (b) One Environmental Safeguard Expert at PMU Level with 35 months of input during construction phase of 36 months and 1 year DLP/O&M phase, (c) one Bio-Diversity Expert will be designated from Tripura Forest Department to oversee and guide the bio-diversity aspects of the project and will be available for entire project implementation period and O&M/DLP phase and (d) One Landscape Architect cum Horticultural Expert with intermittent input of 4 months during construction phase of 36 months and 1 year DLP/O&M phase) for all Industrial Estates under the TIIDP. One more additional independent consultant (for Environmental Safeguard) would be appointed for one year to provide handholding support to the TIDCL and ensure 5-6 month overlapping period with Project Management and Supervision Consultant (PMSC) under the Tripura Industrial Infrastructure Development Project (TIIDP). Positions indicated under (a), (b) & (d) are provisioned through PMSC and (c) position is provisioned through deputation from Tripura Forest Department by DoIC/ TIDCL. One designated officer at Superintending level from, DoIC/TIDCL (as head of ESG Cell).
2	PMSC	<ul style="list-style-type: none"> He/ She will be supported by (a) One Environmental Safeguard Expert at PMSC Level with 35 months of input during construction phase of 36 months and 1 year DLP/O&M phase, (b) one Bio-Diversity Expert will be designated from Tripura Forest Department to look after the bio-diversity aspect of the project and will be available for entire project implementation period and O&M/DLP phase and (c) One Landscape Architect cum Horticultural Expert with intermittent input of 4 months during construction phase of 36 months and 1 year DLP/O&M phase) for all Industrial Estates under the Tripura Industrial Infrastructure Development Project (TIIDP) Positions indicated under (a) & (c) are provisioned through PMSC and (c) position is provisioned through deputation from Tripura Forest Department by DoIC/ TIDCL. The Environment Expert will report to Safeguards Officer at (Executive Engineer at (TIDCL) ESG Cell & PMU and Environment (Safeguard cum Climate Change Expert) at PMU Level.
3	PIUs	<ul style="list-style-type: none"> One designated officer (Executive Engineer level), covering all PIUs (as head of Safeguards at PIU Level). One Environmental Safeguard Expert at PIU Level with 25 months of input during construction phase of 36 months and 1-year DLP/O&M phase.

Sl. No.	Entity	Staff to be Deployed
		<ul style="list-style-type: none"> The Environment Expert will report to Environmental Safeguard Expert at PMSC Level and Safeguard Officer at PIU level (Assistant Engineer)
4	Contractors	<ul style="list-style-type: none"> Each of the contract package(s) shall have one full-time Environmental, Health and Safety (EHS) Officer, to be provided by the respective contractor(s). The EHS officers will report to (a) Safeguards Officer at PIU (Assistant Engineer level), (b) Environment Expert at IE/ PIU level and (c) Environment Expert at PMSC and Environmental (Safeguard cum Climate Change) Expert, at PMU

9.5 Key Tasks & Responsibilities of Superintending or Executive Engineer, PMU

368. The head of the ESG Cell (Superintending or Executive Engineer, level officer) at PMU will have the overall responsibility for implementation of ADB-cleared EMPs in compliance with ADB's SPS 2009, regulatory requirements of the country, project-specific GRM as agreed between DoIC/ TIDCL and ADB.

369. The Key tasks and responsibilities of the Superintending or Executive Engineer, PMU shall be as follows:

- a) Ensure that the final sector-wise EMPs, including relevant mitigation measures which need to be implemented during the construction stage by the contractors, are included in the bidding and contract documents.
- b) Ensure establishment of ESG Cell at PMU and environmental officers at PIUs levels (through relevant office orders).
- c) Ensure all project components have the requisite environmental clearances and comply with the central and state regulations. If not pursue and obtain the same in timely manner.
- d) Ensure timely disclosure of final IEEs/EMPs in locations and form accessible to the public;
- e) Provide guidance and oversee environmental management aspects and ensure EMPs are implemented by PIUs, and contractors at respective industrial estates/ contract package level;
- f) Facilitate and ensure compliance with all regulatory requirements of both central & state particularly related to environmental clearances, CTEs, CTOs, as well as any other statutory requirements, as warranted;
- g) Supervise and provide guidance to the PIUs to carry out the environmental monitoring as per the IEE/EMP;
- h) Review, monitor, and evaluate the effectiveness with which the EMPs are implemented, and recommend corrective actions to be taken as necessary;
- i) Consolidate monthly environmental monitoring reports from PIUs and submit semi-annual environmental monitoring reports (EMR) during construction stage; and annual EMR during operation stage (till issuance of the Project completion report by ADB) to ADB for review and clearance.
- j) Ensure that the contractors understand their responsibilities to implement the EMP and mitigate environmental impacts associated with their construction activities and with support of TIDCL provide training to their staff as required.
- k) In case unanticipated environmental impacts occur during the project implementation stage, including design changes, inform ADB, and, as required, update the IEE and EMP in consultation with relevant government agencies for clearance by ADB before any changes are implemented.

- l) In case of non-compliance, inform ADB, and prepare in consultation with relevant government agencies and implement as necessary a corrective action plan for clearance by ADB.
- m) Ensure that the Grievance redressal committees (GRC) at all three levels are (a) established (following office orders); and (b) functional during implementation of the Project.
- n) Redressal of grievances brought about through the GRM in a timely manner.

370. The institutional roles and responsibilities for environmental safeguards implementation at PIUs, PMSC, and Contractor's level are described below:

9.6 Key Tasks & Responsibilities of PIU

371. The PIU(s) will be responsible for the following:

- a) Liaise with local offices of regulatory agencies in obtaining consents/ permissions/ clearances /approvals.
- b) Review and approve Contractor sub-plans e.g. Construction EMP plus Traffic Management Plan, Construction Waste Management Plan, and Health and Safety Plan with support of PMSC.
- c) Oversee day-to-day implementation of EMPs by contractors, including compliance with all government rules and regulations.
- d) Coordination for timely actions for redressal of GRM by all parties
- e) Ensure that the contractors submit monthly environmental management reports (these reports will be included as part of the contractors' monthly progress reports). Further, review and submit it to PMU.
- f) Coordinate public consultation and information disclosure.
- g) In case unanticipated environmental impacts occur during the project implementation stage, including design changes, inform PMU/ADB, as required, help update the IEE and EMP for clearance by ADB before any changes are implemented.
- h) In case of non-compliance, inform PMU/ADB, and help prepare and implement as necessary a corrective action plan for clearance by ADB.

9.7 Key Tasks & Responsibilities of Environment Safeguard Expert, PMSC

372. The Environment Safeguard Expert (reporting to Superintending or Executive Engineer, PMU) will provide overall supervision to the safeguards team under PMU, PIU, PMSC, and Contractor(s).

373. The key tasks and responsibilities of the Environment Safeguard Expert will be as follows:

- a) Ensure implementation of ADB-cleared EMPs by PIU and contractors including reporting to DoIC/ TIDCL and ADB:
- b) Support DoIC/ TIDCL and PIUs and other officers with environmental responsibilities in ensuring compliance with loan covenants related to environmental safeguards as well as state and national environment laws and regulations.
- c) Develop an environment, health and safety (labor) training plan and provide formal environmental management trainings at the appropriate stage in project implementation as set out in the EMPs (and agreed training plan) including preparation

of all training materials in a format that can be used for future reference, document attendees for trainings through photographs and attendance list.

- d) Develop environment management checklists based on the EMPs for use by officers and PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction and maintenance phases.
- e) Support DoIC/ TIDCL, PIUs and their contractors in understanding the national laws and regulations, international good practices for environmental management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- f) Assist PIUs to monitor and supervise implementation of the project EMP by themselves and their contractors.
- g) Review and confirm that necessary provisions of the disclosed EMP (updated versions if any since bidding stage) are included in the contracts for further implementation and compliance.
- h) Assist DoIC/ TIDCL to update the IEE/prepare addendum to IEE to reflect any changes (such as location, alignment, length, design, addition of new sub-components etc.) including undertaking any site-specific assessment and identifying mitigation measures required.
- i) Review and confirm the detailed designs adequately incorporate all EMP measures and conform with the IFCs EHS guidelines.
- j) Review and confirm that all pre-construction requirements and relevant clearances and permits have been obtained prior to commencement of works.
- k) Maintain records and copies of all clearances, permits, licenses and insurances obtained by DoIC/ TIDCL and contractors.
- l) Review and approve the contractor's pre-construction documentation as required by the EMP (e.g. CEMP/SEMP) and confirm requirements as well as national laws and regulations.
- m) Review documentation and undertake regular site visits to ensure the EMP implementation.
- n) Facilitate monthly EHS meetings and undertake at least one site visit every month to all active project sites across all contract packages during the construction period to check PIUs supervision and monitoring activities and adequate implementation of EMP measures and, advise DoIC/ TIDCL and their contractors if improvements are needed, document each site visit in field visit note including photographs.
- o) In addition to monthly site visits carry out at least quarterly in-depth environmental audits and random spot checks of all contractors to verify compliance to applicable requirements during construction.
- p) Prepare monthly/quarterly updates and assist DoIC/ TIDCL in preparing the semi-annual environmental monitoring reports in accordance with template (ref. **Appendix-11**).
- q) Assist DoIC/ TIDCL to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact, including a change in scope or design, or the siting or routing of project components.

- r) Record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues.
- s) Support DoIC/ TIDCL to locally disclose the IEE/EMP per the EMP requirements, prepare a community liaison plan, and continue to disclose information on and conduct meaningful consultations with the affected communities especially in relation to sites with adjacent properties and the distribution line routings.
- t) Support DoIC/ TIDCL to operationalize and effectively implement the grievance redress mechanism, including raising awareness of its existence with affected communities, resolving grievances related to environmental issues that have been submitted, and keeping adequate documentation.
- u) Support DoIC/ TIDCL to respond to any EHS related grievances.
- v) Prepare operational procedures in line with the requirements set out in the EMP to be adopted by DoIC/ TIDCL and provide them with training on their operationalization.
- w) Prepare a final EMR, setting out in detail the compliance level of all the EMP requirements and capacity strengthening of DoIC/ TIDCL to continue to comply with the EMP requirements during maintenance phase as part of the project completion report (PCR)

9.8 Responsibilities of Environment (Safeguard cum Climate Change) Expert

374. The Environmental (Safeguard cum Climate Change) Expert (reporting to ESG Cell at PMU) and deployed at PIU level will provide overall supervision to the EHS officers of contractors under respective PIU(s).

375. The key tasks and responsibilities of the Environmental (Safeguard cum Climate Change) Expert will be as follows:

- a) Assist the PIU and contractors in day-to-day implementation of ADB-cleared EMPs including reporting to PMU.
- b) Support PIUs and PMU and other officers with environmental responsibilities in ensuring compliance with loan covenants related to environmental safeguards as well as state and national environment laws and regulations.
- c) Assist in providing formal environmental management trainings at the appropriate stage in project implementation as set out in the EMPs (and agreed training plan) including preparation of all training materials in a format that can be used for future reference, document attendees for trainings through photographs and attendance list.
- d) Assist implementing environment management checklists based on the EMPs for use by PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction and maintenance phases.
- e) Support PIUs and their contractors in understanding the national laws and regulations, international good practices for environmental management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- f) Assist PIUs and contractors to monitor and supervise implementation of the project EMP by themselves and their contractors.

- g) Review and confirm that necessary provisions of the disclosed EMP (updated versions if any since bidding stage) are included in the contracts for further implementation and compliance.
- h) Assist PMU/ PIU to review and confirm the detailed designs adequately incorporate all EMP measures and conform with the IFCs EHS guidelines.
- i) Assist to PMU/PIU to review and confirm that all pre-construction requirements and relevant clearances and permits have been obtained prior to commencement of works.
- j) Assist PMU/ PIU to maintain records and copies of all clearances, permits, licenses and insurances obtained by DoIC/ TIDCL and contractors.
- k) Assist PMU/ PIU to review and approve the contractor's pre-construction documentation as required by the EMP (e.g. CEMP/SEMP) and confirm requirements as well as national laws and regulations;
- l) Assist PMU/ PIU to review documentation and undertake regular site visits to ensure the EMP implementation.
- m) Assist PMU/ PIU to facilitate monthly EHS meetings and undertake at least one site visit every month to all active project sites across all contract packages during the construction period to check PIUs supervision and monitoring activities and adequate implementation of EMP measures and, advise DoIC/ TIDCL and their contractors if improvements are needed, document each site visit in field visit note including photographs.
- n) In addition to monthly site visits carry out at least quarterly in-depth environmental audits and random spot checks of all contractors to verify compliance to applicable requirements during construction.
- o) Assist PMU/ PIU to prepare monthly/quarterly updates and assist DoIC/ TIDCL in preparing the semi-annual environmental monitoring reports in accordance with template agreed with ADB.
- p) Assist PMU to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact, including a change in scope or design, or the siting or routing of project components.
- q) Assist PMU/ PIU to record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues;
- r) Assist PMU/ PIU to locally disclose the IEE/EMP per the EMP requirements, prepare a community liaison plan, and continue to disclose information on and conduct meaningful consultations with the affected communities especially in relation to sites with adjacent properties and the distribution line routings.
- s) Assist PMU/ PIU to operationalize and effectively implement the grievance redress mechanism, including raising awareness of its existence with affected communities, resolving grievances related to environmental issues that have been submitted, and keeping adequate documentation.
- t) Assist PMU/ PIU to respond to any EHS related grievances.
- u) Assist PMU/ PIU to prepare operational procedures in line with the requirements set out in the EMP to be adopted by DoIC/ TIDCL and providing them with training on their operationalization.
- v) Assist PMU/ PIU to prepare a final EMR, setting out in detail the compliance level of all the EMP requirements and capacity strengthening of DoIC/ TIDCL to continue to comply with the EMP requirements during maintenance phase as part of the project completion report (PCR).

9.9 Responsibilities of Bio-Diversity Specialist, PMSC

376. The Bio-diversity Specialist (reporting to Superintending or Executive Engineer/ Senior Environmental Specialist, PMU) will have the following key tasks and responsibilities:

- a) Assist the PMU, PIU and contractors in bio-diversity related matters during day-to-day implementation of ADB-cleared EMPs at all industrial estates:
- b) Assist implementing bio-diversity management checklists based on the EMPs for use by PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction and maintenance phases.
- c) Support PIUs and their contractors in understanding the good practices for bio-diversity management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- d) Assist PMU to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact on biodiversity, including a change in scope or design, or the siting or routing of project components.
- e) Assist PMU/ PIU to record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues related to biodiversity matters.
- f) Assist PMU/ PIU to respond to any bio-diversity matters related like species identification prior to site selection, species selection for open area/ green area development during pre-construction, construction and maintenance phases.

9.10 Responsibilities of Horticultural Specialist, PMSC

377. The Horticulture Specialist (reporting to Superintending or Executive Engineer/ Senior Environmental Specialist, PMU) will have the following key tasks and responsibilities:

- a) Assist the PMU, PIU and contractors in horticulture related matters during day-to-day implementation of ADB-cleared EMPs at all industrial estates.
- b) Support PIUs and their contractors in understanding the good practices for horticulture management and monitoring requirements including the corrective actions required for each of the prioritized industrial estates.
- c) Assist PMU/ PIU to record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address non-compliance issues related to horticulture related matters.
- d) Assist PMU/ PIU to respond to any horticulture related matters like species identification prior to site selection, site preparation, species selection for open area/ green area development during pre-construction, construction and maintenance phases.

9.11 Responsibilities of Environment, Health and Safety Officer

378. The Environment, Health and Safety Officer (reporting to ESG Cell at PMU) deployed by respective contractors under respective PIU(s) will have the following key tasks and responsibilities:

- a) Prepare the CEMP/SEMP covering (details of construction camp sites; construction materials storage areas; spoil management plan; health & safety plans; traffic management plans; and on-site grievance redressal mechanism).
- b) Implement the EMP in respect of actions allocated to the Contractor during construction.
- c) Ensure adherence to all applicable national environment, health, safety and labor laws.
- d) Support TIDCL/PMSC to update the IEE for clearance by ADB following the change of location/design/new components identified under the Project.
- e) Ensure that construction workers including all formal and informal subcontractors understand their responsibilities to implement the EMP and mitigate environmental impacts associated with their pre-construction and construction activities with support of TIDCL.
- f) Support the PMU/PIUs in undertaking ongoing consultation and implementing the GRM.
- g) Submit monthly environmental monitoring reports to the PIUs (these reports will be included as part of the contractors' monthly progress reports). It will identify the work undertaken over the reporting period and document the environmental, health and safety measures including qualitative and quantitative monitoring activities that have been carried out, problems encountered, and follow-up actions that were taken (or will be taken) to correct the problems).
- h) In case unanticipated environmental impacts occur during the project implementation stage, including design changes, inform PIUs/PMU, and as required, help update the IEE and EMP for clearance by ADB before any changes are implemented.
- i) In case of non-compliance, inform PIUs/PMU/PMSC, and help prepare and implement as necessary a corrective action plan for clearance by ADB.

9.12 ADB's Responsibility

- a) Conduct periodic site visits during the project implementation to confirm compliance with the EMP.
- b) In case of significant issues, conduct supervision missions with detailed review by ADB's Environment specialists/officers or consultants.
- c) Review the semi-annual reports submitted by TIDCL to ensure that adverse impacts and risks are mitigated as planned and agreed with ADB.
- d) Work with TIDCL 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; and
- e) Prepare a project completion report that assesses whether the objective and desired outcomes of the EMPs have been achieved, considering the baseline conditions and monitoring results.

379. The institutional arrangement for implementation of the EMP during the construction stage is given in **Figure 9-1**.

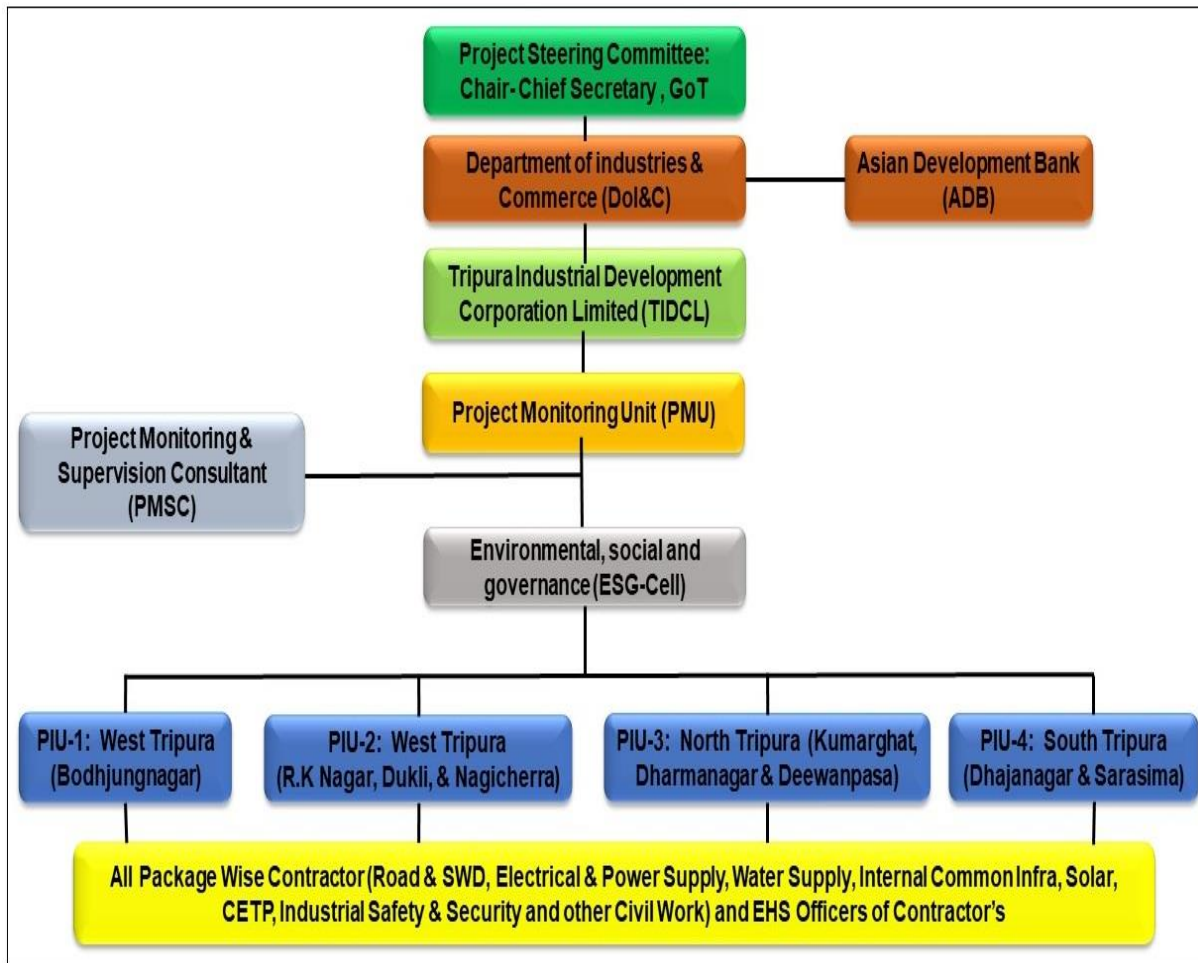


Figure 9-1: Institutional Arrangement for Implementation of EMP

9.13 Training and Capacity Building

380. The training on EMP implementation shall be provided to the Project staff (PMU, PIUs, PMSC, and EHS Officers of contractors) by the Senior Environment specialist of PMU (position provided by PMSC), after mobilization of most of the project staff during construction stage.

381. The outline of training on EMP implementation for capacity building is given in **Table 9-6**. The estimated cost for the training is ₹300,000 (excluding trainings of contractors which will be part of EMP implementation cost during construction) to be covered by the project's capacity building program. The detailed cost and specific modules will be customized for the available skill set after assessing the capabilities of the target participants and the requirements of the project by the Environmental Specialist of PMSC.

Table 9-6: Outline of Training on EMP Implementation for Capacity Building

Description	Duration & Participants	Cost Provision & Source of Fund
1. Introduction and Sensitization to policies and regulatory requirements <ul style="list-style-type: none"> • ADB Safeguards Policy Statement • Government of India and Govt. of Tripura applicable safeguard laws, regulations and policies including labor laws 	Half day All PIU, PMU & Contractors managerial and EHS officers	INR: 300,000 (Lump sum) Included in overall project

Description	Duration & Participants	Cost Provision & Source of Fund
and occupational health and safety (OHS) requirements and practices, etc. <ul style="list-style-type: none"> • Incorporation of EMP into the project design and contracts • Monitoring, reporting and corrective action planning. 		cost
2. Good Construction Practices and EMP implementation <ul style="list-style-type: none"> • All EMP mitigation and monitoring measures under EMP including Roles and responsibilities for implementation • Construction site standard operating procedures (SOP) for both linear and area-based components • Occupational Health and Safety (OHS) requirements and practices, etc. • Site clean-up and restoration, on site sanitation and waste management plan • Grievance redress mechanism • Reporting and disclosure 	Half day All PIU, PMU & Contractors managerial and EHS officers	
3. Orientation to Contractors <ul style="list-style-type: none"> • All EMP mitigation and monitoring measures under EMP • Construction site standard operating procedures (SOP) for both linear and area-based components • Occupational Health and Safety (OHS) requirements and practices, etc including toolbox talk on daily basis. • On site sanitation, waste management plan • Site clean-up and restoration • Reporting and disclosure <p>Note: Shall be conducted once during mobilization of contractor and thereafter refresher orientation once every month. In addition, daily toolbox talks briefing on OHS requirements and practices, prior to start of work</p>	Half day PIU field supervisors and contractors EHS officers, field supervisors and workers (both skilled & unskilled)	

382. Training on ADB's requirements and EMP implementation shall also be provided to the Project staff through the Capacity Development Resource Centre (CDRC) regular program, ADB or during Review Mission.

9.14 Environmental Monitoring Plan

383. During the construction and maintenance phase (concurrent to 1 year defect liability period), the prevailing environment conditions are to be monitored through a NABET accredited laboratory under the supervision of the PIU and ESG Cell.

384. The monitoring schedule, probable monitoring locations, parameters to be monitored and frequency is given in **Table 9-7**. The EHS officer of the contractor shall be primarily responsible for arranging the environmental monitoring under the overall guidance of the PIU and ESG Cell.

Table 9-7: Environmental Monitoring Schedule at Dukli IE

Attribute	Typical Sampling Locations	Component/ Sector, Frequency & Duration for Monitoring		Total No of Samples
		Civil Infra Works (Widening of Roads, SWD, Industrial Safety and Security,)	Upgradation of electrical & power supply and Installation of solar plant and mechanical accessories works	
Package No:--		TIDCL-CW09-ADB-PIU2-DL-01	TIDCL-EW02-ADB-PIU2- DL-01	
Air	Shall cover all active construction site(s), workforce camp site(s), material stack yard(s), crusher/ hot mix /batch mix plants	Construction phase-18 months	Construction phase-30 months	36
		1 location, once a quarter (06 samples)	1 location, once a quarter (10 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	1 location, once in 6 months (10 samples)	
		Total-16	Total-20	
Water	Shall cover drinking water sources for workforce camps and hand pumps/natural water sources along/hear to project construction activities	Construction phase-18 months	Construction phase-30 months	36
		1 location, once a quarter (06 samples)	1 location, once a quarter (10 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	1 location, once in 6 months (10 samples)	
		Total-16	Total-20	
Noise	Shall cover all active construction site(s), workforce camp site(s), material stack yard(s), crusher/ hot mix /batch mix plants	Construction phase-18 months	Construction phase-30 months	36
		1 location, once a quarter (06 samples)	1 location, once a quarter (10 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	1 location, once in 6 months (10 samples)	
		Total-16	Total-20	
Soil	Shall cover adjacent areas of construction sites, camp sites, crusher/hot mix/batch mix plants sites, and workforce camps	Construction phase-18 months	Construction phase-30 months	36
		1 location, once a quarter (06 samples)	1 location, once a quarter (10 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	1 location, once in 6 months (10 samples)	
		Total-16	Total-20	
Provision for Budget of environmental monitoring within IE through NABET Accredited Laboratory (Ambient Air Quality Monitoring, Water quality Monitoring, Noise level Monitoring and Soil Quality Monitoring). (in Lakh)		5.48	6.84	12.32

10.0 CONCLUSIONS AND RECOMMENDATION

385. The IEE has assessed the proposed infrastructure construction works as well as the baseline environment within the core and buffer zones of Dukli IE. The IEE has not identified any significant and irreversible long-term impact, but will have localized, short-term impacts, confined to the existing IE boundary. Therefore, as per ADB's SPS 2009, the Project (Dukli IE) is defined as "category B" for environment safeguards and the IEE report has been prepared.

386. The proposed construction works will not have impact on forest areas, protected areas, endangered/ threatened/ rare flora and fauna, protected monuments/ cultural heritage structures within the core zone. The construction works will require felling of 13 trees, which are commonly found in core and buffer zones. The joint inspection survey with the forest department officials concerned has been completed and a physical verification report for felling/ extraction of these trees has been received.

387. The incidental impacts due to the construction activities like vegetation clearance, dust and noise levels, air pollution due to vehicular emissions, worker's safety, construction site management, construction material management including debris disposal, on and off-site sanitation management works are largely reversible and short term in nature. Measures to minimize such impacts are described under the environmental management plan (sector wise). The EMP also includes institutional responsibilities for supervision & implementation monitoring throughout the construction stage.

388. Additionally, several environmental conservation measures like balancing the cut and fill quantities of earthwork (3127.28 cum), green area development, recharging/ percolation wells at 10 locations to offset the withdrawal of groundwater, plantation of 65 saplings (5 saplings for every tree felled) with 3 year maintenance and minimum 70% survival rate to offset the net loss and ensure net gain from 3rd year onwards, periodical monitoring of ambient air quality, ambient noise levels, water and soil quality at construction sites throughout the construction stage are included under EMP along with necessary budgetary provisions (INR 17,71,000).

389. The EMP will be included in the bid documents, to make it part of civil works contract and binding of the contractor for implementation of the EMP during construction stage.

390. The IEE has determined that the proposed construction works at Dukli IE will not require prior environmental clearances either from the state or central levels (as per EIA notification 2006 and amendments thereof). However, CTE & CTO for campsites, hot-mix plants, concrete batch plants, etc. will be required from the Tripura State Pollution Control Board. Seeking such required extensions, permissions, consents and NOC will not pose any regulatory risks.

391. The stakeholders i.e. owners of the existing industries as well as the workforce within the IE have been consulted, to seek their suggestions/ viewpoints, inadequacies in the existing infrastructure and many of which have been included in the project design.

392. The IEE includes grievance redressal mechanism to resolve any complaints from aggrieved existing industries and/or their workforce, if any arise during the construction stage. The GRM stipulates a time frame for resolution of grievances in a three-tier mechanism. In addition, the contractor will also require having a GRM to resolve any complaints from the construction workforce.

APPENDIX-1
RAPID ENVIRONMENTAL ASSESSMENT (REA)
CHECKLIST-DUKLI IE

APPENDIX-1: RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Safeguards Division (SDSS) for endorsement by the Director, SDSS and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's: (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: IND 58021-001/Tripura Industrial Infrastructure Development Project Dukli Industrial Estate in Tripura

Sector Division: Public Sector Management and Governance Sector Office (PSMG)

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area...		✓	Dukli is an industrial estate (IE) existing since 1982
Densely populated?		✓	This is industrial estate with no provision for residential colonies.
Heavy with development activities?		✓	Only small and medium scale industries are within the IE
Adjacent to or within any environmentally sensitive areas?		✓	No Nearest protected or their notified eco-sensitive zone are not existed.
Cultural heritage site		✓	No No cultural heritage site is located within 300 metres from the IE in all directions.
Protected Area		✓	No No Wildlife Sanctuary or National Park and/or their notified eco-sensitive zones are within 10 km of Dukli industrial estate. RoWa located at a distance of 104.06km, Gomati: 41.78km, Trishna:42.11km & Sepahijala : 10.06 from IE of Dukli.
Wetland		✓	No The Tilla lake wetland is College Tilla Lake, situated at a distance of more than 7km km from IE
Mangrove		✓	None in Tripura State
Estuarine		✓	None in Tripura State
Buffer zone of protected area		✓	No Nearest protected or their notified eco-sensitive zone is not close to IE
Special area for protecting biodiversity		✓	No Special area for protecting biodiversity is not close to IE.
Bay		✓	None in Tripura State
B. Potential Environmental Impacts			

Screening Questions	Yes	No	Remarks
Will the Project cause...			
impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		✓	Minor impacts are anticipated during the construction phase, which can be mitigated by implementing suitable measures
deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity, and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		✓	None anticipated. No untreated effluent will be discharged into the natural drainage channels. The construction stage impact can be mitigated through septic tank and soak pit disposal arrangements.
degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		✓	None/ Not applicable
dislocation or involuntary resettlement of people?		✓	None/ Not applicable
disproportionate impacts on the poor, women and children, Indigenous Peoples, or other vulnerable group?		✓	None/ Not applicable
degradation of cultural property, and loss of cultural heritage and tourism revenues?		✓	None/ Not applicable
occupation of low-lying lands, floodplains, and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to pollutive industries?		✓	None/ Not applicable
water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality, and pollution of receiving waters)?		✓	None anticipated. No untreated effluent will be discharged into the natural drainage channels. The development works also include construction of storm water holding ponds by impounding the existing valley/ local depression(s). The stormwater holding ponds will serve as a supplementary water source for the industrial estate, after requisite water treatment and expected to partially offset the use of ground water for industrial use.
air pollution due to urban emissions?		✓	None/ Not applicable All existing and upcoming industries within IE are regulated for emissions under the Air and Water Pollution Prevention Acts.
risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?		✓	Risks and vulnerability during construction phase are managed through appropriate preventive and safety measures. Chemical and biological hazards are not applicable.
road blocking and temporary flooding due to land excavation during rainy season?		✓	Impacts can be mitigated through appropriate preventive measures.
noise and dust from construction activities?		✓	Dust and noise levels can be regulated through appropriate preventive measures.
traffic disturbances due to construction material transport and wastes?		✓	The impacts can be mitigated through appropriate traffic scheduling and management plans.
temporary silt runoff due to construction?		✓	The temporary impacts are anticipated during the construction stage and can be mitigated through appropriate measures.
hazards to public health due to ambient, household and occupational pollution,		✓	None/ Not applicable

Screening Questions	Yes	No	Remarks
thermal inversion, and smog formation?			
water depletion and/or degradation?		✓	Project design include measures to replenish groundwater resources and reduce the dependence on use of groundwater for industrial use.
overpaying of ground water, leading to land subsidence, lowered ground water table, and salinization?		✓	None/ Not applicable
contamination of surface and ground waters due to improper waste disposal?		✓	None anticipated. No untreated effluent will be discharged into the natural drainage channels. The development works also include construction of storm water holding will serve as a supplementary water source for the industrial estate, after requisite water treatment and expected to partially offset the use of ground water for industrial use.
pollution of receiving waters resulting in amenity losses, fisheries and marine resource depletion, and health problems?		✓	None/ Not applicable
large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		✓	The influx of the workforce will be managed and conflicts with the local people/ community will be avoided through appropriate measures
social conflicts if workers from other regions or countries are hired?		✓	The influx of the workforce will be managed and conflicts with the local people/ community will be avoided through appropriate measures
risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		✓	None/ Not applicable
community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation, and decommissioning?		✓	None/ Not applicable

ASBESTOS SCREENING TOOL

Screening Questions	Yes*	May be*	No	Remarks *For those with answers of YES and MAY be , document the potential likelihood of asbestos being encountered.
Does the proposed project involve, or potentially involve, any of the following activities that are commonly associated with asbestos use:			✓	None/ Not applicable
<ul style="list-style-type: none"> • Construction/commissioning of a new asset? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Refurbishment / demolition of an existing asset? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Post-disaster response, involving reconstruction, repair, or removal of damaged asset? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Maritime activities? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Water supply, water sanitation, wastewater, sewerage, or water hygiene initiatives? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Earthworks, remedial activities, or solid waste management? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Power, telecommunications, or energy supply infrastructure? 			✓	None/ Not applicable
<ul style="list-style-type: none"> • Maintenance, demolition, transportation, or disposal of wastes associated with the above activities? 			✓	None/ Not applicable

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: IND 58021-001/Tripura Industrial Infrastructure Development Project
Dukli Industrial Estate in Tripura

Sector : Public Sector Management and Governance Sector Office (PSMG)

Subsector : Industry and trade sector development

Division/Department : Public Sector Management and Governance Sector Office (PSMG)

Screening Questions		Score	Remarks ¹
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather-related events such as floods, droughts, storms, landslides?	1	See below "other comments"
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	None
Materials and Maintenance	Would weather, current, and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	See below "other comments"
	Would weather, current, and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	0	None
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design lifetime?	1	See below "other comments"

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1–4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which includes providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high-risk project.

Result of Initial Screening (Low, Medium, High): Medium

Other Comments: Climate risk and adaptation assessment (CRA) and Climate Resilience Framework (CRF) has been considered and requisite provisions are included in the project design of all the 9 prioritized industrial estates.

Prepared by: ADB TA Consultant

¹ If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

APPENDIX-2

**Extract of EIA Notification 2006, with reference to
Industrial Estates**

(1)	(2)	(3)	(4)	(5)
6(b)	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	-	All projects	General Condition shall apply
7		Physical Infrastructure including Environmental Services		
7(a)	Air ports	^v "All projects including airstrips, which are for commercial use."	-	^v "Note: Air strips, which do not involve bunkering/ refueling facility and or Air Traffic Control, are exempted."
7(b)	All ship breaking yards including ship breaking units	All projects	-	-
7©	Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.	If at least one industry in the proposed industrial estate falls under the Category A, entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha. and housing at least one Category B industry.	Industrial estates housing at least one Category B industry and area <500 ha. Industrial estates of area > 500 ha. and not housing any industry belonging to Category A or B.	^v "Genral as well as special conditions shall apply." Note: 1. Industrial Estate of area below 500 ha. and not housing any industry of Category 'A' or 'B' does not require clearance. 2. If the area is less than 500 ha. but contains building and construction projects > 20,000 Sq. mts. And or development area more than 50 ha it will be treated as activity listed at serial no. 8(a) or 8(b) in the Schedule, as the case may be."
7(d)	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	All integrated facilities having incineration & landfill or incineration alone	All facilities having land fill only	General Condition shall apply

I; II; III (i), (ii); IV (a), (b); V (i), (ii), (iii)(a), (b), (c), (iv), (v), (vi) (a), (b), (vii), (viii) (a), (b), (ix), (x), (xi), (xii) (a), (b), (xiii), (xiv) (a), (b), (xv) (a), (b), (xvi) (a), (b), (xvii); VI (a), (b); VII & VIII of the Notification, S.O. 3067(E) dated 01.12.2009 of the Ministry of Environment and Forests, (Published in the Gazette of India, Extraordinary, Part-II, and Section 3, Sub-section (ii), No. 2002] New Delhi, Tuesday, November 1, 2009; an amendment to EC notification S.O.1533(E) dated 14.09.2006

(1)	(2)	(3)	(4)	(5)
7(e)	^v “Ports, harbours, break waters, dredging.”	≥ 5 million TPA of cargo handling capacity (excluding fishing harbours)	< 5 million TPA of cargo handling capacity and/or ports/ harbours ≥10,000 TPA of fish handling capacity	^v “General Condition shall apply. Note: 1. Capital dredging inside and outside the ports or harbors and channels are included; 2. Maintenance dredging is exempt provided it formed part of the original proposal for which Environment Management Plan (EMP) was prepared and environmental clearance obtained.”
7(f)	Highways	i) New National High ways; and ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.	^v “ i) All State Highway Project; and ii) State Highway expansion projects in hilly terrain (above 1,000 m AMSL) and or ecologically sensitive areas.”	General Condition shall apply. Note: Highways include expressways.”
7(g)	Aerial ropeways	^{v(xvi)(a)} “(i) All projects located at altitude of 1,000 mtr. And above. (ii) All projects located in notified ecologically sensitive areas.”	^{v(xvi)(b)} “All projects except those covered in column (3).”	General Condition shall apply
7(h)	Common Effluent Treatment Plants (CETPs)		All projects	General Condition shall apply
7(i)	Common Municipal Solid Waste Management Facility (CMSWMF)		All projects	General Condition shall apply
8		Building /Construction projects/Area Development projects and Townships		
8(a)	Building and Construction projects		≥20000 sq.mtrs and <1,50,000 sq.mtrs. of built-up area#	 #(built up area for covered construction; in the case of facilities open to the sky, it will be the activity area)
8(b)	Townships and Area Development projects.		Covering an area ≥ 50 ha and or built up area ≥1,50,000 sq .mtrs ++	++All projects under Item 8(b) shall be appraised as Category B1

I; II; III (i), (ii); IV (a), (b); V (i), (ii), (iii)(a), (b), (c), (iv), (v), (vi) (a), (b), (vii), (viii) (a), (b), (ix), (x), (xi), (xii) (a), (b), (xiii), (xiv) (a), (b), (xv) (a), (b), (xvi) (a), (b), (xvii); VI (a), (b); VII & VIII of the Notification, S.O. 3067(E) dated 01.12.2009 of the Ministry of Environment and Forests, (Published in the Gazette of India, Extraordinary, Part-II, and Section 3, Sub-section (ii), No. 2002] New Delhi, Tuesday, November 1, 2009; an amendment to EC notification S.O.1533(E) dated 14.09.2006

APPENDIX-3

**TEST REPORT OF BASELINE MONITORING OF DUKLI
IE(AIR, NOISE, WATER & SOIL)**

TEST REPORT OF BASELINE MONITORING OF DUKLI IE

Air Quality Test Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0740
"Mott MacDonald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report Date	: 16.11.2023
	Nature of Sample	: Ambient Air
	Sample Mark	: DUKLI
	Sampling Date	: 23.09.2023
	Sample Number	: MSKGI/ED/2023-24/10/00127,00525-00527
Reference No.& Date: RD/AK/426661/10357, Dated : 22.08.2023		

ANALYSIS RESULT

SL. NO.	Location	Concentration of Pollutants					Latitude	Longitude
		PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	CO (µg/m ³)		
1.	Dukli, Location 1	65.1	40.7	6.7	19.6	0.68	23° 46' 54.8328" N	91° 17' 28.086" E
2.	Dukli, Location 2	72.8	40.4	7.4	21.3	0.74	23° 46' 56.5788" N	91° 17' 42.2808" E
3.	Dukli, Location 3	76.2	44.8	7.9	23.5	0.78	91° 17' 42.2808" E	91° 17' 33.7344" E
4.	Dukli, Location 4	69.3	36.5	6.5	20.7	0.66	23° 46' 48.6156" N	91° 17' 30.4044" E
Limit as per CPCB notification, New Delhi, 18th Nov, 2009. for Ambient air quality		100	60	80	80	2		
Sampling and Analysis done according to		IS 5182: Part 23:2006 (Reaff.2012)	IS : 5182 (PT-24).2019	IS 5182 : Part 2 :2001 (Reaff.2012)	IS 5182 : Part 6 :2006 (Reaff.2012)	IS5182:(Part 10):1999		
Limit as per CPCB notification, New Delhi, 18th Nov, 2009. for Ambient air quality								

Report Prepared By:

Mitra S. K. Private Limited

Authorized Signatory



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Head Office: Shracchi Centre (5th floor), 74B, A.J.C. Bose Road, Kolkata - 700 016. West Bengal, India.
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TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0741
"Mott MacDonald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report Date	: 16.11.2023
	Nature of Sample	: Ambient Air
	Sample Mark	: DUKLI
	Sampling Date	: 25.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00528-00531
Reference No. & Date: RD/AK/426661/10357, Dated : 22.08.2023		

ANALYSIS RESULT

SL. NO.	Location	Concentration of Pollutants					Latitude	Longitude
		PM ₁₀ ($\mu\text{g}/\text{m}^3$)	PM _{2.5} ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	CO ($\mu\text{g}/\text{m}^3$)		
1.	Dukli, Location 1	81.7	40.9	8.3	25.1	0.82	23° 46' 54.8328" N	91° 17' 28.086" E
2.	Dukli, Location 2	74.2	43.6	7.6	23.7	0.72	23° 46' 56.5788" N	91° 17' 42.2808" E
3.	Dukli, Location 3	65.1	31.0	6.8	20.3	0.68	91° 17' 42.2808" E	91° 17' 33.7344" E
4.	Dukli, Location 4	72.5	40.3	7.0	22.6	0.70	23° 46' 48.6156" N	91° 17' 30.4044" E
Limit as per CPCB notification, New Delhi, 18th Nov, 2009. for Ambient air quality		100	60	80	80	2		
Sampling and Analysis done according to		IS 5182: Part 23:2006 (Reaff.2012)	IS : 5182 (PT-24),2019	IS 5182 : Part 2 :2001 (Reaff.2012)	IS 5182 : Part 6 :2006 (Reaff.2012)	IS5182:(Part 10):1999		
Limit as per CPCB notification, New Delhi, 18th Nov, 2009. for Ambient air quality								

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Ambient Noise Level Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer "Mott MacDonald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report No.	: MSK/GHY/2023-24/0761
	Report Date	: 16.11.2023
	Nature of Sample	: Noise
	Sample Mark	: DUKLI, NOISE 1
	Sample Drawn On	: 23.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00508
	Latitude	: 23.781647
Longitude	: 91.291533	
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

ANALYSIS RESULT

Day Time	Time (In Hrs.)	Hourly Leq dB(A)
		6.00 am
	7.00 am	45.3
	8.00 am	48.7
	9.00 am	51.9
	10.00 am	52.8
	11.00 am	53.4
	12.00 pm	60.8
	13.00 pm	57.0
	14.00 pm	58.5
	15.00 pm	60.8
	16.00 pm	67.6
	17.00 pm	61.8
	18.00 pm	65.3
	19.00 pm	61.8
	20.00 pm	57.0
	21.00 pm	57.7
	Lday	60.9
	MAX(day)	67.6
	MIN(day)	45.3
	Average(day)	57.7

Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023

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Night Time	Time (In Hrs.)	Hourly Leq dB(A)
		22.00 pm
	23.00 am	48.2
	24.00 am	45.0
	1.00 am	42.4
	2.00 am	42.0
	3.00 am	44.5
	4.00 am	42.3
	5.00 am	43.7
	Lnight	46.1
	MAX(Night)	51.1
	MIN(Night)	42.0
	Average(Night)	45.3

Noise Limit as per CPCB		
Category of Area/Zone	Leq dB(A) Day Time	Leq dB(A) Night Time
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

NOTE :
 Day Time : 06.00 Hr.-22.00 Hr.
 Night Time:22.00 Hr.-06.00 Hr.

Report Prepared By :

for Mitra S. K. Private Limited

Authorised Signatory

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TEST REPORT

Name & Address of the Customer "Mott MacDonald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report No.	: MSK/GHY/2023-24/0762
	Report Date	: 16.11.2023
	Nature of Sample	: Noise
	Sample Mark	: DUKLI, NOISE 2
	Sample Drawn On	: 23.09.2023
	Sample Number	: MSKGI/ED/2023-24/10/00S09
	Latitude	: 23.780167
	Longitude	: 91.293286
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

ANALYSIS RESULT

Day Time	Time (In Hrs.)	Hourly Leq dB(A)
		6.00 am
	7.00 am	69.0
	8.00 am	70.1
	9.00 am	65.4
	10.00 am	70.6
	11.00 am	70.1
	12.00 pm	70.7
	13.00 pm	69.0
	14.00 pm	68.5
	15.00 pm	71.9
	16.00 pm	69.6
	17.00 pm	57.5
	18.00 pm	57.0
	19.00 pm	59.3
	20.00 pm	58.1
	21.00 pm	67.0
	Lday	68.1
	MAX(day)	71.9
	MIN(day)	54.7
	Average(day)	65.4

Cont. To Page-2

Night Time	Time (In Hrs.)	Hourly Leq dB(A)
		22.00 pm
	23.00 am	48.8
	24.00 am	44.8
	1.00 am	45.5
	2.00 am	52.1
	3.00 am	44.9
	4.00 am	41.5
	5.00 am	41.9
	Lnight	47.7
	MAX(Night)	52.1
	MIN(Night)	41.5
	Average(Night)	46.5

Noise Limit as per CPCB

Category of Area/Zone	Leq dB(A) Day Time	Leq dB(A) Night Time
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

NOTE :
Day Time : 06.00 Hr.-22.00 Hr.
Night Time:22.00 Hr.-06.00 Hr.

Report Prepared By :



for Mitra S. K. Private Limited



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Surface Water Quality Test Report

TEST REPORT

Name & Address of the Customer "Mott MacDonald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report No.	: MSK/GHY/2023-24/0789
	Report Date	: 16.11.2023
	Nature of Sample	: Surface Water
	Sample Mark	: DUKLI, SURFACE WATER-1
	Sample Drawn On	: 23.09.2023
Sample Number	: MSKGL/ED/2023-24/10/00195	
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

Chemical Analysis Result as per IS 10500 : 2012

Sl. No.	Parameter	UOM	Standards	Test Method	Result
1.	Ammonia	mg/l	---	APHA (24th Edition) 4500-NH3- F	<0.1
2.	Arsenic(as As)	mg/l	---	APHA (24th Edition), 3120 B	<0.005
3.	Biochemical Oxygen Demand (as BOD)	mg/l	---	APHA (23rd Edition) 5210B : 2017	<2.0
4.	Boron (as B)	mg/l	---	APHA (24th Edition) ,4500 - B C	<0.5
5.	Cadmium (as Cd)	mg/l	---	APHA (24th Edition), 3120 B	<0.001
6.	Calcium (as Ca)	mg/l	0.01	IS 3025 (Part 40)-1991 Rffind 2014	13
7.	Chemical Oxygen Demand (COD)	mg/l	---	APHA (23rd Edition) 5210B : 2017	<4.0
8.	Chloride (as Cl)	mg/l	0.01	IS 3025 (Part 32)- 1988 Rffind 2014	12
9.	Chromium as Cr		---	APHA (24th Edition), 3120 B	<0.01
10.	Colour	Hazen	No noticeable colour	APHA (24th Edition), 2120B	<0.01
11.	Copper (as Cu)	mg/l	0.01	APHA (24th Edition), 3120 B	<0.02
12.	DO	mg/l	5.0	APHA 23rd Ed. 2017-4500-O-C/G (O)	5.8
13.	Dissolved Iron	mg/l	---	APHA (24th Edition), 3500 Fe-B	0.92
14.	Electrical conductivity	mg/l	---	APHA (24th Edition), 2510B	298
15.	Fluoride (as F)	mg/l	---	APHA (24th Edition), 4500 F- C/D	0.16
16.	Lead (as Pb)	mg/l		APHA (24th Edition), 3120 B	<0.005
17.	Magnesium (as Mg)	mg/l	0.01	IS 3025 (Part 46)- 1994 Rffind 2014	5.2

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Sl. No.	Parameter	UOM	Standards	Test Method	Result
18.	Manganese (as Mn)	mg/l	---	APHA (24th Edition), 3120 B	<0.02
19.	Mercury (as Hg)	mg/l	0.01	APHA (24th Edition) 3112 B	<0.001
20.	Nitrate (as NO ₃)	mg/l	---	APHA (24th Edition), 4500 NO ₃ -E	0.52
21.	Odour	mg/l	No offensive odour	IS 3025 (Part 5)-1983 Rffm: 2018	Unobjectionable
22.	Phenol	mg/l	---	APHA (24th Edition), 5530C (Chloroform Extraction)	<0.001
23.	Phosphate (as PO ₄)	mg/l	---	APHA (23rd Edition) 4500 -P D, 2017	<0.05
24.	Potassium (as K)	mg/l	1.0	APHA (24th Edition), 3500 K B	1.9
25.	Salinity	mg/l	---	APHA (24th Edition), 2520B	0.15
26.	Sodium (as Na)	mg/l	1.0	APHA (24th Edition), 3500 Na B	3.9
27.	Sulphate (as SO ₄)	Hazen	---	IS 3025 (Part 24) - 1986 Rffm: 2014	9.7
28.	Surfactants (LAS)	mg/l	---	APHA (24th Edition), 5540 C	<0.02
29.	Temperature	Deg C	---	APHA (24th Edition), 2120B	25
30.	Total Alkalinity	mg/l	None	IS 3025 (Part 23)- 1986 Rffm: 2009	32
31.	Total Dissolved Solids (as TDS)	mg/l	None	IS 3025(Part 16)- 1984 Rffm: 2012	178
32.	Total Hardness (as CaCO ₃)	mg/l	None	IS 3025 (Part 21)-2013	55
33.	Total Suspended Solid (as TSS)	mg/l	None	IS 3025(Part 16)- 1984 Rffm: 2012	<2.5
34.	Turbidity	mg/l	None	IS 3025 (Part 10)-1984 Rffm: 2012	<1.0
35.	Zinc (as Zn)	mg/l	0.01	APHA (24th Edition), 3120 B	<0.02
36.	pH value	mg/l	6.5-8.5	IS 3025 (Part 11)-1984 Rffm: 2012	7.36 at 25 Deg C

Bacteriological Analysis Result as per IS 10500 : 2012

Sl. No.	Characteristic	UOM	Method of Test	Result
1.	Faecal coliform	MPN/100ml	APHA 23rd Edition 9221 E_(O)	<1.8
2.	Phytoplankton	/litr	APHA 23rd Edition, 10200_(O)	Absent
3.	Total coliform bacteria/100ml	MPN/100ml	APHA 23rd Edition 9221 B_(O)	<1.8

Report Prepared By:

[Signature]

Mitra S. K. Private Limited

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Groundwater Quality Test Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer	Report Number	: MSK/GHY/2023-24/0774
"Mott Mac Donald Private Limited" Ist Floor, Pandit Nehru Complex, Earlier Directorate Of I And C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report Date	: 16.11.2023
	Nature of Sample	: Ground Water
	Sample Mark	: DUKLI, GROUND WATER-1
	Sample Drawn On	: 23.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00207
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

CHEMICAL ANALYSIS RESULT (As per IS: 10500-2012)

Sl. No.	Test Parameters	UOM	Desr Limit	Permissible Limit	Method	Result
1.	Alkalinity (as CaCO ₃)	mg/l	200	600	IS 3025 (Part-23)1986 Rffim:2009)	60
2.	Ammonia	mg/l	0.5	No Relaxation	APHA (24 th Edition) 4500-NH3-F	<0.1
3.	Arsenic (as As)	mg/l	0.01	0.05	APHA (24 th Edition), 3210 B	<0.005
4.	Boron (as B)	mg/l	0.5	1.0	APHA (24 th Edition), 4500-B C	<0.5
5.	Cadmium (as Cd)	mg/l	0.003	No Relaxation	APHA (24 th Edition), 3210 B	<0.001
6.	Calcium (as Ca)	mg/l	75	200	IS 3025 (Part 40)-1991 Rffind 2014	19.01
7.	Chloride (as Cl)	mg/l	250	1000	IS 3025 (Part 32)-1998 Rffind-2014	27
8.	Chromium as Cr ⁺⁺	mg/l	0.1	<0.01	APHA (23 rd Edition)3120B:2017	<0.01
9.	Colour	Hazen	5	15	APHA (24 th Edition), 2120B	<5.0
10.	Copper (as Cu)	mg/l	0.05	1.5	APHA (24 th Edition), 3120B	<0.02
11.	Dissolved Iron	mg/l	0.3	No Relaxation	APHA (24 th Edition), 3500 Fe-B	<0.05
12.	Electrical Conductivity	mg/l	---	---	APHA (24 th Edition), 2510B	230
13.	Fluoride (as F)	mg/l	1.0	1.5	APHA (24 th Edition), 4500 F-C/D	0.38
14.	Lead (as Pb)	mg/l	0.01	No Relaxation	APHA (24 th Edition), 3120 B	<0.005
15.	Magnesium (as Mg)	mg/l	30	100	IS 3025 (Part 46)-1994 Rffind 2014	9.50
16.	Manganese (as Mn)	mg/l	0.1	0.3	APHA (24 th Edition), 3120 B	<0.02

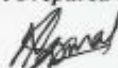
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Sl. No.	Test Parameters	UOM	Desr Limit	Permissible Limit	Method	Result
17.	Mercury (as Hg)	mg/l	0.001	No Relaxation	APHA (24 th Edition) 3112 B	<0.001
18.	Nitrate (as NO ₃)	mg/l	45	No Relaxation	APHA (24 th Edition), 4500 NO ₃ -E	<0.5
19.	Odour	None	Agreeable	Agreeable	IS 3025 (Part 5)-1983 Rffm: 2018	Agreeable
20.	Phenol	mg/l	0.001	No Relaxation	APHA (24 th Edition), 5530C (Chloroform Extraction)	<0.001
21.	Phosphate (as PO ₄)	mg/l	---	---	APHA (23 th Edition) 4500-P D, 2017	<0.05
22.	Potassium (as K)	mg/l	---	---	APHA (24 th Edition), 3500 K B	2.6
23.	Salinity	mg/l	---	---	APHA (24 th Edition), 2520 B	0.12
24.	Sodium (as Na)	mg/l	---	200	APHA (24 th Edition), 3500 Na B	7.2
25.	Sulphate (as SO ₄)	mg/l	200	400	IS 3025 (Part 24)-1986 Rffimd 2014	13.4
26.	Total Dissolved Solids (as TDS)	mg/l	500	2000	IS 3025 (Part 16)-1984 Rffm:2012	138
27.	Total Hardness (as CaCO ₃)	mg/l	200	600	IS 3025 (Part 21)-2013	87.12
28.	Turbidity	mg/l	1	5	IS 3025 (Part 10)-1984 Rffm:2012	<1.0
29.	Zn (as Zn)	mg/l	5	15	APHA (24 th Edition), 3120 B	<0.02
30.	pH value	mg/l	6.5-8.5	No Relaxation	IS 3025 (Part 11)-1984 Rffm:2012	7.29 at 25 Deg C

Report Prepared By :



For Mitra S. K. Private Limited



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TEST REPORT

Name & Address of the Customer	Report Number	: MSK/GHY/2023-24/0775
"Mott Mac Donald Private Limited" 1st Floor, Pandit Nehru Complex, Earlier Directorate Of I And C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report Date	: 16.11.2023
	Nature of Sample	: Ground Water
	Sample Mark	: DUKLI, GROUND WATER-2
	Sample Drawn On	: 23.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00208
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

CHEMICAL ANALYSIS RESULT (As per IS: 10500-2012)

Sl. No.	Test Parameters	UOM	Desr Limit	Permissible Limit	Method	Result
1.	Alkalinity (as CaCO ₃)	mg/l	200	600	IS 3025 (Part-23)1986 Rffin:2009)	56
2.	Ammonia	mg/l	0.5	No Relaxation	APHA (24 th Edition) 4500-NH ₃ -F	<0.1
3.	Arsenic (as As)	mg/l	0.01	0.05	APHA (24 th Edition), 3210 B	<0.005
4.	Boron (as B)	mg/l	0.5	1.0	APHA (24 th Edition), 4500-B C	<0.5
5.	Cadmium (as Cd)	mg/l	0.003	No Relaxation	APHA (24 th Edition), 3210 B	<0.001
6.	Calcium (as Ca)	mg/l	75	200	IS 3025 (Part 40)-1991 Rffind 2014	18.22
7.	Chloride (as Cl)	mg/l	250	1000	IS 3025 (Part 32)-1998 Rffind-2014	25
8.	Chromium as Cr ⁺⁺⁺	mg/l	0.1	<0.01	APHA (23 rd Edition)3120B:2017	<0.01
9.	Colour	Hazen	5	15	APHA (24 th Edition), 2120B	<5.0
10.	Copper (as Cu)	mg/l	0.05	1.5	APHA (24 th Edition), 3120B	<0.02
11.	Dissolved Iron	mg/l	0.3	No Relaxation	APHA (24 th Edition), 3500 Fe-B	<0.05
12.	Electrical Conductivity	mg/l	---	---	APHA (24 th Edition), 2510B	215
13.	Fluoride (as F)	mg/l	1.0	1.5	APHA (24 th Edition), 4500 F-C/D	0.33
14.	Lead (as Pb)	mg/l	0.01	No Relaxation	APHA (24 th Edition), 3120 B	<0.005
15.	Magnesium (as Mg)	mg/l	30	100	IS 3025 (Part 46)-1994 Rffind 2014	9.03
16.	Manganese (as Mn)	mg/l	0.1	0.3	APHA (24 th Edition), 3120 B	<0.02

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Sl. No.	Test Parameters	UOM	Desr Limit	Permissible Limit	Method	Result
17.	Mercury (as Hg)	mg/l	0.001	No Relaxation	APHA (24 th Edition) 3112 B	<0.001
18.	Nitrate (as NO ₃)	mg/l	45	No Relaxation	APHA (24 th Edition), 4500 NO ₃ -E	<0.5
19.	Odour	None	Agreeable	Agreeable	IS 3025 (Part 5)-1983 Rffm: 2018	Agreeable
20.	Phenol	mg/l	0.001	No Relaxation	APHA (24 th Edition), 5530C (Chloroform Extraction)	<0.001
21.	Phosphate (as PO ₄)	mg/l	---	---	APHA (23 th Edition) 4500-P D, 2017	<0.05
22.	Potassium (as K)	mg/l	---	---	APHA (24 th Edition), 3500 K B	2.3
23.	Salinity	mg/l	---	---	APHA (24 th Edition), 2520 B	0.11
24.	Sodium (as Na)	mg/l	---	200	APHA (24 th Edition), 3500 Na B	6.8
25.	Sulphate (as SO ₄)	mg/l	200	400	IS 3025 (Part 24)-1986 Rffmd 2014	12.6
26.	Total Dissolved Solids (as TDS)	mg/l	500	2000	IS 3025 (Part 16)-1984 Rffm:2012	129
27.	Total Hardness (as CaCO ₃)	mg/l	200	600	IS 3025 (Part 21)-2013	83.16
28.	Turbidity	mg/l	1	5	IS 3025 (Part 10)-1984 Rffm:2012	<1.0
29.	Zn (as Zn)	mg/l	5	15	APHA (24 th Edition), 3120 B	<0.02
30.	pH value	mg/l	6.5-8.5	No Relaxation	IS 3025 (Part 11)-1984 Rffm:2012	7.25 at 25 Deg C

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For Mitra S. K. Private Limited



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Soil Quality Test Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer “Mott MacDonald Private Limited” 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report No.	: MSK/GHY/2023-24/0799
	Report Date	: 16.11.2023
	Nature of Sample	: SOIL
	Sample Mark	: DUKLI, SOIL-1
	Sample Drawn On	: 21.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00133
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

Chemical Analysis Result

Sl. No.	Parameter	UOM	Standards	Test Method	Result
1.	Bulk Density	g/cc	---	IS 2720(Part 29) 1975 RA 2015_(O)	1.29
2.	Clay	%	---	TPM/MSK/P&E/1/36A_(O)	22
3.	Electrical conductivity	us/cm	---	IS 14767:2000,RA 2016_(O)	137 (1:2) at 25 deg C
4.	Iron (as Fe)	mg/kg	---	TPM/MSK/P&E/1/13	5.2
5.	Lead (as Pb)	mg/kg	---	EPA 6010D_(O)	7.1
6.	Moisture Retention capacity	%	---	TPM/MSK/P&E/1/17_(O)	35
7.	Organic Matter	%	---	IS 2720 (Part 22)-1972; Rffin:2015_(O)	0.74
8.	Phosphorus	mg/kg	---	TPM/MSK/P&E/1/12_(O)	Available Phosphorus (as P)=4.5
9.	Porosity	%	---	TPM/MSK/P&E/1/30_(O)	46
10.	Potassium	mg/kg	---	TPM/MSK/P&E/1/5, Referr Issue date- April 02, Issue no-03: 2018	Available Potassium=44
11.	Sand	%	---	TPM/MSK/P&E/1/36A_(O)	58
12.	Silt	%	---	TPM/MSK/P&E/1/36A_(O)	20
13.	Texture	None	---	TPM/MSK/P&E/1/36A, Issue date- April 02 Issue no-03: 2018	Sandy Clay Loam
14.	Total Nitrogen (as N)	mg/kg	---	IS 14684 (1999); Rffin:2014_(O)	588
15.	Total Organic Carbon	%	---	IS 2720 (Part 22)-1972;Rffin:2015_(O)	0.43
16.	Infiltration rate	mm/Hr	---	TPM/MSK/P&E/1/42_(O)	15
17.	pH value	None	6.5-8.5	IS 2720 (Part 26) - 1987	5.16 (1:2.5) at 25 deg C

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for Mitra S. K. Private Limited

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TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0800
“Mott MacDonald Private Limited” 1st Floor, Pandit Nehru Complex, Earlier Directorate of I and C Department, Gurkhabasti, Agartala, West Tripura, Tripura, Pin-799006	Report Date	: 16.11.2023
	Nature of Sample	: SOIL
	Sample Mark	: DUKLI, SOIL-2
	Sample Drawn On	: 21.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00134
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

Chemical Analysis Result

Sl. No.	Parameter	UOM	Standards	Test Method	Result
1.	Bulk Density	g/cc	---	IS 2720(Part 29) 1975 RA 2015_(O)	1.36
2.	Clay	%	---	TPM/MSK/P&E/1/36A_(O)	13
3.	Electrical conductivity	us/cm	---	IS 14767:2000,RA 2016_(O)	115 (1:2) at 25 deg C
4.	Iron (as Fe)	mg/kg	---	TPM/MSK/P&E/1/13	11
5.	Lead (as Pb)	mg/kg	---	EPA 6010D_(O)	7.6
6.	Moisture Retention capacity	%	---	TPM/MSK/P&E/1/17_(O)	31
7.	Organic Matter	%	---	IS 2720 (Part 22)-1972; Rffm:2015_(O)	0.45
8.	Phosphorus	mg/kg	---	TPM/MSK/P&E/1/12_(O)	Available Phosphorus (as P)=3.4
9.	Porosity	%	---	TPM/MSK/P&E/1/30_(O)	45
10.	Potassium	mg/kg	---	TPM/MSK/P&E/1/5, Referr Issue date-April 02, Issue no-03: 2018	Available Potassium=38
11.	Sand	%	---	TPM/MSK/P&E/1/36A_(O)	71
12.	Silt	%	---	TPM/MSK/P&E/1/36A_(O)	16
13.	Texture	None	---	TPM/MSK/P&E/1/36A, Issue date- April 02 Issue no-03: 2018	Sandy Loam
14.	Total Nitrogen (as N)	mg/kg	---	IS 14684 (1999); Rffm:2014_(O)	302
15.	Total Organic Carbon	%	---	IS 2720 (Part 22)-1972;Rffm:2015_(O)	0.26
16.	Infiltration rate	mm/Hr	---	TPM/MSK/P&E/1/42_(O)	22
17.	pH value	None	6.5-8.5	IS 2720 (Part 26) - 1987	4.60 (1:2.5) at 25 deg C

Report Prepared By:



for Mitra S. K. Private Limited



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Appendix-4
Biodiversity assessment of Dukli industrial estates

Final report EB-1223



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Biodiversity Impact Assessment for Dukli industrial estate in Agartala, Tripura

Executive summary

The present biodiversity and ecological assessment study encompassed the core area and five distinct buffer areas, ranging from areas in the immediate proximities of the core (0–500 m) to areas farther away from the site, up to 20km. The purpose was to understand the major habitat types and critical species, estimate the total species and their populations, and evaluate threats and conservation opportunities for each zone.

The core area, sampled through 5 quadrats, is primarily characterised by moist deciduous and subtropical habitats. The key concerns for this zone are the encroachments from rubber plantations, settlement effluents, industrial waste, and compromised air quality. The buffer areas ranged from immediate vicinities to larger radial expanses. Habitat varied from terrestrial, moist deciduous to riverine and subtropical woodlands. The threats, however, remain consistent and alarming, with rubber plantations, human settlements, and a lack of green cover being the most dominant.

Rubber plantations have become a significant threat to local biodiversity, affecting the core and buffer areas. The adverse effects on biodiversity due to human settlements, especially with industrial and settlement effluents, are evident in most zones. In the farther buffer regions, limited green covers and plantations in reserve forests further intensify these threats. The study highlights the richness of biodiversity that spans across the core and buffer regions, emphasising the need for its conservation. It is evident that anthropogenic activities, particularly rubber plantations and human settlements, exert immense pressure on local ecosystems. There's a critical need to address these threats, safeguard sensitive habitats, and promote sustainable practices to ensure the long-term well-being of the area's flora and fauna.

Key points:

- **Fragmented Biodiversity:** The core and buffer regions showcase a diverse range of habitats and species, Most of the forest areas are fragmented due to human habitation & major Rubber plantation due to which Biodiversity gets affected
- **Significant Threats:** Rubber plantations, human settlements, and industrial effluents pose major challenges, affecting habitats and species across the study area.
- **Anthropogenic Pressure:** Human-induced activities, especially in buffer regions, lead to habitat fragmentation and biodiversity loss, with specific zones experiencing reduced green cover.
- **Conservation Imperative:** Given the evident biodiversity richness and the looming threats, there's an urgent need for focused conservation efforts and sustainable practices to protect the area's ecological integrity.

TABLE 1: QUADRAT DETAILS IN CORE AREA

Name of Industrial estate			Dukli (91°17'35.45"E, 23°46'54.22"N)
District			West Tripura
State			Tripura
Quadrat ID	Latitude	Longitude	Key Insights
Q1	23.783466	91.291527	Area near settlement dominated by domestic plants like Mango, Champa, Coconut etc.
Q2	23.779877	91.291473	Industrial area with roadside plantation with species like Albizia saman, Neem, Delonix regia etc.
Q3	23.779604	91.291763	Area near settlement dominated by domestic plants like Deudaru, Banana, Moringa etc.
Q4	23.782433	91.292458	Area near Rice processing unit with plants like mango, Tabernaemontana, cassia alata etc., the area is dominated by different bird species due to Rice processing unit.
Q5	23.784004	91.292084	Area near settlement dominated by domestic plants like Mango, Coconut, Jackfruit, Guava etc.

1. INTRODUCTION AND BACKGROUND

In an era marked by escalating environmental challenges, safeguarding biodiversity serves not merely as a conservation imperative, but also as a socio-economic necessity. Understanding the intricate balance between ecosystems and human enterprise forms the cornerstone of ALIGN Consulting Engineers mission. We are pleased to embark on this Biodiversity Assessment Study, as specified in the TOR provided by the client.

The study will focus on industrial estates in Tripura and their project areas of influence (PAI), a region characterised by its rich biodiversity. The aim is to delineate critical habitats, evaluate flora and fauna, and assess the potential environmental impacts—both direct and indirect—of industrial activities. Special emphasis will be placed on species classified as Critically Endangered (CR), Endangered (EN), and Vulnerable (VU) according to the IUCN Red List, as well as on the regional specificities of Northeast India.

ALIGN Consulting Engineers has developed a methodological framework to comprehensively meet the project objectives. The framework combines scientific rigor through literature review with ground-level engagement and employs a suite of ecological and GIS tools, ranging from Quadrat and Line Transect for ecological sampling to Remote Sensing via Google Earth Engine (GEE) and R software and QGIS for landscape analysis. Our approach is undergirded by a thorough literature review, inclusive of government records, forest management strategies, and previously published ecological studies, to provide a robust baseline for our primary research.

Funding for this undertaking will adhere to a phased approach as outlined in our proposal, assuring resource availability at each critical juncture. The budget has been thoughtfully allocated to cover extensive fieldwork, data analysis, and report writing. The final deliverable—a Biodiversity Assessment Report coupled with a Biodiversity Management Plan—will encapsulate our findings and recommendations for mitigation measures and conservation strategies.

In summary, this project aims to create a meticulous and actionable roadmap for sustainable development in Tripura's industrial estates. Through a multi-disciplinary and consultative approach, ALIGN Consulting Engineers aspires to deliver a report that serves as a touchstone for balancing industrial growth with ecological integrity.

2. METHODOLOGY

2.0 IBAT and Nature-Map tools:

We used Integrated Biodiversity Assessment Tool (IBAT) and Nature-Map for rapid analysis and detailed assessment of conservation status and area prioritisation. IBAT is an online platform designed to provide key information on biodiversity priorities at specific locations. It is an interface that combines data from multiple trusted sources, such as the World Database on Protected Areas (WDPA), the IUCN Red List of Threatened Species, and the World Database of Key Biodiversity Areas. IBAT allows for the generation of tailored biodiversity reports, which can be critical for impact assessment and decision-making processes.

2.1 Nature-Map

This is a decision-support tool that allows users to explore and analyze spatial data regarding natural resources and biodiversity. It incorporates satellite imagery, topographical maps, and other datasets to provide a comprehensive view of the land and its biological richness. Users can overlay various types of data such as soil quality, water availability, and land use patterns to get a holistic understanding of an area. In the context of our project, Nature-Map will be employed to gather a broader ecological perspective of the industrial estates in Tripura. Its advanced mapping and analytical capabilities will assist us in understanding how industrial activities interact with the natural landscape. It helps us in planning field surveys and provides key insights into habitat fragmentation and land-use change that could affect biodiversity.

2.2 Biodiversity and literature review:

We adopted a multi-pronged methodology to assess in Tripura's Industrial Estates. For data collection, field surveys recorded various species of flora and fauna, employing a team of specialized botanists, zoologists, GIS experts, and landscape ecologists. The area was stratified based on core area (the industrial estate) and buffer (5-20 km from core), different habitat types and random samples are drawn for biodiversity evaluation.

High-resolution satellite images were collected and scrutinized using R, Google Earth Engine, and QGIS software for remote sensing data, providing an analysis of land-use changes over the past five to ten years. Secondary data from academic journals, governmental reports, and databases were collected to supplement the primary data, enriching our understanding of the area.

2.3 Remote Sensing via GEE and QGIS:

We adopted a multi-pronged methodology to assess in Tripura's Industrial Estates. For data collection, field surveys recorded various species of flora and fauna, employing a team of specialized botanists, zoologists, GIS experts, and landscape ecologists. The area was stratified based on core area (the industrial estate) and buffer (5-20 km from core), different habitat types and random samples are drawn for biodiversity evaluation.

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TABLE 2: DETAILS OF WORKING METHODOLOGY FOR BIODIVERSITY ASSESSMENT

Methodology	Component	Description	Utility
Stage 1: Literature review, tools and planning			
IBAT	Biodiversity reports based on existing data for impact assessment and decision-making processes	An online tool that integrates data from multiple sources like the WDPA, IUCN Red List, and others to provide key biodiversity information at specific locations.	Enables quick identification of high-priority conservation areas and threatened species; supports risk assessment and aids in resource allocation for field studies.
Nature maps	Incorporates satellite imagery, topographical maps, and other datasets to provide a comprehensive view of the land	A decision-support tool that incorporates spatial data like satellite imagery and topographical maps to analyze natural resources and biodiversity.	Offers a comprehensive ecological perspective; helps in planning field surveys and provides insights into habitat fragmentation and land-use change affecting the project.
Literature Review and Data Analysis	Secondary Data Sources	Review of existing datasets, maps, government records, reports, etc.	Comprehensive understanding of existing knowledge and data gaps identification.
IUCN and Schedule Species Comparison	Conservation Significance	Comparison of identified species with IUCN and Schedule species lists.	Identification of species of conservation significance.
Stage 2 (a) : Sampling Ecology and Biodiversity			

Quadrat and Line Transect	Plant and Bird Surveys	Systematic sampling of vegetation and bird populations.	Evaluates species identification, relative abundance, and community structure.
Bioacoustics	Bird, Insect, and Amphibian Surveys	Recording and analysis of sounds produced by various organisms.	Non-invasive identification of species, population size estimation, and behavioural studies.
Observation-based Sampling	Reptiles and Amphibians	Direct field observations of these species.	Facilitates species identification, behaviour study, and abundance estimation.
Stage 2 (b) : Mapping and Remote Sensing			
Remote Sensing via GEE and QGIS	Landscape Analysis	Analysis of Landsat and Sentinel satellite images, Drone imagery (if needed)	Evaluation of land-use land cover and biomass changes over time and habitat impact assessment.
Stage 3: Data analysis and Report Writing			
The collected data will be systematically analyzed using statistical techniques. We will interpret these findings to draft a comprehensive report that includes detailed insights on the biodiversity, ecological impacts, management plans, and compensatory measures.			
Final review: Our team of experts will review the final report for quality assurance before submission			

3. BIODIVERSITY ASSESSMENT BASED ON PRIMARY DATA

3.0 Species checklists – qualitative sampling.

In our latest ecological survey of Dukli, randomized surveys and stratified quadrat-based sampling were employed to assess the abundance and distribution of species. The updated results show a total of 209 species within the core region of our study site. The core zone showcases a variety of species, featuring 31 tree species, 18 shrub species, and 22 herb species. Fauna diversity is notable, with 75 bird species, 28 butterfly species, and other fauna including reptiles, dragonflies, and a single mammal species. Both the table and the graphical representation provided succinctly depict the biodiversity of the area, from the prominent avian population to the less common climbers and ferns, each species contributing to the ecological complexity of Dukli.

Our research methodically catalogued species encounters across both the core and the buffer zones. The quadrat method facilitated precise population measurements, revealing 209 species (flora: 76, fauna: 133) in the core zone (the project site, as shown in figure 1) and 479 species (flora: 210, fauna: 269) within the buffer zone (a 20km radius, as depicted in figure 2). The biodiversity assessment in Dukli identified stark differences between the core and buffer zones. The buffer area, as anticipated, presented greater biodiversity, with 88 tree species, 41 shrub species, and 65 herb species. This zone also recorded 148 bird species and 39 butterfly species.

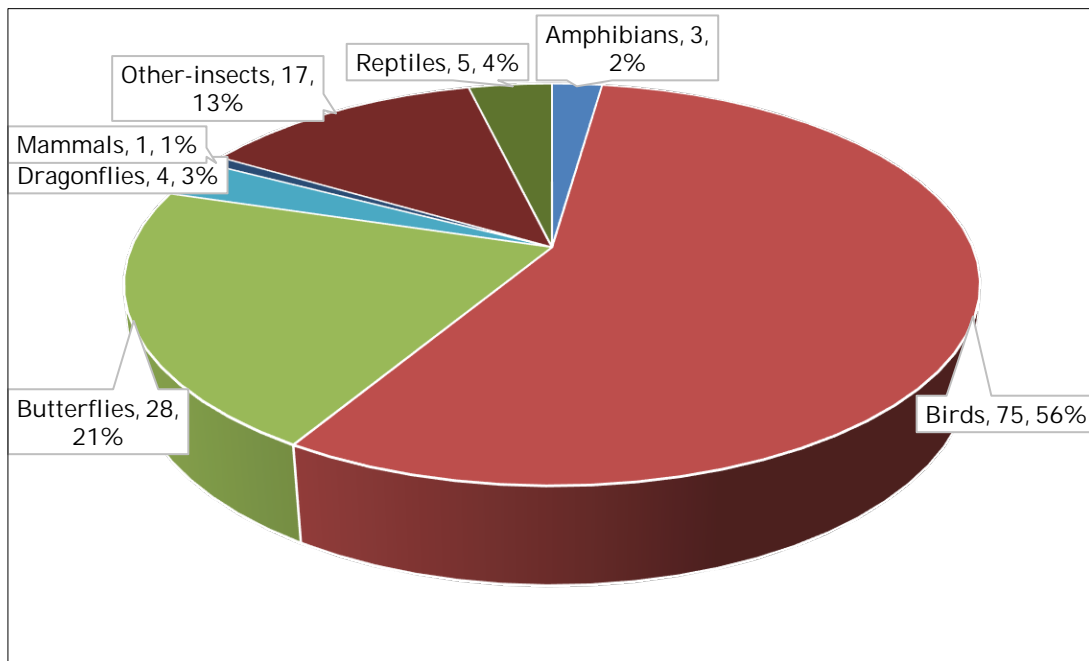


FIGURE 1: DISTRIBUTION OF OBSERVED SPECIES GROUPS IN THE CORE AREA

In contrast, the core zone displayed a more limited ecological composition, with 31 tree species, 18 shrub species, 22 herb species, and 75 bird species, among other fauna. This disparity underscores the unique ecological dynamics between the two zones, confirming our predictions.

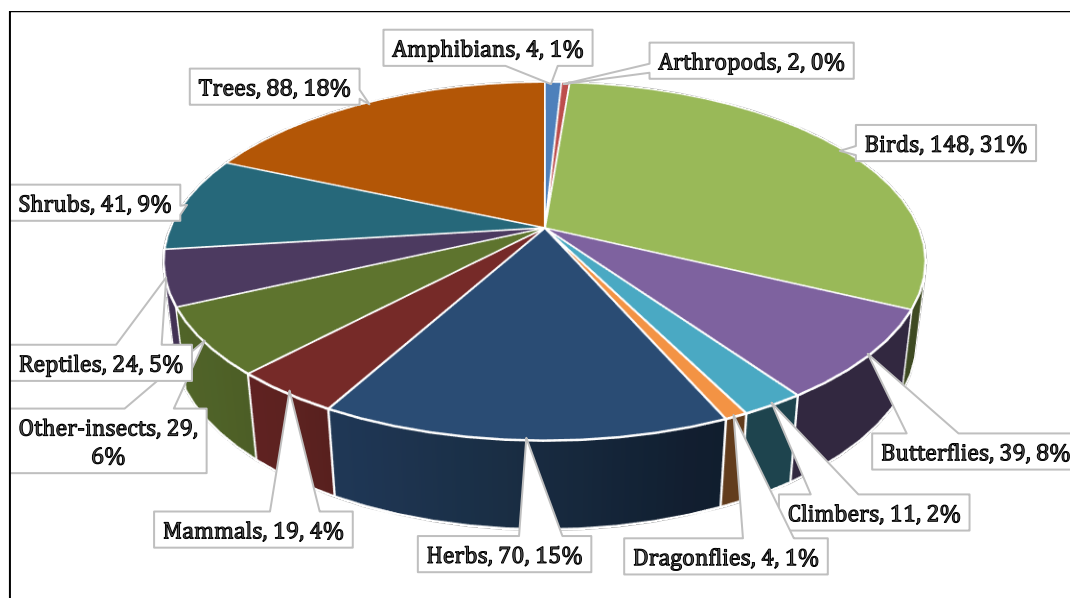


FIGURE 2: DISTRIBUTION OF OBSERVED SPECIES GROUPS IN THE BUFFER AREA

The core area of Dukli presents a unique ecological profile shaped by industrial development. Dominated by shrub species such as *Cassia alata* and *Ricinus communis*, this zone reflects the direct impact of human activities on its natural landscape. The presence of a rubber

plantation is indicative of the area's commercial use, while nearby rice processing facilities have inadvertently created a haven for avian species, with the waste serving as an ample food source that attracts a significant bird population.

This human-altered landscape offers a stark contrast to the biodiversity found in the buffer zone, underscoring the profound effect of anthropogenic factors on ecological dynamics. The core's modified environment, while still supporting life, demonstrates reduced species richness compared to the more natural buffer zone. This difference has made the core area a focal point for environmental research, emphasizing the need for careful consideration of industrial impacts on biodiversity.

For a comprehensive understanding of the species affected and the degree of ecological alteration, detailed species data from both the core and buffer zones are documented in Appendix 1 of the supplementary document repository. This catalog serves not only as a testament to Dukli's ecological diversity but also as a critical resource for ongoing and future environmental impact assessments.

TABLE 3: SPECIES AND THEIR TAXONOMIC GROUPS FOUND IN CORE AND BUFFER

Groups	Buffer	Core
Flora Total	210	76
Tree	88	31
Shrub	41	18
Herb	70	22
Climber	11	5
Fauna Total	269	133
Birds	148	75
Butterflies	39	28
Dragonflies	4	4
Other-Insects	29	17
Mammal	19	1
Reptile	24	6
Amphibian	4	3

Our survey highlights clear disparities in species distribution between the buffer and core zones. In the buffer area, exotic plant species constitute about 29.27% of the flora, while in the core area, they represent a higher percentage at 39.47%. Native flora play a crucial role

in the local ecosystem, evolved in tandem with other indigenous species and providing vital habitats for native wildlife, such as local bird populations. These species are also more attuned to the local climatic conditions and environmental threats, including pests and diseases.

The greater prevalence of exotic species within the core zone is likely a consequence of anthropogenic influences such as urban development, agriculture, and the ornamental use of non-native species. The introduction of these species can lead to their uncontrolled expansion and possible dominance over native plants, potentially causing a reduction in biodiversity. Such an imbalance may have extensive ecological repercussions, disrupting food webs, heightening susceptibility to pests and diseases, decreasing adaptability to climatic shifts, and modifying habitat structures, nutrient cycles, and hydrological patterns. The robust growth habits of these exotic species may overshadow or displace native flora, severely limiting the available habitats for fauna dependent on native plants.

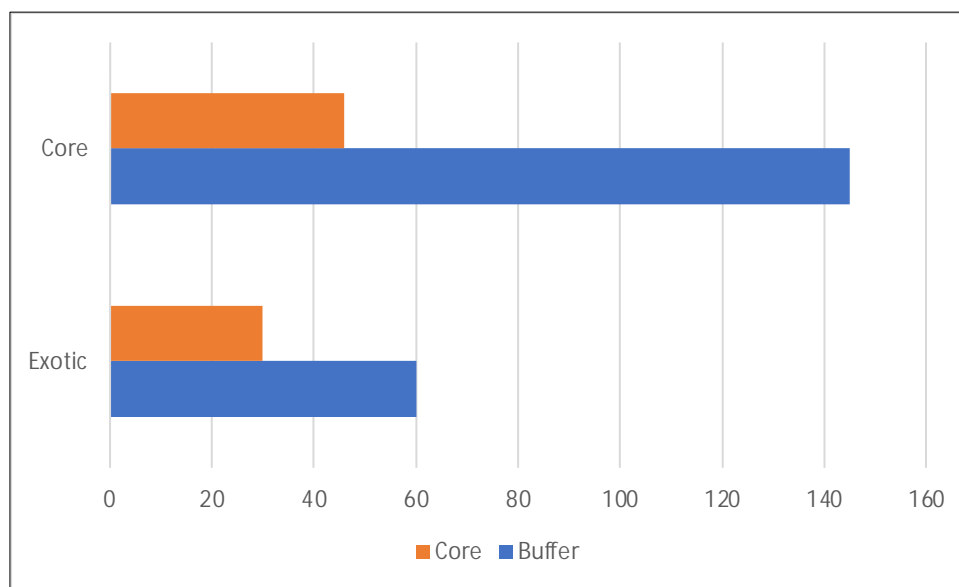


FIGURE 3: NATIVE VS EXOTIC SPECIES IN CORE VS BUFFER

We make specific recommendations for better management of local ecology:

- Regular monitoring of exotic species and their impact on native vegetation.
- Initiating restoration programs focusing on planting and nurturing native species.
- Educating the local community about the importance of native vegetation and the threats of exotic species.
- Implementing strict regulations on the import and planting of non-native species.
- Encouraging research on sustainable agricultural practices that align with native vegetation conservation.
- By adopting these measures, we can hope to strike a balance and ensure the healthy coexistence of both native and exotic species while prioritising ecological integrity.

3.1 Quadrant quantitative sampling.

The ecological survey of Dukli has revealed a compelling gradient of biodiversity that varies significantly with distance from the core area. This gradient is captured through the richness of fauna and flora across different radius ranges, with each range yielding a unique snapshot of the region's ecological tapestry.

At the heart of Dukli, within a radius of 0km, the core area exhibits a substantial diversity with 65 fauna species and 52 flora species identified. Despite the singularity of its location, this zone has been extensively sampled through 5 quadrates, providing a detailed baseline for biodiversity within the industrial hub of the region. Just beyond the core, the immediate buffer at 500m radius displays a slightly lower fauna richness of 60 species, but a higher flora richness at 54 species. Here, the number of quadrates sampled is 4, indicating a focused effort to capture the transition in species diversity just outside the core's influence.

Moving outwards to the 5km radius, there is a marked increase in biodiversity, with fauna richness peaking at 153 species and flora richness at 88 species. Across 21 quadrates, this zone has been the most intensively sampled, reflecting the complex interplay of species within the suburban and semi-natural landscapes that encompass IC Nagar, Prabhapur, Jogendranagar, Tulakona, and Nagicherra. At a 10km radius, there's a slight dip in species richness compared to the 5km radius, with 138 fauna and 77 flora species. Sampling through 16 quadrates across locations such as Dakshin champamura and Ranjit nagar offers insights into the changing ecological patterns as one moves further from the core.

The 15km radius maintains a high level of fauna richness at 142 species, but flora richness declines to 63 species. Surveyed with 15 quadrates, this zone includes areas like Madhupur and Oxygen Park, which potentially serve as transition zones that still retain high biodiversity. At the furthest surveyed radius of 20km, the richness of both fauna and flora surges, boasting 188 and 96 species respectively. The 24 quadrates sampled here cover six distinct locations, including Amtali and Jirania, underscoring the region's role as a reservoir of biodiversity at the periphery of Dukli's urban reach.

Across all radii, the quantity of quadrates sampled reveals a comprehensive effort to quantify Dukli's diverse species range. From the concentrated industrial core to the expansive periphery, the number of locations sampled and the species richness recorded at each radius provide critical data for conservation and management strategies, ensuring the sustenance of Dukli's ecological diversity.

TABLE 4: SPECIES RICHNESS OBSERVATIONS BETWEEN CORE AND BUFFER

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
0km	65	52	5	1	Core
500m	60	54	10	5	Duki Immediate Buffer
5km	153	88	16	4	IC Nagar, Prabhapur, Jogendranagar, Nagicherra

10km	138	77	16	4	Dakshin champamura, Purba noagaon, Khayerpur, Ranjit nagar
15km	142	63	20	5	Madhupur, Paschim takarjala, Baidhya kobra, Oxygen park, Sepahijala Wildlife Sanctuary
20km	188	96	16	4	Amtali, Jirania, Fatikcherra, Bamutia, Kathiram bari, Kandrai charra

The ecological survey of Dukli paints a detailed portrait of the region's biodiversity, with each location contributing uniquely to the area's overall ecological health. At the core, an impressive diversity is maintained with 52 flora and 65 fauna species, indicating a resilient ecosystem at the heart of human activity. Encircling this is the Duki Immediate Buffer, which showcases a slightly higher diversity in flora, suggesting that this transitional habitat plays a vital role in sustaining and enriching biodiversity against the backdrop of urban development.

As one explores the suburban fringes, areas such as Bamutia and Baidhya kobra emerge as significant ecological niches, with flora and fauna species counts of 32 and 30, and 65 and 57, respectively. This is indicative of a rich array of microhabitats that cater to diverse life forms, underlining their importance for ecological studies and conservation initiatives. Locations like Jirania, Jogendranagar, and Kathiram bari are particularly notable for their fauna richness, with species counts approaching or exceeding 96, marking them as critical hotspots of animal diversity and beacons for wildlife conservation.

In contrast, Kandrai charra and Nagicherra boast a high number of plant species, with 38 and 48 respectively, suggesting a lush vegetation cover that supports a wide range of animal species. Oxygen Park, despite the encroachment of development, stands as an oasis of biodiversity with 69 fauna species, highlighting the potential for urban green spaces to serve as sanctuaries for wildlife.

However, not all locations fare as well in terms of biodiversity. Dakshin champamura and Prabhapur present lower species counts, which could signal areas in need of conservation attention to boost their ecological profiles. On the other end of the spectrum, Purba noagaon demonstrates a richer ecological makeup, with 43 flora and 79 fauna species, illustrating the diverse and dynamic nature of ecosystems within Dukli.

Collectively, the varied species counts across these locations signal the intricate mosaic of Dukli's ecosystems. Each area's distinct character adds to the complexity and richness of the

region's biodiversity, calling for nuanced conservation strategies that reflect the specific needs and ecological roles of each location.

TABLE 5: LOCATIONS AND TOTAL SPECIES RICHNESS

Sampled locations	Flora	Fauna
Amtali	15	26
Baidhya kobra	30	57
Bamutia	32	65
Core	52	65
Dakshin champamura	8	26
Duki Immediate Buffer	54	60
Fatikcherra	31	31
IC Nagar	22	51
Jirania	30	111
Jogendranagar	33	96
Kandrai charra	38	50
Kathiram bari	25	96
Khayerpur	36	43
Madhupur	25	46
Nagicherra	48	40
Oxygen park	19	69
Paschim takarjala	20	25
Prabhapur	19	14
Purba noagaon	43	79
Ranjit nagar	34	65
Tulakona	28	39

4. VEGETATION DIVERSITY

4.0 Flora in the Core area – the project site



FIGURE 4 CORE AREA OF THE DUKLI INDUSTRIAL SITE

The core area of Dukli, characterized by its subtropical climate and proximity to human settlements and industrial activities, exhibits a diverse range of vegetation. The abundance and variety of tree species, such as the Kathal (*Artocarpus heterophyllus*) and Aam (*Mangifera indica*), alongside shrubs like the ubiquitous Jack in the Bush (*Chromolaena odorata*) and the medicinal Kalmegh (*Andrographis paniculata*), reflect a complex vegetative structure within this 0km radius. Notably, trees like the Kathal and the Indian Charcoal Tree (*Trema orientalis*) not only show a higher abundance but also contribute significantly to the biomass of the area, suggesting their dominance and ecological importance in the core's landscape.

Shrub species, particularly those adapted to the disturbed conditions such as the Ringworm Bush (*Cassia alata*) and the Coffee Senna (*Cassia occidentalis*), are prevalent due to ongoing development work. The presence of a rubber plantation introduces species like the Rubber Tree (*Hevea brasiliensis*), which further diversifies the plant composition. These shrubs, while indicative of human influence, have become integral components of the core's vegetation, filling ecological niches and contributing to the habitat complexity.

Herbaceous plants and climbers, such as Crown Grass (*Paspalum botterii*) and Bitter Vine (*Mikania micrantha*), though less dominant in biomass, are critical for maintaining the understory diversity and providing ground cover. This understory layer is essential for numerous small fauna and insects, contributing to the overall biodiversity.

The ecological implications of this vegetation diversity are profound. The trees, with their significant biomass, play a vital role in carbon sequestration and form the backbone of the core's ecosystem, offering habitats and food sources for a variety of birds, as evidenced by

the increased avian activity around the rice processing facilities. The waste from these facilities serves as a food source, attracting birds and contributing to a unique ecological interaction that exemplifies the core's dynamic nature.

Furthermore, the dominance of shrubs in certain quadrats hints at a landscape in flux, potentially transitioning from a more forested to a shrub-dominated area due to human activities. This shift in vegetation could have cascading effects on local fauna, altering food webs, and affecting the entire ecosystem's resilience.

In summary, the core area's vegetation diversity, shaped by both natural processes and anthropogenic influences, has significant ecological implications. It supports a rich tapestry of life that includes not just the flora itself but also the fauna that depend on it, demonstrating the intricate balance between biodiversity and human presence in Dukli.

4.1 Flora in the Buffer areas

Immediate vicinity - 0-500m

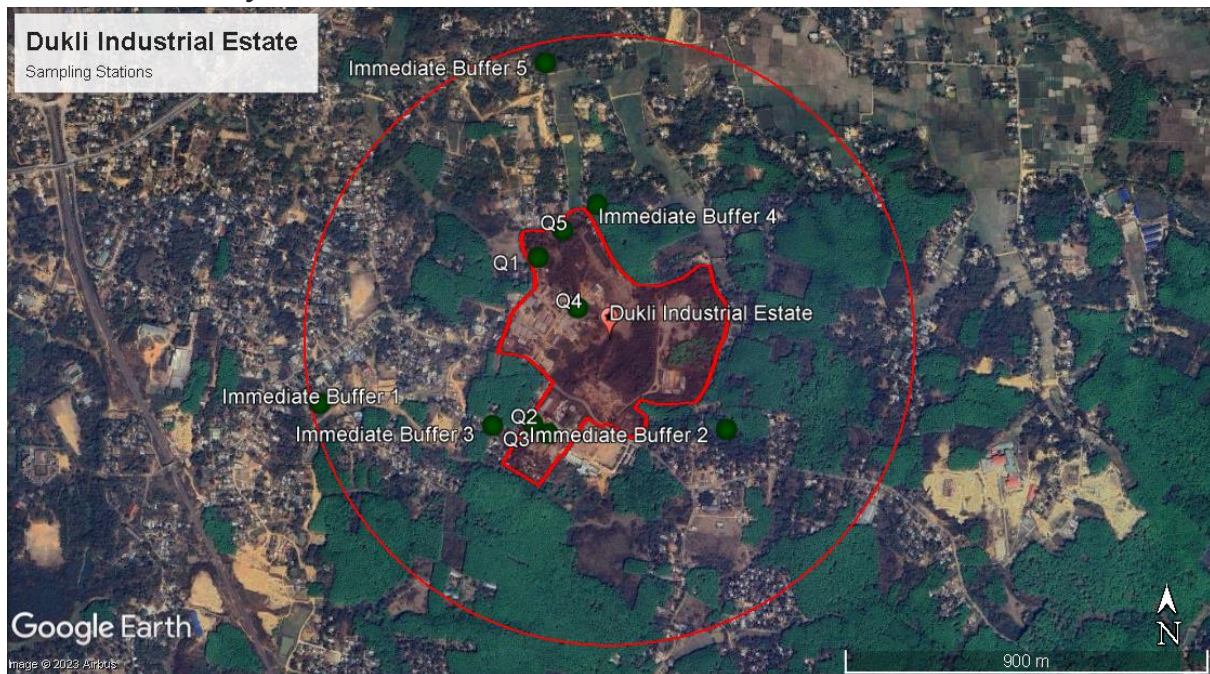


FIGURE 5 IMMEDIATE VICINITY - 0-500M

TABLE 6: QUADRAT DETAILS IMMEDIATE VICINITY - 0-500M

Sr. No.	Location	Latitude	Longitude	Habitat
1	Dukli immediate buffer 1	23.78002	91.28627	Settlement area near water body with some natural habitation with a mix of natural plant like <i>Microcos paniculata</i> , Jamun & Orchard plants like Jackfruit, Guava, Mango etc.

2	Dukli immediate buffer 2	23.779528	91.296112	Fragmented moist deciduous forest area with human habitation dominated by Bamboo & orchard plants like Papaya, Banana. Rubber plantation is significant in the vicinity.
3	Dukli immediate buffer 3	23.779461	91.290817	Fragmented moist deciduous forest area with human habitation dominated by Teak & Holarrhena. Rubber plantation is significant in the vicinity.
4	Dukli immediate buffer 4	23.784657	91.292747	Area dominated by Rubber plantation
5	Dukli immediate buffer 5	23.787815	91.291794	Mixed Deciduous fragmented forest habitat with dominating plants like Schima wallici, Mallotus phillipensis, Microcos paniculata etc.

Within the 500m buffer zone of Dukli, the ecological landscape is profoundly shaped by the prevalence of the Rubber tree (*Hevea Brasiliensis*), with a substantial count of 40 individuals contributing significantly to the area's biomass. The Rubber trees, standing at twice the abundance compared to the core area, underscore their ecological impact on the zone's habitat structure and species composition.

The Rubber tree's dominance, while economically beneficial for rubber production, can also lead to ecological consequences. Their monoculture plantations are known to reduce understorey diversity and alter soil composition and nutrient cycling due to the leaf litter's unique decomposition rate and chemistry. This can affect the natural regeneration of native species and the overall flora richness, as observed in the buffer zone with diverse native species like *Microcos Paniculata* (Pichandi), *Tectona Grandis* (Segun), and a variety of shrub and herb species.

The shrub layer in this area is rich with species like *Chromolaena Odorata* (Jack In The Bush) and *Melastoma Affine* (Blue Tongue), which are crucial for maintaining an ecological balance by providing habitat and food for a range of insects and small animals. However, the dense canopy of Rubber plantations can limit sunlight reaching the forest floor, potentially impacting the growth and abundance of these shrubs.

Herbaceous and climbing plants, while less affected by canopy shade, may still experience indirect effects from the altered microclimate and soil conditions under Rubber trees. The climbers such as *Dioscorea Alata* (True Yam) and *Mikania Micrantha* (Bitter Vine) are important for their role in adding structural complexity to the vegetation, which supports a variety of fauna.

The immediate buffer zone's diverse habitats, from moist deciduous to subtropical semi-evergreen humps, reflect the ecological transitions influenced by the presence of Rubber plantations. While these plantations are a significant feature within the landscape, the interspersed native species such as *Toona Ciliata* (Rongil) and *Trema Orientalis* (Indian Charcoal Tree) indicate a blend of managed and natural ecosystems.

In summary, the Rubber tree's prevalence in the 500m buffer zone of Dukli serves as a double-edged sword—providing economic value while also imposing ecological effects that may diminish native biodiversity. The balance between plantation management and conservation of native species is crucial for maintaining the ecological integrity of the area.

Inner buffer - 5km radius

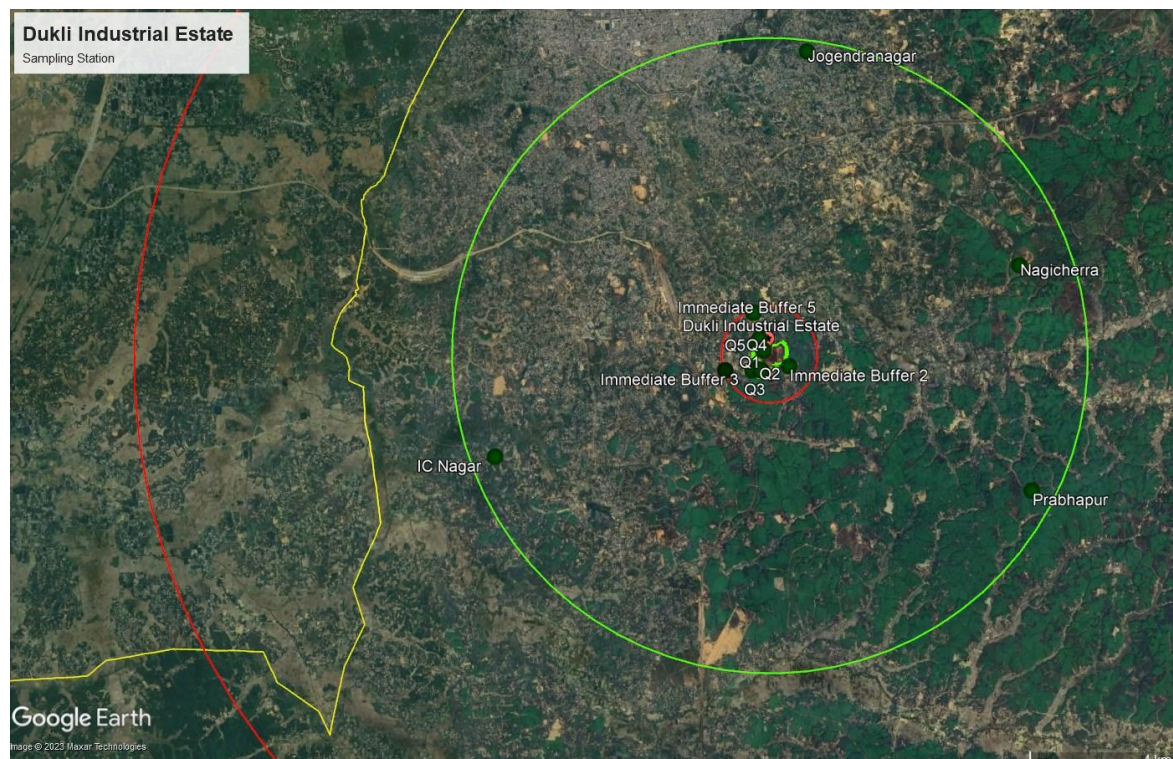


FIGURE 6 INNER BUFFER - 5KM RADIUS

TABLE 7: QUADRAT DETAILS INNER BUFFER - 5KM RADIUS

Sr. No.	Location	Latitude	Longitude	Habitat
1	Prabhapur	23.760365	91.329002	Degraded ecosystem due to monoculture plantation of Rubber & Cashew
2	Jogendranagar	23.824471	91.304214	Fragmented mixed forest enclosed by a settlement with major plants like Teak, <i>Schima wallici</i> , <i>Microcos paniculata</i> etc.
3	Nagichera	23.781659	91.292572	Dominated by Rubber plantation , region has Very few trees like <i>Alstonia scholaris</i> , <i>Butea</i>

				monosperma, <i>Microcos paniculata</i> , etc., shrubs and herbs are abundant, major shrubs include <i>Chromolaena odorata</i> , <i>Melastoma affine</i> , <i>Sida acuta</i> , etc.
4	IC nagar	23.774065	91.247757	Dominated by Bamboo forest & agricultural landscape, major plants are <i>Microcos paniculata</i> , Wild turmeric, <i>Carallia brachiata</i> etc.

At the 5km buffer zone around Dukli, the ecological landscape is notably different from the core and immediate buffer areas, with a varied array of trees that significantly influence the area's biomass and species interactions. The *Microcos Paniculata*, or Pichandi, is the most abundant tree species with 59 individuals, contributing a substantial biomass and indicating its prevalence in the local ecology. The Rubber tree (*Hevea Brasiliensis*), while less dominant than in the immediate buffer, still has a significant presence with 58 individuals. Its role at this range is complex; although beneficial for rubber production, it can lead to ecological shifts such as reduced understorey diversity and altered soil chemistry.

Other tree species such as the *Areca Catechu* (Supari) and *Tectona Grandis* (Segun) add to the structural diversity of the area. The inclusion of fruit-bearing trees like *Mangifera Indica* (Aam) and *Anacardium Occidentale* (Kaju) is particularly important for supporting wildlife, offering both food resources and habitat. These species, along with the Indian Charcoal Tree (*Trema Orientalis*) and others, contribute to a more diverse and potentially resilient ecological network than areas dominated by monocultures.

Shrubs like *Chromolaena Odorata* (Jack In The Bush) and *Clerodendrum Infortunatum* (Bhat) appear in high densities, which, alongside trees, create a complex habitat structure that supports a rich array of insects and animals. The high abundance of herbs like *Paspalum Botterii* (Crown Grass) and *Chrysopogon Aciculatus* (False Beardgrass) points to a well-established herb layer that can influence soil stabilization, microclimates, and provide forage for various species.

Climbing plants, including *Mikania Micrantha* (Bitter Vine) and *Dioscorea Alata* (True Yam), continue to add vertical complexity to the vegetation and serve as important ecological connectors within the canopy.

The 5km buffer zone's habitats, ranging from subtropical semi-evergreen to moist deciduous, reflect a landscape influenced by both natural forests and human settlements. This is evident from the diverse plant communities, which include both cultivated and wild species. Areas like Dukli, Tulakona, and Prabhapur showcase a mix of teak, bamboo, and *Microcos Paniculata*, among others, indicating a blend of native forests and plantations.

In this zone, the Rubber tree's ecological impact is moderated by the presence of other native species, creating a more balanced ecosystem. However, its influence on the understorey diversity and soil conditions still warrants attention to ensure that conservation efforts maintain the integrity of native plant communities and the overall biodiversity of the Dukli area.

Central buffer - 10km radius

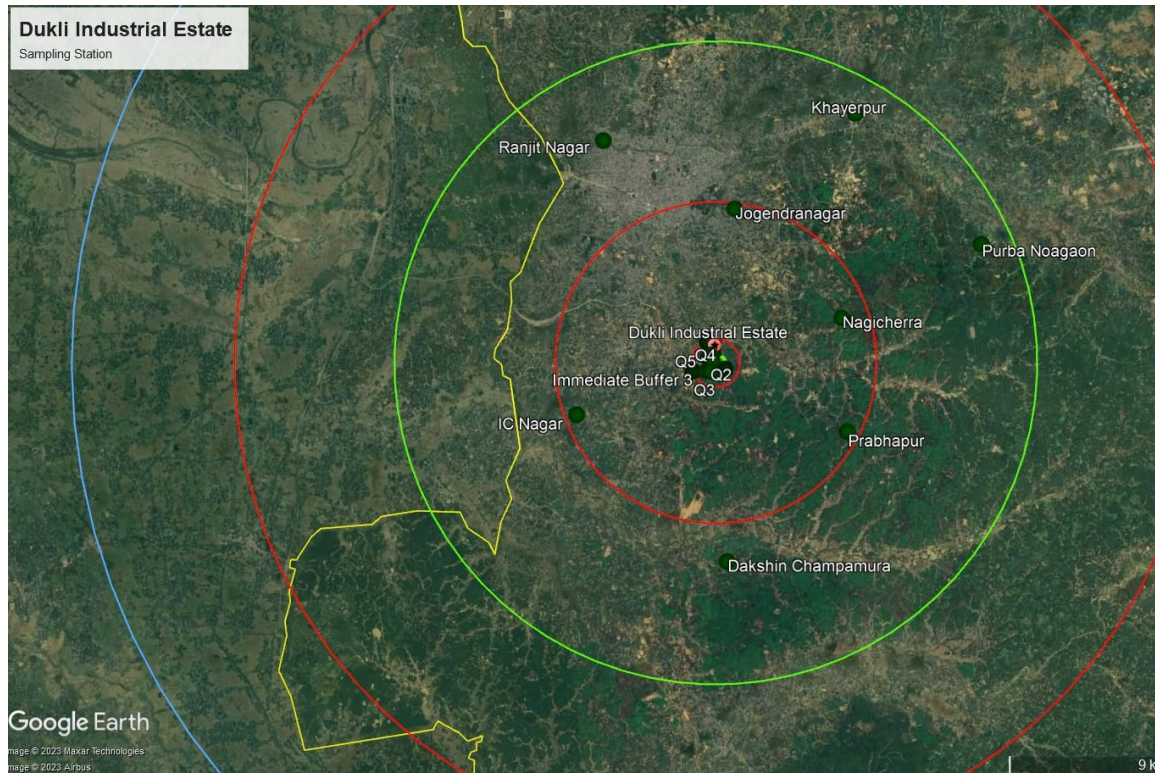


FIGURE 7 CENTRAL BUFFER - 10KM RADIUS

TABLE 8: QUADRAT DETAILS CENTRAL BUFFER - 10KM RADIUS

Sr.No.	Location	Latitude	Longitude	Habitat
1	Ranjit nagar	23.847431	91.266098	Degraded riverine ecosystem due to human settlement dominated by domesticated plants like moringa, bamboo, jackfruit etc.
2	Khayerpur	23.846334	91.345901	Riverine ecosystem dominated by Bamboo forest
3	Dakshin champamura	23.719968	91.290515	Degraded habitat dominated by Rubber plantation
4	Purba noagaon	23.804892	91.377678	Settlement area with waterbody dominated by plants like Bamboo, Microcos paniculata , Ficus religiosa , Alocasia etc. along with domesticatd plants like Betel nut, Jackfruit, mango etc.

In the 10km buffer zone around Dukli, the vegetation demonstrates a marked increase in the Rubber tree (*Hevea brasiliensis*) population, with 65 trees contributing a biomass of over 55 tons per hectare. This increase highlights the Rubber tree's ecological impact, which can have both positive and negative effects. Economically valuable, the Rubber tree's extensive plantations can lead to monocultural practices that may decrease understory diversity, alter soil composition, and disrupt local biodiversity.

The diversity of tree species is rich, with notable numbers of *Microcos paniculata* (Pichandi) and *Lagerstroemia speciosa* (Pride of India) adding to the region's ecological structure. The presence of *Areca catechu* (Supari) and the fruit-bearing *Mangifera indica* (Aam) indicates a variety of food sources for wildlife, contributing to the zone's ecological balance and habitat diversity.

Shrub species, such as *Clerodendrum infortunatum* (Bhat) and *Cassia alata* (Ringworm bush), are prevalent, indicating a dense understory that can support numerous insects and small fauna. The herbaceous layer is dominated by *Bambusa balcooa* (Barak) and *Paspalum botterii* (Crown grass), which help maintain soil health and provide ground cover, preventing erosion and supporting a microhabitat for smaller species.

Climbers like *Mikania micrantha* (Bitter vine) and *Coccinia grandis* (Ivy gourd) weave through this ecological fabric, adding vertical complexity and connecting various strata of the vegetation, which is essential for the mobility and diversity of arboreal and climbing fauna.

The habitats within this buffer are characterized by moist deciduous forests and riverine ecosystems, as seen in areas such as Dakshin Champamura and Khayerpur, where rubber plantations coexist with natural vegetation. The river banks, particularly in Khayerpur and Ranjit Nagar, harbor unique plant communities that include riverine species like *Albizia saman* and bamboo forests, which play a crucial role in stabilizing the riverine ecosystem and providing resources for the local fauna.

Overall, the 10km buffer zone presents an intricate mosaic of vegetation, with the Rubber tree being a significant part of the landscape. Its ecological effects, particularly in forming extensive plantations, necessitate careful management to ensure that biodiversity is conserved and that the ecological functions of native species and varied habitats are maintained.

Outer buffer - 15km radius

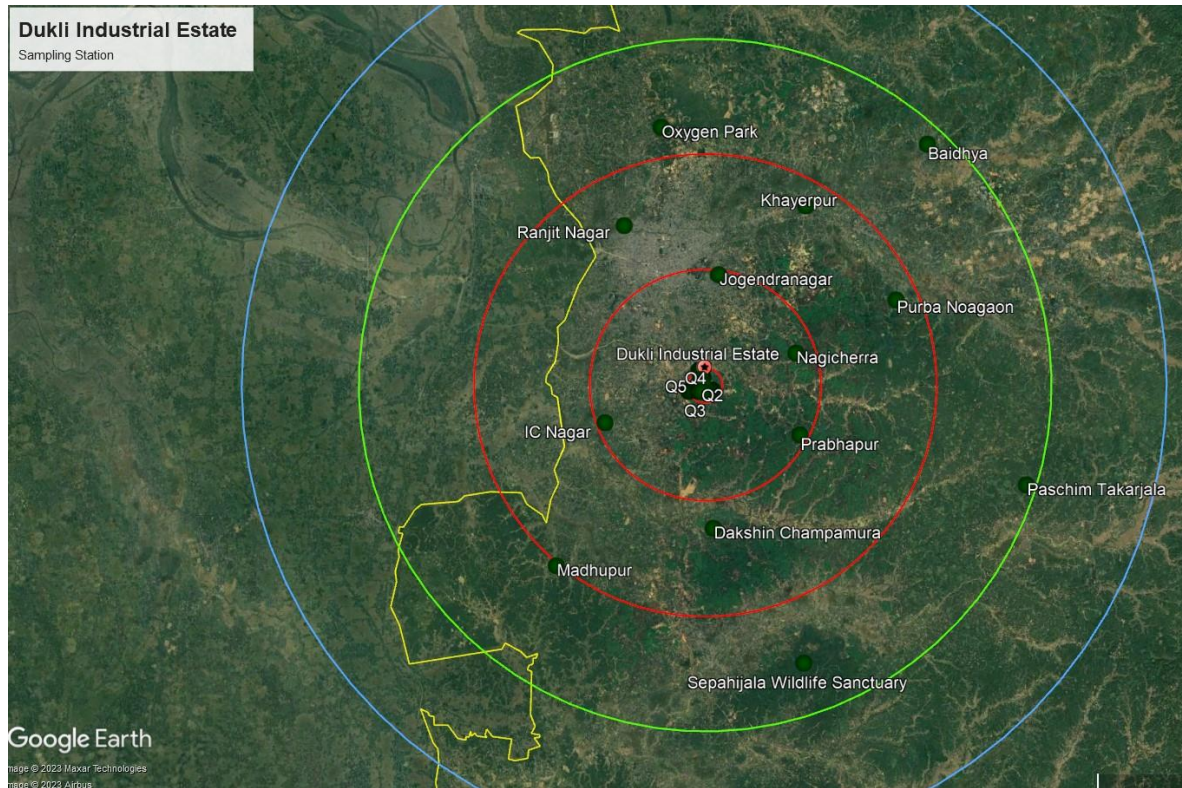


FIGURE 8 OUTER BUFFER - 15KM RADIUS

TABLE 9: QUADRAT DETAILS CENTRAL BUFFER - 15KM RADIUS

Sr.No.	Location	Latitude	Longitude	Habitat
1	Baidhya kobra	23.864408	91.399261	Agricultural habitat with dominated trees like Albizia procera , Ficus hipsida , Microcos paniculata, Teak, Toona ciliata , Cassia obtusifolia etc.
2	Oxygen park	23.88364	91.289276	Dominated by Sal forest & other forest species
3	Paschim takarjala	23.727079	91.42424	Mixed forest near rubber plantation, major plants are Parkia biglandulosa, Albizia procera , Trema orientalis etc.
4	Madhupur	23.719433	91.221306	Settlement area beside Rubber plantation with fragmented mixed moist deciduous forest with plants like Toona ciliata, Areca nut ,Jackfruit, Arjun, Spondias mombin, Microcos paniculata, Teak, Moringa, Parkia biglandulosa, Albizia procera , Trema orientalis etc.

5	Sepahijala Wildlife Sanctuary	23.669805	91.320415	Sepahijala Wildlife Sanctuary is primarily characterized by moist deciduous and evergreen forests. Some common tree species found in the evergreen forests of Sepahijala Wildlife Sanctuary include Dipterocarpus spp., Mesua ferrea, Castanopsis spp., and Canarium strictum. Some of the notable mammal species found in Sepahijala Wildlife Sanctuary include Asian elephants, tigers, leopards, wild boars, barking deer, macaques, and langurs. It serves as a breeding center for several rare and endangered animals, such as clouded leopards and spectacled langurs
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In the 15km buffer zone of Dukli, the Rubber tree (*Hevea Brasiliensis*) emerges as a particularly significant species with a remarkable abundance of 108 trees, which contribute significantly to the zone's biomass. This prevalence is indicative of the species' influence on the local ecosystem, where large Rubber plantations can lead to homogenous landscapes that may not support the same level of biodiversity as more varied forests.

The diverse tree population includes *Microcos Paniculata* (Pichandi) and *Shorea Robusta* (Sal), both of which are notable for their high occurrence and substantial biomass, indicating their importance in the regional ecology. *Tectona Grandis* (Segun) and *Chaetocarpus Castanocarpus* (Wild Sapota) also contribute to the structural diversity of the zone.

The shrub layer is dominated by *Clerodendrum Infortunatum* (Bhat) and *Chromolaena Odorata* (Jack In The Bush), with the former being especially prevalent, suggesting a dense understorey that provides habitat and forage for numerous animal species. The presence of *Sida Acuta* (Wireweed) and *Lantana Camera* (Yellow Sage) contributes to the ecological complexity of the area, offering a variety of microhabitats.

Herbaceous species such as *Paspalum Botterii* (Crown Grass) and *Bambusa Vulgaris* (Bari) are particularly abundant, forming a vital component of the ground layer that aids in soil conservation and provides a habitat for smaller fauna.

Climbing plants, including *Mikania Micrantha* (Bitter Vine) and *Pueraria Phaseoloides* (Tropical Kudzu), are widespread, highlighting the ecological importance of these species in connecting different layers of vegetation and providing pathways for a range of climbing and arboreal animals.

The habitats within this buffer zone are characterized by a mix of moist deciduous forests and subtropical woodlands, as seen in areas like Madhupur, Paschim Takarjala, and Fatikcherra. These areas host a mix of native species such as *Shorea Robusta* (Sal) and various *Ficus*

species, alongside Rubber plantations, indicating a mosaic of managed and natural landscapes.

In this 15km buffer zone, the Rubber tree's ecological footprint is significant, and its prevalence highlights the importance of considering the Rubber tree's impact on local biodiversity and ecosystem functions. While Rubber plantations are economically important, their expansion should be managed in a way that preserves the ecological integrity and species diversity of the Dukli area.

Broader buffer - 20 km radius

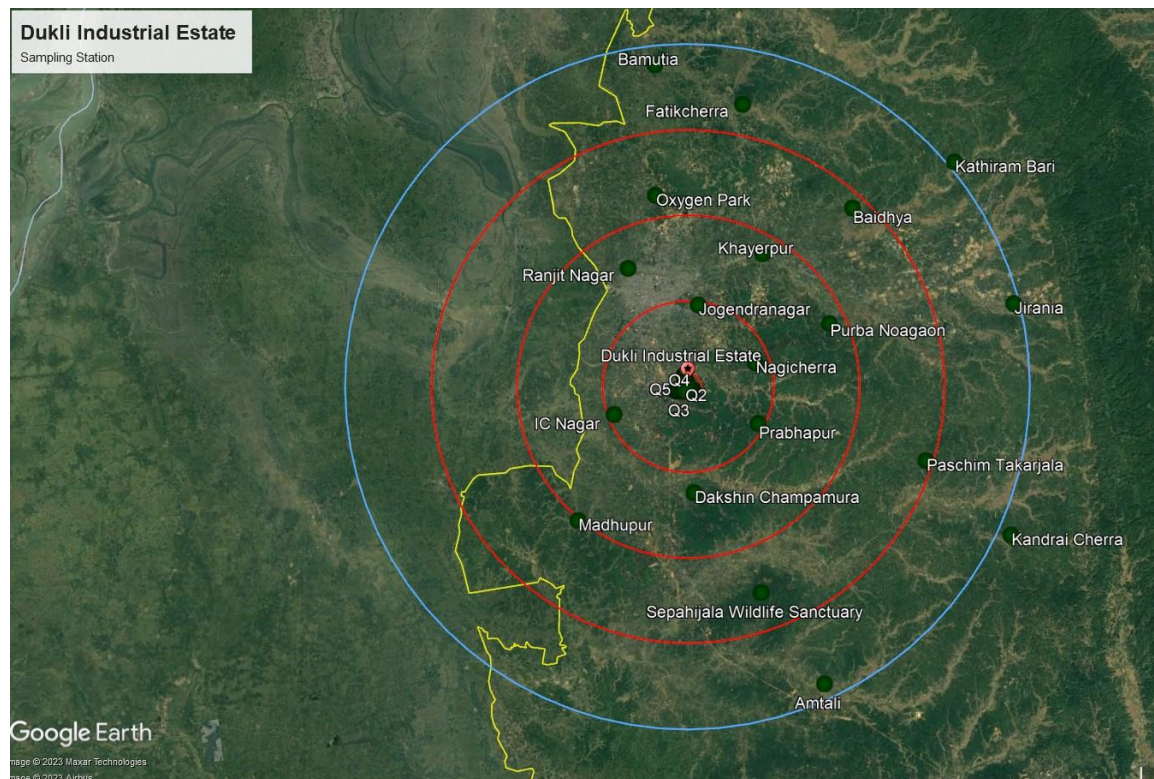


FIGURE 9 BROADER BUFFER - 20 KM RADIUS

TABLE 10: QUADRAT DETAILS BROADER BUFFER - 20 KM RADIUS

Sr.No.	Location	Latitude	Longitude	Habitat
1	Kathiram bari	23.880733	91.461906	Dominated by Teak, Bamboo & Rubber plantation
2	Jirania	23.804144	91.485237	Riverine ecosystem dominated by bamboo forest, other plants are white teak, teak, Palmyra palm, Alocasia, banana also present near settlement
3	Amtali	23.617483	91.349923	Dominated by plantation of Rubber, fragmented moist deciduous forest

				with major trees are teak, Bridelia tomentosa, Nageswar (state flower)
4	Kandrai charra	23.681479	91.465561	Mixed deciduous forest showcases a diverse range of tree species, including Parkia javanica, Schima wallichii, and Microcos paniculata. mix of bamboo, Garjan, and Microcos paniculata, highlighting the presence of versatile bamboo, hardwood, and broadleaf tree species.
5	Bamutia	23.952457	91.296448	Subtropical habitat with a small stream dominated by plants like Jujubi, Trema orientalis, Ficus hipsida, Microcos paniculata etc.
6	Fatikcherra	23.924822	91.343864	Mixed forest dominated by Teak, bamboo, Microcos paniculata & Rubber plantation

In the 20km buffer area of Dukli, the diversity and biomass of the vegetation indicate a rich ecological fabric. Microcos Paniculata (Pichandi) leads in abundance with 55 trees, contributing to a significant biomass of over 282 tons per hectare, reflecting its prominence in this zone's vegetation structure. The Rubber tree (Hevea Brasiliensis) also maintains a strong presence with 54 trees, but its ecological influence is balanced by the presence of other species, unlike in the closer buffer zones where it dominates.

Tectona Grandis (Segun) and Areca Catechu (Supari) add to the diversity, providing valuable resources for both human use and wildlife. Albizia Procera (Koroi) and Schima Wallichii (Needlewood Tree) further enhance the ecological structure, supporting a multitude of animal species and contributing to the habitat complexity. Shrub species, such as Chromolaena Odorata (Jack in The Bush) and Clerodendrum Infortunatum (Bhat), are highly abundant, underpinning a thick understorey layer that is crucial for many species for shelter and food. This layer is also enriched by the presence of Urena Lobata (Caesarweed) and Cassia Obtusifolia (Sicklepod), which contribute to the biological diversity and complexity of the area. The herbaceous layer, led by Paspalum Botterii (Crown Grass), is dense and diverse, with species like Bambusa Balcooa (Barak) and Spermacoce Latifolia (False Button Weed) adding to the ground cover. This layer is essential for soil conservation and provides a habitat for a range of smaller fauna. Climbers such as Mikania Micrantha (Bitter Vine) and Pueraria Phaseoloides (Tropical Kudzu) weave through the vegetation, providing connectivity among the trees and creating pathways for various climbing and arboreal species, thus enhancing the ecological dynamics of the forest.

The habitats within the 20km buffer zone are characterized by a mosaic of moist deciduous forests, subtropical woodlands, and riverine ecosystems. This is evident in areas like Amtali,

Kandrai Charra, and Jirania, where mixed forests with a variety of species like *Parkia Javanica*, *Schima Wallichii*, and Bamboo coexist with human settlements and agricultural lands, indicating a blend of natural and anthropogenic landscapes.

In this outer buffer zone, the Rubber tree's ecological footprint is integrated within a broader context of species diversity and habitat variety, which can be beneficial for maintaining the area's biodiversity. However, its expansion should still be managed to ensure the conservation of native species and the maintenance of ecological functions. The diversity of plant life in the 20km buffer zone underscores the ecological richness of the Dukli area and highlights the importance of these ecosystems for the conservation of biodiversity.

4.2 Vegetation diversity comparison between core and buffer areas

The vegetation diversity across the Dukli area, when comparing the core to its surrounding buffer zones, reflects the significant impact of human activities, particularly in the core area. The core area, influenced by urbanization and industrial activities, presents a unique ecological scenario.

In the core of Dukli, the influence of an industrial site and rice plantation is evident, with the Rubber tree (*Hevea brasiliensis*) being a notable species. This suggests that the area has been subjected to industrial forestry practices, leading to a landscape where native vegetation diversity may be compromised. Although other tree species like *Microcos Paniculata* (Pichandi) and *Tectona Grandis* (Segun) are present, the overall balance of the ecosystem is likely skewed by the industrial and urban impacts.

Moving to the immediate 500m buffer zone, the dominance of the Rubber tree becomes more pronounced, potentially as a result of extended human cultivation. This zone still maintains a level of biodiversity, but the ecological effects of the Rubber plantations, such as reduced understorey diversity, begin to become more apparent. As we expand further to the 5km and 10km buffer zones, there's a gradual decrease in the Rubber tree's dominance, with a corresponding increase in native species diversity. This shift suggests a reduction in the intensity of human agricultural activities and a transition towards more naturally composed forests, indicative of lesser human disturbance compared to the core area.

In the outer 15km and 20km buffer zones, the vegetation profile changes markedly, showcasing a rich array of native tree species, shrubs, and herbs. These areas are less influenced by the Rubber tree and display a more diverse and complex ecosystem, supporting a wider range of wildlife. The presence of diverse plant species in these outer buffers highlights a more intact and ecologically varied landscape, potentially less impacted by the industrial activities affecting the core area.

Overall, the comparison between the core and the buffer zones in Dukli illustrates the profound impact of human activities, particularly industrial and urban development, on vegetation diversity. The core area is significantly impacted and altered by industrial and human activities, resulting in a shift in the ecological balance. In contrast, the outer buffer zones, with their richer diversity of native species, present a more complex and ecologically robust environment,

underlining the importance of preserving these areas to maintain the overall biodiversity and ecological health of the Dukli region.

TABLE 11: MOST DOMINANT VEGETATION SPECIES IN DIFFERENT CORE AND BUFFER ZONES

Radius	Group	Abundance	Species richness	Dominant Species - Scientific name	Biomass tonnes hectare
0km	Herbs	60	10	Chrysopogon Aciculatus	126.68
0km	Shrubs	49	11	Chromolaena Odorata	158.35
0km	Trees	11	10	Artocarpus Heterophyllus	26.25
10km	Herbs	200	31	Bambusa balcooa	3.49
10km	Shrubs	42	15	Clerodendrum infortunatum	4.19
10km	Trees	65	22	Hevea brasiliensis	55.69
15km	Herbs	171	22	Paspalum Botterii	380.05
15km	Shrubs	124	12	Clerodendrum Infortunatum	443.39
15km	Trees	108	32	Hevea Brasiliensis	113.09
20km	Herbs	180	28	Paspalum Botterii	257.49
20km	Shrubs	126	16	Chromolaena Odorata	229.82
20km	Trees	55	34	Microcos Paniculata	282.43
500m	Herbs	46	6	Paspalum Botterii	126.68
500m	Shrubs	46	9	Chromolaena Odorata	221.7
500m	Trees	40	10	Hevea Brasiliensis	29.06
5km	Herbs	187	32	Paspalum Botterii	380.05
5km	Shrubs	95	21	Chromolaena Odorata	316.71
5km	Trees	59	35	Microcos Paniculata	158.72

5. ANIMAL DIVERSITY

5.0 Fauna in the Core area – the project site

The core area of Dukli, with its subtropical climate and industrial backdrop, provides a fascinating case study for fauna diversity and its ecological implications. The assortment of birds, from the Common Myna (*Acridotheres tristis*), which is the most abundant with 18

individuals, to the variety of egrets and drongos, reflects a rich avian life that is deeply influenced by the surrounding human activities. The presence of rice processing facilities in particular has a notable effect, as the byproducts serve as a substantial feeding ground, attracting large numbers of birds such as the House Sparrow (*Passer domesticus*) and the Spotted Dove (*Spilopelia chinensis*), which are among the highest in occurrence.

The bird population, with species like the Asian Palm Swift (*Cypsiurus balasiensis*) and the Ashy-Headed Green Pigeon (*Treron phayrei*), is indicative of the availability of various ecological niches and the adaptability of these species to the changing environment. The core's vegetative structure, dominated by shrubs such as *Cassia alata* and trees like the Indian Charcoal Tree, provides habitats that are crucial for nesting and foraging. Moreover, the rubber plantation introduces a monoculture that, while reducing diversity, creates a different kind of habitat that some bird species may find advantageous.

Insects and arthropods, though less visible, are no less important. The Wandering Glider (*Pantala flavescens*) dragonfly stands out with an abundance of 25 individuals, suggesting the presence of water bodies or moist areas conducive to their lifecycle. The diversity of insects, including the Blister Beetle (*Mylabris pustulata*) and various spiders like the Lynx Spider (*Oxyopes* sp.), forms the foundational levels of the food web, supporting a multitude of predatory birds and contributing to the area's overall ecological balance.

Reptiles, represented by the Garden Lizard (*Calotes irawadi*) and the House Gecko (*Hemidactylus frenatus*), though less abundant, play their part in controlling insect populations and adding to the biodiversity. Their presence, although in smaller numbers, is a key indicator of the health of the core's ecosystem.

5.1 Fauna in the Buffer areas

Immediate vicinity - 0-500m

The immediate buffer area, extending to a 500m radius, shows a slightly different ecological makeup compared to the core area. The predominant habitat here is also characterized by rubber plantations, but with a more diverse mix of plant species. This area sees a blend of moist deciduous and subtropical semi-evergreen habitats. Significant vegetation includes Teak (*Tectona grandis*), *Toona ciliata*, *Cassia siamea*, and *Microcos paniculata*.

The avifauna in this area is dominated by species like the Spotted Dove, Chestnut-Tailed Starling (*Sturnia malabarica*), and the Common Myna (*Acridotheres tristis*). These species show a higher relative density here than in the core area, possibly due to the varied habitat that offers abundant food sources and nesting sites.

Butterflies and dragonflies, such as the Common Grass Yellow (*Eurema hecabe*) and the Wandering Glider (*Pantala flavescens*), add to the biodiversity of this buffer zone. Their presence is essential for pollination and as indicators of environmental health. Mammals like the Pallas's Squirrel (*Callosciurus erythraeus*) also contribute to the ecological diversity of this area.

In summary, both the core and the immediate buffer areas host a rich tapestry of biodiversity, each with its unique characteristics and species compositions. The core area's focus is more

on shrubs and herbs, with a significant presence of bird species, while the buffer area shows a more varied habitat with a mix of different flora and fauna, illustrating the dynamic nature of these ecosystems.

Inner buffer - 5km radius

The 5km buffer area around the core exhibits a rich and diverse habitat, predominantly characterized by subtropical semi-evergreen and moist deciduous environments. This region is a mosaic of rubber plantations and mixed forests, with notable flora including Teak, *Microcos paniculata*, bamboo, and various fruit trees like mango and jackfruit.

Bird life in this area is abundant and varied, with the Chestnut-Tailed Starling (*Sturnia malabarica*), Spotted Dove (*Spilopelia chinensis*), and House Sparrow (*Passer domesticus*) being particularly prominent. The presence of a wide variety of bird species, including the Asian Green Bee-Eater (*Merops orientalis*) and the Blue-Tailed Bee-Eater (*Merops philippinus*), indicates a healthy and thriving ecosystem. Butterflies such as the Common Grass Yellow (*Eurema hecabe*) and the Common Wanderer (*Pareronia valeria*) add to the area's biodiversity, playing crucial roles in pollination. Dragonflies like the Wandering Glider (*Pantala flavescens*) and the Picture Wing (*Rhyothemis variegata*) are also significant, indicating well-maintained water bodies and wetlands in the area.

Mammalian life, represented by species like Pallas's Squirrel (*Callosciurus erythraeus*), underscores the area's ecological balance. The presence of a variety of insects, including the Blister Beetle (*Mylabris pustulata*) and various spider species, further contributes to the ecological diversity.

Central buffer - 10km radius

Extending to a 10km radius, this buffer zone showcases a habitat similar to the 5km area but with a more pronounced presence of rubber plantations. This region is characterized by terrestrial, moist deciduous environments, with significant vegetation like bamboo forests and a variety of local flora.

Bird diversity is remarkable, with species like the Spotted Dove, Black Drongo (*Dicrurus macrocercus*), and Common Myna (*Acridotheres tristis*) being highly prevalent. The Yellow-Footed Green Pigeon (*Treron phoenicopterus*) and the Red-Vented Bulbul (*Pycnonotus cafer*) also contribute to the avian richness. Butterfly species, including the Plain Tiger (*Danaus chrysippus*) and the Indian Cabbage White (*Pieris canidia*), enhance the ecological fabric of this area. Their presence, along with a variety of dragonflies and other insects, indicates a balanced ecosystem with adequate floral diversity and water resources. The presence of amphibians like the Common Indian Toad (*Duttaphrynus melanostictus*) and the Cricket Frog (*Minevarya teraiensis*), along with reptiles such as the Garden Lizard (*Calotes irawadi*) and several species of geckos, reflects the ecological complexity and health of this buffer zone.

In summary, both the 5km and 10km buffer areas display rich biodiversity with a blend of various habitats supporting a wide range of species. These areas serve as crucial ecological buffers, maintaining the balance and health of the region's overall ecosystem..

Outer buffer - 15km radius

The 15km buffer area is a transition zone where the natural habitats of moist deciduous and subtropical forests meet human settlements. This area, encompassing places like Madhupur and Paschim Takarjala, features a mix of rubber plantations and diverse vegetation such as Arjun, Spondias mombin, and Microcos paniculata, reflecting an interplay between natural and modified landscapes.

Birdlife in this area is marked by high populations of Indian White-Eye (*Zosterops palpebrosus*) and Ashy Woodswallow (*Artamus fuscus*). The diversity of avian species, including the Common Myna (*Acridotheres tristis*) and various species of Bee-Eaters, indicates a rich ecological network supporting a variety of food chains. Butterflies and dragonflies, such as the Common Grass Yellow (*Eurema hecabe*) and the Wandering Glider (*Pantala flavescens*), add to the area's biodiversity, indicating healthy ecosystems with abundant floral resources and water bodies.

The presence of amphibians like the Cricket Frog (*Minevaria teraiensis*) and the Common Indian Toad (*Duttaphrynus melanostictus*) alongside a variety of insects and mammals like Pallas's Squirrel (*Callosciurus erythraeus*) underscores the ecological richness of this buffer zone.

Broader buffer - 20 km radius

The 20km area extends into regions like Amtali and Jirania, where the landscape is characterized by a mix of moist deciduous forests and subtropical woodlands. This zone is marked by a dominance of rubber plantations alongside natural vegetation such as bamboo, teak, and various fruit-bearing trees, creating a habitat conducive to a wide range of species.

Bird populations, including the Common Myna and House Sparrow (*Passer domesticus*), are significant in this area. The presence of the Blue-Tailed Bee-Eater (*Merops philippinus*) and the Red-Vented Bulbul (*Pycnonotus cafer*) highlights the area's ability to support diverse avian life. The variety of butterflies, like the Plain Tiger (*Danaus chrysippus*) and the Common Crow (*Euploea core*), along with dragonflies such as the Green Marsh Hawk (*Orthetrum sabina*), reflects the ecological health of the area, particularly in terms of floral diversity and water resources.

Mammalian species like Pallas's Squirrel and other small rodents indicate a balanced ecosystem, while the presence of various insects and reptiles, including garden lizards and geckos, adds to the overall biodiversity.

In summary, 20km buffer zones exhibit a rich biodiversity, characterized by an intermingling of natural habitats and human-influenced landscapes. These areas play a crucial role in sustaining the region's ecological balance, supporting a wide range of species across different trophic levels.

5.2 Faunal diversity comparison between core and buffer areas

The faunal diversity between the core area and its buffer zones reveals a nuanced pattern of species distribution and abundance, shaped by the nature of the habitat and human activities.

In the core area (0km), there is a rich diversity of specialized species, a reflection of the undisturbed subtropical habitat. This region is home to a variety of unique birds such as the Asian Green Bee-Eater and Ashy-Headed Green Pigeon, along with a rich array of insects and amphibians. The limited human impact in this core zone allows for the thriving of sensitive and specialized species, evident in the abundance of certain bird and insect life, characteristic of a healthy ecosystem. However industrial activities and urbanisation still threatens the local biodiversity and ecology.

As we move to the immediate buffer zone (500m), there's a noticeable increase in generalist species that can adapt well to edge habitats and environments altered by human activities. The proximity to human settlements leads to a shift in species composition, favoring those that can coexist alongside humans. This zone also shows a significant presence of butterflies and dragonflies, indicative of diverse plant life and the availability of water resources.

In the 5km and 10km buffer zones, there is a shift in the populations of birds and amphibians. Species like the Chestnut-Tailed Starling and the Common Indian Toad are more prevalent, suggesting different habitat preferences. These areas, characterized by mixed-use landscapes including agricultural land, have a different impact on the types of species found. Despite the human influence, the diversity of insect life, including various butterflies and dragonflies, remains a prominent feature.

The 15km and 20km buffer zones display an even wider range of species, including mammals like Pallas's Squirrel. This diversity indicates larger, more connected habitats capable of supporting a wide range of fauna. Here, widespread species like the Indian White-Eye and Common Myna dominate, showing an environment favoring generalists. The presence of diverse dragonfly and butterfly populations continues, signaling sustained ecological health with abundant flora and water resources.

In conclusion, the core area is distinguished by a high diversity of specialized species due to the relatively undisturbed habitat. Moving outward, there is a gradual transition towards species that are more adaptable to human-altered environments. The outer buffers, influenced by a mix of natural and human landscapes, support a broad range of fauna, indicative of larger and more diverse habitats. This gradient in faunal diversity highlights the significance of both core and buffer areas in maintaining ecological balance and biodiversity in the region.

TABLE12: DOMINANT FAUNAL SPECIES IN CORE AND BUFFER AREAS

Radius	Group	Dominant Species - Common name	Abundance	Species richness
0km	Birds	Asian Green Bee-Eater	9	29
0km	Butterflies	Common Emigrant	2	3
0km	Dragonflies	Green Marsh Hawk	1	1
0km	Other insects	Blister Beetle	20	6

5km	Birds	Chestnut-Tailed Starling	53	74
5km	Dragonflies	Wandering Glider	25	8
5km	Butterflies	Common Grass Yellow	8	28
5km	Amphibians	Cricket Frog	4	4
5km	Arthropods	Rusty Millipede	1	1
5km	Mammals	Pallas's Squirrel	3	2
5km	Other insects	Blister Beetle	7	28
5km	Reptiles	Garden Lizard	5	6
500m	Birds	Spotted Dove	31	35
500m	Dragonflies	Wandering Glider	40	3
500m	Butterflies	Common Grass Yellow	6	8
500m/	Other insects	hBlister Beetle	15	5
500m	Mammals	Pallas's Squirrel	2	1
15km	Dragonflies	Wandering Glider	360	4
15km	Birds	Indian White-Eye	78	47
15km	Other insects	Blister Beetle	43	14
15km	Mammals	Pallas's Squirrel	8	1
15km	Amphibians	Cricket Frog	4	2
10km	Other insects	Weaver Ant	51	14
10km	Birds	Spotted Dove	36	42
10km	Butterflies	Plain Tiger	6	12
10km	Reptiles	Garden Lizard	3	3
10km	Mammals	Pallas's Squirrel	3	1
20km	Birds	Common Myna	46	70
20km	Other insects	Blister Beetle	39	24

20km	Dragonflies	Wandering Glider	25	4
20km	Butterflies	Common Crow	13	21
20km	Mammals	Pallas's Squirrel	5	1
20km	Amphibians	Cricket Frog	2	2
20km	Arthropods	Two Tailed Spider	2	1
20km	Reptiles	Garden Lizard	3	5

6. BIODIVERSITY INDICATORS

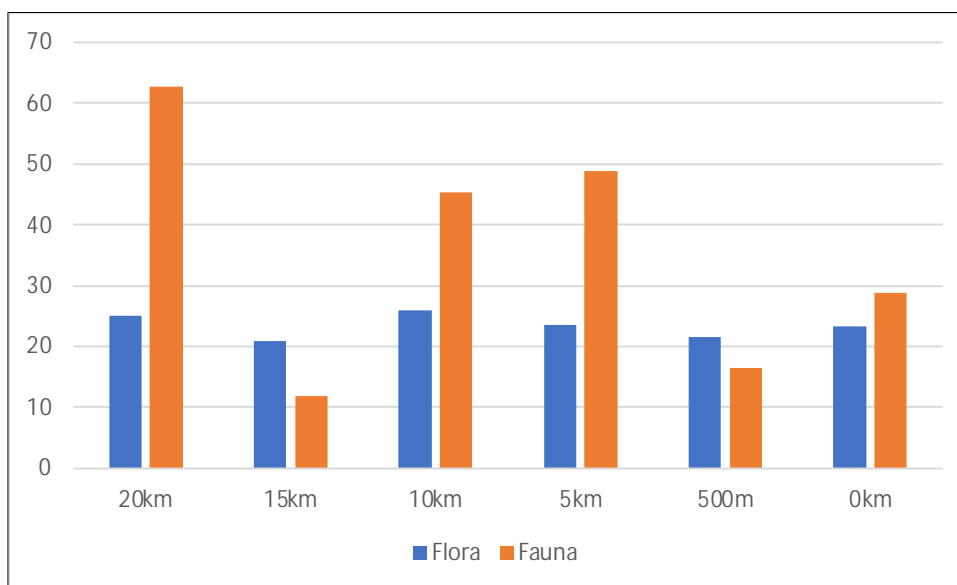


FIGURE 10: RADIUS COMPARISON WITH DIVERSITY

The diversity of both flora and fauna across the core and buffer zones of Dukli can be quantitatively described using several biodiversity indices. The Shannon index, which accounts for both abundance and evenness of the species present, shows a high value for fauna at the 20km radius, suggesting a highly diverse and even community. This is further supported by the Simpson index, indicating a low probability of the same species being repeatedly sampled, thus implying a rich biodiversity. The Inverse Simpson index corroborates these findings, with a high value reflecting a large number of equally abundant species.

In terms of species richness, the 20km buffer zone has the highest number of fauna species, totaling 188. The flora in this zone also presents considerable diversity with 96 species. The Jaccard Similarity index here indicates a high level of similarity between the species compositions of different communities within this radius, suggesting a shared ecological landscape that supports a wide array of species.

As we move closer to the 15km radius, there's a slight decline in fauna diversity and species richness, but the diversity indices still indicate a robust and varied ecological community. Flora at this radius also shows high diversity, but with fewer species compared to the 20km buffer zone.

The 10km radius maintains high diversity in fauna, with the Shannon and Simpson indices suggesting a complex and varied community structure. Flora diversity remains high but less so than in the 20km radius, possibly due to the increased human activity or environmental changes occurring closer to the core area.

The 5km radius fauna diversity is slightly higher than at 10km, indicating that the closer proximity to the core area may not necessarily result in decreased fauna diversity. In contrast, the flora diversity is somewhat lower, which could reflect a more disturbed habitat or a difference in the flora communities that are able to thrive closer to the core.

Within the immediate 500m buffer, both flora and fauna diversity indices show lower values compared to the larger radii, which could be a result of the more immediate impact of human activities on biodiversity. However, the diversity is still relatively high, indicating a resilient ecosystem capable of sustaining a variety of species despite environmental pressures.

Finally, at the 0km core area, the fauna diversity is quite high, which could be attributed to the presence of a variety of habitats within the industrial and settlement areas, providing niches for different species. The flora diversity, while slightly lower than in the 500m buffer zone, is still substantial, which could reflect the presence of a variety of plant species that have adapted to the urban environment.

Overall, the diversity indices across the core and buffer zones indicate that while there is a gradient of biodiversity that decreases towards the core area, the core itself still maintains a significant level of biodiversity. This suggests a complex interaction between natural and anthropogenic factors influencing species distribution and abundance in Dukli.

6.0 management implications of biodiversity indicators

In the core area: The data suggests that the core site of the industrial estate harbours significant biodiversity, especially in the fauna category. For the management of the industrial estate, this signifies a responsibility to ensure that ongoing or future developments minimally impact this rich ecological diversity. The presence of such a diverse ecosystem could also be an opportunity for the owner to champion sustainable and eco-friendly practices, potentially positioning the estate as a green industry leader. Additionally, understanding the rich biodiversity can aid in stakeholder communications and offer potential for eco-tourism or educational initiatives. However, it's equally crucial for management to conduct regular biodiversity assessments to monitor the health and diversity of the ecosystem, ensuring conservation measures are effective.

In the buffer area: The data from the buffer zones, especially at distances like 500m and 5km, indicates a notable presence of biodiversity in both flora and fauna categories. For the management of the industrial estate, this highlights the importance of extending conservation

efforts beyond the core site, ensuring that the surrounding areas, which serve as a buffer, maintain their ecological health and diversity. The buffer zones can act as a safety net, mitigating potential negative impacts on the core site's biodiversity. To promote sustainable development, the management can consider implementing green corridors or wildlife passages in these buffer zones. This would ensure safe movement for fauna and facilitate gene flow among plant populations. Regular environmental impact assessments, community engagement, and habitat restoration initiatives in these buffer areas can help balance industrial activities with ecological preservation.

7. HABITAT AND LANDCOVER ASSESSMENTS

7.0 Observation in the core area

The land use and landcover map of the core area, as illustrated in Figure 11, presents a diverse range of biophysical environments, indicative of the various types of land cover present within the core area. The dominant land cover type appears to be trees, which likely represents a forested region or a densely wooded area. This extensive green cover is crucial for maintaining biodiversity, sequestering carbon, and regulating the local climate.

Adjacent to the forested regions are patches of shrubland, depicted in a different shade, which are typically areas covered with short woody plants and often indicative of transitional zones between forested areas and grasslands or human-altered environments. Shrublands can support a variety of wildlife and are often important for the ecology of the region. Grassland areas are also visible, which could suggest the presence of meadows or savannas that support a range of fauna and are often used for grazing if located near human habitation. The presence of cropland indicates areas that have been converted for agricultural use, signifying human influence and alteration of the natural landscape for food production.

The built-up areas, marked in red, denote urbanization or development within the core area, including infrastructure such as buildings, roads, and other manmade structures. The proximity of these built-up areas to the natural environments could have implications for land use planning and environmental conservation, balancing human needs with the preservation of natural habitats.

The land cover classification provided by the map is essential for understanding the ecological characteristics of the core area, assessing the impact of land use changes, and guiding conservation efforts. It serves as a visual representation of how land is utilized and the extent of human impact, which is vital for sustainable land management practices.

Satellite Resolution mentioned in the **table no 16**.



FIGURE 11: LAND USE AND LANDCOVER MAP OF THE CORE AREAS

The land use and landcover map of the core areas provides critical insights into the ecological and anthropogenic components shaping the landscape. The core is characterized by a mosaic of various landcover types, each supporting different aspects of the region's biodiversity and human activity.

The dominant green swathes on the map likely represent areas with dense tree cover, which serve as crucial habitats for local fauna and play a vital role in carbon sequestration. These treed areas are interspersed with shrubland, which may indicate either naturally occurring vegetation or areas that have undergone some degree of human disturbance but have recovered to a secondary successional stage. Shrublands are important for a variety of species, including birds, insects, and small mammals, and often serve as transitional zones between forested areas and other landcover types.

Grassland patches, as seen in the map, are typically open, flat areas that can be natural or result from land clearance. Grasslands are important for species that require open spaces or those that thrive in grassy habitats. Croplands, depicted in the map, reflect the agricultural use of the land, which can have both positive and negative impacts on local biodiversity. While

they can provide food resources for a number of wild species, they can also replace natural habitats and potentially lead to conflicts with wildlife.

Built-up areas are clearly marked and denote human settlements, industrial complexes, and other infrastructures. These areas are usually less conducive to wildlife, although some species have adapted to urban environments. The presence of built-up areas within the core indicates a significant human footprint, which has implications for land management and conservation efforts. Barren or sparse vegetation areas could be indicative of either recently disturbed sites, such as construction areas, or naturally less productive soils. These areas are often challenging for conservation but can be important indicators of environmental health and targets for reforestation or rehabilitation projects.

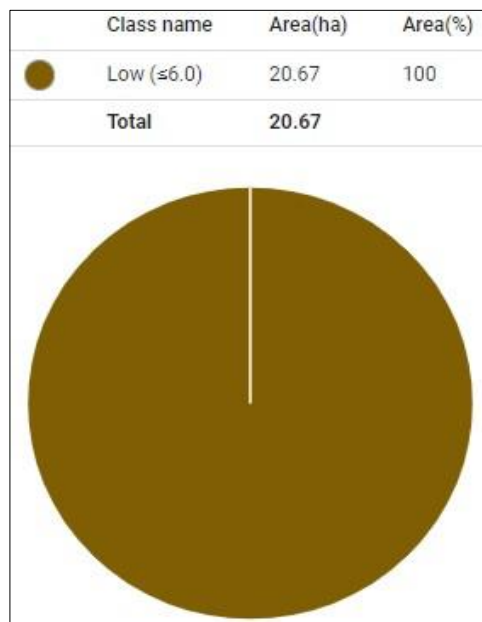


FIGURE 12: THE CORE AREA IS CLASSIFIED AS LOW ECOLOGICAL INTEGRITY DUE TO SIGNIFICANT FOREST AND BIODIVERSITY LOSS.

Figure 12 portrays a sobering view of the core area, where it is classified as having low ecological integrity, which is a reflection of significant forest and biodiversity loss. This classification underscores the impact of human activities, such as urban development, agriculture, and industrialization, which often result in habitat fragmentation and degradation, leading to a decrease in native species and a disruption of natural processes. Ecological integrity is a measure of the presence of native vegetation and the health of ecological systems, and low scores in this domain suggest that the core area's ability to support diverse life forms and maintain ecological functions has been compromised. This loss of integrity not only affects the flora and fauna of the region but can also have far-reaching implications for ecosystem services such as water purification, climate regulation, and soil fertility that are essential for human well-being.

The data from Figure 13 highlights the pattern of tree cover loss within and around the Dukli site, which is designated as the core area. Initially, the area had a substantial canopy cover, with the tree-covered area constituting 37.68 percent of the total area in 2000. However, by 2022, the tree cover dramatically declined, with the area now only covering 18.63 percent, nearly halving the initial coverage. The total forest loss during this period amounted to 2.68 hectares, a substantial reduction given the scale of the site.

The table summarising the forest loss pattern in the core area, with values in both hectares and as a percentage of the total area, is presented below:

Table13: summarising the forest loss pattern in the core area

Description	Total Area	Forest in 2000	Forest in 2022	Total Forest Loss (2000-2022)
Area in Hectares	20.67	7.38	7.00	0.23
Area in Percentage (%)	100	35.68	33.5	3%



FIGURE 13: TREE COVER LOSS PATTERNS IN AND AROUND THE DUKLI SITE

7.1 Observations in the buffer areas

The landcover and land use in the buffer area, as shown in Figure 15, reflect a transitional zone between the highly protected core area and the more altered outer landscapes. This buffer zone typically aims to provide an additional layer of protection for the core while also accommodating a mix of land uses that can include more human activity.

In the depicted buffer area, we can observe a significant presence of trees, suggesting that forested land remains a major component of this zone. This continuity of tree cover into the buffer area is important for wildlife corridors and maintaining ecological processes that extend beyond the core's boundaries. Shrubland areas intersperse with the trees, creating a mosaic of habitats that can support a diverse array of species and serve as a transition between the denser forest core and more open spaces. Grasslands within the buffer are likely to provide foraging grounds for a variety of species and could be used for pastoral activities, given their proximity to areas of human influence.

Cropland patches within the buffer suggest agricultural activities. These areas are critical for local communities' livelihoods and must be managed sustainably to prevent adverse effects on the core area's ecology. Built-up regions within the buffer area show the human settlements and infrastructure. The management of these built-up areas is crucial to mitigate potential negative impacts on the core area, such as pollution, habitat fragmentation, and introduction of invasive species.

Overall, the land use and landcover map of the buffer area showcases a landscape influenced by both natural habitats and human activities. The management of this buffer zone is vital, ensuring that it serves its purpose in protecting the core area while allowing for sustainable use that benefits both biodiversity and the local human population.

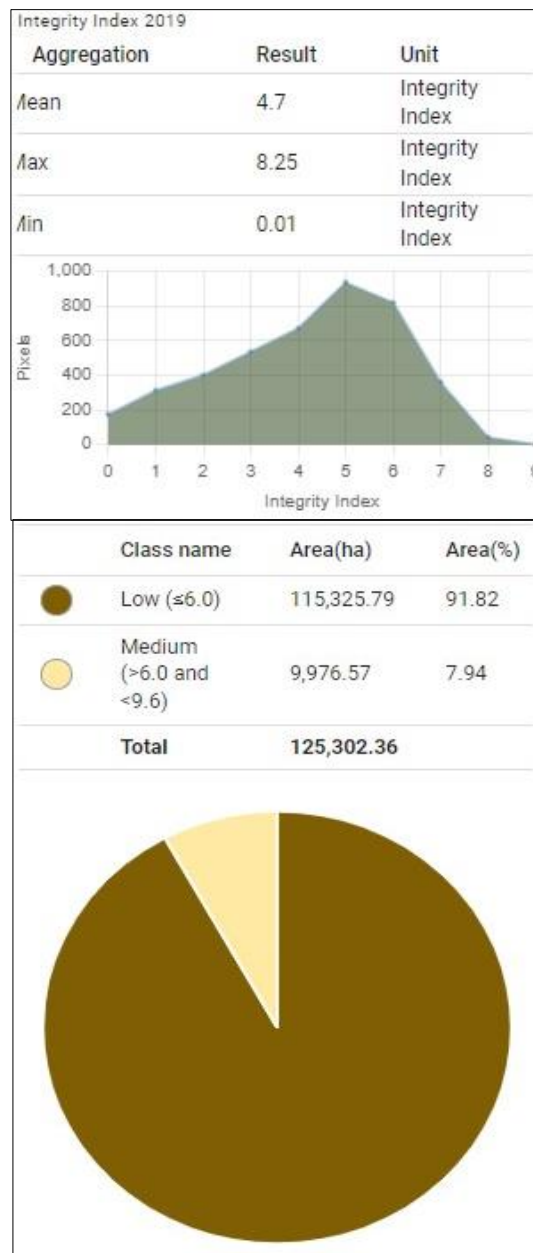


FIGURE14: PATTERNS OF CHANGE IN THE BUFFER AREA

Figure 14 presents data on the patterns of change within the buffer area, indicating a mixed level of ecological integrity. The area is divided into two categories: low ecological integrity, which occupies the majority of the area at 89.11%, and medium ecological integrity, which makes up a smaller portion at 10.66%. This distribution is visualized in a pie chart, highlighting the predominance of areas with low integrity, suggesting significant environmental pressure and alterations from their natural state. The bar graph above the pie chart might be showing the frequency distribution of integrity levels, but without further context, it's difficult to interpret. The mean, max, and min values of the Landscape Integrity Index indicate variability within the buffer zone. Overall, the buffer area appears to have retained some ecological functions but is primarily classified as having low ecological integrity, suggesting that it has experienced

considerable ecological disturbances and may require conservation strategies to prevent further degradation and support ecological restoration.

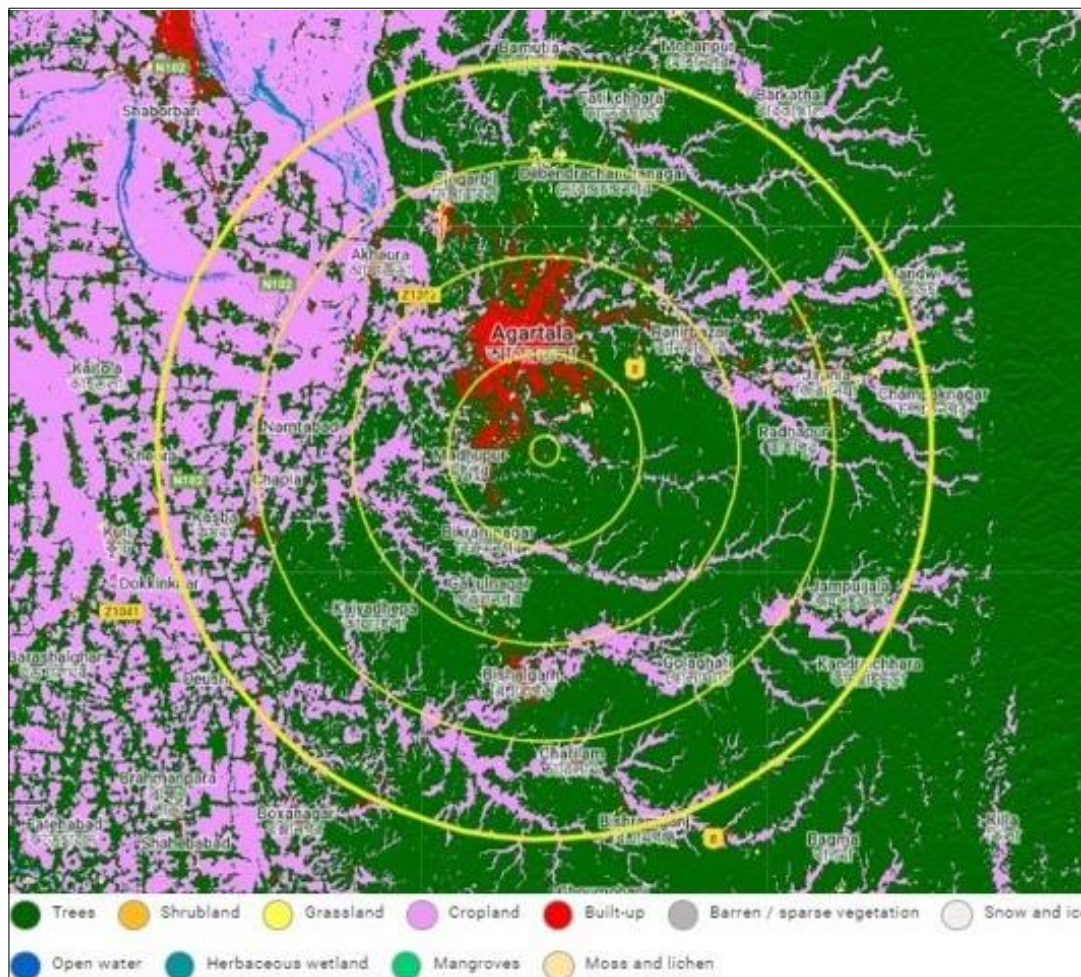


FIGURE 15: LANDCOVER AND LAND USE IN THE BUFFER AREA

Figure 16 illustrates the pattern of forest loss in the buffer area of Dukli, showcasing a significant reduction in tree cover over the period from 2000 to 2022. The bar graph indicates fluctuations in forest loss across the years, with some years experiencing higher rates of deforestation. This suggests variability in the factors contributing to forest loss, which could include agricultural expansion, logging, or urban development.

The data provided reveals that the total area covers 125,261.41 hectares. In the year 2000, there was a forest cover of 53,331.21 hectares, while by 2022, the forested area reduced to 49,932.02 hectares. This represents a total forest loss of 3,398.09 hectares over the 22-year period. Moreover, the average canopy cover in the year 2000 stood at 19.17 percent, which further implies a forest density that has likely been compromised over time. The tree cover gain from 2000 to 2012 was 22.35 hectares, which is minimal compared to the loss, suggesting that reforestation or natural regeneration has not significantly offset the loss of forest cover.

The table summarizing the forest loss pattern in hectares and percentage is as follows:

Table 14: summarizing the forest loss pattern in hectares and percentage

Description	Total Area	Forest in 2000	Forest in 2022	Total Forest Loss (2000-2022)
Area in Hectares	125,261.41	53,331.21	49,932.02	3,398.09
Area in Percentage (%)	100	42.57	39.87	6.37



Figure 16: Tree cover loss in Buffer of Dukli

Satellite Resolution mentioned in the **table no 15**.

8. ECOLOGICAL AND CONSERVATION SIGNIFICANCE

8.0 Key ecologically essential species in the core and buffer

In our detailed study, we've identified a select group of species that hold immense practical value for both ecological balance and human welfare. From our findings, it's evident that these species aren't just theoretical markers of biodiversity; they're tangible contributors to our

everyday lives. They are the potential powerhouses for large-scale plantation projects, capable of reviving degraded landscapes and enhancing soil quality.

A significant portion of our identified species are arboreal, many of which are indigenous, such as *Microcos paniculata* (Pichandi) and *Trema orientalis* (Indian charcoal tree). These species predominantly flourish on hilltops, slopes, and in the vicinity of water bodies. Native shrubberies like *Ardisia neriifolia* (Coralberry) and *Clerodendrum infortunatum* (Bhat) are mainly observed on the plains and slopes. The region's herbaceous layer is enriched with various bamboo species, notably *Bambusa cuharensis* (Bom bamboo), which is unique to north-east India. Other significant herbaceous species include wild banana variants like *Musa flaviflora*. Fern diversity is also pronounced, with species such as *Dryopteris* spp. (male fern) and *Pteris vittata* (Chinese brake) are frequently seen adjacent to water sources and on slopes.

Key Species Identification:

- *Gmelina arborea* (Gamai): An indigenous tree of the Verbenaceae family, predominantly seen on hilltops and plains.
- *Toona ciliata* (Rongil): A member of the Meliaceae family, this indigenous tree is frequently located on hilltops, slopes, and plains.
- *Lagerstroemia speciosa* (Pride of India): A regional representative of the Lythraceae family, commonly located adjacent to aquatic habit.

The list is predominantly composed of species native to the region, underscoring the area's rich endogenous biodiversity. Trees such as *Aquilaria Malaccensis* (Agar) warrant special attention due to their critically endangered status, while the *Oroxylum indicum* (Indian trumpet tree) is also noteworthy given its vulnerable classification. A few introduced species, including *Parkia javanica* (tree bean) and *Lantana camara* (Yellow Sage), have been identified. While they might present certain ecological advantages, unchecked proliferation could disrupt the balance of indigenous ecosystems.

For successful ecological restoration, species placement recommendations are grounded in their natural habitats. For instance, trees like *Gmelina arborea* (Gamai) and *Ficus benghalensis* (Bat) are ideal for hilltops and plains, whereas *Lagerstroemia speciosa* (Pride of India) thrives near aquatic zones.

A comprehensive sheet detailing ecologically important species is attached in the supporting document database.

8.1 Protected species in the region

The study area showcases a diverse assemblage of Schedule 1 Protected Species, ranging from the Phayre's Leaf Monkey and Capped Langur to the Slow Loris, Crested Serpent Eagle, Shikra, Clouded leopard, Mountain Hawk-Eagle, Oriental Pied Hornbill, Small Indian mongoose, Monocled cobra, Red-breasted Parakeet, Black softshell turtle, and Tokay Gecko. This assortment underlines the rich biodiversity of the region, with each species playing a

distinct role in the local ecosystem. The Schedule 2 Protected Species include the Red-headed Trogon, Ashy-headed Green Pigeon, Blossom-headed Parakeet, and Indian flying fox, contributing further to the area's ecological diversity. The designation of certain species as Endangered, such as the Indian Trumpet Tree, Agar, and the Black softshell turtle, emphasizes the need for targeted conservation measures to prevent further decline. The inclusion of Endemic Species like *Psidium guineense* (Brazilian Guava) and Bom (*Bambusa cacharensis*) highlights the unique and region-specific nature of the flora. Vulnerable species like the Clouded leopard, Capped Langur, Slow Loris, and River Tern underscore the importance of conservation efforts. Additionally, species listed as Near Threatened, such as the Ashy-headed Green Pigeon, Blossom-headed Parakeet, and Red-breasted Parakeet, emphasize the need for ongoing monitoring and comprehensive conservation strategies. Collaborative initiatives involving environmental authorities, researchers, and local communities are crucial to ensuring the preservation of these protected species and the overall health of the study area's ecosystem.

Schedule 1 Protected Species:

- Phayre's Leaf Monkey (*Trachypithecus phayrei*)
- Capped Langur (*Trachypithecus pileatus*)
- Slow Loris (*Nycticebus bengalensis*)
- Crested Serpent Eagle (*Spilornis cheela*)
- Shikra (*Accipiter badius*)
- Clouded leopard (*Neofelis nebulosi*)
- Mountain Hawk-Eagle (*Nisaetus nipalensis*)
- Oriental Pied Hornbill (*Anthracoceros albirostris*)
- Small Indian mongoose (*Herpestes auropunctatus*)
- Monocled cobra (*Naja kaothia*)
- Red-breasted Parakeet (*Psittacula alexandri*)
- Black softshell turtle (*Nilssonia nigricans*)
- Tokay Gecko (*Gekko Gecko*)

Schedule 2 Protected Species:

- Red-headed Trogon (*Harpactes erythrocephalus*)
- Ashy-headed Green Pigeon (*Treron phayrei*)
- Blossom-headed Parakeet (*Psittacula roseata*)
- Indian flying fox (*Pteropus medius*)

Endangered Species:

- Indian Trumpet Tree (*Oroxylum indicum*)
- Agar (*Aquilaria Malaccensis*)
- Black softshell turtle (*Nilssonia nigricans*)

Endemic Species:

- *Psidium guineense* (Brazilian Guava)

- Bom (*Bambusa cacharensis*)

Vulnerable:

- Clouded leopard (*Neofelis nebulosi*)
- Capped Langur (*Trachypithecus pileatus*)
- Slow Loris (*Nycticebus bengalensis*)
- River Tern (*Sterna aurantia*)

Near Threatened:

- Ashy-headed Green Pigeon (*Treron phayrei*)
- Blossom-headed Parakeet (*Psittacula roseata*)
- Red-breasted Parakeet (*Psittacula alexandri*)

These species, distributed across the core and buffer regions, require varying protection and conservation attention, as indicated by their classification.

9. BIODIVERSITY ASSESSMENT BASED ON SECONDARY

9.0 Literature Review

The project area's biodiversity, as gleaned from secondary literature, showcases an array of species from varied taxonomic classes, highlighting the ecological richness and complexity of the habitat. Based on the literature review we found a total of 68 species across six main classes, including Aves (birds), Magnoliopsida (flowering plants), Insecta (insects), Arachnida (spiders), Basidiomycota (fungi), Chilopoda (centipedes), and Diplopoda (millipedes). Among these, a majority are birds and plants, indicating a habitat that is conducive to avian and plant biodiversity.

Birds: The avian fauna is notably diverse, with 24 bird species such as the Common Myna (*Acridotheres tristis*), Ashy Woodswallow (*Artamus fuscus*), and the Lesser Coucal (*Centropus bengalensis*), typically inhabiting open woodlands, grasslands, and urban areas. Most of these species are of Least Concern according to the IUCN, except for the Phayre's Leaf Monkey (*Trachypithecus phayrei*), which is marked as Endangered, signifying the need for conservation focus on this species.

Plants: The flora includes 23 species of flowering plants like Devil's Horsewhip (*Achyranthes aspera*) and Peacock Flower (*Caesalpinia pulcherrima*), which are adapted to a range of tropical habitats, from forests to disturbed areas. These species have not been evaluated by IUCN, indicating a potential lack of specific conservation data.

Insects: The insect population in the area is represented by 15 species such as the Amerila astreus (*Amerila astreus*), a moth species, and the Ditch Jewel (*Brachythemis contaminata*), an insect that frequents freshwater habitats. The insects here show adaptability to varied environmental conditions, from aquatic to forest ecosystems.

Spiders (Arachnida), Fungi (Basidiomycota), Centipedes (Chilopoda), and Millipedes (Diplopoda): Lesser-represented classes include spiders, fungi, centipedes, and millipedes, with each class having one to two species recorded such as the Ant-mimic Spiders (Genus *Myrmarachne*) and the *Panaeolus antillarum*, a type of fungus. These species are typically found in moist environments and are not evaluated by IUCN.

The key habitats identified from the data include tropical and subtropical forests, urban areas, grasslands, freshwater habitats, and varied, often disturbed areas. These habitats are essential for providing the ecological niches required by the diverse species present.

Conservation Status: A total of 17 species are listed under IUCN's Least Concern category, reflecting a stable presence in their natural habitats. However, a significant number of species, specifically 50, have not been evaluated by the IUCN, underscoring a gap in conservation assessment and potential unrecognised threats to these species.

The data underscores the richness of the project area's biodiversity and the importance of its varied habitats, which range from urban areas to natural woodlands and forests. Urban areas, while often considered less ideal for wildlife, are shown here to support a variety of bird life, demonstrating their adaptability and the importance of urban biodiversity. Conversely, the presence of species such as the Endangered Phayre's Leaf Monkey (*Trachypithecus phayrei*) in tropical forests highlights the critical need for habitat conservation and the potential impact of habitat loss due to development or other anthropogenic pressures.

9.1 Integrated Biodiversity Assessment Tool (IBAT)

The Integrated Biodiversity Assessment Tool (IBAT) is a software tool that provides access to a wide range of global biodiversity and conservation information. It is designed to support decision-making processes and help assess potential impacts on biodiversity during project planning and development.

IBAT integrates various datasets from reputable sources, including the International Union for Conservation of Nature (IUCN), BirdLife International, and other data providers, into a single platform. These datasets include information on species distributions, protected areas, Key Biodiversity Areas (KBAs), and other relevant biodiversity indicators.



FIGURE 17: GEOGRAPHICAL LOCATION

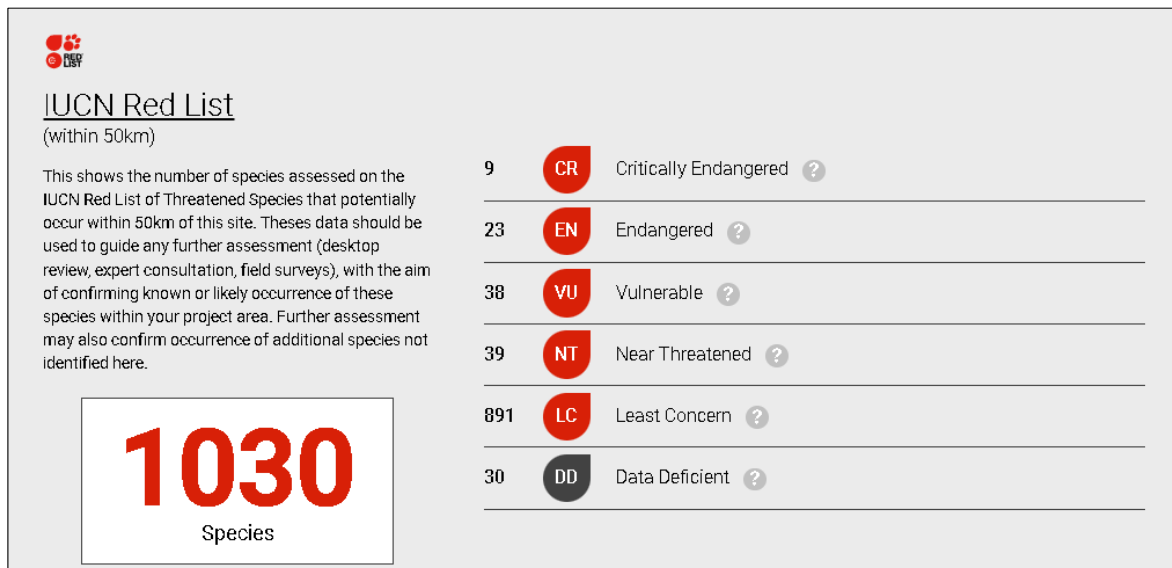


FIGURE 18: IBAT ASSESSMENT WITHIN 50 KMS

According to the IUCN⁶ (International Union for Conservation of Nature), we have categorised species into different conservation statuses. The following are the species falling under the categories of Critically Endangered, Endangered, Vulnerable, Near Threatened & Data Deficient within 50 km radius of the project site. However, we have not included species

classified as Least Concerned as they are considered less significant in terms of conservation status.

TABLE15: SPECIES AND RED LIST CRITERIA

S.No	Scientific Name	Class Name	Red list Category	Red list Criteria
1	Ophiophagus hannah	Reptilia	Vulnerable	A2acd
2	Elaphe taeniura	Reptilia	Vulnerable	A2d
3	Dipterocarpus costatus	Magnoliopsida	Vulnerable	A2cd
4	Dipterocarpus turbinatus	Magnoliopsida	Vulnerable	A2cd
5	Pangshura tecta	Reptilia	Vulnerable	A4d
6	Lissemys punctata	Reptilia	Vulnerable	A2cd+4cd
7	Crocodylus palustris	Reptilia	Vulnerable	A2cd
8	Arctonyx collaris	Mammalia	Vulnerable	A2cd+3cd+4cd
9	Arctictis binturong	Mammalia	Vulnerable	A2cd+3cd+4cd
10	Rusa unicolor	Mammalia	Vulnerable	A2cd+3cd+4cd
11	Ortygornis gularis	Aves	Vulnerable	A2cd+3cd+4cd
12	Clanga hastata	Aves	Vulnerable	C2a(ii)
13	Leptoptilos javanicus	Aves	Vulnerable	A2cd+3cd+4cd
14	Oryza malampuzhaensis	Liliopsida	Vulnerable	B1ab(iii,v)
15	Helarctos malayanus	Mammalia	Vulnerable	A2cd+3cd+4cd
16	Schizothorax plagiostomus	Actinopterygii	Vulnerable	A2b
17	Beilschmiedia assamica	Magnoliopsida	Vulnerable	B2ab(iii)
18	Python bivittatus	Reptilia	Vulnerable	A2acd
19	Aquila heliaca	Aves	Vulnerable	C2a(ii)
20	Capricornis sumatraensis	Mammalia	Vulnerable	A2cd
21	Panthera pardus	Mammalia	Vulnerable	A2cd
22	Lutrogale perspicillata	Mammalia	Vulnerable	A2cde+3cde
23	Aonyx cinereus	Mammalia	Vulnerable	A2cde+3cde
24	Ursus thibetanus	Mammalia	Vulnerable	A2cd
25	Wallago attu	Actinopterygii	Vulnerable	A2d
26	Sterna aurantia	Aves	Vulnerable	A2bcd+3bcd+4bcd
27	Buceros bicornis	Aves	Vulnerable	A3cd+4cd
28	Macaca arctoides	Mammalia	Vulnerable	A2cd+3cd
29	Trachypithecus pileatus	Mammalia	Vulnerable	A2ac+3c
30	Neofelis nebulosa	Mammalia	Vulnerable	A2cd+4cd
31	Dalbergia thomsonii	Magnoliopsida	Vulnerable	B2ab(iii)
32	Clanga clanga	Aves	Vulnerable	A2cde
33	Aythya ferina	Aves	Vulnerable	A2abcd+3bcd+4abcd
34	Bagarius bagarius	Actinopterygii	Vulnerable	A2d
35	Macaca leonina	Mammalia	Vulnerable	A2acd+3cd
36	Xenochrophis cerasogaster	Reptilia	Vulnerable	A2c

37	Varanus bengalensis	Reptilia	Near Threatened	A2d
38	Eryx conicus	Reptilia	Near Threatened	A2d
39	Herpetoreas xenura	Reptilia	Near Threatened	B1b(iii)
40	Ptyas korros	Reptilia	Near Threatened	A2d
41	Parambassis lala	Actinopterygii	Near Threatened	
42	Rousettus leschenaultii	Mammalia	Near Threatened	A2cd
43	Coelops frithii	Mammalia	Near Threatened	A4c
44	Arborophila atrogularis	Aves	Near Threatened	C1+2a(i)
45	Mareca falcata	Aves	Near Threatened	A2bd+3bd+4bd
46	Calidris ruficollis	Aves	Near Threatened	A2bc+3bc+4bc
47	Vanellus duvaucelii	Aves	Near Threatened	A3cde
48	Anhinga melanogaster	Aves	Near Threatened	A2bcd+3bcd+4bcd
49	Threskiornis melanocephalus	Aves	Near Threatened	A2bcd+3bcd+4bcd
50	Ephippiorhynchus asiaticus	Aves	Near Threatened	A2bc+3bc+4bc; C1
51	Catopuma temminckii	Mammalia	Near Threatened	
52	Palaeornis eupatria	Aves	Near Threatened	A2cd+3cd+4cd
53	Limosa lapponica	Aves	Near Threatened	A2abc+3bc+4abc
54	Himalayapsitta roseata	Aves	Near Threatened	A2cd+3cd+4cd
55	Psittacula alexandri	Aves	Near Threatened	A2cd+3cd+4cd
56	Limosa limosa	Aves	Near Threatened	A2bcde+3bcde+4bcde
57	Ichthyophaga ichthyaetus	Aves	Near Threatened	A2cd+3cd+4cd; C1+2a(i)
58	Numenius arquata	Aves	Near Threatened	A2bcd+3bcd+4bcd
59	Pelecanus philippensis	Aves	Near Threatened	A2cd; C1
60	Graminicola bengalensis	Aves	Near Threatened	C2a(i)
61	Calidris canutus	Aves	Near Threatened	A2abc+3bc+4abc
62	Aythya nyroca	Aves	Near Threatened	A2cd+3cd+4cd
63	Haematopus ostralegus	Aves	Near Threatened	A2bc+3b+4bc
64	Aegle marmelos	Magnoliopsida	Near Threatened	A2acd
65	Ompok bimaculatus	Actinopterygii	Near Threatened	
66	Microphis deocata	Actinopterygii	Near Threatened	
67	Anguilla bicolor	Actinopterygii	Near Threatened	A2bcde
68	Anguilla bengalensis	Actinopterygii	Near Threatened	A2cd
69	Treron phayrei	Aves	Near Threatened	A2cd+3cd+4cd
70	Falco jugger	Aves	Near Threatened	A2cd+3cd+4cd; C1
71	Ducula aenea	Aves	Near Threatened	A3cd+4cd
72	Circus macrourus	Aves	Near Threatened	A2cde+3cde+4cde
73	Morenia petersi	Reptilia	Endangered	A2cd+4cd
74	Nilssonia gangetica	Reptilia	Endangered	A2d+4d
75	Nilssonia hurum	Reptilia	Endangered	A2d+4d
76	Hardella thurjii	Reptilia	Endangered	A2bcd+4bcd

77	Hoolock hoolock	Mammalia	Endangered	A4acd
78	Elephas maximus	Mammalia	Endangered	A2c
79	Platanista gangetica	Mammalia	Endangered	A2abcde+3bcde+4abcde
80	Cuon alpinus	Mammalia	Endangered	C2a(i)
81	Leptoptilos dubius	Aves	Endangered	A2bcd+3bcd+4bcd; C2a(ii)
82	Urogymnus polylepis	Chondrichthyes	Endangered	A2bcd
83	Laticilla cinerascens	Aves	Endangered	A2c+3c+4c; C2a(i)
84	Perdicula manipurensis	Aves	Endangered	C2a(i)
85	Varanus flavescens	Reptilia	Endangered	A2cd
86	Geoclemys hamiltonii	Reptilia	Endangered	A2cd+4cd
87	Trachypithecus phayrei	Mammalia	Endangered	A2cd
88	Nycticebus bengalensis	Mammalia	Endangered	A2acd+3cd+4acd
89	Haliaeetus leucoryphus	Aves	Endangered	C2a(ii)
90	Aquila nipalensis	Aves	Endangered	A2abcd+3bcd+4abcd
91	Panthera tigris	Mammalia	Endangered	A2abcd
92	Johnius gangeticus	Actinopterygii	Data Deficient	
93	Blythia reticulata	Reptilia	Data Deficient	
94	Taenioides cirratus	Actinopterygii	Data Deficient	
95	Macrobrachium kempfi	Malacostraca	Data Deficient	
96	Maydellithelphusa falcidigitis	Malacostraca	Data Deficient	
97	Globithelphusa pistorica	Malacostraca	Data Deficient	
98	Globithelphusa cylindra	Malacostraca	Data Deficient	
99	Travancoriana napaea	Malacostraca	Data Deficient	
100	Acanthopotamon fungosum	Malacostraca	Data Deficient	
101	Platycephalus indicus	Actinopterygii	Data Deficient	
102	Stenothyra echinata	Gastropoda	Data Deficient	
103	Assimineia hungerfordiana	Gastropoda	Data Deficient	
104	Camptoceras austeni	Gastropoda	Data Deficient	
105	Badis chittagongis	Actinopterygii	Data Deficient	
106	Gobiopterus chuno	Actinopterygii	Data Deficient	
107	Pseudolaguvia inornata	Actinopterygii	Data Deficient	
108	Physunio micropteroides	Bivalvia	Data Deficient	
109	Neritina platyconcha	Gastropoda	Data Deficient	
110	Auriculodes gangetica	Gastropoda	Data Deficient	
111	Ranalisma rostrata	Liliopsida	Data Deficient	
112	Limnophila diffusa	Magnoliopsida	Data Deficient	
113	Limnophila pulcherrima	Magnoliopsida	Data Deficient	
114	Megalops cyprinoides	Actinopterygii	Data Deficient	
115	Prunus bifrons	Magnoliopsida	Data Deficient	
116	Oryza coarctata	Liliopsida	Data Deficient	

117	Planiliza tade	Actinopterygii	Data Deficient	
118	Doryichthys martensii	Actinopterygii	Data Deficient	
119	Micryletta aishani	Amphibia	Data Deficient	
120	Pelochelys cantorii	Reptilia	Critically Endangered	A2cd+4cd
121	Nilssonina nigricans	Reptilia	Critically Endangered	A4cd
122	Aquilaria malaccensis	Magnoliopsida	Critically Endangered	A2cd
123	Emberiza aureola	Aves	Critically Endangered	A2acd+3cd+4acd
124	Houbaropsis bengalensis	Aves	Critically Endangered	A3bcd+4abcd
125	Indotestudo elongata	Reptilia	Critically Endangered	A2cd
126	Aythya baeri	Aves	Critically Endangered	A2cd+3cd+4cd; C2a(ii)
127	Manis pentadactyla	Mammalia	Critically Endangered	A3d+4d
128	Gyps bengalensis	Aves	Critically Endangered	A2abce+4abce

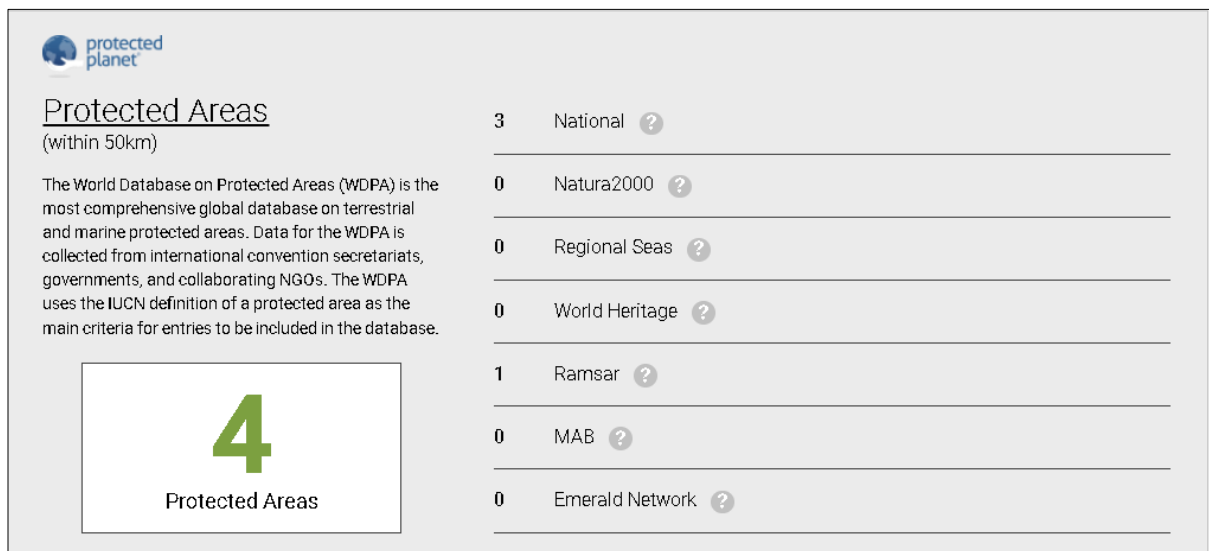


FIGURE 19 : PROTECTED AREAS

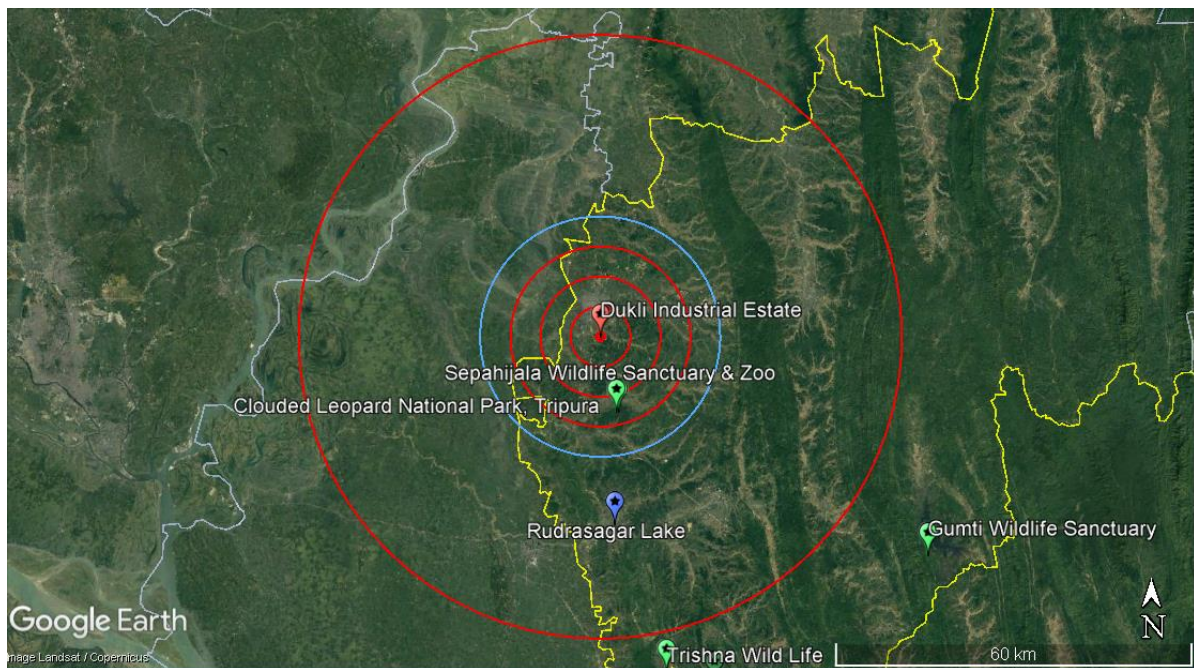


FIGURE 20: PROTECTED AREAS WITHIN 50 KM RADIUS

According to IBAT (Integrated Biodiversity Assessment Tool), protected areas refer to specific geographic areas that are legally designated and managed to conserve biodiversity and natural resources. These areas are established with the objective of safeguarding ecosystems, habitats, species, and ecological processes from potential threats and human activities that could harm their integrity.

Protected areas can vary in size, ranging from small reserves to large national parks or even transboundary conservation areas. They can include a wide range of habitats such as forests, wetlands, grasslands, marine areas, and more.

The designation and management of protected areas are typically governed by national or regional legislation, policies, and regulations. These areas may have different levels of protection and management categories, such as strict nature reserves, national parks, wildlife sanctuaries, or community conserved areas, depending on their conservation objectives and the level of human use permitted within them.

Below is the list of Key Protected Areas within 50 km radius within India

- Clouded leopard National Park
- Sepahijala Wildlife Sanctuary
- Rudrasagar Lake (Ramsar Site)

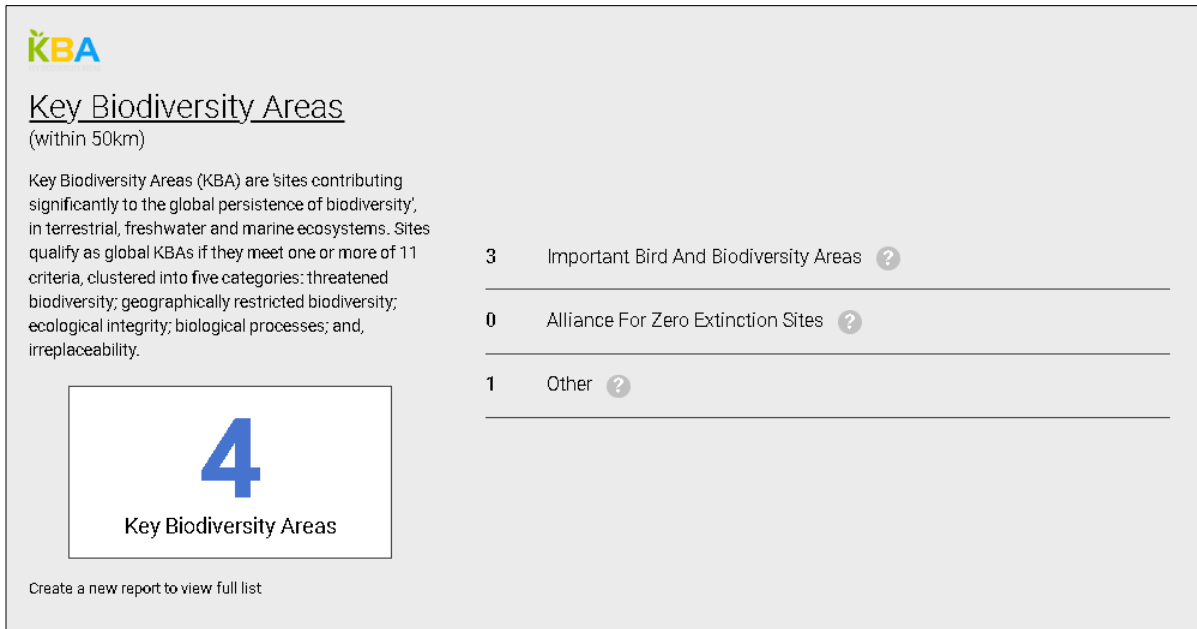


FIGURE 21: KEY BIODIVERSITY AREAS

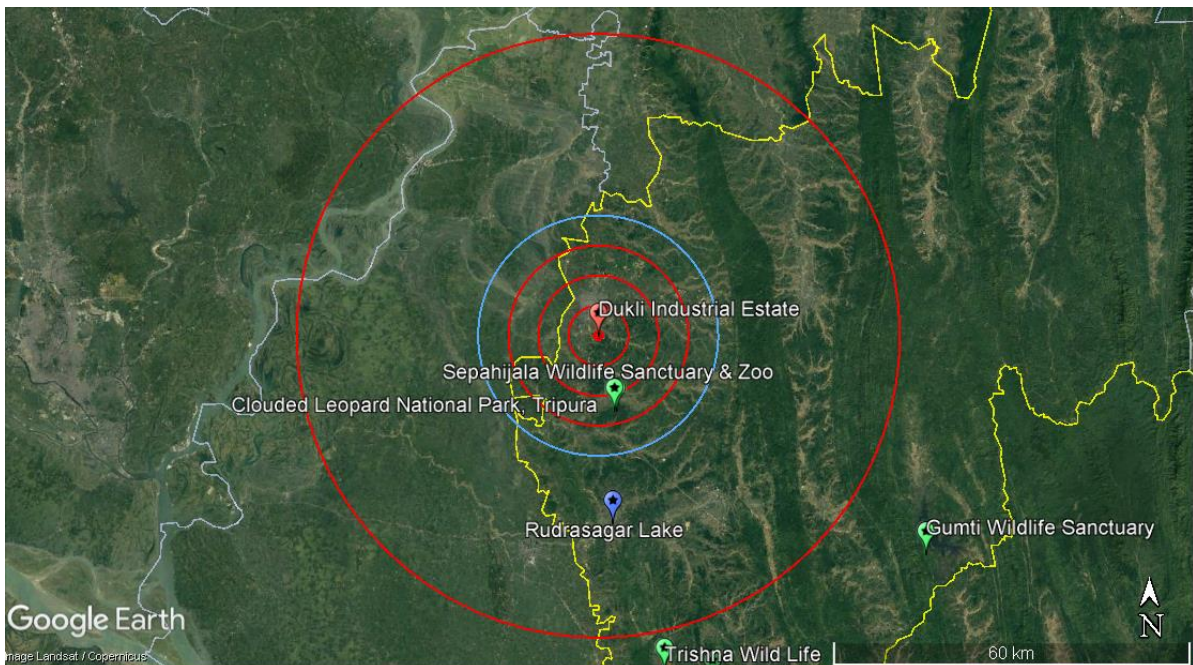


FIGURE 22: KBAS WITHIN 50 KM RADIUS

Key Biodiversity Areas (KBAs) in Tripura are specific sites that have been identified as having exceptional biodiversity significance. These areas are crucial for the conservation of species, habitats, and ecological processes.

KBAs are typically identified through a systematic and scientific approach that takes into account various factors such as species richness, endemism, threat status of species, and

ecological uniqueness. The identification process involves the assessment of available data, including species distribution records, ecological studies, and expert consultations.

These areas can encompass a range of ecosystems, including forests, wetlands, grasslands, and other habitats. KBAs play a vital role in maintaining biodiversity and often serve as important refuges for endangered or vulnerable species.

Below is the list of Key Biodiversity Areas within 50 km radius within India

- Clouded leopard National Park
- Sepahijala Wildlife Sanctuary
- Rudrasagar Lake (Ramsar Site)

9.2 IUCN Status

Population trends of species

Our survey provides critical insights into the population trends of the local species, categorised into four distinct segments based on the data observed. The findings are graphically represented in the pie chart (figure 12) in this report section, which outlines the percentage of species within each population trend category.

- **Unknown Trends:** Alarmingly, the largest segment of the chart, accounting for 39%, represents species with 'Unknown' population trends. This significant figure indicates a substantial gap in our monitoring and data collection efforts, emphasising the need for enhanced research to understand the ecological dynamics in the Dukli area better.
- **Stable Populations:** A positive note is that 32% of the species observed have 'Stable' populations. This stability suggests that, for now, these species are maintaining their numbers, which could be indicative of suitable habitat conditions and the effectiveness of current conservation measures within this locale.
- **Decreasing Populations:** A cause for concern is the 24% of species that are experiencing a 'Decreasing' trend in their populations. This decline points to possible challenges in the ecosystem, such as habitat loss, pollution, or overexploitation, which need to be addressed promptly to prevent further losses.
- **Increasing Populations:** A mere 5% of the species are on an 'Increasing' trend. While this is a hopeful sign for these species, it is a small number compared to those with declining populations, underscoring the necessity for continued conservation efforts to foster such positive trends across a broader array of species in the Dukli area.

In conclusion, the population trend data from the Dukli area presents a mixed but concerning picture, with a notable number of species either in decline or with insufficient data to assess their status. Moving forward, it is imperative that we fill knowledge gaps and mitigate the factors leading to population declines, thereby ensuring the protection and resilience of biodiversity in Dukli buffer areas.

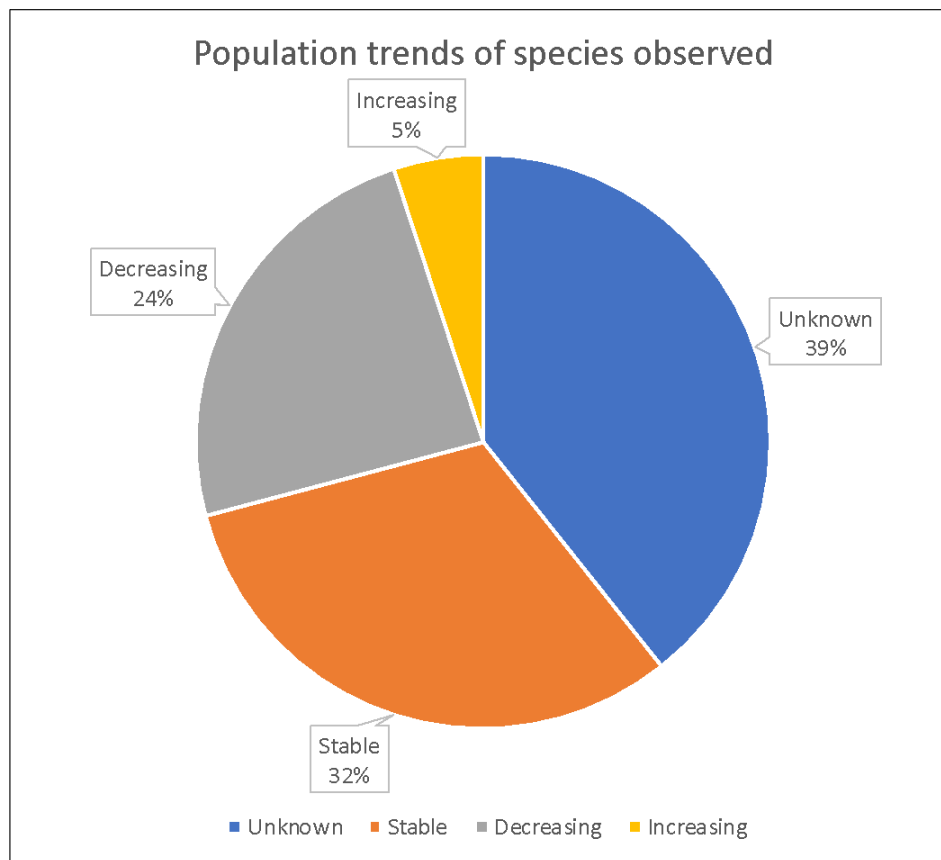


FIGURE 23: POPULATION TRENDS OF SPECIES OBSERVED

Status of species:

This assessment of the Dukli areas provides an overview of the species' risk categories as defined by the International Union for Conservation of Nature (IUCN):

- **Critically Endangered:** Representing 7% of the species assessed, the Critically Endangered category includes those species that are facing an extremely high risk of extinction in the wild. This small but significant portion highlights the urgent need for targeted conservation efforts to avert the loss of these species.
- **Endangered:** Making up 15% of the observations, the Endangered species are at a very high risk of extinction. The status of these species is particularly concerning and calls for immediate action to identify and mitigate the primary threats to their survival.
- **Vulnerable:** Constituting 28% of the species assessed, those classified as Vulnerable are at a high risk of extinction. While not as immediately at risk as the Endangered or Critically Endangered categories, the need for protective measures is pressing to ensure their populations do not decline further.
- **Near Threatened:** The Near Threatened species, accounting for 28% of the observations, are close to qualifying for or are likely to qualify for a threatened category soon. This substantial proportion reflects species that could face more serious risks if current trends continue or if no conservation actions are implemented.

- Data Deficient:** Alarming, 22% of the species fall under the Data Deficient category. This significant percentage indicates a lack of sufficient information to make a direct, or indirect, assessment of their risk of extinction. It underscores the critical need for more comprehensive biological and ecological research in the Dukli area to inform conservation strategies.

In summary, the Dukli area harbours a range of species with varying levels of conservation concern. A considerable number of these species are threatened or near threatened, emphasising the necessity for conservation initiatives. Moreover, the large proportion of Data Deficient species highlights an urgent need for further research to properly assess their status and to formulate effective conservation plans.

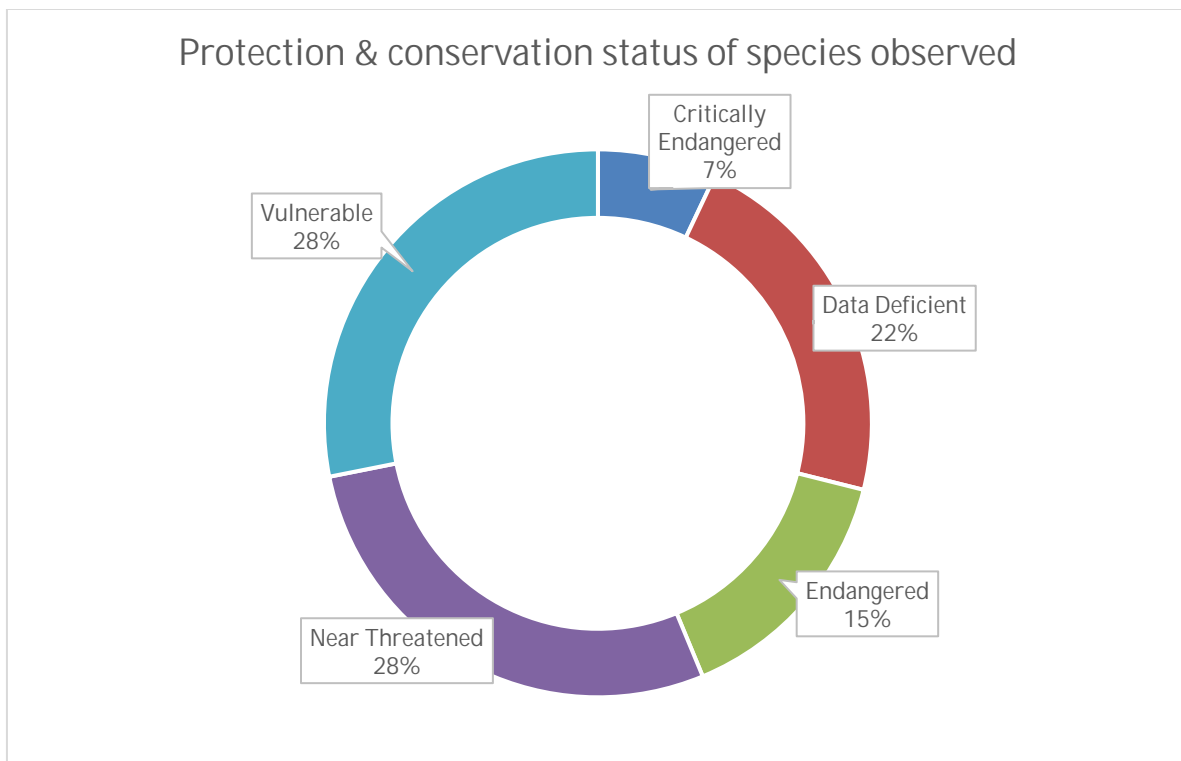


FIGURE 24: CONSERVATION STATUS OF SPECIES

10. BIODIVERSITY CONSERVATION POLICIES BY THE STATE

The Tripura state strategies and action plan on biodiversity conservation encompass various initiatives and efforts aimed at preserving the rich biological diversity of the region. The Tripura Biodiversity Board (TBB) plays a pivotal role in raising awareness about the conservation of biological diversity and the sustainable use of its components through mass media. Tripura's biodiversity is characterised by a significant range of floral diversity, with approximately 8.6% of angiosperms known from India recorded in Tripura. The state's floral diversity, comprising 1546 species belonging to 862 genera and 192 families, reflects the region's ecological significance. In terms of legal frameworks, the Tripura Biological Diversity Rules, 2006,

establish the composition, duties, and responsibilities of the Biodiversity Management Committees and Bodies, emphasising the state's commitment to biodiversity management and conservation. Tripura's strategies and action plan on biodiversity conservation encompass a multi-faceted approach, including awareness creation, conservation breeding, and legal frameworks, reflecting the state's dedication to preserving its rich biological diversity for the well-being of present and future generations.

The key components of Tripura's biodiversity conservation action plan include the following:

- **Development of Picnic Spots:** The plan includes the development of picnic spots to promote eco-tourism and raise awareness about the region's biodiversity.
- **Habitat Improvement and Management:** Efforts are directed towards the improvement and management of habitats, including the enrichment of vegetation and maintenance of older grasslands.
- **Inventorization of Bio-Diversity Resources:** The action plan involves the incentivization of biodiversity resources to assess and document the region's biological diversity.
- **Conservation Breeding:** The state has focused on conservation breeding to protect key species, emphasising the importance of preserving genetic diversity and preventing the extinction of valuable species.
- **State Biodiversity Strategy and Action Plan (SBSAP):** The Tripura Biodiversity Board has invited proposals for the development of the State Biodiversity Strategy and Action Plan (SBSAP) up to 2030, indicating a forward-looking approach to biodiversity conservation.
- **Ecosystem Diversity:** The plan recognizes the significance of ecosystem diversity, species diversity, and genetic diversity in Tripura, emphasising the need to conserve and sustainably manage these components of biodiversity.
- **Legal Frameworks:** The Tripura Biological Diversity Rules, 2006, establish the composition, duties, and responsibilities of the Biodiversity Management Committees and
- **Involvement of Village Communities and Panchayats:** The involvement of village communities and panchayats in biodiversity conservation activities is considered essential for the successful implementation of conservation efforts. This approach likely includes engaging local communities in habitat protection and restoration initiatives, thereby contributing to the conservation of endangered species.
- **Shifting Cultivation and Habitat Conservation:** Addressing the impact of shifting cultivation on habitat loss is crucial for biodiversity conservation in Tripura. Efforts to manage shifting cultivation practices and their impact on habitats can contribute to the protection of endangered species and their habitats.

11. HIGH-RESOLUTION SATELLITE IMAGERY

In the endeavour to map land cover and analyse forest cover change over the past decade, Sentinel-2 imagery has been an indispensable asset. The Sentinel-2 mission, part of the European Union's Copernicus Programme, provides high-resolution multispectral data crucial for environmental monitoring and land management applications. With its twin satellites, Sentinel-2A and Sentinel-2B, the mission captures the Earth's surface in 13 spectral bands, ranging from visible, near-infrared to shortwave infrared at spatial resolutions of 10, 20, and 60 metres. The 10-metre resolution bands, in particular, have been pivotal in the classification process, enabling the discrimination of fine-scale land cover features which is essential for creating detailed and accurate land cover maps.

Utilising Sentinel-2's frequent revisit time of 5 days, we were able to compile a time-series dataset that facilitated the detection of temporal changes and trends in land use, especially within forested regions. By applying advanced remote sensing techniques and classification algorithms to this multispectral dataset, we generated precise land cover maps that not only provided a snapshot of the current land use but also traced the transformation of the landscape over time. Through change detection analysis, quantifiable evidence of deforestation, forest degradation, and regrowth was identified, offering critical insights into the health and dynamics of forest ecosystems.

This analytical process was enhanced by the rich spectral information provided by Sentinel-2's red edge and shortwave infrared bands, which are particularly sensitive to vegetation health and biomass. These bands were instrumental in assessing the vigour of the vegetation and allowed for a more nuanced evaluation of forest cover changes. By leveraging the temporal resolution and spectral depth of Sentinel-2 imagery, we gained a comprehensive understanding of the land cover dynamics and were able to document the rate and patterns of forest change, providing valuable information for conservation initiatives, sustainable management, and policy formulation.

Key points:

- Leveraged high-resolution Sentinel-2 multispectral imagery, with 13 spectral bands at 10, 20, and 60 metres, to conduct detailed land cover mapping and monitor forest cover dynamics over a decade.
- Applied advanced classification algorithms to Sentinel-2's temporal datasets, allowing for accurate discrimination of land use changes, including deforestation, forest degradation, and regrowth.
- Exploited the 10-metre resolution bands for fine-scale feature recognition, enhancing the precision of land cover classifications and enabling the assessment of subtle environmental changes.
- Utilised the red edge and shortwave infrared bands of Sentinel-2 to assess vegetation health and biomass, providing critical insights for sustainable land management and conservation policies.



FIGURE 25: SATELLITE IMAGERY OF CORE AREA BASED ON 2022-2024 COMPOSITE OF SENTINEL 2 B4, B3, B2 BANDS



FIGURE 26: SATELLITE IMAGERY OF ZOOMED OUT AREA AROUND THE CORE BASED ON 2022-2024 COMPOSITE OF SENTINEL 2 B4, B3, B2 BANDS

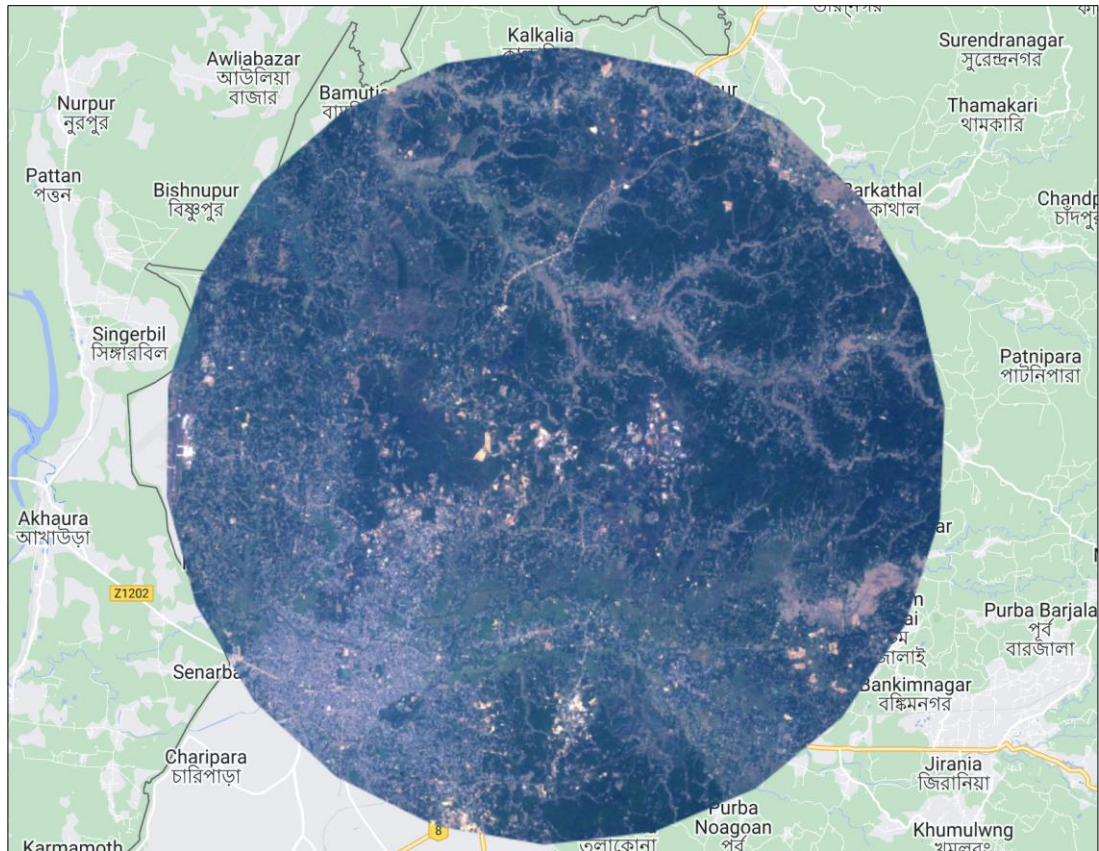


FIGURE 27: SATELLITE IMAGERY OF 15 KM AREA BASED ON 2022-2024 COMPOSITE OF SENTINEL 2 B4, B3, B2 BANDS

Access To Satellite Imagery Is Provided Blow :

https://drive.google.com/drive/folders/1hJ_UOKC2dFzt-WOZJcGnuENRPkqCGmP9?usp=sharing

TABLE16: SATELLITE RESOLUTION

Band	Central Wavelength(μm)	Resolution (m)	Description	Land Cover Parameter	Use Cases
B1	0.443	60	Coastal aerosol band, used for atmospheric corrections.	Coastal and aerosol studies	Coastal monitoring, atmospheric corrections
B2	0.49	10	Blue band, very sensitive to vegetation and chlorophyll content.	Chlorophyll content, vegetation health	Crop monitoring, forest management
B3	0.56	10	Green band, penetrates water well and reflects off of plant chlorophyll.	Chlorophyll absorption, plant vigour	Vegetation tracking, inland water bodies

B4	0.665	10	Red band, sensitive to chlorophyll and can indicate vegetation stress.	Plant health, species differentiation	Agricultural health assessment, forest surveys
B5	0.705	20	Red-edge band, indicative of the chlorophyll content of vegetation.	Chlorophyll gradient, biomass	Precision agriculture, forest parameter monitoring
B6	0.74	20	Red-edge band, helps in assessing plant health and stress.	Vegetation stress, leaf area index	Health status of crops, vegetation classification
B7	0.783	20	Red-edge band, used for chlorophyll content, plant species identification.	Crop type discrimination, moisture content	Agricultural surveys, forest species mapping
B8	0.842	10	Near-infrared, strong reflectance from healthy vegetation.	Biomass growth, vegetation cover	Crop yield prediction, forest monitoring
B8A	0.865	20	Narrow near infrared, for detailed vegetation studies.	Leaf water content, plant stress	Drought assessment, detailed vegetation studies
B9	0.945	60	Water vapour band, used for atmospheric correction.	Atmospheric water vapour	Climate studies, correcting imagery for water vapour
B10	1.375	60	SWIR for atmospheric corrections especially for cirrus clouds.	Cirrus cloud detection	Cloud mapping, improved surface studies

12. BIODIVERSITY MANAGEMENT PLAN

The Dukli Industrial Estate, encompassed by its surrounding buffer zones, is a landscape rich with varied ecosystems. These regions, from the immediate vicinity of the industrial core to the extended buffer zones reaching up to 20 kilometres, are home to a mosaic of biodiversity. The habitats transition from moist deciduous forests in closer proximity to subtropical environments as one move outward. Recognizing the intrinsic ecological value and the escalating threats posed by industrial and human activities, this management plan is dedicated to preserving the unique biological tapestry of the area. It is a blueprint for action, aiming to counteract the impacts of industrial expansion and anthropogenic pressures while fostering sustainable practices that align with the ecological needs of the region.

12.0 Objectives of the Plan:

The objectives of this plan are ambitious and holistic in nature. Primarily, it seeks to safeguard the biodiversity encapsulated within the Dukli Industrial Estate and its surrounding buffers. This entails a concerted effort to negate the adverse effects stemming from the industrial complex and the encroachment of human development. The strategy is to embed sustainable practices deeply within the fabric of the local communities and industries, thereby ensuring the ecological integrity of the area while not undermining its economic potential. Integral to this plan is the formation of a robust monitoring and evaluation system. This system will serve as the ecological barometer for the region, consistently providing insights into the health of the ecosystems and facilitating informed decision-making to achieve both immediate and extended conservation targets.

Legal and Policy Framework: Our approach is grounded in strict adherence to the Indian Wildlife (Protection) Act of 1972 and the Forest Conservation Act of 1980. Collaborative efforts with the Botanical Survey of India and the Zoological Survey of India will be essential for the targeted conservation of species. This plan also aligns with the guidelines provided by the National Biodiversity Authority, ensuring that all actions are legally compliant and geared toward effective biodiversity stewardship.

Habitat and Species Conservation Strategies: An immediate mitigation for deforestation and land conversion for rubber plantations or industrial use is the cornerstone of this plan. We aim to restore the lost forest cover, with a targeted increase in average canopy cover. Native species will be prioritised for plantation, which will support local fauna and reduce the effects of monoculture of rubber plantations. Special attention will be given to species listed in the Red Data Book, and protection measures for endangered species like Phayre's Leaf Monkey will be implemented. These strategies are designed not only to restore habitats but also to rebuild the ecological framework that supports biodiversity.

Pollution Control Measures: To address pollution, we will establish effluent treatment plants for the industrial estate, ensuring that neither water bodies nor the soil is contaminated by industrial processes. Air quality will be rigorously monitored, and emissions from industries will be regulated to meet stringent standards. Furthermore, a zero-waste policy will be pursued, with industrial recycling and waste reduction measures in place to minimise the ecological footprint of the estate.

Sustainable Land Use and Agricultural Practices: Sustainable agricultural practices will be promoted vigorously. Organic farming and agroforestry will replace harmful agrochemicals, bolstering ecological resilience. Support for natural pest management will be offered, reducing reliance on chemical pesticides. Additionally, the development of community-based industries, such as bamboo and cane crafts, will provide alternative livelihoods that are in harmony with the conservation goals.

Community Engagement and Education: The plan includes comprehensive environmental education programs for local communities to foster an understanding of biodiversity and its importance. Community participation in forest management will be encouraged, providing a

sense of ownership and responsibility for local conservation efforts. Training programs will be initiated, focusing on sustainable livelihoods that support the ecological objectives of the region.

Research and Monitoring: Continued biodiversity research and monitoring are essential to this plan. A biodiversity information system will be established to document species populations and habitat health. This system will serve as a reference point for management decisions and will be developed in collaboration with academic institutions that bring expertise in local ecosystems.

12.1 Implementation plan

The implementation of this plan will be structured into immediate, short-term, medium-term, and long-term goals. Actions to prevent further habitat degradation will be taken immediately. Short-term goals will focus on establishing pollution control measures and engaging the community in conservation efforts. Medium-term goals will see improvements in habitat quality and the development of sustainable practices. Long-term goals aim to establish a stable increase in the populations of key species and the successful operation of the biodiversity information system.

Immediate Actions:

Upon ratification of the plan, immediate actions will be undertaken to halt habitat degradation. These will include:

- Enforcing a moratorium on the clearance of any additional forested or natural areas within the estate and its buffer zones.
- Implementing emergency measures to protect critical habitats, particularly those that house endangered species or are of high ecological value.
- Establishing a rapid response team to address any urgent biodiversity threats, such as illegal poaching or sudden pollution incidents.

Short-Term Goals (1-3 Years):

The short-term phase is crucial for laying the groundwork for longer-term conservation success and will focus on the following:

- **Pollution Control:** Installation of effluent treatment plants and air quality monitoring stations. Development of waste management strategies to reduce the industrial footprint.⁵
- **Community Engagement:** Launching educational campaigns, setting up participatory conservation programs, and incentivizing sustainable agricultural practices among local communities.
- **Biodiversity Baselines:** Conducting comprehensive biodiversity surveys to establish baselines for flora and fauna populations.

Medium-Term Goals (4-7 Years):

As the plan progresses, medium-term goals will aim to consolidate gains from initial efforts and expand the scope of conservation activities:

- **Habitat Restoration:** Intensifying efforts to reforest and rehabilitate degraded lands, with particular attention to creating wildlife corridors and restoring native plant species.
- **Sustainable Practices:** Promoting eco-friendly industrial processes, expanding sustainable land-use practices, and integrating biodiversity conservation into corporate operations.
- **Community Development:** Deepening community involvement through sustainable livelihood initiatives and expanding the reach of educational programs.

Long-Term Goals (8-10 Years and Beyond):

The long-term goals of the plan envision a self-sustaining ecosystem that thrives alongside human activity:

- **Species Population Stability:** Aiming for a stable or increasing trend in the populations of key species through ongoing conservation efforts and habitat management.
- **Biodiversity Information System:** Fully implementing a biodiversity information system that tracks, analyzes, and reports on ecological data, informing adaptive management and policy decisions.
- **Legacy Projects:** Establishing flagship conservation projects, such as large-scale rewilding or the creation of extensive protected areas, to leave a lasting conservation legacy.

12.2 Monitoring and evaluation

Monitoring and Evaluation (M&E) are pivotal components of the Biodiversity Management Plan for Dukli Industrial Estate and its surrounding buffer areas, designed to ensure that the plan's execution remains on track and is effective in meeting its conservation goals. This M&E framework is established to continuously assess the ecological health of the region, gauge the success of implemented strategies, and adapt to emergent challenges or new ecological insights.

Bi-Annual Monitoring Reports:

The M&E strategy entails the development of detailed bi-annual reports. These reports are intended to provide a comprehensive overview of the current state of biodiversity within the Dukli region. They will detail the abundance and health of species populations, the integrity of various habitats, and the quality of water and air. Special attention will be paid to species of conservation concern, changes in land use patterns, and the presence of invasive species. The reporting will also assess the effectiveness of pollution control measures, the degree to

which industries comply with environmental standards, and the success of community engagement in conservation efforts.

Data Collection and Analysis:

Data for these reports will be collected through a variety of methods, including remote sensing for land cover changes, field surveys for species inventory, water and soil testing for pollution levels, and social surveys to understand community engagement. Advanced statistical and spatial analysis tools will be utilized to interpret this data, enabling the identification of trends and the pinpointing of areas requiring additional focus.

Performance Indicators:

Specific performance indicators will be established to quantify the success of various initiatives. These indicators will include measures such as the number of species benefited from habitat restoration, percentage reduction in pollution levels, and the extent of community participation in sustainable practices. The indicators will provide clear metrics for success and facilitate the transparent reporting of progress to stakeholders.

Feedback Loops and Adaptation:

The M&E framework will incorporate feedback loops, ensuring that report findings can inform and adjust the management plan. If certain strategies are found to be ineffective or if new threats to biodiversity arise, the plan will be revised accordingly. These feedback loops will also facilitate the integration of new scientific findings, ensuring that the management plan remains aligned with the best available science and practices in conservation.

Stakeholder Involvement:

Stakeholders, including local communities, conservationists, and industrial representatives, will be involved in the M&E process. Their insights and on-the-ground experiences will be invaluable in interpreting data and refining the management strategies. This inclusive approach will not only improve the effectiveness of the plan but also ensure stakeholder buy-in and support for conservation actions.

Long-Term Sustainability:

Ultimately, the goal of the M&E framework is to ensure the long-term sustainability of the region's biodiversity. By methodically assessing the health of the ecosystem and the impact of the management plan, the framework serves as an early-warning system for potential ecological decline and a guidepost for conservation successes. It will be instrumental in shaping a sustainable future for Dukli Industrial Estate that harmonizes industrial activity with the preservation of its rich ecological heritage.

Ecotourism Development

Ecotourism initiatives will be carefully developed to provide economic benefits while promoting conservation. These activities will be regulated to prevent habitat disturbance and ensure that the exploitation of wildlife is not a byproduct of tourism.

Institutional Arrangements

A Biodiversity Management Committee will be formed, comprising environmental groups, government agencies, local communities, and industry representatives. This committee will meet regularly to review progress, troubleshoot challenges, and adapt management strategies as necessary.

Funding and Resource Allocation

Financial resources for conservation activities will be allocated from state government funds and contributions from industries within the Dukli Industrial Estate. Additional funding will be sought through conservation grants and corporate social responsibility initiatives.

Implementation Schedule

The implementation of this plan will be structured into immediate, short-term, medium-term, and long-term goals. Actions to prevent further habitat degradation will be taken immediately. Short-term goals will focus on establishing pollution control measures and engaging the community in conservation efforts. Medium-term goals will see improvements in habitat quality and the development of sustainable practices. Long-term goals aim to establish a stable increase in the populations of key species and the successful operation of the biodiversity information system.

13. CONCLUSION

The extensive study of the core and buffer areas underscores the profound ecological significance of these regions, teeming with a diverse array of species and habitats. Yet, the encroaching threats, predominantly from human activities, cast a looming shadow over this biodiversity. As we move forward, it becomes paramount that conservation measures are not just deliberated upon but actively implemented, ensuring that the harmony of this ecological treasure is preserved for future generations.

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9. *Psidium guineense* Swartz. (Myrtaceae) - An Endemic Threatened Species of Tripura, India <https://www.semanticscholar.org/paper/Psidium-guineense-Swartz.-%28Myrtaceae%29-an-endemic-of-Chakraborti-Sinha/d4dd27120c0697de649dc9b06bc739594c36fd97>

Dukli Industrial estate Ecologically important species for conservation & restoration

S. No	Scientific name	Common name	Family	Habit	Origin	Where to plant
1	<i>Gmelina arborea</i>	Gamai	Verbenaceae	Tree	Native	Hilltop/plains
2	<i>Microcos paniculata</i>	Pichandi	Malvaceae	Tree	Native	Hilltop/plains
3	<i>Toona ciliata</i>	rongil	Meliaceae	Tree	Native	Hilltop/slope/plains
4	<i>Tectona grandis</i>	segun	Lamiaceae	Tree	Native	Hilltop/plains
5	<i>Trema orientalis</i>	Indian charcoal tree	Cannabaceae	Tree	Native	Hilltop/slope/near water body
6	<i>Lannea coromandelica</i>	Indian ash tree	Anacardiaceae	Tree	Native	Hilltop/slope
7	<i>Peltophorum pterocarpum</i>	Copper pod tree	Fabaceae	Tree	Native	Hilltop/plains
8	<i>Neolamarckia cadamba</i>	kadam	Rubiaceae	Tree	Native	Hilltop/plains
9	<i>Lagerstroemia speciosa</i>	Pride of india	Lythraceae	Tree	Native	Near water body
10	<i>Albizia procera</i>	Koroi	Fabaceae	Tree	Native	Hilltop/plains
11	<i>Ficus benghalensis</i>	Bat	Moraceae	Tree	Native	Hilltop/slope/plains
12	<i>Artocarpus lacucha</i>	monkey fruit	Moraceae	Tree	Native	Hilltop/plains
13	<i>Stereospermum tetragonum</i>	yellow snake tree	Bignoniaceae	Tree	Native	Hilltop/slope
14	<i>Antidesma montanum</i>	mountain currant tree	Phyllanthaceae	Tree	Native	Hilltop/slope
15	<i>Chaetocarpus castanocarpus</i>		Peraceae	Tree	Native	Hilltop/near water body
16	<i>Sterculia villosa</i>	elephant rope tree	Sterculiaceae	Tree	Native	Slope/near water body
17	<i>Aphanomixis polystachya</i>	pithraj tree	Meliaceae	Tree	Native	Hilltop/slope
18	<i>Dillenia pentagyna</i>	Nepali elephant apple	Dilleniaceae	Tree	Native	Hilltop/slope
19	<i>Holigarna amottiana</i>	Black Varnish Tree	Anacardiaceae	Tree	Native	Hilltop/plains
20	<i>Schima wallichii</i>	needlewood tree	Theaceae	Tree	Native	Hilltop/plains

21	<i>Melia azedarach</i>	jangli neem	Meliaceae	Tree	Native	Hilltop/slope/plains
22	<i>Cassia fistula</i>	golden shower tree	Fabaceae	Tree	Native	Hilltop/slope/plains
23	<i>Careya arborea</i>	Patana oak	Lecythidaceae	Tree	Native	Hilltop/plains/plains
24	<i>Ficus religiosa</i>	Asathwa	Moraceae	Tree	Native	Slope/plains
25	<i>Ziziphus oenoplia</i>	jackal jujube	Rhamnaceae	Tree	Native	Slope/plains
26	<i>Parkia javanica</i>	tree bean	Mimosaceae	Tree	Exotic	plains/hilltop
27	<i>Dipterocarpus turbinatus</i>	Garjan	Dipterocarpaceae	Tree	Native	Hilltop/plains
28	<i>Mallotus philippensis</i>	Kamala tree	Euphorbiaceae	Tree	Native	Hilltop/plains
29	<i>Aquilaria Malaccensis</i>	Agar	Thymelaeaceae	Tree	Native	plains/slopes (critically endangered)
30	<i>Carallia brachiata</i>	Corkwood	Rhizophoraceae	Tree	Native	plains/lowlands/near water body
31	<i>Oroxylum indicum</i>	Indian trumpet tree	Bignoniaceae	Tree	Native	Hilltop/plains (Threatened)
32	<i>Bridelia tomentosa</i>	Khy	Phyllanthaceae	Tree	Native	plains/slopes
33	<i>Ardisia neriifolia</i>	Coralberry	Primulaceae	Shrub	Native	plains/slopes
34	<i>Clerodendrum infortunatum</i>	Bhat	Lamiaceae	Shrub	Native	plains
35	<i>clerodendrum paniculatum</i>	Pagoda Flower	Lamiaceae	Shrub	Native	plains
36	<i>Urena lobata</i>	Caesarweed	Malvaceae	Shrub	Native	plains
37	<i>Lantana camera</i>	Yellow Sage	Verbenaceae	Shrub	Exotic	Slope/plains
38	<i>Thyrsostachys oliveri</i>	Kanakaich bamboo	Poaceae	Herb	Native	Slope/plains

39	<i>Bambusa balcooa</i>	barak bamboo	Poaceae	Herb	Native	plains
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40	<i>Bambusa cucharensis</i>	Bom bamboo	Poaceae	Herb	Native	plains (endemic to north east India)
41	<i>bambusa pallida</i>	makhla bamboo	Poaceae	Herb	Native	Slope/plains
42	<i>Bambusa polymorpha</i>	Paura bamboo	Poaceae	Herb	Native	Slope/plains
43	<i>Bambusa Tulda</i>	Mirtinga bamboo	Poaceae	Herb	Native	Slope/plains
44	<i>Bambusa vulgaris</i>	Bari bamboo	Poaceae	Herb	Native	plains
45	<i>Dendrocalamus longispathus</i>	Rupai bamboo	Poaceae	Herb	Native	plains
46	<i>Melocana baccifera</i>	Muli bamboo	Poaceae	Herb	Native	Slope/plains
47	<i>Schizostachyum dullooa</i>	Dolu bamboo	Poaceae	Herb	Native	Plains
48	<i>Dendrocalamus hamitonii</i>	Pencha bamboo	Poaceae	Herb	Native	Plains
49	<i>Artocarpus chaplasha</i>	chaplaish	Moraceae	Tree	Native	Hilltop/plains
50	<i>Baccaurea ramiflora</i>	latkan	Phyllanthaceae	Tree	Native	Hilltop/plains
51	<i>Bischofia javanica</i>	bishop wood	Phyllanthaceae	Tree	Native	Hilltop/plains
52	<i>Butea monosperma</i>	palash	Fabaceae	Tree	Native	Hilltop/plains
53	<i>Nymphaea pubescens</i>	Pink water lily	Nymphaeaceae	Herb	Native	Water body
54	<i>Pontederia crassipes</i>	kochuripana	Pontederiaceae	Herb	Native	Water body
55	<i>Musa flaviflora</i>	wild banana	Musacea	Herb	Native	Slope/plains
56	<i>Musa balbisiana</i>	aitta kola	Musacea	Herb	Native	Slope/plains
57	<i>Curcuma aromatica</i>	wild turmeric	Zingiberaceae	Herb	Native	plains/near water body
58	<i>Ficus hispida</i>	Dumur	Moraceae	Tree	Native	Slope/plains

59	<i>Canna indica</i>	Kolaboti	Cannaceae	Herb	Exotic	Slope/plains
60	<i>Polygonum hydropiper</i>	Water pepper	Polygonaceae	Herb	Native	Near water body
61	<i>Saccharum spontaneum</i>	wild sugarcane	Poaceae	Herb	Native	Slope/plains
62	<i>Thysanolaena latifolia</i>	tiger grass	Poaceae	Herb	Native	Slope/plains
63	<i>Ruellia tuberosa</i>	Snapdragon root	Acanthaceae	Herb	Exotic	plains
64	<i>Tectaria spp.</i>	Least Halberd	Tectariaceae	Fern	Native	Near water body/slopes
65	<i>Dryopteris spp.</i>	male fern	Dryopteridaceae	Fern	Native	Near water body/slopes
66	<i>Aglaomorpha quercifolia</i>	Oak leaf fern	Polypodiaceae	Fern	Native	Near water body/slopes
67	<i>Pteris vittata</i>	Chinese brake	Pteridaceae	Fern	Native	Near water body/slopes
68	<i>Lygodium spp</i>	vine-like fern	Lygodiaceae	Fern	Native	Near water body/slopes
69	<i>Adiantum capillus-veneris</i>	venus hair fern	Pteridaceae	Fern	Native	Near water body/slopes
70	<i>Cystopteris fragilis</i>	common fragile fern	Dryopteridaceae	Fern	Native	Near water body/slopes
71	<i>Cymbidium spp.</i>	boat orchids	Orchidaceae	Herb	Native	Tree trunk
72	<i>Wedelia chinensis</i>	Bhringraj	Asteraceae	Herb	Native	Near water body/slopes/plains

FLORA AND FAUNA DETAILS WITH THE BOUNDARY OF DUKLI INDUSTRIAL ESTATE**Protected species in the Dukli industrial estate (core) & mitigation measures during construction phase:****Protected species:****Schedule 2 Protected Species:**

- Ashy-headed Green Pigeon (Treron phayrei)

Near Threatened Species:

- Ashy-headed Green Pigeon (Treron phayrei)

In the core site designated for industrial development, the presence of the Ashy-headed Green Pigeon, listed as a Schedule 2 Protected Species and categorized as Near Threatened, underscores the need for targeted mitigation measures during the construction phase to ensure the preservation of this species and its habitat. Mitigation efforts should prioritize the establishment of protected zones, minimizing disturbances to nesting and feeding areas. Construction practices should incorporate measures to reduce noise and light pollution, which can have adverse effects on the Ashy-headed Green Pigeon's behavior and well-being. Additionally, the implementation of buffer zones around critical habitats, coupled with regular monitoring programs, is crucial to track the population dynamics and address any unforeseen impacts. Collaboration between environmental authorities, construction companies, and local communities is essential to develop and enforce effective conservation strategies, promoting the coexistence of industrial development and the protection of the Ashy-headed Green Pigeon as a representative of the Near Threatened species in the core site.

Mitigation measures during construction phase:

During the construction phase of an industrial area within this region, stringent mitigation measures are imperative to minimize the impact on these protected species. Specific steps should include conducting thorough surveys to identify the presence and distribution of these species in areas earmarked for development.

Establishing barricades around critical habitats is crucial to minimize direct disturbances. These zones act as protective barriers, shielding sensitive ecosystems from potential harm caused by human activities. In the context of construction, it is imperative to implement practices that go beyond the mere establishment of barricades. Construction processes should actively minimize noise levels, vibrations, and any form of habitat destruction. This comprehensive approach significantly contributes to reducing the overall impact on species residing in these critical habitats. By carefully planning and executing construction practices with environmental sensitivity, we can ensure the preservation of biodiversity and the ecological balance within these essential ecosystems.

Regular monitoring during and after the construction phase is essential to assess the effectiveness of mitigation measures and make any necessary adjustments. Collaborative efforts between environmental experts, construction teams, and local authorities are crucial to ensuring that industrial development occurs in harmony with the conservation goals for the protected species in the core site.

Mitigation approaches that best ensure the protection of vulnerable species of plants and animals and their specialized habitats likely to be impacted by the project require the implementation of following choices exclusively or in combination.

- Restriction of construction activities to defined areas which are ecologically less sensitive.
- Scheduling of operations to take account of animal breeding seasons.
Removal of rare/endangered plants from the site and transplant them temporarily or permanently.
- Removal of rare/endangered animals from site or promote the use of suitable alternate locations.
- Management of site activities (e.g., use of machinery, transport, waste/overburden removal) to maintain acceptable soil, water and vegetation quality.
Restoration/duplication of vegetation and other habitat features.
Maintenance of viable population of animal species.
Creation/restoration of habitats to compensate for damage caused.

The following recommendations have taken due care to ensure mitigation of most project impacts on ecological/biological values by adopting a combination of choices discussed above. Sources Wild life institute of India

https://wii.gov.in/eia/casestudies/river_valley_projects5_mitigation_planning

Table 1 : Biodiversity within core site

SNo	Scientific Name	Common Name	Famiy	Habit	Trait	Distribut ion	Group
1	Acacia Auriculiformis	Akashmoni	Fabaceae	Trees	Autotrophs	Exotic	flora
2	Ageratum Conyzoides	Goat Weed	Asteraceae	Herbs	Autotrophs	Exotic	flora
3	Albizia Procera	Koroi	Fabaceae	Trees	Autotrophs	Native	flora
4	Albizia Saman	Monkey Pod Tree	Fabaceae	Trees	Autotrophs	Exotic	flora
5	Alocasia Indica	Kochu	Araceae	Herbs	Autotrophs	Native	flora
6	Alstonia Scholaris	Chatim	Apocynaceae	Trees	Autotrophs	Native	flora
7	Amaranthus Spinous	Spiny Amaranth	Amaranthaceae	Herbs	Autotrophs	Exotic	flora
8	Amaranthus Viridis	Slender Amaranth	Amaranthaceae	Herbs	Autotrophs	Exotic	flora
9	Andrographis Paniculata	Kalmegh	Acanthaceae	Shrubs	Autotrophs	Native	flora
10	Areca Catechu	Supari	Arecaceae	Trees	Autotrophs	Exotic	flora
11	Artocarpus Heterophyllus	Kathal	Moraceae	Trees	Autotrophs	Native	flora
12	Azadirachta Indica	Neem	Meliaceae	Trees	Autotrophs	Native	flora
13	Bambusa Balcooa	Barak	Poaceae	Herbs	Autotrophs	Native	flora
14	Calotropis Procera	Giant Milkweed	Apocynaceae	Shrubs	Autotrophs	Native	flora
15	Carica Papaya	Pepe	Caricaceae	Trees	Autotrophs	Exotic	flora
16	Cassia Alata	Ringworm Bush	Fabaceae	Shrubs	Autotrophs	Exotic	flora
17	Cassia Obtusifolia	Sicklepod	Fabaceae	Shrubs	Autotrophs	Native	flora
18	Cassia Occidentalis	Coffee Senna	Fabaceae	Shrubs	Autotrophs	Exotic	flora
19	Chromolaena Odorata	Jack In The Bush	Asteraceae	Shrubs	Autotrophs	Exotic	flora
20	Chrysopogon Aciculatus	False Beardgrass	Poaceae	Herbs	Autotrophs	Native	flora
21	Citrus Maxima	Jambura	Rutaceae	Trees	Autotrophs	Native	flora
22	Citrus Spp.	Lebu	Rutaceae	Shrubs	Autotrophs	Native	flora
23	Cleome Rutidosperma	Fringed Spider Flower	Cleomaceae	Herbs	Autotrophs	Exotic	flora

24	Cleome Viscosa	Dog Mustard	Cleomaceae	Shrubs	Autotrophs	Native	flora
25	Clerodendrum Infortunatum	Bhat	Lamiaceae	Shrubs	Autotrophs	Native	flora
26	Coccinia Grandis	Ivy Gourd	Cucurbitaceae	Climbers	Autotrophs	Native	flora
27	Cocos Nucifera	Narkel	Arecaceae	Trees	Autotrophs	Exotic	flora
28	Commelina Benghalensis	Benghal Dayflower	Commelinaceae	Herbs	Autotrophs	Native	flora
29	Cucurbita Moschata	Misti Kumro	Cucurbitaceae	Climbers	Autotrophs	Exotic	flora
30	Curcuma Aromatica	Wild Turmeric	Zingiberaceae	Herbs	Autotrophs	Native	flora
31	Delonix Regia	Krishnachura	Fabaceae	Trees	Autotrophs	Native	flora
32	Digitaria Sanguinalis	Hairy Crabgrass	Poaceae	Herbs	Autotrophs	Native	flora
33	Dioscorea Alata	True Yam	Dioscoreaceae	Climbers	Autotrophs	Exotic	flora
34	Ficus Hispida	Dumur	Moraceae	Trees	Autotrophs	Native	flora
35	Ficus Religiosa	Asathwa	Moraceae	Trees	Autotrophs	Native	flora
36	Gmelina Arborea	Gamai	Verbenaceae	Trees	Autotrophs	Native	flora
37	Hevea Brasiliensis	Rubber	Euphorbiaceae	Trees	Autotrophs	Exotic	flora
38	Holarrhena Antidysenterica	Kurchi	Apocynaceae	Shrubs	Autotrophs	Native	flora
39	Jatropha Curcas	Physic Nut	Euphorbiaceae	Shrubs	Autotrophs	Exotic	flora
40	Jatropha Gossypifolia	Bellyache Bush	Euphorbiaceae	Shrubs	Autotrophs	Exotic	flora
41	Justicia Gendarussa	Krishna Nirgundi	Acanthaceae	Herbs	Autotrophs	Exotic	flora
42	Lantana Camera	Yellow Sage	Verbenaceae	Shrubs	Autotrophs	Exotic	flora
43	Leucas Aspera	Ghal Ghase	Lamiaceae	Herbs	Autotrophs	Native	flora
44	Mangifera Indica	Aam	Anacardiaceae	Trees	Autotrophs	Native	flora
45	Melastoma Affine	Blue Tongue	Melastomataceae	Shrubs	Autotrophs	Exotic	flora
46	Melia Azedarach	Jangli Neem	Meliaceae	Trees	Autotrophs	Native	flora
47	Microcos Paniculata	Pichandi	Malvaceae	Trees	Autotrophs	Native	flora
48	Mikania Micrantha	Bitter Vine	Asteraceae	Climbers	Autotrophs	Exotic	flora
49	Mimosa Pudica	Lojjabati	Fabaceae	Herbs	Autotrophs	Exotic	flora
50	Mitracarpus Hirtus	Girdlepod	Rubiaceae	Herbs	Autotrophs	Exotic	flora
51	Monoon Longifolium	Debbaru	Annonaceae	Trees	Autotrophs	Native	flora
52	Moringa Oleifera	Sajne	Moringaceae	Trees	Autotrophs	Native	flora
53	Musa Indica	Banana	Musacea	Herbs	Autotrophs	Native	flora
54	Neolamarckia Cadamba	Kadam	Rubiaceae	Trees	Autotrophs	Native	flora
55	Oplismenus Hirtellus	Basket Grass	Poaceae	Herbs	Autotrophs	Native	flora
56	Parthenium Hysterophorus	Famine Weed	Asteraceae	Herbs	Autotrophs	Exotic	flora
57	Paspalum Botterii	Crown Grass	Poaceae	Herbs	Autotrophs	Exotic	flora
58	Phoenix Dactylifera	Khejur	Arecaceae	Trees	Autotrophs	Native	flora
59	Phyllanthus Urinaria	Gripeweed	Phyllanthaceae	Herbs	Autotrophs	Native	flora
60	Plumeria Alba	Champa	Magnoliaceae	Trees	Autotrophs	Native	flora
61	Plumeria Rubra	Kathgolap	Apocynaceae	Trees	Autotrophs	Native	flora
62	Psidium Guajava	Peyara	Myrtaceae	Trees	Autotrophs	Native	flora
63	Pueraria Phaseoloides	Tropical Kudzu	Fabaceae	Climbers	Autotrophs	Native	flora
64	Sida Acuta	Wireweed	Malvaceae	Shrubs	Autotrophs	Exotic	flora
65	Solanum Sisymbriifolium	Sticky Nightshade	Solanaceae	Shrubs	Autotrophs	Exotic	flora

66	Spermacoce Latifolia	False Button Weed	Rubiaceae	Herbs	Autotrophs	Exotic	flora
67	Spondias Mombin	Amra	Anacardiaceae	Trees	Autotrophs	Exotic	flora
68	Streblus Asper	Ruposhi Gach	Moraceae	Trees	Autotrophs	Native	flora
69	Tabernaemontana Divaricata	Tara Ful	Apocynaceae	Shrubs	Autotrophs	Native	flora
70	Tectona Grandis	Segun	Lamiaceae	Trees	Autotrophs	Native	flora
71	Toona Ciliata	Rongil	Meliaceae	Trees	Autotrophs	Native	flora
72	Trema Orientalis	Indian Charcoal Tree	Cannabaceae	Trees	Autotrophs	Native	flora
73	Tridax Procumbens	Coatbuttons	Asteraceae	Herbs	Autotrophs	Exotic	flora
74	Urena Lobata	Caesarweed	Malvaceae	Shrubs	Autotrophs	Native	flora
75	Wedelia Chinensis	Bhringraj	Asteraceae	Herbs	Autotrophs	Native	flora
76	Ziziphus Mauritiana	Boroi	Rhamnaceae	Trees	Autotrophs	Native	flora
77	Zapornia Pusilla	Baillon's Crake	Rallidae	Birds	Ominvores	Resident	fauna
78	Acridotheres Tristis	Common Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Resident	fauna
79	Ardeola Grayii	Indian Pond Heron	Ardeidae (Herons, Bitterns)	Birds	Ominvores	Resident	fauna
80	Corvus Culminatus	Indian Jungle Crow	Corvidae (Crows, Jays)	Birds	Ominvores	Resident	fauna
81	Dicurus Macrocerus	Black Drongo	Dicuridae (Drongos)	Birds	Ominvores	Resident	fauna
82	Dicurus Paradiseus	Greater Racket-Tailed Drongo	Dicuridae (Drongos)	Birds	Ominvores	Resident	fauna
83	Halcyon Smyrnensis	White-Throated Kingfisher	ALcedinidae (Kingfishers)	Birds	Carnivores	Resident	fauna
84	Prinia Inornata	Plain Prinia	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Resident	fauna
85	Streptopelia Decaocto	Eurasian Collared Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
86	Merops Orientalis	AsianGreen Bee-Eater	Meropidae (Bee-eaters)	Birds	Insectivores	Resident	fauna
87	Accipiter Badius	Shikra	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Resident	fauna
88	Acridotheres Fuscus	Jungle Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Resident	fauna
89	Acridotheres Ginginianus	Bank Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Near-endemic	fauna
90	Actitis Hypoleucos	Common Sandpiper	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Resident	fauna
91	Acytolepis Puspa	Common Hedge Blue	Lycaenidae	Butterflies	Herbivores	Resident	fauna
92	Aegithina Tiphia	Common Iora	Aegithinidae (Ioras)	Birds	Insectivores	Resident	fauna
93	Amaurornis Phoenicurus	White-Breasted Waterhen	Rallidae (Rails, Crakes and Coots)	Birds	Ominvores	Resident	fauna
94	Aplonis Panayensis	Asian Glossy Starling	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Resident	fauna
95	Apus Nipalensis	House Swift	Hemiprocnidae (Treeswifts)	Birds	Insectivores	Resident	fauna
96	Artamus Fuscus	Ashy Woodswallow	Artamidae	Birds	Insectivores	Resident	fauna
97	Athene Brama	Spotted Owlet	Strigidae (Owls)	Birds	Carnivores	Resident	fauna
98	Borbo Cinnara	Rice Swift	Hesperidae	Butterflies	Herbivores	Resident	fauna
99	Brachydiplax Sobrina	Little Blue Marsh Hawk	Libellulidae	Dragonflies	Carnivores	Resident	fauna
100	Bubus Coromandus	Eastern Cattle Egret	Ardeidae (Herons, Bitterns)	Birds	Ominvores	Resident	fauna
101	Callosciurus Erythraeus	Pallas's Squirrel	Sciuridae	Mammals	Ominvores	Resident	fauna

102	Caprimulgus Macrurus	Large-Tailed Nightjar	Caprimulgidae (Nightjars)	Birds	Insectivores	Resident	fauna
103	Catopsilia Pomona	Common Emigrant	Pieridae	Butterflies	Herbivores	Resident	fauna
104	Catopsilia Pyranhe	Mottled Emigrant	Pieridae	Butterflies	Herbivores	Resident	fauna
105	Cecropis Daurica	Red-Rumped Swallow	Hirundinidae (Swallows, Martins)	Birds	Ominvores	Resident	fauna
106	Ceropus Sinensis	Greater Coucal	Cuculidae (Cuckoos)	Birds	Ominvores	Resident	fauna
107	Chalcophaps Indica	Common Emerald Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
108	Chilasa Clytia	Common Mime	Papilionidae	Butterflies	Herbivores	Resident	fauna
109	Chrysococcyx Maculatus	Asian Emerald Cuckoo	Cuculidae (Cuckoos)	Birds	Ominvores	Resident	fauna
110	Columba Livia	Rock Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
111	Copsychus Sauraris	Oriental Magpie Robin	Muscicapidae (Chats, Old World Flycatchers)	Birds	Insectivores	Resident	fauna
112	Coracias Affinis	Indo-Chinese Roller	Coraciidae (Rollers)	Birds	Ominvores	Resident	fauna
113	Corvus Splendens	House Crow	Corvidae (Crows, Jays)	Birds	Ominvores	Resident	fauna
114	Danaus Chrysippus	Plain Tiger	Nymphalidae	Butterflies	Herbivores	Resident	fauna
115	Danaus Genutia	Striped Tiger	Nymphalidae	Butterflies	Herbivores	Resident	fauna
116	Dendrocitta Vagabunda	Rufous Treepie	Corvidae (Crows, Jays)	Birds	Ominvores	Resident	fauna
117	Dicrurus Annectens	Crow-Billed Drongo	Dicruridae (Drongos)	Birds	Ominvores	Resident	fauna
118	Dicrurus Hottenottus	Hair-Crested Drongo	Dicruridae (Drongos)	Birds	Ominvores	Resident	fauna
119	Dicrurus Leucophaeus	Ashy Drongo	Dicruridae (Drongos)	Birds	Ominvores	Resident	fauna
120	Dinopium Bengalense	Black-Rumped Flameback	Picidae (Woodpeckers)	Birds	Insectivores	Near-endemic	fauna
121	Diplacodes Trivialis	Ground Skimmer	Libellulidae	Dragonflies	Carnivores	Resident	fauna
122	Ducula Aenea	Green Imperial Pigeon	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
123	Duttaphrynus Melanostictus	Common Indian Toad	Bufo	Amphibians	Insectivores	Native	fauna
124	Egretta Garzetta	Little Egret	Ardeidae (Herons, Bitterns)	Birds	Ominvores	Resident	fauna
125	Epacromia Sps	Banded Grasshopper	Orthoptera	Other-insects	Herbivores	Native	fauna
126	Eptis Hylas	Common Sailer	Nymphalidae	Butterflies	Herbivores	Resident	fauna
127	Erthesina Fullo	Stink Bug	Pentatomidae	Other-insects	Herbivores	Native	fauna
128	Eudynamis Scolopaceus	Asian Koel	Cuculidae (Cuckoos)	Birds	Ominvores	Resident	fauna
129	Eumemes Sps	Potter Wasp	Eumenidae	Other-insects	Insectivores	Native	fauna
130	Euodice Malabarica	Indian Silverbill	Estrildidae (Waxbills, Munias and Allies)	Birds	Ominvores	Resident	fauna
131	Euploea Core	Common Crow	Nymphalidae	Butterflies	Herbivores	Resident	fauna
132	Eurema Hecabe	Common Grass Yellow	Pieridae	Butterflies	Herbivores	Resident	fauna
133	Gallinago Gallinago	Common Snipe	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Resident	fauna
134	Gallinago Stenura	Pin-Tailed Snipe	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Resident	fauna
135	Gallinula Chloropus	Common Moorhen	Rallidae (Rails, Crakes and Coots)	Birds	Ominvores	Resident	fauna

136	Gallus Gallus	Red Junglefowl	Phasianidae (Pheasants and Allies)	Birds	Omnivores	Resident	fauna
137	Calotes Irawadi	Garden Lizard	Agamidae	Reptiles	Carnivores	Resident	fauna
138	Glaucidium Cuculoides	Asian Barred Owlet	Strigidae (Owls)	Birds	Carnivores	Resident	fauna
139	Gracupica Contra	Indian Pied Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Resident	fauna
140	Graphium Dosaon	Common Jay	Papilionidae	Butterflies	Herbivores	Resident	fauna
141	Graphium Sarpedon	Common Bluebottle	Papilionidae	Butterflies	Herbivores	Resident	fauna
142	Hemidactylus Aquilonius	Smooth Scaled House Gecko	Geckoidae	Reptiles	Carnivores	Resident	fauna
143	Hemidactylus Frenatus	Common House Gecko	Geckoidae	Reptiles	Carnivores	Resident	fauna
144	Hemidactylus Garnotii	Garnot's House Gecko	Geckoidae	Reptiles	Carnivores	Resident	fauna
145	Hemidactylus Platyurus	Flat Tailed Gecko	Geckoidae	Reptiles	Carnivores	Resident	fauna
146	Hirundo Rustica	Barn Swallow	Hirundinidae (Swallows, Martins)	Birds	Omnivores	Resident	fauna
147	Humbertiella Ceylonica	Indian Bark Mantis	Hymenoptera	Other-insects	Insectivores	Native	fauna
148	Hypolimnas Bolina	Great Eggfly	Nymphalidae	Butterflies	Herbivores	Resident	fauna
149	Hypolycaena Erylus	Common Tit	Family: Lycaenidae	Butterflies	Herbivores	Resident	fauna
150	Ictinogomphus Rapax	Common Club Tail	Gomphidae	Other-insects	Insectivores	Native	fauna
151	Ischnura Aurora	Golden Dartlet	Coenagrionidae	Other-insects	Insectivores	Native	fauna
152	Ischnura Senegalensis	Senegal Golden Darlet	Coenagrionidae	Other-insects	Insectivores	Native	fauna
153	Junonia Almana	Peacock Pansy	Nymphalidae	Butterflies	Herbivores	Resident	fauna
154	Junonia Atlites	Grey Pansy	Nymphalidae	Butterflies	Herbivores	Resident	fauna
155	Junonia Iphita	Chocolate Pansy	Nymphalidae	Butterflies	Herbivores	Resident	fauna
156	Junonia Lemonias	Lemon Pansy	Nymphalidae	Butterflies	Herbivores	Resident	fauna
157	Lanius Schach	Long-Tailed Shrike	Laniidae (Shrikes)	Birds	Insectivores	Resident	fauna
158	Leptocoma Zeylonica	Purple-Rumped Sunbird	Nectariniidae (Sunbirds)	Birds	Omnivores	Resident	fauna
159	Leptosia Nina	Psyche	Pieridae	Butterflies	Herbivores	Resident	fauna
160	Lonchura Striata	White-Rumped Munia	Estrildidae (Waxbills, Munias and Allies)	Birds	Omnivores	Resident	fauna
161	Melanitis Leda	Common Evening Brown	Nymphalidae	Butterflies	Herbivores	Resident	fauna
162	Merops Philippinus	Blue-Tailed Bee-Eater	Meropidae (Bee-eaters)	Birds	Insectivores	Resident	fauna
163	Milvus Migrans	Black Kite	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Resident	fauna
164	Minevaria Teraiensis	Cricket Frog	Dicoglossidae	Amphibians	Carnivores	Native	fauna
165	Mylabris Pustulata	Blister Beetle	Meloidae	Other-insects	Nectarivores	Native	fauna
166	Nephila Pilipes	Golden Wood Spider	Salticidae	Other-insects	Carnivores	Resident	fauna
167	Neurothemis Fulvia	Fulvous Forest Skimmer	Libellulidae	Dragonflies	Carnivores	Resident	fauna
168	Oecophylla Smaragdina	Weaver Ant	Formicidae	Other-insects	Insectivores	Native	fauna
169	Oriolus Xahornus	Black-Hooded Oriole	Oriolidae	Birds	Omnivores	Resident	fauna
170	Orthetrum Sabina	Green Marsh Hawk	Libellulidae	Dragonflies	Carnivores	Resident	fauna

171	Orthotomus Sutorius	Common Tailorbird	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Resident	fauna
172	Oxyopes Sp	Lynx Spider	Salticidae	Other-insects	Insectivores	Resident	fauna
173	Papilio Demoleus	Common Lime Butterfly	Papilionoidea	Other-insects	Nectarivores	Native	fauna
174	Papilio Demoleus	Lime Butterfly	Papilionidae	Butterflies	Herbivores	Resident	fauna
175	Papilio Polytes	Common Mormon	Papilionidae	Butterflies	Herbivores	Resident	fauna
176	Parantica Aglea	Glassy Tiger	Nymphalidae	Butterflies	Herbivores	Resident	fauna
177	Pareronia Valeria	Common Wanderer	Pieridae	Butterflies	Herbivores	Resident	fauna
178	Passer Domesticus	House Sparrow	Passeridae (Old World Sparrows, Snowfinches)	Birds	Ominvores	Resident	fauna
179	Passer Moanus	Eurasian Tree Sparrow	Passeridae (Old World Sparrows, Snowfinches)	Birds	Ominvores	Resident	fauna
180	Phaenicophaeus Tristis	Green-Billed Malkoha	Cuculidae (Cuckoos)	Birds	Ominvores	Resident	fauna
181	Pieris Canidia	Indian Cabbage White	Pieridae	Butterflies	Herbivores	Resident	fauna
182	Plexippus Paykulli	Pantropical Jumper	Salticidae	Other-insects	Carnivores	Resident	fauna
183	Polistella Sps	Red Paper Wasp	Vespidae	Other-insects	Nectarivores	Native	fauna
184	Polypedates Sp	Tree Frog	Rhacophoridae	Amphibians	Insectivores	Native	fauna
185	Prinia Hodgsonii	Grey-Breasted Prinia	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Resident	fauna
186	Psilopogon Haemacephalus	Coppersmith Barbet	Megalaimidae (Asian Barbets)	Birds	Ominvores	Resident	fauna
187	Psilopogon Lineatus	Lineated Barbet	Megalaimidae (Asian Barbets)	Birds	Ominvores	Resident	fauna
188	Psittacula Krameri	Rose-Ringed Parakeet	Psittaculidae (Old World Parrots)	Birds	Ominvores	Resident	fauna
189	Pycnonotus Cafer	Red-Vented Bulbul	Pycnonotidae (Bulbuls)	Birds	Ominvores	Resident	fauna
190	Rhipidura Albicollis	White-Throated Fantail	Rhipiduridae	Birds	Insectivores	Resident	fauna
191	Spilopelia Chinensis	Spotted Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
192	Spilornis Cheela	Crested Serpent Eagle	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Resident	fauna
193	Streptopelia Orientalis	Oriental Turtle Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
194	Streptopelia Tranquebarica	Red Collared Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
195	Sturnia Malabarica	Chestnut-Tailed Starling	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Resident	fauna
196	Sturnia Pagodarum	Brahminy Starling	Sturnidae (Starlings, Rhabdornises)	Birds	Ominvores	Near-endemic	fauna
197	Tachymarptis Melba	Alpine Swift	Hemiprocnidae (Treeswifts)	Birds	Insectivores	Resident	fauna
198	Telostylus Sps	True Fly	Neriidae	Other-insects	Nectarivores	Native	fauna
199	Tephrodornis Pondicerianus	Common Woodshrike	Vangidae (Vangas and Allies)	Birds	Insectivores	Resident	fauna
200	Treron Bicinctus	Orange-Breasted Green Pigeon	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
201	Treron Phayrei	Ashy-Headed Green Pigeon	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
202	Treron Phoenicopterus	Yellow-Footed Green Pigeon	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Resident	fauna
203	Trithemus Festiva	Black Stream Glider	Libellulidae	Other-insects	Insectivores	Native	fauna

204	Trophaneura Aristolochiae	Coomon Rose	Papilionidae	Butterflies	Herbivores	Resident	fauna
205	Vanellus Indicus	Red-Wattled Lapwing	Charadriidae (Plovers)	Birds	Insectivores	Resident	fauna
206	Xylocopa Auripennis	Carpenter Bee	Apidae	Other-insects	Nectarivores	Native	fauna
207	Ypthima Baldus	Common Five-Ring	Nymphalidae	Butterflies	Herbivores	Resident	fauna
208	Ypthima Huebneri	Common Four-Ring	Nymphalidae	Butterflies	Herbivores	Resident	fauna
209	Zosterops Palpebrosus	Indian White-Eye	Zosteropidae (White-eyes)	Birds	Ominvores	Near-endemic	fauna

Annexure - 3

Site Photographs

Project Site



Image 1 : Core site



Image 2 : Discussion with the locals



Image 3: Team working in the Field



Image 4: Fatikcharra



Image 5: Bamutia



Image 6: Jirania



Image 7: Kandrai charra



Image 8: Gandhari



Image 9: Gangacharra



Image 10 : Scaly-breasted munia feeding on rice husk in core



Image 11: Spotted dove looking out for food in core



Image12 : White-rumped munia



Image 13: Black hooded oriole



Image 14: Common clubtail



Image 15: Lemon pansy



Image 16: Monocled cobra



Image 17: Orange skimmer

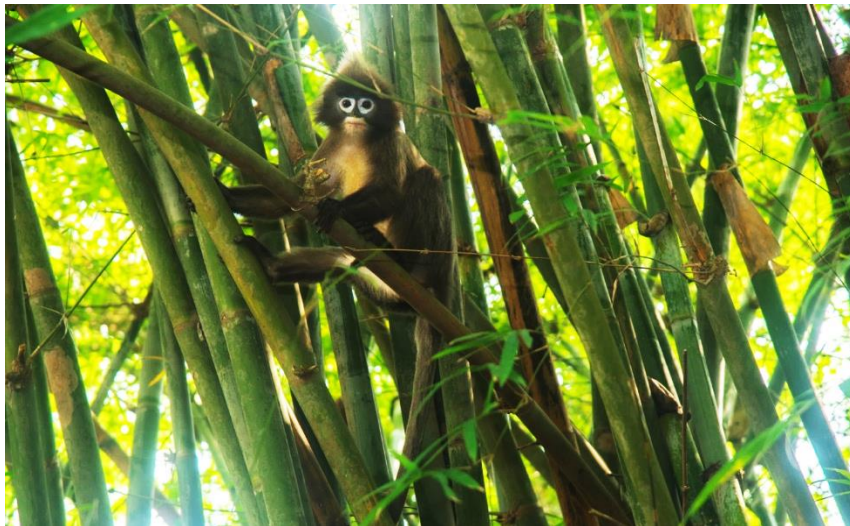


Image 18: Phayre's Leaf Monkey



Image 19: Common Picture-wing Dragonfly



Image 20: Pig-tailed Macaque



Image 21: Red-tail Pitviper

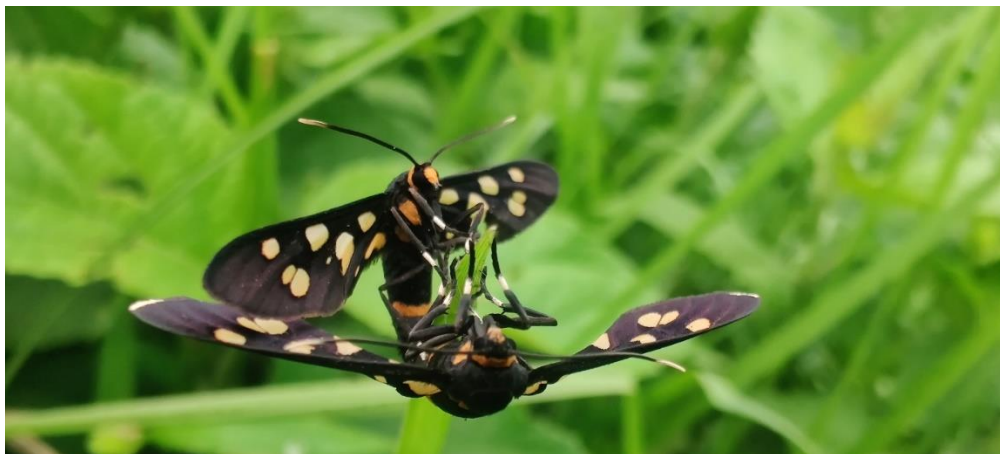


Image 22: Wasp moth mating



Image 23: Bamboo-tail damselfly



Image 24: Black-rump flameback



Image 25: Oriental Honey Buzzard



Image 26: Paddyfield dragonfly



Image 27: Plain tiger butterfly



Image 28: Praying mantis



Image 29: Rufous treepie



Image 30: Scaly-breasted munia

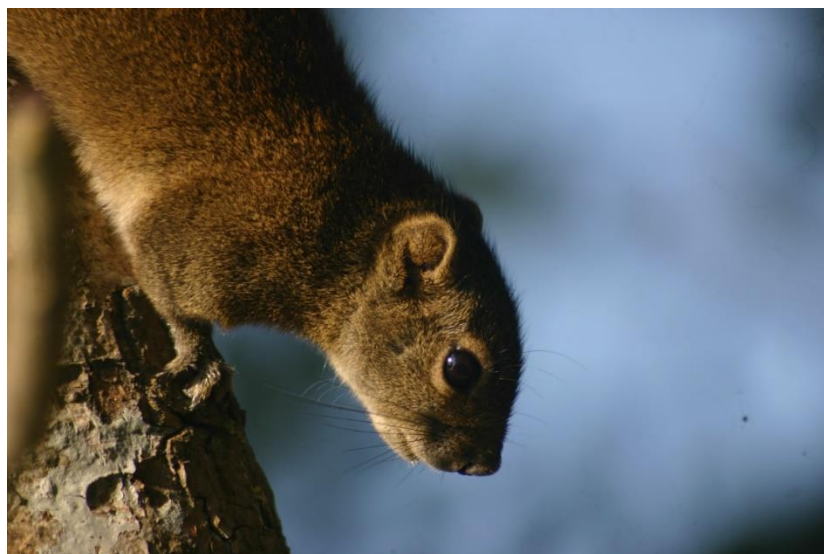


Image 31: Pallas's squirrel



Image 32: White throated kingfisher

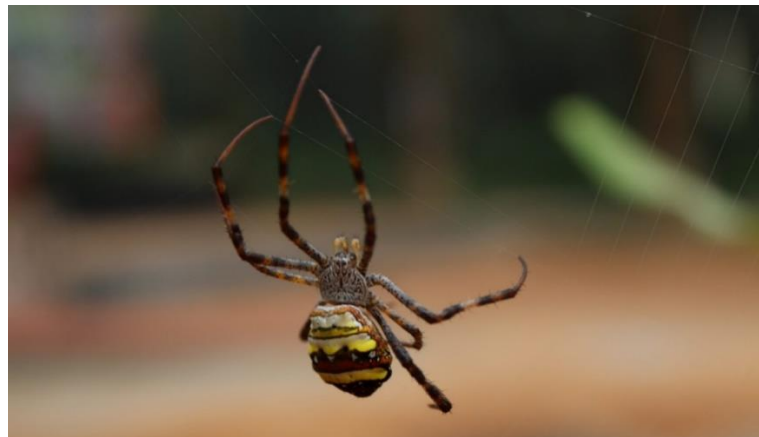


Image 33: Signature spider



Image 34: Trapdoor spider



Image 35: Polypedates teraiensis (tree frog)



Image 36: Ttwo striped jumper



Image 37: Tokay gecko



Image 38: *Gymnopetalum chinense*



Image 39: *Lagerstroemia speciosa*



Image 40: *Luffa cylindrica*



Image 41: *Mussaenda frondosa*



Image 42: *Phoenix dactylifera*



Image 43 : Psidium guineense (An Endemic Threatened Species of Tripura)

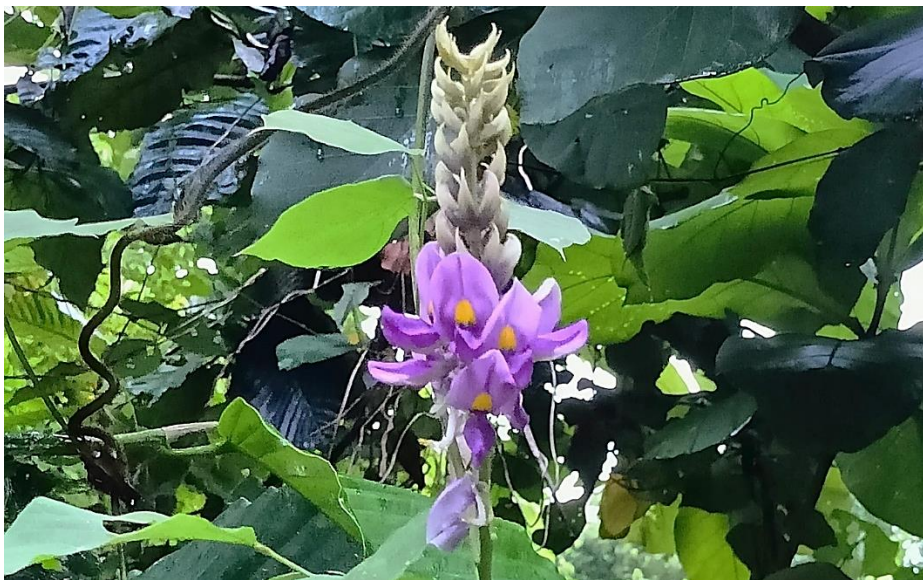


Image 44: Pueraria montana



Image 45: Ricinus communis



Image 46: Schima wallichii



Image 47: Wedelia cinensis



Image 48: Zingiber zerumbet



Image 49: Mimosa pudica



Image 50: Ficus hispida



Image 51: Tridax procumbens

APPENDIX-5

**Joint Verification and Communication from Tripura
Forest Department regarding Tree felling/
Extraction**

No.F.6-5/Deptt.Oprtn/Timber/SSD/Vol-III/2024-25/ 305-07

GOVERNMENT OF TRIPURA
OFFICE OF THE SUB-DIVISIONAL FOREST OFFICER
SADAR FOREST SUB-DIVISION, AGARTALA
PO – AGARTALA COLLEGE, PIN – 799001.
sdfosadar@gmail.com

Dated, 04.06.2024.

To
The Managing Director
TIDCL
Agartala

Subject: - Request for Placement of fund amounting of RS- 24,227/- (Twenty Four thousand Two hundred Twenty Seven) only, in connection with extraction of 13 (Thirteen) nos Misc trees at Dukli Estate Land, under Sadar Range jurisdiction. –regarding.

Reference: - No.F.4(2)/SDM/SDR/REV/2018/2204, dated- 02-08-2023 of Dukli Revenue Circle.

Even No.F.31/SDR/2024-25/ 218 Dt. 03/06/2024, of Range Officer, Sadar Forest Range.


Sir,

With reference to the subject cited above, I would like to inform you that the joint verification with respect to extraction of 13 (Thirteen) nos Misc trees at Dukli Estate Land, Agartala, under Sadar Range jurisdiction, has done by the Range Officer, Sadar Forest Range and Sri. Akash Ghosh, Civil Engineer, Dukli Revenue Circle, Agartala. The joint enquiry reports along with tree enumeration list and estimate has also been prepared and submitted for placement of fund amounting of RS- 24,227/- (Twenty Four thousand Two hundred Twenty Seven) only, for extraction of 13 (Thirteen) nos Misc trees. After placement of fund please send fund allotment copy through SDFOs, Mail.

Account details.

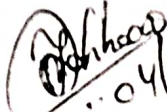
Name of Account holder	Account No.	Bank	Branch	IFSC Code
Sub Divisional Forest Officer, Sadar, Deptt. Oprnt	130022010000947	Union Bank of India	Akhaura	UBIN0913006

Yours Faithfully


(T.K. Debbarma, TFS)
Sub-Divisional Forest Officer,
Sadar Forest Sub-Division.

Copy to: -

1. The District Forest Officer, West Forest District, Agartala for favour of kind information.
2. The Range Officer, Sadar Range, for information and necessary action.


Sub-Divisional Forest Officer,
Sadar Forest Sub-Division

GOVERNMENT OF TRIPURA
OFFICE OF THE FOREST RANGE OFFICER
SADAR FOREST RANGE OFFICE

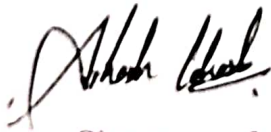
Sub:- Joint Inspection Report against the cutting of 13 (Thirteen) nos. Misc tree at Dukli Estate land owned and occupied by the TIDCL/ I & C Dept., Agartala.

Ref:- No.F.4(2)/SDM/SDR/REV/2018/2204 Dt. 02/08/2023 of Office of the Dukli Revenue Circle.

Today on 01-05-2024 at about 12:45 pm I went to the Dukli Estate land, Agartala, for physical inspection as per letter received from Dukli Revenue Circle. Then with Sri Akash Ghosh, Civil Engineer, Dukli Revenue Circle, inspected the trees. During Joint Inspection he has shown me 13 (Thirteen) nos. tree which are required to be extract.

Details of trees :-

Sl No.	Species	Measurement (in cm)		Remarks
		BHG	Height	
1	Ordinary	80	1000	
2	Ordinary	115	1000	
3	Banyan	70	500	
4	Debdaru	128	1600	
5	Kathal	190	180	Br-2
6	Ordinary (Naicha)	80	900	
7	Ordinary (Naicha)	70	800	
8	Ordinary (Naicha)	65	600	
9	Ordinary	80	700	
10	Ordinary	75	800	
11	Ordinary	73	900	
12	Khejur	115	800	
13	Khejur	112	800	



Signature of
Sri. Akash Ghosh, Civil Engineer
Dukli Revenue Circle



Junior Engineer
Engg. Cell, TIDC Ltd.



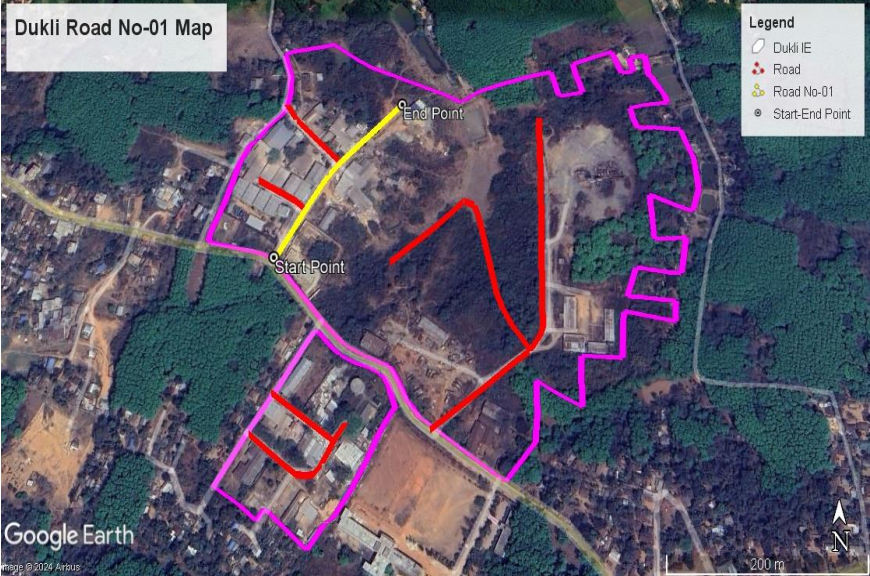
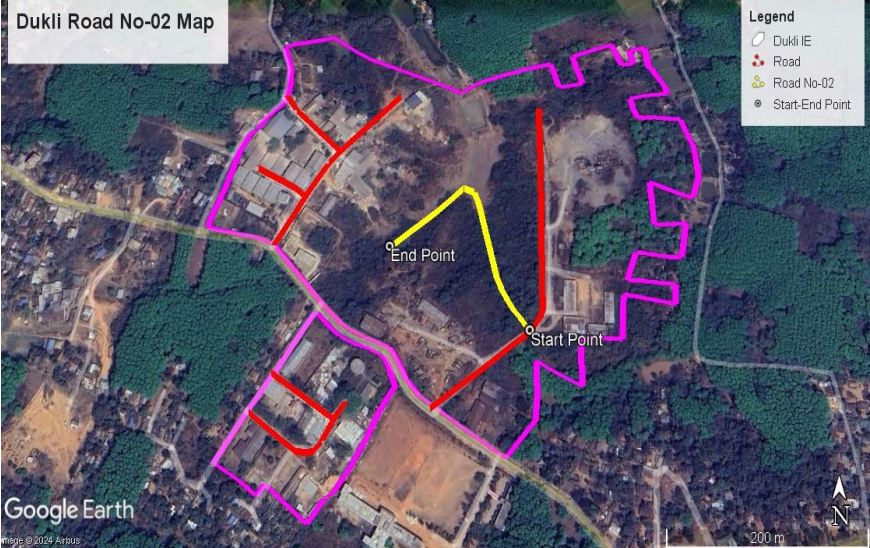
Signature of
the Range Officer,
Sadar Range Office

APPENDIX-6

Environmental Sensitivity of linear (15m both sides of road, SWD, Water supply & power supply)

and

Area-based (500mt radius of building and other infrastructure) components proposed within Dukli IE

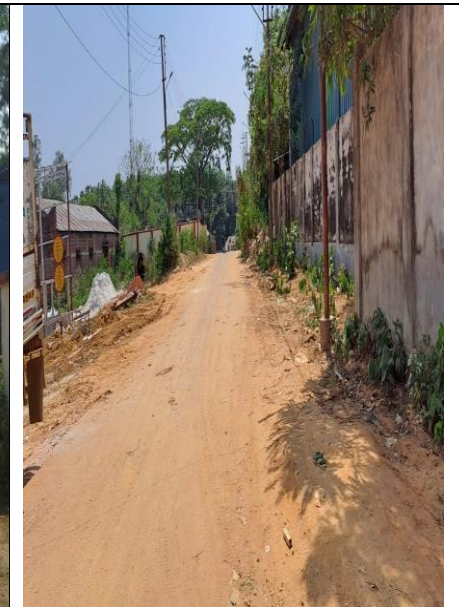
Sl. No.	Proposed Structure	Environmental Sensitivity within 15m of Both Sides of Road	Photograph
1	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 01</p> <p>Location:-Dukli IE.</p> <p>Start Point</p> <p>Lat-Long: - 23°46'52.75"N, 91°17'29.37"E</p> <p>End Point</p> <p>Lat-Long: - 23°46'58.92"N, 91°17'34.81"E</p> <p>Road Length: - 251 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There is 1 local ordinary species / tree (Ber (Baroi)-Ziziphus jujuba), proposed to be cut on the Right side of road during the construction phase. • There are no trees proposed to be cut on the Left side of road during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There are no existing culverts that cross the proposed road. • The Terrain is Undulating. 	 <p>Dukli Road No-01 Map</p> <p>Google Earth</p>
2	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 02</p> <p>Location: –Dukli IE</p> <p>Start Point</p> <p>Lat-Long: - 23°46'49.82"N, 91°17'39.38"E</p> <p>End Point</p> <p>Lat-Long: - 23°46'52.55"N, 91°17'33.95"E</p> <p>Road Length: - 276 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road. • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There are two number of local ordinary trees (Naicha-Trema orientalis (L)) are proposed to be cut on left and right side of proposed road during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There is no existing culverts that cross the proposed road. • The Terrain is Undulating. 	 <p>Dukli Road No-02 Map</p> <p>Google Earth</p>

3

Section: - Road & Junction.

Name of Proposed Structure: - Road No- 03
Location: –Dukli IE
Start Point
Lat-Long: -
23°46'47.39"N,
91°17'35.60"E
End Point
Lat-Long: -
23°46'58.03"N,
91°17'40.23"E
Road Length: - 390 meter



- There is no educational institutional building surrounded by the proposed Road.
- There is no major habitation surrounded by the proposed Road.
- There are no significant protected forest & Wildlife sanctuaries in and around the proposed road.
- There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc).
- There are 6 Nos trees (**Debdaru-Polyalthia longifolia(2 trees)** **Naicha-Trema orientalis (L)(2 trees)**, **BL**, **Khejur-Phoenix dactylifera(2)** trees are proposed to be cut on the Left side of road during the construction phase.
- There are 4 Nos trees (**Naicha-Trema orientalis (L)** **BL(2 trees)**, **Jackfruit- Artocarpus hetro(2 trees)** proposed to be cut on the Right side of road during the construction phase.
- There is no natural drainage channel that crosses the proposed road.
- There is no pond located from the proposed road.
- There are no existing culverts that cross the proposed road.
- The Terrain is Undulating.



<p>4</p>	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 04</p> <p>Location: –Dukli IE</p> <p>Start Point Lat-Long: - 23°46'54.47"N, 91°17'30.51"E</p> <p>End Point Lat-Long: - 23°46'55.55"N, 91°17'28.47"E</p> <p>Road Length: - 68 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road. • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut on both side of road (Right, Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There are no existing culverts that cross the proposed road. • The Terrain is Undulating. 	<p>Dukli Road No-04 Map</p> <p>Google Earth</p>
<p>5</p>	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 05</p> <p>Location: –Dukli IE</p> <p>Start Point Lat-Long: - 23°46'56.13"N, 91°17'31.81"E</p> <p>End Point Lat-Long: - 23°46'58.44"N, 91°17'29.41"E</p> <p>Road Length: - 90 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road. • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut on both side of road (Right, Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There are no existing culverts that cross the proposed road. • The Terrain is Undulating. 	<p>Dukli Road No-05 Map</p> <p>Google Earth</p>

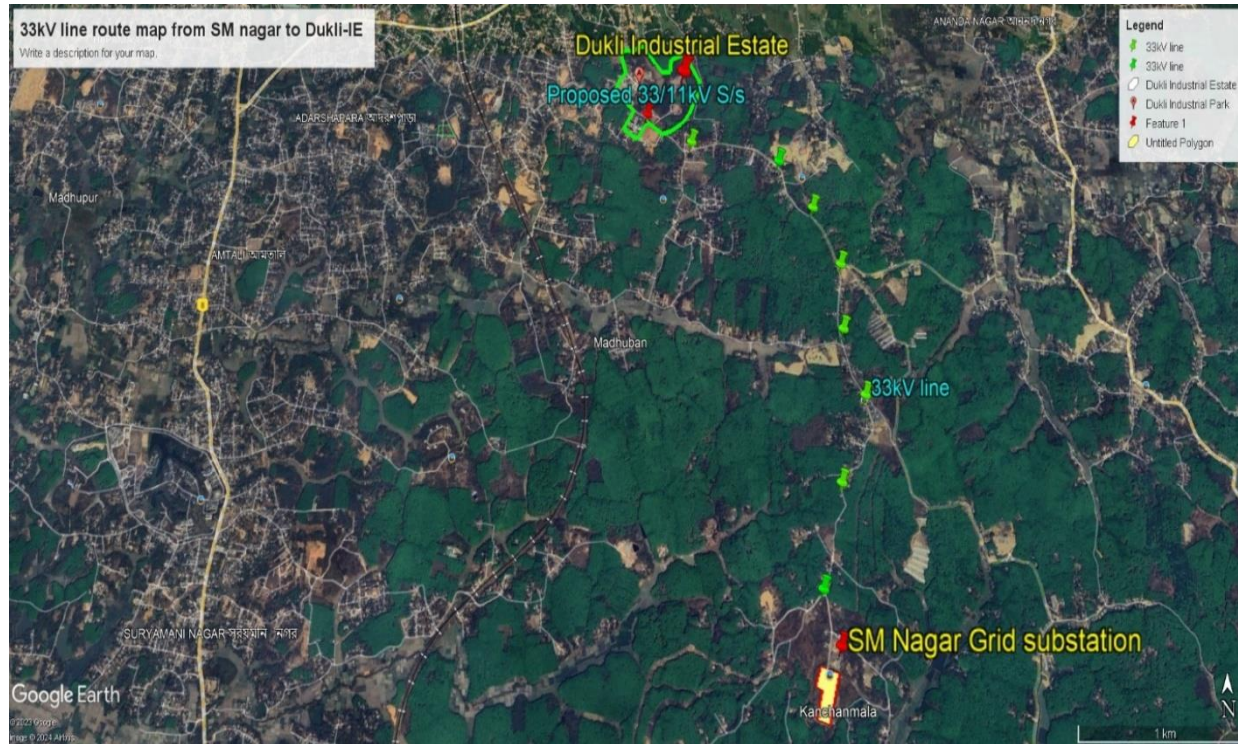
<p>6</p>	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 05</p> <p>Location: –Dukli IE</p> <p>Start Point</p> <p>Lat-Long: - 23°46'47.23"N, 91°17'29.05"E</p> <p>End Point</p> <p>Lat-Long: - 23°46'47.48"N, 91°17'32.54"E</p> <p>Road Length: - 141 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road. • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut on both side of road (Right, Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There are no existing culverts that cross the proposed road. • The Terrain is Undulating. 	<p>Dukli Road No-06 Map</p> <p>Google Earth</p> <p>Start Point</p> <p>End Point</p> <p>Legend</p> <ul style="list-style-type: none"> Dukli IE Road Road No-06 Start-End Point <p>200 m</p>
<p>7</p>	<p>Section: - Road & Junction.</p> <p>Name of Proposed Structure: - Road No- 05</p> <p>Location: –Dukli IE</p> <p>Start Point</p> <p>Lat-Long: - 23°46'48.35"N, 91°17'29.74"E</p> <p>End Point</p> <p>Lat-Long: - 23°46'47.04"N, 91°17'32.11"E</p> <p>Road Length: - 82 meter</p>	<ul style="list-style-type: none"> • There is no educational institutional building surrounded by the proposed Road. • There is no major habitation surrounded by the proposed Road. • There are no significant protected forest & Wildlife sanctuaries in and around the proposed road. • There is no religious infrastructure surrounded by the proposed Road. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut on both side of road (Right, Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located from the proposed road. • There are no existing culverts that cross the proposed road. • The Terrain is Undulating. 	<p>Dukli Road No-07 Map</p> <p>Google Earth</p> <p>Start Point</p> <p>End Point</p> <p>Legend</p> <ul style="list-style-type: none"> Dukli IE Road Road No-07 Start-End Point <p>200 m</p>

Environmental sensitivity within 500m of proposed aerial components

Sl. No.	Proposed Structure	Environmental Sensitivity within 500m of proposed component	Photograph
1	<p>Section: - Social Infrastructure Name of Proposed Structure: - Weighbridge and Parking Location: – Dukli Industrial Estate Lat-Long: - 23°46'51.15"N, 91°17'31.60"E</p>	<ul style="list-style-type: none"> • Located opposite side of Existing Water Supply Dukli. • There are No Educational Institutional Building nearby propose site. • There is no major habitation nearby this proposed site. • There is no significant protected forest / Wildlife sanctuary.in and around the project area and • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees are identified to cut during construction phase. • There is no water body nearby proposed site. • The Terrain is undulating. 	 <p style="text-align: right;">GPS Map Camera</p> <div style="position: absolute; bottom: 10px; left: 10px;">  <p>Madhuban, Tripura, India Q7JR+WHV TIDC Ind Area, Dukli, Madhuban, Tripura 799003, India Lat 23.781116° Long 91.291957° 21/02/24 02:46 PM GMT +05:30</p> </div>

Associated Facility Related Details & Maps Under the Project

To lay a new 33 KV Feeder from 132/ 33 KV SM nagar S/s (which has spare 33 KV bay complete with breaker and panel. The new 33 KV line shall be extended from the 33 KV Bus. The 33 KV feeder shall be laid on 11m MS Tubular Poles with covered Dog Conductor for route length of 10 Kms.



33kV line route map from 132/33kV SM Nagar grid to 33/11kV Dukli Substation

APPENDIX-7

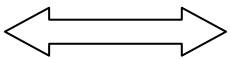
Disaster Management and Emergency Response Plan for Infrastructure Development Construction Phase at Industrial Estate

DISASTER MANAGEMENT & EMERGENCY RESPONSE PLAN				At Dukli Site Level
HIERARCHY ACTION IN CASE OF EMERGENCY				
Issued By	Checked By	Approved By	Date of Issue	Revision
Incident Controller/ Manager (Projects)	Site Controller/ GM (Projects)	PMSC/ PMU (DIC & TIDCL)		0

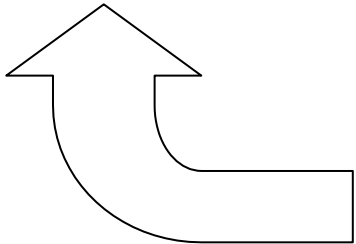
IN CASE OF EMERGENCY PLEASE CONTACT



EXTERNAL AGENCY	
NAME	TELEPHONE NUMBER
Police	
Fire	
Ambulance	
Hospital(s)	
Dist. Collector Officer	
Any other agency	



Name of the Contractor		
NAME	DESIGNATION	TELEPHONE NUMBER
	Project Manager/ Incident Controller	
	Site Controller / Emergency Controller	
	Safety In-charge / Assembly Area Coordinator	
	Security/ Watch ward	



CLIENT – DIC/ TIDCL (represented through Project Management and Supervision Consultant)		
NAME	DESIGNATION	TEL. NUMBER
	Project Director, PMU	
	Team Leader, PIU(s)/ Executive Engineer,	
	Team Leader, PMSC	
	Environmental Specialist, PMSC	

Disaster Management Plan (DMP) & Emergency Preparation Plan of M/s..... (Name of the Contractor-**Package Specific**)

(Important Note: Needs to be updated/ prepared by the respective Contractor of the awarded package in consultation with District Disaster Management Authority, scrutinized & checked by PMSC and approved by PMU to be prepared separately for each of the industrial estates)

1. Background

2. The Disaster Management Act 2005 envisages disaster and its management as Disaster - Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade cause, or by accident or negligence which result in substantial loss of life or human suffering or damage to, or degradation of, environment, and is of such nature or magnitude as to be beyond the coping capacity of the community of the affected area.

3. Disaster Management Plan (DMP) and Emergency Preparedness Plan (EPP)

4. Disaster or Emergency and its Possibility

5. A disaster, and therefore an emergency, occurring as a result of a malfunction of the normal operating procedures or an intervention of an outside natural phenomenon force such as earthquake, floods, landslides, winds or sabotage, that may affect several sections within it and/or may cause serious injuries, loss of lives, extensive damage to property or serious disruption outside the works.

6. Apart from natural phenomenon, major fire and disruption, serious accidents may take place through explosion in Gas/Fuel Tankers, heavy leakage and subsequent fire in the oil tankers etc. near construction camp/ establishment sites.

7. Objective of Disaster Management Plan

8. In order to be in a state of readiness to face any accident or disaster caused during the project construction, a Disaster Management Plan shall be prepared. Such a plan ought to cover possible disaster, on and off-site emergency preparedness plan, establishment of Emergency Control Centres (ECC), location of emergency services, and duties of the officers/staff during emergency.

9. Basic Contents of DMP

10. Basically, the DMP shall contain the following aspects:

- Description of the Site
- On-site Emergency Plan
- Off-site Emergency Plan

11. Disaster Management - Disaster Management implies continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary as expedient for

- Prevention of danger or threat to any disaster.
- Mitigation or reduction of risk of any disaster or its severity or consequences.
- Capacity building.
- Preparedness to deal with any disaster.
- Prompt response to any threatening disaster situation or disaster.
- Assessing the severity of magnitude of effect of every disaster.
- Evacuation rescue & relief.
- Rehabilitation and reconstruction.

12. BASIC DEFINITIONS

1. **On-Site Plans** - address incidents originating at any of construction/ operation sites or establishment sites.

2. **Off-Site Plans** - address incidents originating at any of construction/ operation sites or establishment sites outside but affecting the Project Work

3. **Risk** - The chance of an adverse event occurring in some period or in a specific circumstance, in the process of engaging in an activity.

4. **Hazard** - A phenomenon which may cause disruption to persons and their infrastructure; and is an undesirable outcome in the process of engaging in an activity.
 5. **Disaster** - An event which can cause immense damage and disruption and causing loss to live of workforce and property.
 6. **Emergency** - Serious sudden situation or occurrence that happens unexpectedly and demands immediate action to correct or to protect lives and/or property.
 7. **Crisis** - Unstable situation of extreme danger. and may lead to the following elements: - Surprise- -Rapid flow of events-Lack of or insufficient information-Internal conflict-confusion.
 8. **Disaster Management** - Set of actions and processes designed to lessen disastrous effects before, during and after a disaster.
 9. **Preparedness** - Measures undertaken in advance to ensure that individuals and agencies will be ready to react, such as emergency plans, logistical support and resource, inventories, and emergency information & communications systems.
 10. **Response** - Those measures undertaken immediately after a disastrous or hazardous event has occurred and for a limited period thereafter, primarily to save human life, property, treating the injured, prevent further injury and other forms of property loss and to mitigate disruption. They include response plan activation, declaration and communication of emergency to the concerned potential population and facilities at risk, opening and staffing of emergency operation centres, mobilization of resources, issuance of warnings and directions and provision of aid.
 11. **Mitigation** - Those measures and activities aimed at reducing or eliminating hazards or lessening the impact of the event.
 12. **Prevention** - Mitigation of hazard effects through public education, early warning or detection systems, safety systems, building and land- use codes and regulation.
 13. **Recovery** - Those measures undertaken to restore normal conditions. The time frame for recovery begins as soon as a reduction in critical response activities permits the re-allocation of resources and could include physical restoration and reconstruction.
 14. **All Clear** – Direction given by the incident coordinator (or authorized person) that the emergency has been revoked and that there is no further damage.
 15. **Assembly Areas** – On decision of evacuation, the place where people will move first to assembly area where further instruction will be given.
 16. **Suspect Device** – Any item that contains an explosive or mechanical device designated to explode by means of timer, touching, impact or by remote control a suspect device may appear suspicious by its placement, the circumstances surrounding its location or other information that may cause any person to become suspicious and decide that further investigation is necessary.
13. **Key Objectives of the Plan**
- To build a safe and disaster resilient project construction sites by developing
 - a holistic,
 - proactive,
 - multi-disaster oriented and
 - technology driven strategy through
 - prevention,
 - mitigation,
 - preparedness and
 - response
14. **Objective of Disaster Management Plan**
- To improve state of preparedness to meet any contingency
 - To reduce response time in organizing assistance by
 - defining responsibilities,
 - procedures for facilitating the curtailment and/ or restoration of Asset(s).

- To identify
- major resources,
- manpower, material & equipment needed to make the plan operational
- Making optimum use of resources.
- Closure of emergency, its analysis and identification of lessons learnt

15. Scope of Disaster Management Plan

- Landslides
- Floods
- earthquake
- Cloud burst
- Fire
- Terrorist Attack
- Any other hazard

16. Prevention of Disasters

17. Design the system after considering factors like:

- Highest flood level
- Seismic zones
- Wind zones
- Fire protection system
- Physical Security arrangements
- Another critical parameter

18. Disaster Management Cell at Contractor

- Management level at Contractor's Corporate Office
- Site level at respective project sites

19. Site level Disaster Management Committee

- Site Manager
- Site Engineers
- Safety In charge

20. Disaster Management at Site Level Responsibilities

- To maintain and update emergency call out list of persons:
- for emergency control,
- key personnel of Client
- fire safety
- first aid, medical emergencies
- Security, Police, District Administration Authorities
- Display communication details of nodal officers to be contacted in emergency
- Fixing of permanent notice boards at all suitable locations at project operation/ establishment sites displaying information, map, escape routes, precautions to be taken during emergency.
- To arrange food, drinking water, Tent for office space at site, accommodation for deployed employees/ workers (all levels)

21. Appointment of Key Persons and their Role at Project Road/ Site Level

1. Site Controller (SC)

The General Manager (however called) or his nominated deputy will assume overall responsibility for the Site and its personnel.

2. Incident Controller (IC)

Project Manager or an Officer of similar rank will be nominated to act as the IC. Immediately on learning about an emergency, he will rush to the incident site and take overall charge and report to the SC.

Liaison Officer (LO)

Personnel/Administrative Manager or his nominated Officer of deputy rank will work as LO and will be stationed at the Nodal Control Centres during emergency to handle Police, District Administration, Hospitals and other enquiries.

Forward Area Controller (FAC)

Departmental In charge of the concerned area will be the FAC to take care of the respective departments during emergency.

Task Specific Team Leaders (TLs)

As number of specified activities may have to be carried out, for which specific teams have to be formulated and their roles or duties defined, each of them will be headed by a Team Leader, in accordance. The following teams are suggested:

- Task Force
- Repair Team
- Fire Fighting Team
- Communication Team
- Security Team
- Manpower Team
- Safety Team
- Transport Team
- Medical Team

Emergency Control Centres (ECC)

Emergency Control Room is to be set up and marked on the site plan for the knowledge of all concerned. ECC is the focal point and it should be well connected with internal and external telephones and furnished with list of personnel and their addresses.

Assembly Points

Assembly points, the pre-determined safe places, where people will be directed after evaluation from the hazardous locality, have to be set up and marked on the site plan. Escape routes from assembly points have to be clearly defined and depicted.

Alarms

Suitable sirens will be provided at Site, which could be operated from the Nodal Control Rooms. The coding of the siren should be as per the standards and well circulated within the facility.

Tie Ups for Aid with Institutions (Hospitals, Wards, Police Stations etc.)

It is essential to have mutual aid arrangements among the industries in the neighborhood which would help in the case of a major disaster.

Training and Mock Drills

Proper training of the key personnel and other non-key personnel, who will take part in case of an emergency, should be arranged through engagement of district level disaster management authorities. Mock drills shall be performed to test the performance of the procedure laid

Emergency Callout List

Sl. No.	Name of Official/ Agency	Mobile No.	Landline No.	Address
1	Site Manger			
2	Site Engineer			
3	Safety In charge			
4	Team Leader, PMSC			
5	Resident Engineer, PMSC			
6	Executive Engineer, PIU			
7	Environmental Specialist PMU			
8	Project Director, PMU			
9	Nearest Fire Station-I			
10	Nearest Fire Station-II			
11	Nearest Hospital-I			
12	Nearest Hospital-II			
13	Police Station			
14	District Magistrate			
15	Superintendent of Police			
16	District Disaster Management Cell			
17	State Disaster Management Cell			
18	National Disaster Management Cell			

APPENDIX-8

FORMAT FOR RECEIVING GRIEVANCES FROM AGGRIEVED PERSON(S)

Grievance Registration Format
(to be translated in the local language)

The _____ Project welcomes complaints, suggestions, queries and comments regarding project implementation.

Aggravated persons may provide grievance with their name and contact information to enable us to get in touch for clarification and feedback.

In case someone chooses not to include personal details and wants the information provided to remain confidential, please indicate by writing/typing *(CONFIDENTIAL)* above the grievance format.

Thank you.

Date	Place of registration				
Contact Information/Personal Details					
Name		Gender	* Male *Female	Age	
Home Address					
Place					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question: Please provide the details (who, what, where, and how) of your grievance below:					
If included as an attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or an update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of Official registering grievance)	
Mode of communication: Note/Letter E-mail Verbal/Telephonic Web	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

APPENDIX-9

Terms of Reference for Engagement of following experts through PMSC

- **Independent Consultant (for Environmental Safeguard)**
- **Environmental Safeguard cum Climate Change Expert**
- **Environmental Safeguard**
- **Bio-Diversity Expert**
- **Landscape Architect cum Horticultural Expert**

Terms of Reference for Engagement of Independent Consultant for Environmental Safeguard at PMU/TIDCL

A. Minimum Qualification Requirements

The Independent Consultant for Environmental Safeguard should have an advanced (masters) degree in environmental sciences or relevant field with experience in environmental/social assessments in infrastructure development sector. A thorough understanding of ADB's Safeguards Policy Statement, 2009 and other related guidelines, policies, and procedures of Government of India concerning environmental and social safeguards is preferable.

- Minimum General Experience : **15 years**
- Minimum Specific Experience : **8 years**
(relevant to assignment)

B. Detailed Tasks and/or Expected Output

- a) Ensure implementation of ADB-cleared EMPs by PIU and contractors including reporting to DoIC/ TIDCL and ADB.
- b) Support DoIC/ TIDCL and PIUs and other officers with environmental responsibilities in ensuring compliance with loan covenants related to environmental safeguards as well as state and national environment laws and regulations.
- c) Develop an environment, health, and safety (labour) training plan and provide formal environmental management trainings at the appropriate stage in project implementation as set out in the EMPs (and agreed training plan) including preparation of all training materials in a format that can be used for future reference, document attendees for trainings through photographs and attendance list.
- d) Develop environment management checklists based on the EMPs for use by officers and PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction, and maintenance phases.
- e) Support DoIC/ TIDCL, PIUs and their contractors in understanding the national laws and regulations, international good practices for environmental management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- f) Assist PIUs to monitor and supervise implementation of the project EMP by themselves and their contractors.
- g) Review and confirm that necessary provisions of the disclosed EMP (updated versions if any since bidding stage) are included in the contracts for further implementation and compliance.
- h) Assist DoIC/ TIDCL to update the IEE/prepare addendum to IEE to reflect any changes (such as location, alignment, length, design, addition of new sub-components etc.) including undertaking any site-specific assessment and identifying mitigation measures required.
- i) Review and confirm the detailed designs adequately incorporate all EMP measures and conform with the IFCs EHS guidelines.

- j) Review and confirm that all pre-construction requirements and relevant clearances and permits have been obtained prior to commencement of works.
 - k) Maintain records and copies of all clearances, permits, licenses and insurances obtained by DoIC/ TIDCL and contractors.
 - l) Review and approve the contractor's pre-construction documentation as required by the EMP (e.g. CEMP/SEMP) and confirm requirements as well as national laws and regulations.
 - m) Review documentation and undertake regular site visits to ensure the EMP implementation.
 - n) Facilitate monthly EHS meetings and undertake at least one site visit every month to all active project sites across all contract packages during the construction period to check PIUs supervision and monitoring activities and adequate implementation of EMP measures and, advise DoIC/ TIDCL and their contractors if improvements are needed, document each site visit in field visit note including photographs.
 - o) In addition to monthly site visits carry out at least quarterly in-depth environmental audits and random spot checks of all contractors to verify compliance to applicable requirements during construction.
 - p) **Training and Capacity Building:** Provide training to project staff and contractors on environmental safeguard policies and procedures and strengthen the capacity of the PMU to manage environmental safeguards effectively.
 - q) Assist DoIC/ TIDCL to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact, including a change in scope or design, or the siting or routing of project components.
 - r) Record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues.
 - s) Support DoIC/ TIDCL to locally disclose the IEE/EMP per the EMP requirements, prepare a community liaison plan, and continue to disclose information on and conduct meaningful consultations with the affected communities especially in relation to sites with adjacent properties and the distribution line routings.
 - t) Support DoIC/ TIDCL to operationalize and effectively implement the grievance redress mechanism, including raising awareness of its existence with affected communities, resolving grievances related to environmental issues that have been submitted, and keeping adequate documentation.
 - u) **Risk Management:** Identify and manage environmental risks associated with the project. And ensure that any unanticipated environmental impacts are addressed promptly.
 - v) Support DoIC/ TIDCL to respond to any EHS related grievances.
 - w) Prepare operational procedures in line with the requirements set out in the EMP to be adopted by DoIC/ TIDCL and providing them with training on their operationalization.
 - x) Prepare a final EMR, setting out in detail the compliance level of all the EMP requirements and capacity strengthening of DoIC/ TIDCL to continue to comply with the EMP requirements during maintenance phase as part of the project completion report (PCR).
- C. Inputs required:** Appointed for one year to provide handholding support to the TIDCL and ensure 5-6 month overlapping period with Project Management and Supervision Consultant (PMSC) under the Tripura Industrial Infrastructure Development Project (TIIDP).

Terms of Reference for Engagement of Senior Environmental Safeguard cum Climate Change Expert (1 Position) through PMSC

A. Minimum Qualification Requirements

The Senior Environment Safeguard cum Climate Change Expert should have an advanced (masters) degree in environmental sciences or relevant field with experience in environmental/social assessments in infrastructure development sector. A thorough understanding of ADB's Safeguards Policy Statement, 2009 and other related guidelines, policies, and procedures of Government of India concerning environmental and social safeguards is preferable.

- Minimum General Experience : **15 years**
- Minimum Specific Experience : **8 years**
(relevant to assignment)

B. Detailed Tasks and/or Expected Output

- a) Ensure implementation of ADB-cleared EMPs by PIU and contractors including reporting to DoIC/ TIDCL and ADB.
- b) Support DoIC/ TIDCL and PIUs and other officers with environmental responsibilities in ensuring compliance with loan covenants related to environmental safeguards as well as state and national environment laws and regulations.
- c) Develop an environment, health, and safety (labour) training plan and provide formal environmental management trainings at the appropriate stage in project implementation as set out in the EMPs (and agreed training plan) including preparation of all training materials in a format that can be used for future reference, document attendees for trainings through photographs and attendance list.
- d) Develop environment management checklists based on the EMPs for use by officers and PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction, and maintenance phases.
- e) Support DoIC/ TIDCL, PIUs and their contractors in understanding the national laws and regulations, international good practices for environmental management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- f) Assist PIUs to monitor and supervise implementation of the project EMP by themselves and their contractors.
- g) Review and confirm that necessary provisions of the disclosed EMP (updated versions if any since bidding stage) are included in the contracts for further implementation and compliance.
- h) Assist DoIC/ TIDCL to update the IEE/prepare addendum to IEE to reflect any changes (such as location, alignment, length, design, addition of new sub-components etc.) including undertaking any site-specific assessment and identifying mitigation measures required.
- i) Review and confirm the detailed designs adequately incorporate all EMP measures and conform with the IFCs EHS guidelines.

- j) Review and confirm that all pre-construction requirements and relevant clearances and permits have been obtained prior to commencement of works.
- k) Maintain records and copies of all clearances, permits, licenses and insurances obtained by DoIC/ TIDCL and contractors.
- l) Review and approve the contractor's pre-construction documentation as required by the EMP (e.g. CEMP/SEMP) and confirm requirements as well as national laws and regulations.
- m) Review documentation and undertake regular site visits to ensure the EMP implementation.
- n) Facilitate monthly EHS meetings and undertake at least one site visit every month to all active project sites across all contract packages during the construction period to check PIUs supervision and monitoring activities and adequate implementation of EMP measures and, advise DoIC/ TIDCL and their contractors if improvements are needed, document each site visit in field visit note including photographs.
- o) In addition to monthly site visits carry out at least quarterly in-depth environmental audits and random spot checks of all contractors to verify compliance to applicable requirements during construction.
- p) Prepare monthly/quarterly updates and assist DoIC/ TIDCL in preparing the semi-annual environmental monitoring reports in accordance with template agreed with ADB.
- q) Assist DoIC/ TIDCL to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact, including a change in scope or design, or the siting or routing of project components.
- r) Record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues.
- s) Support DoIC/ TIDCL to locally disclose the IEE/EMP per the EMP requirements, prepare a community liaison plan, and continue to disclose information on and conduct meaningful consultations with the affected communities especially in relation to sites with adjacent properties and the distribution line routings.
- t) Support DoIC/ TIDCL to operationalize and effectively implement the grievance redress mechanism, including raising awareness of its existence with affected communities, resolving grievances related to environmental issues that have been submitted, and keeping adequate documentation.
- u) Support DoIC/ TIDCL to respond to any EHS related grievances.
- v) Prepare operational procedures in line with the requirements set out in the EMP to be adopted by DoIC/ TIDCL and providing them with training on their operationalization.
- w) Prepare a final EMR, setting out in detail the compliance level of all the EMP requirements and capacity strengthening of DoIC/ TIDCL to continue to comply with the EMP requirements during maintenance phase as part of the project completion report (PCR).

C. **Inputs required:** Intermittent basis from commencement to completion of the construction works (infrastructure development) at the designated industrial estates (estimated 25 months of intermittent input spread over construction phase of 36 months and 1 year O&M phase/ DLP phase).

Terms of Reference for Engagement of Environmental Safeguard Expert (2 Positions) through PMSC

A. Minimum Qualification Requirements

The Environment Safeguard Expert should have an advanced (masters) degree in environmental sciences or relevant field with experience in environmental/social assessments in infrastructure development sector. A thorough understanding of ADB's Safeguards Policy Statement, 2009 and other related guidelines, policies, and procedures of Government of India concerning environmental and social safeguards is preferable.

- Minimum General Experience : **10 years**
- Minimum Specific Experience : **5 years**
(relevant to assignment)

B. Detailed Tasks and/or Expected Output

- a) Ensure implementation of ADB-cleared EMPs by PIU and contractors including reporting to DoIC/ TIDCL and ADB:
- b) Support DoIC/ TIDCL and PIUs and other officers with environmental responsibilities in ensuring compliance with loan covenants related to environmental safeguards as well as state and national environment laws and regulations.
- c) Develop an environment, health and safety (labour) training plan and provide formal environmental management trainings at the appropriate stage in project implementation as set out in the EMPs (and agreed training plan) including preparation of all training materials in a format that can be used for future reference, document attendees for trainings through photographs and attendance list.
- d) Develop environment management checklists based on the EMPs for use by officers and PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction and maintenance phases.
- e) Support DoIC/ TIDCL, PIUs and their contractors in understanding the national laws and regulations, international good practices for environmental management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- f) Assist PIUs to monitor and supervise implementation of the project EMP by themselves and their contractors.
- g) Review and confirm that necessary provisions of the disclosed EMP (updated versions if any since bidding stage) are included in the contracts for further implementation and compliance.
- h) Assist DoIC/ TIDCL to update the IEE/prepare addendum to IEE to reflect any changes (such as location, alignment, length, design, addition of new sub-components etc.) including undertaking any site-specific assessment and identifying mitigation measures required.
- i) Review and confirm the detailed designs adequately incorporate all EMP measures and conform with the IFCs EHS guidelines.
- j) Review and confirm that all pre-construction requirements and relevant clearances and permits have been obtained prior to commencement of works.

- k) Maintain records and copies of all clearances, permits, licenses and insurances obtained by DoIC/ TIDCL and contractors.
- l) Review and approve the contractor's pre-construction documentation as required by the EMP (e.g. CEMP/SEMP) and confirm requirements as well as national laws and regulations.
- m) Review documentation and undertake regular site visits to ensure the EMP implementation.
- n) Facilitate monthly EHS meetings and undertake at least one site visit every month to all active project sites across all contract packages during the construction period to check PIUs supervision and monitoring activities and adequate implementation of EMP measures and, advise DoIC/ TIDCL and their contractors if improvements are needed, document each site visit in field visit note including photographs.
- o) In addition to monthly site visits carry out at least quarterly in-depth environmental audits and random spot checks of all contractors to verify compliance to applicable requirements during construction.
- p) Prepare monthly/quarterly updates and assist DoIC/ TIDCL in preparing the semi-annual environmental monitoring reports in accordance with template agreed with ADB.
- q) Assist DoIC/ TIDCL to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact, including a change in scope or design, or the siting or routing of project components.
- r) Record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues.
- s) Support DoIC/ TIDCL to locally disclose the IEE/EMP per the EMP requirements, prepare a community liaison plan, and continue to disclose information on and conduct meaningful consultations with the affected communities especially in relation to sites with adjacent properties and the distribution line routings.
- t) Support DoIC/ TIDCL to operationalize and effectively implement the grievance redress mechanism, including raising awareness of its existence with affected communities, resolving grievances related to environmental issues that have been submitted, and keeping adequate documentation.
- u) Support DoIC/ TIDCL to respond to any EHS related grievances.
- v) Prepare operational procedures in line with the requirements set out in the EMP to be adopted by DoIC/ TIDCL and providing them with training on their operationalization.
- w) Prepare a final EMR, setting out in detail the compliance level of all the EMP requirements and capacity strengthening of DoIC/ TIDCL to continue to comply with the EMP requirements during maintenance phase as part of the project completion report (PCR).

C. Inputs required:

- (1) Continuous basis from commencement to completion of the construction works (infrastructure development) at the designated industrial estates (estimated 35 months of intermittent input spread over construction phase of 36 months and 1 year O&M phase/ DLP phase).
- (2) Intermittent basis from commencement to completion of the construction works (infrastructure development) at the designated industrial estates (estimated 25 months

of intermittent input spread over construction phase of 36 months and 1 year O&M phase/ DLP phase).

**Terms of Reference for Engagement of Bio-Diversity Expert
(Designated from Tripura Forest Department)**

A. Minimum Qualification Requirements

The Bio-Diversity Expert should have a postgraduate degree in botany/ taxonomy/ environmental sciences with experience in bio-diversity studies for environmental assessment/ management plans in infrastructure development works. A thorough understanding of ADB's Safeguards Policy Statement, 2009 and other related guidelines, policies, and procedures of Government of India concerning environmental and social safeguards is preferable.

- Minimum General Experience : **8 years**
 - Minimum Specific Experience : **5 years**
- (candidate with Ph.D in Botany or Biodiversity will be preferred)

B. Detailed Tasks and/or Expected Output

- a) Assist the PMU, PIU and contractors in bio-diversity related matters during day-to-day implementation of ADB-cleared EMPs at all industrial estates.
- b) Assist implementing bio-diversity management checklists based on the EMPs for use by PIU and contractor's staff with environmental responsibilities, to undertake daily checks in their supervision and monitoring activities during pre-construction, construction, and maintenance phases.
- c) Support PIUs and their contractors in understanding the good practices for bio-diversity management, and the mitigation and monitoring requirements set out in the IEE and EMPs including the corrective actions required for each of the prioritized industrial estates.
- d) Assist PMU to update the IEE (additional assessment and consultations) and EMPs in the event of unanticipated impact on biodiversity, including a change in scope or design, or the siting or routing of project components.
- e) Assist PMU/ PIU to record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address exceedance of performance standards or non-compliance issues related to biodiversity matters.
- f) Assist PMU/ PIU to respond to any bio-diversity matters related like species identification prior to site selection, species selection for open area/ green area development during pre-construction, construction, and maintenance phases.

C. Inputs required: One Bio-Diversity Expert will be designated from Tripura Forest Department to oversee and guide the bio-diversity aspects of the project and will be available for entire project implementation period and O&M/DLP phase.

Terms of Reference for Engagement of Landscape Architect cum Horticultural Expert through PMSC

A. Minimum Qualification Requirements

The Landscape Architect cum Horticultural Expert should have a postgraduate degree in Architect with experience in all types of landscaping architect/ horticulture for development works. A thorough understanding of ADB's Safeguards Policy Statement, 2009 and other related guidelines, policies, and procedures of Government of India concerning environmental and social safeguards is preferable.

- Minimum General Experience : **10 years**
- Minimum Specific Experience : **5 years**
(relevant to assignment)

B. Detailed Tasks and/or Expected Output

- (i) Assist the PMU, PIU and contractors in horticulture related matters during day-to-day implementation of ADB-cleared EMPs at all industrial estates:
- (ii) Support PIUs and their contractors in understanding the good practices for horticulture management and monitoring requirements including the corrective actions required for each of the prioritized industrial estates.
- (iii) Assist PMU/ PIU to record and help DoIC/ TIDCL to develop and implement corrective action as necessary to address non- compliance issues related to horticulture related matters.
- (iv) Assist PMU/ PIU to respond to any horticulture related matters like species identification prior to site selection, site preparation, species selection for open area/ green area development during pre-construction, construction and maintenance phases.

C. Inputs required: Intermittent basis from commencement to completion of the construction works (infrastructure development) at the designated industrial estates (estimated 04 months of intermittent input spread over construction phase of 36 months and 1 year O&M phase/ DLP phase).

Appendix-10

Detailed Calculations of Budgetary Provision for EMP Implementation

Table-1: Civil Infra Works (Widening of Roads, SWD, Industrial Safety and Security)

Sl. No.	Description of Items of Work	Unit	Qty.	Final (in INR)	Amount (in INR)
A	Construction phase-18 months				
1	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Ambient Air Quality Monitoring , . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-18 months of 1 location, once a quarter (06 samples) of two sector/Component.	Nos.	6	7,129.02	42,774.12
2	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Water Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-18 months of 1 location, once a quarter (06 samples) of two sector/Component.	Nos.	6	10,693.53	64,161.18
3	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Noise Level Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-18 months of 1 location, once a quarter (06 samples) of two sector/Component.	Nos.	6	4,277.41	25,664.46
4	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Soil Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-18 months of 1 location, once a quarter (06 samples) of two sector/Component.	Nos.	6	12,119.33	72,715.98
Total (A)					205,315.74
B	Maintenance/ DLP phase- 60 months				
5	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Ambient Air Quality Monitoring , . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component of two sector/Component	Nos.	10	7,129.02	71,290.20
6	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Water Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	10,693.53	106,935.30
7	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Noise Level Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	4,277.41	42,774.10
8	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Soil Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	12,119.33	121,193.30
Total (B)					342,192.90
Total Cost (A + B)					547,508.64

Table-2: Tree Felling and Provision for Planting of Sapling within Dukli IE

Sl. No	Reference	Reference/ SOR Item #	Description of Items of Work	Unit	Qty.	Final Rate (in INR)	Amount (in INR)
A Tree felling Cost							
1	Rate given by Forest Department	Office of the Subdivisional Forest Officer, Sadar forest sub division, Agartala West Tripura wide letter no-No.F.6-5/Deptt./Timber/SSD/Vol -III/2023-24/905-07,Date-04-06-2024	Extraction of 13 (Thirteen) Nos. of tree from the land of Industry Department at Dukli IE (G/P) including transportation	Nos	13	24,227.00	24,227.00
Total (A)							24,227.00
B Provision for Planting of Saplings							
1	SOR 2023 PWD(R&B) Road & Bridge	Chapter - 11: Horticulture 11.6	Planting of Trees and their Maintenance for Two Year Planting of trees by the roadside (Avenue trees) in 0.60 m dia holes, 1 m deep dug in the ground, mixing the soil with decayed farmyard/sludge manure, planting the saplings, backfilling the trench, watering, fixing the tree guard and maintaining the plants for two years.	Nos	65	2,634.52	171,243.99
2		Chapter - 11: Horticulture 11.7	Making Tree Guard 53 cm dia and 1.3 m High as per Design from Empty Bitumen Drums Compensatory Afforestation Making tree guard 53 cm dia and 1.3 m high as per design from empty bitumen drum, slit suitably to permit sun and air including providing and fixing 2 nos MS sheet rings 50 x 0.5 mm with rivets, complete in all respect.	Nos	65	665.20	43,238.00
Total (B)							214,481.99
Total (A + B)							238,708.99
Total Estimate (Round-off)							238,709.00

Table-3: Upgradation of electrical & power supply and Installation of solar plant and mechanical accessories works

Sl. No.	Description of Items of Work	Unit	Qty.	Final (in INR)	Amount (in INR)
A	Construction phase-30 months				
1	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Ambient Air Quality Monitoring , . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-30 months of 1 location, once a quarter (10 samples) of two sector/Component.	Nos.	10	7,129.02	71,290.20
2	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Water Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-30 months of 1 location, once a quarter (10 samples) of two sector/Component.	Nos.	10	10,693.53	106,935.30
3	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Noise Level Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-30 months of 1 location, once a quarter (10 samples) of two sector/Component.	Nos.	10	4,277.41	42,774.10
4	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Soil Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Construction phase-30 months of 1 location, once a quarter (10 samples) of two sector/Component.	Nos.	10	12,119.33	121,193.30
Total (A)					342,192.90
B	Maintenance/ DLP phase- 60 months				
5	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Ambient Air Quality Monitoring , Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component of two sector/Component	Nos.	10	7,129.02	71,290.20
6	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Water Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	10,693.53	106,935.30
7	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Noise Level Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	4,277.41	42,774.10
8	Provision for carrying out environmental monitoring within IE through NABET Accredited Laboratory Soil Quality Monitoring . Monitoring locations shall cover all active construction sites, workforce camp site, material stack yard for Maintenance/ DLP phase- 60 months of 1 location, once in 6 months (10 samples) of two sector/Component	Nos.	10	12,119.33	121,193.30
Total (B)					342,192.90
Total Cost (A + B)					684,385.80

APPENDIX-11

**Format for Environmental Monitoring Report
(Semi-annual)**

Environmental Monitoring Report

Loan Number: -----

Reporting period: (month/year to month/year)

(Title of Project)

Prepared by: -----

Implementing Agency: -----

Executing Agency: -----

Date: (dd/ mm/ yyyy)

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1. Introduction
2. Compliance status with National /State /Local statutory environmental requirements
3. Compliance status with the environmental covenants as stipulated in the Loan Agreement
4. Compliance status with environmental management and monitoring plans and environmental assessment and review framework/procedures as stipulated in the environmental documentation as agreed with ADB
5. Approach and methodology engaged for environmental monitoring of the project
6. Monitoring of environmental receptors/ attributes (e.g. ambient air, surface water, ground water, land, ecological aspects, noise, hazardous/toxic wastes, etc.)
7. Any other environmental aspects, impacts observed during implementation which were not covered earlier
8. Details of complaints received from public and actions taken thereof to resolve
9. Follow-up actions and conclusions

1. Introduction

- overall project description;
- project objectives;
- environmental category;
- environmental performance indicators, if any;
- overall project progress, agreed milestones and implementation schedules;
- any other information useful for assessing environmental performance of the project

2. Compliance status with National /State /Local statutory environmental

requirements

- Tabular presentation of statutory environmental requirements for the project at national, state and local levels (applicable to the borrower, sub-borrowers, contractors, vendors, etc. as the case may be), and the status of compliance thereof.
- If the project is not in compliance with any of those requirements, the report would provide actions proposed for achieving compliance within an agreed time frame duly approved by the respective regulatory agencies.

3. Compliance status with the environmental covenants as stipulated in the Loan Agreement

- Tabular presentation of environmental covenants as stipulated in the Loan Agreement and the status of compliance thereof.
- If the project is not in compliance with any of those requirements, the report would provide actions proposed for achieving compliance within a time frame to be reviewed and approved by the ADB.

4. Compliance status with environmental management and monitoring plans as stipulated in the environmental documentation as agreed with ADB

- Tabular presentation of environmental management and monitoring plans and environmental assessment and review framework/procedures as agreed and the status of implementation thereof.
- The status chart would provide details of actions proposed to be taken by various agencies, including contractors/vendors for implementation, the current status of compliance.
- In case any corrective measures are warranted, the status chart would outline the corrective action plan with an agreed time frame duly agreed by all those agencies concerned for ADB's review and concurrence.
- In case of corrective measures are implemented based on the earlier monitoring, the status chart would elaborate clearly the improvements noticed and further steps required if any.

5. Approach and methodology engaged for environmental monitoring of the project

- Monitoring basis
 - rationale for selection of sampling/ monitoring locations,

- selection of environmental receptors /attributes for monitoring,
- linkage with environmental performance indicators agreed upon,
- phases of project – design, construction, operation
- Standards /monitoring methods to be employed for assessment
- Monitoring Quality Control

6. Monitoring of environmental receptors/ attributes (e.g. ambient air, surface water, ground water, land, ecological aspects, noise, hazardous/toxic wastes, etc.)

- Type of environmental receptor/attribute to be monitored (for each type)
 - Method of monitoring
 - Duration and frequency of monitoring
 - Equipment /instrumentation to be used for monitoring
 - Sampling locations/ sites for monitoring (linked with Enclosure-1: location map)
 - Reporting monitoring results (provide tabular presentation)
 - Detailed analyses of monitoring reports and conclusions (use histograms or any other methods)
 - Correlate the monitoring results with statutory requirements at national/state/local levels
 - Corrective actions proposed in case on non-compliance /improvements noticed due to corrective actions taken during the reporting period, and further actions required if any.
 - Recommendations /Suggestions.

7. Any other environmental aspects, impacts observed during implementation which were not covered earlier

8. Details of Grievance Redress Committee and complaints received from public and actions taken thereof to resolve

9. Follow-up actions and conclusions

Enclosure-1

Location Map for Environmentally Sensitive Sites and Monitoring Stations