

Draft Initial Environmental Examination

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India: Tripura Industrial Infrastructure Sector Development Program (Nagicherra Industrial Estate)

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

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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

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 November 2023)
Currency unit – Indian rupee (Rs)
Rs1.00 = \$0.012
\$1.00 = INR 83.40

NOTES

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

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EXECUTIVE SUMMARY

1. The Department of Industries & Commerce (DoIC), Government of Tripura has initiated an ambitious Project Readiness Financing (PRF) (Loan 6046-IND, the Project) for the infrastructure development of 9 prioritized industrial estates (IE) in Tripura state through Asian Development Bank's (ADB) loan. The DoIC has received the PRF facility from the ADB for preparation of feasibility and detailed project reports for the prioritized IEs in Tripura for the ensuing loan.

2. The DoIC is the 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 Consultant¹ (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) 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.

3. The sector development program (SDP) will support the state of Tripura to boost manufacturing sector's competitiveness through expansion and upgrading of industrial estates (IEs) and policy reforms to support private investment. The program comprises (i) a programmatic PBL component under which the Asian Development Bank (ADB) assisted the state government in implementing policy actions to strengthen institutional structures and mechanisms for industrial development, improve inclusiveness and enhance business environment; and (ii) an investment component, supported by project loan, which will build climate resilient industrial infrastructure and upgrade Tripura's industrial estates (IEs). The investment thus helps improve industrial infrastructure critical for industrialization, economic growth and job creation.

4. The proposed SDP will have three outputs, which include policy and investment components: (i) institutional structures and mechanisms for industrial development strengthened, and business environment enhanced, (ii) climate resilient infrastructure and gender responsive industrial environment built, and (iii) industrial estates developed and upgraded. IEs are a critical driver of industrialization;² the state government has prioritized the development of nine IEs with ADB's support.

5. **Output 1: Institutional structures and mechanisms for industrial development strengthened, and business environment enhanced.** This output includes key policy reforms critical for Tripura's industrial development. It includes adoption of a new industrial policy by the Government of Tripura (GoT) to promote industrial development and development of green IEs in the state, adoption of guidelines for zoning and gender responsible and inclusive building standards and measures to enhance climate resilience for industrial units in industrial parks. It also includes gender responsive industrial land allotment policy and establishment of Investment Promotion Agency of Tripura (IPAT). Project component under output 1 includes establishment of PMU and 4 PIUs within the TIDCL and dedicated environment social and gender (ESG) cell to address environmental, social, and

¹ M/s. Mott MacDonald Private Limited has been engaged by DoIC/ TIDCL as PDMC.

² UNIDO. 2019. International Guidelines for Industrial Parks.

gender related issues observed during implementation of infrastructure development within the 9 IEs under the proposed SDP. Output 1 also includes training programs in gender responsible industrial estate management and climate change and environmental safeguards.

6. **Output 2: Climate resilient infrastructure and gender responsive and inclusive industrial environment built.** This output includes both project and policy components. Policy component includes development and adoption of new skills policy to upgrade skills of the workforce in line with industry demand with specific emphasis for skill building of women especially in non-traditional and management sectors. It also includes adoption of State Policy for Empowerment of Women aimed at increasing employment of women in the state's IEs. Project components include development of 34 kms of climate resilient road infrastructure, adjoining utility trenches, 66 kms of storm water drainage and 70 rainwater harvesting system, with retention ponds built in 7 IEs. Project component also includes development of 35 kms of water supply distribution pipeline in 6 IEs. Project components under this output includes geo cell earth retaining wall for protection and erosion control. It also includes development of gender responsive infrastructure in the IEs, including dedicated space for day care centers in all 9 IEs with at least 3 centers operational, and gender desk in 6 IEs to address concerns of women workers.

7. **Output 3: Industrial estates developed and upgraded.** This output is the major component of the investment project and includes activities to develop and upgrade nine IEs. To ensure adequate energy supply in the IEs, power distribution network will be upgraded in all 9 IEs, while streetlights will be installed, and solar power facility will be established in 7 IEs. This output includes repair and restoration of CETP in 1 IE and building of common multi-facility building in 5 IEs. At least 26 additional industrial pre-engineered sheds will be built in 4 IEs, and parking area of 5 acres spread over 6 IEs will be developed. Transportation system in the IEs will be improved by introducing 4 compressed natural gas (CNG) buses, 18 electrical vehicles (EV), and 9 EV charging stations. To improve safety and security in IEs (i) 1 fire station will be upgraded; (ii) 7 weigh bridges built; (iii) 15 kms of boundary walls will be built in 8 IEs and another 11 kms of the existing wall will be upgraded; (iv) 23 watch towers will be built; (v) 600 cameras with junction board as security and surveillance systems will be installed; (vi) 1 integrated command and control center build to monitor 4 IEs in West Tripura. All the infrastructure developed and built will be inclusively managed, with women trained and provided employment opportunities in various facility management services as far as possible.

8. The project includes infrastructure development of nine IEs (namely Bodhjunnagar, R.K.Nagar, Kumarghat, Dhajanagar, Dharmanagar, Deewanpasa, Dukli, Sarasima & Nagicherra) spread across five districts in state of Tripura. Nagicherra is a greenfield IE of West Tripura district, is located 10 km from Agartala city center, 4 km from NH 8 and 7 km from Agartala Railway Station, thus ensuring smooth connectivity to other parts of the region. Nagicherra IE is spread over an area of 12.56 ha. and is adjacent to the rubber wood processing center owned by the Tripura Forest Development and Plantation Corporation (TFDPC), making it in an ideal location for manufacturing hub for rubber wood furniture and other rubber-based industries. Given that the IE is a greenfield, no infrastructure/ facilities are present except the boundary wall and a partially built brick road.

9. Based on the need analysis, infrastructure development components considered within the Nagicherra IE comprise of (i) development of vacant land into additional industrial

plots (17 nos. spread over 5.41 ha); (ii) utility corridor with a total length of 2.808 km and 1.75m width to accommodate power supply cables (HT/LT), Optical Fiber Cable (OFC), (iii) construction of internal roads of major and minor intersections/ junctions with adequate lighting facilities (1.404 km); (iv) storm water drains (3.434 km) with 6 culverts and 12 rainwater harvesting and recharging points; (v) construction of water supply (5 new deep tube wells, 5 pumphouses, raw water transmission pipelines, 4 raw water reservoirs of 70 KL each and 1 raw water reservoir 1350 KL with built fire reservoirs, 1 package type iron removal plant (30,000 GPH), 1 clear water reservoir with pumping station (400 KL), 1 overhead tank (750 KL), raw water pipelines (1.56 km), clear water rising mains and distribution pipelines 1.386 km; (vi) augmentation of power system (HT/ LT/ SCADA cables/ OFC); and 10 KW solar panels (vi) infrastructure and buildings for common facilities spread over nearly 8000 sqm, like common facilitation center 1640 sq.m; (vii) plots have been earmarked for future provisions like (a) Commercial shops & business center-1300 sqm; (b) residential housing-worker housing, staff quarter, women hostel (plot area of 3419 sq. m); (c) warehouse -4074 sqm. and (d) development of parks and open areas (2.77 ha); (viii) Two battery-operated small E-vehicles, along with the necessary charging infrastructure, have been proposed to improve internal mobility within IE.

10. All the proposed developments are within the existing boundary of Nagicherra IE, spread over an area of 12.56 ha. owned by TIDCL/ DoIC and does not involve any fresh land acquisition.

11. The Nagicherra being a green field industrial estate does not have any project component(s) which qualify as “existing facility” but has a 375m long approach road, which qualify as “associated facility³”. An onsite assessment of the ‘approach road’ indicate that adequate right of way is available, will not require felling of trees and does not have any other environmental concerns. The on-site assessment⁴ of the ‘approach road’ did not identify any past and present environmental concerns/ outstanding issues, which warrant corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

12. Since, Nagicherra IE is a green field site, it does not have any existing infrastructure, which qualify as ‘Existing Facilities’ and hence, does not warrant any corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

13. 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)

³ 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).

⁴ On-site assessment of the 375m long approach road to Nagicherra IE was carried out as a pre-cursor to the IEE. The assessment included field inspection and interactions with the concerned PWD officials of Govt. of Tripura. The field inspection indicated the approach road has adequate right of way with no sensitive receptors like educational institutions/ hospitals/ religious structures, surface water bodies, lakes, forest/ ecologically sensitive areas, flood/ inundation/ drainage concerns within its 15m on either side.

along with institutional arrangements to mitigate the likely impacts during construction and operation phases of the IE under the project.

14. The IEE report has determined that the proposed development works at Nagicherra IE will not require prior environmental clearance (as per EIA notification 2006 and amendments thereof) either from the state or central levels in compliance with environmental regulations of the country. However, the contractor will be required to obtain permission of 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. No Objection Certificate (NOC) will be required from the Central Ground Water Authority for the construction of new tube wells to meet the projected industrial water demand of the IE. Seeking such required extensions, permissions, consents, and NOCs by following the duly laid down procedure will not pose any regulatory risks.

15. Geologically, the core and buffer zones⁵ 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.

16. The core and buffer zones fall 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 core and buffer zones 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 35 km aerial distance from the Nagicherra IE.

17. The elevation of Nagicherra IE ranges between 32 to 50 meters above mean sea level (MSL) and is at a relatively higher level as compared to the surrounding region. Consequently, Nagicherra 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.

18. The climate of the core and buffer zones 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 35⁰C to 40⁰C and average minimum temperature is in winter nights range between 6⁰C to 8⁰C.

19. The average annual rainfall received in the core and buffer zones between years 2018 and 2022 is 1862 mm, most of which occurring between May to October months. The visibility range between 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

⁵ IEE considers Nagicherra IE and a 500m wide strip all along its periphery as core zone and entire West Tripura district as buffer zone for assessment of baseline environment.

the year. The wind speed ranges between 1 to 19 km per hour for 247 days and calm days for nearly 117 days in normal years.

20. The baseline environmental monitoring (ambient air quality, ambient noise levels, surface and ground water, and soil quality) within the Nagicherra IE 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.

21. 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 at a distance of 11.24 km from the Nagicherra IE, in the adjoining Sepahijala district.

22. Ecological investigations carried out through I-BAT has cataloged 57 flora and 143 fauna groups within 500m core zone, including Nagicherra IE, as compared to the 205 flora and 251 fauna groups in the buffer zone for IBAT (beyond 500m and up to 20 kms). This abridgement in the flora and its richness in the core zone can be attributed to the anthropogenic activity, limited industrial operations and consequent environmental stressors within the Nagicherra IE. None of the taxa identified during the investigation was found to be under the rare endangered and threatened (RET) category. The proposed improvement works will not require any tree felling within Nagicherra IE.

23. 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 both core and buffer zones during the past 8-10 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.

24. Tripura has eight protected archeological and/or historical monuments protected under the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and amendments thereof. However, none of them are within core zone i.e. Nagicherra IE and its peripheral area up to 500m.

25. Tripura state as a whole 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 on Seismic Zone-V and has higher probability of occurrence of big earthquakes measuring 8 and above on Richter scale.

26. The IEE report has not identified any significant and irreversible environmental impacts 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 due to the proposed improvements. However, the proposed improvements will have localized, largely reversible short-term impacts, confined to the Nagicherra IE boundary.

27. 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 operation phases of the IE. 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 stage.

28. Additionally, several environmental conservation measures have been considered in the EMP like balancing the cut and fill quantities of earthwork (1,29,220 cum), construction of one stormwater holding/ retention pond with a capacity of 3.6 million liters, groundwater recharging/ percolation wells at 13 locations, rain water harvesting and recharging at 1 location (CFC building), development of landscaped green belt in open areas (2.77 ha) and periodical monitoring of ambient air quality, ambient noise levels, water, soil quality at construction sites have been considered along with necessary budgetary provisions (INR 33,11,298). Capacity development for PMU, PIUs, and contractors have also been included in the EMP.

29. Alternative analysis has compared options like (i) no project scenario (ii) proposed improvement 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 other stake holders during pre-construction, construction, and operation phases of the IE development.

30. Based on the baseline environmental assessment of the core and buffer zones and the proposed infrastructure improvement works within Nagicherra IE, the IEE has not identified any significant and irreversible long term environmental impacts on environmental attributes such as geology, hydrogeology, soil, flora, fauna etc. of the core and buffer zones.

31. The proposed improvements will however have short-term and localized construction stage impacts confined to the existing boundary. The construction of the natural gas pipe network (2.808 km) and addition of 10 KW solar power generation component within solar park of IE will lead to 43.47% reduction in greenhouse gases (GHG) emissions by offsetting the energy demand from fossil fuel.

32. The rapid environmental assessment (REA) checklist (ref. **Appendix-1**) has been prepared for Nagicherra IE. As per ADB's SPS 2009, the Nagicherra IE is defined as "category B" for environment safeguards and the IEE report has been prepared.

1.0 INTRODUCTION

1.1 Background

33. 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.

34. The DoIC is the executing agency (EA) and Tripura Industrial Development Corporation Limited (TIDCL) is designated as implementing agency (IA) for the PRF. The DoIC has engaged a Project Design and Management Consultant⁶ (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 ADB loan.

1.2 Prioritized Industrial Estates

35. 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 remaining 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	Bodhjungnagar	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	Deewanpasa	Dharmanagar	North Tripura	Existing/ Brownfield	3.22	7.95
5	Nagicherra	Agartala	West Tripura	New/ Greenfield	12.56	31.02
6	Dukli	Agartala	West Tripura	Existing/ Brownfield	22.51	55.6
7	Dharmanagar	Dharmanagar	North Tripura	Existing/ Brownfield	7.61	18.79
8	Dhajanagar	Udaipur	Gomati	Existing/ Brownfield	15.94	39.38
9	Sarasima	Belonia	South Tripura	Existing/ Brownfield	16.30	40.27

1.3 Objectives and Methodology of IEE

36. The green field Nagicherra IE 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.

37. The entire Nagicherra 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

⁶ M/s. Mott MacDonald Private Limited has been engaged by DoIC/ TIDCL as PDMC.

environment. The core zone can be vulnerable to various construction activities during the project implementation stage. The West Tripura district as a whole has been considered as a buffer zone for assessment of the baseline environmental conditions within the region surrounding the Nagicherra IE.

38. The baseline environmental profile of the core and buffer zones that have been assessed includes 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.

39. 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 the IEE Report

40. 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

41. 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 Nagicherra IE development is presented in this section.

2.1 Applicable Regulations of GoI/Government of Tripura

42. The GoI has laid out various policies, acts, regulations, and guidelines pertaining to environment safeguards requirements for varied type 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 Nagicherra IE are given in **Table 2-1**.

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

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra 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 relate 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 Nagicherra IE does not fall under the listed projects and activities of 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 method 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 Nagicherra 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 Nagicherra IE will not require prior environmental clearance under the current EIA Notification, 2006 and its amendments thereof.
4.	MoEF&CC Notification for use of fly ash, 28 th	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for	No There is no coal based thermal power plant within 300 km of the

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
	April 2016.	disposal	Nagicherra IE. The improvement of Nagicherra 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 Nagicherra 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 Nagicherra 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 The infrastructure development of Nagicherra IE is limited to the land owned by DoIC, Govt. of Tripura. The development work within IE will not warrant felling of trees. Therefore, no permissions for tree felling will be required from the Tripura Forest Department.
8.	The Wildlife Protection Act, 1972	To protect wildlife such as National Parks and Sanctuaries	No. Sepahijala WLS Wildlife Sanctuary and its notified eco-sensitive zone is the nearest protected area located at 11.24 km from the Nagicherra industrial estate (ref. Figure 4-11 under Section 4).
9.	Biological Diversity Act, 2002 and Biological Diversity (Amendment) ACT, 2023	Conservation of biodiversity	No 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	Not applicable as subprojects components are not located in or near to designated wetland area.

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
		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.	
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 Nagicherra 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 Nagicherra 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 Nagicherra IE.
14.	The Explosive Act 1884	Safe transportation, storage, and use of explosive material	No (as explosive are prohibited to be used.)
15.	The Mines and Minerals (Development and Regulation) Act 1957	For opening new quarry.	No Only licensed quarries will be used, and no new quarries will be developed for sourcing sand. 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, contractor shall obtain clearances from State Environmental Impact Assessment Authority (SEIAA)/ State Pollution Control Board and other competent authorities as per environmental regulations. Nagicherra 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.
16.	The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010	Conservation of cultural and historical remains found in India	No 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)

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
	and The Tripura Ancient Monuments and Archaeological Sites and Remains Act, 1997		Act, 2010 and amendments thereof. Nagicherra industrial estate does not have any such protected monument and archaeological sites within 300 meters in all directions. 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.
17.	Municipal Solid Waste (Management & Handling) Rules, 2000 (MSW Rules)	Segregation, Handling & safe disposal of domestic solid waste	Yes Solid waste generated at proposed facilities shall be managed and disposed in accordance with the Rules. 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.
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 contractors' responsibility for compliance during construction stage. Contractor 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 contractors' responsibility for compliance during construction stage. Contractor shall obtain requisite Pollution Under Control certificates during construction stage for all vehicles

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
			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 And Regulation) Act, 1986	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 forth in the Schedule, after his school hours or during vacations.	Yes No children between the ages of 14 to 18 years will be engaged in hazardous working conditions. This shall be contractors' responsibility for compliance.
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 Contractor shall register with 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 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

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
			main contractor (who has been awarded) will also be responsible, if the sub-contractors 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 Water Act, 1974; Water Cess Act, 1977; Forest (Conservation) Act, 1980; Air Act, 1981; Environment (Protection) Act, 1986; Public Liability 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.	Yes Stakeholders / affected persons may approach NGT to resolve project induced environmental issues. This shall be DoIC and contractors' responsibility for compliance.
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

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
30.	The Petroleum Rules, 2002	Safe use and storage of petroleum products and 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.
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 Contractor shall obtain the requisite licenses for handling and disposal of E-waste generated (if becomes applicable) during 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	Yes NOC shall be obtained by DoIC/ TIDCL for construction of new tube wells within the industrial estate for industrial use. NOC shall be obtained in accordance with the notification by the Ministry of Jal Shakti/ CGWA, vide Gol, gazette notification dated 24 th Sept. 2020.

Sl. No.	Act / Rules	Key Purpose	Applicability to Nagicherra industrial estate
34.	Construction & Demolition, Waste Management Rules, 2016	This rule shall be applicable to construction waste/debris resulting from construction activities	<p>Not anticipated since the infrastructure within the existing Nagicherra IE is merely being upgraded and unlikely to generate demolition waste as per Rules.</p> <p>Applicable only, if the developmental activities within Nagicherra industrial estate is likely to generate more than 20MT waste per day and/or 300 MT in a month, a project specific waste management plan will be required as per the stipulations under this rule.</p> <p>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.</p>
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.	<p>Yes</p> <p>This shall be DoIC/ TIDCL's responsibility for compliance</p>
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 has to 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.	<p>Yes</p> <p>Applicable to the Nagicherra IE infrastructure in terms of making it more accessible to person with disabilities/physically challenged and project design considers the same.</p>

2.2 ADB’s Safeguard Requirements

43. 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.

44. The process of determining a project’s environment category is to prepare a Rapid Environmental Assessment (REA) checklist, taking into account 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 to 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.

45. The rapid environmental assessment checklist (ref. Appendix-1) has been prepared for the **Nagicherra** IE development indicates that it is unlikely to cause irreversible and significant adverse impacts. Therefore, as per ADB’s SPS 2009, Nagicherra IE is categorized as “category B” for environmental safeguards and the IEE report including EMP (component-wise) has been prepared.

2.3 Statutory Clearances and Permissions

46. The pre-construction and construction stage statutory clearances/ permissions required for the **Nagicherra** IE development is given in **Table 2-2**.

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

Sl. No.	Clearances/ Permissions required	Competent Authority to Accord Clearances	Responsibility to Obtain Clearance
A. Pre-construction Stage			
1	No Objection Certificate (NOC) for construction of new tube wells for	Central Ground Water Authority, Govt. of India/ Designated/	TIDCL/ DoIC, Govt of Tripura

Sl. No.	Clearances/ Permissions required	Competent Authority to Accord Clearances	Responsibility to Obtain Clearance
	industrial use within Nagicherra industrial estate	Competent Department of the State Govt. of Tripura	
B. Construction Stage			
1	Consent to establish and 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. License will be required only if 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 & unskilled)	Respective District Level Labour Officer under Directorate of Labour, Govt. of Tripura	Respective PIU/ Contractor

3.0 DESCRIPTION OF THE PROJECT

3.1 Nagicherra Industrial Estate

47. Nagicherra is a green field Industrial Estate and is located in Dukli Block of West Tripura district and is 10 km from Agartala city Centre. The national highway NH-8 is 4 Kms away from the Industrial Estate and it further connects to NH-8, ensuring smooth connectivity to other parts of the region. The Latitude and Longitude of the Nagicherra industrial estate is 23°47'25.34"N and 91°20'3.21"E. respectively.

48. Nagicherra IE is spread over an area of 12.56 ha. and is adjacent to the rubber wood processing center owned by the Tripura Forest Development and Plantation Corporation (TFDPC), making it in an ideal location for manufacturing hub for rubber wood furniture and other rubber-based industries. Given that the IE is a greenfield, no infrastructure/ facilities are present except the boundary wall and a partially built brick road.

49. Nagicherra IE is in proximity to R. K Nagar & Bodhjunnagar industrial estates, which are also the prioritized industrial estates under the ensuing ADB loan. All these industrial estates have rail, road and air connectivity to the rest of the country and adjacent Bangladesh for accessing both domestic and international markets.

50. The salient features of Nagicherra 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 Nagicherra IE

Particulars	Features
Location	Dukli Block, West Tripura District. Latitude - 23°47'25.34"N Longitude - 91°20'3.21"E.
Total Land Area for development	31.02 acres / 12.56 hectares (As per Revenue Records).
Ownership	Tripura Industrial Development Corporation Limited (TIDCL).
Topography	Undulating Terrain
Connectivity	4 km from NH 8 7km from Nearest Railway Station 12 km from Agartala Integrated Check Post (ICP)
Distance of wetland (Protected/RAMSAR Site)	RAMSAR site: Neermahal is located at 35 Kms from Nagicherra IE
distance from Reserve Forest area/forest area.	IE is not located close to any forest areas.
Existing facilities	None except a boundary wall and a partially built brick road
New facilities	New industrial plots, Roads, Stormwater drains, Construction of water supply, solar, Infrastructure and buildings for common facilities

3.2 Associated and Existing Facility

51. The Nagicherra, a green field (new) industrial estate, has an existing approach road of 375m length from the nearby passing other district road, which further connects to NH-8 at a distance of 4 km (ref. **Figure 3-2**). The 375m long approach road is dedicated to IE but the

widening/ upgradation of the road will be undertaken through the state funds by the Public Works Department (PWD), Govt. of Tripura and is not included under the ensuing ADB loan. Since the approach road is critical for the effective functioning of IE, it qualify as “associated facility” in accordance with ADB’s SPS, 2009.

52. An on-site assessment of the ‘approach road’ indicates that adequate right of way is available, will not require felling of trees and does not have any other environmental concerns. The on-site assessment⁷ of the ‘approach road’ did not identify any past and present environmental concerns/ outstanding issues, which warrant corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

53. Since, Nagicherra IE is a green field site, it does not have any existing infrastructure, which qualify as ‘Existing Facilities’ and hence, does not warrant any corrective action plan to address environmental concerns or any other outstanding regulatory compliance(s) in accordance with the ADB’s SPS, 2009.

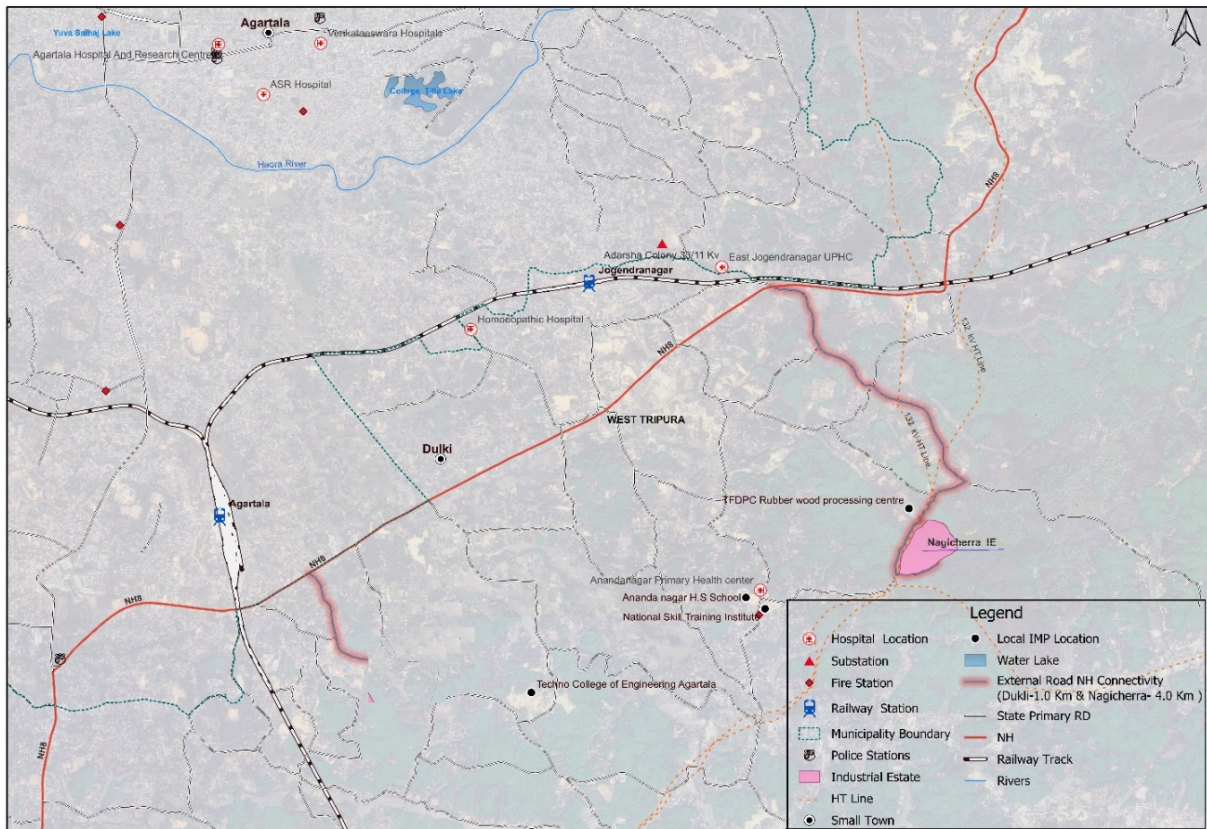


Figure 3-1: Regional Connectivity of Nagicherra IE

⁷ On-site assessment of the 375m long approach road to Nagicherra IE was carried out as a pre-cursor to the IEE. The assessment included field inspection and interactions with the concerned PWD officials of Govt. of Tripura. The field inspection indicated the approach road has adequate right of way with no sensitive receptors like educational institutions/ hospitals/ religious structures, surface water bodies, lakes, forest/ ecologically sensitive areas, flood/ inundation/ drainage concerns within its 15m on either side.

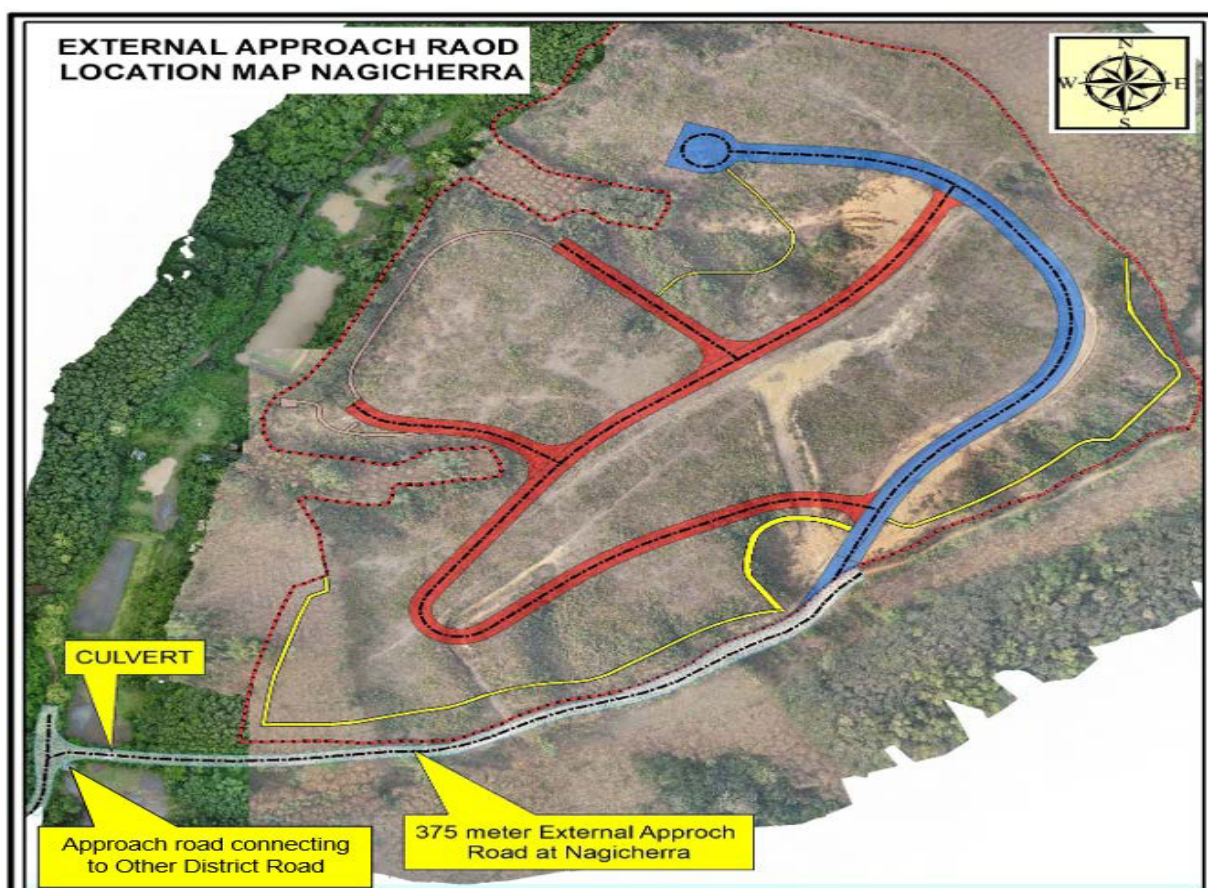


Figure 3-2: Location Plan of ‘Approach Road’ qualifying as Associated Facility

3.3 Proposed Development Works

54. Based on the need analysis, the infrastructure works considered within the Nagicherra IE comprise development of land into Industrial plots, construction of internal roads, storm water drainage, water supply, power system, natural gas network, social infrastructure amenities like common facilitation center, shops & business center, residential housing, development of parks and open areas among others. The proposed master plan development along with the respective land use distribution is shown in **Figure 3-3**. The summary of development components considered within Nagicherra is given **Table 3-2**.

Table 3-2: Development Components of Nagicherra IE

Sl. No.	Development Components	Proposed
1	New Industrial Plots	17 plots, spread over 5.41 ha
2	Utility corridor	length - 2808 m and width - 1.75 m with SWD, Green Area Development along roadside - 2106 sqm.
3	Roads	1.404 km rigid pavements have been considered. (0.532 km with 12m RoW and 0.872 km with 10 ROW).
4	Stormwater drains	3.434 km along both sides of roads along with 06 culverts 12 Rainwater Harvesting and Recharging Points
5	Construction of water supply	Water demand 1.31 MLD Source of water- Ground water Proposed deep tube wells (DTW) – 5 nos 1 no piezometric well, 5 no. Pumphouses,

Sl. No.	Development Components	Proposed
		<p>Raw Water Pipelines: various dia with total length 1560 m</p> <ol style="list-style-type: none"> 1) (P-DTW 1) Pump to Fire cum Raw Water Reservoir (RWR) UGSR- 5 HP, (1W+1S), 10.5 lps, Head - 18 m, Suction Pipe - 125 mm, Delivery -125 mm RM Length - 520 m, Dia - 125 mm, Mat - DI K9. 2) (P-DTW 2) Pump to Fire UGSR- 5 HP, (1W+1S), 10.5 lps, Head - 18 m, Suction Pipe - 125 mm, Delivery -125 mm RM Length - 450 m, Dia - 125 mm, Mat - DI K9. 3) (P-DTW 3) Pump to Fire UGSR- 5 HP, (1W+1S), 10.5 lps, Head - 13 m, Suction Pipe - 125 mm, Delivery -125 mm RM Length - 220 m, Dia - 125 mm, Mat - DI K9. 4) (P-DTW 4) Pump to Fire UGSR- 5 HP, (1W+1S), 10.5 lps, Head - 16 m, Suction Pipe - 125 mm, Delivery -125 mm RM Length - 225 m, Dia - 125 mm, Mat - DI K9 5) (P-DTW 5) Pump to Fire UGSR- 5 HP, (1W+1S), 10.5 lps, Head - 15 m, Suction Pipe - 125 mm, Delivery -125 mm RM Length - 115 m, Dia - 125 mm, Mat - DI K9. 6) Fire cum Raw Water Reservoir (RWR) to Iron Removal Plant (IRP) - 15 HP, (1W+1S), 36.27 lps, Head - 17 m, Suction Pipe - 200 mm, Delivery -200 mm RM Length -30 m, Dia - 150 mm, Mat - DI K9. <p>Clear water pipeline: total length 1386m</p> <ol style="list-style-type: none"> 1) Pump to pure water sump to P-OHT- 20 HP, (1W+1S), 38.28 lps, Head - 23 m, Suction Pipe - 200 mm, Delivery -200 mm RM Length - 50 m, Dia - 200 mm, Mat - DI K9. 2) Raw Water reservoir Sump (70 KL each), Fire reservoir within RWS of 1350 KL capacity. 3) 1 no. Centralized Water Treatment Plant- Iron Removal Plant (IRP) of capacity 30000 GPH with CWR (450KL) and Pumping Station. 4) 1 no. OHT of 750 KL, Clear water rising main, distribution pipeline of about 1.386 Kms, plot service connections.
6	Infrastructure and buildings for common facilities	<p>Spread over approx. 8,000 sqm plot area and 1640 sqm of built-up area- comprising: common facilitation centre (administrative office, creche facility, dispensary, canteen), industrial shed, parking area, public toilet and food kiosk etc.</p> <p>Plots have been earmarked for future provisions for residential & commercial facilities such as (workers housing, staff quarters and women's hostel, Warehouse, commercial shopping complex etc)</p>
7	Industrial Safety & Security	<p>Total boundary wall – 1635 m, (upgradation of existing boundary wall – 857-meter, construction of new boundary wall with barbed wire of height 2.5m- 278 m, construction of new boundary wall with grill- 500 m</p> <p>Gate – 2 Nos.</p> <p>Security Cabin – 1 Nos.</p> <p>Watch Towers – 3 nos. Security & Surveillance System (fixed outdoor camera-30 and PTZ- 11 with junction box-13) Fire and Safety System</p> <p>Signage – direction and informative signages</p>
8	Electrical works	<ul style="list-style-type: none"> • Replacement of 1x7.5 MVA Power Transformer by 1x10 MVA • Power Transformer, • 33 KV Breaker (Outdoor), 11 KV VCB Indoor Breakers, • 33 KV Control Relay Panel, and 33 KV & 11 KV CTs & PTs shall be replaced at Adarsha Colony S/s, • New 11 KV bay for 2 nos outgoing UG cable towards IE, • Two nos 185 sq.mm UG XLPE cable shall be laid from the 11 KV bay of Adarsha Colony S/s up to IE,

Sl. No.	Development Components	Proposed
		<ul style="list-style-type: none"> Laying of ACSR Weasel Covered conductor on GI Pole of 11 m, for entire road route length of 1.6 Kms, Installation of energy efficient distribution transformers of 500KVA, 315KVA and 200KVA capacity, Laying of LT OH with ABC 150 sqm cable shall be laid composite with 11 KV feeder, Street Light with 100-Watt LED Luminaire, 4 Nos High Masts 10 KW solar power panels
7	Public Transport	<ul style="list-style-type: none"> Two battery-operated small E- vehicles along with the necessary charging infrastructure have been proposed.

55. It can be seen from **Table 3-3** that Nagicherra IE has 12.56 ha. vacant land area, which has been utilized for all the proposed components under the masterplan development.

Table 3-3: Proposed Land Use under Masterplan Development for Nagicherra IE

Sl. No.	Land Use	Standard as per URDPFI Guidelines (%)	Net Area (ha)	In %
1	Industrial Area Plotted development & Industrial Sheds	45 – 50%	5.41	43.10%
2	Transportation Roads, Junction, Parking etc.	16 – 18%	1.364	10.86%
3	Facilities <u>Public and Semi- Public:</u> Health care centre, educational institutes, weighbridge, and administration etc. <u>Utilities:</u> Electric substation, Pumping Stations, Underground Reservoirs/ Firefighting tanks and other utilities, etc.	6 – 8%	2.68	21.31%
4	Residential Staff Quarters	2 0%	0.34	2.71%
5	Green & Open Space Parks, green area and open areas around it, steep slopes, and low-lying lands	8 – 10%	2.77	22.02%
Total			12.56	100%

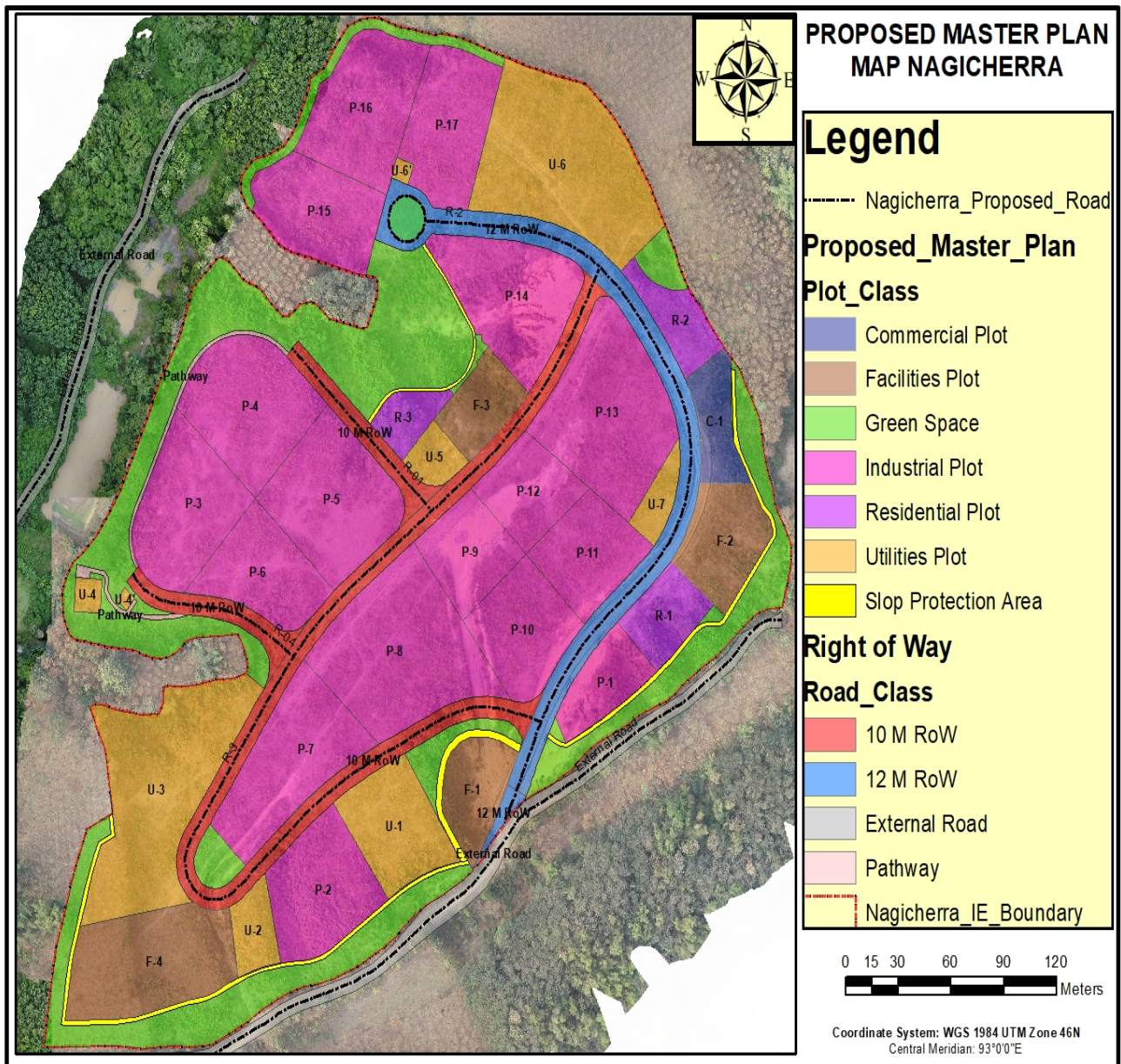


Figure 3-3: Proposed Land Use under Master Plan Development for Nagicherra IE

3.4 Development of Industrial Plots

56. At present, Nagicherra IE has got 12.56 ha of vacant land, which is available for the development of industrial plots and other amenities. In accordance with the need analysis, the masterplan for infrastructure development has considered 5.41 ha of land for development of 17 industrial plots, constitute mere 43.10% area of the overall Nagicherra IE (ref. Table 3-3).

3.5 Infrastructure and Common Facilities

57. Based on the need analysis, the proposed masterplan development for infrastructure and common facilities is spread over 2.68 ha (ref. Table 3-3), which includes common facilitation center, residential and commercial facilities and other common facilities as given in **Table 3-4** and **Figure 3-4**.

Table 3-4: Proposed Infrastructure and Common Facilities for Nagicherra IE

Sl. No.	Type of Facilities	Provisions
1.	Common Facilitation Center	To be developed over a plot area of 2156.74 sq. m (0.2156 ha) with a built-up area of 1640 sq. m.
a.	Administrative Office	It would include TIDCL office, other office halls and spaces which can be used for banks and small financing institutions. Furthermore, it would have conference hall, courier dispatch room and tax/GST room for smooth functioning of industries.
b.	Creche facility	Total area allocated is 88 sq.m. for 30 children
c.	Dispensary	Total area allocated is 46 sq. mts.
d.	Canteen	Total area allocated is 118 sq.m. including kitchen for both workers and visitors.
e.	Miscellaneous utility centers	Provision of 1000 sq.m for printing/ xerox center, multipurpose hall, dining/pantry, control room & surveillance, server/UPS/AHU room, electrical room, public toilets and ATM.
2.	Residential facilities	Plots have been earmarked for future provisions for residential facilities such as workers housing, staff quarters and women's hostel has been proposed.
a.	Staff quarter, Worker's housing and Working women Hostel	Provision for worker housing over a plot area of 827.27 sq. m has been reserved for Eight units of staff quarters (G+1) and Worker housing with total plot area of 1375 sq.m. has been proposed for staff engaged in daily operation and maintenance activities within the estate. Additionally, there is also a provision for working women's hostel with plot area up of 1216 sq. m.
3.	Commercial facilities	A commercial center having future provisions for shops have been proposed. The plot area is 1300 sq.m.
4.	Other common facilities	
a.	Industrial shed	A plot area of 2849.11 sq.m. has been earmarked for industrial shed for industrial sheds of micro and small industries and built up area is 2405 sqm, and Total no of industrial sheds are 5 nos
b.	Warehouse	A Warehouse have been proposed for the storage of raw materials, work-in-progress inventory, and finished goods. The plot area of proposed future provision warehouse is 4074 sq.m.
c.	Truck parking	A plot area of 1,613 sq.m has been proposed for truck parking (872 sq.m.) and weigh bridge (741 sq.m.) at the entry to the estate on the southeastern side. Additionally, another plot area of 1,394 sq.m. has been proposed for truck parking at the center of the estate near the retention pond. Together, the total truck parking area of 2,135 sq.m. can accommodate 24 trucks at a time.
d.	Weigh bridge	Has been planned near Gate 1
e.	Food Kiosk	Within the truck parking and weigh bridge zone, 02 nos. of food kiosk has been proposed; the floor plan is 12 sqm..
f.	Public toilet	A common public toilet is proposed adjacent to the food kiosk near the truck parking area while another public toilet is proposed in the truck parking located near the retention pond.
g.	Safety and security	Total boundary wall – 1635 meter, (upgradation of existing boundary wall – 857 meter, construction of new boundary wall with barbed wire of height 2.5m- 278 m, construction of new boundary wall with grill- 500 m, Gate – 2 Nos, Security Cabin – 1 Nos, Watch Towers – 5 nos., Security & Surveillance System, Fire and Safety System, Signage – direction and informative signages..

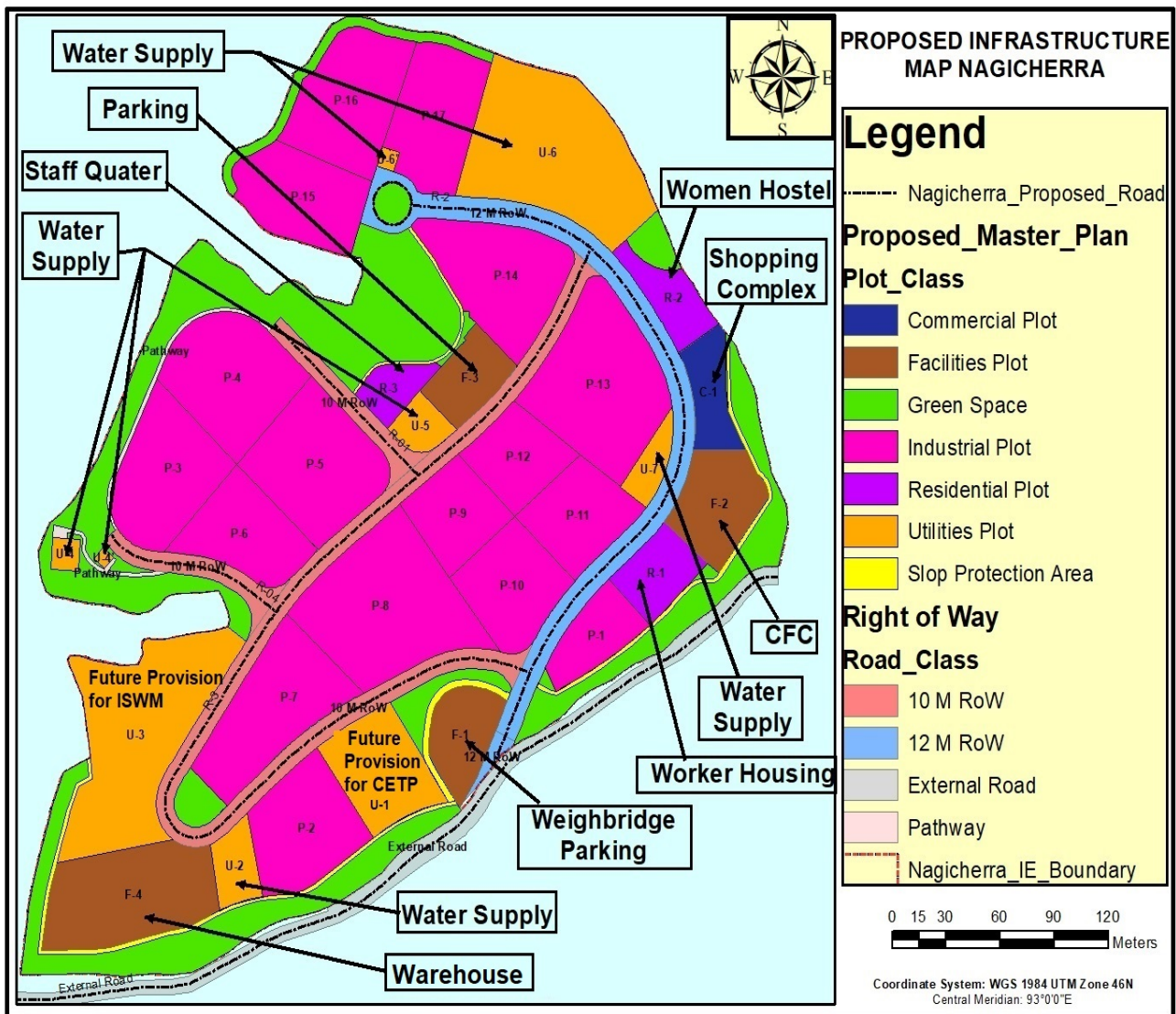


Figure 3-4: Proposed Infrastructure and Common Facilities

3.6 Construction of Roads

58. Nagicherra is a green field industrial and currently no industries are in operation. The IE has no existing bituminous/rigid pavement road except a brick road pathway of 0.634 Km long with carriageway width of 7.0 m and serves as the temporary access.

59. Under the proposed development, 1.404 km road with rigid pavement have been considered (0.532 km with 12m RoW and 0.872 km with 10 ROW). All major and minor intersections/ junctions are provided with adequate lighting facilities as per the IRC standards.

60. The road network as per the proposed masterplan development along with typical cross sections are given in **Figures 3-5 & 3-6** respectively.

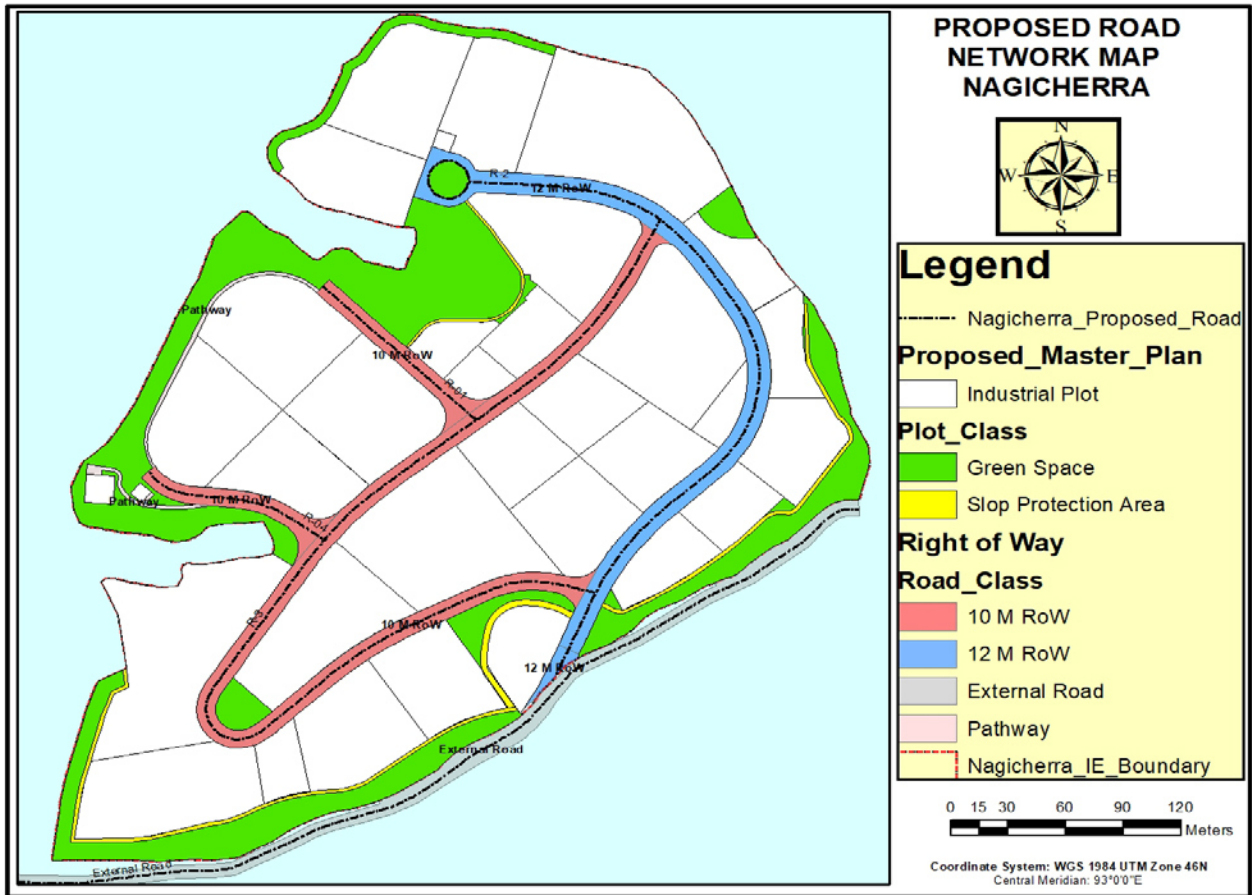
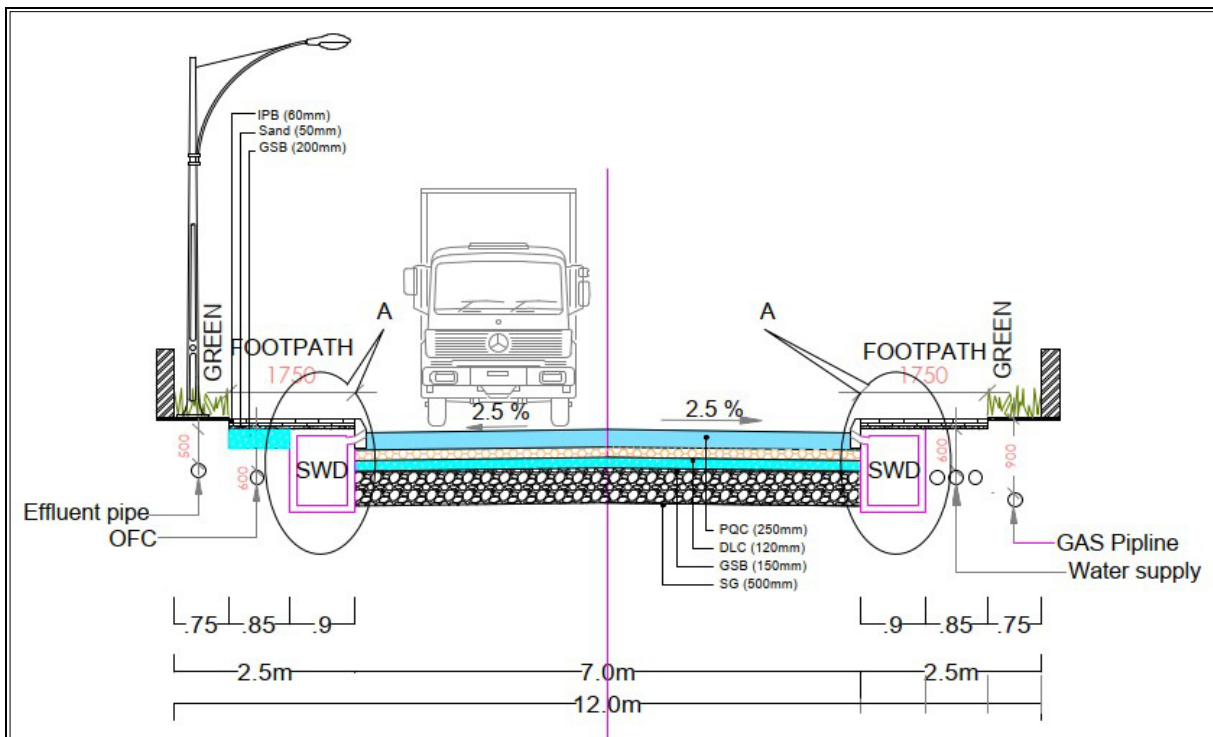


Figure 3-5: Proposed Road Network as per Master Plan Development



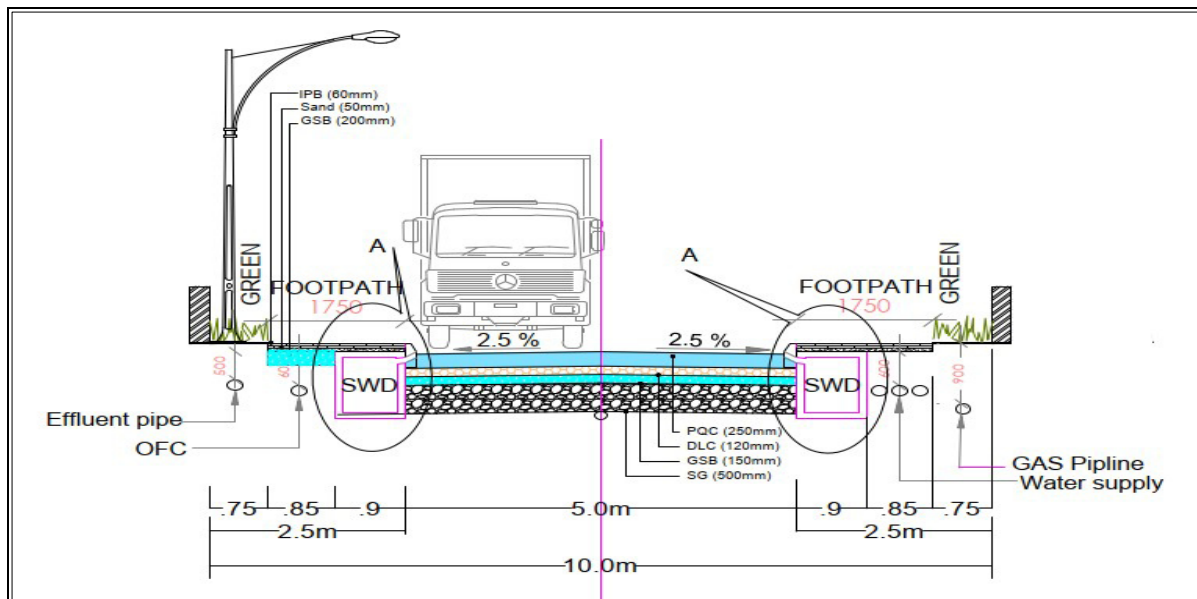


Figure 3-6: Typical Section of Proposed Roads within Nagicherra IE

3.7 Construction of Water Supply & Treatment

61. At present Nagicherra IE has no water supply demand and does not have any infrastructure for water source, storage, treatment and distribution. Hence it is warranted to develop all the required new infrastructure.

62. The projected water demand of the IE for 30-year design period is given in **Table 3-5**. Accordingly, proposed components of water supply scheme are as given in **Table 3-6**. The augmented water supply distribution system along with the schematic layout is given in **Figures 3-7 & 3-8**.

Table 3-5: Water Demand Projection for Nagicherra IE

Sl. No.	Particulars	Projected workforce/ Population	Water Demand (MLD)		
			Domestic	Industrial	Total
1	Base year (2025)	317	0.018	0.248	0.266
2	Intermediate Phase (2040)	1156	0.065	1.240	1.305
3	Ultimate Phase (2055)	1156	0.065	1.240	1.305

Table 3-6: Proposed Components of Water Supply Scheme

Sl. No.	Components	Quantities
1	Deep Tube Wells (DTW)	5 nos
2	Pump Houses	5 nos
3	Raw Water Transmission Pipelines-various dia	1560m
4	4 raw water reservoirs of 70 KL each and 1 raw water reservoir cum fire reservoir of 1350 KL	5 nos
5	Iron Removal Plant (30,000 GPH) with clear water reservoir (450 KL) and Pumping Station	1 no
6	Overhead Tank (750 KL)	1 no
7	Clear water distribution pipelines-various dia	1386m
8	Other Ancillary Items, plot service connection and SCADA	As required

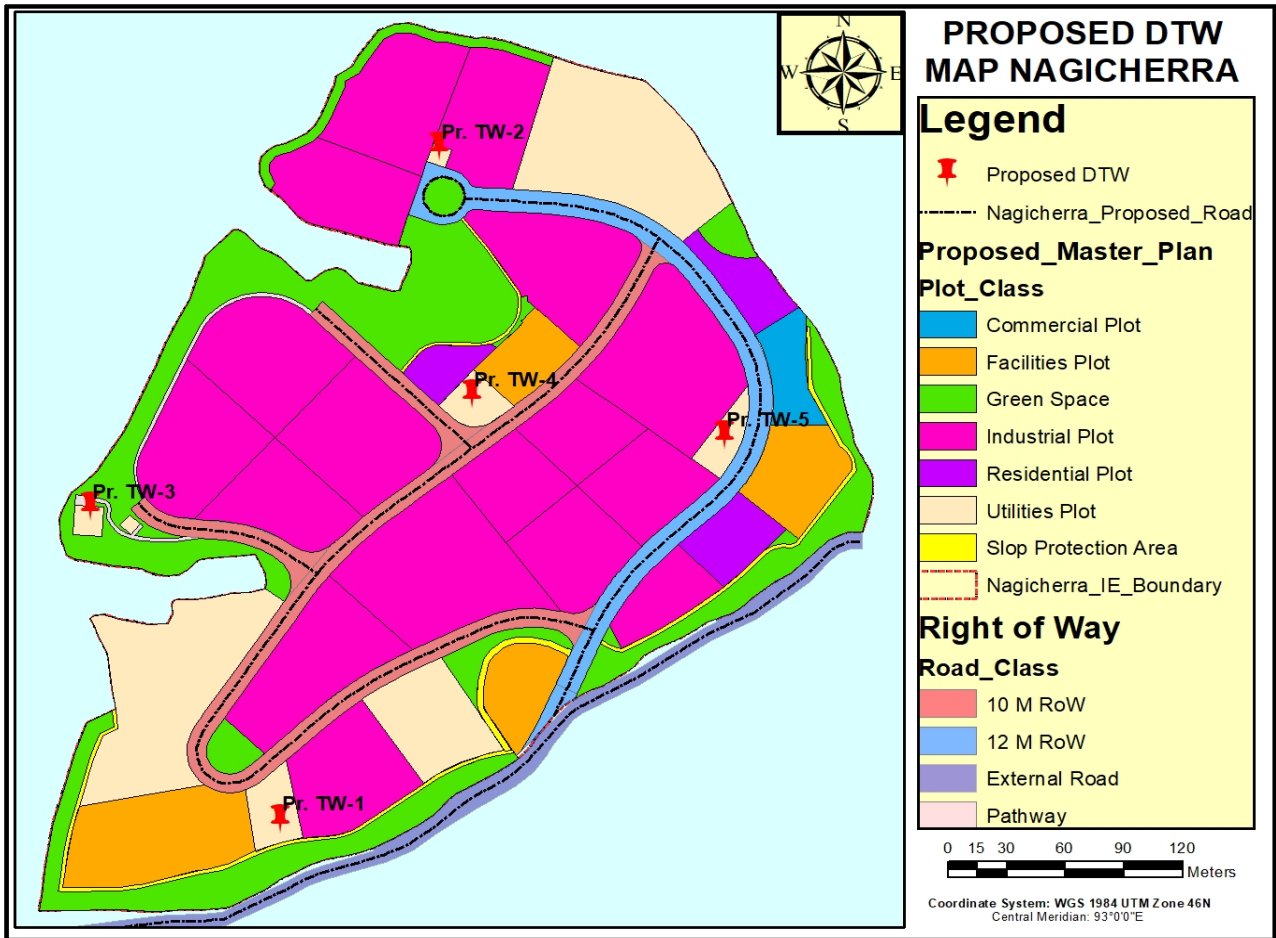


Figure 3-7: Proposed Location of Deep Tube-Wells within Nagicherra IE

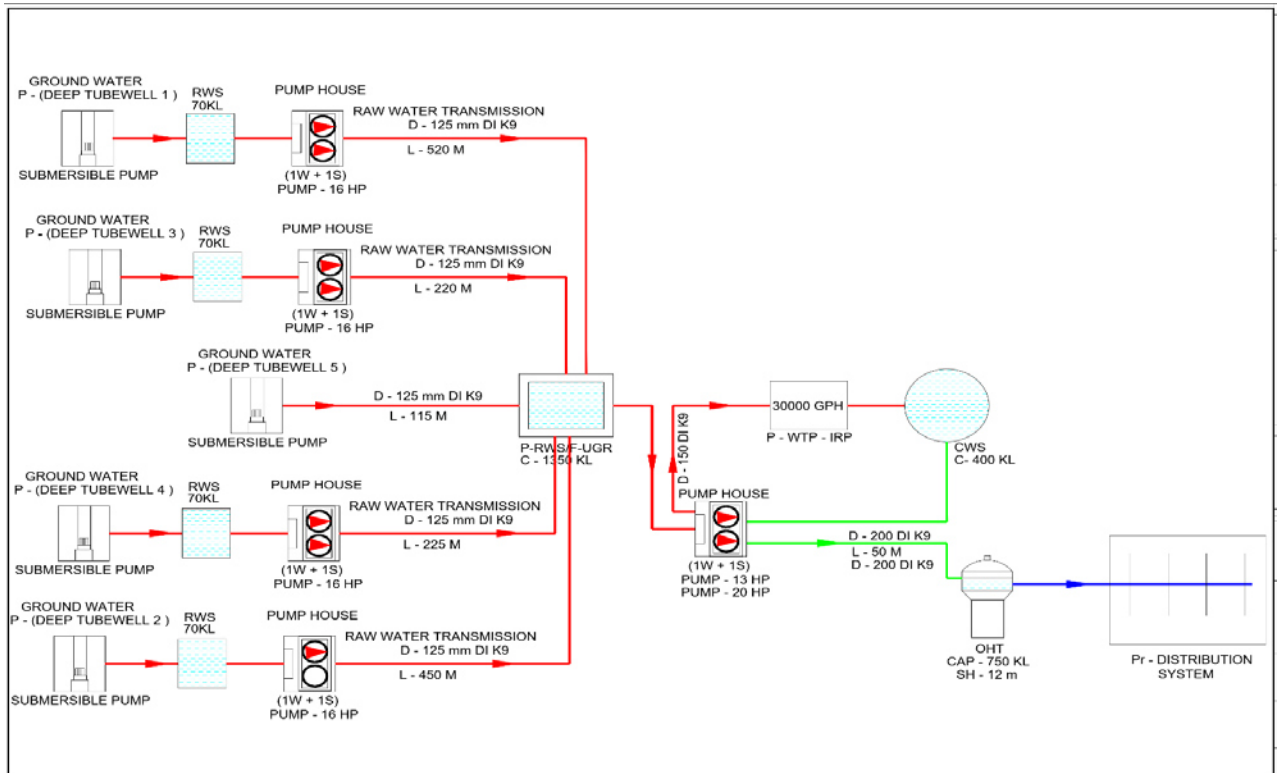


Figure 3-8: Schematic Diagram of Water Supply to Nagicherra IE

3.8 Storm Water Management

63. At present Nagicherra IE has no stormwater collection and drainage system and hence it is warranted to develop all the required infrastructure.

64. The project design has considered RCC rectangular covered storm water drains (750 mm wide) along all the roads with a cumulative length of 3.434 km along with six cross drainage structures/ culverts with four outfalls connecting to the nearest natural drainage channels (ref. **Figure 3-9**). The design also include construction of rainwater percolation wells at 13 locations across IE and one rainwater harvesting and recharging structure in CFC building. All the proposed public buildings within are IE will have roof top rainwater harvesting and ground water recharging structures.

65. 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.

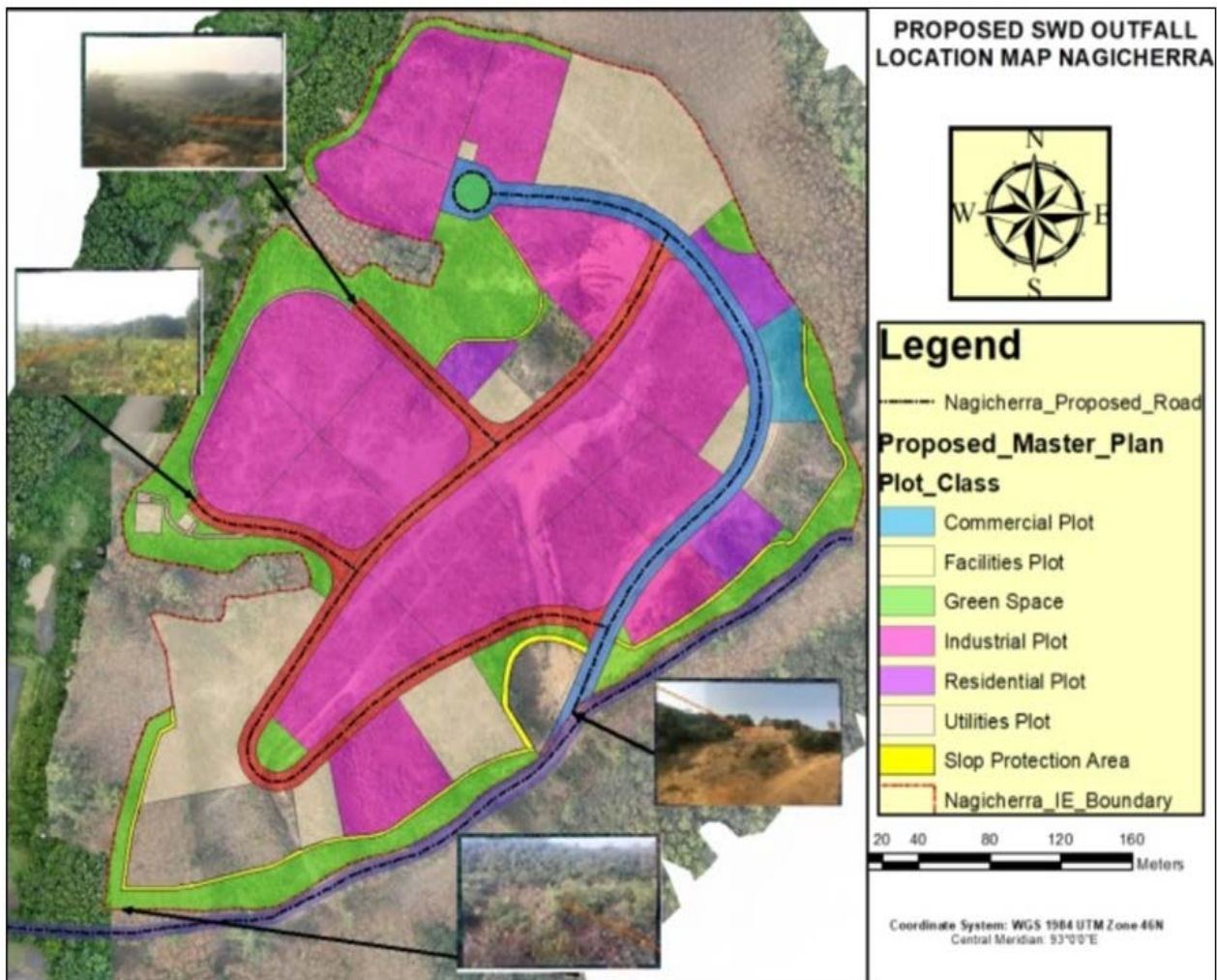


Figure 3-9: Stormwater Drainage with Outfall Locations within Nagicherra IE

3.9 Industrial Wastewater Management

66. Nagicherra IE is a green field site and therefore does not have sewerage network or centralized Sewage Treatment Plant (STP)/ industrial wastewater treatment plant.

67. The master plan development does not include any proposal for sewerage network or centralized Sewage Treatment Plant (STP) or common effluent treatment plant (CETP) within IE in the immediate future.

3.10 Industrial Solid Waste Management System

68. Nagicherra IE does not have any facility for collection, treatment and disposal of solid waste. The master plan development also does not include any proposal for development of a centralized integrated solid waste management facility at Nagicherra IE in the immediate future.

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

3.11 Electrical and Power Supply System

70. At present the Nagicherra is getting fed from Adarsha Colony Substation (S/s). From this S/s, 11KV power is distributed through existing OH system and UG system. There are numerous distribution transformers installed across the feeder. The nearest 11 KV Line to Nagicherra IE is 11 KV TFDPC (Tripura Forest Department Colony) emanating from 3 3/11 KV, 10 MVA Power Transformer of Adarsh Colony S/s and is running at very light load of 20 amp. The projected load is 4.0 MVA considering the demand/ growth for next 10 years.

71. In view of the above, to maintain smooth and steady power supply both at Industrial Plants, it is decided to lay new feeder as 11 KV UG cable of size 3 Core, 185 sqm from TFDPC to Industrial Estate. The cable will be laid in soil-brick trench, and in-order to meet up the increasing demand of power supply, up-gradation and augmentation works are required at this Sub-Station.

72. The considered works in Nagicherra IE are as below:

- New 11 KV feeder from TFDPC to IE shall be laid UG with XLPE, Armored, 2 Runs 3 Core 185 sqm.
- To increase the reliability of power, it is considered to replace the bare conductor by Covered ACSR Weasel conductor.
- The 11 KV Feeder inside IE shall be laid OH with ACSR Weasel Covered conductor on 11 m MS Tubular pole, for entire road route length of 1.6 Kms. The pole span shall be 35 m. For 1.6 Km Road route, 2.0 Kms length of cables is considered including HT Kiosks Connections etc.
- To cater the estimated load of 3,990 KVA, 12 DTRs of following capacity will be installed.
 - 500 KVA – 3 Nos = 1,500 KVA.
 - 315 KVA – 6 Nos = 1,890 KVA
 - 200 KVA – 3 Nos = 600 KVA
- LT OH with ABC 150 sqm cable shall be laid composite with 11 KV feeder on entire road route length with LT Feeder Pillar at every 100 m length. For 1.404 Km Road route, 2.0 Kms length of cables is considered including Feeder Pillar Connections etc.

73. The single line diagram (SLD) of 33 / 11 KV Adarsha Colony Substation with TFDPC Feeder details is given in **Figure 3-10**.

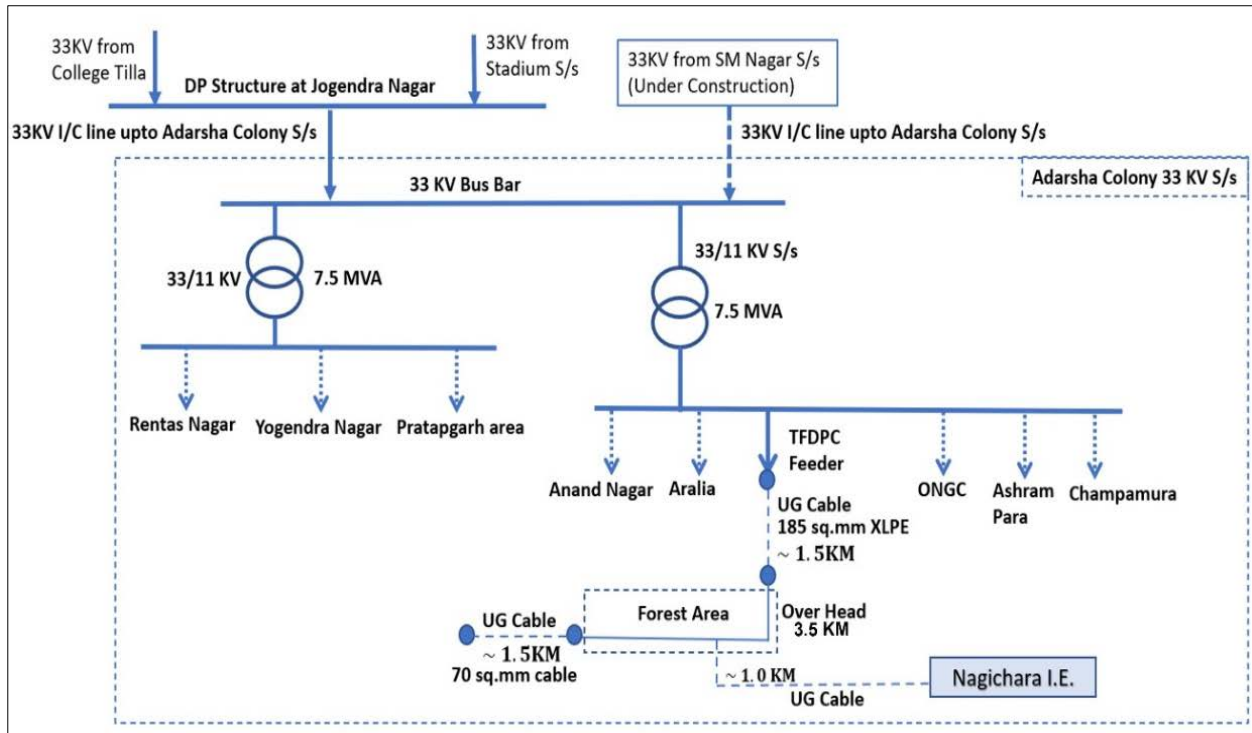


Figure 3-10: SLD of 33 / 11 KV Adarsha Colony Substation with TFDPC Feeder

74. **LT Feeders:** LT OH with ABC 150 sqm cable shall be laid composite with 11 KV feeder on entire road route length with LT Feeder Pillar at every 100 m length. For 1.404 Km Road route, 2.0 Kms length of cables is considered including Feeder Pillar Connections etc.

75. To extend LT service connections from LT Cable Network, it is considered to erect LT Feeder Pillars at every 100 m distance of LT Cable network. The exact location of Feeder Pillars shall be decided as per actual site locations and LT consumer location. The feeder Pillar shall be complete with main MCCB for incomer and feeder MCBs, of appropriate capacity and nos. The box shall be outdoor conforming to environment protection, corrosion protection. There shall be 15 LT Feeder Pillars.

76. **Streetlights:** - There shall be 50 Streetlight fittings with 100-Watt LED Luminaire shall be installed on the same composite pole with 11 KV and LT. However, the street light cable of 4 Core 16 sq mm armored shall be laid underground inside 32 mm MDPE Pipe PN6. Provision of LED Gate lights at the entry gate of IE is also considered.

77. **High Masts:** - 4 High Masts are proposed; one near entry gate and other inside IE at major Road crossings. 8 luminaires each of 250 Watt LED shall be installed on each High Mast. High Mast shall be erected on 20 m Pole height. The High Masts shall get power from Street Light circuits.

3.12 Industrial Safety and Security

78. 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.

79. CCTV cameras-based surveillance system and Fire Safety System has been proposed for monitoring the industrial safety and security of Nagicherra IE.

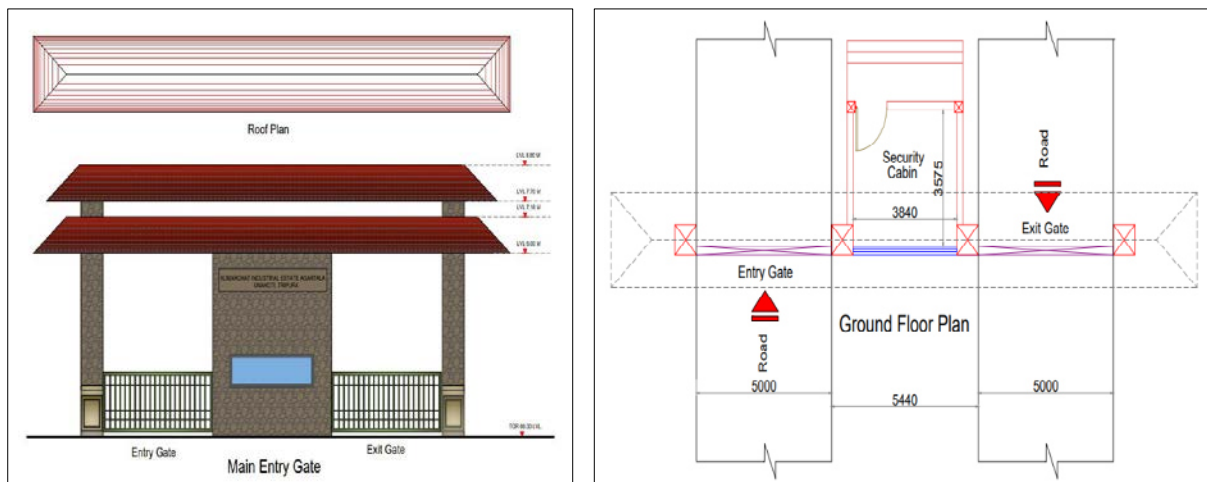
80. The proposed surveillance system components include surveillance IP cameras (Fixed & PTZ) along the boundary wall, roads and building locations with 24x7 monitoring and recording. Live feeds and data to be stored for up to 1 month.

81. Monitoring Room of approx. 25-30 sq. meter will be provided and equipped with LED Display, power points, dust free environment with air conditioner, earthing, fire protection equipment, furniture etc. to host the safety & security systems.

82. IT systems to be equipped with NVR, storage, switches, LIU, racks, ACs etc. and UPS to host the power systems with minimum 2-hour backup with proper earthing and Fire extinguishers, fire alarm system and separate OFC backbone has been proposed.

83. 1.635 km New boundary wall construction and renovation of existing boundary wall is 0.857 km, 2 nos. Entrance gate and 05 nos. Watch tower has been also proposed.

84. Typical arrangements of the entrance gate, peripheral boundary wall with provision of concertina and watch towers are given in **Figure 3-11**.



Entry Gate



Boundary Wall



Watch Tower

Figure 3-11: Provision for Safety and Security for Nagicherra IE

3.13 Proposed of Natural Gas Pipe Network

85. Natural gas (NG) is among the least polluting and environmentally friendly fossil fuels and Tripura has its own natural gas reserves, estimated at 29.27 billion standard cubic meters (SCM) in 2022. Tripura Natural Gas Company Limited is the authorized entity to provide natural gas (NG) for the Nagicherra IE.

86. There are no current consumers of natural gas in the Nagicherra Industrial Area. As per the masterplan development, the following industries are expected to be developed and the average consumption from such units is estimated at 6,250 SCMD as given in **Table 3-7**.

Table 3-7: Anticipated Natural Gas Consumption in Nagicherra IE

New industries	Proposed number of units	Estimated units reliant on NG	Average consumption of NG (SCMD/ unit)	Total NG demand (SCMD)
Rubber Industries	7	4	1500	6,000
Other Industries	4	1	250	250
Total	11	5		6,250

87. Under the masterplan development, the required pipe network for complying supply and service lines with a length of 3.6 km will be laid within the dedicated utility corridors for all other utilities.

3.14 Solar Power Generation

88. As a green initiative and concern for reducing the carbon footprint, 1 module of ground mounted solar power generation unit with capacity of 10 KW is proposed within IE as given in **Table 3-8**.

Table 3-8: Proposed Solar Power Generation in Nagicherra IE

Sl. No.	Particulars	Capacity (Kw)	No. of Solar Modules	Total Capacity (KW)	Area Required (Sqm)
1	Solar Power	10 KW	1	10	250
	Total	10 KW	1	10 KW	250

3.15 Public Transport

89. It is proposed to deploy two battery-operated small e-vehicles, along with the necessary charging infrastructure to improving 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

90. The infrastructure development works at Nagicherra IE will require an estimated 399 construction workforce at all levels (337 skilled and unskilled Labour and 62 supervisory and managerial staff). It is anticipated that nearly 70-75% of skilled and unskilled Labour (approx. 300) are likely to be to be migrant workers from other states and the rest are likely to be sourced from nearby villages and settlements areas (ref. **Table 3-9**).

Table 3-9: Estimated Construction Workers requirement at Nagicherra IE

Sl. No.	Labour/Staff Type/Designation	Package wise Manpower Involvement			Total
		Civil Infra Works (Roads, SWD, Industrial Security, Development and Landscaping)	Electrical & Power Supply and Mechanical Works	Building Works - CFC Building, Toilet Blocks, Fire Station, Security Cabin, Driver's Rest Room, Warehouse)	
1	Project Manager	1	1	1	3
2	Deputy Project Manager	2	1	2	5
3	Sector Specialist Construction Engineers including designated EHS officers	4	2	4	10
4	Junior Engineer	8	4	8	20
	Sub-contract Personnel including designated EHS officers	20	2	2	24
6	Skilled Labour	19	5	19	43
7	Unskilled Labour	170	19	105	294
	Total	224	34	141	399

3.17 Campsite and Workforce Camp Establishment

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

92. Both campsite and workforce camps will be established in the vacant areas within the boundary of IE with all the amenities like water, sanitation, medical facilities etc. (ref. Table 9-1 to 9-5 of EMP for more details).

3.18 Construction Material Requirement

93. The estimated construction material requirement of Nagicherra IE development works as per the project design is given in **Table 3-10**.

Table 3-10: Estimated Construction Material Requirement at Nagicherra IE

Sl. No.	Item	Quantity	Unit
1	Excavated Earth	147612.40	cum
2	Backfilled Earth	18392.04	cum
3	Excess Earth	129220.36	cum
4	Stone Aggregate	9999.02	cum
5	Sand	7006.26	cum
6	Cement	20638.49	cum
7	Bitumen	41747.00	kg
8	Steel	465.11	ton
9	Shuttering	23370.62	sqm
10	Bricks	608,282.00	Nos.

3.19 Implementation Schedule

94. The construction works related to infrastructure development of Nagicherra IE is anticipated to be implemented in 36 months, including monsoon season, commencing from March 2025 to February 2028.

95. 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, OHT, building works, electrical works, natural gas among others. 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.

96. 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), which will be responsible for the project management and work supervision at the field levels of all the prioritized industrial estates (including Nagicherra). 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

97. The baseline environment of the core and buffer zones surrounding the Nagicherra IE is given in this section. The core zone considers the entire area within the Nagicherra 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 buffer zone considers the entire West Tripura district for assessment of baseline environmental conditions prevailing in the region surrounding the Nagicherra IE.

98. The baseline information on various environmental attributes for both core and buffer zones have 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 5 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 Area, Wildlife Corridors /Migratory routes	Department of Forest, Govt. of Tripura, Consultations with DFOs, Forest Range Officers of forest department and with local community.	Forest area as of 2022-23, published by Tripura Forest Department and Primary investigations/ ecological assessment of the core and buffer zones during May-September 2023.

Environmental Attribute	Source of data / Information	Date and Year of the Data
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

99. Geologically, both core and buffer zones is 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 overlie 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 does not have geological reserves of rock/stone aggregates.

100. The geological succession of both core and buffer zones i.e. West Tripura district 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	Massive medium to coarse sandstone with sandy shale.
		Manubazar	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

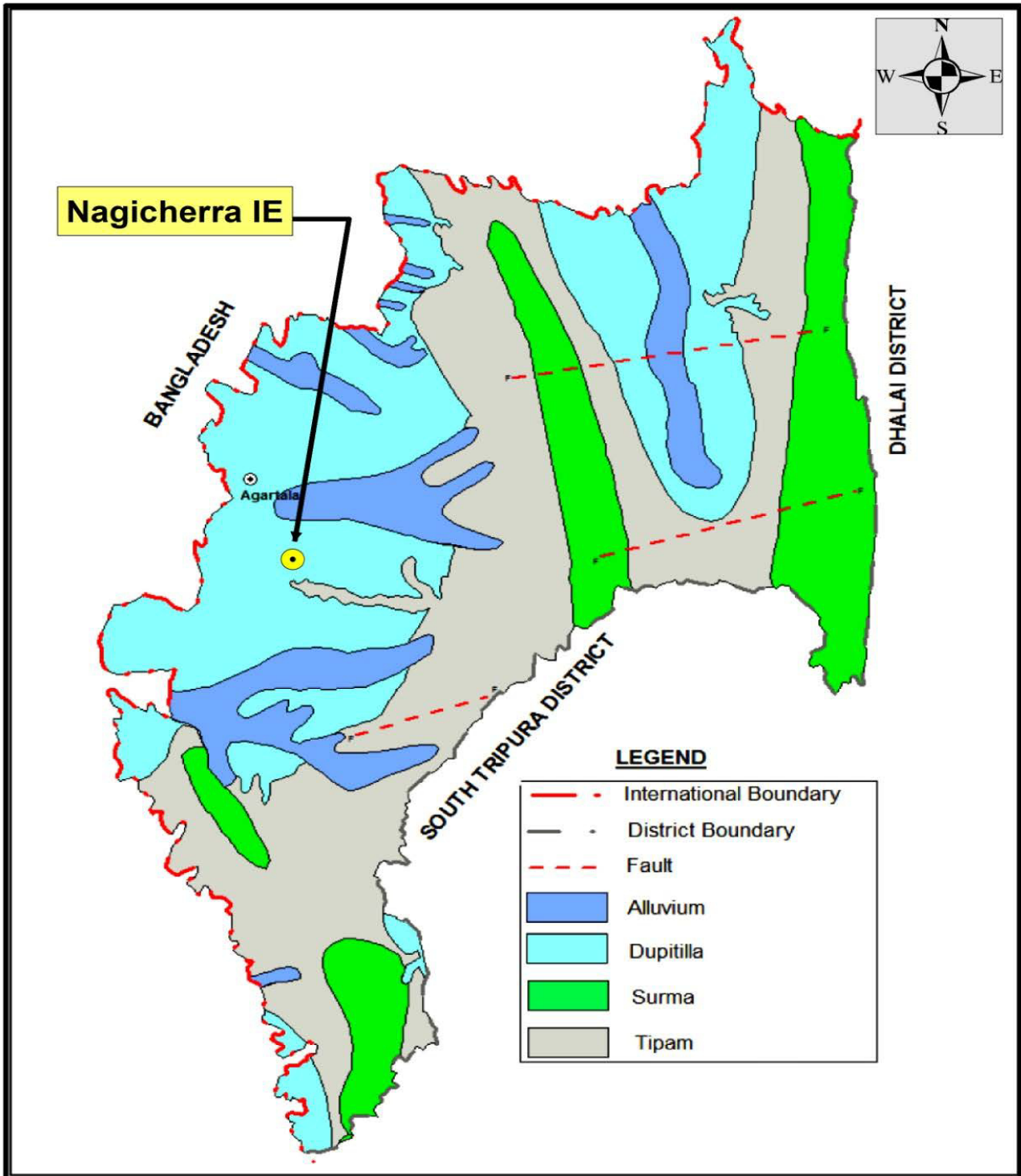


Figure 4-1: Geological Map of West Tripura District (Buffer Zone)

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

4.2.2 Hydrogeology

101. 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 wells with discharges ranging between 100 to 150 cum. per hour within a drawdown of 15 meters.

102. The assessment has indicated that the entire buffer zone is under safe category and therefore no area or block 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.

103. The ground water resources and iron levels within the core and buffer zones are shown in **Figures 4-2 & 4-3**.

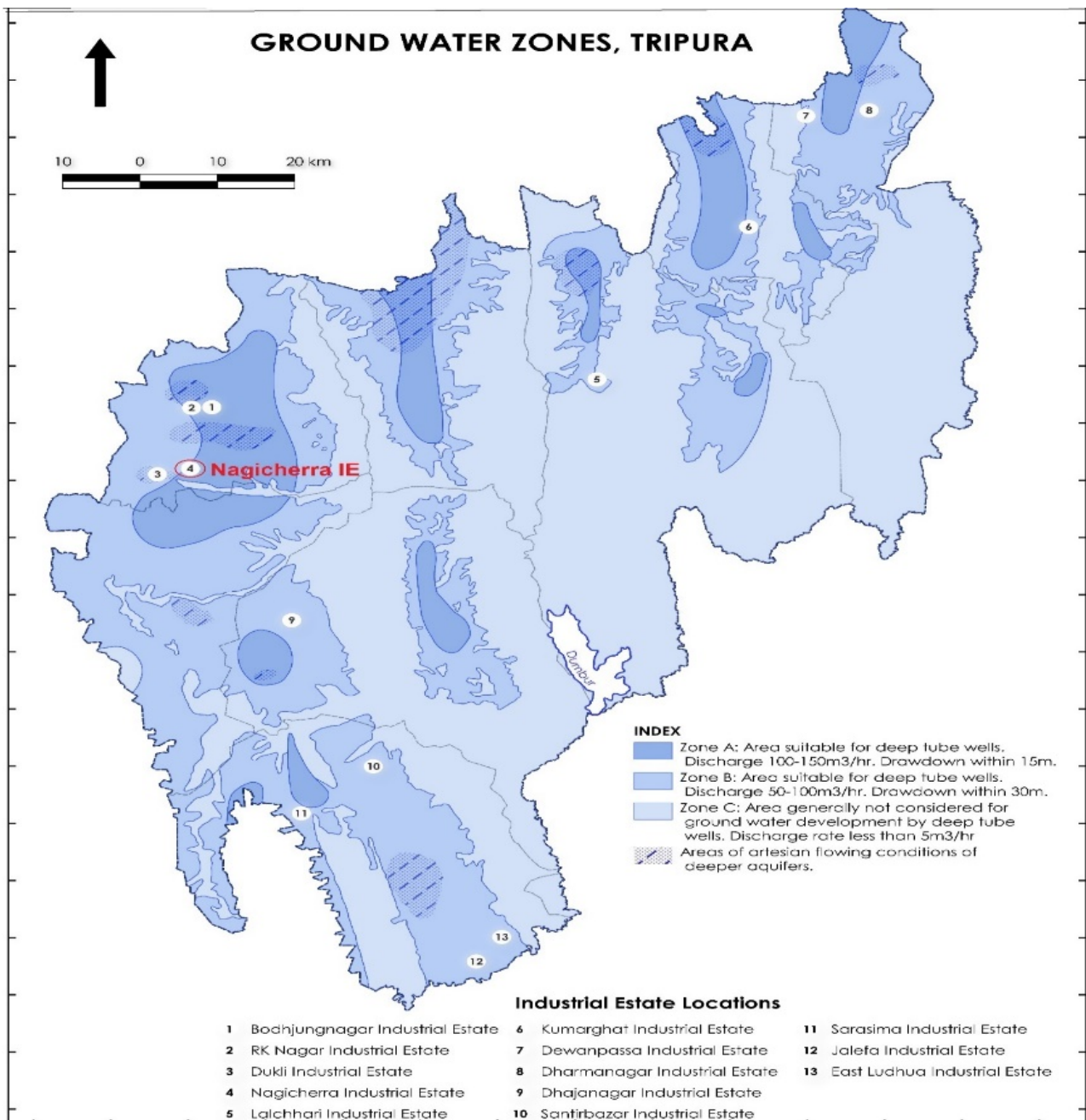


Figure 4-2: Ground Water Resource Map of Tripura State

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

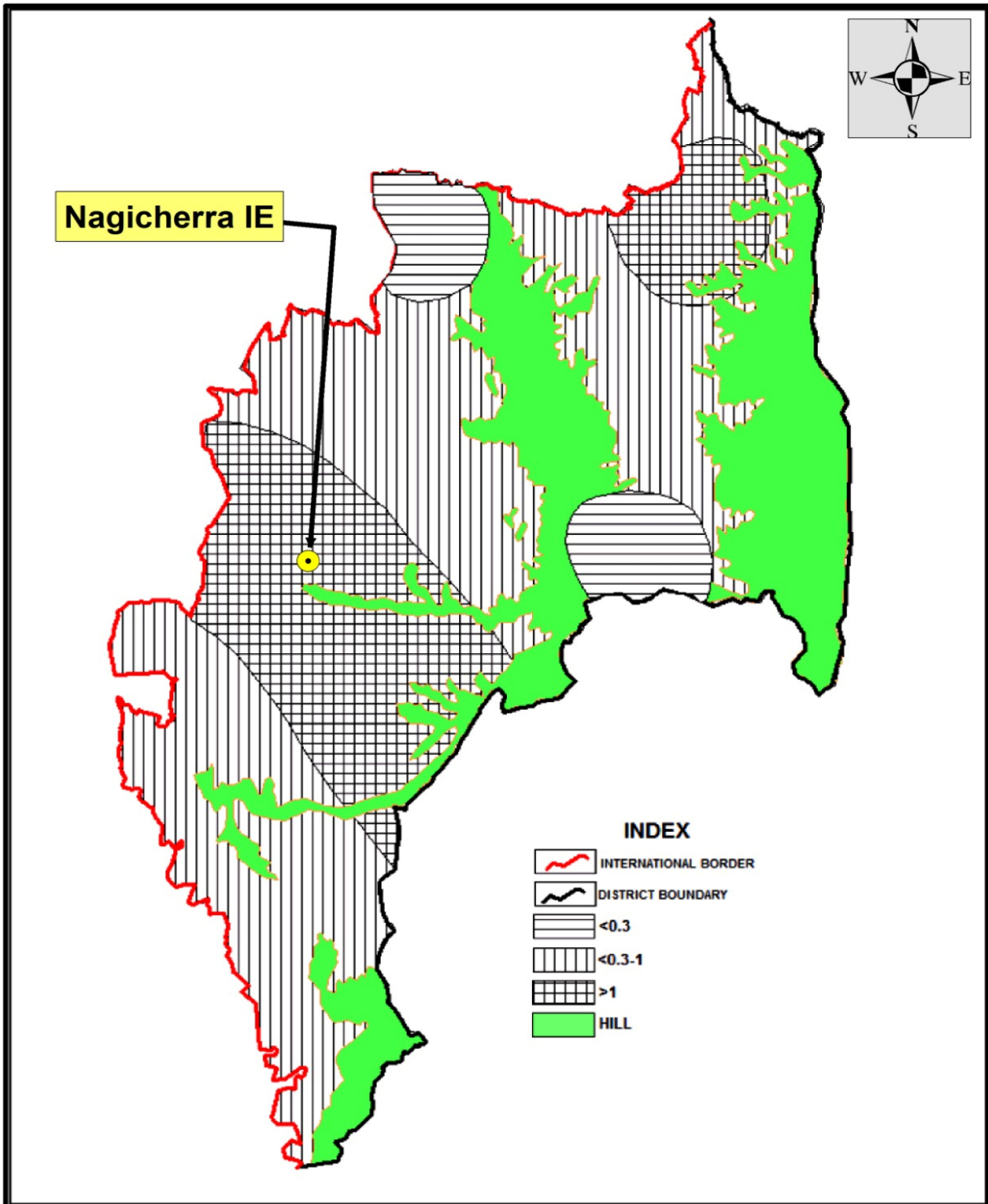


Figure 4-3 Distribution of Iron within West Tripura District (Buffer Zone)

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

4.2.3 Physiography

104. Physiography of core and buffer zones can be divided into two parts i.e. Anticlinal Hill Ranges and Synclinal flat-bottomed valleys.

105. The core zone including the Nagicherra 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”.

106. The core zone including Nagicherra IE also has many such steeply undulating loonga lands.

4.2.4 Hydrology and Drainage

107. 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**).

108. The core zone including Nagicherra 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. The majority of these streams remain dry or carry meagre discharge during most part of the year and none of them are prone to floods even during the monsoon season or heavy rainfall years (ref. **Figure 4-4**). Although the buffer zone has few flood hazard zones, IE and its surrounding core zone is not prone to such flood hazards (ref. Figure 4-4). The core zone does not have any major surface water bodies and/or wetlands and is not prone to flood hazards.

109. The elevation within Nagicherra IE varying between 32 to 50m with some areas having steeper slopes. The natural drainage pattern in the surrounding region is well established, with a several low lying areas within IE serve as natural drainage channels, connecting into the nearby tributaries/nallas and valleys on the southern side as per natural topography and drains into Bangeswar river which eventually join Haora river (ref. Figure 4-4). The higher elevation levels of Nagicherra IE compared to the surrounding region pose no risk of either stormwater flowing into the IE or causing floods.

110. The stormwater drainage system within Nagicherra IE has been planned to have 4 outfalls connecting to the nearest natural drainage channels (ref. Figure 3-9).

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

SI. 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	Bisalgahar
9	Muhuri	1014	Belonia

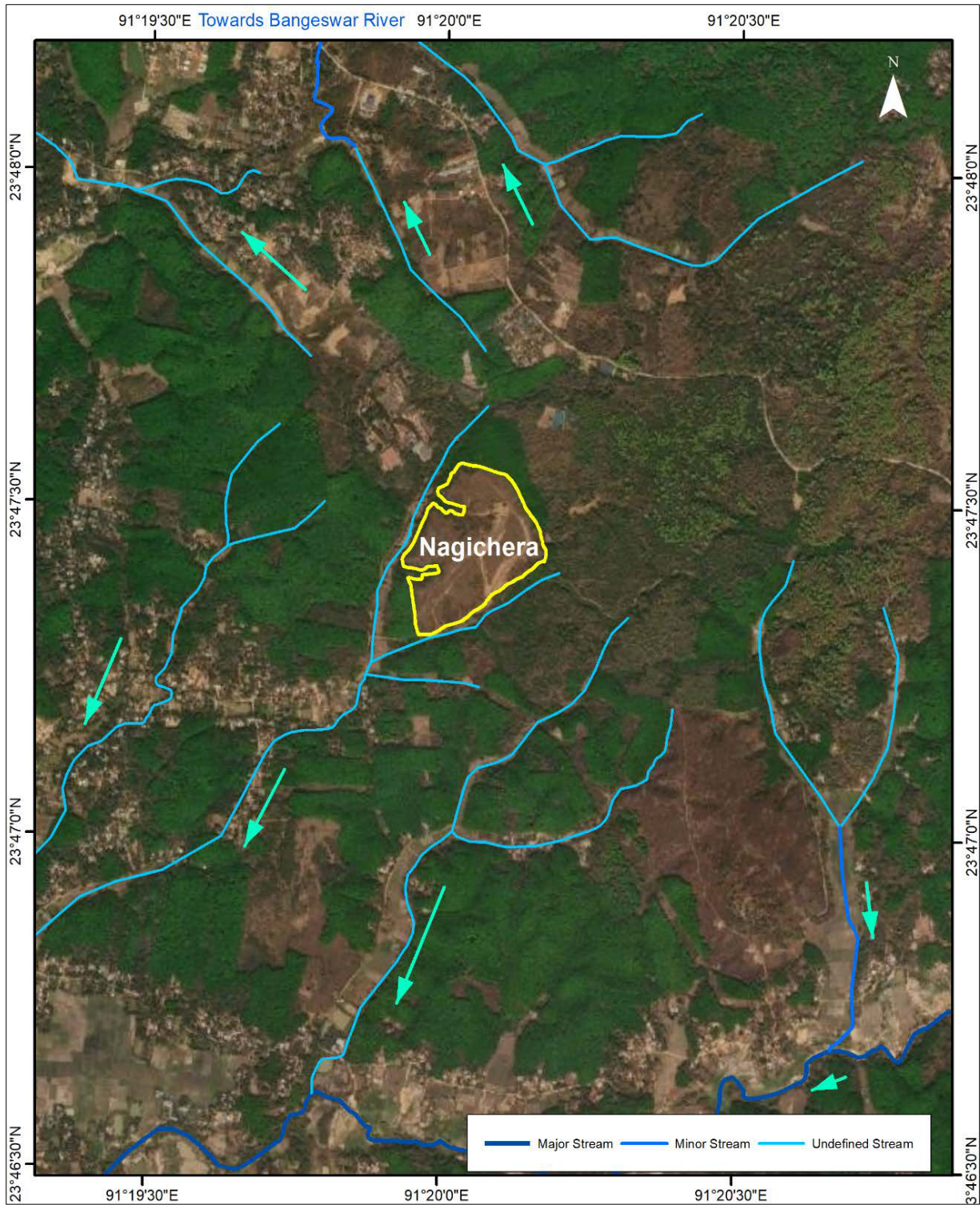


Figure 4-4: Drainage Pattern surrounding Nagicherra IE (Core Zone)

4.2.5 Topography and Elevation

111. The elevation of the core zone i.e. Nagicherra IE and peripheral areas up to 500m range between 32 to 50 meters above MSL (ref. **Figure 4-5**), and is at a relatively higher level as compared to the surrounding region. Consequently, Nagicherra IE is not prone to submergence and/ or floods even during heavy rainfall days (ref. Figure 4-4).

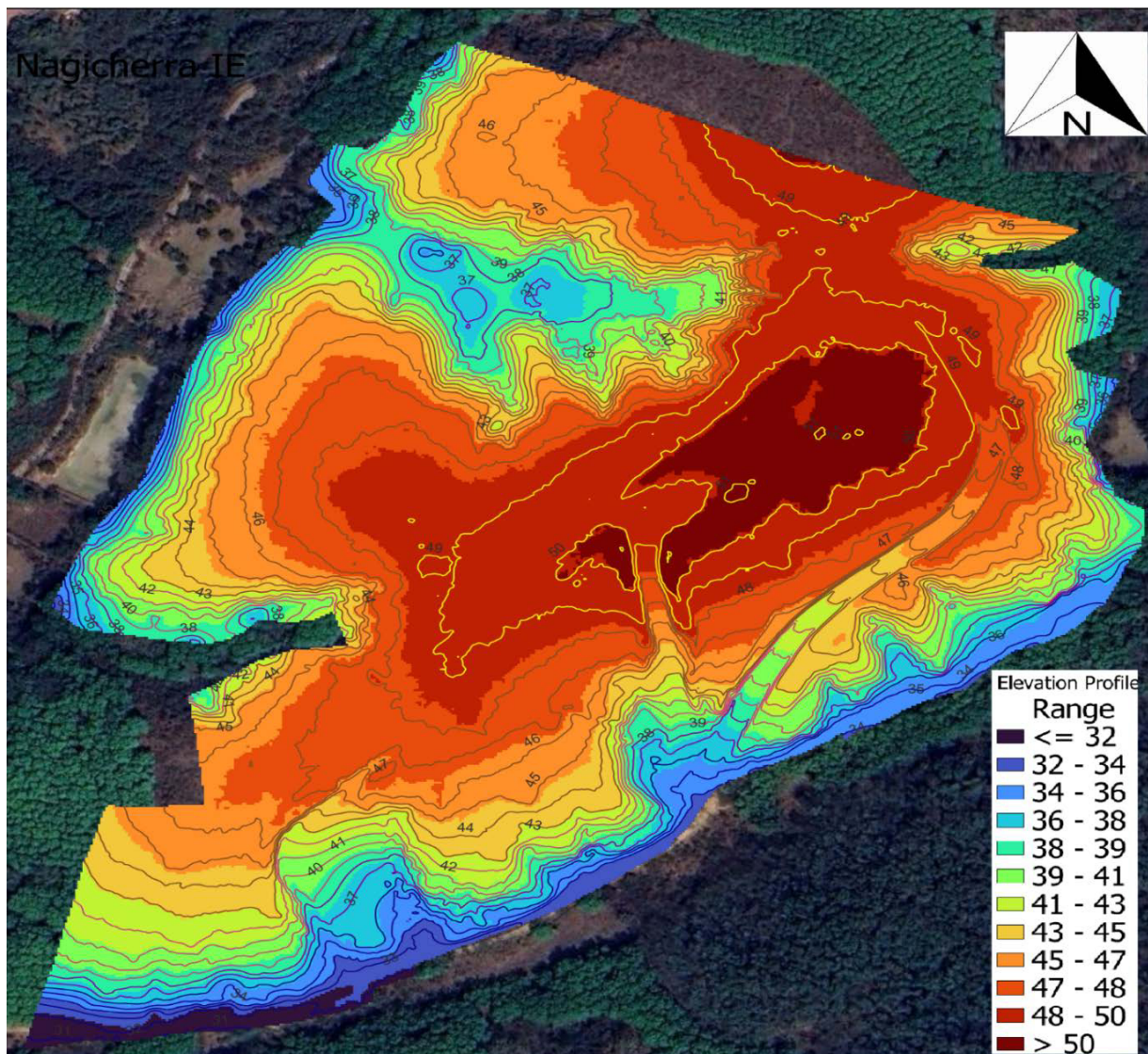


Figure 4-5: Elevation Profile of Nagicherra IE (Core Zone)

4.2.6 Geo-morphology and Soils

112. 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.

113. 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 zone is high, it inhibits the growth and decreases production of crops when used for irrigation.

4.2.7 Land Use

114. The land use land cover map (LULC) of West Tripura district i.e. buffer zone prepared using standard land use classification system is given in **Table 4-4** and shown in **Figure 4-6**.

Table 4-4: LULC Classification 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

115. Nagicherra IE is a green field site spread across 12.56 ha and is yet to be developed. The proposed land use/ master plan development for Nagicherra IE is given in **Table 4-5**.

Table 4-5: Land Use/ Master Plan Development for Nagicherra IE (Core Zone)

Sl. No.	Land Use	Area (ha)	In %
1	Industrial Area Plotted development & Industrial Sheds	5.41	43.10%
2	Transportation Roads, Junction, Parking etc.	1.36	10.86%
3	Facilities Public and Semi- Public: Health care centre, educational institutes, weighbridge, and administration etc. Utilities: Electric substation, Pumping Stations, Underground Reservoirs/ Firefighting tanks and other utilities, etc.	2.68	21.31%
4	Residential Staff Quarters	0.34	2.71%
5	Open Space Parks and open areas around it, steep slopes, and low-lying lands	2.77	22.02%
	Total	12.56	100%

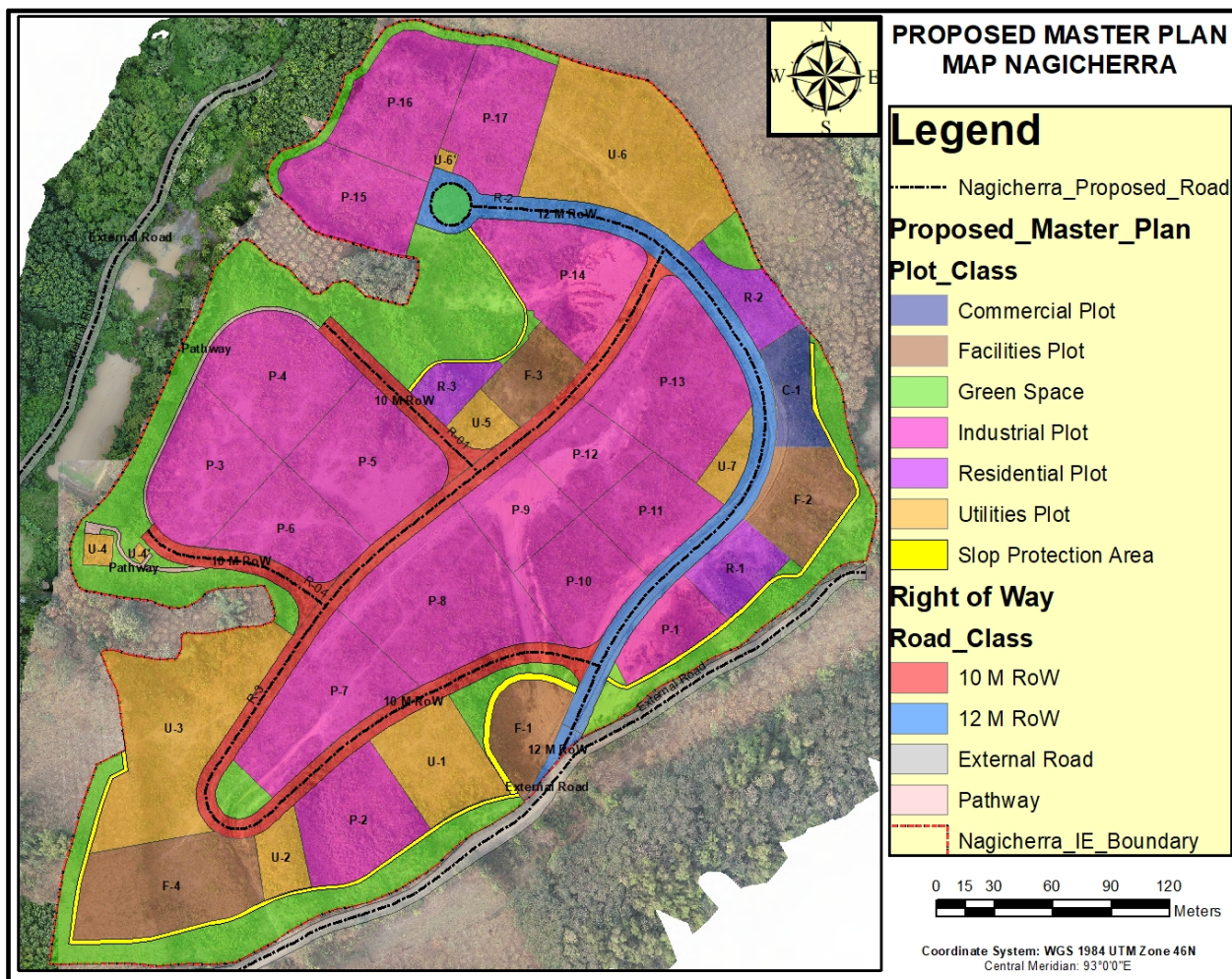


Figure 4-6: Master Plan Development/ Land Use of Nagicherra IE (Core Zone)

4.2.8 Agriculture

116. The predominant crops grown within the core zone 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 in a limited scale.

117. 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.

118. The core zone i.e. Nagicherra IE being an industrial estate does not have any agricultural activities.

4.2.9 Climate and Rainfall

119. The climate of the 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.

120. The core and buffer zones receives rainfall mainly from Southwest Monsoon between May to October months. The average annual rainfall received within the West Tripura District between 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 4-7**.

Table 4-6: Annual Average Rainfall (mm) in West Tripura District (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

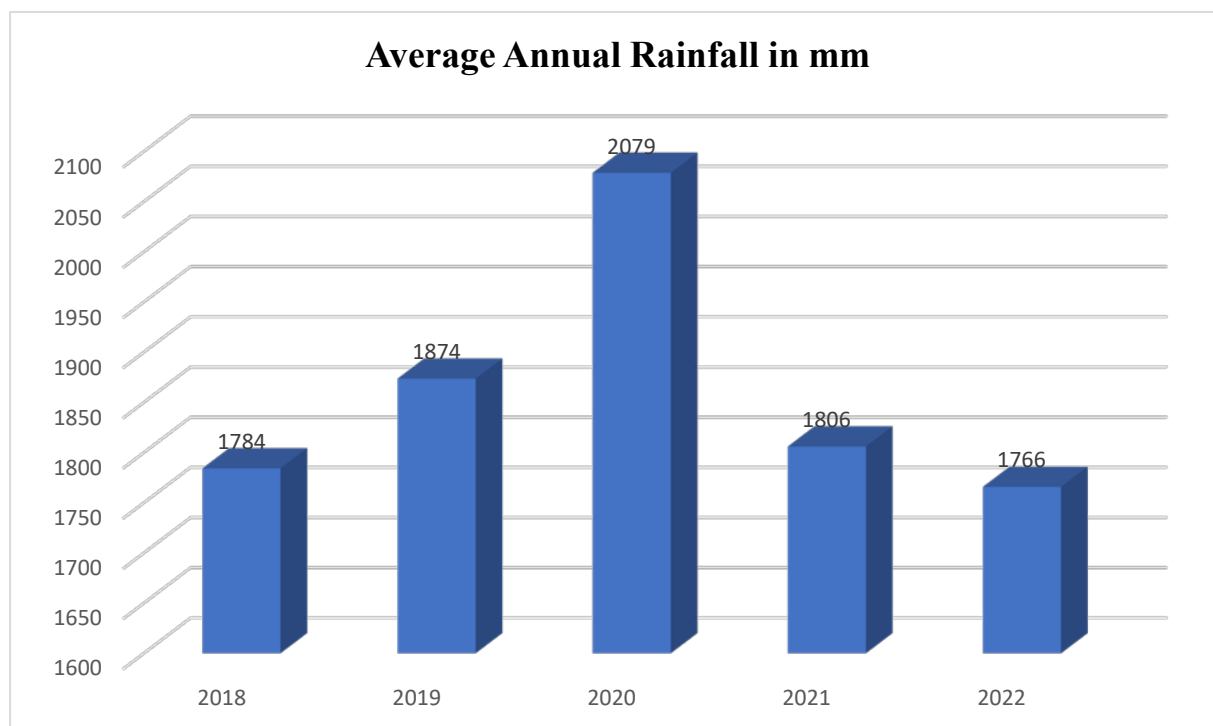


Figure 4-7: Annual Average Rainfall of West Tripura District (Buffer Zone)

4.2.10 Snowfall

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

4.2.11 Visibility

122. The core and 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

123. The core as well buffer zones does not experience any dust storms in any part of year. The pre monsoon season starts from March which also brings thunderstorms accompanied with rain and these thunderstorm events in the pre-monsoon season are known as 'Nor 'westers' or 'Kalbaisakhi' in Tripura. The Kalbaisakhi begins in March and progressively increases with the advance of the season reaching to its peak in May.

124. 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.

4.2.13 Wind Speed and Direction

125. The core and buffer zones experience calm days for nearly 117 days followed by wind speed with 1 to 19 km per hour for 247 days in a year. The pre-dominant wind direction within the core and buffer zones is South followed by Southeast both during morning and evening hours throughout the year.

4.2.14 Baseline Environment Monitoring

126. 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 area i.e. Nagicherra IE during the month of 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 Nagicherra IE are shown in **Figure 4-8**. 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 Nagicherra IE

Sl. No.	Parameters	Monitoring Location/ Category	Monitoring Date	Coordinates of Monitoring Location
A	Ambient Air Quality			
1	AQ-01	Nagicherra -1/ Industrial	24.09.2023 & 27.09.2023	23° 47' 21.7212" N 91° 20' 4.6392" E
2	AQ-02	Nagicherra -2/ Industrial	24.09.2023 & 27.09.2023	23° 47' 23.8776" N 91° 20' 7.7856" E
3	AQ-03	Nagicherra -3/ Industrial	24.09.2023 & 27.09.2023	23° 47' 29.4252" N 91° 19' 57.2448" E

Sl. No.	Parameters	Monitoring Location/ Category	Monitoring Date	Coordinates of Monitoring Location
4	AQ-04	Nagicherra -4/ Industrial	24.09.2023 & 27.09.2023	23° 47' 18.9384" N 91° 20' 0.0708" E
B	Ambient Noise Levels			
1	NQ-01	Nagicherra -1/ Industrial	24.09.2023	23° 47' 26.304" N 91° 20' 3.4836"E
2	NQ-02	Nagicherra -2/ Industrial	24.09.2023	23° 47' 26.7"N 91° 20' 8.79"E
C	Water Quality			
1	WQ-01 (SW)	Nagicherra -1	27.09.2023	Surface Water
2	WQ-01 (GW)	Nagicherra -2	27.09.2023	Ground Water
D	Soil			
1	SQ-01	Nagicherra -1	24.09.2023	Soil
2	SQ-02	Nagicherra -2	24.09.2023	Soil

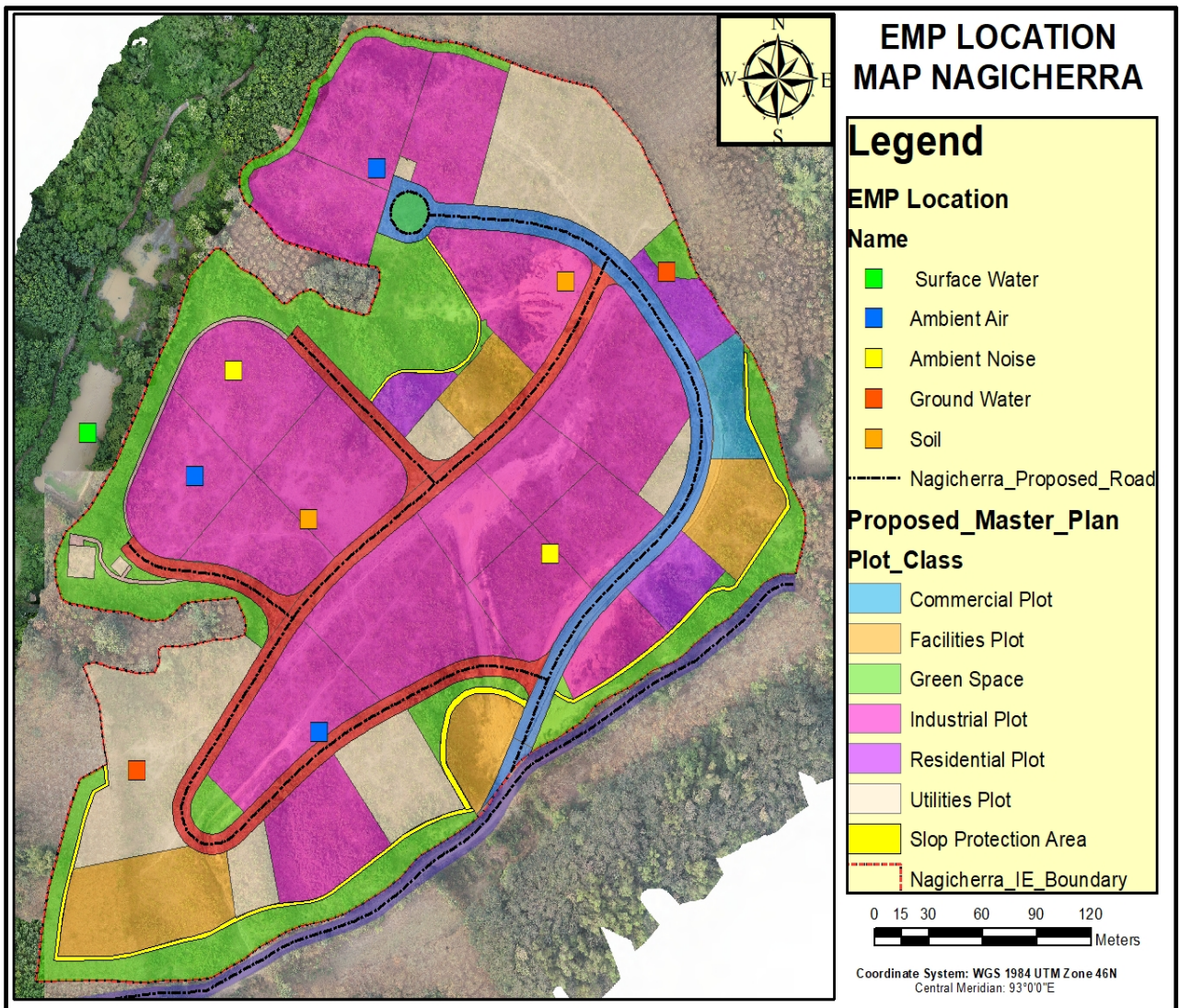


Figure 4-8: Environment Monitoring Locations at Nagicherra IE (Core Zone)

4.2.15 Ambient Air Quality

127. The ambient air quality was tested at 4 locations within Nagicherra IE during September 2023 on 2 different days. 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.

128. It may be seen that the ambient air quality (for tested parameters) at all monitored locations are below the National Ambient Air Quality Standards, whereas only the PM₁₀ and PM_{2.5} levels are exceeding the IFC-EHS guideline values (24-hour) (ref. Table 4-9), which can be attributed to the absence of any major/ significant industrial activities within Nagicherra IE/ core zone.

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

Sl. No.	Monitoring Locations/ Category	Monitoring Date	Monitored Parameters/ Units				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
			µg/m ³	µg/m ³	µg/m ³	µg/m ³	mg/m ³
1	Nagicherra -1/ Industrial	24.09.2023	58.3	36.4375	<6.0	12.7	0.6
2	Nagicherra -2/ Industrial	24.09.2023	65.1	36.16667	6.7	16.3	0.68
3	Nagicherra -3/ Industrial	24.09.2023	73.8	43.41176	7.5	21.5	0.74
4	Nagicherra -4/ Industrial	24.09.2023	69.7	36.68421	7	19.8	0.7
5	Nagicherra -5/ Industrial	27.09.2023	72.5	36.25	7.4	20.5	0.76
6	Nagicherra -6/ Industrial	27.09.2023	64.8	38.11765	6.5	18.3	0.66
7	Nagicherra -7/ Industrial	27.09.2023	67.2	32	6.9	19.6	0.68
8	Nagicherra -8/ Industrial	27.09.2023	59.1	32.83333	<6.0	14.8	0.56
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

4.2.16 Ambient Noise Levels

129. The ambient noise levels within the core zone i.e. Nagicherra 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.

130. 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. 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 Nagicherra IE (Core Zone)

Sl. No.	Monitoring Location/ Category	Date	Ambient Noise Levels Leq dB (A)	
			Daytime	Night-time
1	Nagicherra -1/ Industrial	24.09.2023	53.4	51.5
2	Nagicherra -2/ Industrial	24.09.2023	56.4	54.2
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

131. The water quality within core zone i.e. Nagicherra IE was tested at 2 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.

132. 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 Nagicherra IE (Core Zone)

Sl. No	Parameters	Unit	GW-1	Drinking water Standards as per BIS 10500:2012	
				Acceptable Limit	Permissible Limit
1	Alkalinity (as CaCO ₃)	mg/l	48	-	-
2	Ammonia	mg/L	<0.1	-	-
3	Arsenic (as As)	mg/L	<0.005	0.01	0.05
4	Boron (as B)	mg/L	<0.5	0.5	1
5	Cadmium Cd	mg/L	<0.001	0.003	No Relaxation
6	Calcium as Ca	mg/L	11.09	75	200
7	Chlorides as Cl	mg/L	12	250	1000
8	Chromium as Cr	Mg/l	<0.01	-	-
9	Colour	CU	<5.0	5	16
10	Copper as Cu	mg/L	<0.02	0.05	1.5
11	Dissolved Iron	mg/L	0.34	-	-
12	Electric conductivity	mg/L	172	-	-
13	Fluorides as F ⁻	mg/L	0.26	1	1.5
14	Lead as Pb	mg/L	<0.005	0.01	No Relaxation
15	Magnesium as Mg	mg/L	4.75	30	100
16	Manganese as Mn	mg/L	<0.02	0.1	0.3
17	Mercury	mg/L	<0.001	0.001	No Relaxation
18	Nitrate as NO ₃	mg/L	<0.5	45	No relaxation
19	Odour	--	Agreeable	Agreeable	Agreeable
20	Phenol	mg/L	<0.001	-	-
21	Phosphate as (PO ₄)	mg/L	<0.05	-	-
22	Potassium as K	mg/L	2.1	-	-
23	Salinity	mg/L	0.09	-	-
24	Sodium as Na	mg/L	6.2	-	-
25	Sulphates as SO ₄ ⁻²	mg/L	9.3	200	400
26	Total Dissolved Solids	mg/L	103	500	2000
27	Total Hardness as CaCO ₃	mg/L	47.52	200	600
28	Turbidity	NTU	<1.0	1	5
29	Zinc as Zn	mg/L	<0.02	5	15
30	pH Value at 25°C	mg/L	7.43 at 25 Deg C	-	-

Table 4-12: Surface Water Quality within Nagicherra 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	11
7	Chemical Oxygen Demand	mg/L	<4.0
8	Chlorides as Cl	mg/L	9.6
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	5.4
13	Dissolved Iron	mg/L	0.52
14	Electric conductivity	mg/L	302
15	Fluorides as F ⁻	mg/L	0.14

Sl. No	Parameters	Unit	SW-1
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	<0.5
21	Odour	--	Unobjectionable
22	Phenol	mg/L	<0.001
23	Phosphate as (PO ₄)	mg/L	<0.05
24	Potassium as K	mg/L	2.8
25	Salinity	mg/L	0.15
26	Sodium as Na	mg/L	6.5
27	Sulphates as SO ₄ ⁻²	mg/L	5.7
28	Surfactants	mg/L	<0.02
29	Temperature	Deg.C	25
30	Total Alkalinity	mg/L	28
31	Total Dissolved Solids	mg/L	181
32	Total Hardness as CaCO ₃	mg/L	50
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	7.46 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/l 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/l 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 500 (desirable) 2500	To ensure low sewage contamination Faecal coliform

Sl. No.	Criteria		Rationale
	MPN/100 ml	(Maximum Permissible)	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, MoEFCC

4.2.18 Soil Quality

133. The soil quality within Nagicherra IE was tested at 2 locations and test values are given in **Table 4-15**. The laboratory test reports, and test methods followed are given in Appendix-3.

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

Sl. No	Test Parameters	Units	SQ-01	SQ-02
1	Bulk Density	gm/cc	1.32	1.26
2	Electric Conductivity at 25°C	µS/cm	8.0	17
3	Iron (as Fe)	mg/kg	54 (1:2) at 25 deg C	234 (1:2) at 25 deg C
4	Lead (as Pb)	mg/kg	5.2	5.8
5	Moisture Retention Capacity	%	5.4	6.3
6	Organic Matter	%	23	34
7	Phosphorus	mg/kg	0.45	0.41
8	Porosity	%	Available Phosphorus (as P)=11	Available Phosphorus (as P)=3.3
9	Potassium	mg/kg	43	46
10	Clay	%	Available Potassium=29	Available Potassium=91
11	Sand	%	77	55
12	Silt	%	15	28
13	Texture	-	Sandy Loam	Sandy Loam
14	Total Nitrogen as N	mg/kg	370	313
15	Total Organic Carbon	%	0.26	0.24
16	Infiltration Rate	Mm/hr.	20	17
17	pH Value	-	4.84 (1:2.5) at 25 deg C	4.42 (1:2.5) at 25 deg C

4.2.19 Hazard and Vulnerability

134. Tripura state as a whole 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 earthquake as it is situated on Seismic Zone-V and has higher probability of occurrence of big earthquakes measuring 8 and above on Richter scale.

135. The state has witnessed the worst earthquakes in 1897 and 1950 measuring 8 and above on 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.

136. Floods are recurrent and have potential for disaster in the State. They occur every year during normal monsoon season and cause temporary floods in valley and plain land area 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.

137. 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.

138. The core and buffer zones of Nagicherra IE i.e. West Tripura district is also vulnerable to natural disasters on the same lines of the state. The hazard and vulnerability along with probable months of occurrence for the core and buffer zones of the Nagicherra IE i.e. West Tripura District is given in **Table 4-16 & 4-17**.

139. 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 and cyclones (ref. **Figure 4-9**).

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

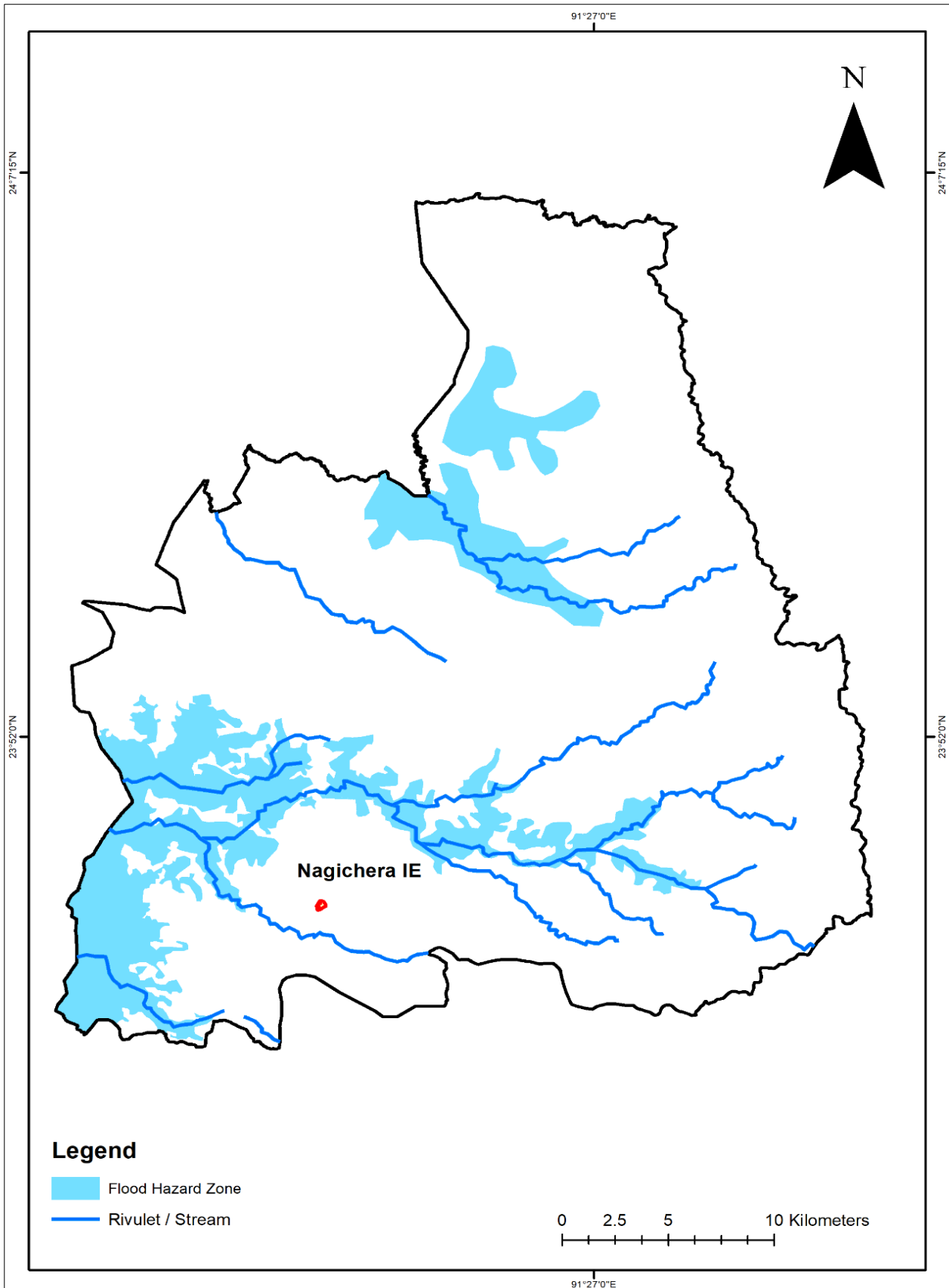


Figure 4-9: Flood Hazard & Drainage Pattern of West Tripura District (Buffer Zone)

4.3 Ecological Resources

4.3.1 Forest Area within Buffer Zone

140. The buffer zone of Nagicherra IE, which entirely constitutes West Tripura District has a forest cover of 214.58 sq km, which is 25.37% of total district's forest area and 3.4% of state's forest area 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
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

141. The land within the Nagicherra IE is owned by DoIC/ TIDCL and the proposed infrastructure development is limited to the existing boundary, with no further land requirement or acquisition. 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 map prepared by Tripura Forest Department, confirming the absence of forest areas surrounding the Nagicherra IE is given in **Figure 4-10**.

4.3.3 Protected Areas within Buffer Zone

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

143. The Sepahijala Wildlife Sanctuary (WLS) and its notified eco-sensitive zone is the nearest protected area, which is in the adjoining Sepahijala district, at a distance of 11.24 km from the Nagicherra IE and shown in **Figure 4-11**. The eco-sensitive zone of Sepahijala WLS is limited to a mere 10m on eastern side and maximum of 50m on the western side (ref. **Figure 4-12**). Thus, the Nagicherra IE boundary is 11.24 km from the eco-sensitive zone of Sepahijala WLS.

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

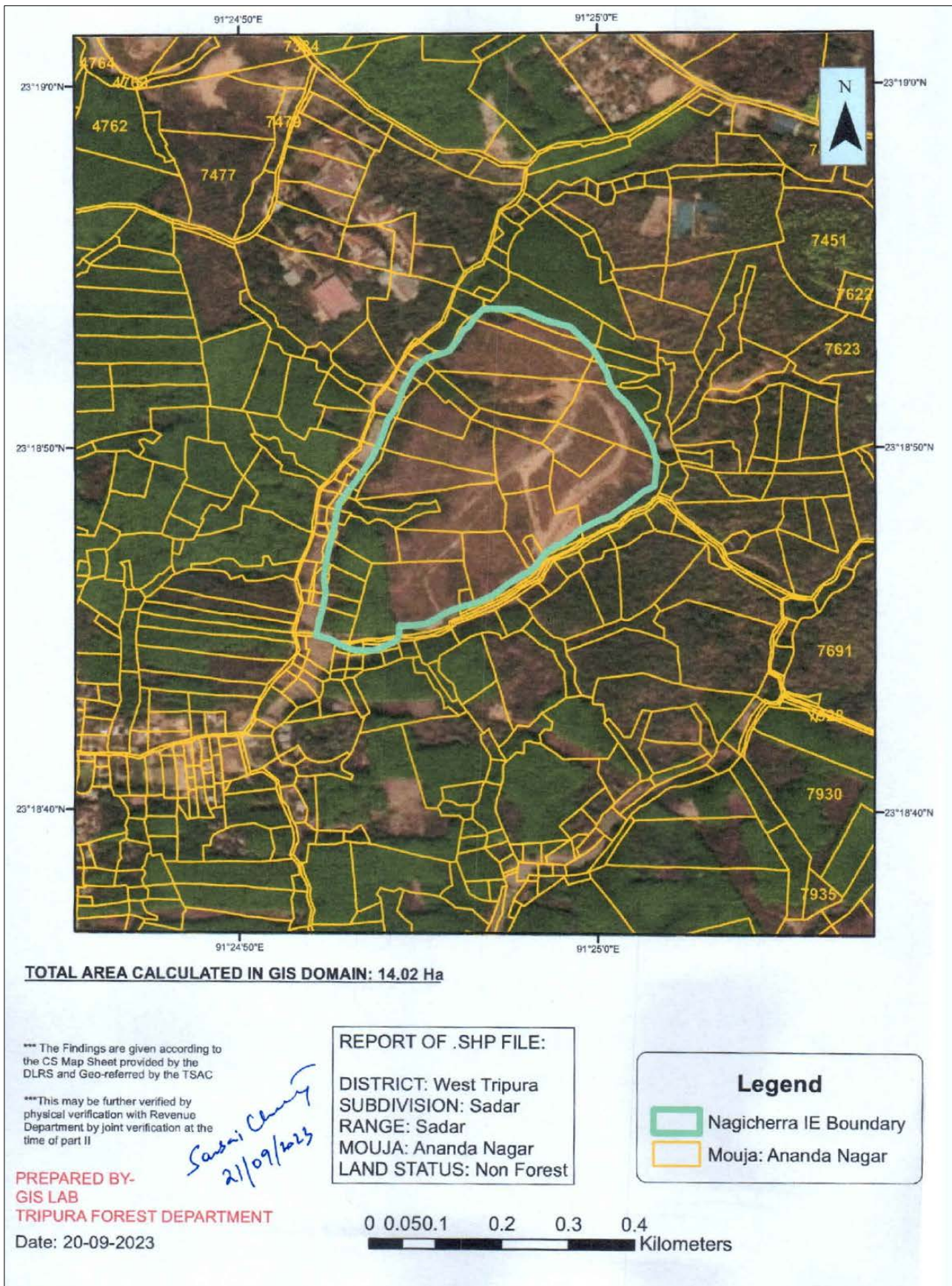


Figure 4-10: Map Confirming Non-Forest Areas surrounding Nagicherra IE (Core Zone)

(Source: Forest Department of Tripura)

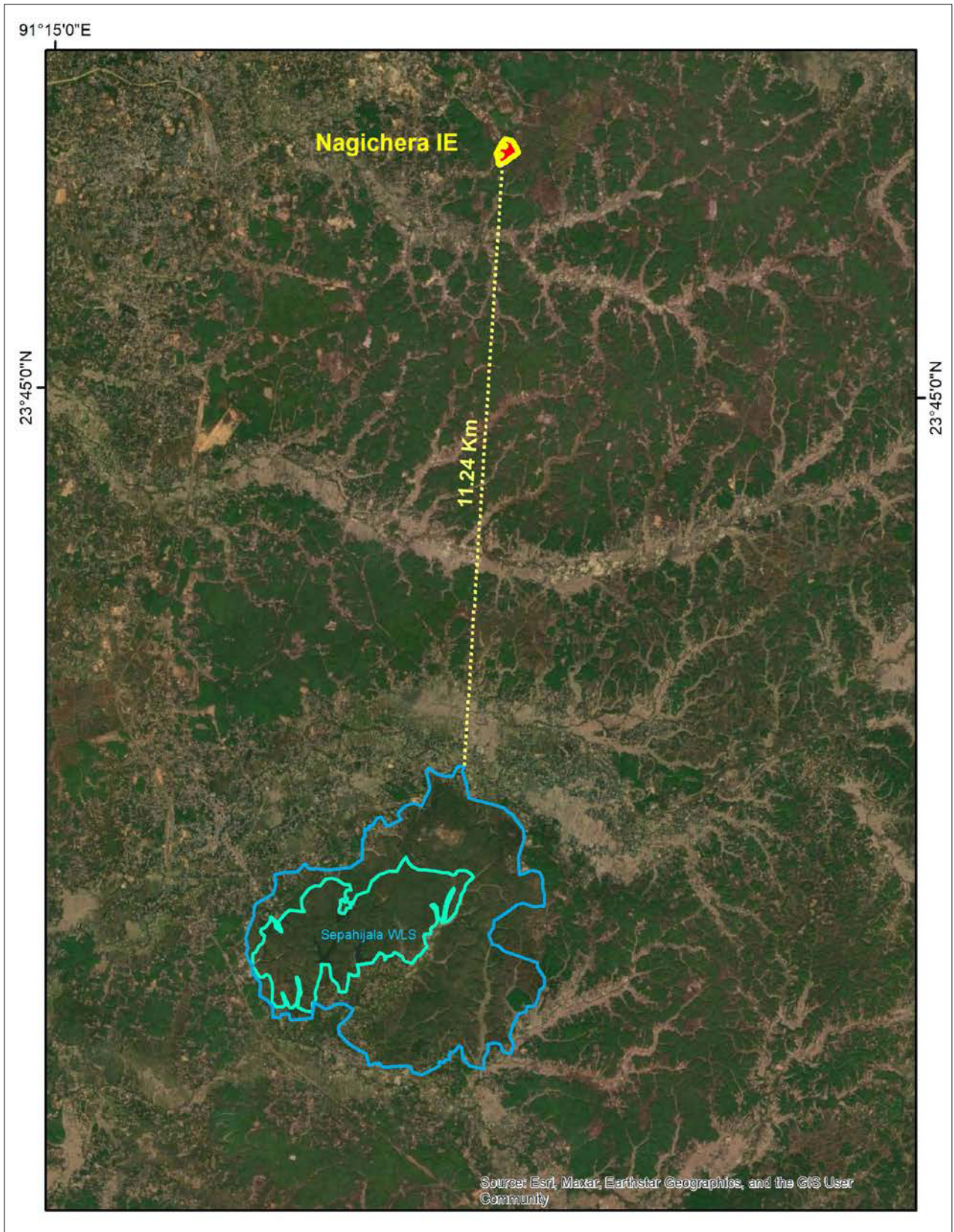


Figure 4-11: Distance of Protected Areas from Nagicherra IE (Core Zone)

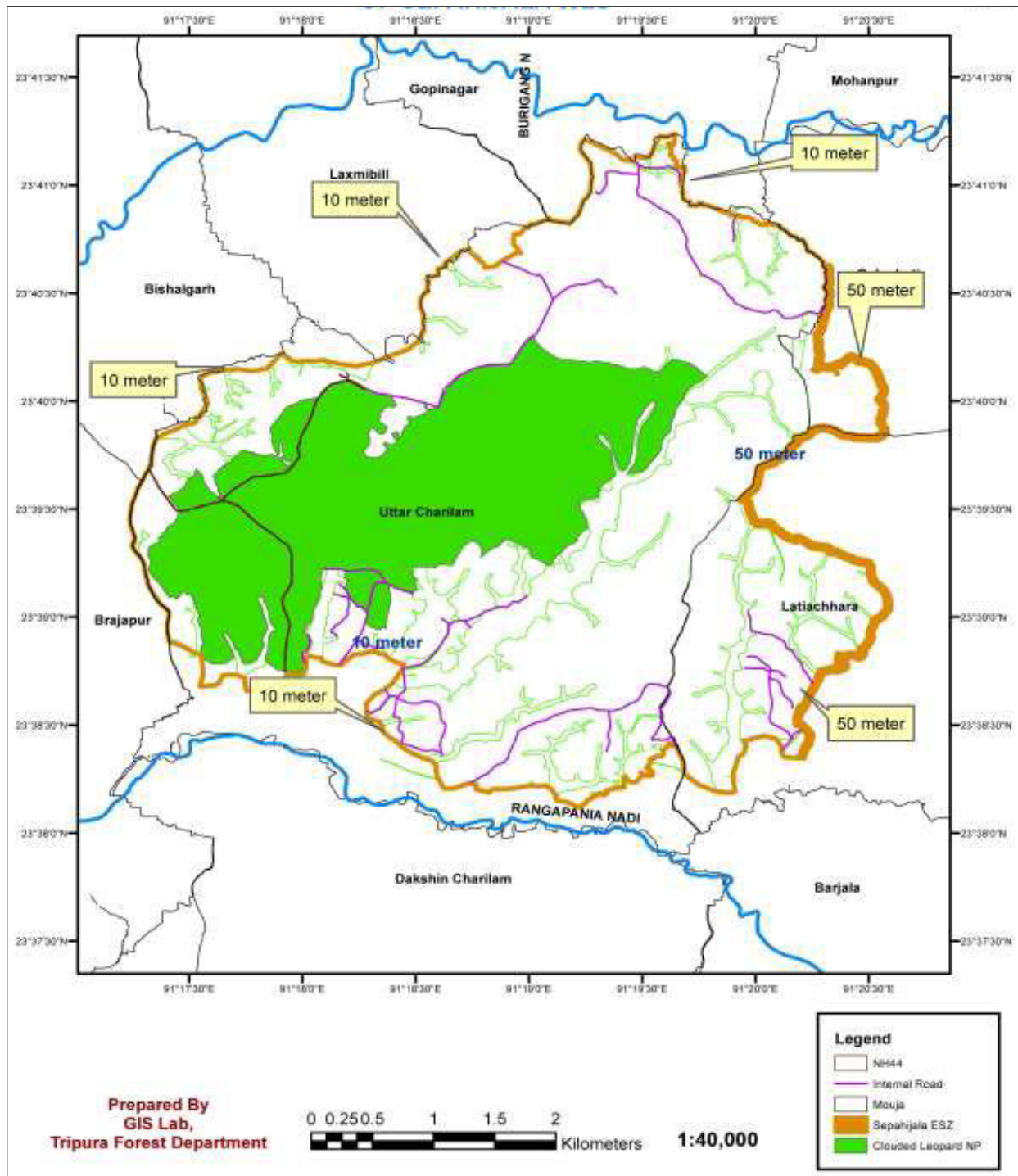


Figure 4-12: Eco-Sensitive Zone Boundary of Sepahijala WLS

4.3.4 Biodiversity

144. Tripura state is extremely rich in bio-diversity⁸, situated within the Indian sub-region of Oriental Zoo-geographic region and flora & fauna of the state bear a very close affinity and resemblance with floral and faunal components of Indo-Malayan and Indo-Chinese sub-regions.

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

Flora of State

145. 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.

146. 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 and Buffer Zones (IBAT)

147. 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 500-meter peripheral area surrounding the Nagicherra IE as the core zone (ref. **Figure 4-13**) 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.

148. The I-BAT has cataloged 57 flora and 143 fauna groups within 500m core zone, including Nagicherra IE, as compared to the 203 flora and 251 fauna groups in the buffer zone. This abridgement can be attributed to the anthropogenic activities as well as urbanization and consequent environmental stressors within the 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**.

149. Contrastingly, the buffer zone i.e. up to 20 km beyond core zone, is characterized by forest patches with less intensive human activity, showcase more robust biodiversity with 203 identified species. The forested areas act as ecological buffers and corridors, facilitating gene flow and providing refuge for wildlife, thus enhancing species richness. Trees (84 species), shrubs (41 species), and herbs (64 species) in these forest patches contribute to ecological resilience, offering a spectrum of habitats and food sources. Abundant birds (147 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**.

150. Out of the 31 known biodiversity hotspots⁹ of the state, none are located within the core and buffer zones of the Nagicherra IE.

⁹ 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 4-13: Core Zone for Biodiversity Studies using I-BAT

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

Groups	Buffer Zone IBAT	Core Zone IBAT
Flora	203	57
Tree	84	16
Shrub	41	16
Herb	64	18
Climber	9	4
Fern	5	3
Fauna	251	143
Aves	147	79
Insect-Butterfly	39	32
Insect-Odonata	5	5
Other-Insects	25	17
Mammal	17	1
Reptile	13	6
Amphibian	4	3
Arthropod	1	0

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

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
0km	40	36	5	1	Core
500m	60	29	8	4	Nagicherra immediate buffer

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
5km	152	96	20	5	Purba noagaon, Prabhapur, Jogendranagar, Dukli, Tulakona
10km	117	76	16	4	Dakshin champamura, Ranjit nagar, Khayerpur, IC Nagar
15km	150	73	20	5	Madhupur, Paschim takarjala, Baidhya kobra, Fatikcherra, Oxygen Park
20km	189	88	20	5	Jirania, Kathiram bari, Bamutia, Amtali, Kandrai charra

4.3.5 Endemic & RET Species within Core Zone

151. 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 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 rafflesiana</i>	Lantana kalasi	Climber
12	<i>Drosera burmanni</i>	Surja sisir	Herb
13	<i>Elaocarpus prunifolia</i>	Ban jalpai	Tree
14	<i>Mangifera sylavatica</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 aerifolius</i>	-	Tree
20	<i>Xantolis assamica</i>	-	Tree

Source: Tripura Forest Department

4.3.6 Tree Felling Requirement

152. The proposed improvement works within Nagicherra IE will not require felling of any trees.

4.3.7 Fauna

153. Tripura reportedly has 90 mammal species¹⁰ 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 4-23**.

154. 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 4-23: Rare and Threatened Fauna of Tripura

Sl. No.	Common Name	Scientific Name	Schedule-I WL(P) Act	Appendix-I 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>	-	+
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

155. 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 *Psuedoatoptus 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.

156. Although, Tripura has important bird areas (IBAs) within Gomti WLS and Trishna WLS, but these are beyond at 36.80 kms and 45.06 kms respectively from the core zone of the Nagicherra IE.

4.3.9 Reptilian Fauna

157. 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

¹⁰ Source: <https://forest.tripura.gov.in/forest-of-tripura>

Wildlife (Protection) Act., 1972. (Sanyal, D.P. et.al. Reptilia, Fauna of Tripura, Vol.-1, Zoological Survey of India, In Press).

158. The faunal surveys carried out within the core zone of Nagicherra 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

159. The core zone does not have any wetlands, although the state has 408 freshwater wetlands as given in **Table 4-24**. Of these, Rudrasagar Lake is the only RAMSAR site within the buffer zones i.e. West Tripura district. The Rudrasagar Lake is about 35 km aerial distance from the Nagicherra IE. The core zone i.e. within 500m periphery of the Nagicherra IE does not have any surface water bodies or wetlands.

Table 4-24: 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

160. The buffer zone i.e. West Tripura district has its district headquarters is Agartala, which is also the capital of the State. The demographic features of the district i.e. buffer zone is given in **Table 4-25**.

Table 4-25: 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.		

Sl. No	Particulars	Remarks
	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

161. 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 as largest producer of tea in the state of Tripura.

4.4.3 Culture and Tourism

162. 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, Koloi, Murasing, Chakma, Halam, Garo, Hajong, Kuki, Mizo, Mogh, Munda, Oraon, Santhal, and Uchoi.

163. The main tourist attractions of the district (buffer zone) 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

164. Agriculture forms a primary sector of the economy of Tripura. More than 75% of the district's economy 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.

165. 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

166. The health care infrastructure is divided into three tiers – the primary health care network, a secondary care system comprising district and sub-divisional hospitals and tertiary hospitals providing specialty and super specialty care. As on 2013–14, there are 84 Primary Health Centers, 18 Community Health Centers, 13 Sub Divisional Hospitals, 3 District Hospitals, 6 State Hospitals.

167. 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

168. 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 Nagicherra IE.

169. 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

170. The core zone of Nagicherra 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

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

172. During the IEE report preparation, environmental sensitivity covering the environmental features within 15 meters on either side i.e. corridor of impact (COI) of linear components (roads, stormwater drains, water supply pipelines, power feeder cables), 500m radius of area-based components (buildings, common facilities) have been used to determine the likely impacts within the corridor of direct impact due to the respective infrastructure development works/ components. The details are provided in **Appendix-5** and the likely impacts are summarized in **Table 5-1**. The environmental impacts and the respective risk level is given in **Table 5-2**.

173. The impacts due to the proposed infrastructure development works/ components within Nagicherra IE are short-term, confined to the respective corridor of direct impact(s) 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 & buffer zones.

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

Sl. No.	Development Components	Corridor of Direct Impact	Likely Impacts
1	New industrial plots: 17 plots, spread over 5.41 ha	Respective plot and its 500m 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	Construction of New Roads –1.404 km and construction of 06 culverts	15 meters on either side of the existing road alignment	<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. Inconvenience to existing road users due to traffic diversions. As per preliminary site visit, utility shifting is required (Electric Pole, OFC Cable etc.). There is no religious infrastructure (Mandir/masjid/Church/etc.) within Proposed Project Site. Workers/ community safety On site drainage, disposal of construction debris No sensitive receptors are present in proximity of the proposed site
3	Construction of new Stormwater drains – 3.434 km (both sides of roads)		
4	Utility Corridors for laying various utilities like HT/LT feeder cables, SCADA/ OFC communication cables, Water Supply Scheme, Natural Gas Pipelines (various dia meters), Length-2.808 km and 10 KW solar panel		
5	5 new deep tube wells, 5 pumphouses, raw water transmission pipelines, 4 raw water reservoirs of 70 KL each and 1 raw water reservoir 1350 KL with built fire reservoirs, 1	Respective site and its 500m peripheral area	<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 construction works.

Sl. No.	Development Components	Corridor of Direct Impact	Likely Impacts
	package type iron removal plant (30,000 GPH), 1 clear water reservoir with pumping station (400 KL), 1 overhead tank (750 KL), raw water pipelines (1.56 km), clear water rising mains and distribution pipelines 1.386 km; and plot service connection and ancillary items, SCADA		<ul style="list-style-type: none"> Workers/ community safety On site drainage, disposal of construction debris. There is no religious infrastructure (Mandir/masjid/Church/etc.) within Proposed Project Site. One natural drainage channel which is approx. 150m distance from proposed site. No sensitive receptors are present in proximity of the proposed site
6	Spread over approx. 10,000 sqm plot area and 1640 sqm of built up area-comprising: common facilitation center (administrative office, creche facility, dispensary, canteen), misc. utility centers, residential facilities for staff, workers and hostel for working women, commercial facilities, other common facilities (industrial shed, warehouse, truck parking, weigh bridge, bus shelters, recreational area, public toilet), Boundary wall – 1635 Kms, renovation of existing boundary wall – 857 Kms, height 2.5m, Gate – 2 Nos., Security Cabin – 1 Nos. Watch Towers – 5 nos, safety & security systems.	Respective site and its 500m 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. Inconvenience to existing road users due to traffic diversions. Workers/ community safety. There is no govt. Educational Institutions Building within proposed site. There is no major habitation nearby this location within industrial boundary. There is no significant protected forest in and around the project area. No sensitive receptors are present nearby proximity. There is no religious infrastructure (Mandir/masjid/Church/etc.) within Proposed Project Site On site drainage, disposal of construction debris

Table 5-2: Environmental Impacts and Risk Level

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

Sl. No.	Environmental Attributes	Risk-Construction Phase		Risk-Operation Phase	
		Linear Components	Area Components	Linear Components	Area Components
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)

174. 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.

175. 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 similar to Good International Industry Practices (GIIPs) and considered incidental to works.

176. The impacts arising due to laying of various utilities like water supply pipeline, electric cables (HT/ LT), natural gas pipelines and OFC cables are avoided through the provision of a utility corridor. Moreover, specialized works like laying of electrical cables, OFC and natural gas pipelines 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

177. The construction works for the infrastructure development will not have any impact on geology, since the core and buffer zones does 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	7006.26	Mohanpur	10
2	Bitumen	KG	-	-	-
3	Stone Aggregates	Cum	9999.02	Churaibari	165
4	Cement	MT	20638.49	Agartala	10
5	Steel	MT	465.11	Agartala	10
6	Bricks	Nos	608,282.00	Jirania	15

178. The construction works within the Nagicherra 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 its previous levels after construction works.

179. Therefore, the construction works within Nagicherra IE is not anticipated to cause any long or short term impacts on geology of the core and buffer zones.

Mitigation Measures

- Project design has been considered to minimize the construction footprint as well as resource efficiency in all the proposed works, in order 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 core and buffer zones. However, measures required for containing the impacts during construction activities are described under environmental management plan (EMP) (ref. Table 9-1 to 9-5).
- The EMP also specify the responsibility for planning and execution of such measures along with mechanism for supervision & monitoring throughout the construction stages.

Impacts-Operation Phase

180. The operation phase of the proposed infrastructure development works will not require any construction materials and neither involve any deep excavation and related activity, similar 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

181. The proposed infrastructure development works at Nagicherra 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 3.11 KL (ref. **Table 5-4**), which is intended to be met through ground water resources.

182. At present, there are no existing tube wells and five deep tube wells, each with an average yield of 125 cum/hr. are proposed for meeting both construction water demand. The core and buffer zones are under safe category and has adequate groundwater resources, as per the assessment carried out by the CGWB (ref. Section 4.2.2 for available groundwater resources).

183. The core and buffer zones does not have any surface water bodies/ sources (ref. Section 4.2.4).

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

Sl. No	Activity	Water Requirement (L)
1	Consolidation of Earth and Compaction	320953
2	Mixing and Curing of Concrete	990006
3	Dust suppression and Camp site management	13769
4	Sanitation & Drinking water at workforce camps	27539
Water Requirement in Kilo Liters (KL)		1352.27
Add 15% for wastage and contingency		202.84
Total Water Requirement (KL)		1555.11
Avg. Daily Water Requirement for 500 workdays in Kilo Liters per Day (KLD)		3.11

Mitigation Measures

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

- Construction of rainwater percolation wells for recharging groundwater have been considered at 13 locations selected based on in-situ percolation rate within the IE. These percolation wells across the IE will be constructed as per the guidelines of the Central Ground Water Authority (CGWA) and/or the Central Public Works Department, Govt. of India.
- 2.77 ha within Nagicherra IE is being developed as green belt area i.e. parks and open areas, which is also expected to replenish groundwater, which works out to 22.02% of total 12.56 ha, considered for the present development (ref. Section 4.2.9 for rainfall data in West Tripura district).
- Construction of stormwater holding/ retention pond at 1 location by impounding the existing valley/ local depression(s), with an outlet weir for discharge of excess/overflow within the Nagicherra IE with a capacity of 3.6 million liters as shown in **Figure 5-1**. The stormwater holding/ retention pond can meet about 7 days of water requirement of IE even after losses due to evaporation and infiltration. The water from holding/ retention pond can be used within the IE like watering the green belt/ landscaped areas and various other requirements.
- DoIC/ TIDCL will encourage all industrial units (upcoming) within the Nagicherra IE, to install roof water harvesting and groundwater recharging structures within individual industrial plots, to promote replenishment of groundwater resources

Impacts-Operation Phase

185. The projected water demand for the operation phase (for 30-year period) is 1.305 MLD (ref. Table 3-5). The 5 new tube wells proposed under development works will be adequate to meet operation phase demand, given the prevailing groundwater resources of the core and buffer zones.

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

Mitigation Measures

187. 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 upkeeping of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater.
- Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial use.
- DoIC/ TIDCL shall continue to encourage and promote all industrial units (both existing and upcoming) within the Nagicherra IE, to install roof water harvesting and groundwater recharging structures within their respective individual industrial plots for replenishment of groundwater resources.

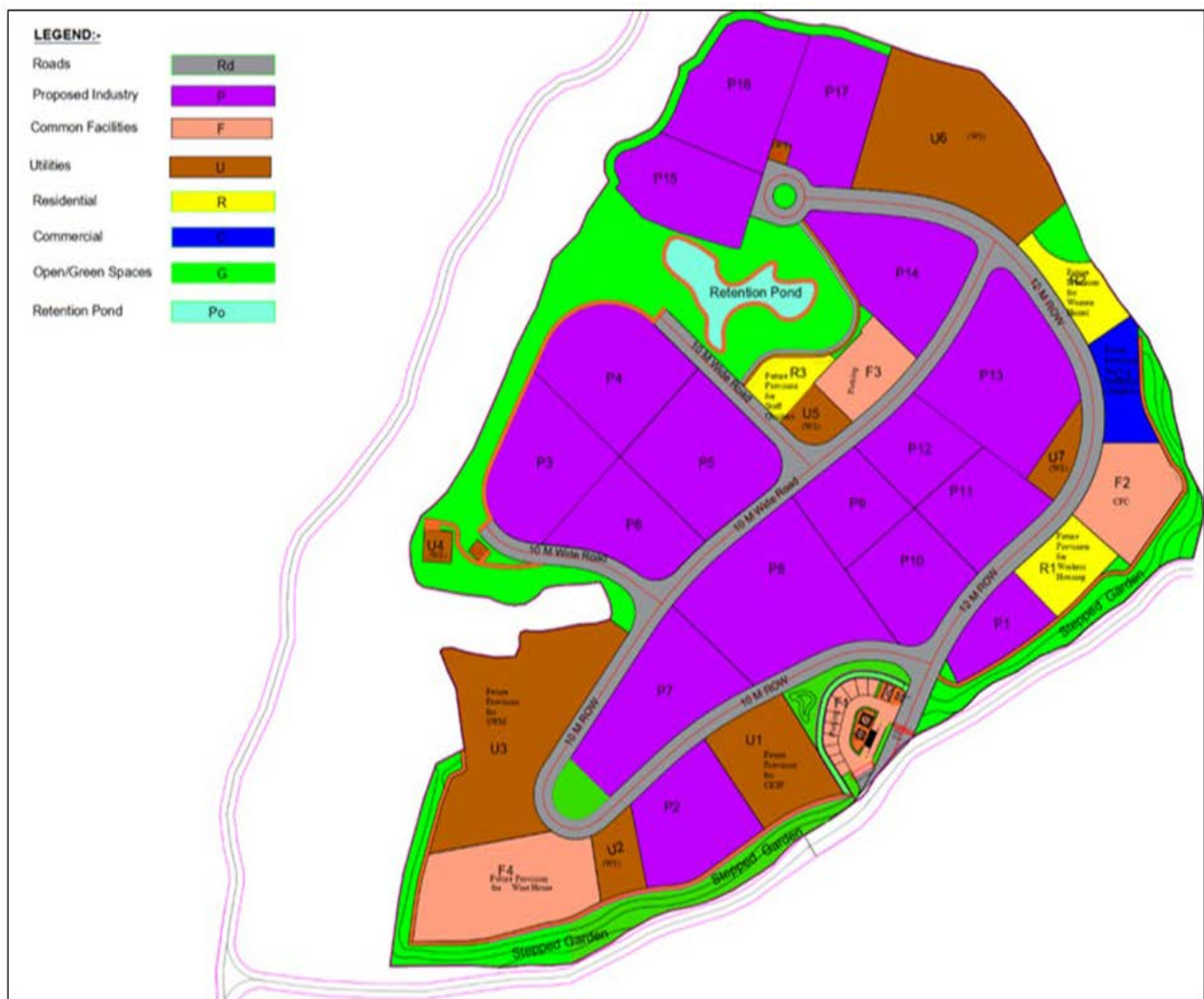


Figure 5-1: Proposed Stormwater Holding/ Retention Ponds within Nagicherra IE

5.4 Physiography and Elevation

Impacts-Construction Phase

188. The proposed infrastructure development works at Nagicherra IE do not involve any major construction or deep excavation works, which alters the existing physiography and/ or elevation profile of the core zone. The proposed works like development of new industrial

plots, widening of roads, augmentation of water supply, stormwater drainage, laying of pipelines and feeder cables etc. follows the existing physiography and elevation profile/ topography (ref. 4.2.3 and 4.2.5 under Section 4).

189. Therefore, no significant impacts are foreseen on the alteration of physiography and elevation profile/ topography due to proposed works. On the contrary, the proposed works will augment industrial growth and consequently socio-economic benefits to the state.

Mitigation Measures

190. No specific mitigation measures are required for managing the impacts on physiography and elevation profile/ topography within the core zone during both construction and operation phases of Nagicherra IE. However, several GIIPs (good international industry practices) for mitigating incidental impacts, which may arise during 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) (ref. Table 9-1 to 9-5).

Impacts-Operation Phase

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

192. Thus, the operation phase of the Nagicherra 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

193. 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

194. The project design considers 3.434 km long stormwater drains along with 6 culverts, covering the entire IE with 4 outfalls, to efficiently drain the runoff from the core zone i.e. entire IE (ref. Section 3.8). The stormwater outfalls will connect to the nearest natural drainage channels within core zone. In addition, project design has validated the discharge capacities of storm water drains considering maximum/ peak daily intensity of rain fall reported in the last 50 years (or as available) and accounting for additional discharge capacity due to excess rainfall/ changing weather pattern induced by climate change¹¹.

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

196. Since, core zone i.e. Nagicherra IE and surrounding areas does not have any surface water bodies/ lakes (ref. Section 4.2.4) there will be no impact on surface water resources as a consequence of this project construction.

¹¹ Climate Risk and Adaptation Assessment (CRA) and Climate Resilience Framework Report, prepared as part of the detailed project report.

Mitigation Measures

197. In order to conserve and reuse of surface runoff, it is considered to construct a storm water holding/ retention pond within IE, with a cumulative holding capacity 3.6 million liters by impounding the existing valley/ local depression(s), with an outlet weir for discharge of excess/overflow (ref. Section 4.2.9 for rainfall data).

198. The stormwater holding pond will serve as a supplementary water source, which can serve up to 7 days of water requirement for the industrial estate, after requisite treatment and will reduce the withdrawal of groundwater for industrial use (ref. Figure 5-1).

199. In addition, specific mitigation measures, which are required to minimize the impacts on hydrology and drainage within the core zone during construction phases are described in the EMP (ref. Table 9-1 to 9-5).

Impacts-Operation Phase

200. 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.

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

Mitigation Measures

202. 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

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

204. 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, etc.	Cum	147612.40
	Total A		147612.40
B	Reuse of excavated materials		
1	Back filling of earth work in MUD, Stormwater drains, all utility buildings, etc.	Cum	18392.04
2	Leveling and Re-grading the industrial plots	Cum	129220.36
	Total B		147612.40

Mitigation Measures

205. Specific mitigation measures required for segregated collection and preservation of topsoil (up to 30cm depth), prior to site clearance of any construction activities and reuse of preserved topsoil for land scaping and green belt development are described in the EMP (ref. Table 9-1 to 9-5).

206. 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).

Impacts-Operation Phase

207. 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

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

5.7 Land Use

Impacts-Construction Phase

209. The proposed works within Nagicherra IE is limited to 5.41 ha. i.e. merely 43.10% of 12.56 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 3-3 for more details).

210. All the proposed development works are within the industrial estate and no land is being acquired afresh or diverted for industrial use. Thus, the impacts are short term, limited to the existing industrial estate as a consequence of this project.

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

Sl. No.	Land Use*	Net Area (ha)	In %
1	Industrial Area Plotted development & Industrial Sheds	5.41	43.10%
2	Transportation Roads, Junction, Parking etc.	1.36	10.86%
3	Facilities <u>Public and Semi- Public:</u> Health care centre, educational institutes, weighbridge, and administration etc. <u>Utilities:</u> Electric substation, Pumping Stations, Underground Reservoirs/ Firefighting tanks and other utilities, etc.	2.68	21.3%
4	Residential Staff Quarters	0.34	2.71%
5	Open Space Parks and open areas around it, steep slopes, and low-lying lands	2.77	22.02%
	Total	12.56	100%

Mitigation Measures

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

- Development of green belt area along the road/ utility corridor spread over 2106 sq.m.
- Development of green belt/ land scaped area within Nagicherra IE i.e. parks and open areas spread over 2.77 ha (22.02% of 12.56 ha) in order to offset the impacts due to change in the land use viz. industrial plot and infrastructure development.
- Preserved topsoil from site clearance activity shall be used 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).
- Establishment of contractor's campsites, material stack yards, hot mix plant, concrete batch plant and workforce camps within 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 9-5).
- 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

212. The operation phase of the Nagicherra 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).

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

Mitigation Measures

214. 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites.

215. 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

216. The development works within Nagicherra IE will not have any direct impact (short or long term) on the present agriculture or cropping pattern either in core or buffer zones.

Mitigation Measures

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

218. In the unlikely event of supplying excess excavated earth to private agriculture lands from the construction works at Nagicherra IE, 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

219. 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.

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

Mitigation Measures

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

5.9 Forest and Protected Areas

Impacts-Construction Phase

221. The construction works at Nagicherra 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).

222. Similarly, the construction works at Nagicherra IE will not have any impacts (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 7.9 km from the IE (ref. Section 4.3.3).

Mitigation Measures

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

Impacts-Operation Phase

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

Mitigation Measures

225. 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

226. The site clearance activity for infrastructure development components like plot development works, widening of roads, stormwater drain, laying of pipelines and feeder cables etc. will involve shrub/ vegetation clearance but no felling of tree is required.

227. The ecological investigations have reported that none of the flora within Nagicherra IE belong to rare, endangered and threatened floral species notified by the Tripura Forest Department (ref Section 4.3.4 to 4.3.6).

Mitigation Measures

228. Since there is no impact on flora or trees, no specific mitigation measures are warranted. However, instructions for conservation natural resources to be followed by the construction workforce as per the EMP given under EMP (ref: Table 9-1 to 9-5).

Impacts-Operation Phase

229. 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 is likely to offset the short term impacts due to construction activities like site/ vegetation clearance among others.

Mitigation Measures

230. No specific mitigation measures are required to minimize or reclaim the impacts on flora during the operation phase, except to ensure routine maintenance and upkeep of all the green belt areas within the IE.

5.11 Fauna

Impacts-Construction Phase

231. The ecological investigations as well as consultations with the local community has not indicated presence or sighting of any wildlife and/or any animal-human conflicts during the past 10 years within the core zone i.e. Nagicherra IE (ref. 4.3.7 under Section 4). The nearest wildlife sanctuary and national parks (Sepahijala WLS, Clouded Leopard National Park and Sepahijala Zoological Park) is a distance from 11.24 km. Therefore, the infrastructure development works from the Nagicherra IE is not likely to have any impact on fauna.

Mitigation Measures

232. No specific mitigation measures are required to avoid impacts on fauna of the core or 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 (ref. Table 9-1 to 9-5).

Impacts-Operation Phase

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

Mitigation Measures

234. 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

235. The construction works within Nagicherra IE, i.e. core zone will not cause any emissions that can impact local weather and climate in long term. The baseline air, noise

and water quality are within the stipulated national standards and does not critically exceed the respective national permissible limits (ref. Section 4.2.15 to 4.2.18).

Mitigation Measures

236. 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 (ref. Table 9-1 to 9-5).

Impacts-Operation Phase

237. No major industries are likely to come up within the Nagicherra 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).

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

Mitigation Measures

239. 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

240. The core zone i.e. Nagicherra 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).

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

Mitigation Measures

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

243. However, in the unlikely event or scenario of sighting of "remnants" or "chance finds" of archaeological or historical importance 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 9-5).

Impacts-Operation Phase

244. 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

245. 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

246. The core zone i.e. Nagicherra 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).

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

Mitigation Measures

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

249. 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 9-5).

Impacts-Operation Phase

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

Mitigation Measures

251. 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

252. 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 ¹²	Quantity in Liters Per Day
1	Supervision staff at camp site office	34	90	3,060
2	Non-local /migrant labor at workforce camps	100	90	9,000
			Sub-total	12,060
			Add 15% for wastage and Contingency	1,810

¹² LPD refers to liters per day consumption or discharge as per the Government of India Norms

Sl. No.	Category	User Nos	LPD ¹²	Quantity in Liters Per Day
	Daily Water Requirement for Sanitation and Ablution (rounded off to)			13,870
	Estimated Quantity of Sewage generation @ 80% of Water Consumption as per Govt. of India Norms			11,100

Mitigation Measures

253. 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 9-5).

254. The EMP also includes provision for oil interceptors with separate drainage system at all vehicle servicing and oil/lube/fuel storage areas.

255. No other specific mitigation measures are required for managing the impacts on surface and ground water pollution.

Impacts-Operation Phase

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

Mitigation Measures

257. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within Nagicherra IE and disposed off 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

258. The baseline ambient air quality for all monitored parameters (PM₁₀, PM_{2.5}, SO₂, NO₂, CO) within Nagicherra 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.

259. The construction works within Nagicherra 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. All such impacts on the air quality are short term, transitory in nature and limited to construction phase.

Mitigation Measures

260. Key avoidance and mitigation measures, like suppression of dust levels and regulation of vehicular emissions during construction phase are included in the EMP (ref. Table 9-1 to 9-5).

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

Impacts-Operation Phase

262. No major industries are likely to come up within the Nagicherra 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

263. 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).

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

265. 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

266. One of the components in the proposed works at Nagicherra IE includes capacity of the natural gas pipe network to 6,250 SCM per day, which is mainly consumed by the energy intensive industries (ref. Section 3.14). In the absence of capacity augmentation, industries will be constrained to meet energy demand from fossil fuel, which will contribute to increased GHG emissions.

267. 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

268. The capacity augmentation of the natural gas network led to reduction in GHG emissions by nearly 43.47% as given in **Table 5-8**. Additionally, as a green initiative and concern for reducing the carbon footprint, 1 module of solar power generation unit with a cumulative capacity of 10 KW is also considered under the proposed development works within IE, which will offset energy demand from fossil fuel.

269. 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.

270. The reduction in GHG emissions due to the improvements of NG network and solar energy is a small step towards reduction of carbon footprint and to address climate change concerns.

Table 5-8: Estimated GHG Emission reduction due to augmentation of NG Network

Particulars	Value	UoM	Remarks/ source
Existing gas consumption- NG	-	SCMD	Mott MacDonald Estimate
Future gas consumption- NG	6,250	SCMD	Mott MacDonald Estimate
GCV of NG	10,000	kcal/SCM	PPAC Ready reckoner 2022-23
NCV	90%	of GCV	PPAC Ready reckoner 2022-23
NCV of NG	9,000	kcal/SCM	Calculated
GCV of G4 coal	6,250	kcal/kg	From Northeast Coalfields
Hydrogen content	4.53	%	From Northeast Coalfields
NCV of G4 coal	6,011	kcal/kg	NCV = (GCV-0.09H*587)- Dulong's formula
Coal equivalent of NG	1.497	kg/SCM	Calculated
Existing consumption- coal eq.	-	kg/ day	Calculated
Future consumption- coal eq.	9,358	kg/ day	Calculated
Specific carbon footprint for coal	2.40	kg CO2/kg	GHG Emissions Calculation ver 02.6, UNFCC Secretariat, Sep 22
Specific carbon footprint for NG	2.03	kgCO2/ SCM	GHG Emissions Calculation ver 02.6, UNFCC Secretariat, Sep 22
Carbon footprints (kg CO2 per day)	Gas	Coal	Reduction %
Current consumption	Nil	Nil	NA
Future consumption	12,717.06	22,495.96	43.47%

Impacts-Operation Phase

271. The operation phase of the Nagicherra IE is not likely to have any long or short term impacts on GHG emissions. However, it is anticipated that the Nagicherra IE may be provided with a natural gas pipe connectivity in the near future (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 also address climate change concern.

Mitigation Measures

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

273. All the damaged and dis-functional solar panel, if any are to be disposed off in accordance with Solar E-waste Management Rules (ref. Table 2-1).

5.18 Noise & Vibration

Impacts – Noise-Construction Phase

274. The baseline ambient noise levels within Nagicherra IE were below the national ambient standards, which can be attributed to rural expense, present low vehicular traffic and absence of major noise emitting industrial activities (ref. Table 4-10 of 4.2.16 under Section 4).

275. The principal source of noise during construction works would be from operation of equipment, machinery and vehicles deployed for construction activities (ref. 4.2.16 under Section 4 for baseline noise levels).

276. The earth-moving machineries 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 5-9** and **5-10**.

Table 5-9: 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
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 5-10: 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

277. The noise generated during the construction would cause short term inconvenience to the population at nearby areas (up to 100m), beyond which it would get drastically attenuated to acceptable levels. Since the areas within the Nagicherra IE is 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

278. The mitigation measures to limit the ambient noise levels by the construction vehicles, equipment and machinery are given in the EMP (ref. Table 9-1 to 9-5).

279. In addition, periodical noise level 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

280. No major industries are likely to come up within the Nagicherra 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

281. 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

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

283. The vibration velocity levels in rural settlement areas or low-density settings like Nagicherra 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 VdB¹³.

284. 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.

285. 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

286. The roads within the IE, even during the construction stage will be paved and maintained¹⁴ 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.

287. 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.

¹³ Source: Guidelines for Noise and Vibrations for Metro Rail Transit System by Research Designs and Standards Organization, Ministry of Railways, Government of India

¹⁴ 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.

Impact-Operation Phase

288. The operation phase of the Nagicherra IE is not likely to cause any long or short term vibration impacts.

Mitigation Measures

289. During operation phase, 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.

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

5.19 Slope Stability and Landslide Hazards

Impacts-Construction Phase

291. Landslide is one of the most significant, unpredictable occurrences, which often leads to road blockages, accidents and even could lead to loss of life at times.

292. The construction activities related to infrastructure works within IE in itself does not involve significant hill (locally known as tilla) cutting operations. However, site clearance operations as well as excavation operations for construction of structures could trigger mud slips or localized landslides, particularly during or just after monsoon months.

Mitigation Measures

293. The recommended slope cuts during earth work excavation which shall be adopted for minimizing mud slips/ landslides and ensuring slope stability during the excavation are given **Table 5-11** and included in EMP (ref. Table 9-1 to 9-5).

Table 5-11: Recommended Slope cuts for Slope Stability

Sl. No	Type of Material	Recommended Slope cuts
1	Loose Soil and Vulnerable Slopes	2V: 1H
2	Compacted Soil with Slope towards Road	4V: 1H
3	Hard Soil/ Soft Rock	6V: 1H

294. Further, project design has considered nature-based solutions/measures (bio engineering) within IE to improve the slope stability and minimize erosion during or after monsoon season or heavy rainfall months (ref. **Figure 5-2**). The species which may be considered for the bio-engineering solutions as well as for green belt development/ landscaping areas are given in **Appendix-6**.

Impacts-Operation Phase

295. The operation phase of the Nagicherra IE is not likely to cause any long or short term landslide impacts.

Mitigation Measures

296. No specific measures are required for mitigation of impact related to slope stability and landslide hazards during the operation phase.

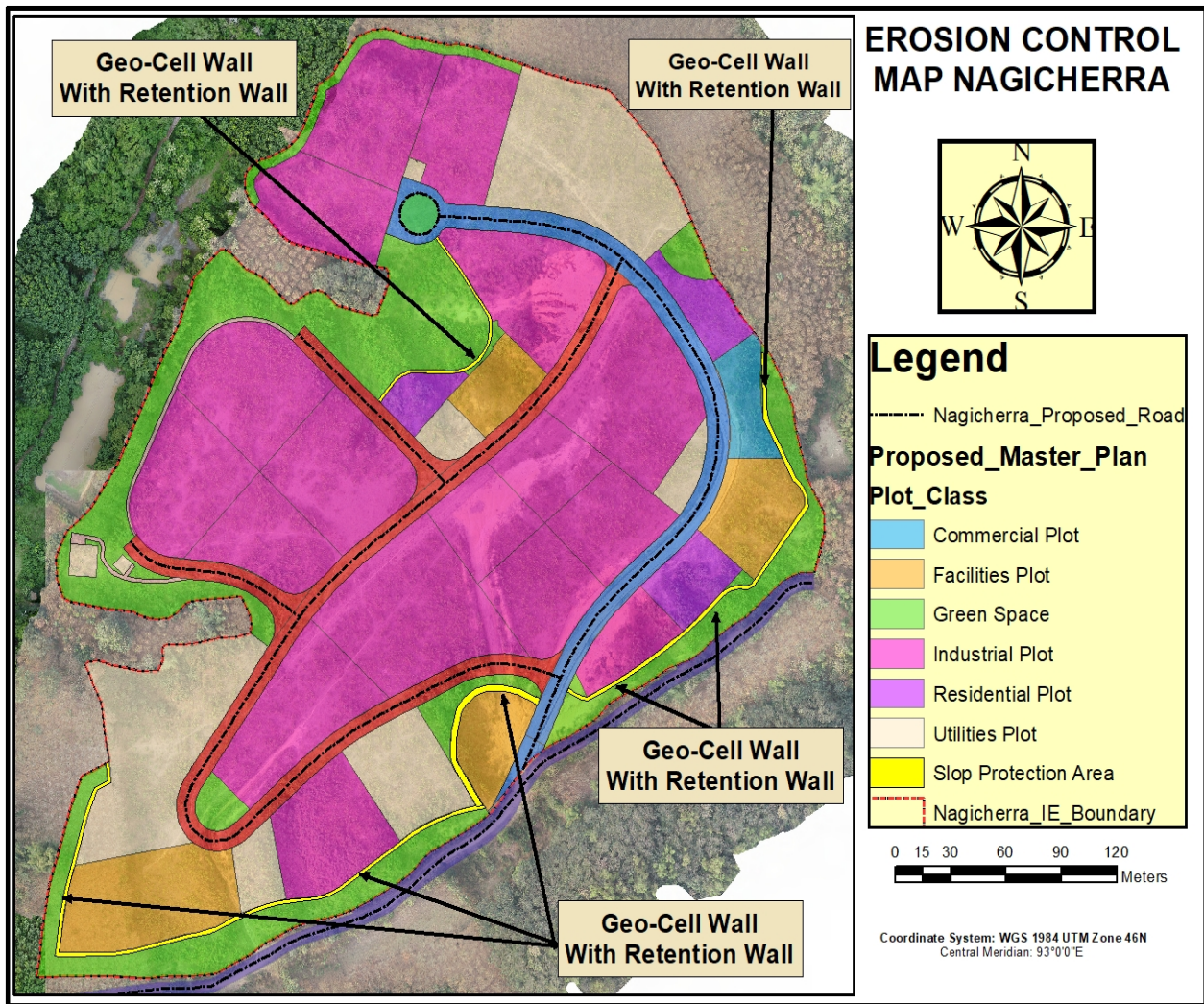


Figure 5-2: Nature Based Bio-engineering Provisions for Erosion Control

5.20 Hazardous and Non-Hazardous Wastes

Impacts-Hazardous Wastes-Construction Phase

297. The construction works at Nagicherra IE is not anticipated to generate hazardous waste and therefore, no impacts are foreseen.

Impacts-Non-Hazardous Wastes-Construction Phase

298. 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.

299. The construction within Nagicherra 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.

300. 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.

301. During the construction stage, the municipal solid waste generation from construction camp site offices and workforce camps is estimated as 35.2 kg per day as shown in **Table 5-12**, which is to be safely handled and stored prior to its disposal at approved places by district administration

Table 5-12: 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	34	0.300	10.2
Non-local /migrant labor at workforce camps	100	0.250	25
Total Municipal Solid Waste generation in Kg/day			35.2
Organic Waste Generation @ 40%			14.08
In organic Waste Generation @ 60%			21.12

Mitigation Measures-Hazardous & Non-Hazardous Wastes

302. 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.

303. No specific mitigation measure are required for handling the hazardous waste during the construction phase.

304. 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.

305. 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.

306. 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.

307. The solid waste management from all campsites, workforce camps and all other operational sites shall be collected periodically and disposed off through the waste collection trucks operated by the Agartala Municipal Corporation (AMC) and transported to their solid waste management facility for further treatment and disposal.

308. The sanitary/ sullage/ sewage generated at campsites, work force camps and other operational sites are to be disposed off through septic tanks and soak pit disposal arrangements, details of which are given in EMP (ref. Table 9-1 to 9-5).

309. 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 9-5).

Impacts-Operation Phase-Hazardous/ Non-hazardous Waste

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

Mitigation Measures

311. 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 (ref. Table 2-1).

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

5.21 Work Zone Safety and Community Safety Risks

Impacts-Construction Phase

313. The construction works within Nagicherra 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

314. 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 9-5).

Impacts-Operation Phase

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

Mitigation measures

316. 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.

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

5.22 Natural Disasters/ Calamity and Hazard Vulnerability

Impacts-Construction Phase

318. Given the fact that the Nagicherra 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.

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

Mitigation Measures

320. 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.

321. 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 to seek quick response, in the event of natural disaster and/or any other natural calamity.

322. 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.

323. 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 on a daily basis.

324. 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.

325. A template for Disaster Management and Emergency Response Plan for the construction phase at Nagicherra IE has been given in **Appendix-7**, which is to be dovetailed with the West Tripura district disaster management plan and suiting to requirements of contractor's scale of establishment for the construction phase.

Impacts-Operation Phase

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

Mitigation Measures

327. 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 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 on a daily basis.

- 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.

5.23 Labour and Working Conditions

Impacts-Construction Phase

328. The infrastructure development at Nagicherra will require an estimated 399 construction workforce at all levels (337 skilled and unskilled Labour and 62 supervisory and managerial staff). It is anticipated that nearly 70-75% of skilled and unskilled labour (approx. 300) are likely to be 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).

329. 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

330. 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 9-5).

Impacts-Operation Phase

331. The operation phase is not likely to cause any risk related to labour and working condition within Nagicherra IE.

Mitigation Measures

332. 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).

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

5.24 Gender Based Violence (GBV) Risks

Impacts-Construction Phase

334. 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.

335. 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 Nagicherra 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

336. 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 9-5).

Impacts-Operation Phase

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

Mitigation Measures

338. 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.

6.0 ANALYSIS OF ALTERNATIVES

6.1 Considerations for Alternatives

339. 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

340. 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. Nagicherra green field IE is one of the Nine prioritized industrial estates identified for development with Best-in-Class Infrastructure development.

341. Nagicherra IE, is a green field industrial estate and spread over 12.56 ha, presently requires an immediate developed infrastructure. 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.

342. Therefore, the infrastructure development works at Nagicherra IE is utmost essential to sustain the industrial growth and economy of the state. The proposed works include development of vacant land within the IE into industrial plots for setting of new industries construction of internal roads, storm water drainage, construction of water supply, installation of power system, natural gas network, social infrastructure amenities like common facilitation center, shops & business center, residential housing, development of parks and open areas among others. Moreover, while planning, care has been taken to follow alignments and avoid opening of new areas for laying the infrastructure works, for minimization of impacts.

343. 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

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

345. 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 (129220.36 cum) for green belt development and landscaping of open areas (2.77

ha) within the IE boundary. Thus, avoiding opening of new areas for debris disposal. The area under green belt and landscape development works out to 22.02% of total 12.56 ha, considered for the present development.

- Construction of 13 rainwater percolation wells at suitable locations within IE, selected based on in-situ percolation rate for recharging groundwater and to compensate withdrawal of groundwater for industrial use.
- Construction of stormwater holding/ retention pond(s) by impounding the existing valley/ local depression(s), with an outlet weir for discharge of excess/overflow within the Nagicherra IE with a capacity of 3.6 million liters (ref. Figure 5-1). The proposed stormwater holding/ retention pond can meet about 7 days of water requirement of IE even after losses due to evaporation and infiltration. The water from holding/ retention pond can be used within the IE like watering the green belt/ landscaped areas and various other requirements.

7.0 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1 Public Consultations

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

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

- Officials of TIDCL at Nagicherra IE
- Officials of Tripura State Pollution Control Board having jurisdiction of Nagicherra IE
- People who visit IE for miscellaneous activities like cattle grazing etc.
- Civil Society Organization active in the buffer zone

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

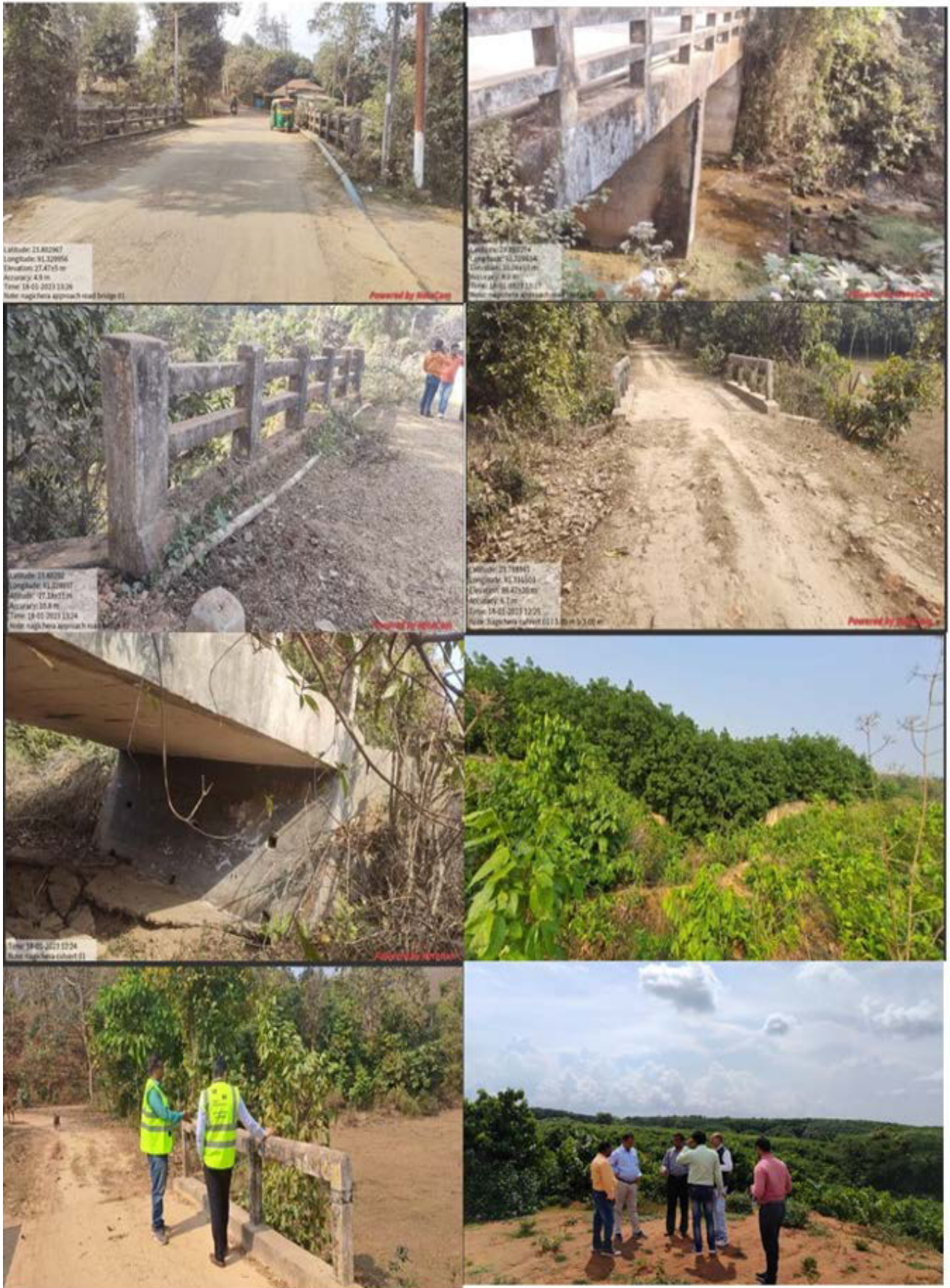
- Objectives of DoIC/ TIDCL for developing the industrial estates in Tripura
- Features/ components of the infrastructure development works considered to access to Nagicherra IE
- Likely beneficial impacts arising due to development like increased employment and business opportunities.

349. The consultations were carried out during December 2022 & February 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">• Local/ nearby residents were happy to know that development of IE is being taken up by DoIC/ TIDCL, Govt. of Tripura.• They have suggested the provision of widening of roads with footpath for pedestrian safety.• suggested the construction of proper culverts and covered drains for safety purpose.• Have suggested provision for streetlights at approach roads as on priority.• Some residents of households residing close to IE have complained about difficulty accessing safe drinking water and sanitization. They also expect employment opportunities within IE.	<ul style="list-style-type: none">• The project design has considered 3.434 km of stormwater drains for the entire IE. 06 CD structures/ culverts along the roads are being reconstructed to improve cross drainage and avoid water stagnation and also power supply.• Footpaths and streetlights at approach roads have been considered for pedestrian safety.• The water supply within the IE has been tube wells, storage reservoirs, overhead tanks and distribution system to ensure equitable water supply for the entire IE.• The project design considers widening of about 1.404 km of roads from single lane to intermediate/ two lane along with improvement of major and minor intersections/ junctions with adequate lighting facilities as per requirement.

Table 7-2: Photographs taken during site visits





7.2 Gender Based Violence (GBV) Consultations

350. 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 Nagicherra IE.
- Women workforce of the existing industries of Nagicherra IE are at potential risk for eve teasing, stalking, harassment including sexual exploitation and abuse by the migrant construction workers.

351. 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

352. 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.

353. 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.

354. 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

355. 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.

356. 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.

357. 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.

358. 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.

359. **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.

360. **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.

361. **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**.

362. **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 concerned staff and contractors will be posted and displayed at all construction sites.

363. **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.

364. **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 level¹⁵. 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 ¹⁶ .	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)

365. **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

¹⁵ DOIC, Government of Tripura (GOT) is the executing agency under the loan.

¹⁶ 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).

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.

366. **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.

367. **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.

368. 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, 2013.¹⁷ GRM will continue to be in place throughout the duration of the project. The grievance redress process is shown in **Figure 8-1**.

¹⁷ The authority admits grievance only with reference to the land acquisition, resettlement and rehabilitation issues under the RFCTLARRA, 2013.

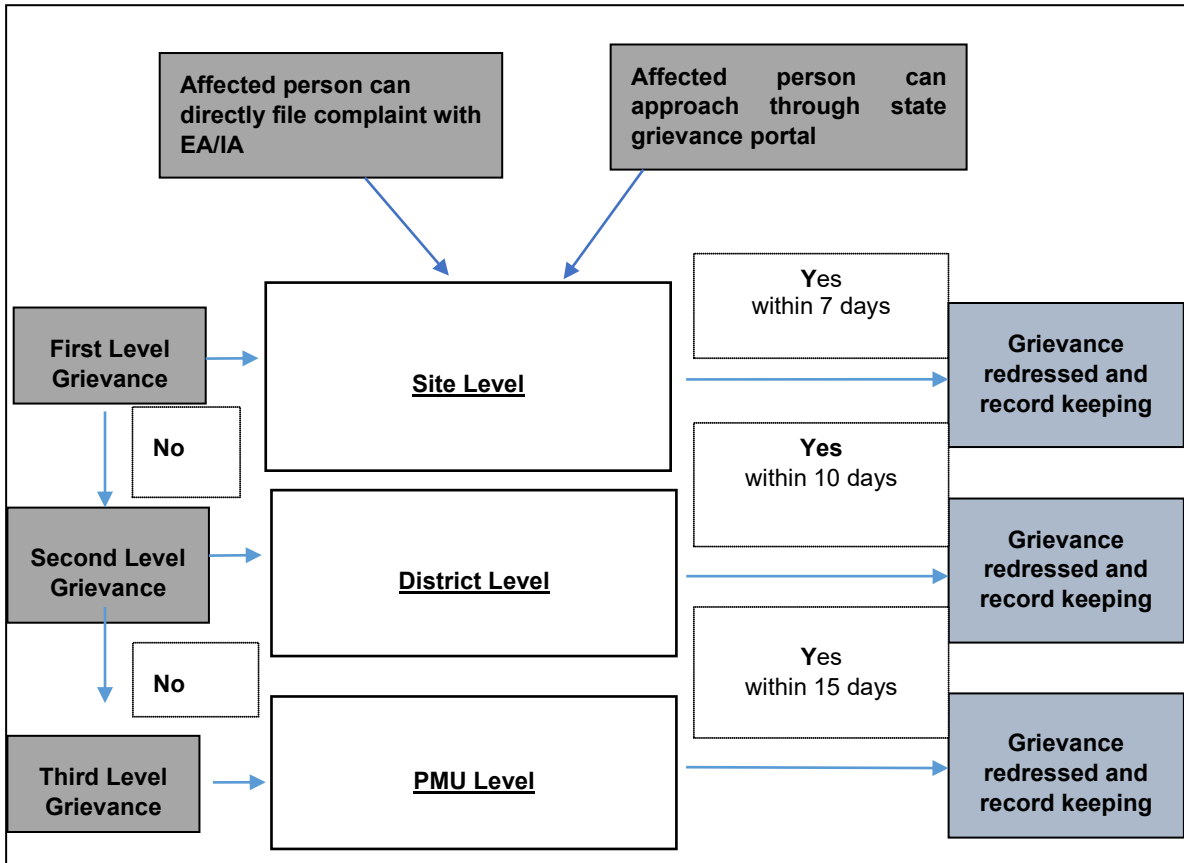


Figure 8-1: Grievance Redressal Mechanism

369. **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. In the event that the established GRM is not in a position 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 make an effort 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 information¹⁸ will be included in the project-relevant information to be distributed to the affected communities as part of the project GRM.

370. **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

¹⁸ <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.

371. **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.

372. **Periodic 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.

373. **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

374. 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 Nagicherra IE.

375. The construction stage impacts like vegetation/shrub 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 IE boundary. The impacts arising due to laying of various utilities like water supply, power supply, SWD, electric cables natural gas pipelines are completely avoided through the provision of utility corridors. Moreover, specialized works like laying of electrical cables and natural gas pipelines are governed by the respective regulations and code of practices, which stipulates all technical and safety requirements during erection, testing and commissioning stages.

376. 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 **9-5**. 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 9-5.

377. 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.

378. 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.

379. 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 – Road, power supply, water supply, & SWD.

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	No permissions required, however there will be minor impact due to vegetation/ shrub clearance	<ul style="list-style-type: none"> Site clearance or pre-construction activities shall be initiated in stretches/ areas, which involve shrub clearance. 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 (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
6.	Disaster Management & Emergency	Will enable contractor(s) preparedness and response to any	<ul style="list-style-type: none"> The overall vulnerability of West Tripura district including Nagicherra IE is categorized as High for earthquakes and thunderstorms. In order to ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Nagicherra 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 	EHS Officer, Contractor and Environmental	Senior Environmental Specialist of ESG

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
	Response Plan	emergency during project implementation phase	<p>under Appendix-7 to IEE.</p> <ul style="list-style-type: none"> 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 on a daily basis. 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 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. 	Officers of PIU & PMU at IE Level	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 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 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 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. 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. 	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"> 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 number of 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, so as 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 and complied by 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 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 overhead water storage, well always maintained and in usable condition. Bottom tanks shall be regularly cleaned, and overhead tank replenished as per requirement. Work force shall be oriented to use 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 contractor. If establishing workforce camps become 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 its 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. 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. 	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.	Arrangement for	Reduction/ depletion of	<ul style="list-style-type: none"> The contractor shall be responsible to arrange construction water demand in compliance to requisite statutory requirements. In doing so, the contractor 	EHS Officer,	Senior

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
	Construction Water	ground water resources	<p>shall assess water source availability and shall prepare a construction water demand and management plan for approval of ESG Cell.</p> <ul style="list-style-type: none"> Construction water requirements are to be met from only existing tube wells, with prior approval of ESG Cell and competent authorities. Contractor shall preferably have more than one source to avoid over dependence on single source and affect pre-existing users. Contractor shall obtain prior approvals from 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 safe category and therefore contractor 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 	Contractor and Environmental Officers of PIU & PMU at IE Level	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 sites. 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 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 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 up only in segments of 250 m stretch or specified zones at a time and no new stretches/ zones shall be opened up 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. 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, contractor 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 existing industries	Inconvenience to existing industries and other road users within IE Safety issues for road users particularly during nighttime Air and noise pollution due to deployed vehicles,	<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. 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 of 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 the deployed to manage the traffic for the entire construction phase. 	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
		equipment and machinery	<ul style="list-style-type: none"> 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 so as 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. 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 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 same is always being used by work force, while at work. In case of damaged or lost PPEs, same 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 purpose 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 camp site to attend to health issues/first aids and shall conduct regular health check-up of all staffs and workers employed in 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 area, 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 ongoing operations on that specific time and related safety requirement at work site including safe distances to keep during the site visit. 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. 	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.	Water Pollution	Surface and ground water pollution at all operational sites, camp offices and	<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. 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 	EHS Officer, Contractor and Environmental	Senior Environmental Specialist of ESG

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility																																																					
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		workforce camps	<p>lubricants do not contaminate soil and groundwater.</p> <ul style="list-style-type: none"> 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 project 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 join 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	Officers of PIU & PMU at IE Level	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. 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 record and conduct fitness test of all vehicles and machinery at regular interval of one year and 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																																																				

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				Planning and Execution	Supervision/ Monitoring
			<ul style="list-style-type: none"> 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 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. 	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
22.	Bio-diversity Management (flora and fauna)	Shrub clearance	<ul style="list-style-type: none"> Only shrub clearance will be required, However contractor shall be guided to not impact the existing ecological environment of IE 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 and Chance Finds/ Physical Cultural Resources	Impact/ loss of cultural/ historical resources	<ul style="list-style-type: none"> Nagicherra IE and its surrounding areas does 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 notice of ESG Cell and TIDCL upon discovery of any such articles thereof and carry out TIDCL's instructions for dealing 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. Contractor shall recommence the work in the site, only after site is cleared and getting 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 trainings. 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 	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
			<p>related issues at workplace on regular basis for creating a sense of confidence, privacy, security, and awareness of complaints mechanism and GRM thereof.</p> <ul style="list-style-type: none"> ○ 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. at all times 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 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					
	<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. • Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial use. • 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites. • Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed off 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 dis-functional solar panel, if any are to be disposed off 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 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 on a daily basis. ○ 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 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 9-2: Environment Management Plan - Sector/ Component – Laying, Testing and Commissioning of Natural Gas Pipelines

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 natural gas pipelines	None	<ul style="list-style-type: none"> Tripura Natural Gas Company Limited is the designated and Nodal Agency for installation, testing and commissioning of natural gas pipelines within Nagicherra IE. Hence, permission from any other agency is not required. Contractor designated for laying natural gas pipelines shall have valid license and approved/ enlisted by the Tripura Natural Gas Company Limited. Copy of the valid license and approved/ enlistment by the Tripura Natural Gas Company Limited 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"> Contractor shall inspect the pipeline corridor and check the readiness of duct for laying of natural gas pipelines. Minor modifications or alterations, if any required shall be got done through the civil contractor and the respective PIU 	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.	Laying, test and commissioning of pipelines	None	<ul style="list-style-type: none"> All works during supply, erection, testing and commissioning of natural gas pipelines shall be executed confirming to the technical and safety requirements are governed by the code of practice for design and installation of natural gas pipelines (BIS 15663 (Part-1): 2006) All works shall be well planned, coordinated and swiftly completed including providing connections to the existing industries and newly developed industrial plots. 		
4.	Site clearance and abandoning/ disusing existing pipelines	Waste disposal	<ul style="list-style-type: none"> The utility corridors shall be cleared of all debris/ remanent/ residual materials, after commissioning of the pipelines. The pipelines 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 at dumped at solid waste management facility of Agartala Municipal Corporation, Agartala. The existing gas pipelines shall be abandoned/ disused, and no excavation shall be carried out to retrieve the existing pipelines 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 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 pipe 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 Nagicherra IE is categorized as High for earthquakes and thunderstorms. In order to ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Nagicherra 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 on a daily basis. 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 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
8.	Work Zone Safety Requirements	Will enable contractor to ensure safety requirements at work zones during project implementation	<ul style="list-style-type: none"> Prior to commencement of pipe 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, 	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
		phase	<p>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.</p> <ul style="list-style-type: none"> The orientation shall be carried 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. 		
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 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: 	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.	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 same is always being used by work force, while at work. In case of damaged or lost PPEs, same 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 purpose 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 camp site to attend to health issues/first aids and shall conduct regular health check-up of all staffs and workers employed in project. Further, no wages shall be cut for a period of absence as a result of injury – The contractor shall mandatorily have Contractor All Risk (CAR) policy to cover workers of the 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, as a consequence of operations. The supervisory staff shall be provided with a wireless communication system (mobile telephones for better communication at operational area and also with other operational area, 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 ongoing operations on that specific time and related safety requirement at work site including safe distances to keep during the site visit. 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. 	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.	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 pipe 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 record and conduct fitness test of all vehicles and machinery at regular interval of one year and 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	<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. 		

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
		sites			
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 trainings. 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. at all times 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. 	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.	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
17.	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 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					
	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: <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. Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial use. 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites. 			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"> • Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed off 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 dis-functional solar panel, if any are to be disposed off 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 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 on a daily basis. ○ 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 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 – Laying, Testing and Commissioning of Electrical Feeder Cables (33/11 KV) and Communication Cables (SCADA/ OFC)

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 Nagicherra IE. Hence, permission from any other agency is not required. Contractor designated for laying electrical feeder (33/11 KV) cables shall have 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"> Contractor shall inspect the cable corridor and check the readiness of corridors 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 	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.	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 works shall be well planned, coordinated and swiftly completed including providing connections to the industries and newly developed industrial plots. 		
4.	Site clearance and abandoning/ disusing existing electric feeder cables	Waste disposal	<ul style="list-style-type: none"> The utility corridors 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 at 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 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 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 Nagicherra IE is categorized as High for earthquakes and thunderstorms. In order to ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Nagicherra 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 on a daily basis. 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 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
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 	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
			<p>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.</p> <ul style="list-style-type: none"> The orientation shall be carried 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. 		
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 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: 		
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 same is always being used by work force, while at work. In case of damaged or lost PPEs, same 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 purpose 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 camp site to attend to health issues/first aids and shall conduct regular health check-up of all staffs and workers employed in project. Further, no wages shall be cut for a period of absence as a result of injury – The contractor shall mandatorily have Contractor All Risk (CAR) policy to cover workers of 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, as a consequence of operations. The supervisory staff shall be provided with wireless communication system (mobile telephones for better communication at operational area and also with other operational area, 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 ongoing operations on that specific time and related safety requirement at work site including safe distances to keep during the site visit. 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. 	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.	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 record and conduct fitness test of all vehicles and machinery at regular interval of one year and 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. 	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
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 trainings. 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. at all times during project implementation phase. Sensitization of workforce about strict prohibition of eve-teasing, stalking of women/adolescent girls near work sites/ educational institutions at all times 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. 	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.	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 coming into contact with 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,	<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, 	EHS Officer, Contractor and Environmental	Senior Environmental Specialist of ESG Cell, PMU under the overall

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
		existing workforce of IE and community of nearby areas	community-based meetings, consultations in camp, distribution of leaf let, IEC communication, posters, banners	Officers of PIU & PMU at IE Level	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 all garbage, night soils and POL (Petroleum, Oil and Lubricants) wastes as approved by ESG Cell. 		
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 upkeeping of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial use. 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites. Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed off 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 dis-functional solar panel, if any are to be disposed off 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 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 on a daily basis. 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 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. 			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

Table 9-4: Environment Management Plan - Sector/ Component –Laying, Testing and Commissioning of Water Supply and Distribution Line.

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
Pre-Construction/ Design Stage Activities					
1.	Permissions for installation, testing and commissioning of water and effluent pipelines	None	<ul style="list-style-type: none"> Drinking Water & Sanitation Wing of Public Works Department, Govt. of Tripura is the designated and Nodal Agency for installation, testing and commissioning of water pipelines within Nagicherra IE. Hence, permission from any other agency is not required. Contractor designated for laying water and effluent pipelines shall have valid license and approved/ enlisted by the Drinking Water & Sanitation Wing of Public Works Department, Govt. of Tripura. Copy of the valid license and approved/ enlistment by the Drinking Water & Sanitation 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)
Construction Stage Activities					
2.	Site inspection	None	<ul style="list-style-type: none"> Contractor shall inspect the pipeline corridor and check the readiness of duct for laying of water and effluent pipelines. Minor modifications or alterations, if any required shall be got done through the civil contractor and the respective PIU 	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.	Laying, test and commissioning of pipelines	None	<ul style="list-style-type: none"> All works during supply, erection, testing and commissioning of water pipelines shall be executed confirming to the technical and safety requirements are governed by the code of practice for design and installation of water and effluent pipelines. All works shall be well planned, coordinated and swiftly completed including providing connections to the existing industries and newly developed industrial plots. 		
4.	Site clearance and abandoning/ disusing existing pipelines	Waste disposal	<ul style="list-style-type: none"> The utility corridors shall be cleared of all debris/ remanent/ residual materials, after commissioning of the pipelines. The pipelines shall have line markers of approved type at regular intervals. All debris/ remanent materials shall be collected, scavenged for reuseable materials and waste materials shall be disposed of as scrap or at dumped at solid waste management facility of Agartala Municipal Corporation, Agartala. The water pipelines shall be abandoned/ disused, and no excavation shall be carried out to retrieve the existing pipelines 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 pipe 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 Nagicherra IE is categorized as High for earthquakes and thunderstorms. In order to ensure safety of work force during any kind of natural calamity like earthquake a Disaster Management and Emergency Response Plan for Nagicherra 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 on a daily basis. 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 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
8.	Work Zone Safety Requirements	Will enable contractor to ensure safety requirements at work zones during project	<ul style="list-style-type: none"> Prior to commencement of pipe 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". 	EHS Officer, Contractor and Environmental Officers of PIU &	Senior Environmental Specialist of ESG Cell, PMU under the overall guidance of

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
		implementation phase	<ul style="list-style-type: none"> 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 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. 	PMU at IE Level	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 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: 		
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 same is always being used by work force, while at work. In case of damaged or lost PPEs, same 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 purpose 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 camp site to attend to health issues/first aids and shall conduct regular health check-up of all staffs and workers employed in project. Further, no wages shall be cut for period of absence as a result 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, as a consequence of operations. The supervisory staff shall be provided with wireless communication system (mobile telephones for better communication at operational area and also with other operational area, 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 ongoing operations on that specific time and related safety requirement at work site including safe distances to keep during the site visit. 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. 	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.	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 pipe 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 record and conduct fitness test of all vehicles and machinery at regular interval of one year and 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	<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. 		

Sl. No.	Project Stage/ Activity	Anticipated Impacts	Mitigation Management Measures/ GIIP Measures	Responsibility	
				Planning and Execution	Supervision/ Monitoring
		sites			
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 trainings. 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. at all times during project implementation phase. Sensitization of workforce about strict prohibition of eve-teasing, stalking of women/adolescent girls near work sites/ educational institutions at all times 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. 	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.	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
17.	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 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					
	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: <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 upkeeping of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial use. 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites. 			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"> • Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed off 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 dis-functional solar panel, if any are to be disposed off 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 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 on a daily basis. ○ 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 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 9-5: Environment Management Plan - Sector/ Component – Buildings under CFC/ Industrial Sheds,

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.	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 bye-laws and is approved by local competent authorities. The Project Proponent shall obtain all necessary clearance/ permission from all relevant agencies including 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				
2.	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 of heavy metals and other toxic contaminants. Top fertile soil to be preserved and to be later used in landscape. The excavation/demolition debris must be disposed off in designated landfill areas or to be used within site for levelling purpose. Under no circumstance, the debris will be disposed in riverbed/ 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
3.	Water	<ul style="list-style-type: none"> Proponent shall obtain permission for ground water withdrawal from 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 by the use of 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
4.	Wastewater Treatment	<ul style="list-style-type: none"> Sewage treatment plant of capacity capable of treating 100% wastewater to be installed on site. 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
5.	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 sewer for areas where sewerage network is present. In areas where sewerage network is absent, the excess treated water can be used for agriculture or can be disposed off 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 off 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
6.	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. 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
7.	Solid Waste	During construction phase:	EHS Officer,	Senior Environmental

Sl. No.	Project Stage/ Activity	Mitigation Management Measures/ GIIP Measures	Responsibility	
			Planning and Execution	Supervision/ Monitoring
	Management	<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 purpose. 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 compost (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 MoEF&CC. Make arrangements for recycling of waste through local dealers. Use of covering sheets should be done for trucks to prevent dust dispersion from the trucks and washing of tyres when trucks with soil & 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. Improper disposal of household hazardous wastes can include pouring them 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. 	Contractor and Environmental Officers of PIU & PMU at IE Level	Specialist of ESG Cell, PMU under the overall guidance of Project Director
8.	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 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, so as 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> <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: 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 case of railway tracks, a minimum distance of 50m to 70m may be provided between the buildings and the tracks. 	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.	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 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. 76. 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. 	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 building should be oriented optimally based on Sun-path and engineering analysis to curtail excessive solar radiations. 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 occupant leaving the space. It should also have option for manual turning on lights when the space is occupied. ECBC requires controls in day lit areas that are capable of reducing 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 reduced use of conventional sources of energy. Roof tops of buildings as well as other exposed areas such as of parking shades should be utilized for installation of SPV systems. Hot water requirement in buildings should be met through 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 the areas outside the building should be integral part of the project design and should be in place before project commissioning. Used CFLs and TFLs should be properly collected and disposed off /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. 		
10.	Traffic Movement System	<ul style="list-style-type: none"> Width of driveways, parking provision, ramp width and slope to be kept as per local bye 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
11.	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 by 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
12.	Green Belt/Green Cover	<ul style="list-style-type: none"> Native species of trees to be planted wherever avenue and block plantation is proposed within IE. (ref. Appendix-6) Vegetation to provide shading and promote 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 detail proposal for tree plantation, landscaping, creation of open areas etc. along with a layout plan to an appropriate scale. 	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.	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. 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
14.	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. Importance of maintenance of environmental 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. Concerns of the communities being affected by the Project are to be responded on 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
15.	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				
	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: <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 upkeeping of the green belt area i.e. parks and open areas, which is also expected to replenish groundwater. Routine maintenance and cleaning of storm water holding pond during pre and post monsoon seasons and ensure regular reuse of stored water to offset the withdrawal of groundwater for industrial 		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
	<p>use.</p> <ul style="list-style-type: none"> • 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 its previous stage. All the construction remanent materials/ debris shall be cleared and disposed off at approved disposal sites. • Ensure routine maintenance and periodical cleaning/ desludging of all septic tank and soak pit combines by the allocated industries within industrial estate and disposed off 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 dis-functional solar panel, if any are to be disposed off 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 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 on a daily basis. ○ 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 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. 			

9.2 Budgetary Provision for Additional EMP Measures

380. The IEE has identified specific environmental enhancement measures, which are to be implemented, in addition to the GIIPs included under EMP (Table 9-1 to 9-5). The estimated budgetary provisions for such environmental enhancement measures are INR **33.11 lacs** and is given in **Table 9-6**.

Table 9-6: Budgetary Provisions for EMP Implementation

Sl. No.	Description	INR in lakhs
1	Civil Infrastructure Works (Roads, SWD, Water Supply, Industrial Safety and Security, Land Development and Landscaping)	
(a)	Provision for development of green belt area i.e. parks and open areas, spread over 2.77 ha.	Included in civil works cost
(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 9-9 for parameters, monitoring locations, duration and frequency)	6.50 (ref. Appendix-10, Table-1 for detailed calculation)
(c)	Provision for construction of stormwater holding/ retention pond at 1 location with a cumulative holding capacity of 3.6 million liters. Provision includes necessary arrangements for pumping the water to the nearest rubber/ other industries, which require water for industrial use and/or any other utility.	Included in civil works cost
2	Building Works - CFC Building, Toilet Blocks, Fire Station, Security Cabin, Driver's Rest Room, Warehouse)	
(a)	Provision for construction of rainwater percolation wells at 13 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
(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 9-9 for parameters, monitoring locations, duration and frequency)	15.06 (ref. Appendix-10, Table-2 for detailed calculation)
3	Electrical and Power Supply	
(a)	Provision for construction of upgradation of 33 KV substation and new constructed 11 KV substation and also considering UG Network for 33 KV, 11 KV, LT and Street Light and Dismantling of existing overhead network.	Included in civil works cost
(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 9-9 for parameters, monitoring locations, duration and frequency)	8.55 (ref. Appendix-10, Table-3 for detailed calculation)
4	Provision for Environmental Specialist (full time), Bio-Engineering Specialist (intermittent input) and Horticultural specialist (intermittent input)	Positions to be deployed by PMSC
5	Cost for institutional strengthening, capacity building and training	3.0 Training to be provided through PMSC Safeguard Specialists
	Total Rounded off (in Lacs)	33.11

381. The specific environment enhancement measures will be included in the bid documents, to make it part of 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

382. 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.

383. 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

384. The DoIC, GoT will establish a dedicated Project Management Unit (PMU) and four 4 PIUs¹⁹ for implementation of all 9 industrial estates. The DoIC will also appoint a Project Management and Supervision Consultant (PMSC), which 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.

385. 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 SDP. 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 Sector Development Program (SDP). All experts will be appointed by the Tripura Industrial Development Corporation (TIDCL) through the Project Monitoring & Supervision Consultant (PMSC).

386. 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

¹⁹ 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 South Tripura district.

Table 9-7. 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 9-7: 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 SDP. 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 Sector Development Program (SDP). Positions indicated under (a), (b) & (d) is 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 Sector Development Program (SDP) Positions indicated under (a) & (c) is 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. 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

387. 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.

388. 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.

389. 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

390. 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 S Environment Safeguard Expert, PMSC

391. 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).

392. 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 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).

9.8 Responsibilities of Environment (Safeguard cum Climate Change) Expert.

393. 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).

394. 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

395. 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

396. 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

397. 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, taking into account the baseline conditions and monitoring results.

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

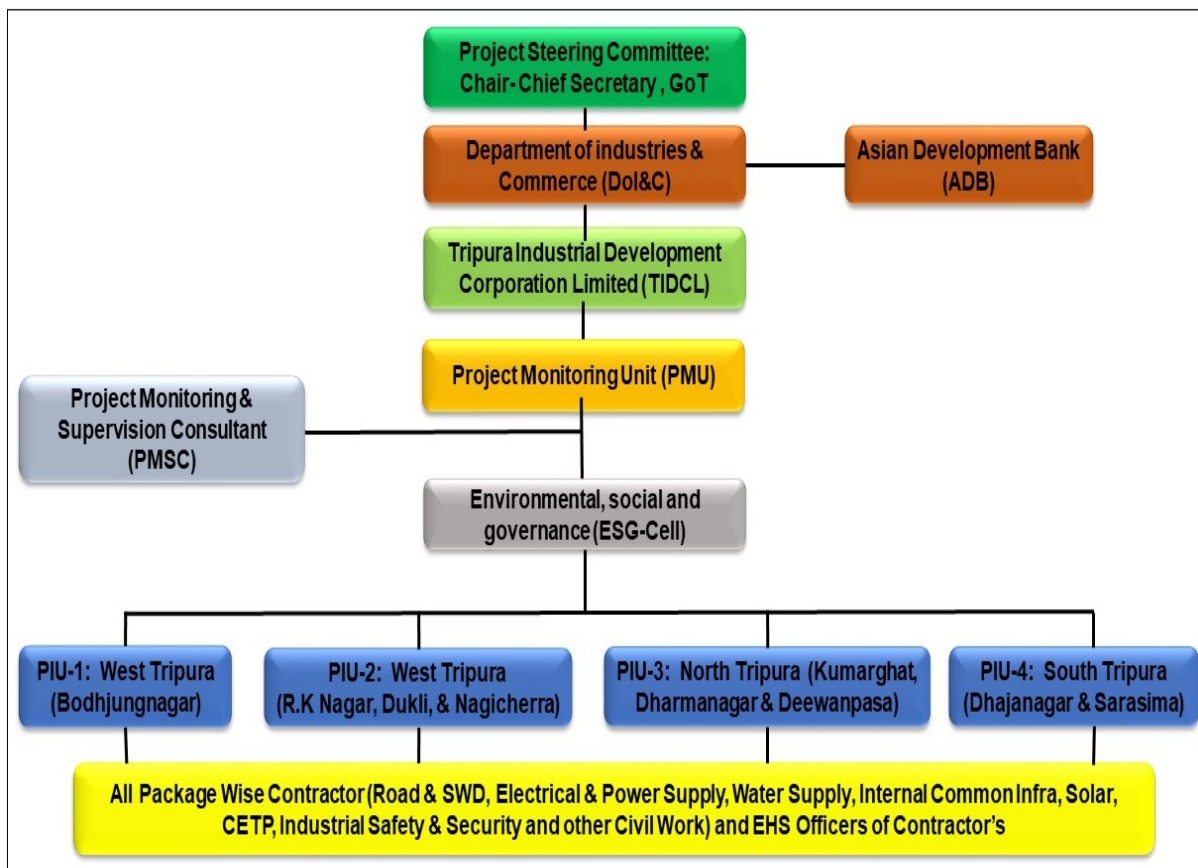


Figure 9-1: Institutional Arrangement for Implementation of EMP

9.13 Training and Capacity Building

398. 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.

399. The outline of training on EMP implementation for capacity building is given in **Table 9-8**. 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 9-8: Outline of Training on EMP Implementation for Capacity Building

Description	Duration & Participants	Cost Provision & Source of Fund
<p>1. Introduction and Sensitization to policies and regulatory requirements</p> <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 and occupational health and safety (OHS) requirements and practices, etc. • Incorporation of EMP into the project design and contracts • Monitoring, reporting and corrective action planning. 	<p>Half day</p> <p>All PIU, PMU & Contractors managerial and EHS officers</p>	
<p>2. Good Construction Practices and EMP implementation</p> <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 	<p>Half day</p> <p>All PIU, PMU & Contractors managerial and EHS officers</p>	<p>INR: 300,000 (Lump sum)</p> <p>Included in overall project cost</p>
<p>3. Orientation to Contractors</p> <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 tool-box 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>	<p>Half day</p> <p>PIU field supervisors and contractors EHS officers, field supervisors and workers (both skilled & unskilled)</p>	

400. 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

401. 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.

402. The monitoring schedule, probable monitoring locations, parameters to be monitored and frequency is given in **Table 9-9**. 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 9-9: Environmental Monitoring Schedule at Nagicherra IE

Attribute	Typical Sampling Locations	Component/ Sector, Frequency & Duration for Monitoring			Total No of Samples
		Civil Infra Works (Roads & Junction and Storm Water Drainage (SWD),)	Building Works - CFC Building, Toilet Blocks, Fire Station, Security Cabin, Driver's Rest Room, Warehouse)	Upgradation of electrical & power supply and Installation of solar plant and mechanical accessories works	
Package No		TIDCL-CW06-ADB-PIU2-NC-01	TIDCL-CW16-ADB-PIU2-NC-01	TIDCL-EW02-ADB-PIU2-(NC)-01	
Air (CO, NOx, PM ₁₀ , PM _{2.5} and SO ₂)	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-24 months	Construction phase-30 months	88
		2 locations, once a quarter (9 samples)	4 locations, once a quarter (24 samples)	2 locations, once a quarter (15 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	2 locations, once in 6 months (20 samples)	1 location, once in 6 months (10 samples)	
		Total-19	Total-44	Total-25	
Water (As per Drinking Water Standards)	Shall cover drinking water sources for workforce camps and hand pumps/natural water sources along/near to project construction activities	Construction phase-18 months	Construction phase-24 months	Construction phase-30 months	88
		2 locations, once a quarter (9 samples)	4 locations, once a quarter (24 samples)	2 locations, once a quarter (15 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	2 locations, once in 6 months (20 samples)	1 location, once in 6 months (10 samples)	
		Total-19	Total-44	Total-25	
Noise (Noise Levels on dB (A) scale)	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-24 months	Construction phase-30 months	88
		2 locations, once a quarter (9 samples)	4 locations, once a quarter (24 samples)	2 locations, once a quarter (15 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	2 locations, once in 6 months (20 samples)	1 location, once in 6 months (10 samples)	
		Total-19	Total-44	Total-25	
Soil (Nitrogen, Potassium, Phosphorous) and Oil and Grease)	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-24 months	Construction phase-30 months	88
		2 locations, once a quarter (9 samples)	4 locations, once a quarter (24 samples)	2 locations, once a quarter (15 samples)	
		Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	Maintenance/ DLP phase- 60 months	
		1 location, once in 6 months (10 samples)	2 locations, once in 6 months (20 samples)	1 location, once in 6 months (10 samples)	
		Total-19	Total-44	Total-25	
Provision for Budget of		6.50	15.06	8.55	30.11

Attribute	Typical Sampling Locations	Component/ Sector, Frequency & Duration for Monitoring			Total No of Samples
		Civil Infra Works (Roads & Junction and Storm Water Drainage (SWD),)	Building Works - CFC Building, Toilet Blocks, Fire Station, Security Cabin, Driver's Rest Room, Warehouse)	Upgradation of electrical & power supply and Installation of solar plant and mechanical accessories works	
	Package No	TIDCL-CW06-ADB-PIU2-NC-01	TIDCL-CW16-ADB-PIU2-NC-01	TIDCL-EW02-ADB-PIU2-(NC)-01	
	environmental monitoring within IE through NABET Accredited Laboratory (Ambient Air Quality Monitoring, Water quality Monitoring, Noise level Monitoring and Soil Quality Monitoring). (in Lakh)				

10.0 CONCLUSIONS AND RECOMMENDATION

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

404. The proposed development works within IE 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 proposed development works will also not require felling of trees.

405. The 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.

406. Additionally, several environmental conservation measures have been considered in the EMP like balancing the cut and fill quantities of earthwork (129220.36 cum), construction of one stormwater holding/ retention pond with a capacity of 3.6 million liters, groundwater recharging/ percolation wells at 13 locations, rain water harvesting and recharging at 1 location (CFC building), development of green belt in open areas (2.77 ha) and periodical monitoring of ambient air quality, ambient noise levels, water, soil quality at construction sites throughout the construction phase have been considered along with necessary EMP budgetary provisions (INR 33,11,298). Capacity development for PMU, PIUs, and contractors have also been included in the EMP.

407. 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.

408. The IEE covers the applicable environmental regulations and has determined that the proposed development works at Nagicherra IE will not require prior environmental clearances either from the state or central levels (as per EIA notification 2006 and amendments thereof). However, contractor will be required to obtain CTE and CTO for campsites, hot-mix plants, concrete batch plants, etc. from the Tripura State Pollution Control Board. No Objection Certificate (NOC) will be required from the Central Ground Water Authority for construction of new tube wells to meet the projected industrial water demand of the IE. Seeking such required extensions, permissions, consents and NOC will not pose any regulatory risks.

409. 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 time frame for resolution of grievances in a three-tier mechanism. In addition, the contractor will also require to have a GRM to resolve any complaints from the construction workforce.

APPENDIX-1
RAPID ENVIRONMENTAL ASSESSMENT (REA)
CHECKLIST-NAGICHERRA 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 Sector Development Program
Infrastructure Development within Nagicherra 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...		✓	Nagicherra is an industrial estate (IE) is green field (boundary wall constructed in 2014)
Densely populated?		✓	This is industrial estate with no provision for residential colonies.
Heavy with development activities?		✓	No industrial activity 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. The Sepahijala Wildlife Sanctuary (WLS) and its notified eco-sensitive zone is the nearest protected area, which is in the adjoining Sepahijala district, 11.09 km from the Nagicherra IE.
Wetland		✓	No Wetland are not close or near to this 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 Will the Project cause...			

Screening Questions	Yes	No	Remarks
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 retention ponds by impounding the existing valley/ local depression(s). This 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, thermal inversion, and smog formation?		✓	None/ Not applicable
water depletion and/or degradation?		✓	Project design include measures to replenish

Screening Questions	Yes	No	Remarks
			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
• Construction/commissioning of a new asset?			✓	None/ Not applicable
• Refurbishment / demolition of an existing asset?			✓	None/ Not applicable
• Post-disaster response, involving reconstruction, repair, or removal of damaged asset?			✓	None/ Not applicable
• Maritime activities?			✓	None/ Not applicable
• Water supply, water sanitation, wastewater, sewerage, or water hygiene initiatives?			✓	None/ Not applicable
• Earthworks, remedial activities, or solid waste management?			✓	None/ Not applicable
• Power, telecommunications, or energy supply infrastructure?			✓	None/ Not applicable
• 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 Sector Development Program
Infrastructure Development within Nagicherra 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
NAGICHERRA IE
(AIR, NOISE, WATER & SOIL)**

TEST REPORT OF BASELINE MONITORING OF NAGICHERRA IE

Air Quality Test Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0732
"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	: NAGICHORA
	Sampling Date	: 24.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00095-00098
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.	Nagichora, Location 1	58.3	36.4	<6.0	12.7	0.60	23° 47' 21.7212" N	91° 20' 4.6392" E
2.	Nagichora, Location 2	65.1	36.2	6.7	16.3	0.68	23° 47' 23.8776" N	91° 20' 7.7856" E
3.	Nagichora, Location 3	73.8	43.4	7.5	21.5	0.74	23° 47' 29.4252" N	91° 19' 57.2448" E
4.	Nagichora, Location 4	69.7	36.7	7.0	19.8	0.70	23° 47' 18.9384" N	91° 20' 0.0708" 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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TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0733
"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	: NAGICHORA
	Sampling Date	: 27.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00099-00102
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.	Nagichora, Location 1	72.5	36.3	7.4	20.5	0.76	23° 47' 21.7212" N	91° 20' 4.6392" E
2.	Nagichora, Location 2	64.8	38.1	6.5	18.3	0.66	23° 47' 23.8776" N	91° 20' 7.7856" E
3.	Nagichora, Location 3	67.2	32.0	6.9	19.6	0.68	23° 47' 29.4252" N	91° 19' 57.2448" E
4.	Nagichora, Location 4	59.1	32.8	<6.0	14.8	0.56	23° 47' 18.9384" N	91° 20' 0.0708" 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/2023-24/0753
	Report Date	: 16.11.2023
	Nature of Sample	: Noise
	Sample Mark	: NAGICHERA, NOISE 1
	Sample Drawn On	: 24.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00510
	Latitude	: 23.790640
Longitude	: 91.334301	
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

Day Time	Time (In Hrs.)	Hourly Leq dB(A)
		6.00 am
	7.00 am	44.4
	8.00 am	49.0
	9.00 am	46.9
	10.00 am	45.5
	11.00 am	43.0
	12.00 pm	47.6
	13.00 pm	48.5
	14.00 pm	55.4
	15.00 pm	57.3
	16.00 pm	61.1
	17.00 pm	56.0
	18.00 pm	55.1
	19.00 pm	51.8
	20.00 pm	49.2
	21.00 pm	47.5
	Lday	53.4
	MAX(day)	61.1
	MIN(day)	41.8
	Average(day)	50.3

Night Time	Time (In Hrs.)	Hourly Leq dB(A)
		22.00 pm
	23.00 am	47.1
	24.00 am	43.0
	1.00 am	49.0
	2.00 am	55.9
	3.00 am	52.3
	4.00 am	50.5
	5.00 am	48.4
	LNight	51.5
	MAX(Night)	55.9
	MIN(Night)	43.0
	Average(Night)	50.1

Noise Limit as per CPCB			NOTE : Day Time : 06.00 Hr.-22.00 Hr. Night Time:22.00 Hr.-06.00 Hr.
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	

Report Prepared By :
Almond

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/2023-24/0754
	Report Date	: 16.11.2023
	Nature of Sample	: Noise
	Sample Mark	: NAGICHERA, NOISE 2
	Sample Drawn On	: 24.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00511
	Latitude	: 23.790750
	Longitude	: 91.335775
Reference No.& Date: RD/AK/426661/10357, Dated : 31.08.2023		

	Time (In Hrs.)	Hourly Leq dB(A)
	Day Time	6.00 am
7.00 am		49.4
8.00 am		49.7
9.00 am		51.2
10.00 am		51.6
11.00 am		53.7
12.00 pm		54.3
13.00 pm		55.6
14.00 pm		56.9
15.00 pm		57.3
16.00 pm		61.1
17.00 pm		58.0
18.00 pm		56.1
19.00 pm		54.0
20.00 pm		54.6
21.00 pm		62.3
Lday		56.4
MAX(day)		62.3
MIN(day)		47.4
Average(day)		54.7

Count. To Page-2

	Time (In Hrs.)	Hourly Leq dB(A)
	Night Time	22.00 pm
23.00 am		48.9
24.00 am		50.5
1.00 am		48.1
2.00 am		55.9
3.00 am		52.3
4.00 am		50.5
5.00 am		48.4
Lnight		54.2
MAX(Night)		60.5
MIN(Night)		48.1
Average(Night)		52.5

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

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/2023-24/0790
	Report Date	: 16.11.2023
	Nature of Sample	: Surface Water
	Sample Mark	: NAGICHERA, SURFACE WATER-1
	Sample Drawn On	: 27.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00196
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 Rffmd 2014	11
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 Rffmd 2014	9.6
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)	5.4
13.	Dissolved Iron	mg/l	---	APHA (24th Edition), 3500 Fe-B	0.52
14.	Electrical conductivity	mg/l	---	APHA (24th Edition), 2510B	302
15.	Fluoride (as F)	mg/l	---	APHA (24th Edition), 4500 F- C/D	0.14
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 Rffmd 2014	5.2

Contd. To Page-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	<0.5
21.	Odour	mg/l	No offensive odour	IS 3025 (Part 5)-1983 Rffim: 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	2.8
25.	Salinity	mg/l	---	APHA (24th Edition), 2520B	0.16
26.	Sodium (as Na)	mg/l	1.0	APHA (24th Edition), 3500 Na B	6.5
27.	Sulphate (as SO ₄)	Hazen	---	IS 3025 (Part 24) - 1986 Rffind 2014	5.7
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 Rffim: 2009	28
31.	Total Dissolved Solids (as TDS)	mg/l	None	IS 3025(Part 16)- 1984 Rffim: 2012	181
32.	Total Hardness (as CaCO ₃)	mg/l	None	IS 3025 (Part 21)-2013	50
33.	Total Suspended Solid (as TSS)	mg/l	None	IS 3025(Part 16)- 1984 Rffim: 2012	<2.5
34.	Turbidity	mg/l	None	IS 3025 (Part 10)-1984 Rffim: 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 Rffim: 2012	7.46 at 25 Deg C

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Groundwater Quality Test Report

Mitra S. K. Private Limited



TEST REPORT

Name & Address of the Customer	Report Number	: MSK/GHY/2023-24/0776
"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	: NAGICHERA, GROUND WATER-1
	Sample Drawn On	: 27.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00209
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 Rffm:2009)	48
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 Rffmd 2014	11.09
7.	Chloride (as Cl)	mg/l	250	1000	IS 3025 (Part 32)-1998 Rffmd-2014	12
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	0.34
12.	Electrical Conductivity	mg/l	---	---	APHA (24 th Edition), 2510B	172
13.	Fluoride (as F)	mg/l	1.0	1.5	APHA (24 th Edition), 4500 F-C/D	0.26
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 Rffmd 2014	4.75
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	2.1
23.	Salinity	mg/l	---	---	APHA (24 th Edition), 2520 B	0.09
24.	Sodium (as Na)	mg/l	---	200	APHA (24 th Edition), 3500 Na B	6.2
25.	Sulphate (as SO ₄)	mg/l	200	400	IS 3025 (Part 24)-1986 Rffmd 2014	9.3
26.	Total Dissolved Solids (as TDS)	mg/l	500	2000	IS 3025 (Part 16)-1984 Rffm:2012	103
27.	Total Hardness (as CaCO ₃)	mg/l	200	600	IS 3025 (Part 21)-2013	47.52
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	7.43 at 25 Deg C

Report Prepared By :



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/2023-24/0809
	Report Date	: 16.11.2023
	Nature of Sample	: SOIL
	Sample Mark	: NAGICHERA , SOIL-1
	Sample Drawn On	: 24.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00143
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)	1.32
2.	Clay	%	---	TPM/MSK/P&E/1/36A_(O)	8.0
3.	Electrical conductivity	us/cm	---	IS 14767:2000,RA 2016_(O)	54 (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)	5.4
6.	Moisture Retention capacity	%	---	TPM/MSK/P&E/1/17_(O)	23
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)=11
9.	Porosity	%	---	TPM/MSK/P&E/1/30_(O)	43
10.	Potassium	mg/kg	---	TPM/MSK/P&E/1/5, Referr Issue date-April 02, Issue no-03: 2018	Available Potassium=29
11.	Sand	%	---	TPM/MSK/P&E/1/36A_(O)	77
12.	Silt	%	---	TPM/MSK/P&E/1/36A_(O)	15
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)	370
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)	20
17.	pH value	None	6.5-8.5	IS 2720 (Part 26) - 1987	4.84 (1:2.5) at 25 deg C

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TEST REPORT

Name & Address of the Customer	Report No.	: MSK/GHY/2023-24/0810
"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	: NAGICHERA , SOIL-2
	Sample Drawn On	: 24.09.2023
	Sample Number	: MSKGL/ED/2023-24/10/00144
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)	1.26
2.	Clay	%	---	TPM/MSK/P&E/1/36A_(O)	17
3.	Electrical conductivity	us/cm	---	IS 14767:2000,RA 2016_(O)	234 (1:2) at 25 deg C
4.	Iron (as Fe)	mg/kg	---	TPM/MSK/P&E/1/13	5.8
5.	Lead (as Pb)	mg/kg	---	EPA 6010D_(O)	6.3
6.	Moisture Retention capacity	%	---	TPM/MSK/P&E/1/17_(O)	34
7.	Organic Matter	%	---	IS 2720 (Part 22)-1972; Rffm:2015_(O)	0.41
8.	Phosphorus	mg/kg	---	TPM/MSK/P&E/1/12_(O)	Available Phosphorus (as P)=3.3
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=91
11.	Sand	%	---	TPM/MSK/P&E/1/36A_(O)	55
12.	Silt	%	---	TPM/MSK/P&E/1/36A_(O)	28
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)	313
15.	Total Organic Carbon	%	---	IS 2720 (Part 22)-1972;Rffm:2015_(O)	0.24
16.	Infiltration rate	mm/Hr	---	TPM/MSK/P&E/1/42_(O)	17
17.	pH value	None	6.5-8.5	IS 2720 (Part 26) - 1987	4.42 (1:2.5) at 25 deg C

Report Prepared By:



for Mitra S. K. Private Limited



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APPENDIX-4

**Integrated Biodiversity Impact Assessment
(I-BAT) for Nagicherra Industrial estate,
Agartala , Tripura.**



Biodiversity assessment of Nagicherra industrial estates

Final report EB-1223



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Biodiversity Impact Assessment for Nagicherra Industrial estate and surrounding areas, 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 Fragmented natural habitats which is dominated by Rubber plantation in the vicinity

- **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			Nagicherra (91°20'2.12"E, 23°47'25.27"N)
District			West Tripura
State			Tripura
Quadrat ID	Latitude	Longitude	Key Insights
Q1	23.78834	91.33173	Rubber plantation, shrubs and herbs are abundant, major shrubs include Clerodendrum infortunatum, Jatropha gossypifolia, Chromolaena odorata, etc.
Q2	23.79003	91.33347	Moist deciduous forest patches, Rubber plantation
Q3	23.79062	91.33272	Very few trees like White teak, Trema orientalis, Microcos paniculata, shrubs and herbs are abundant, major shrubs include Melastoma affine, Chromolaena odorata, Mikania micrantha, Pueraria montana, etc.
Q4	23.79167	91.33508	Very few trees like Alstonia scholaris, Butea monosperma, Microcos paniculata, etc., shrubs and herbs are abundant, major shrubs include Chromolaena odorata, Melastoma affine, Sida acuta, etc.
Q5	23.79129	91.33568	No trees, only juvenile teak plants are there, shrubs and herbs are abundant, major shrubs include Melastoma affine, Chromolaena odorata, Microcos paniculata, 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 recent ecological survey of Nagicherra, we employed randomized surveys and stratified quadrat-based sampling to assess species abundance and distribution. The results indicated a total of 200 species within the core region of our study site. The core zone, as illustrated in

the attached table, encompasses a diverse array of species, including 16 tree species, 16 shrub species, and 18 herb species. The fauna is equally varied, with 79 bird species, 32 species of butterflies, and a lesser representation of other categories such as reptiles, dragonflies, and a solitary mammal species. The table and the corresponding graphical representation succinctly encapsulate the area's biodiversity, highlighting the extent and variety of species, from the predominant birds to the relatively rare ferns and climbers, each an integral strand in the ecological fabric of Nagicherra.

Through our research, we meticulously recorded species encounters in both the core and surrounding buffer zones. Our quadrat-based approach also allowed for precise population quantification. In total, we identified 200 species (flora: 57, fauna: 143) in the core zone (site of the project, as shown in figure 1) and 454 species (flora: 203, fauna: 251) within the buffer zone (20km radius, as seen in figure 2). The biodiversity assessment in Nagicherra revealed marked contrasts between the core and buffer zones. The buffer area, as expected, exhibited a richer biodiversity, with 84 tree species, 41 shrub species, and 64 herb species. It also noted 147 bird species and 39 butterfly species.

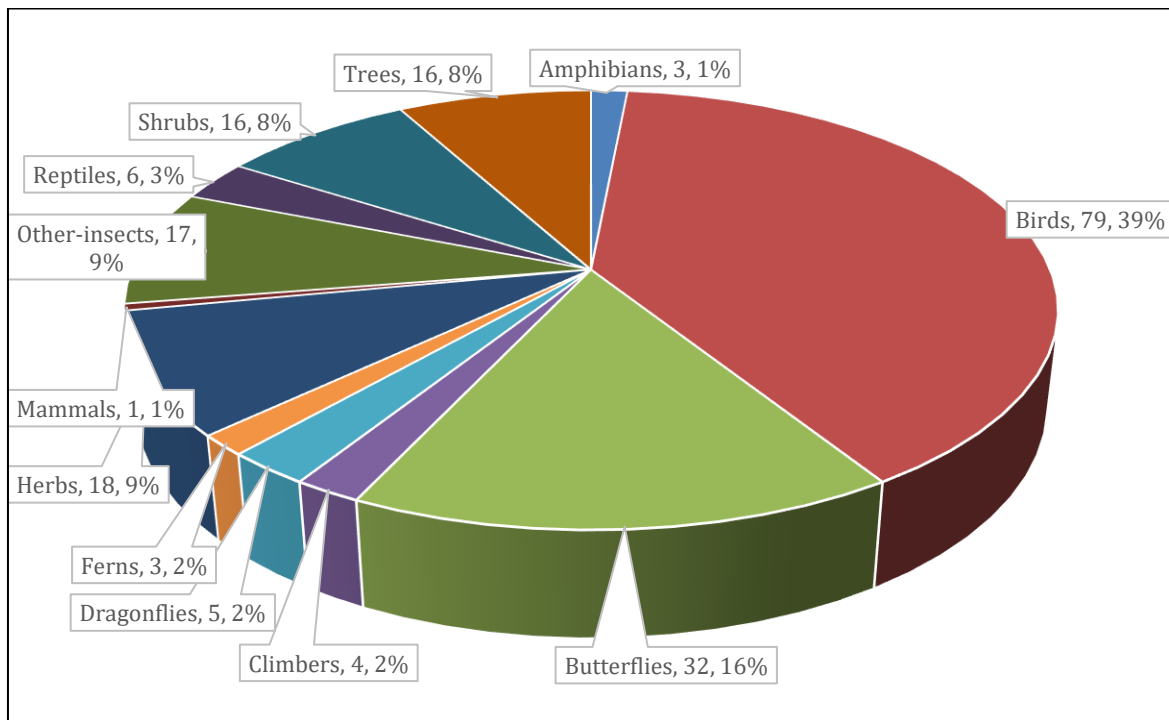


FIGURE 1: DISTRIBUTION OF OBSERVED SPECIES GROUPS IN THE CORE AREA

In comparison, the core zone featured a more constrained ecological makeup, with 16 tree species, 16 shrub species, 18 herb species, and 79 bird species, amongst other fauna. This difference underlines the distinct ecological dynamics of the two regions, which align with predictions. Site photographs attached in annexure -3

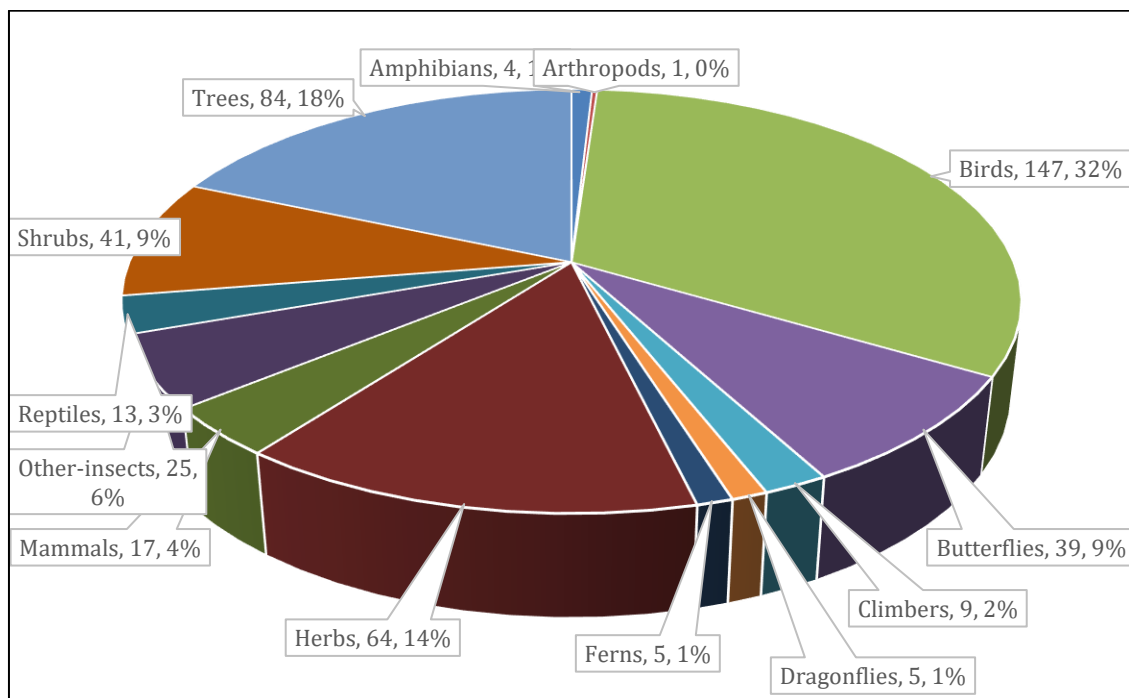


FIGURE 2: DISTRIBUTION OF OBSERVED SPECIES GROUPS IN THE BUFFER AREA

The discernible disparity between the core and buffer zones (table 1) is largely due to significant human interference in the core. This area has undergone extensive anthropogenic changes, positioning it as a focal point for environmental impact studies. Conversely, the buffer zone contains various patches of undisturbed vegetation that serve as vital refuges, supporting a broad spectrum of species by providing essential habitats and sustenance. This setting fosters a biodiversity that surpasses that of the core area. For further detail on the species cataloged, a thorough list is compiled and accessible in the supplementary document repository (Annexure 1: Species checklist).

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

Groups	Buffer	Core
Flora	203	57
Tree	84	16
Shrub	41	16
Herb	64	18
Climber	9	4
Fern	5	3
Fauna	251	143

Aves	147	79
Insect-Butterfly	39	32
Insect-Odonata	5	5
Other-Insects	25	17
Mammal	17	1
Reptile	13	6
Amphibian	4	3
Arthropod	1	0

Our findings have shown distinctive differences in species distribution between the buffer and core areas. In the buffer zone, exotic species make up about 30.51% of the total, while the core area has a notably higher proportion of exotic species at approximately 35.08%. Native species are integral to the local ecosystem due to their co-evolution with other local species, providing essential habitats for native fauna, including indigenous birds. They are also better adapted to the local climate, as well as to the threats from pests and diseases.

The increased presence of exotic species in the core area could be a result of human activities such as urban development, agriculture, and the use of non-native species in horticulture for their ornamental value or utility. Once these non-native species are introduced, they may proliferate unrestrained and potentially outcompete the native flora, leading to a decline in biodiversity. This imbalance can trigger ripple effects throughout the ecosystem, disrupting food chains, increasing vulnerability to pests and diseases, diminishing resilience to climate change, and altering the structure of habitats, nutrient cycling, and water regimes. The vigorous growth patterns of exotic plants may overshadow or completely supplant native species, which can drastically reduce the habitats available for wildlife that rely on indigenous vegetation.

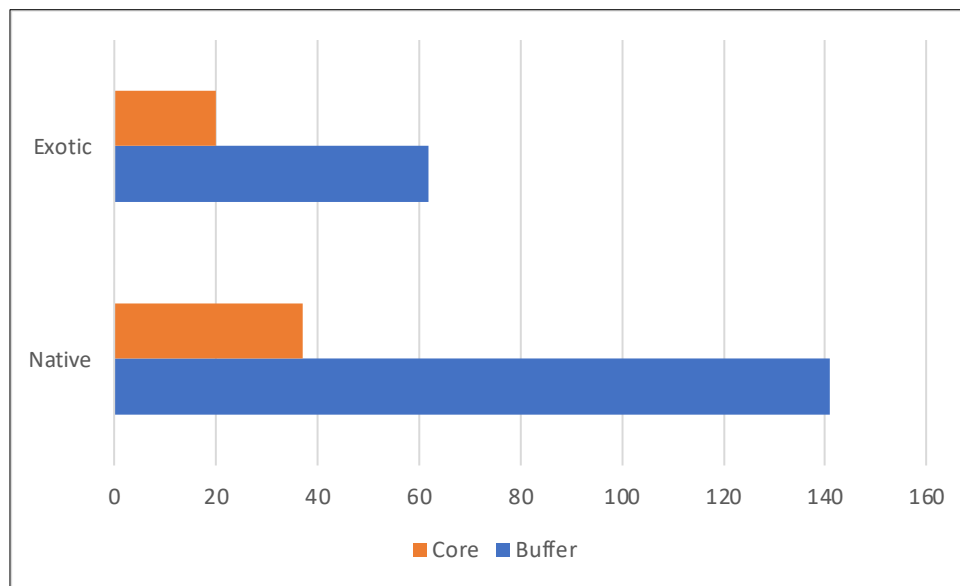


FIGURE 3: NATIVE VS EXOTIC SPECIES IN CORE VS BUFFER

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 Quadrature quantitative sampling.

The biodiversity within the Nagicherra area exhibits a distinct trend of increasing richness with distance from the core.

- At the very center, the core holds 40 fauna species and 36 flora species, with only one location sampled.
- Moving outward to a 500m radius, the immediate buffer zone around Nagicherra sees a slight increase in fauna richness to 60 species, though flora richness drops to 29 species, with two quadrates sampled in one location.
- As we extend to a 5km radius, there is a substantial jump in species richness, with 152 fauna and 96 flora species distributed across 20 sampled quadrates in five locations, including Purba noagaon and Prabhapur.

- At a 10km distance, the numbers slightly dip to 117 fauna and 76 flora species over 16 quadrates and four locations such as Dakshin champamura and Khayerpur.
- Further out at a 15km radius, there's another increase, with 150 fauna and 73 flora species noted across 19 quadrates in five locations including Madhupur and Oxygen park.
- The pattern of increasing biodiversity continues at the furthest sampled radius of 20km, which boasts the highest number of fauna species at 189 and 88 flora species across 20 quadrates in five locations, such as Jirania and Amtali.

This gradient of biodiversity, expanding from the core to a 20km radius, underscores the variation in species distribution and richness in relation to distance from the central point of Nagicherra, revealing how ecological diversity flourishes with increasing distance from the central core area.

TABLE 4: SPECIES RICHNESS OBSERVATIONS BETWEEN CORE AND BUFFER

Radius range	Fauna richness	Flora richness	Quadrates sampled	Locations sampled	Location names
0km	40	36	5	1	Core
500m	60	29	8	4	Nagicherra immediate buffer
5km	152	96	20	5	Purba noagaon, Prabhapur, Jogendranagar, Dukli, Tulakona
10km	117	76	16	4	Dakshin champamura , Ranjit nagar, Khayerpur, IC Nagar
15km	150	73	20	5	Madhupur, Paschim takarjala, Baidhya kobra, Fatikcherra, Oxygen Park
20km	189	88	20	5	Jirania, Kathiram bari, Bamutia, Amtali, Kandrai charra

The diversity of flora and fauna in the Nagicherra area presents a fascinating mosaic of ecological variety across different locations. In the core of the study area, there is a balance of species with 36 types of flora and 40 of fauna, indicating a modest level of biodiversity within the central point of the survey.

As we venture into the immediate buffer zone of Nagicherra, flora richness slightly decreases to 29 species, but fauna richness experiences a significant increase to 60 species, suggesting a more animal-diverse environment close to the core.

In contrast, locations like Dukli and Jogendranagar show a remarkable increase in fauna richness with 45 and 96 species, respectively, while maintaining a robust flora presence with

48 and 33 species. This trend continues in Jirania, which stands out with an impressive count of 111 fauna species along with 30 flora species, indicating a hotspot of animal diversity.

Bamutia and Kathiram bari, with their 32 and 25 flora species and 65 and 96 fauna species respectively, also underscore the diverse ecological tapestry of the area. Conversely, locations such as Dakshin champamura and Paschim takarjala show a lesser diversity, with flora and fauna counts not exceeding 26 and 25 species respectively, suggesting a possible impact of environmental factors or human activities on biodiversity.

The richness in species is not uniform, as evidenced by the varying counts across the surveyed locations. For instance, Baidhya kobra supports a substantial number of both flora (30 species) and fauna (57 species), whereas Prabhapur leans towards a more florally diverse area with 19 flora species compared to its 14 fauna species.

Moreover, the location of Kandrai charra showcases a balance with 38 flora species and 50 fauna species, illustrating a relatively even distribution of plant and animal life. This balance is less pronounced in areas like Oxygen Park, where the fauna richness of 69 species far surpasses the 19 flora species, suggesting an environment that may favor animal habitation or migration.

The diversity within Purba noagaon and Ranjit nagar, holding 43 and 34 flora species and 79 and 65 fauna species respectively, further exemplifies the ecological richness that can be found as one moves away from the core.

This assessment of flora and fauna across various locations near Nagicherra reveals the complexity and richness of the region's biodiversity. It underscores the need for detailed ecological studies to understand the underlying causes of such diversity and to inform conservation strategies that take into account the unique environmental dynamics 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	36	40
Dakshin champamura	8	26
Dukli	48	45
Fatikcherra	31	31
IC Nagar	22	51

Jirania	30	111
Jogendranagar	33	96
Kandrai charra	38	50
Kathiram bari	25	96
Khayerpur	36	44
Madhupur	25	46
Nagicherra immediate buffer	29	60
Oxygen park	19	69
Paschim takarjala	20	25
Prabhapur	19	14
Purba noagaon	43	79
Ranjit nagar	34	65
Tulakona	28	38

4. VEGETATION DIVERSITY

4.0 Flora in the Core area – the project site



FIGURE 4 CORE AREA OF THE NAGICHERRA INDUSTRIAL SITE

The core area of Nagicherra presents a detailed snapshot of the region's vegetation diversity, characterized by a range of species that vary in abundance and ecological significance. The dominant tree species, *Hevea Brasiliensis*, commonly known as Rubber, is the most abundant with 20 individuals contributing to a biomass of over 15 tons per hectare, reflecting its significance in the area's habitat structure. Other notable tree species include *Microcos Paniculata* or Pichandi, and *Tectona Grandis*, known as Segun, with their substantial contributions to the biomass and occurrence in the core.

The area's shrub layer is rich and varied, with *Chromolaena Odorata*, known locally as Jack In The Bush, being the most prevalent shrub species, boasting an impressive 49 individuals. This species alone contributes significantly to the biomass, along with other common shrubs such as *Holarrhena Antidysenterica* (Kurchi), *Melastoma Affine* (Blue Tongue), and *Clerodendrum Infortunatum* (Bhat), all of which appear frequently within the core.

Herbaceous species, which include *Chrysopogon Aciculatus* (False Beardgrass) and *Spermacoce Latifolia* (False Button Weed), are found in high abundance, suggesting a well-established ground layer. These species, along with others like *Grona Triflora* (Beggarweed) and *Mimosa Pudica* (Lojjabati), play a crucial role in maintaining the understory diversity and contribute to the area's overall biomass.

Ferns such as *Dryopteris* spp. (Male Fern) and *Pteris Vittata* (Chinese Brake) are less abundant but are significant contributors to the biodiversity, indicating the presence of microhabitats within the core area.

Climbing plants like *Mikania Micrantha* (Bitter Vine) and *Pueraria Phaseoloides* (Tropical Kudzu) add to the vertical complexity of the vegetation, providing habitat for various fauna and contributing to the ecological dynamics of the core.

The core area's vegetation is distributed across various habitats, from rubber plantations to subtropical humps, each with its unique assemblage of plants. Notable is the presence of juvenile teak plants and an abundance of shrubs and herbs across the five quadrats sampled, each contributing to the intricate ecological tapestry of the region.

This rich vegetation diversity underscores the ecological value of the core area of Nagicherra, highlighting the need for conservation efforts to protect and manage these habitats that are critical for maintaining the region's biodiversity.

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	Nagicherra immediate buffer 1	23.899157	91.359570	Dominated by Rubber plantation with fragmented natural habitat with dominating plants like Teak, Toona ciliata, Microcos paniculata etc.
2	Nagicherra immediate buffer 2	23.883574	91.369544	Dominated by Rubber plantation with fragmented natural habitat with dominating plants like Teak, Toona ciliata, Microcos paniculata, bamboo etc.
3	Nagicherra immediate buffer 3	23.881029	91.346817	Dominated by Rubber plantation with fragmented natural habitat with dominating plants like Teak, Toona ciliata, Microcos paniculata, etc.
4	Nagicherrra immediate buffer 4	23.877410	91.355685	Dominated by Rubber plantation with fragmented natural habitat with

				dominating plants like Trema orientalis, Alstonia scholaris ,Microcos paniculata, Jangli neem etc.
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Within the 500m buffer zone of Nagicherra, 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.

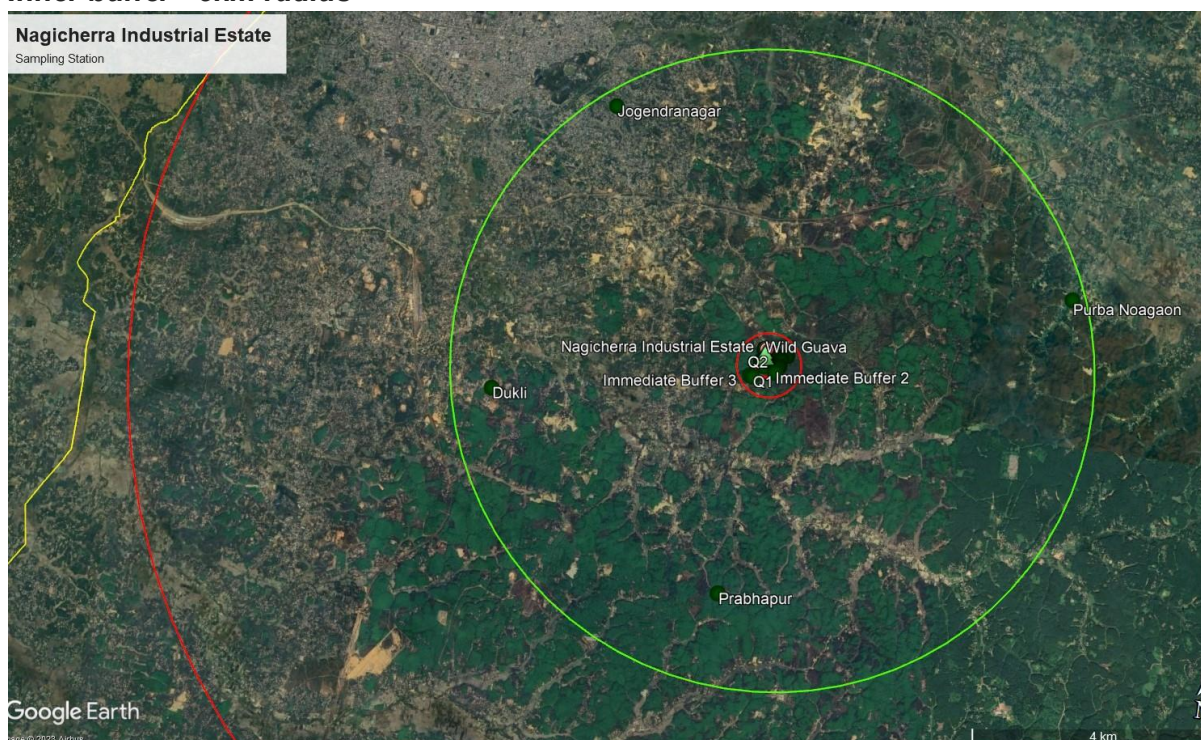
The Rubber tree's dominance, while economically beneficial for rubber production, can also lead to ecological consequences. Their monoculture plantations are known to reduce understorey diversity and alter soil composition and nutrient cycling due to the leaf litter's unique decomposition rate and chemistry. 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 Nagicherra 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, Schima wallici, Microcos paniculata etc.
3	Dukli	23.781659	91.292572	Industrial area dominated by shrubs like Cassia alata, Ricinus communis due to development work. The presence of rice processing facilities in the area has led to a significant amount of bird activity. The rice processing waste serves as a feeding ground, attracting hundreds of birds to the area.
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.

At the 5km buffer zone around Nagicherra, 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 Nagicherra area.

Central buffer - 10km radius

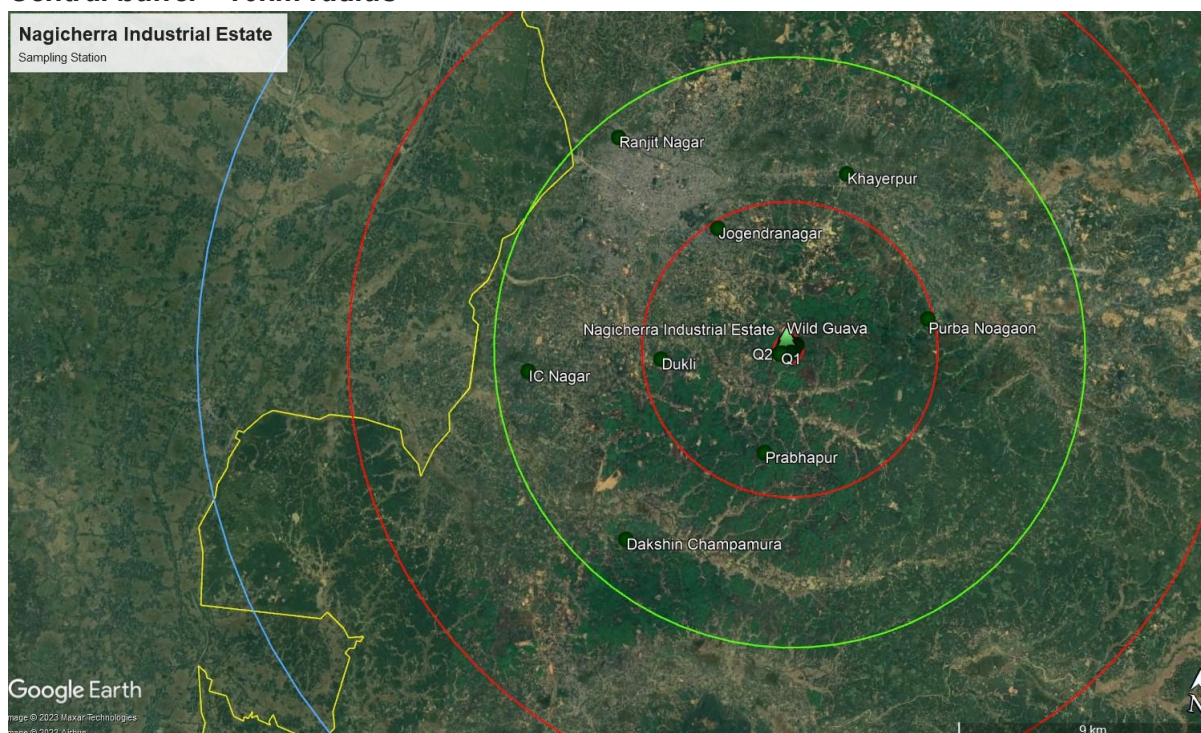


FIGURE 7 CENTRAL BUFFER - 10KM RADIUS

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	IC nagar	23.774065	91.247757	Dominated by Bamboo forest & agricultural landscape, major plants are Microcos paniculata, Wild turmeric, Carallia brachiata etc.

In the 10km buffer zone around Nagicherra, 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 understorey diversity, alter soil composition, and disrupt local biodiversity.

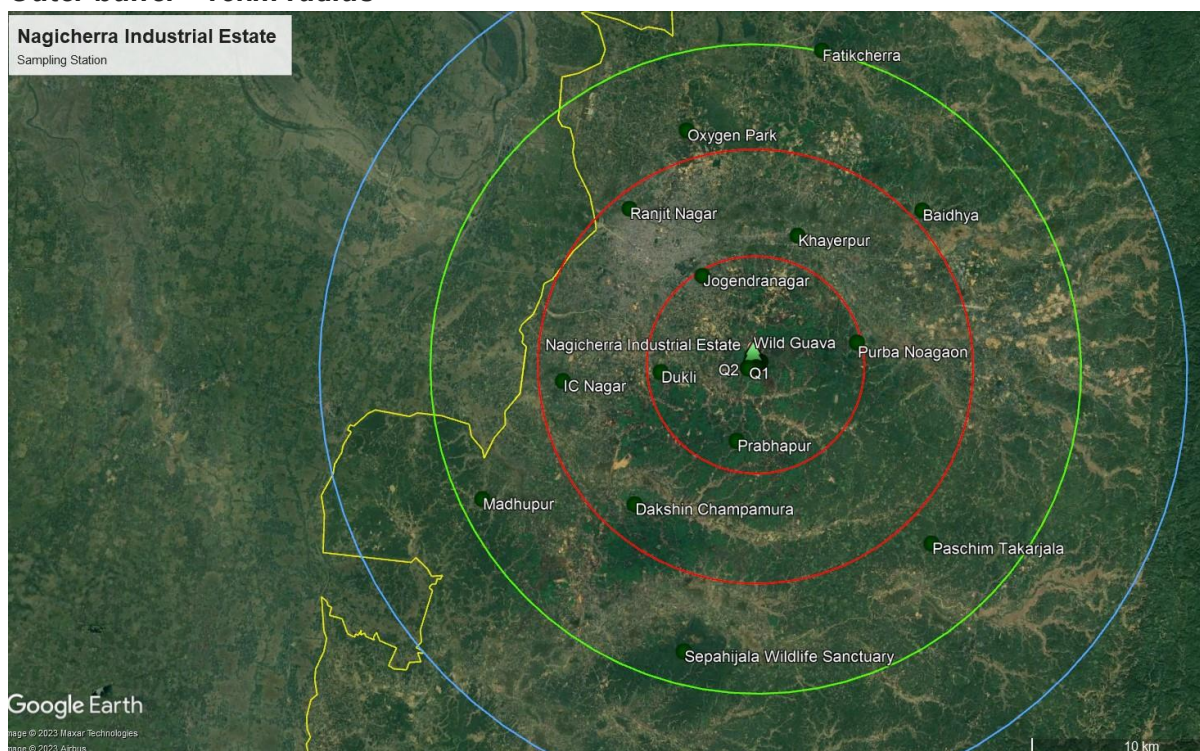
The diversity of tree species is rich, with notable numbers of *Microcos paniculata* (Pichandi) and *Lagerstroemia speciosa* (Pride of India) adding to the region's ecological structure. The presence of *Areca catechu* (Supari) and the fruit-bearing *Mangifera indica* (Aam) indicates a variety of food 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 understorey 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	Fatikcherra	23.924822	91.343864	Mixed forest dominated by Teak, bamboo, Microcos paniculata & Rubber plantation

6	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 Nagicherra, 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 Nagicherra area.

Broader buffer - 20 km radius

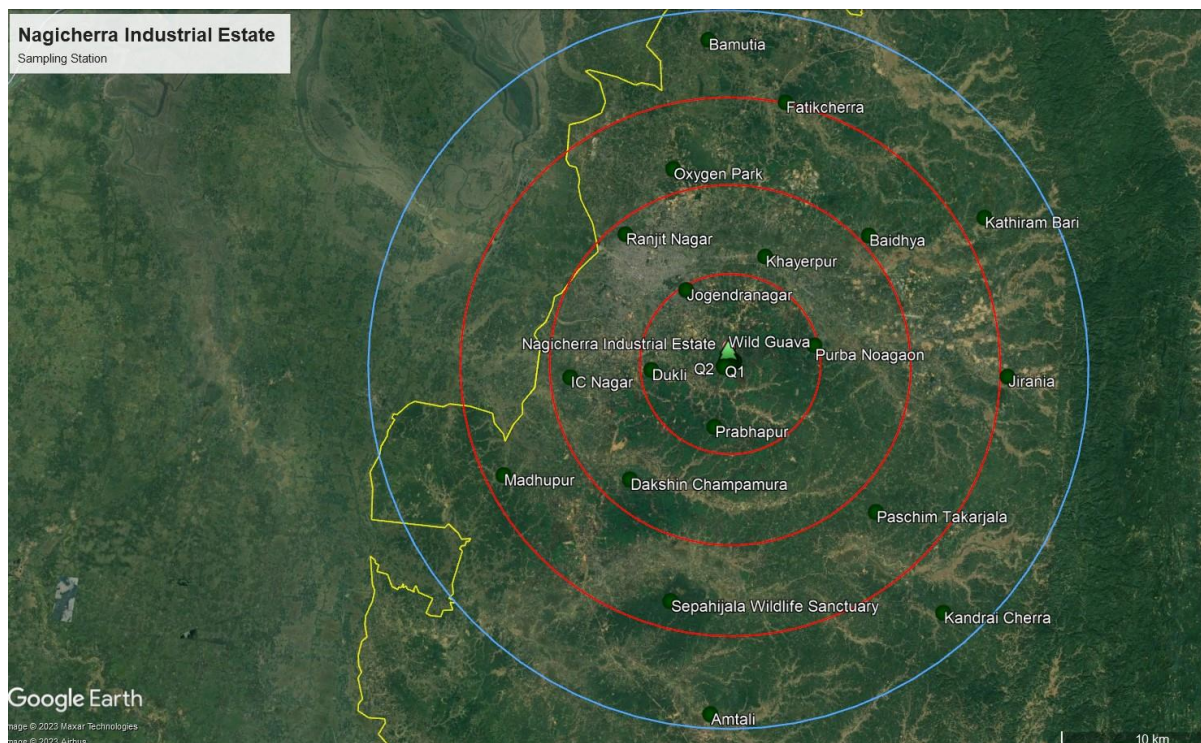


FIGURE 9 BROADER BUFFER - 20 KM RADIUS

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.

In the 20km buffer area of Nagicherra, 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 Nagicherra 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 Nagicherra 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 Nagicherra, the influence of an industrial site 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 Nagicherra 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 Nagicherra 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	<i>Chrysopogon Aciculatus</i>	126.68
0km	Shrubs	49	11	<i>Chromolaena Odorata</i>	158.35

0km	Trees	20	9	Hevea Brasiliensis	15.25
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, situated within a 0km radius, exhibits a diverse ecosystem with a variety of flora and fauna. The dominant habitat in this area is a subtropical hump with rubber plantations. This region is abundant in shrubs and herbs, with notable species such as Clerodendrum infortunatum, Jatropha gossypifolia, and Chromolaena odorata. In terms of tree diversity, the area is relatively sparse, hosting mainly juvenile teak plants and a few tree species like White teak (*Tectona grandis*), *Trema orientalis*, and *Microcos paniculata*.

The avian population in the core area is rich and varied, with species like the Asian Green Bee-Eater (*Merops orientalis*), Ashy-Headed Green Pigeon (*Treron phayrei*), and the Spotted Dove (*Spilopelia chinensis*) being quite abundant. The relative density of these birds indicates a significant presence in the ecosystem, contributing to its vibrancy and ecological complexity.

Insects like the Blister Beetle (*Mylabris pustulata*) and various species of spiders such as the Lynx Spider (*Oxyopes* sp) and the Huntsman Spider (*Heteropoda* sp) also play crucial roles in the ecological balance of the core area. Their presence is indicative of a healthy ecosystem, with a food web that supports a wide range of species.

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 (*Dicurus 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 (*Minevarya 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 sabinat*), 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	Blister 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

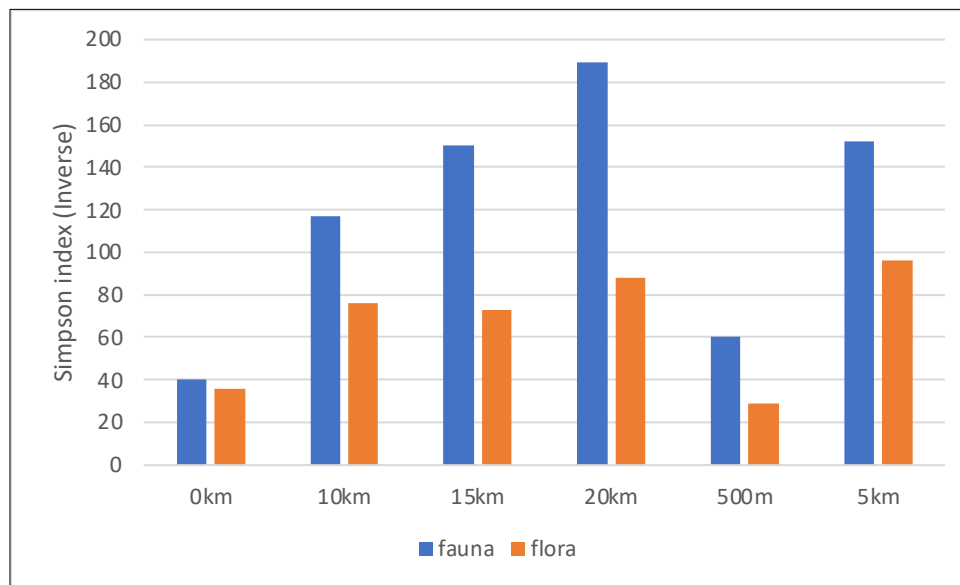


FIGURE 10: RADIUS

Diversity in ecosystems is commonly assessed using a variety of metrics, each capturing different aspects of the community's complexity. The Shannon index is a commonly used diversity index that accounts for both abundance and evenness of the species present. The Simpson index measures the probability of two individuals randomly selected from a sample belonging to the same species, with lower values indicating higher diversity. Its inverse, the Inverse of Simpson index, is particularly insightful as it provides a diversity measure that is more sensitive to changes in common species rather than rare species; higher values indicate greater diversity.

Species richness simply counts the number of different species present, providing a straightforward measure of diversity that doesn't consider the abundances of the species or their relative proportions. The Jaccard dissimilarity index compares the similarity between two communities, with a value closer to 1 indicating greater dissimilarity between them.

Focusing on the Inverse of Simpson index and species richness, we can see that at a 20km radius, fauna has a much higher Inverse of Simpson index (61.83) compared to flora (24.97), indicating a more diverse fauna community. However, flora at this radius has a lower species richness (88) compared to fauna (189), suggesting that while the flora may be less diverse, it has a considerable number of different species.

At a 15km radius, the trend is similar, with fauna (9.26) having a lower Inverse of Simpson index than at 20km but still higher than flora (22.89), again indicating a more diverse fauna community. Flora at this radius has a species richness of 73, which is less than fauna's 150.

As the radius decreases, the Inverse of Simpson index and species richness generally decrease for both fauna and flora, which might suggest that diversity tends to be concentrated more towards the core of the surveyed area. For instance, at 0km, both metrics for fauna and

flora are the lowest across all radii, with fauna having an Inverse of Simpson index of 22.55 and species richness of 40, while flora has an Inverse of Simpson index of 18.46 and species richness of 36.

The image provided shows the Inverse of Simpson index for both fauna and flora across different radii. It illustrates that fauna consistently has a higher Inverse of Simpson index compared to flora, indicating a higher diversity of fauna across all surveyed radii. The index peaks dramatically for fauna at 15km, suggesting a hotspot of diversity at this intermediate radius. Meanwhile, the diversity of flora peaks at 5km and shows less variation across distances compared to fauna. This disparity and pattern can be due to a variety of ecological factors, including habitat heterogeneity, the presence of different ecological niches, or human impact, which might be less pronounced in the core areas reflected by lower radii measurements.

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.

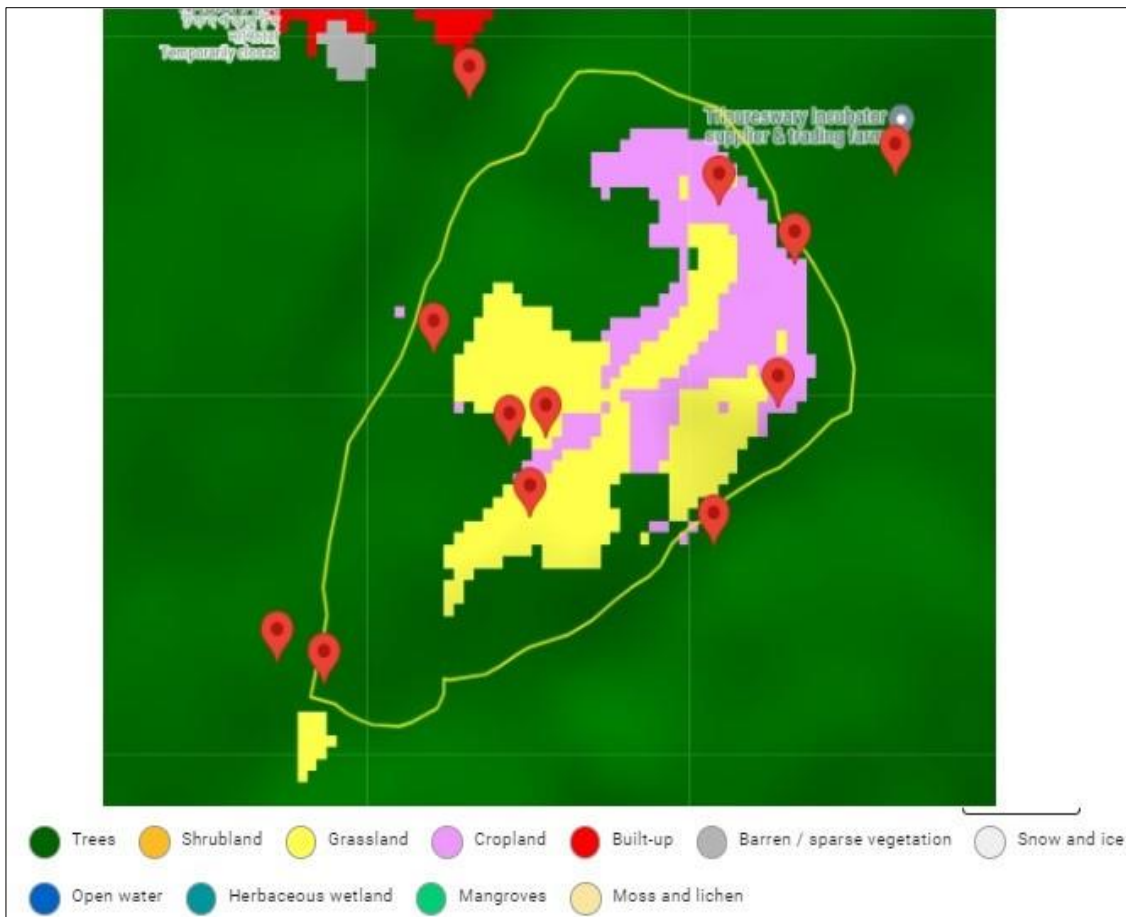


FIGURE 11: LAND USE AND LANDCOVER MAP OF THE CORE AREAS

Satellite Resolution mentioned in the **table no 17**.

Figure 12 indicates that the core area is classified as having low ecological integrity, which suggests that this region has undergone significant forest and biodiversity loss. This classification is typically based on various factors such as the degree of habitat disturbance, loss of native vegetation, fragmentation, and the presence of invasive species that together contribute to a diminished state of naturalness and ecological function. A low integrity score can also reflect compromised ecosystem services, such as reduced carbon storage, water purification, and soil conservation capabilities. The assessment, represented in the figure, underscores the urgent need for targeted conservation efforts to restore and protect the remaining natural habitats to prevent further degradation of the core area's ecological health.

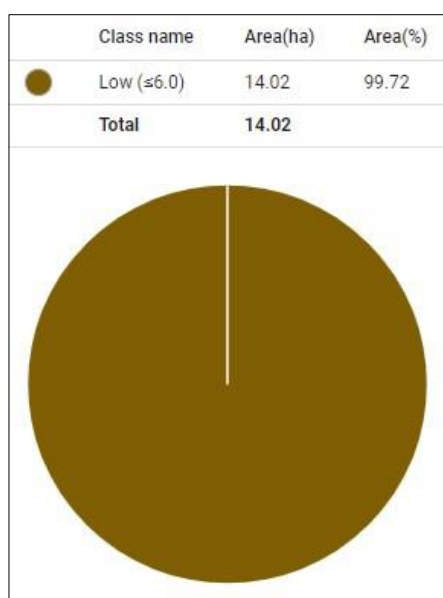


FIGURE 12: THE CORE AREA IS CLASSIFIED AS LOW ECOLOGICAL INTEGRITY DUE TO SIGNIFICANT FOREST AND BIODIVERSITY LOSS.

The data from Figure 13 highlights the pattern of tree cover loss within and around the Nagicherra site, which is designated as the core area. This figure reveals a relatively small total area of 14.06 hectares. In the year 2000, this area had a forest cover of 5.3 hectares, which has decreased by 2.68 hectares, indicating a significant loss given the size of the area. The tree cover gain from 2000 to 2012 was minimal, at only 0.03 hectares, which is not substantial when compared to the loss. The average canopy cover in the year 2000 was 13.86 percent, and the tree covered area in 2000 was 37.68 percent of the total area. By 2022, the tree cover loss was 0.62 hectares, and the gain during the same period was a mere 0.04 hectares, emphasizing a continued trend of decline in tree cover.

The table summarizing the forest loss pattern in the core area, with values in both hectares and as a percentage of the total area, is presented below:

TABLE:13 SUMMARIZING 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	14.06	5.3	2.62	2.68
Area in Percentage (%)	100	37.68	18.63	50.5



FIGURE 13: TREE COVER LOSS PATTERNS IN AND AROUND THE NAGICHERRA 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.

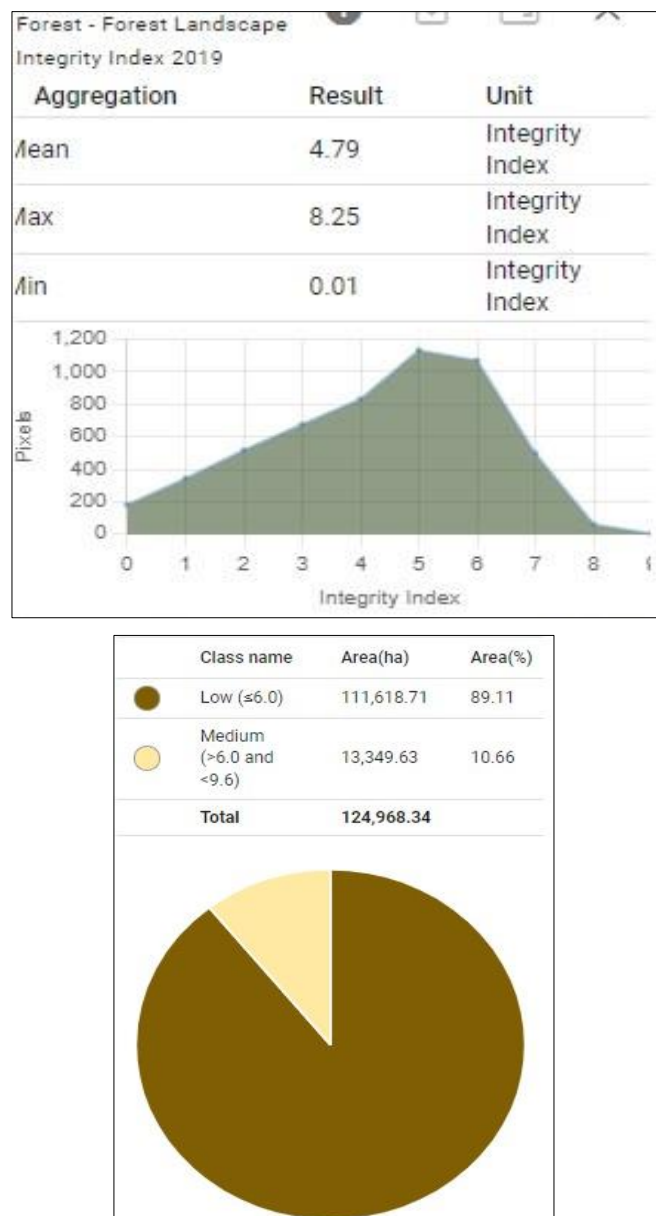


FIGURE14: PATTERNS OF CHANGE IN THE BUFFER AREA

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.

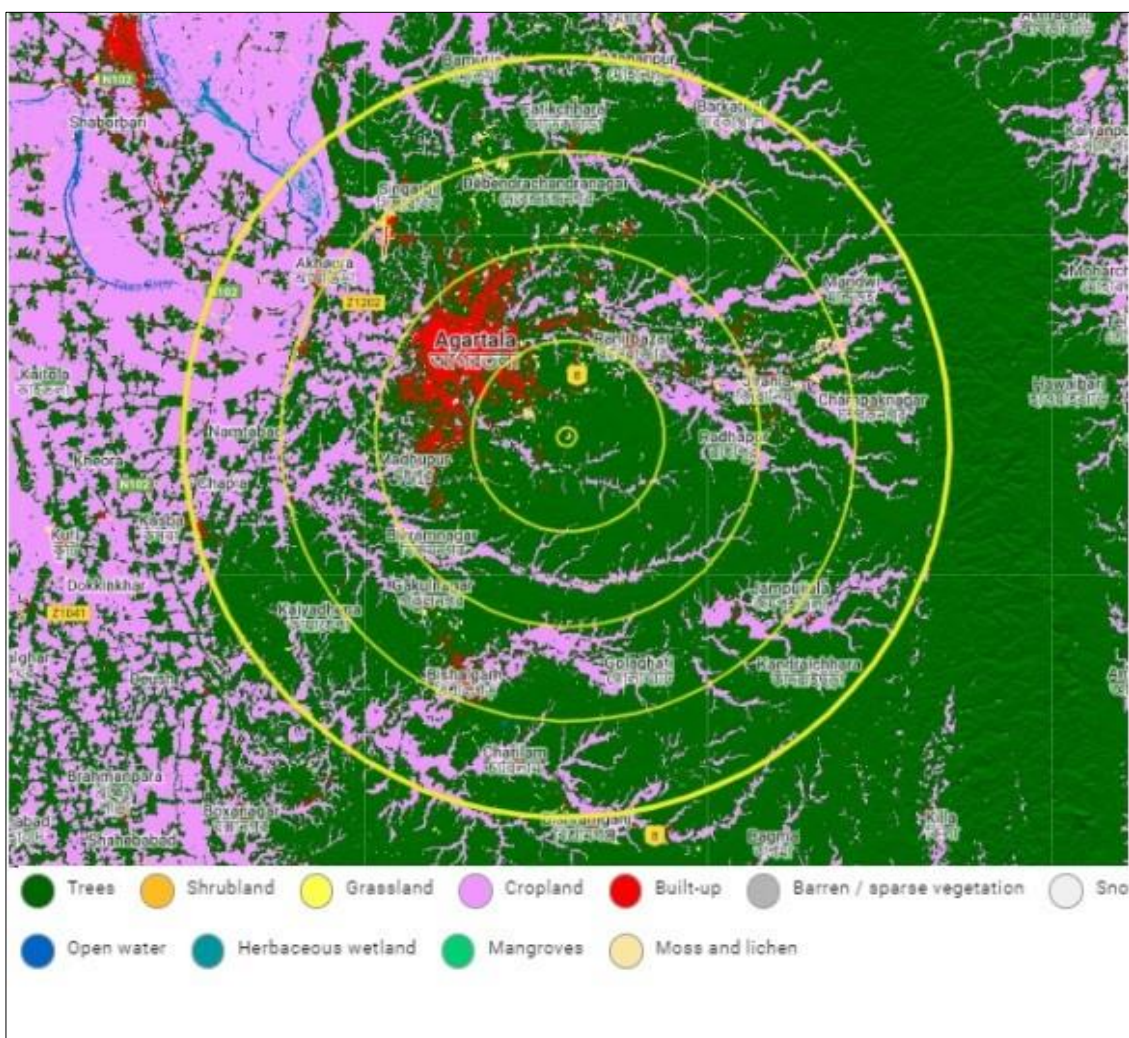


FIGURE 15: LANDCOVER AND LAND USE IN THE BUFFER AREA

Satellite Resolution table number16

Figure 16 illustrates the pattern of forest loss in the buffer area of Nagicherra, 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.

TABLE :14 SUMMARIZING THE FOREST LOSS PATTERN IN HECTARES AND PERCENTAGE IS AS FOLLOWS:

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 NAGICHERRA

Satellite Resolution mentioned in the **table no 16**.

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 cucharensis* (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

In the study area, both the core and buffer regions harbour species of significant conservation importance. In the designated study area, the presence of an extensive list of protected species underscores the importance of implementing robust conservation measures. The Schedule 1 Protected Species, including Phayre's Leaf Monkey, Capped Langur, Slow Loris, Crested Serpent Eagle, Monocled cobra, Shikra, Clouded Leopard, Mountain Hawk-Eagle, Oriental Pied Hornbill, Small Indian mongoose, Red-breasted Parakeet, and Black softshell turtle, necessitates careful planning during any developmental activities. Mitigation efforts should include the creation of protected zones, habitat restoration initiatives, and measures to minimize disturbances to these species. Additionally, the Schedule 2 Protected Species, featuring the Red-headed Trogon, Ashy-headed Green Pigeon, Blossom-headed Parakeet, and Indian flying fox, require similar attention. The presence of Endangered Species such as the Indian Trumpet Tree, Agar, and the Black softshell turtle, along with Vulnerable species like the Clouded leopard, Capped Langur, Slow Loris, and River Tern, emphasizes the need for stringent environmental impact assessments and ongoing monitoring. The study area's biodiversity, including Endemic Species like the Brazilian Guava and Bom, highlights the unique ecological significance of the region. Collaborative efforts among environmental authorities, researchers, and local communities are imperative to ensure the coexistence of developmental activities with the preservation of the diverse and vulnerable species within the study area.

Within core we observed species like **Monocled cobra (Naja kaothia)** which is a schedule I species & **Psidium guineense (Brazilian Guava)** which is endemic as well as threatened species of Tripura.

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*)
- Red-breasted Parakeet (*Psittacula alexandri*)
- Monocled cobra (*Naja kaothia*)
- Black softshell turtle (*Nilssonina nigricans*)
- Tockay 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 (*Nilssonina 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.

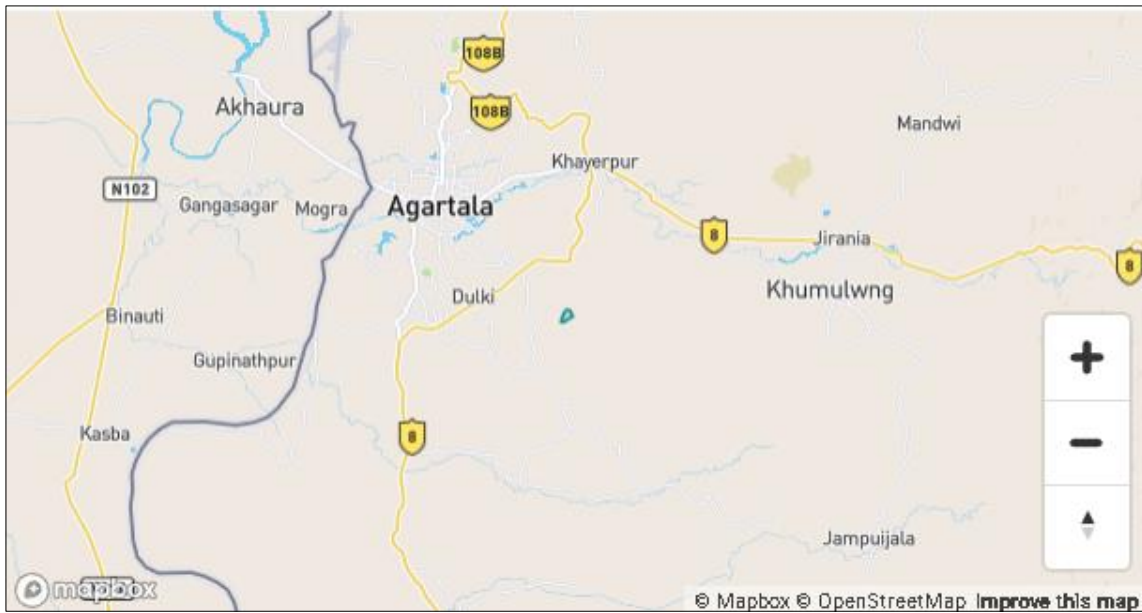


FIGURE 17 : GEOGRAPHICAL LOCATION

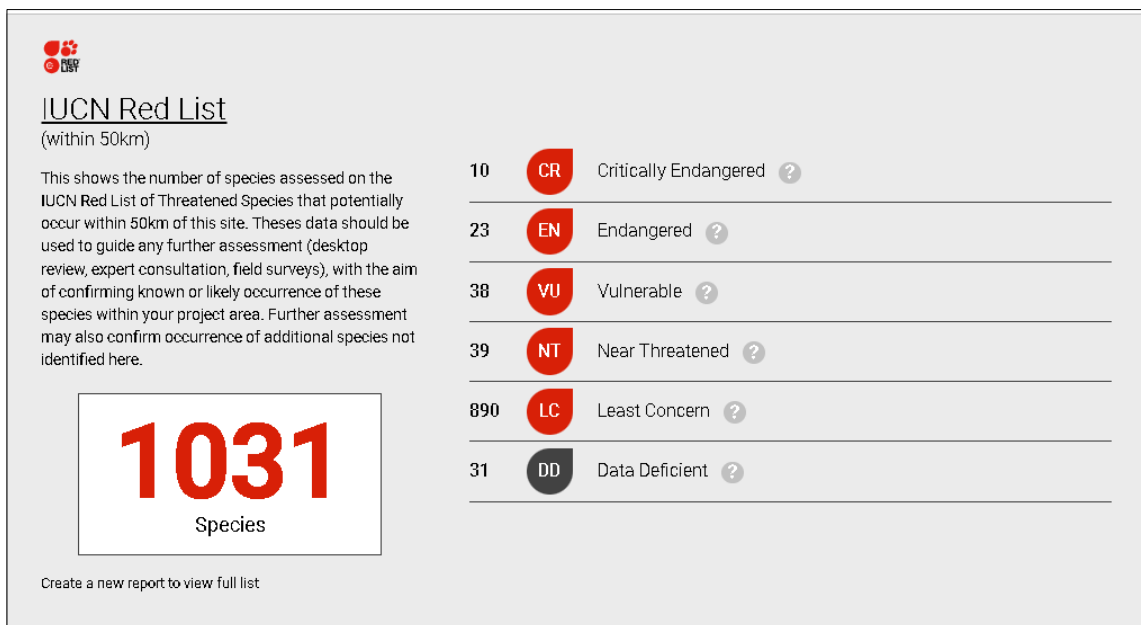


FIGURE 18: IBAT ASSESSMENT WITHIN 50 KMS

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	<i>Pelochelys cantorii</i>	Reptilia	Critically Endangered	A2cd+4cd
2	<i>Nilssononia nigricans</i>	Reptilia	Critically Endangered	A4cd
3	<i>Aquilaria malaccensis</i>	Magnoliopsida	Critically Endangered	A2cd
4	<i>Emberiza aureola</i>	Aves	Critically Endangered	A2acd+3cd+4acd
5	<i>Houbaropsis bengalensis</i>	Aves	Critically Endangered	A3bcd+4abcd
6	<i>Ardea insignis</i>	Aves	Critically Endangered	C2a(i)
7	<i>Indotestudo elongata</i>	Reptilia	Critically Endangered	A2cd
8	<i>Aythya baeri</i>	Aves	Critically Endangered	A2cd+3cd+4cd; C2a(ii)
9	<i>Manis pentadactyla</i>	Mammalia	Critically Endangered	A3d+4d
10	<i>Gyps bengalensis</i>	Aves	Critically Endangered	A2abce+4abce
11	<i>Johnius gangeticus</i>	Actinopterygii	Data Deficient	
12	<i>Blythia reticulata</i>	Reptilia	Data Deficient	
13	<i>Taenioides cirratus</i>	Actinopterygii	Data Deficient	
14	<i>Macrobrachium kempfi</i>	Malacostraca	Data Deficient	
15	<i>Maydelliatelphusa falcidigitis</i>	Malacostraca	Data Deficient	
16	<i>Globitelphusa pistorica</i>	Malacostraca	Data Deficient	
17	<i>Globitelphusa cylindra</i>	Malacostraca	Data Deficient	
18	<i>Travancoriana napaea</i>	Malacostraca	Data Deficient	
19	<i>Acanthopotamon fungosum</i>	Malacostraca	Data Deficient	
20	<i>Platycephalus indicus</i>	Actinopterygii	Data Deficient	
21	<i>Stenothyra echinata</i>	Gastropoda	Data Deficient	
22	<i>Assimineia hungerfordiana</i>	Gastropoda	Data Deficient	
23	<i>Camptoceras austeni</i>	Gastropoda	Data Deficient	

24	Badis chittagongis	Actinopterygii	Data Deficient	
25	Gobiopterus chuno	Actinopterygii	Data Deficient	
26	Pseudolaguvia inornata	Actinopterygii	Data Deficient	
27	Pseudolaguvia muricata	Actinopterygii	Data Deficient	
28	Physunio micropteroides	Bivalvia	Data Deficient	
29	Neritina platyconcha	Gastropoda	Data Deficient	
30	Pseudolaguvia virgulata	Actinopterygii	Data Deficient	
31	Auriculodes gangetica	Gastropoda	Data Deficient	
32	Ranalisma rostrata	Liliopsida	Data Deficient	
33	Limnophila diffusa	Magnoliopsida	Data Deficient	
34	Limnophila pulcherrima	Magnoliopsida	Data Deficient	
35	Megalops cyprinoides	Actinopterygii	Data Deficient	
36	Prunus bifrons	Magnoliopsida	Data Deficient	
37	Quercus gomeziana	Magnoliopsida	Data Deficient	
38	Oryza coarctata	Liliopsida	Data Deficient	
39	Planiliza tade	Actinopterygii	Data Deficient	
40	Doryichthys martensii	Actinopterygii	Data Deficient	
41	Micryletta aishani	Amphibia	Data Deficient	
42	Morenia petersi	Reptilia	Endangered	A2cd+4cd
43	Nilssonina gangetica	Reptilia	Endangered	A2d+4d
44	Nilssonina hurum	Reptilia	Endangered	A2d+4d
45	Hardella thurjii	Reptilia	Endangered	A2bcd+4bcd
46	Hoolock hoolock	Mammalia	Endangered	A4acd
47	Elephas maximus	Mammalia	Endangered	A2c
48	Platanista gangetica	Mammalia	Endangered	A2abcde+3bcde+4abcde
49	Cuon alpinus	Mammalia	Endangered	C2a(i)
50	Leptoptilos dubius	Aves	Endangered	A2bcd+3bcd+4bcd;C2a(ii)
51	Urogymnus polylepis	Chondrichthyes	Endangered	A2bcd
52	Asarcornis scutulata	Aves	Endangered	A2cd+3cd+4cd;C2a(i)

53	Laticilla cinerascens	Aves	Endangered	A2c+3c+4c; C2a(i)
54	Perdicula manipurensis	Aves	Endangered	C2a(i)
55	Tor putitora	Actinopterygii	Endangered	A2abcd
56	Varanus flavescens	Reptilia	Endangered	A2cd
57	Geoclemys hamiltonii	Reptilia	Endangered	A2cd+4cd
58	Trachypithecus phayrei	Mammalia	Endangered	A2cd
59	Nycticebus bengalensis	Mammalia	Endangered	A2acd+3cd+4acd
60	Haliaeetus leucoryphus	Aves	Endangered	C2a(ii)
61	Aquila nipalensis	Aves	Endangered	A2abcd+3bcd+4abcd
62	Panthera tigris	Mammalia	Endangered	A2abcd
63	Varanus bengalensis	Reptilia	Near Threatened	A2d
64	Eryx conicus	Reptilia	Near Threatened	A2d
65	Herpetoreas xenura	Reptilia	Near Threatened	B1b(iii)
66	Ptyas korros	Reptilia	Near Threatened	A2d
67	Maydelliathelphusa edentula	Malacostraca	Near Threatened	
68	Asiagomphus personatus	Insecta	Near Threatened	
69	Parambassis lala	Actinopterygii	Near Threatened	
70	Balitora brucei	Actinopterygii	Near Threatened	
71	Rousettus leschenaultii	Mammalia	Near Threatened	A2cd
72	Coelops frithii	Mammalia	Near Threatened	A4c
73	Arborophila atrogularis	Aves	Near Threatened	C1+2a(i)
74	Mareca falcata	Aves	Near Threatened	A2bd+3bd+4bd
75	Calidris ruficollis	Aves	Near Threatened	A2bc+3bc+4bc
76	Vanellus duvaucelii	Aves	Near Threatened	A3cde
77	Anhinga melanogaster	Aves	Near Threatened	A2bcd+3bcd+4bcd
78	Ephippiorhynchus asiaticus	Aves	Near Threatened	A2bc+3bc+4bc;C1
79	Catopuma temminckii	Mammalia	Near Threatened	

80	Palaeornis eupatria	Aves	Near Threatened	A2cd+3cd+4cd
81	Limosa lapponica	Aves	Near Threatened	A2abc+3bc+4abc
82	Himalayapsitta roseata	Aves	Near Threatened	A2cd+3cd+4cd
83	Psittacula alexandri	Aves	Near Threatened	A2cd+3cd+4cd
84	Limosa limosa	Aves	Near Threatened	A2bcde+3bcde+4bcde
85	Ichthyophaga ichthyaetus	Aves	Near Threatened	A2cd+3cd+4cd; C1+2a(i)
86	Numenius arquata	Aves	Near Threatened	A2bcd+3bcd+4bcd
87	Pelecanus philippensis	Aves	Near Threatened	A2cd; C1
88	Graminicola bengalensis	Aves	Near Threatened	C2a(i)
89	Calidris canutus	Aves	Near Threatened	A2abc+3bc+4abc
90	Aythya nyroca	Aves	Near Threatened	A2cd+3cd+4cd
91	Haematopus ostralegus	Aves	Near Threatened	A2bc+3b+4bc
92	Aegle marmelos	Magnoliopsida	Near Threatened	A2acd
93	Ompok bimaculatus	Actinopterygii	Near Threatened	
94	Microphis deocata	Actinopterygii	Near Threatened	
95	Anguilla bicolor	Actinopterygii	Near Threatened	A2bcde
96	Anguilla bengalensis	Actinopterygii	Near Threatened	A2cd
97	Treron phayrei	Aves	Near Threatened	A2cd+3cd+4cd
98	Falco jugger	Aves	Near Threatened	A2cd+3cd+4cd; C1
99	Ducula aenea	Aves	Near Threatened	A3cd+4cd
100	Circus macrourus	Aves	Near Threatened	A2cde+3cde+4cde
101	Ophiophagus hannah	Reptilia	Vulnerable	A2acd
102	Elaphe taeniura	Reptilia	Vulnerable	A2d
103	Dipterocarpus costatus	Magnoliopsida	Vulnerable	A2cd
104	Dipterocarpus turbinatus	Magnoliopsida	Vulnerable	A2cd
105	Pangshura tecta	Reptilia	Vulnerable	A4d
106	Lissemys punctata	Reptilia	Vulnerable	A2cd+4cd
107	Crocodylus palustris	Reptilia	Vulnerable	A2cd
108	Arctonyx collaris	Mammalia	Vulnerable	A2cd+3cd+4cd

109	Arctictis binturong	Mammalia	Vulnerable	A2cd+3cd+4cd
110	Rusa unicolor	Mammalia	Vulnerable	A2cd+3cd+4cd
111	Ortygornis gularis	Aves	Vulnerable	A2cd+3cd+4cd
112	Clanga hastata	Aves	Vulnerable	C2a(ii)
113	Leptoptilos javanicus	Aves	Vulnerable	A2cd+3cd+4cd
114	Oryza malampuzhaensis	Liliopsida	Vulnerable	B1ab(iii,v)
115	Gallinago nemoricola	Aves	Vulnerable	C2a(ii)
116	Helarctos malayanus	Mammalia	Vulnerable	A2cd+3cd+4cd
117	Schizothorax plagiostomus	Actinopterygii	Vulnerable	A2b
118	Beilschmiedia assamica	Magnoliopsida	Vulnerable	B2ab(iii)
119	Python bivittatus	Reptilia	Vulnerable	A2acd
120	Aquila heliaca	Aves	Vulnerable	C2a(ii)
121	Capricornis sumatraensis	Mammalia	Vulnerable	A2cd
122	Panthera pardus	Mammalia	Vulnerable	A2cd
123	Lutrogale perspicillata	Mammalia	Vulnerable	A2cde+3cde
124	Aonyx cinereus	Mammalia	Vulnerable	A2cde+3cde
125	Ursus thibetanus	Mammalia	Vulnerable	A2cd
126	Wallago attu	Actinopterygii	Vulnerable	A2d
127	Sterna aurantia	Aves	Vulnerable	A2bcd+3bcd+4bcd
128	Buceros bicornis	Aves	Vulnerable	A3cd+4cd
129	Macaca arctoides	Mammalia	Vulnerable	A2cd+3cd
130	Trachypithecus pileatus	Mammalia	Vulnerable	A2ac+3c
131	Neofelis nebulosa	Mammalia	Vulnerable	A2cd+4cd
132	Dalbergia thomsonii	Magnoliopsida	Vulnerable	B2ab(iii)
133	Clanga clanga	Aves	Vulnerable	A2cde
134	Aythya ferina	Aves	Vulnerable	A2abcd+3bcd+4abcd
135	Bagarius bagarius	Actinopterygii	Vulnerable	A2d
136	Macaca leonina	Mammalia	Vulnerable	A2acd+3cd

137	Xenochrophis cerasogaster	Reptilia	Vulnerable	A2c
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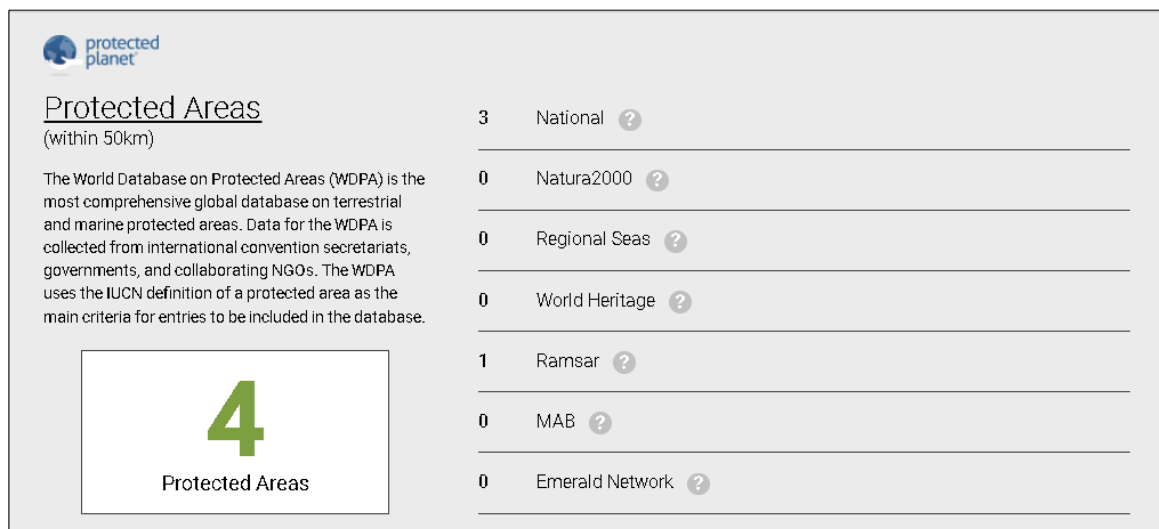


FIGURE 19 : PROTECTED AREAS

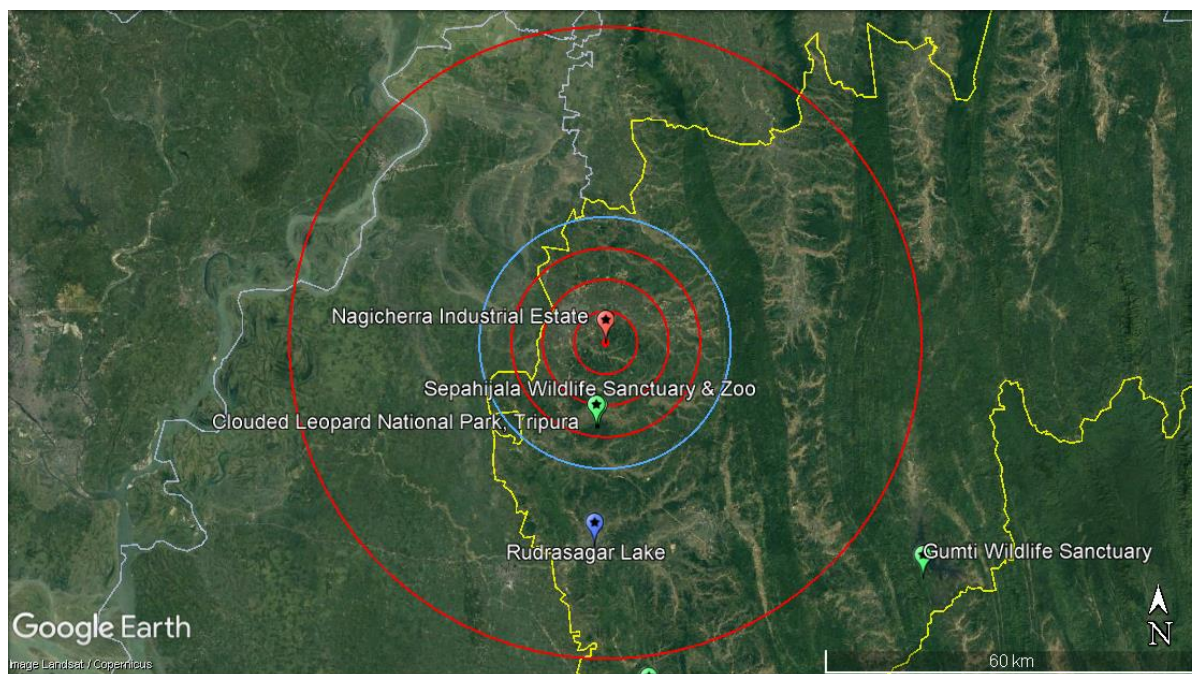


FIGURE 20: PROTECTED AREAS WITHIN 50 KM RADIUS

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 (Within 10-15 km Radius)
- Sepahijala Wildlife Sanctuary (Within 10-15 km Radius)
- Rudrasagar Lake (Within 20-50 km Radius) (Ramsar Site)

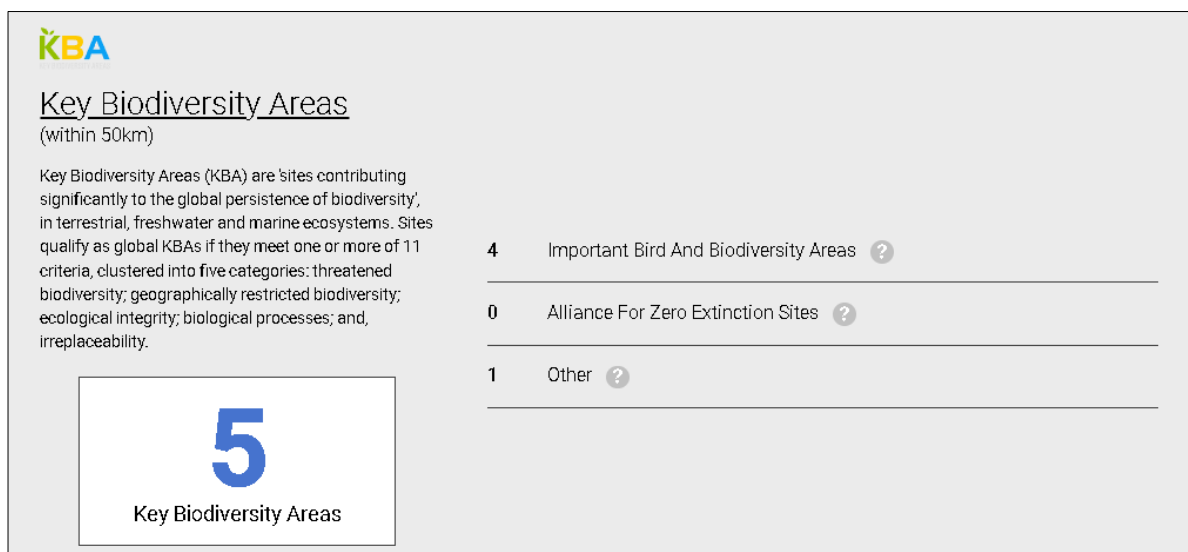


FIGURE 21: KEY BIODIVERSITY AREAS

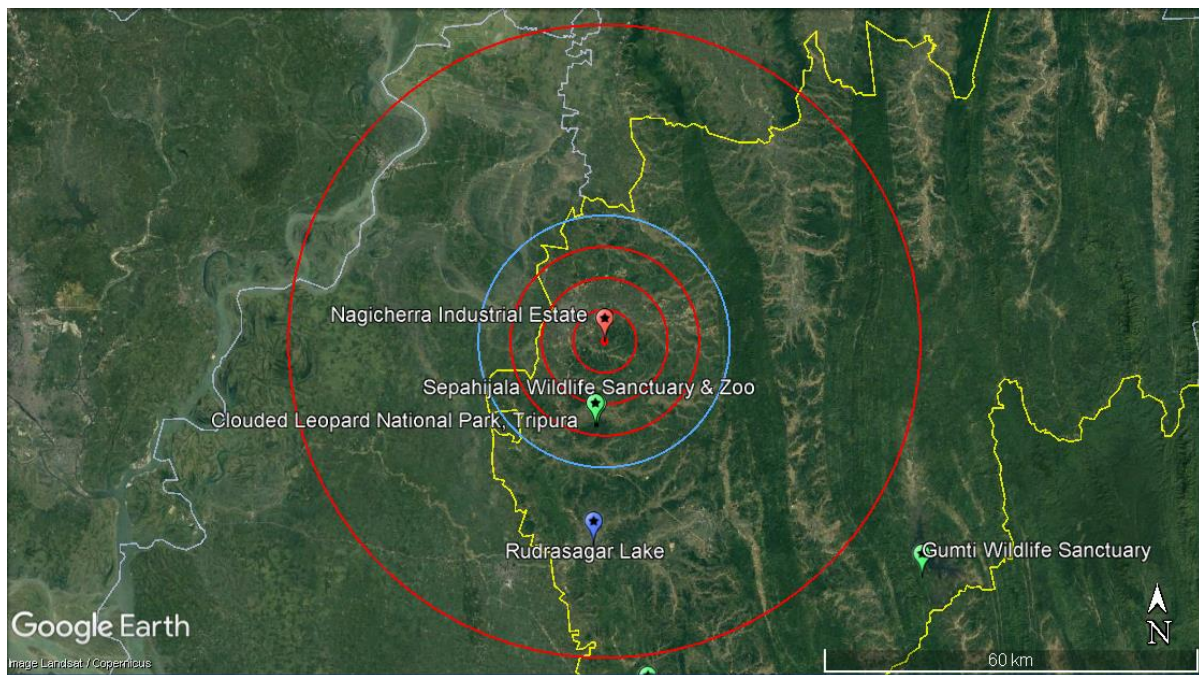


FIGURE 22: KBAs WITHIN 50 KM RADIUS

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 from within 50 km radius within India

- Clouded leopard National Park (Within 10-15 km Radius)
- Sepahijala Wildlife Sanctuary (Within 10-15 km Radius)
- Rudrasagar Lake (Within 20-50 km Radius) (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:** Alarming, 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 Nagicherra 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 Nagicherra area.

In conclusion, the population trend data from the Nagicherra 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 Nagicherra buffer areas.

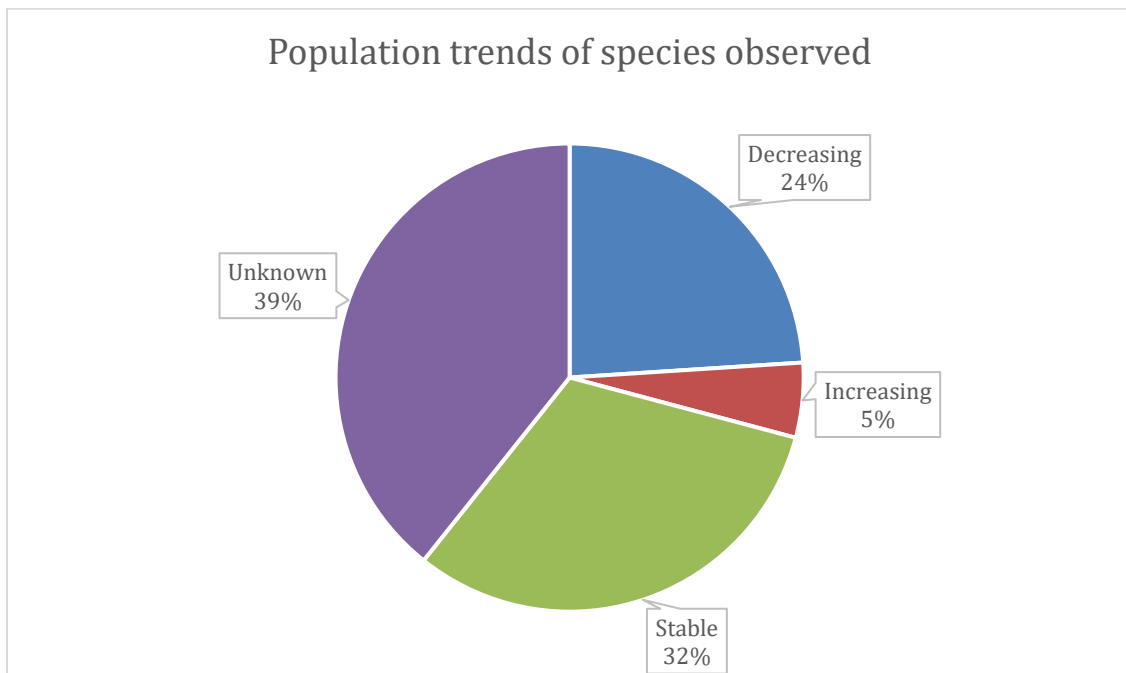


FIGURE 23: POPULATION TRENDS OF SPECIES OBSERVED

Status of species:

This assessment of the Nagicherra 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 27% 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, 23% 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 Nagicherra area to inform conservation strategies.

In summary, the Nagicherra 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.

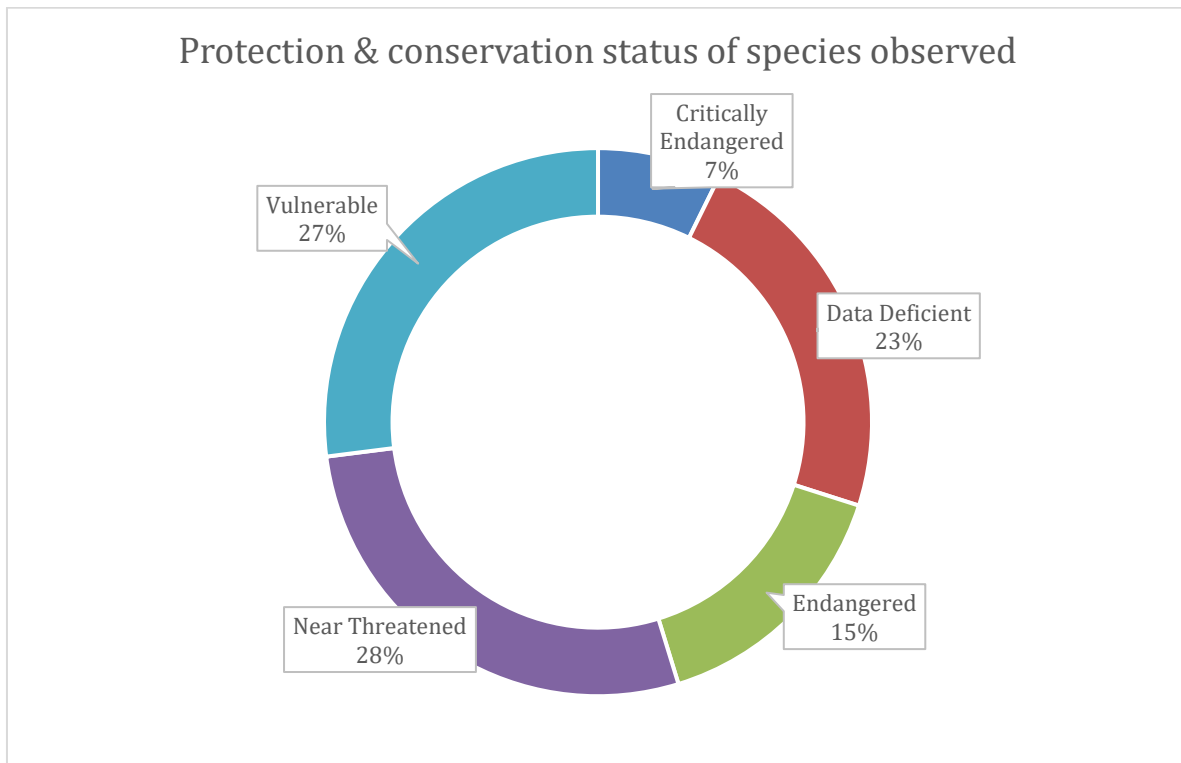


FIGURE 24: CONSERVATION STATUS OF SPECIES

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

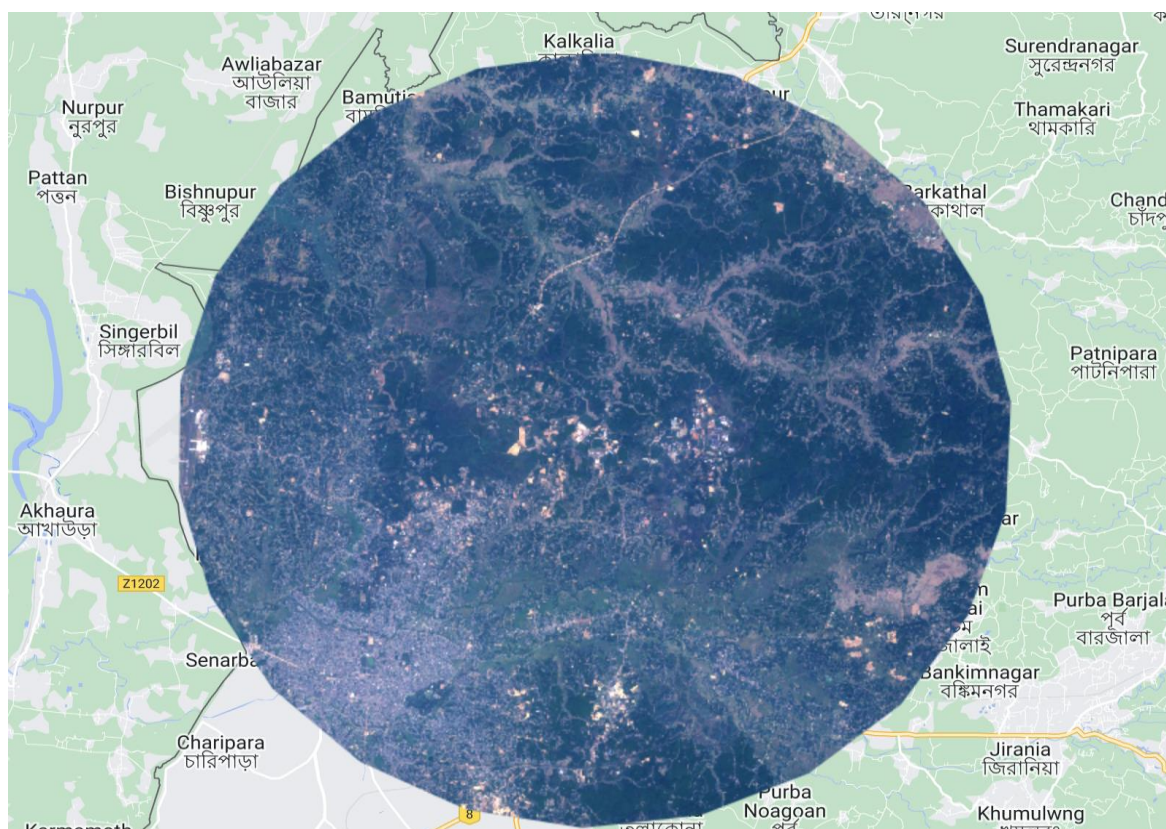


FIGURE 27: SATELLITE IMAGERY OF 15 KM AREA BASED ON 2022-2024 COMPOSITE OF SENTINEL 2 B4, B3, B2 BANDS

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	Chlorophyll absorption, plant vigour	Vegetation tracking, inland water bodies

			and reflects off of plant chlorophyll.		
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 Nagicherra 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 Nagicherra 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 Nagicherra 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 Nagicherra 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 Nagicherra 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 Nagicherra 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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Nagicherra 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 arnottiana</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

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 NAGICHERRA INDUSTRIAL ESTATE**Protected species in the Nagicherra industrial estate (core) & mitigation measures during construction phase:****Protected species:****Schedule 1 Protected Species:**

- Monocled cobra (*Naja kaothia*)

Schedule 2 Protected Species:

- Ashy-headed Green Pigeon (*Treron phayrei*)

Endemic Species:

- Brazilian Guava (*Psidium guineense*)

Threatened:

- Brazilian Guava (*Psidium guineense*)

Near Threatened Species:

- Ashy-headed Green Pigeon (*Treron phayrei*)

In the core site where industrial development is planned, the presence of protected species necessitates careful consideration and implementation of mitigation measures during the construction phase. The Monocled cobra, listed as a Schedule 1 Protected Species, requires specific attention to avoid any negative impact on its habitat and well-being. Mitigation measures should include the establishment of exclusion zones, where construction activities are limited to minimize disturbance to the cobra's natural environment. For the Schedule 2 Protected Species, the Ashy-headed Green Pigeon, similar protective measures should be implemented, including creating buffer zones around critical habitats and employing construction practices that minimize noise and disruption. The Endemic Species, Brazilian Guava, which is both Threatened and the subject of conservation concern, calls for habitat preservation and restoration efforts to mitigate potential disruptions during construction. Additionally, the Near Threatened status of the Ashy-headed Green Pigeon underscores the importance of ongoing monitoring programs to track population dynamics and address any unforeseen impacts.

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



Psidium guineense tree Location in industrial area



Psidium guineense in core site

Table 1 : Biodiversity within core site

Sr. No.	Scientific Name	Common Name	Family	Habit	Trait	Distribution	Group
1	Acmella Paniculata	Panicled Spot Flower	Asteraceae	Herbs	Autotrophs	Native	flora
2	Alocasia Indica	Kochu	Araceae	Herbs	Autotrophs	Native	flora
3	Alstonia Scholaris	Chatim	Apocynaceae	Trees	Autotrophs	Native	flora
4	Alternanthera Sessilis	Brazilian Spinach	Amaranthaceae	Herbs	Autotrophs	Exotic	flora
5	Aphanomixis Polystachya	Pithraj Tree	†Meliaceae	Trees	Autotrophs	Native	flora
6	Biancaea Decapetala	Mysore Thorn	Fabaceae	Shrubs	Autotrophs	Native	flora
7	Careya Arborea	Patana Oak	Lecythidaceae	Trees	Autotrophs	Native	flora
8	Cassia Obtusifolia	Sicklepod†	Fabaceae	Shrubs	Autotrophs	Native	flora
9	Cassia Occidentalis	Coffee Senna	Fabaceae	Shrubs	Autotrophs	Exotic	flora
10	Cassia Siamea	Kassod Tree	Fabaceae	Trees	Autotrophs	Native	flora
11	Cassia Sophera	Kalkasunda	Fabaceae	Trees	Autotrophs	Exotic	flora
12	Chromolaena Odorata	Jack In The Bush	Asteraceae	Shrubs	Autotrophs	Exotic	flora
13	Chrysopogon Aciculatus	False Beardgrass	Poaceae	Herbs	Autotrophs	Native	flora
14	Cleome Rutidosperma	Fringed Spider Flower	Cleomaceae	Herbs	Autotrophs	Exotic	flora
15	Clerodendrum Infortunatum	Bhat	Lamiaceae	Shrubs	Autotrophs	Native	flora
16	Curcuma Aromatica	Wild Turmeric	Zingiberaceae	Herbs	Autotrophs	Native	flora
17	Digitaria Sanguinalis	Hairy Crabgrass	Poaceae	Herbs	Autotrophs	Native	flora
18	Dioscorea Alata	True Yam	Dioscoreaceae	Climbers	Autotrophs	Exotic	flora
19	Dioscorea Bulbifera	Air Potato	Dioscoreaceae	Climbers	Autotrophs	Native	flora
20	Dryopteris Spp.	Male Fern	Dryopteridaceae	Ferns	Autotrophs	Native	flora
21	Ficus Hispida	Dumur	Moraceae	Trees	Autotrophs	Native	flora
22	Gmelina Arborea	Gamai	Verbenaceae	Trees	Autotrophs	Native	flora
23	Grona Triflora	Beggarweed	Fabaceae	Herbs	Autotrophs	Native	flora
24	Hevea Brasiliensis	Rubber	Euphorbiaceae	Trees	Autotrophs	Exotic	flora
25	Holarrhena Antidysenterica	Kurchi	Apocynaceae	Shrubs	Autotrophs	Native	flora
26	Jatropha Curcas	Physic Nut	Euphorbiaceae	Shrubs	Autotrophs	Exotic	flora
27	Jatropha Gossypifolia	Bellyache Bush	Euphorbiaceae	Shrubs	Autotrophs	Exotic	flora
28	Lanea Coromandelica	Indian Ash Tree	Anacardiaceae	Trees	Autotrophs	Native	flora
29	Lantana Camera	Yellow Sage	Verbenaceae	Shrubs	Autotrophs	Exotic	flora
30	Melastoma Affine	Blue Tongue	Melastomataceae	Shrubs	Autotrophs	Exotic	flora
31	Mesosphaerum Suaveolens	Mint Weed	Lamiaceae	Shrubs	Autotrophs	Exotic	flora
32	Microcos Paniculata	Pichandi	Malvaceae	Trees	Autotrophs	Native	flora
33	Mikania Micrantha	Bitter Vine	Asteraceae	Climbers	Autotrophs	Exotic	flora
34	Mimosa Pudica	Lojjabati	Fabaceae	Herbs	Autotrophs	Exotic	flora
35	Oldenlandia Corymbosa	Diamond Flower	Rubiaceae	Herbs	Autotrophs	Native	flora
36	Oplismenus Hirtellus	Basket Grass	poaceae	Herbs	Autotrophs	Native	flora
37	Parthenium Hysterophorus	Famine Weed	Asteraceae	Herbs	Autotrophs	Exotic	flora
38	Paspalum Botterii	Crown Grass	Poaceae	Herbs	Autotrophs	Exotic	flora

39	Peltophorum Pterocarpum	Copper Pod Tree	Fabaceae	Trees	Autotrophs	Native	flora
40	Psidium Guineense Swartz.	Brazilian Guava	Myrtaceae	Shrubs	Autotrophs	Native	flora
41	Pteris Vittata	Chinese Brake	Pteridaceae	Ferns	Autotrophs	Native	flora
42	Pueraria Phaseoloides	Tropical Kudzu	Fabaceae	Climbers	Autotrophs	Native	flora
43	Saccharum Spontaneum	Wild Sugarcane	Poaceae	Herbs	Autotrophs	Native	flora
44	Sida Acuta	Wireweed	Malvaceae	Shrubs	Autotrophs	Exotic	flora
45	Sida Cordifolia	Flannel Weed	Malvaceae	Shrubs	Autotrophs	Native	flora
46	Solanum Sisymbriifolium	Sticky Nightshade	Solanaceae	Shrubs	Autotrophs	Exotic	flora
47	Spermacoce Latifolia	False Button Weed	Rubiaceae	Herbs	Autotrophs	Exotic	flora
48	Streblus Asper	Ruposhi Gach	Moraceae	Trees	Autotrophs	Native	flora
49	Tectaria Spp.	Least Halberd	Tectariaceae	Ferns	Autotrophs	Native	flora
50	Toona Ciliata	Rongil	Meliaceae	Trees	Autotrophs	Native	flora
51	Torenia Crustacea	Malaysian False Pimpernel	Linderniaceae	Herbs	Autotrophs	Native	flora
52	Trema Orientalis	Indian Charcoal Tree	Cannabaceae	Trees	Autotrophs	Native	flora
53	Tridax Procumbens	Coatbuttons	Asteraceae	Herbs	Autotrophs	Exotic	flora
54	Uria Spp.	Prishniparni	Fabaceae	Herbs	Autotrophs	Native	flora
55	Urena Lobata	†Caesarweed	Malvaceae	Shrubs	Autotrophs	Native	flora
56	Ziziphus Mauritiana	Boroi	Rhamnaceae	Trees	Autotrophs	Native	flora
57	Ziziphus Oenoplia	Jackal Jujube	Rhamnaceae	Trees	Autotrophs	Native	flora
58	Zapornia Pusilla	Baillon'S Crake	Rallidae	Birds	Ominvores	Native	fauna
59	Gallus Gallus	Red Junglefowl	Phasianidae	Birds	Ominvores	Native	fauna
60	Caprimulgus Macrurus	Large-Tailed Nightjar†	Caprimulgidae (Nightjars)	Birds	Insectivores	Native	fauna
61	Hirundapus Gigaesus	Brown-Backed Needletail	Hemiprocnidae (Treeswifts)	Birds	Insectivores	Native	fauna
62	Tachymarptis Melba	Alpine Swift†	Hemiprocnidae (Treeswifts)	Birds	Insectivores	Native	fauna
63	Apus Nipalensis	House Swift†Apus	Hemiprocnidae (Treeswifts)	Birds	Insectivores	Native	fauna
64	Ceropus Sinensis	Greater Coucal†	Cuculidae (Cuckoos)	Birds	Ominvores	Native	fauna
65	Phaenicophaeus Tristis	Green-Billed Malkoha†	Cuculidae (Cuckoos)	Birds	Ominvores	Native	fauna
66	Eudynamys Scolopaceus	Asian Koel†Eudynamys	Cuculidae (Cuckoos)	Birds	Ominvores	Native	fauna
67	Chrysococcyx Maculatus	Asian Emerald Cuckoo†	Cuculidae (Cuckoos)	Birds	Ominvores	Native	fauna
68	Streptopelia Orientalis	Oriental Turtle Dove†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
69	Columba Livia	Rock Dove	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
70	Streptopelia Decaocto	Eurasian Collared Dove†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
71	Streptopelia Tranquebarica	Red Collared Dove†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
72	Spilopelia Chinensis	Spotted Dove†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
73	Chanophaps Indica	Common Emerald Dove†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
74	Treron Phayrei	Ashy-Headed Green Pigeon†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna

75	Treron Phoenicopterus	Yellow-Footed Green Pigeon†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
76	Ducula Aenea	Green Imperial Pigeon†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
77	Amaurornis Phoenicurus	White-Breasted Waterhen†	Rallidae (Rails, Crakes and Coots)	Birds	Ominvores	Native	fauna
78	Gallinula Chloropus	Common Moorhen†	Rallidae (Rails, Crakes and Coots)	Birds	Ominvores	Native	fauna
79	Vanellus Indicus	Red-Wattled Lapwing†	Charadriidae (Plovers)	Birds	Insectivores	Native	fauna
80	Gallinago Stenura	Pin-Tailed Snipe†	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Native	fauna
81	Gallinago Gallinago	Common Snipe†	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Native	fauna
82	Actitis Hypoleucos	Common Sandpiper†	Scolopacidae (Sandpipers, Snipes)	Birds	Insectivores	Native	fauna
83	Artamus Fuscus	Ashy Woodswallow†	Artamidae	Birds	Insectivores	Native	fauna
84	Ardeola Grayii	Indian Pond Heron	Ardeidae (Hérons, Bitterns)	Birds	Ominvores	Native	fauna
85	Bubus Coromandus	Eastern Cattle Egret†	Ardeidae (Hérons, Bitterns)	Birds	Ominvores	Native	fauna
86	Egretta Garzetta	Little Egret†	Ardeidae (Hérons, Bitterns)	Birds	Ominvores	Native	fauna
87	Accipiter Badius	Shikra†	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Native	fauna
88	Milvus Migrans	Black Kite†	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Native	fauna
89	Glaucidium Cuculoides	Asian Barred Owlet†	Strigidae (Owls)	Birds	Carnivores	Native	fauna
90	Athene Brama	Spotted Owlet†	Strigidae (Owls)	Birds	Carnivores	Native	fauna
91	Coracias Affinis	Indochinese Roller†	Coraciidae (Rollers)	Birds	Ominvores	Native	fauna
92	Halcyon Smyrnensis	White-Throated Kingfisher†	Alcedinidae (Kingfishers)	Birds	Carnivores	Native	fauna
93	Merops Philippinus	Blue-Tailed Bee- Eater	Meropidae (Bee- eaters)	Birds	Insectivores	Native	fauna
94	Merops Orientalis	Asian†Green Bee- Eater†	Meropidae (Bee- eaters)	Birds	Insectivores	Native	fauna
95	Psilopogon Lineatus	Lineated Barbet†	Megalaimidae (Asian Barbets)	Birds	Ominvores	Native	fauna
96	Psilopogon Haemacephalus	Coppersmith Barbet†	Megalaimidae (Asian Barbets)	Birds	Ominvores	Native	fauna
97	Dinopium Benghalense	Black-Rumped Flameback†	Picidae (Woodpeckers)	Birds	Insectivores	Near- endemic	fauna
98	Psittacula Krameri	Rose-Ringed Parakeet†	Psittaculidae (Old World Parrots)	Birds	Ominvores	Native	fauna
99	Tephrodornis Pondicerianus	Common Woodshrike†	Vangidae (Vangas and Allies)	Birds	Insectivores	Native	fauna
100	Aegithina Tiphia	Common Iora†	Aegithinidae (Ioras)	Birds	Insectivores	Native	fauna
101	Lanius Scheduleach	Long-Tailed Shrike†	Laniidae (Shrikes)	Birds	Insectivores	Native	fauna
102	Oriolus Xahornus	Black-Hooded Oriole†	Oriolidae	Birds	Ominvores	Native	fauna
103	Dicrurus Macrocerus	Black Drongo	Dicruridae (Drongos)	Birds	Ominvores	Native	fauna
104	Dicrurus Leucophaeus	Ashy Drongo†	Dicruridae (Drongos)	Birds	Ominvores	Native	fauna
105	Dicrurus Annectens	Crow-Billed Drongo†	Dicruridae (Drongos)	Birds	Ominvores	Native	fauna

106	Dicrurus Hottenottus	Hair-Crested Drongo†	Dicruridae (Drongos)	Birds	Omnivores	Native	fauna
107	Dicrurus Paradiseus	Greater Racket-Tailed Drongo	Dicruridae (Drongos)	Birds	Omnivores	Native	fauna
108	Rhipidura Albicollis	White-Throated Fantail†	Rhipiduridae	Birds	Insectivores	Native	fauna
109	Dendrocitta Vagabunda	Rufous Treepie†	Corvidae (Crows, Jays)	Birds	Omnivores	Native	fauna
110	Corvus Splendens	House Crow†	Corvidae (Crows, Jays)	Birds	Omnivores	Native	fauna
111	Corvus Culminatus	Indian Jungle Crow	Corvidae (Crows, Jays)	Birds	Omnivores	Native	fauna
112	Pycnonotus Cafer	Red-Vented Bulbul†	Pycnonotidae (Bulbuls)	Birds	Omnivores	Native	fauna
113	Hirundo Rustica	Barn Swallow†	Hirundinidae (Swallows, Martins)	Birds	Omnivores	Native	fauna
114	Cecropis Daurica	Red-Rumped Swallow†	Hirundinidae (Swallows, Martins)	Birds	Omnivores	Native	fauna
115	Prinia Hodgsonii	Grey-Breasted Prinia†	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Native	fauna
116	Prinia Inornata	Plain Prinia	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Native	fauna
117	Orthotomus Sutorius	Common Tailorbird†	Cisticolidae (Cisticolas and Allies)	Birds	Insectivores	Native	fauna
118	Pomatorhinus Scheduleisticeps	White-Browed Scimitar Babbler†	Timaliidae (Babblers, Scimitar Babblers)	Birds	Insectivores	Native	fauna
119	Argya Earlei	Striated Babbler†	Leiothrichidae (Laughingthrushes and Allies)	Birds	Omnivores	Near-endemic	fauna
120	Zosterops Palpebrosus	Indian White-Eye†	Zosteropidae (White-eyes)	Birds	Omnivores	Near-endemic	fauna
121	Aplonis Panayensis	Asian Glossy Starling†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
122	Gracula Religiosa	Common Hill Myna†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
123	Gracupica Contra	Indian†Pied Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
124	Acridotheres Fuscus	Jungle Myna†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
125	Acridotheres Ginginianus	Bank Myna†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Near-endemic	fauna
126	Acridotheres Tristis	Common Myna	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
127	Sturnia Malabarica	Chestnut-Tailed Starling†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Native	fauna
128	Sturnia Pagodarum	Brahminy Starling†	Sturnidae (Starlings, Rhabdornises)	Birds	Omnivores	Near-endemic	fauna
129	Leptocoma Zeylonica	Purple-Rumped Sunbird†	Nectariniidae (Sunbirds)	Birds	Omnivores	Native	fauna
130	Passer Domesticus	House Sparrow†	Passeridae (Old World Sparrows, Snowfinches)	Birds	Omnivores	Native	fauna
131	Passer Moanus	Eurasian Tree Sparrow†	Passeridae (Old World Sparrows, Snowfinches)	Birds	Omnivores	Native	fauna
132	Euodice Malabarica	Indian Silverbill†	Estrildidae (Waxbills, Munias and Allies)	Birds	Omnivores	Native	fauna

133	Lonchura Striata	White-Rumped Munia†	Estrildidae (Waxbills, Munias and Allies)	Birds	Omnivores	Native	fauna
134	Graphium Sarpedon	Common Bluebottle	Papilionidae	Butterflies	Herbivores	Native	fauna
135	Graphium Doston	Common Jay	Papilionidae	Butterflies	Herbivores	Native	fauna
136	Chilasa Clytia	Common Mime	Papilionidae	Butterflies	Herbivores	Native	fauna
137	Papilio Polytes	Common Mormon	Papilionidae	Butterflies	Herbivores	Native	fauna
138	Papilio Helenus	Red Helen	Papilionidae	Butterflies	Herbivores	Native	fauna
139	Papilio Memnon	Great Mormon	Papilionidae	Butterflies	Herbivores	Native	fauna
140	Papilio Demoleus	Lime Butterfly	Papilionidae	Butterflies	Herbivores	Native	fauna
141	Trophaneura Aristolochiae	Common Rose	Papilionidae	Butterflies	Herbivores	Native	fauna
142	Eurema Hecabe	Common Grass Yellow	Pieridae	Butterflies	Herbivores	Native	fauna
143	Catopsilia Pomona	Common Emigrant	Pieridae	Butterflies	Herbivores	Native	fauna
144	Catopsilia Pyranhe	Mottled Emigrant	Pieridae	Butterflies	Herbivores	Native	fauna
145	Pareronia Valeria	Common Wanderer	Pieridae	Butterflies	Herbivores	Native	fauna
146	Pieris Canidia	Indian Cabbage White	Pieridae	Butterflies	Herbivores	Native	fauna
147	Leptosia Nina	Psyche	Pieridae	Butterflies	Herbivores	Native	fauna
148	Hypolycaena Erylus	Common Tit	Family: Lycaenidae	Butterflies	Herbivores	Native	fauna
149	Acytolepis Puspa	Common Hedge Blue	Family: Lycaenidae	Butterflies	Herbivores	Native	fauna
150	Danaus Genutia	Striped Tiger	Nymphalidae	Butterflies	Herbivores	Native	fauna
151	Danaus Chrysippus	Plain Tiger	Nymphalidae	Butterflies	Herbivores	Native	fauna
152	Paradica Aglea	Glassy Tiger	Nymphalidae	Butterflies	Herbivores	Native	fauna
153	Euploea Core	Common Crow	Nymphalidae	Butterflies	Herbivores	Native	fauna
154	Melanitis Leda	Common Evening Brown	Nymphalidae	Butterflies	Herbivores	Native	fauna
155	Ypthima Baldus	Common Five-Ring	Nymphalidae	Butterflies	Herbivores	Native	fauna
156	Ypthima Huebneri	Common Four-Ring	Nymphalidae	Butterflies	Herbivores	Native	fauna
157	Eptis Hylas	Common Sailer	Nymphalidae	Butterflies	Herbivores	Native	fauna
158	Cyrestis Thyodamas	Common Map	Nymphalidae	Butterflies	Herbivores	Native	fauna
159	Junonia Iphita	Chocolate Pansy	Nymphalidae	Butterflies	Herbivores	Native	fauna
160	Junonia Atlites	Grey Pansy	Nymphalidae	Butterflies	Herbivores	Native	fauna
161	Junonia Almana	Peacock Pansy	Nymphalidae	Butterflies	Herbivores	Native	fauna
162	Junonia Lemonias	Lemon Pansy	Nymphalidae	Butterflies	Herbivores	Native	fauna
163	Hypolimnas Bolina	Great Eggfly	Nymphalidae	Butterflies	Herbivores	Native	fauna
164	Tagiades Japetus	Common Snow Flat	Hesperiidae	Butterflies	Herbivores	Native	fauna
165	Borbo Cinnara	Rice Swift	Hesperiidae	Butterflies	Herbivores	Native	fauna
166	Brachydiplax Sobrina	Little Blue Marsh Hawk	Libellulidae†	Dragonflies	Carnivores	Native	fauna
167	Diplacodes Trivialis	Ground Skimmer	Libellulidae†	Dragonflies	Carnivores	Native	fauna
168	Neurothemis Fulvia†	Fulvous Forest Skimmer	Libellulidae†	Dragonflies	Carnivores	Native	fauna
169	Orthetrum Sabina†	Green Marsh Hawk	Libellulidae†	Dragonflies	Carnivores	Native	fauna
170	Ischedulenura Aurora	Golden Dartlet	Libellulidae†	Dragonflies	Carnivores	Native	fauna

171	Epacromia Sps	Banded Grasshopper	Orthoptera	Other-insects	Herbivores	Native	fauna
172	Erthesina Fullo	Stink Bug	Pentatomidae	Other-insects	Herbivores	Native	fauna
173	Eumemes Sps	Potter Wasp	Eumenidae	Other-insects	Insectivores	Native	fauna
174	Humbertiella Ceylonica	Indian Bark Mantis	Hymenoptera	Other-insects	Insectivores	Native	fauna
175	Ictinogomphus Rapax	Common Club Tail	Gomphidae	Other-insects	Insectivores	Native	fauna
176	Ischedulenura Aurora	Golden Dartlet	Coenagrionidae	Other-insects	Insectivores	Native	fauna
177	Ischedulenura Senegalensis	Senegal Golden Darlet	Coenagrionidae	Other-insects	Insectivores	Native	fauna
178	Mylabris Pustulata	Blister Beetle	Meloidae	Other-insects	Nectarivores	Native	fauna
179	Oecophylla Smaragdina	Weavesr Ant	Formicidae	Other-insects	Insectivores	Native	fauna
180	Papilio Demoleus	Common Lime Butterfly	Papilionoidea	Other-insects	Nectarivores	Native	fauna
181	Polistella Sps	Red Paper Wasp	Vespidae	Other-insects	Nectarivores	Native	fauna
182	Telostylinus Sps	True Fly	Neriidae	Other-insects	Nectarivores	Native	fauna
183	Trithemus Festiva	Black Stream Glider	Libellulidae	Other-insects	Insectivores	Native	fauna
184	Xylocopa Auripennis	Carpenter Bee	Apidae	Other-insects	Nectarivores	Native	fauna
185	Hemidactylus Frenatus	Common House Gecko	Geckoidae	Reptiles	Carnivores	Native	fauna
186	Hemidactylus Platyurus	Flat Tailed Gecko	Geckoidae	Reptiles	Carnivores	Native	fauna
187	Hemidactylus Aquilonius	Smooth Scaled House Gecko	Geckoidae	Reptiles	Carnivores	Native	fauna
188	Hemidactylus Garnotii	Garnot'S House Gecko	Geckoidae	Reptiles	Carnivores	Native	fauna
189	Plexippus Paykulli	Pantropical Jumper	Salticidae	Other-insects	Carnivores	Native	fauna
190	Nephila Pilipes	Golden Wood Spider	Salticidae	Other-insects	Carnivores	Native	fauna
191	Copsychus Sacularis	Oriental Magpie Robin	Muscicapidae (Chats, Old World Flycatchers)	Birds	Insectivores	Native	fauna
192	Oxyopes Sp	Lynx Spider	Salticidae	Other-insects	Insectivores	Native	fauna
193	Calotes Irawadi	Garden Lizard	Agamidae	Reptiles	Carnivores	Native	fauna
194	Callosciurus Erythraeus	Pallas'S Squirrel	Sciuridae	Mammals	Omnivores	Native	fauna
195	Minevarya Teraiensis	Cricket Frog	Dicroglossidae	Amphibians	Carnivores	Native	fauna
196	Duttaphrynus Melanostictus	Common Indian Toad	Bufonidae	Amphibians	Insectivores	Native	fauna
197	Polypedates Sp	Tree Frog	Rhacophoridae	Amphibians	Insectivores	Native	fauna
198	Treron Bicinctus	Orange-Breasted Green Pigeon†	Columbidae (Pigeons, Doves)	Birds	Frugivoures	Native	fauna
199	Spilornis Cheela	Crested Serpent Eagle†	Accipitridae (Kites, Hawks, Eagles)	Birds	Carnivores	Native	fauna
200	Naja Kaothia	Monocled Cobra	Elapidae	Reptiles	Carnivores	Native	fauna

Site Photographs

Project site:



Image 1 : Core site



Image 2 : Discussion with the locals

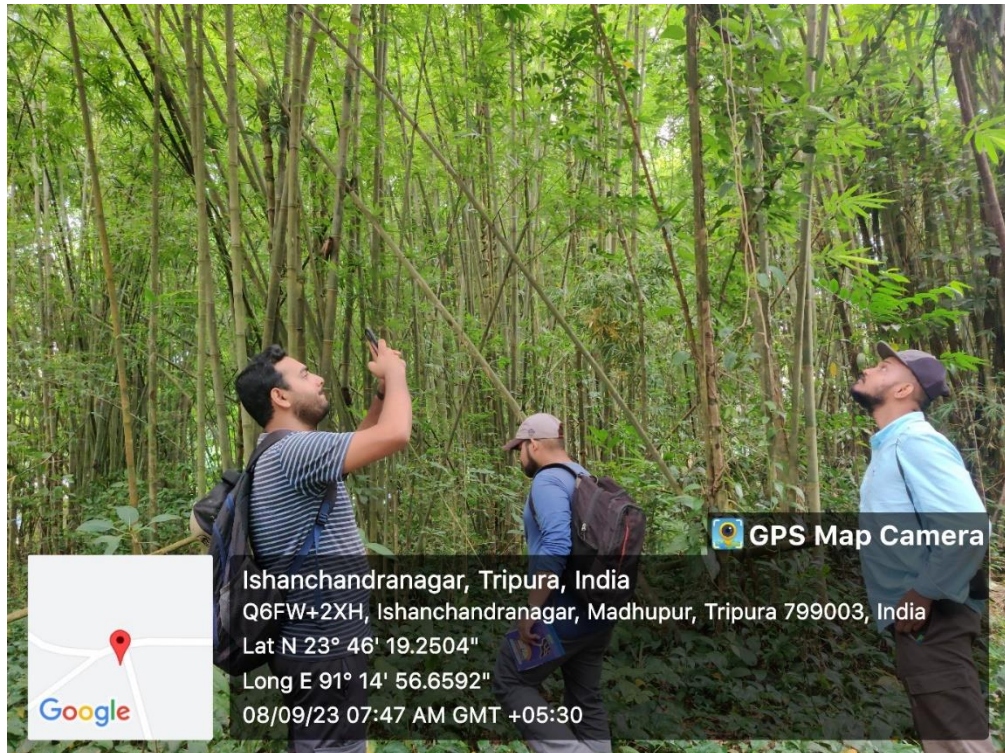


Image 3 : IC Nagar –team working in the Field



Image 4 : Fatikcharra



Image 5 : Bamutia



Image 6 : Jirania



Image 7 : Kandrai charra



Image 8 : Gandhari



Image 9 : Gangacharra



Image 10 : Black hooded oriole

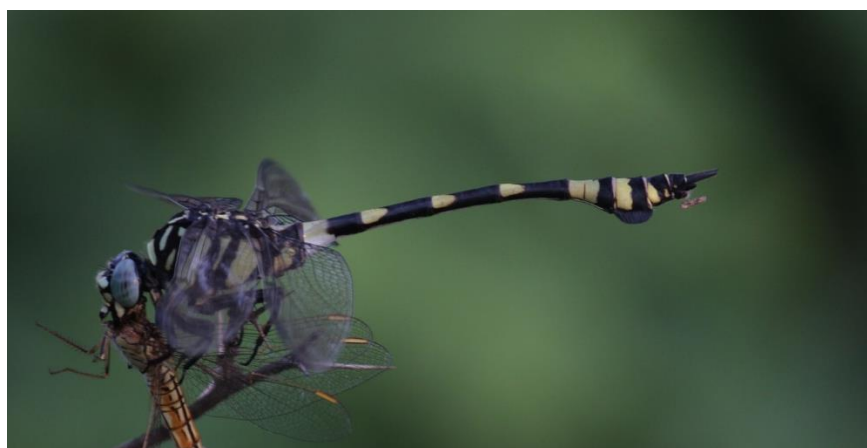


Image 11 : Common clubtail



Image 12 : Lemon pansy



Image 13 : Monocled cobra



Image 14 : Orange skimmer

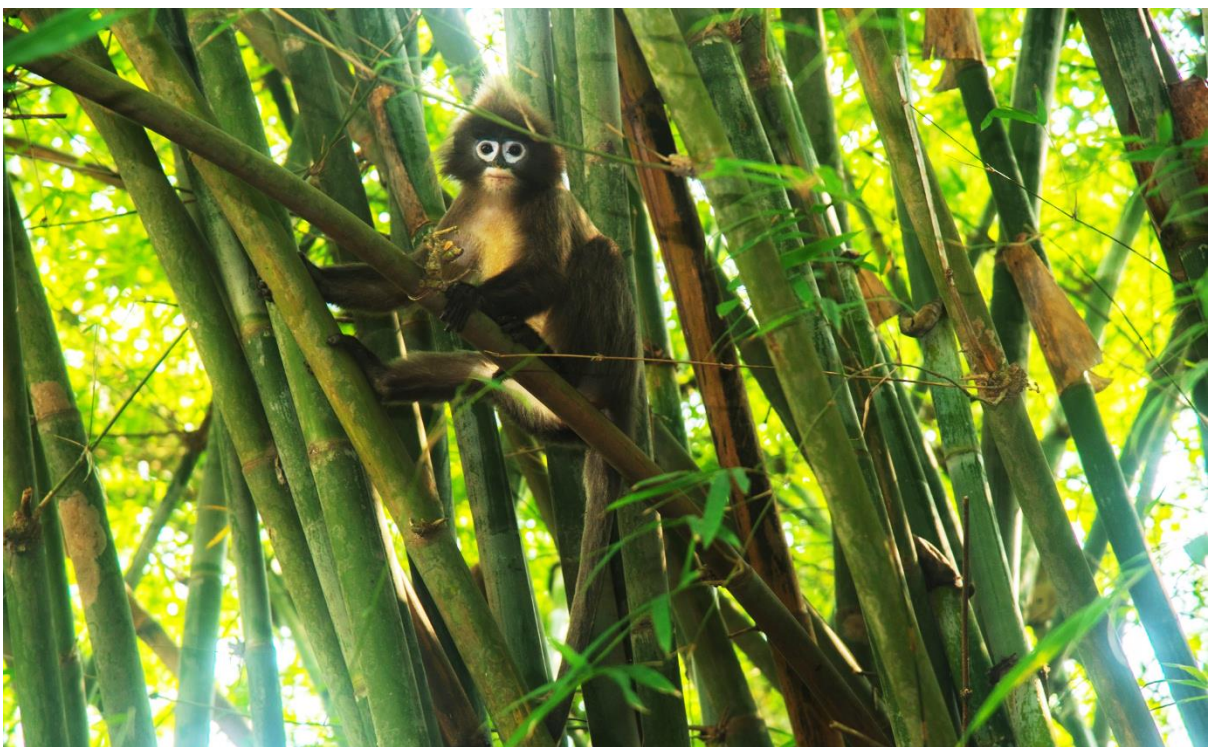


Image 15 : Phayre's Leaf Monkey



Image 16 : Common Picture-wing Dragonfly

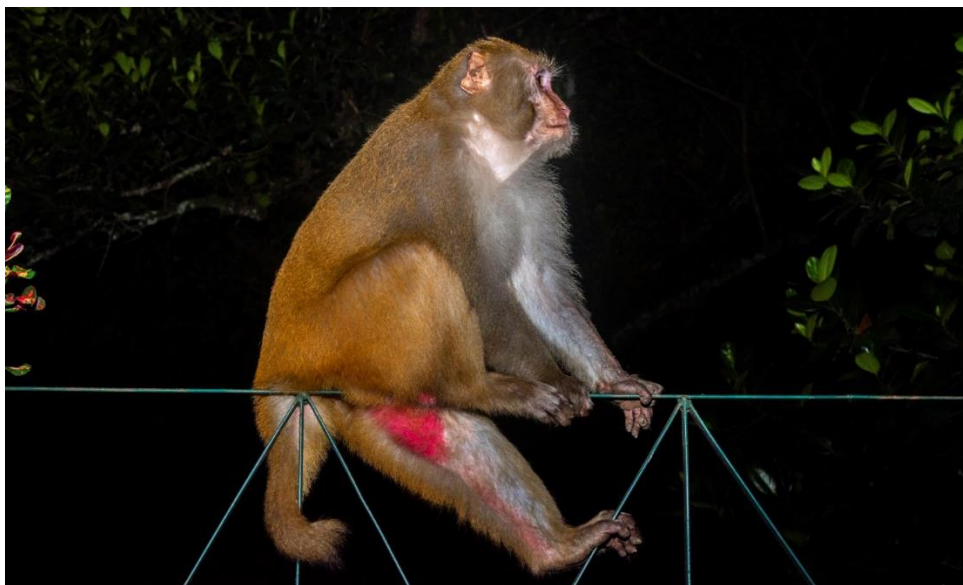


Image 17 : Pig-tailed Macaque



Image 18 : Red-tail Pitviper



Image 19 : Wasp moth mating



Image 20 : Bamboo-tail damselfly



Image 21 : Black-rump flameback



Image 22: Oriental Honey Buzzard



Image 23: Paddyfield dragonfly



Image 24 : Plain tiger butterfly



Image 25 : Praying mantis

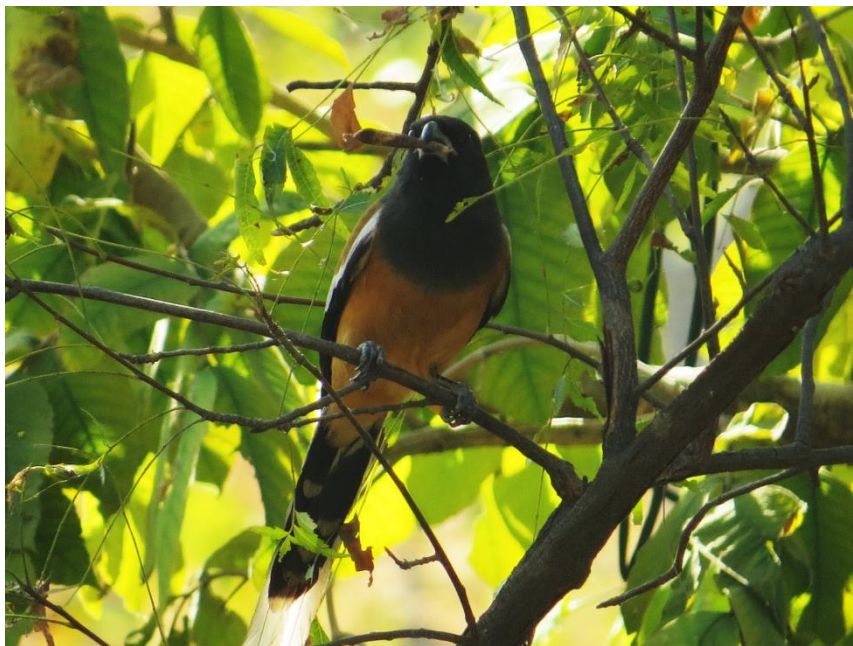


Image 26 : Rufous treepie



Image 27 : Scaly-breasted munia



Image 28 : Pallas's squirrel



Image 29 : White throated kingfisher



Image 30: Signature spider



Image 31 : Trapdoor spider



Image 32 : Polypedates teraiensis (tree frog)



Image 33: Two striped jumper



Image 34 : Tockay gecko



Image 35 : Gymnopetalum chinense



Image 36 : Lagerstroemia speciosa



Image 37 : Luffa cylindrica



Image 38 : *Mussaenda frondosa*



Image 39 : *Phoenix dactylifera*



Image 40 : Psidium guineense (An Endemic Threatened Species of Tripura)

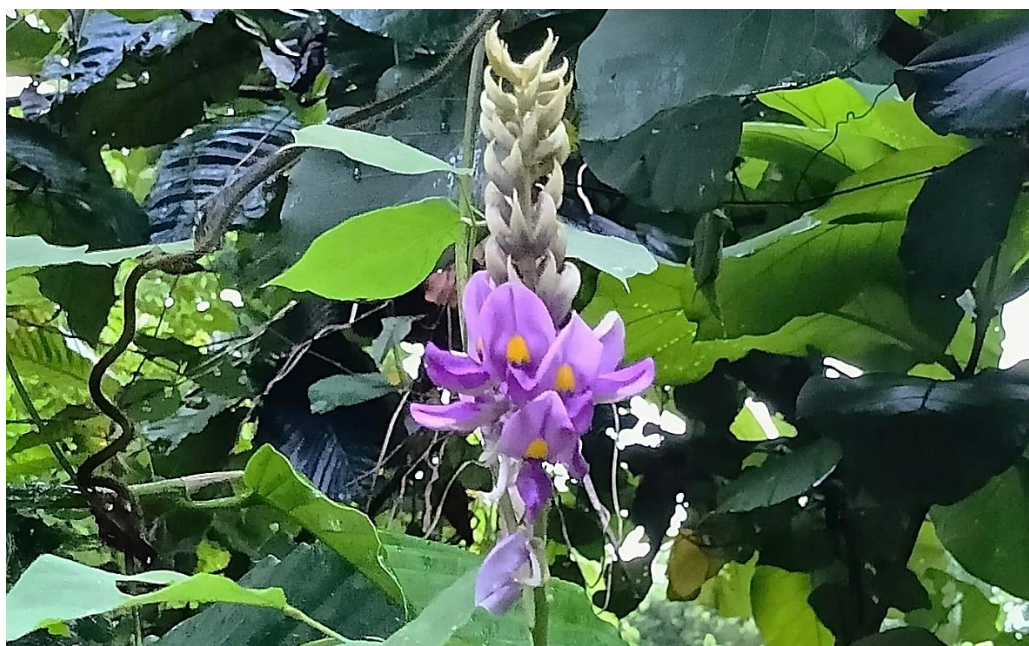


Image 41 : Pueraria montana



Image 42 : Ricinus communis



Image 43 : Schima wallichii



Image 44 : Schima wallichii



Image 45 : Schima wallichii



Image 46 : Mimosa pudica



Image 47 : Ficus hispida

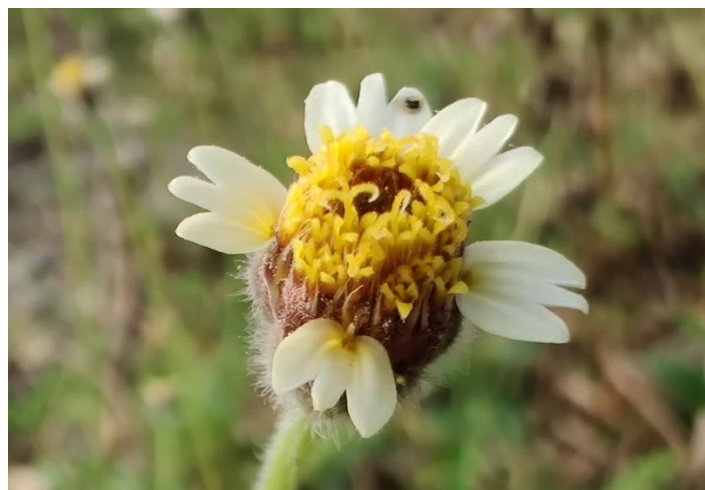


Image 48 : Tridax procumbens

APPENDIX-5

**Strip Chart of Environmental Sensitivity for
linear components (15m both sides of road,
SWD, Water supply & power supply)**

and



**Area-based components (building and other
common facilities centers) within Nagicherra**



IE



Sr. No.	Proposed Structure	Environmental Sensitivity within 15m of Both Sides of Road	Photograph
1	<p>Proposed Structure: - Road No- 01</p> <p>Location: – Nagicherra IE</p> <p>Start Point Lat-Long: - 23°47'26.33"N, 91°20'3.48"E</p> <p>End Point Lat-Long: - 23°47'28.72"N, 91°20'0.55"E</p> <p>Road Length: - 128.83 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 is no significant protected forest, Wildlife sanctuary located 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 and Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located approximately 100 meters from the proposed road. • There are no existing culverts that cross the proposed road no-01. • The Terrain is Undulating. 	
2	<p>Proposed Structure: - Road No- 02</p> <p>Location: – Nagicherra IE</p> <p>Start Point Lat-Long: - 23°47'20.38"N, 91°20'3.37"E</p> <p>End Point Lat-Long: - 23°47'30.69"N, 91°20'3.46"E</p> <p>Road Length: - 532.90 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 is no significant protected forest, Wildlife sanctuary located 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 and Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located approximately 100 meters from the proposed road. • There is no existing culverts that cross the proposed road no-02. • The Terrain is Undulating 	


Sr. No.	Proposed Structure	Environmental Sensitivity within 15m of Both Sides of Road	Photograph
3	<p>Proposed Structure: - Road No- 03 Location: – Nagicherra IE</p> <p>Start Point Lat-Long: - 23°47'23.17"N, 91°20'5.64"E End Point Lat-Long: - 23°47'29.97"N, 91°20'6.75"E Road Length: - 608.70 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 is no significant protected forest, Wildlife sanctuary located 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 and Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located approximately 100 meters from the proposed road. • There are no existing culverts that cross the proposed road no-03.The Terrain is Undulating. 	
4	<p>Proposed Structure: - Road No- 04 Location: – Nagicherra IE</p> <p>Start Point Lat-Long: - 23°47'24.08"N, 91°20'0.68"E End Point Lat-Long: - 23°47'24.99"N, 91°19'57.67"E Road Length: - 91.41 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 is no significant protected forest, Wildlife sanctuary located 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 and Left) during the construction phase. • There is no natural drainage channel that crosses the proposed road. • There is no pond located approximately 100 meters from the proposed road. • There are no existing culverts that cross the proposed road no-04, the Terrain is Undulating. 	



Environmental sensitivity status for area-based (500mt radius) components proposed within Nagicherra IE



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
1	<p>Section: - Water Supply Name of Proposed Infrastructure: - Utility Plot (U-1) for Water Supply Location: – Nagicherra Lat-Long: - 23°47'18.41"N, 91°19'57.96"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.350-meter distance from proposed site. • The Terrain is Lowline Area. 	
2	<p>Section: - Water Supply Name of Proposed Infrastructure: - Utility Plot (U-2) for Water Supply Location: – Nagicherra Lat-Long: - 23°47'31.46"N, 91°20'6.74"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is Lowline Area. 	


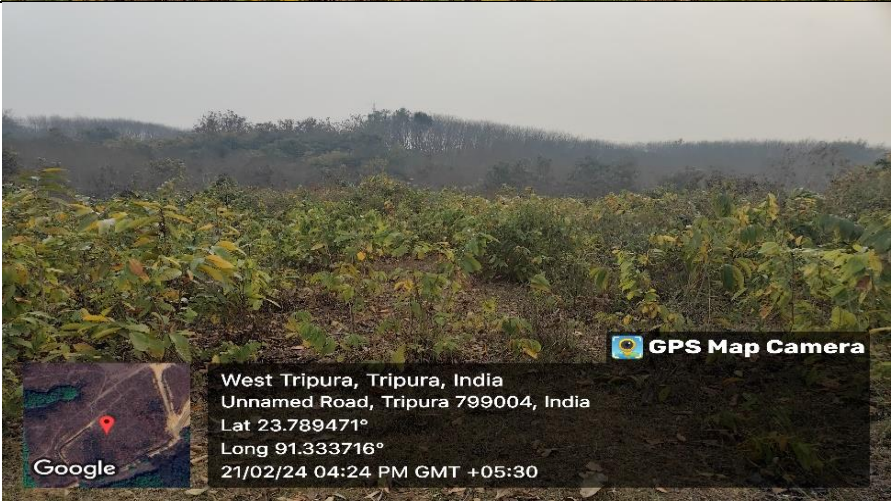
Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
3	<p>Section: - Water Supply</p> <p>Name of Proposed Infrastructure: - Utility Plot (U-3) for Water Supply</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'25.91"N, 91°20'7.51"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.350-meter distance from proposed site. • The Terrain is Lowline Area. 	
4	<p>Section: - Water Supply</p> <p>Name of Proposed Infrastructure: - Utility Plot (U-4) for Water Supply</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'25.66"N, 91°20'1.97"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is Lowline Area. 	 <p>GPS Map Camera</p> <p>Madhuban, Tripura, India Q7JR+WHV TIDC Ind Area, Dukli, Madhuban, Tripura 799003, India Lat 23.781116° Long 91.291947° 21/02/24 03:56 PM GMT +05:30</p>



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
5	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Utility Plot (U-5) for Water Supply</p> <p>Location: - Nagicherra</p> <p>Lat-Long: - 23°47'24.62"N, 91°19'54.38"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.200-meter distance from proposed site. • The Terrain is Lowline Area. 	 <p>GPS Map Camera</p> <p>Madhuban, Tripura, India Q7JR+WHV TIDC Ind Area, Dukli, Madhuban, Tripura 799003, India Lat 23.781116° Long 91.291947° 21/02/24 03:56 PM GMT +05:30</p>
6	<p>Section: - Water Supply</p> <p>Name of Proposed Infrastructure: - Proposed Over Head Tank (OHT) with Pumping Station.</p> <p>Lat-Long: - 23°47'31.46"N, 91°20'6.74"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is Lowline Area. 	 <p>Water Supply & Pump House</p>



SI.No.	Proposed Structure	Environmental Sensitivity	Photograph																					
7	Section: - Water Supply Name of Proposed Structure: - Water Treatment Plant-IRP, CWR and Pumping Station Lat-Long: - 23°47'31.46"N, 91°20'6.74"E	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed plot. • There is no major habitation surrounded by the proposed plot. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed plot. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is Lowline Area. 																						
8	Section: - Water Supply Name of Proposed Structure: - Distribution Network Location: - Nagicherra IE.	<table border="1"> <thead> <tr> <th>HDPE OD (mm)</th> <th>Pipe dia (mm)</th> <th>HDPE Length (m)</th> </tr> </thead> <tbody> <tr> <td>63</td> <td>52.4</td> <td>94</td> </tr> <tr> <td>75</td> <td>62.4</td> <td>364</td> </tr> <tr> <td>110</td> <td>92</td> <td>56</td> </tr> <tr> <td>160</td> <td>133.8</td> <td>872</td> </tr> <tr> <td>200</td> <td>167.4</td> <td>78</td> </tr> <tr> <td colspan="2">All Diameters</td> <td>1,38</td> </tr> </tbody> </table>	HDPE OD (mm)	Pipe dia (mm)	HDPE Length (m)	63	52.4	94	75	62.4	364	110	92	56	160	133.8	872	200	167.4	78	All Diameters		1,38	
HDPE OD (mm)	Pipe dia (mm)	HDPE Length (m)																						
63	52.4	94																						
75	62.4	364																						
110	92	56																						
160	133.8	872																						
200	167.4	78																						
All Diameters		1,38																						



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
9	<p>Section: - Electrical & Power Supply</p> <p>Name of Proposed Structure: - Installation of 10 kw Solar Plant. (1x10 kw.)</p> <p>Location: – Proposed Solar Plant South-East Direction of Industrial Estate.</p> <p>Lat-Long: - 23°47'21.95"N, 91°19'57.52"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. 	
10	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Common Facilitation Centre (CFC)</p> <p>(i)Administrative Offices: (ii) Creche: (iii) Dispensary: (iv) Canteen: (v) Miscellaneous:</p> <p>Location: – Nagicherra</p> <p>Lat-Long: -</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.200-meter distance from proposed site. • The Terrain is Lowline Area. 	



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
	23°47'24.53"N, 91°20'9.29"E		
11	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Working Women Hostel</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'28.64"N, 91°20'8.86"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.50-meter distance from proposed site. • The Terrain is Lowline Area. 	
12	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Staff Quarters</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'26.10"N, 91°20'1.10"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is undulating Area. 	



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
13	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Shopping Complex</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'24.53"N, 91°20'9.29"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.200-meter distance from proposed site. • The Terrain is Lowline Area. 	 <p>GPS Map Camera</p> <p>West Tripura, Tripura, India Unnamd Road, Tripura 799004, India Lat 23.789464° Long 91.333144° 21/02/24 04:21 PM GMT +05:30</p>
14	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Commercial Centre 11 nos. G+1 Industrial Shed</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'27.87"N, 91°20'6.86"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.100-meter distance from proposed site. • The Terrain is Undulating. 	 <p>GPS Map Camera</p> <p>West Tripura, Tripura, India Unnamd Road, Tripura 799004, India Lat 23.789471° Long 91.333716° 21/02/24 04:24 PM GMT +05:30</p>



Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
15	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Commercial Centre Warehouse</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'19.33"N, 91°19'58.40"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.225-meter distance from proposed site. • The Terrain is Undulating. 	
16	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Commercial Centre 02 nos. of Parking Truck Parking-1</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'21.39"N, 91°20'4.30"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.350-meter distance from proposed site. • The Terrain is Lowline Area. 	

Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
17	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Commercial Centre 02 nos. of Parking Truck Parking-2</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'23.72"N, 91°19'59.71"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.175-meter distance from proposed site. • The Terrain is Lowline Area. 	
18	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Commercial Centre Weigh Bridge & Food Kiosk and Truck Parking</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'21.36"N, 91°20'3.50"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. 	

Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
19	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Bust shelter</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'21.36"N, 91°20'3.50"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. 	
20	<p>Section: - Social Infrastructure and Common Facilities</p> <p>Name of Proposed Structure: - Public Toilets</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'25.03"N, 91°20'9.40"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.200-meter distance from proposed site. • The Terrain is Lowline Area. 	 <p>GPS Map Camera</p> <p>Madhuban, Tripura, India Q7JR+WHV TIDC Ind Area, Dukli, Madhuban, Tripura 799003, India Lat 23.781116° Long 91.291947° 21/02/24 03:56 PM GMT +05:30</p>

Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
21	<p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Entrance Gate</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'20.15"N, 91°20'3.48"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. 	
22	<p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Boundary Wall</p> <p>Location: – Nagicherra</p> <p>Length: - 2.5 km</p> <p>Lat-Long: - 23°47'25.48"N, 91°19'56.40"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. • Boundary wall to be proposed total 2.5 km 	

Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
23	<p>Section: - Industrial Safety and Security</p> <p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Watch Tower-1</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'20.15"N, 91°20'3.48"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building which having surrounded from proposed site. • There is no major habitation nearby this location. • There is no significant protected forest in and around the project area and Wildlife sanctuary. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.250-meter distance from proposed site. • The Terrain is Undulating. 	
24	<p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Watch Tower-2</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'23.72"N, 91°19'59.71"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.175-meter distance from proposed site. • The Terrain is Lowline Area. 	

Sl.No.	Proposed Structure	Environmental Sensitivity	Photograph
25	<p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Watch Tower-3</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'31.46"N, 91°20'6.74"E</p>	<ul style="list-style-type: none"> • There is no Educational Institutional Building surrounded by proposed site. • There is no major habitation surrounded by the proposed site. • There is no significant protected forest, Wildlife sanctuary located in and around the proposed site. • There is no religious infrastructure nearby Proposed site. (Mandir/masjid/Church/etc). • There are no trees proposed to be cut during the construction phase. • One natural water body which having approx.150-meter distance from proposed site. • The Terrain is Lowline Area. 	
26	<p>Section: - Industrial Safety and Security</p> <p>Name of Proposed Structure: - Industrial Safety and Security CCTV Control Room</p> <p>Location: – Nagicherra</p> <p>Lat-Long: - 23°47'20.15"N, 91°20'3.48"E</p>	<ul style="list-style-type: none"> • CCTV Control Room • PTZ and fixed IP cameras, qty is 90 Nos (BW-26 Nos) approx. • CCTV cameras will be used to monitor boundary walls, roads/junctions, buildings, SWM/water supply/wastewater and electrical substations UPS backup for control room and field components. • Fire & Safety Systems for all buildings and control rooms • Separate OFC backbone for Safety & Security Systems 	

APPENDIX-6

**LIST OF SPECIES FOR BIO-ENGINEERING
INTERVENTION, CONSERVATION &
RESTORATION WITHIN NAGICHERRA IE**

LIST OF SPECIES FOR BIO-ENGINEERING INTERVENTION, CONSERVATION & RESTORATION WITHIN NAGICHERRA IE

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	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 elephantapple	Dilleniaceae	Tree	Native	Hilltop/slope
19	<i>Holigarna arnottiana</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 balcoa</i>	barak bamboo	Poaceae	Herb	Native	plains

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

APPENDIX-7

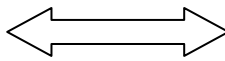
Disaster Management and Emergency Response Plan for Infrastructure Development Construction Phase at Nagicherra Industrial Estate

DISASTER MANAGEMENT & EMERGENCY RESPONSE PLAN				At Nagicherra 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

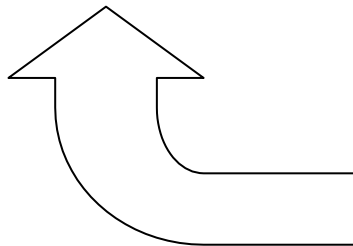
IN CASE OF EMERGENCY PLEASE CONTACT



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 Sector Development Program (SDP).

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 Infrastructure Works (Roads, SWD, Water Supply, Industrial Safety and Security, Land Development and Landscaping)

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 2 locations, once a quarter (09 samples) of two sector/Component	Nos.	9	7,129.02	64,161.18
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 2 locations, once a quarter (09 samples) of two sector/Component	Nos.	9	10,693.53	96,241.77
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 2 locations, once a quarter (09 samples) of two sector/Component	Nos.	9	4,277.41	38,496.69
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 2 locations, once a quarter (09 samples) of two sector/Component	Nos.	9	12,119.33	109,073.97
Total (A)					307,973.61
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 four 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)					650,166.51

Table-2: Building Works - CFC Building, Toilet Blocks, Fire Station, Security Cabin, Driver's Rest Room, Warehouse)

Sl. No.	Description of Items of Work	Unit	Qty.	Final (in INR)	Amount (in INR)
A	Construction phase-24 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-24 months of 4 locations, once a quarter (24 samples) of four sector/Component	Nos.	24	7,129.02	171,096.48
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-24 months of 4 locations, once a quarter (24 samples) of four sector/Component	Nos.	24	10,693.53	256,644.72
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-24 months of 4 locations, once a quarter (24 samples) of four sector/Component	Nos.	24	4,277.41	102,657.84
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-24 months of 4 locations, once a quarter 24 samples) of four sector/Component	Nos.	24	12,119.33	290,863.92
Total (A)					821,262.96
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 2 locations, once in 6 months (20 samples) of four sector/Component of four sector/Component	Nos.	20	7,129.02	142,580.40
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 2 locations, once in 6 months (20 samples) of four sector/Component	Nos.	20	10,693.53	213,870.60
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 2 locations, once in 6 months (20 samples) of four sector/Component	Nos.	20	4,277.41	85,548.20
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 2 locations, once in 6 months (20 samples) of four sector/Component	Nos.	20	12,119.33	242,386.60
Total (B)					684,385.80
Total Cost (A + B)					1,505,648.76

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 2 locations, once a quarter (15 samples) of two sector/Component	Nos.	15	7,129.02	106,935.30
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 2 locations, once a quarter (15 samples) of two sector/Component	Nos.	15	10,693.53	160,402.95
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 2 locations, once a quarter (15 samples) of two sector/Component	Nos.	15	4,277.41	64,161.15
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 2 locations, once a quarter (15 samples) of two sector/Component	Nos.	15	12,119.33	181,789.95
Total (A)					513,289.35
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 four 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)					855,482.25

APPENDIX-11

**Format for Environmental Monitoring Report
(Monthly/ Quarterly/ 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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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