DRAFT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Upgradation of Rongsai Borjhora Bajengdoba (RBB) Road from Single to Intermediate Lane

Meghalaya Logistics and Connectivity Improvement Project (MLCIP)

Submitted
to

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Disclaimer: The is a draft version and is being reviewed by the World Bank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ASI	:	Archaeological Survey of India
BIS	:	Bureau of Indian Standards
BMC	:	Biodiversity Management Committee
CESMP	:	Contractor's Environmental and Social Management Plan
CGWB	:	Central Ground Water Board
CoI	:	Corridor of Impact
CPR	:	Common Property Resources
CTE/CTO	:	Consent To Establish/Consent to Operate
CW	:	Carriageway
DG	:	Diesel Generator
DPR	:	Detailed Project Report
E&S	:	Environment and Social
EHS	:	Environment Health and Safety
EIA	:	Environmental Impact Assessment
ESF	:	Environmental and Social Framework
ESIA	:	Environmental and Social Impact Assessment
ESMP	:	Environmental and Social Management Plan
E&S Cell	:	Environment& Social Cell
ESMF	:	Environmental and Social Management Framework
ESS	:	Environmental and Social Standards
ESZ	:	Eco-Sensitive Zone
FPIC	:	Free, Prior, and Informed Consent
GBV	:	Gender-Based Violence
GIS	:	Geographic Information System
GoM	:	Government of Meghalaya
GRM	:	Grievance Redress Mechanism
GHADC		Garo Hills Autonomous District Council
HIV	:	Human Immunodeficiency Virus
IBA	:	Important Bird Area
IBAT	:	Integrated Biodiversity Assessment Tool
IEC	:	Information, Education, and Communication
IFC	:	International Finance Corporation
IRC	:	Indian Road Congress
ISFR	:	India State of Forest Report
IUCN	:	The International Union for Conservation of Nature
KBA	:	Key Biodiversity Area
LHS	:	Left Hand Side
LULC	:	Land Use Land Cover
MDR/ SH	:	Major District Roads/State Highways
MoEF&CC	:	Ministry of Environment, Forest and Climate Change
MLCIP	:	Meghalaya Logistics and Connectivity Improvement Project

MSPCB	:	Meghalaya State Pollution Control Board
MSDMA	:	Meghalaya State Disaster Management Authority
NATMO	:	National Atlas and Thematic Mapping Organization
NBSAP	:	National Biodiversity Strategy and Action Plan
NGO	:	Non-Governmental Organization
NH	:	National Highway
NOC	:	No Objection Certificate
NO_x	:	Oxides of Nitrogen
NTFP	:	Non-timber forest product
OF	:	Open Forest
OHS	:	Occupational Health and Safety
OIP	:	Other Interested Parties
PAP	:	Project Affected Person
PESO	:	Petroleum and Explosives Safety Organization
PIA	:	Project Influence Area
PM	:	Particulate Matter
POSH	:	Prevention of Sexual Harassment
PPE	:	Personal Protective Equipment
PUC	:	Pollution Under Control
PWD	:	Public Works Department
R&R	:	Resettlement and Rehabilitation
RAP	:	Resettlement Action Plans
RF	:	Reserve Forest
RFCTLARR	:	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013
RHS	:	Right Hand Side
RoW	:	Right of Way
SBB	:	State Biodiversity Board
SEA	:	Sexual Exploitation and Abuse
SEIAA	:	State Environment Impact Assessment Authority
SEP	:	Stakeholder Engagement Plan
SH	:	Sexual Harassment
SIA	:	Social Impact Assessment
SOP	:	Standard Operating Procedures
ST	:	Scheduled Tribes
SC	:	Scheduled Caste
TSG	:	Technical Support Group
WB	:	World Bank
WHO	:	World Health Organization
WPA, 1972	:	Wildlife Protection Act, 1972
WPA, 2022	:	Wild Life (Protection) Amendment Act, 2022

EXECUTIVE SUMMARY

E.1 INTRODUCTION

MLCIP includes 10 Roads and 6 Bridges totaling to approximately 300 km respectively. This ESIA is for Sub Project RBB has a total length of 18.27 km, commencing from Kosi Junction at chainage 00+000 and terminating at Bajengdoba at chainage 18+270..

The additional land required for the proposed road improvement is approximately 0.133 Ha and for spoil disposal 1.142 ha. Details of land requirement is given in is given in Table 3.16.

The sub-project would include reconstruction and upgradation of the existing pavement from a single lane carriageway to intermediate lane. It also includes climate-resilient design measures based on vulnerability assessment considering Meghalaya's high rainfall conditions. Drainage capacity has been improved through enlarged culverts, additional cross-drainage structures, and properly graded roadside drains to prevent flooding and waterlogging. Slope protection measures such as retaining walls, turfing, and bio-engineering using local grasses have been proposed to control erosion and landslides. Durable pavement layers (CTB/CTSB) and paved shoulders, along with safety features, ensure an all-weather, resilient and safe road infrastructure.

E.2 PROJECT DESCRIPTION AND NEED

The project is designed to improve road infrastructure with additional land acquisition at certain stretches and about 0.35 ha land is required for spoil disposal. The intervention includes pavement strengthening, drainage improvement, slope stabilization, and safety enhancements. The road serves as a vital link connecting villages and economic centers, thereby improving mobility and reducing travel time and costs.

E.3 BASELINE ENVIRONMENTAL CONDITIONS

The project area experiences high rainfall and humid climatic conditions, making it prone to erosion, drainage congestion, and slope instability. The terrain is characterized by undulating topography with soil types vulnerable to erosion. Surface water bodies, streams, and riverbanks are present along the alignment, playing an important role in local hydrology and community use.

Air and noise quality in the region are generally within acceptable limits due to low industrial activity. The biological environment includes local vegetation and fauna typical of the Garo Hills, with no critical habitats significantly impacted by the project. The area also falls under a high seismic zone (Zone V), indicating vulnerability to natural hazards.

E.4 SOCIO-ECONOMIC PROFILE

The project area is predominantly inhabited by tribal communities governed under the Sixth Schedule, with strong traditional institutions like Nokmas managing land and resources. Livelihoods are mainly dependent on agriculture, small businesses, and daily wage activities. The project affects a number of households (156 PAHs), with 419 PAPS with minor impacts on livelihoods and structures.

Consultations revealed key community concerns such as poor road conditions, flooding during monsoon, lack of drainage, and safety issues. Communities generally supported the project, expecting improved connectivity and economy. The proposed 18.27 km RBB road sub-project has been designed to minimize land acquisition and associated social impacts while improving connectivity. About 13.163 km of the road will be upgraded within the existing 12 m Right of Way (RoW), and only 0.133 ha of additional land will be required over 5.163 km for minor widening, drainage, and safety features. This additional land affects 6 Project Affected Households (PAHs) and involves partial loss of agricultural land impacting 26 PAPs, though the land is currently not in use. Importantly, no

residential or commercial structures are affected, and no physical displacement is anticipated. Community infrastructure proposed under FPIC will also be accommodated within the existing RoW.

The project will temporarily require 1.142 ha of land for spoil disposal, identified across 9 locations in consultation with PWD officials and local communities, including the Nokma. These sites will be restored and returned to landowners after construction. In total, 156 PAHs comprising 419 PAPs will be affected, with impacts being largely minor, partial, and localized. A significant portion includes 102 households (249 PAPs) operating informal roadside kiosks (non-title holders), who will need to relocate outside the RoW. While this will temporarily disrupt their business locations and income, they are expected to resume similar livelihood activities nearby, with no permanent livelihood loss anticipated.

A 30-day advance notice will be provided to affected persons for relocation, and impacts will be managed through compensation, livelihood assistance, and provisions outlined in the Resettlement Action Plan (RAP). Overall, the project does not involve physical displacement and is expected to have manageable social impacts, primarily limited to relocation of informal activities and minor land loss, which will be mitigated through appropriate planning and community engagement benefits.

E.5 KEY ENVIRONMENTAL AND SOCIAL IMPACTS

During the **construction phase**, potential impacts include:

- Soil erosion and slope instability due to earthwork
- Air and noise pollution from construction activities
- Water contamination from runoff and waste
- Temporary disruption to local traffic and community access
- Occupational health and safety risks for workers

During the **operation phase**, impacts are relatively limited but may include:

- Increased vehicular emissions and noise
- Road safety concerns due to higher traffic speed
- Risk of erosion if drainage and slope protection are not maintained

TableE.1 : ESIA Observation and Compliance

Sr. No.	Observation of RBB Road	Compliance / Proposal in DPR
1	Drains with footpath and railing required at Kosi Bazaar (Chainage 0.00 Km).	From Km 0+000 to Km 0+250, footpath-cum-drain has been provided.
2	Road submerged at Km 0.600; embankment to be raised with new culvert. Toe walls required to protect paddy fields. Footpath.	FRL raised by 1.0 m at Km 0+600. Toe wall proposed from Km 0+610 to Km 0+670.
3	Drains with footpath required at Omon Bazaar (Km 1.30).	Footpath-cum-drain provided from Km 1+280 to Km 1+660. Bus Shed (RHS) proposed for repair at Km 1+400.
4	Road between Km 1.20–1.30 submerged during heavy rains; level to be raised with culvert.	FRL raised at Km 1+200. New Box Culvert proposed at Km 1+310.
5	Toe walls required at Km 1.80 due to paddy fields and road expansion.	As per design, toe wall not required.

6	Retaining walls required at Km 2.90 and 3.20 to protect houses.	As per design, retaining wall not required.
7	Drains with footpath required at Kristo Jyoti HSS and Govt. LP School (Km 3.50). Zebra crossings, speed calming, cycle parking, separate toilets required.	Zebra crossings and speed calming measures proposed.
8	Cross drainage works required at Km 4.10 with protection works.	New Pipe Culvert proposed at Km 4+150. Gabion Wall proposed from Km 3+990 to Km 4+090.
9	At Mansinggre locality (Km 5.40–7.60), toe walls along paddy fields and uphill protection works required.	435 m protection works proposed between Km 5+400 to Km 7+600.
10	Retaining wall required at Km 12.50.	Gabion Wall proposed from Km 12+430 to Km 12+490.
11	610 m approach road required to Waramgre village (Km 17.60).	Zebra crossings and speed calming measures proposed
12	In 17+020 to 17+600 Elephant corridor and Community vegetation falls under this location.	The Existing Blacktop wil be maintained only with no further improvement. speed restrictions (rumble strips/table-top crossing), signages and timed movement restrictions at night, if necessary, to ensure safe passage and reduce human–elephant conflict. Installation of AI-based camera systems (as per RDSO specifications, RDSO/SPN/TC/65/2021) along identified elephant movement zones to continuously monitor and detect elephant presence. TCS 6 is designed for the Elephant crossings.

E.6 MITIGATION MEASURES AND DESIGN INTERVENTIONS

To address these impacts, several mitigation measures have been integrated into the project design:

- **Erosion control measures** such as toe walls, gabion walls, stone pitching, and river training works at vulnerable chainages
- **Improved drainage systems** to prevent waterlogging and flooding
- **Slope stabilization techniques** including bio-engineering methods like turfing and vegetation
- **Climate-resilient pavement design** with durable materials and stress-absorbing layers
- **Safety measures** including curve improvements, junction design, and traffic calming features

Environmental management during construction will include dust suppression, proper waste management, noise control, and water protection measures.

E.7 SOCIAL SAFEGUARDS AND COMMUNITY ENGAGEMENT

The project follows the World Bank Environmental and Social Framework (ESF), ensuring compliance with national regulations and international standards. Free, Prior, and Informed Consent (FPIC) has been undertaken to engage tribal communities and incorporate their feedback into project design.

A Resettlement Action Plan (RAP) and Indigenous Peoples Development Plan (IPDP) have been prepared to address impacts on affected households and ensure fair compensation and livelihood restoration. A Grievance Redress Mechanism (GRM) is also established to address community concerns effectively.

E.8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The ESMP outlines mitigation measures, monitoring requirements, institutional responsibilities, and budget allocation. It includes:

- Environmental monitoring (air, water, noise, soil)
- Social monitoring (livelihood restoration, community safety)
- Occupational health and safety measures
- Capacity building for implementing agencies

ESMP Budget is INR 56, 20, 000.

E.9 STAKEHOLDER CONSULTATIONS

Stakeholder consultations for the RBB Road sub-project were conducted at multiple locations between 21 August 2025 and 10 December 2025, involving government agencies, local communities, and vulnerable groups. Initial consultations were held with forest authorities in East & North Garo Hills, including the Divisional Forest Officer (21 August 2025; 4 participants), Forest Ranger Office (23 August 2025; 3 participants), and PCCF, Shillong (28 August 2025; 4 participants). These discussions highlighted that the road alignment passes through community vegetation and active elephant movement corridors, raising concerns regarding habitat disturbance, need for forest clearances, and mitigation of human–wildlife conflict through appropriate safety and conservation measures.

Community-level consultations were conducted with local residents (23 August 2025; 6 participants, including 1 female), who emphasized that the poor road condition is severely affecting daily commuting, children's access to education, and overall road safety. Consultations with street vendors (16 September 2025; 20 participants, 12 male and 8 female) indicated strong support for road improvement to enhance accessibility and business opportunities. A meeting with the Village Nokma (16 September 2025; 1 participant) highlighted public health concerns, particularly the prevalence of waterborne diseases due to inadequate water supply and sanitation.

Focused discussions were also held with youth groups (15 & 23 September 2025; 13 participants, 8 male and 5 female) and women groups from Laitsohum, Mawrapad, and Mawkasai (19 & 25 September 2025; 10 participants). Youth participants raised issues of limited employment opportunities, skill gaps, and migration risks, while women highlighted constraints related to mobility, lack of childcare support, and limited awareness of government schemes, expressing interest in local enterprise and cooperative development.

Further, Free, Prior, and Informed Consent (FPIC) consultations were conducted with community members and Project Affected Households on 09, 19, and 25 September, and 10 December 2025, covering 4 consultations with a total of 148 participants (127 male and 21 female). During these consultations, the community expressed broad support for the project, subject to inclusion of key provisions such as upgradation to intermediate lane standards, construction of drainage and safety features in habitation areas, provision of passenger waiting sheds, development of footpath-cum-drains, and installation of separate sanitation facilities.

Overall, the consultations demonstrate strong stakeholder acceptance of the project, with clear expectations for improved connectivity, enhanced safety, environmental safeguards, and inclusion of community-specific infrastructure and livelihood considerations.

E.10 CONCLUSION

The proposed upgradation of the RBB road is a strategically important infrastructure intervention that will significantly enhance regional connectivity, accessibility, and socio-economic development in North Garo Hills. The ESIA indicates that while the project traverses environmentally sensitive areas, including submergence-prone stretches, erosion-prone hilly terrain, and an identified elephant movement corridor, the anticipated environmental impacts are site-specific, largely temporary, and manageable through appropriate design and mitigation measures.

Key environmental concerns such as drainage congestion, slope instability, vegetation loss, and potential wildlife disturbance have been addressed through climate-resilient engineering solutions, including improved drainage systems, slope protection works, bio-engineering measures, and wildlife safety interventions. With the implementation of the Environmental and Social Management Plan (ESMP), impacts related to air, noise, soil, and water during construction will be effectively controlled, while long-term benefits such as reduced erosion, improved road durability, and safer movement are expected.

From a social perspective, the project involves no physical displacement and only minor, localized impacts, primarily related to temporary relocation of informal roadside livelihoods and limited acquisition of non-productive land. A total of 156 Project Affected Households (PAHs) will be impacted, with mitigation measures outlined in the Resettlement Action Plan (RAP), including compensation, livelihood restoration, and advance notice for relocation. The project has received broad community support through FPIC consultations, with incorporation of community-prioritized features such as drainage, safety measures, and basic amenities.

Overall, the project is assessed to be environmentally sustainable and socially acceptable, consistent with the World Bank Environmental and Social Framework (ESF). The identified risks particularly related to hydrology, geotechnical stability, and biodiversity are adequately addressed through chainage-specific mitigation and robust management measures.

With effective implementation, monitoring, and stakeholder engagement, the project is expected to deliver long-term, climate-resilient, and inclusive development benefits, while maintaining environmental integrity and social equity.

1. INTRODUCTION

1.1 BACKGROUND

The Meghalaya Logistics and Connectivity Improvement Project (MLCIP), with a total investment of USD 300 million comprising USD 240 million from the World Bank and USD 60 million from the Government of Meghalaya (hereinafter refer to as the state government) aims to: a) enhance connectivity to key growth centers along identified road corridors; b) improved rural and district-level logistics infrastructure and services; c) provide greater market access and reduced average cost/time for select agriculture and horticulture products; and, d) strengthen institutional capacity for efficient, climate-resilient transport and logistics, West and East Meghalaya. The rehabilitation of the state roads will be carried out in phases.

MLCIP includes 10 Roads and 6 Bridges totaling to approximately 300 km respectively. This ESIA is for Sub Project RBB which has a total length of 18.27 km, commencing from Kosi Junction at chainage 00+000 and terminating at Bajengdoba at chainage 18+270.

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1.2 SCOPE FOR CONDUCTING THE ESIA STUDY

The sub-project is rated as High Risk based on the screening due to significant environmental and social sensitivities along the project corridor such as Elephant Crossings at Chainage 17+020 and 17+600, and community vegetation between Chainage 17+020 to 17+600, and 156 Project Affected Households (PAH), leading to notable livelihood concerns. During the consultations, it was also found that during monsoon, few sections of the road get inundated. Considering these factors, along with the need for climate-resilient measures such as improved drainage, slope protection, and durable pavement design to address high rainfall conditions, the sub-project has been classified as High Risk. [1]Based on this assessment, the scope of the ESIA study was defined, and the following activities were undertaken for the detailed assessment.

- Collection of project information
- Literature review and data compilation
- Baseline environmental and social assessment
- Identification of potential impacts
- Stakeholder identification and consultation:
- Preliminary climate and cumulative impact assessment:

[1] The project has obtained **78.125% as per environmental screening criteria and therefore categorize as High risk**. The social risk is categorized as **Moderate** since the impact on affected households involves **less than 10% loss of assets, including both land and structures**, indicating temporary shifting and manageable livelihood impacts. Hence, the sub-project falls under the **High Risk Category**

- Environmental and Social Management Plan (ESMP) preparation
- Monitoring framework:

1.3 APPROACH AND METHODOLOGY

The methodology adopted for the ESIA complied with the requirements of the World Bank ESF (ESSs), the EIA Notifications of the Ministry of Environment, Forest and Climate Change (MoEF&CC), the Indian Roads Congress (IRC) guidelines, the MoRTH Guidelines, and other national guidelines. The following table summarizes the approach adopted for conducting the ESIA study.

Table 1.1:Approach and methodology adopted for conducting the ESIA

Sl. No.	Stages	Activities Done
1.	Screening and Scoping	Identified key issues through primary and secondary surveys, assessed stakeholders, and analyzed potential impacts considered in the Environmental and Social Impact Assessment, following the Free, Prior, and Informed Consent (FPIC) process to ensure meaningful participation and consent of Indigenous Peoples and affected communities. The Divisional officers, PWD, GoMe also interacted with the concerned DFO to understand the location of forest areas in these stretches.
2.	Public Consultation for Scoping Report	Identified key issues to understand stakeholder concerns and inform sub-project design and build awareness on the project including the Free, Prior, and Informed Consent (FPIC) process. This involved engaging with Indigenous Peoples and affected communities through meaningful consultations in a transparent and participatory manner. Consultations were held with the community which include village heads and community members to raise awareness about the project and the need for FPIC. These consultations allowed the community to be briefed on the role of the ESIA consultants and seek permission to meet and discuss the different components of the project activities. During this period, liaison was initiated with the forest Department, GoM to understand the location and boundary of protected areas and the wildlife corridors
3.	Baseline Data Collection	Gathered and reviewed primary and secondary data on environmental and social conditions in and around the sub-project area, including air quality, water resources, biodiversity, cultural heritage, and socio-economic factors. Primary physical monitoring was carried out as per the EIA guidelines. For ecological monitoring, transect walks, quadrat analysis, community consultation were carried out. The Forest Department, GoM, provided the maps demarcating the legally protected forest including “community reserve”. Information was also provided about the Wildlife crossing/ wildlife corridors. Information was also collected for the Forest Department, GoM about the animal kills / collisions on these corridors. In addition to these data collection form secondary sources, primary data on natural environment was also collected. Potential areas of community health safety conflicts were also identified and the design team was informed about these.
4.	Impact Assessment	Using baseline data, the RBB Project road potential impacts on the environment and local communities were assessed, including direct and indirect effects, as well as short-term and long-term impacts. A targeted assessment was carried as a part of ESIA since the sub-project area falls under a Schedule VI region with the presence of tribal communities. The Second round of FPIC consultations were undertaken as part of the impact assessment to ensure meaningful engagement with Indigenous Peoples (IP’s) to further discuss the project design, benefits and impacts, and to provide the communities’ priorities and inputs to drafting of the mitigation plans and measures. During this consultation, IPs’ written consent to proceed with the Project has been recorded through a resolution and countersigned by the participants, with attendance sheets, photos, etc. and

Sl. No.	Stages	Activities Done
		attached as Annexure 7.3.
5.	Mitigation and Management Measures	Based on the impact assessment, measures were proposed to mitigate or minimize adverse environmental and social impacts while enhancing positive outcomes. These included exploring Project Road design alternatives to reduce Involuntary resettlement and environmental degradation, community health safety conflicts etc were carried out. These measures have been integrated in the draft Environmental and Social Management Plan, Resettlement Action Plan, Indigenous People's Development Plan, including project-level Labor Management Procedures, Stakeholder Engagement Plan and SEA/SH Action Plan, among others.
6.	Draft ESIA Report	A draft report summarizing the findings of the Environmental and Social Impact Assessment (ESIA) has been prepared.
7.	Public Disclosure of ESIA	Public Consultations informed each stage of the ESIA development. In accordance with both GoM and WB requirements, the draft ESIA report and mitigation plans (ESMPs, RAP, IPDP) has been prepared for disclosure and public consultation. Stakeholders, including local communities, NGOs, government agencies, and experts, will be invited to provide feedback and the final report will be revised based on the feedback received. In addition, No Objection Certificates (NOCs) will be obtained from the village-level traditional institutions to ensure community consent and administrative approval before proceeding with the project in the proposed area.
8.	Final ESIA Report	The draft ESIA report and mitigation plans (ESMPs, RAP, IPDP) will be finalized by incorporating feedback from the public consultation. Comments received will be addressed, and the assessment or proposed measures/plans will be revised as necessary.
9.	Approval and Implementation	The final ESIA report along with mitigation plans will be submitted to the MPWD and the World Bank.
10.	Monitoring	Monitoring of ESIA implementation and management of risks throughout the project implementation

Table 1.2: Source and methodology for primary and secondary data collection

Parameters	Secondary Source
	Environment
Air	**Primary Survey** **Primary Monitoring (PM10, PM2.5, SOx, NOx) at 3 Locations** **Secondary Source** Central pollution control Board (CPCB, https://cpcb.nic.in/) / Meghalaya State Pollution Control Board (MSPCB, https://megspcb.gov.in/)
Water	**Primary Survey** **Primary Monitoring at** **Secondary Source** 1. District Survey Report, North Garo Hills District, 2024(https://northgarohills.gov.in/document/district-survey-report-of-north-garo-hills-district-for-sand-mining-2019/) 2.CGWBData 2024(https://www.cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Meghalaya/North%20Garo%20Hills_Report.pdf)
Noise	**Primary Survey** **Primary Monitoring** **Secondary Source** CPCB (https://cpcb.nic.in/regulation-control/)
Soil	**Primary Survey** **Primary Monitoring** **Secondary Source** 1.District Irrigation Plan 2016-2020(https://pmksy.gov.in/mis/Uploads/2017/20170331050822078-1.pdf) 2.Mapping India's Climate Vulnerability A District Level Assessment (2021) (https://www.ceew.in/sites/default/files/ceew-study-on-climate-change-vulnerability-index-and-district-level-risk-assessment.pdf)
Biodiversity	**Primary survey** 1.Field observation 2.Vegetation assessment was conducted using Nested Quadrate method 4.Faunal assessment was conducted using Visual encounters, sign survey, line transect, and netting survey method

Parameters	Secondary Source
	6.LULC analysis through ground truthing **Secondary Source** 1.Desktop study/secondary data collection - Govt. notified acts, peer review published scientific articles, Govt. reports, 2.Online open-source biodiversity databases such as Meghalaya Biodiversity Portal (https://megbiodiversity.nic.in/), PARIVESH Portal (MoEF&CC) (https://parivesh.nic.in/), Global Forest Watch (https://www.globalforestwatch.org/), IUCN Red List of Threatened Species(https://www.iucnredlist.org/) 3.Stakeholder consultation
Hazards and Vulnerability	**Primary survey** Field observation and Consultation with concerned departments and local community **Secondary Source** 1. District Disaster Management Plan for North Garo Hills, 2024 (https://northgarohills.gov.in/disaster-management/) 2. Meghalaya State Disaster Management Authority (MSDMA) (https://msdma.gov.in/)
Natural Environment	**Secondary Source** 1.Customized Rainfall Information System, Hydromet Division, IMD (https://hydro.imd.gov.in/) 2.District Census Handbook, North Garo Hills(https://northgarohills.gov.in/demography/) 3.Geological Survey of India(https://www.gsi.gov.in/webcenter/portal/OCBIS) 4. District Irrigation Plan 2016-2020 ((https://pmksy.gov.in/mis/Uploads/2017/20170331050822078-1.pdf) 5. Consultant's Analysis, Source IMD Gridded Data(https://www.imdpune.gov.in/cmpg/Griddata/Rainfall_25_NetCDF.html) 6. State Action Plan on Climate Change (SAPCC), Meghalaya(https://moef.gov.in/uploads/2017/08/Meghalaya.pdf) 7. Statistical Handbook, Meghalaya 2023 (https://des.megplanning.gov.in/documents/SHB2023-as-on-02-05-24.pdf)
Climate	**Secondary Source** India Meteorological Department – Shillong Climatological Normals, (1991–2020) (https://dsp.imdpune.gov.in/home_normals.php#)
	Land and Livelihood Impact

Parameters	Secondary Source
Land, Livelihood and Common Property Resources	**Primary survey** 1.Census/Household Survey (PAH:156) 2.Focus Group Discussions (3) 3.Key Informants Interviews (25) 4.Field Observations **Secondary Source** Census 2011 (https://www.census2011.co.in/)
	Other Socio-Economic Parameters
Ethnicity	**Primary survey** Consultation, Focus Group Discussion **Secondary Source** Census 2011(https://www.census2011.co.in/)
Gender	**Primary Survey** Focus Group Discussion Public Consultations Interviews **Secondary Source** Workforce Participation Rate as per Census 2011 (https://www.census2011.co.in/) National Family Heath Survey- 5 (https://mohfw.gov.in › files › NFHS-5_Phase-II_0)
Prevalence of GBV	**Primary survey** Focus Group Discussions with women group **Secondary Source** Police records National Crime Records Bureau (NCRB) (https://ncrb.gov.in)

1.4 STRUCTURE OF THE ESIA REPORT

This Environmental and Social Impact Assessment (ESIA) report has been structured into ten chapters including this introduction chapter as follows.

CHAPTER	DESCRIPTION
Chapter 1	INTRODUCTION
Chapter 2	LEGAL AND INSTITUTIONAL FRAMEWORK
Chapter 3	PROJECT ROAD DESCRIPTION
Chapter 4	THE BASELINE ENVIRONMENT
Chapter 5	ENVIRONMENTAL AND SOCIAL RISKS AND
Chapter 6	ANALYSIS OF ALTERNATIVES,
Chapter 7	STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE
Chapter 8	ENVIRONMENTAL AND SOCIAL MONITORING & REPORTING PROGRAMME
Chapter 9	GRIEVANCE REDRESSAL MECHANISM
Chapter 10	CONCLUSION AND RECOMMENDATIONS

2. LEGAL AND INSTITUTIONAL FRAMEWORK

This chapter reviews all acts, rules, and policies applicable to the proposed road development.

2.1 APPLICABLE ENVIRONMENTAL AND SOCIAL REGULATIONS/ ACTS/ POLICIES AT NATIONAL AND STATE LEVEL

To understand the scope of the environmental and social assessment for the proposed improvements or road works, the relevant laws, legislation, and policies at the national and state levels were reviewed and summarized in Table 2.1 below, including an examination of the legal and institutional frameworks applicable to indigenous and tribal communities as part of the targeted assessment.

Table 2.1: Applicable Environmental and Social Regulations/ACTs/Policies

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
ENVIRONMENTAL REGULATIONS					
1	Environment Protection Act/ Rules 1986	The Environment Protection Act, 1986 (the "Environment Act") provides for the protection and improvement of the environment. Under the Environment Act, the Central Government issues notifications for the protection of ecologically sensitive areas or issues guidelines for matters under the Environment Act	The various environmental quality standards notified under this act apply to MPWD works.		Meghalaya State Pollution Control Board (MSPCB)
2	EIA Notification 14th Sep 2006 and 17 March 2025	Borrowing of minerals (earth, sand, aggregates, etc.) will require prior environment clearance under mining category	Borrowing of minerals (earth, sand, aggregates, etc.) for embankment, bridge, approach road construction	Environmental Clearance through Contractor	SEIAA Meghalaya
3	Air (Prevention and Control of Pollution) Act, 1981, 1987	To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes.	Air pollution from proposed Batching Plant or Hot mix plants, stone crusher, DG set etc. during construction stage	Consent to Establish and operate through Contractor	Meghalaya State Pollution Control Board (MSPCB)
4.	Water Prevention and Control of Pollution) Act, 1974, 1988	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	Water pollution during the construction stage from construction/labour camp	Consent to Establish and Operate through Contractor	Meghalaya State Pollution Control Board (MSPCB)
5.	Noise Pollution (Regulation and Control Act) 2000 and amendment till date	The ambient noise standards for day and night across various land use categories were notified by the MoEF&CC under the Noise Pollution (Regulation and Control) Rules, 2000, based on recommendations of the CPCB	Noise emission from proposed activities during construction stage like operation of DG sets, equipment and concrete mixers should be within applicable standards	Regulatory clearance not required but noise monitoring results should be below applicable standard as per CPCB .	MSPCB

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
6	Hazardous & Other Wastes (Management and Trans-boundary Movement) Rules, 2016 and March, 2024	Protection against improper handling, storage and disposal of hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal.	Hazardous waste generation from proposed activities like generation of paints waste, used oil/waste oil, bitumen waste, etc.	Contractor to obtain authorization for storage, transport, and disposal of hazardous and other wastes	MSPCB
7	Construction and Demolition Waste Management Rules, 2016	To manage the demolition and construction waste and prevent environmental degradation	Construction and demolition waste will be generated from proposed activities	Required permission will be obtained by Contractor for proper disposal as per the site specific waste management plan.	Village Council, Municipal Boards
8	Solid Waste management Rules, 2016 and amended thereof	To manage solid waste or semi-solid domestic waste, sanitary waste	Solid Waste will be generated from proposed activities due to influx of labour	Required permission will be obtained by Contractor for proper disposal as per the site specific waste management plan.	Village Council, Municipal Boards
9	Vehicle Act 1988 Central Motor Vehicle Rules 1989	To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution.	Transportation of manpower and material will involve vehicular movement. Vehicles must have valid Pollution Under Control (PUC) certificates, Insurance, Fitness Certificate. Driver should have valid Driving License.	PUC and fitness certificates, Insurance. Driving License, Fitness Certificate should be submitted to the PMU before the vehicle is mobilized in the project	State Transport Authorities approved PUC certificate providers
10	The Gas Cylinder Rules 2016	To regulate the storage of gas / possession of gas cylinder more than the exempted quantity.	Gas cylinders may be used during welding and other electromechanical work. Storage within threshold quantity and as per capability analysis. Handling with defined safe practices	Yes, Permission will be required by the Contractor if the storage of gas / possession of gas cylinder is more than the exempted quantity(i.e more than 25 cylinders of total weight exceeding 200 kg for flammable non-toxic gases).	Petroleum and Explosives Safety Organization (PESO)
11	The Mines and Minerals	For development and regulation of mines and minerals in a sustainable	The construction of works will require stones, aggregates, sand, earth, etc.	The mining permit,EC and CTO has to be submitted to the PMU	Mines and Mineral Department

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	(Development and Regulation) Act, 1957	manner. The rules regulate the mining of mineral and dealerships for mining and trading.		for clearance .No material shall be procured without the approval .For material procured during the constrction the e-transit pass would be submitted along with IUFR.	
12	Meghalaya Forest Regulation (Application and Amendment) Act, 1973	The Act provides a comprehensive legal framework for conservation and sustainable use of bio-resources, reflects a strict regime for access, control and benefit sharing. It restricts access and use of biological resources by outsiders and creates decentralized institutional structures (State Biodiversity Boards -SBB and GP level Biodiversity Management Committees) for conservation of biological diversity.	Provisions of this act will not be applicable since road will not adversely affect any biological diversity	No	Meghalaya State Biodiversity Board
13	Meghalaya Biodiversity Rules, 2010	Conservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising out of the use of biological resources	Provisions of this act will not be applicable since road will not adversely affect any biological diversity	No	Meghalaya State Biodiversity Board
14	Wildlife protection Act 1972, 2022	Protection of wildlife in the state of Meghalaya	Wildlife impact is not anticipated in this project.. Though two Elephant passing on Chainage 17+062 and 17+600 are falling on Sub Project Road. Proper mitigation measures like speed calming measures, safety signages will be undertaken.	No	State Forest Department
15	Meghalaya Tree (Preservation) Act,	Conservation of forest and controlled felling of trees	Approx. 70 nos of tree are falling within the ROW.	Permission for felling of trees	State Forest Department

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	1976, and the Meghalaya Tree Felling (Non-Forest Areas) Rules, 2006				
16	Disaster Management Act, 2005	The purpose is to have an effective management of disasters and for matters connected therewith or incidental thereto	The project area falls under the seismic (earthquake prone) zone V and hence construction activities/ interventions will be under purview of this act	No. Contractor should be aware of Guidelines/SOPs/Advisory of MSDMA	Meghalaya State Disaster Management Authority (MSDMA)/MPWD
17	Meghalaya Disaster Management Rules, 2008	The rule is to provide measures' to be adopted for prevention and mitigation of disaster; mitigation measure to be integrated with development plans and projects; build capacity and preparedness measure; and specify roles and responsibilities to each dept. in relation to adopted measure	During implementation, setting of labour camps and capacity building of contractor staff	No Contractor should be aware of Guidelines/SOPs/Advisory of MSDMA No tree felling shall be felled without permission from the Forest Department.	Meghalaya State Disaster Management Authority (MSDMA)/MPWD
18	Plastic waste management Rules, 2016	The Plastic Waste Management Rules, 2016 provide a framework for the effective management of plastic waste. They aim to minimize the adverse environmental impact of plastic waste and promote sustainable practices for its handling and disposal.	Plastic waste generation from proposed activities. Safe disposal as per Rules	No. Properly segregate plastic waste at source and hand it over to authorized waste collectors, local bodies, or MSPCB authorized agencies/Recyclers	Village Council/ Municipal Authority/MSPCB
19	Petroleum Act, 1934, Petroleum Rules, 2002 (under the Petroleum Act, 1934)	Regulates the storage, transport, handling, and use of petroleum and diesel. Requires licenses for storage of petroleum products beyond prescribed limits.	Storage of High Speed Diesel (HSD) at construction sites (above threshold limits of 2,500 liters in multiple barrels or 1,000 liters in a singletank requires license/approval.	License for storage from PESO (Petroleum and Explosives Safety Organization) for >25000L; NOC from District Authority/Fire Department. (for >2500 L to 25000L)	PESO, Nagpur (through Regional Office) & District Magistrate/Chief Controller of Explosives.
20	Ground Water Regulation (Central Ground Water	Governs the extraction of groundwater for industrial, infrastructure, or commercial use.	Applicable (if groundwater extraction proposed) Groundwater extraction for construction,	NOC for groundwater abstraction.	CGWA or State Ground Water Authority (if notified).

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	Authority – CGWA Guidelines, 2017, adopted by States)	Requires NOC/permission prior to abstraction.	camp use, or dust suppression requires prior permission.		
21	The Meghalaya Water Act, 2011	State-level mandate for use of surface water from rivers, streams, ponds, lakes, etc. for non-domestic/commercial purposes.	Construction water requirements may involve use of surface water from nearby streams/rivers with state approval. Surface water from the Didram river can be used for road construction with prior permission from the Water Resources Department, North Garo Hills District, Meghalaya.	Permission/Allocation order for surface water abstraction.	Water Resources Department, Government of Meghalaya.
SOCIAL REGULATIONS					
1.	Article 244(2) &275(1) of the Constitution of India - The Sixth Schedule	Article 244(2) establishes Autonomous District Councils (ADCs) in tribal areas, granting them legislative and administrative powers, empowering them to legislate on land, resources, and local governance. Article 275(1) provides financial grants for the welfare and development of Scheduled Tribes and Scheduled Areas	Applicable in designated tribal areas under the Sixth Schedule	No	Government of India, Autonomous District Councils
2.	The Meghalaya Transfer of Land (Regulation) Act, 1971	The Act stipulates that no land (including immovable property of every description and any rights over such property) in Meghalaya can be transferred by a tribal to a non-tribal or by a non-tribal to another non-tribal except with the prior sanction of the competent authority.	Relevant to all project interventions involving land acquisition, leasing, or transfer. The project will ensure that all land-related activities including documentation, due diligence, and land management planning comply with this Act. No land transfer or use will be undertaken without approval from the competent authority, ensuring protection of tribal land rights and consistency with ESS5 (Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement)..	Prior permission / No Objection from the concerned Autonomous District Council and compliance with the provisions of the Act before land transfer or acquisition.	Revenue Department; Village Councils-Autonomous District Councils (ADCs)

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
3.	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	The Act ensures transparent land acquisition with fair compensation, rehabilitation, and resettlement. It sets minimum compensation norms, R&R entitlements, and facilities for the displaced, allowing states to enhance benefits. The Act also includes special provisions to protect the interests of Scheduled Castes and Scheduled Tribes.	Yes, as the area falls under 6th schedule A review of the legal and institutional framework applicable to indigenous/tribal communities.	No	Revenue Department, Government of Meghalaya, Garo Hills Autonomous District Council The Sixth Schedule establishes the ADC or VC as institutional mechanisms for governing these areas.
4.	Meghalaya Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2017	Aim to provide a fair, transparent, and participatory process for land acquisition while ensuring adequate compensation and rehabilitation for affected families. These rules align with the broader objectives of the RFCTLARR Act to minimize the adverse impact of land acquisition and promote the welfare of those affected by it.	Impact on private Assets and properties	Ensure fair compensation and Guarantee transparency in the acquisition process.	Revenue Department/ District Administration, Village Council
5.	Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014 & Meghalaya Street Vendors (Protection of Livelihood and Regulation of Street Vending) Rules, 2016	It regulates street vending and protects the rights of street vendors by legalizing their right; protects them from sudden eviction or relocation; spells their rights and obligations.	Applicable to all Project road corridors in case of economic displacement and relocation of street vendors.	No	District Administration/ District Municipal Authority, Village Councils under the Autonomous District Councils
6.	Rights of Persons	Ensures that the Persons with	For the entire Project road corridor where	No	Department of Social

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	with Disabilities Act, 2016	Disability (PWD) enjoy the right to equality, life with dignity, and respect for his or her own integrity equally with others.	PwD are present and affected, and for designing the project in an inclusive manner.		Welfare, Government of Meghalaya
7.	Right to Information Act, 2005	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.	All documents pertaining to the project would be disclosed to public.	No	Public Information Officer (PIO)
8.	The Cadastral Survey and Preparation of Records of Rights Act, 1980 (as amended in 1991)	The Act provides for cadastral survey of lands and preparation of land records in the state. The 1991 amendment enables the ADCs to undertake cadastral surveys with financial and technical assistance from the State Government.	Applicable for project activities involving detailed mapping and verification of land ownership or tenure. Under Project, cadastral mapping and systematic land documentation will support preparation of RAP and verification of community and private ownership. Prior clearance from the concerned village councils will be obtained for all project interventions located on or adjacent to community forest land, in line with ESS1 and ESS5.	yes	Revenue and Disaster Management Department; Autonomous District Councils (ADCs)
9.	GHAD (Land transfer regulation) 1958	Regulates the transfer of land within the Garo Hills to protect tribal land ownership. It restricts transfer of land from tribal communities to non-tribals without prior approval of the	Applicable where land within the jurisdiction of the Garo Hills Autonomous District Council is involved in acquisition, transfer, or use for development projects. If the project utilizes existing government ROW without land transfer, it may not	Prior permission/No Objection Certificate (NOC) may be required for transfer, lease, or use of land falling under the jurisdiction of the District	Garo Hills Autonomous District Council

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
		Autonomous District Council.	require permission.	Council.	
LABOUR LAWS APPLICABLE					
1	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	It regulates the employment and conditions of service of building and other construction workers and provides for their safety, health and welfare.	Applicable for all building or other constructions works under the project that employs 10 or more workers.	Establishment Registration is required	Labour Commissioner, Meghalaya
2	Workmen Compensation Act, 1923	It provides for payment of compensation by employers to their employees for injury by accident i.e., personal injury or occupational disease.	Construction workers will be involved in the Project road corridors	Workmen compensation Insurance Policy	Commissioner for Workmen's Compensation
3	ESI Act, 1948 (Employees State Insurance Act, 1948)	Employees State Insurance Act provides for health care and hospitalization benefits for construction work force	Construction workers will be involved in the Project Road corridors	Insurance Policy.	Commissioner for Workmen's Compensation
4	Inter-state Migrant Workers Act, 1979	It protects workers whose services are requisitioned outside their native states in India. A contractor who employs or who employed five or more Inter-State migrant workmen need to obtain registration under this act	Construction workers will be involved in the Project Road corridors	Registration/Labour license	Labour Commissioner, Meghalaya
5	The Child Labour (Prohibition & Regulation) Amendment Act, 2016	It prohibits employment of children in specified hazardous occupations and processes and regulates the working conditions in others.	There should not be any child labour (less than 14 years) in any project activity and adolescents (above 14 and less than 18 years) in any hazardous activity.	No	Labour Commissioner, Meghalaya/ Department of Social Welfare, Government of Meghalaya
6	Sexual Harassment of Women at the Workplace	It mandates every organization having more than ten employees to constitute an Internal Complaints Committee (ICC) in the prescribed	Applicable to all implementing agencies	No	District Officer (District Magistrate or Additional District Magistrate)

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	(Prevention, Prohibition and Redressal) Act, 2013 (POSH Act)	manner to receive and address the complaints of any sort of sexual harassment from women in a time-bound and extremely confidential manner			
7	Contract Labour (Regulation & Abolition) Act 1970	To provide proper and habitable working conditions. To regulate the functioning of the advisory boards. To lay down the rules and regulations regarding the registration procedure of the establishments employing contract labour	Applicable to all implementing agencies	Labour License Required	Labour Commissioner, Meghalaya
8	Payment of Wages Act, 1936 and the Minimum Wages Act, 1948	Lays down as to by what date, wages are to be paid, when it will be paid and what deductions be made from the wages of the workers, if any.	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
9	Payment of Gratuity Act, 1972 The payment of gratuity rules Meghalaya 1972	Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation, if an employee has completed 5 years of service with employer	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
10	Employees Provident Fund and Miscellaneous Provision Act, 1952	Provides for monthly contributions by the employer and as well as by workers with a provision as return of pension of a lump sum (principal and interest accrued) at the end of his/her service term).	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
11	Maternity Benefit Act, 1951 Meghalaya Maternity benefit Rules 1965	Provides for maternity leave for women, during pregnancy and after giving birth and some other benefits to women employees, in case of medical recommendation of bed rest or miscarriage etc.	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
12	Payment of Bonus Act, 1965 The Payment of Bonus Rules Meghalaya 1975	Provides payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages.	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
13	The Bonded Labour (Abolition) Act 1976 Bonded Labour System (Abolition) Rules 1976	An Act to provide for the abolition of bonded labour system, with a view to prevent economic and physical exploitation of the weaker sections of the people and for all matters connected there with or incidental thereto	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
14	The Trade Union Act, 1926	Lays down the procedure for registration of trade union of workers and employers. The trade unions registered under the Act have been given certain immunities for civil and criminal liabilities.	Applicable to all implementing agencies	No	Labour Commissioner, Meghalaya
15	Schedule Caste and Schedule Tribe (Prevention of Atrocities Act 1989)	Atrocity with SC and ST community is defined as an offense punishable under Section 3 of the Act	Project Area is protected under Sixth Schedule of the Constitution	No	Social Welfare Department, Meghalaya
16	Meghalaya Right to Public Services Act, 2020	Ensures timely delivery of notified public services to citizens by government departments, enhancing transparency, accountability, and efficiency in governance.	Applicable to all government departments and public service providers in Meghalaya	No	Meghalaya State Public Services Delivery Commission (MSPSDC)
17	Occupational Safety, Health & Working Conditions (OSH) Code, 2020 + Meghalaya Factories Rules, 2015	Site safety standards, PPE, welfare amenities, working hours, accident reporting, medical checks, registration of establishments.	Applicable to all construction, labour camps, work fronts, and site facilities	Yes*	Labour Commisioner, Government of Meghalaya

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
18	Code on Wages, 2019 + Meghalaya Minimum Wages Notifications (latest revision)	Minimum wages (Skilled/Semiskilled/ Unskilled), equal pay, wage slips, timely payment, prohibition of illegal deductions.	Applicable to all wage payments through contractors and subcontractors at MLCIP sites.	Yes*	Labour Commisioner, Government of Meghalaya
19	Industrial Relations (IR) Code, 2020 + Meghalaya Industrial Disputes Rules, 1973	Conciliation, dispute settlement, prohibition of unfair labour practices, notice of changes in service conditions.	Applicable for grievance redress, worker disputes, conciliation and retrenchment-related issues.	Yes*	Labour Commisioner, Government of Meghalaya
20	Code on Social Security, 2020 + Meghalaya BOCW Welfare Board Rules, 2006	Social security benefits, maternity benefits, PF/ESI, construction worker registration, insurance and disability benefits.	Applicable to EPF/ESI coverage (where notified), worker registration, welfare board benefits.	Yes*	Central: EPFO, ESIC State: Meghalaya BOCW Welfare Board; Labour Department State Rules: Meghalaya BOCW (RE&CS) Rules, 2006

*The labour codes shall be applicable in the state of Meghalaya upon receiving notification from the Government of Meghalaya.

2.2 IRC AND MORTH CODES APPLICABLE TO THE PROJECT

All road works in India must comply with the IRC, MoRTH guidelines and BIS Codes. Key relevant IRC codes that may directly or indirectly influence the environmental and social management during the design, construction and operational phases are given in **Annexure 2.1**.

2.3LAND REVENUE GOVERNANCE AND ADMINISTRATION IN GHADC

When Meghalaya was formed in 1972, the Garo Hills Autonomous District Council (GHADC) was retained with its mandate and governance framework largely unchanged. Over time, the Autonomous District Councils (ADCs) have undertaken efforts to codify tribal customary laws through legislations enacted under their authority. Traditional customary institutions have maintained a strong presence in the region, and despite the historical shifts introduced by the British administration and subsequently the Indian State, these institutions have continued to function adapting their practices to align with evolving legal and administrative frameworks.

The Sixth Schedule of the Constitution of India provides the framework for the establishment of Autonomous District Councils (ADCs) in tribal areas. Members of the ADCs are elected by the tribal population for a term of five years. The Garo Hills ADC functions with its own rural and urban local bodies, serving as an important institutional layer of governance.

ADCs act as a bridge between formal state structures and traditional tribal institutions, ensuring that governance reflects both constitutional provisions and customary practices. The Sixth Schedule establishes a system of autonomous, decentralized governance, endowing ADCs with legislative, executive, and judicial powers, including authority to adjudicate certain categories of civil and criminal cases.

In rural areas, traditional institutions such as the Nokmas a two-tier political system among the Garos continue to play a central role. In practice, it is not the State Government, but rather the Autonomous District Councils (ADCs) in conjunction with tribal institutions, that function as the primary authorities for the administration and management of natural resources, including land.

In the Garo Hills, the traditional village chief (Nokma) is regarded as the owner and custodian of community lands. In practice, the Nokma's husband exercises rights to manage the land through his wife, and may dispose of land only with her consent. Village inhabitants are entitled to cultivate as much land as they require, and may select plots within the village boundary, subject to the Nokma's approval. Outsiders are also permitted to settle in the village, provided they offer either an annual rent or a one-time gift/present to the headman.

Details of land procurement mechanisms are provided below in Table 2.2.

Table 2:2: land procurement mechanisms

Category	*Garos*
Basis of classification	Ownership of land
Type of land	2 types of ownership a) Community Land b) Private Property 5 Types of land: 1.A-king Land, 2.A-mate land, 3.A-jinma or A-joma land , 4.A-jikse land, 5. A-milam land
Control and Management	The ancestral head Nokma (head of the clan) manages and allots land to the community. While the Maharis (clan members) look after A-jinma land.
Inheritance	Women inherit and own property: It is usually the youngest daughter who inherits the property.
Records	*Pattas* are the primary records available in the region, dating from the

Category	*Garos*
	colonial period. In Garo Hills, land is primarily owned and managed by the communityies and land records are generally maintained through customary institutions, where the Nokma (village head) manages and allocates A'king land (clan/community land) to clan members for cultivation and settlement. The Hill areas of Garo Hills are the A'King lands, which belongs to the A'King Nokma (headman) of a particular clan. The entire A'King lands are managed by the A'King Nokma who is the guardian and custodian of a particular clan or motherhood. J.D. Walker demarcated the A'King land boundaries and gave the *Nokma*s settled maps in the late 1920s. The availability of patta documents in the villages part of the study show the colonial legacy which is often the only record of the land. (Marak, 1986). Garo Hill Autonomous District Council (GHADC) is known to have the maps for large parts of the district in the Garo Hills.
Systems for sale/purchase/ mortgage	Pattas are instrumental in mortgaging land in the bank for loans. Selling of the land in the village requires the *Nokma*s presence as witness. Any transactions or inheritance pertaining to the land is recorded in the patta at the District Council, Office. The District Council do not have direct control over the A'King lands and cannot take any arbitrary decisions in matters of sale, mortgage, gift, transfer, etc.
Managing private property	The *Nokna* (heiress) is the owner of family property and has a say in management of both movable and immovable property, whether ancestral or self-acquired. Customarily, no property can be disposed of without the consent of the heiress. However, there might be variations in practice.
Managing community property	For the community lands, the power to make decisions is vested in the *nokma* of the village. For the clan land, the *nokna* (in heiress) along with her husband and the *chras* (brothers and maternal uncles) decides together. Any such transaction undertaken without prior consent of the wife *(nokna)* andher C*hra* is considered null and void (Marak, 1986).[2]

[2] Source:Momin, M. (Ed.). (2003). Readings in History and Culture of the Garos (Essays in honour of Milton S. Sangma). Regency Publications

Awensing R. Sangma: Atchu Ambini Poedorang, p 39; Also see Wangalani Bimik by the same author, pp 31-32.

Marak, G. S. (1986). *Janggi Tangani*. Tura, West Garo Hills: Published by Surendra S. Marak.

3. SUB PROJECT ROAD DESCRIPTION

3.1 RONGSAI BORJHORA BAJENGDOBA (RBB) SUB PRO ROAD

The proposed RBB project road (Sub Project Road RBB) has a total length of 18.27 km, commencing from Kosi Junction at chainage 00+000 and terminating at Bajengdoba at chainage 18+270. The proposed road existed before the formation of Meghalaya state as per discussions with the MPWD officials.

3.2 LOCATION DETAILS OF THE RBB SUB PROJECT ROAD

This stretch traverses a diverse landscape, including hilly terrains, agricultural lands, scrublands, built-up areas, and passes through 6 Villages including 17 habitations. The RBB Road serves as a critical regional connector, enhancing access to economic hubs, industrial centers, and tourism destinations.

Table 3.1 presents the chainage-wise details of Sub Project Road RBB while Figure 3.1 illustrates the road alignment map.

Table 3.1: Chainage wise RBB Sub Project Road details

Sl. No.	Starting Chainage	End Chainage	Corridor No.	Project length as per DPR	Districts
1	00+000	18+270	3	18.27	North Garo Hills

Figure 3.1: Road alignment map for RBB Road

3.3 PROJECT INFLUENCE AREA

For the purpose of this study, the Project Influence Area has been categorized in three tiers to facilitate a holistic environmental and social impact assessment of the road stretch and to minimize potential environmental and social risks. Three tiers are given below

1. 12 m of ROW for Direct Impact (6m from Centre line) i.e. Corridor of Direct Impact (CoI)
2. 500 m buffer for indirect impact area [3] i.e. Corridor of Indirect Impact
3. 10 km of study area

The existing and proposed Right of Way (RoW) of the corridor has been considered adequate for characterizing baseline conditions and for assessing direct socio-economic impacts, including the profile of affected persons, religious structures, and common property resources.

The study impact area has been delineated as 0.5 km on either side of the proposed RoW from the Centre line . This buffer has been considered adequate to cover drainage channels, biodiversity-rich zones, natural habitats, protected areas, agricultural land, landslide- and landslip-prone stretches, marshy areas, surface water bodies, physical features, and settlements, among others.

The following sections of this chapter provide details of the existing road characteristics, key project components, resource requirements and proposed improvements.

3.4 KEY EXISTING CONDITIONS AND PROPOSED IMPROVEMENTS OF THE RBB ROADS

The key existing conditions and proposed improvements for the RBB project road are presented in the following sub-sections. These have been compiled based on primary field surveys and the Detailed Project Report (DPR).

3.4.1 RIGHT OF WAY, CARRIAGE WIDTH AND PAVEMENT CONDITIONS

The Right of Way (RoW) and Carriage Way (CW) for the 18.27 km sub-project road are summarized in **Table 3.2**. The Rongsai–Borjhora–Bajengdoba (RBB) Road is presently a single-lane roadway with a bituminous pavement surface.The existing road conditions are generally poor, with potholes prevalent across most stretches. Inadequate drainage exacerbates deterioration during rainfall, making traffic movement difficult, particularly on earthen sections. Notably, the road segments between chainages 12+000 and 12+200 currently lack a bituminous surface. Existing Carriage width of Sub Project road is 3.75 m and Proposed width is 5.5 m for intermediate lane. As per DPR design, the Sub project requires 11m – 12m. However at some places, the ROW is less than 11m and some places More than 12 m. Details of additional land requirement is discussed in section 3.7 .

Table 3.2: Details of Available ROW

Sl. No.	Name of Habitation/Village	Chainage From (km)	Chainage To (km)	Length (km)	Block/District	Available RoW (m)
1	Kosi Junction	0.000	0.250	0.250	Bajengdoba, North Garo Hills District	12
2	Kosi Junction	0.250	0.680	0.430	Bajengdoba,	10

[3] Based on Earlier experiences it was observed that dust, noise and other environmental parameters would get attenuated/diluted to meet existing baseline conditions within 500 m from the source.

					North Garo Hills District	
3	Kosi Junction	0.680	0.800	0.120	Bajengdoba, North Garo Hills District	11
4	Moamari	0.800	0.940	0.140	Bajengdoba, North Garo Hills District	10
5	Moamari	0.940	1.200	0.260	Bajengdoba, North Garo Hills District	10
6	Omorpur	1.200	1.280	0.080	Bajengdoba, North Garo Hills District	11
7	Omorpur	1.280	1.400	0.120	Bajengdoba, North Garo Hills District	11
8	Omor Bazaar	1.400	1.600	0.200	Bajengdoba, North Garo Hills District	10
9	Bajengdoba	1.600	1.660	0.060	Bajengdoba, North Garo Hills District	9
10	Bajengdoba	1.660	1.900	0.240	Bajengdoba, North Garo Hills District	9
11	Bajengdoba	1.900	1.980	0.080	Bajengdoba, North Garo Hills District	13
12	Bajengdoba	1.980	2.080	0.100	Bajengdoba, North Garo Hills District	13
13	Bajengdoba	2.080	2.500	0.420	Bajengdoba, North Garo Hills District	14
14	Bajengdoba	2.500	2.600	0.100	Bajengdoba, North Garo Hills District	12
15	Upper Bajengdoba	2.600	2.800	0.200	Bajengdoba, North Garo Hills District	14
16	Line Ading	2.800	2.900	0.100	Bajengdoba, North Garo Hills District	12
17	Line Ading	2.900	3.220	0.320	Bajengdoba, North Garo Hills District	12
18	Line Ading	3.220	3.275	0.055	Bajengdoba, North Garo Hills District	12
19	Line Ading	3.275	5.000	1.725	Bajengdoba, North Garo Hills District	12
20	Rongbang	5.000	5.140	0.140	Bajengdoba,	11

					North Garo Hills District	
21	Rongbang	5.140	5.400	0.260	Bajengdoba, North Garo Hills District	11
22	Mansingre	5.400	5.960	0.560	Bajengdoba, North Garo Hills District	12
23	Mansingre	5.960	6.200	0.240	Bajengdoba, North Garo Hills District	12
24	Mansingre	6.200	6.330	0.130	Bajengdoba, North Garo Hills District	12
25	Mansingre	6.330	6.800	0.470	Bajengdoba, North Garo Hills District	12
26	Gosinpita	6.800	8.800	2.000	Bajengdoba, North Garo Hills District	11
27	Bongbanchi	8.800	9.090	0.290	Bajengdoba, North Garo Hills District	11
28	Bongbanchi	9.090	9.600	0.510	Bajengdoba, North Garo Hills District	11
29	Aneaga	9.600	10.200	0.600	Bajengdoba, North Garo Hills District	10
30	Aneaga	10.200	10.840	0.640	Bajengdoba, North Garo Hills District	10
31	Aneaga	10.840	10.950	0.110	Bajengdoba, North Garo Hills District	10
32	Aneaga	10.950	11.200	0.250	Bajengdoba, North Garo Hills District	10
33	Rangagora	11.200	12.200	1.000	Bajengdoba, North Garo Hills District	11
34	Sembalgare	12.200	12.600	0.400	Bajengdoba, North Garo Hills District	10
35	Bolsong	12.600	12.640	0.040	Bajengdoba, North Garo Hills District	10
36	Bolsong	12.640	13.060	0.420	Bajengdoba, North Garo Hills District	10
37	Bolsong	13.060	13.760	0.700	Bajengdoba, North Garo Hills District	10
38	Bolsong	13.760	14.030	0.270	Bajengdoba,	10

					North Garo Hills District	
39	Bolsong	14.030	14.200	0.170	Bajengdoba, North Garo Hills District	10
40	Bolsong B Mahal	14.200	15.030	0.830	Bajengdoba, North Garo Hills District	10
41	Bolsong B Mahal	15.030	15.150	0.120	Bajengdoba, North Garo Hills District	10
42	Bolsong B Mahal	15.150	15.514	0.364	Bajengdoba, North Garo Hills District	10
43	Bolsong B Mahal	15.514	15.570	0.056	Bajengdoba, North Garo Hills District	10
44	Bolsong B Mahal	15.570	15.980	0.410	Bajengdoba, North Garo Hills District	10
45	Bolsong B Mahal	15.980	16.300	0.320	Bajengdoba, North Garo Hills District	10
46	Bolsong B Mahal	16.300	17.020	0.720	Bajengdoba, North Garo Hills District	10
47	Bolsong B Mahal	17.020	17.200	0.180	Bajengdoba, North Garo Hills District	10
48	Borjhora	17.200	17.600	0.400	Bajengdoba, North Garo Hills District	10
49	Borjhora	17.600	17.720	0.120	Bajengdoba, North Garo Hills District	8
50	Borjhora	17.720	18.247	0.527	Bajengdoba, North Garo Hills District	12

Pavement Details:

The pavement design for the main carriageway has been carried out in accordance with IRC: SP:72-2015 and IRC: 37-2018 guidelines. The design considers a 15-year design life, design traffic of 5 MSA, and an effective subgrade CBR of 5%. The proposed pavement composition consists of 40 mm Bituminous Concrete (BC), 170 mm Cement Treated Base (CTB), 200 mm Cement Treated Sub-Base (CTSB), and 500 mm Subgrade.

A Stress Absorbing Membrane Interlayer (SAMI) is proposed between the bituminous layer and cementitious base to delay reflection cracking from the CTB layer. The SAMI layer will consist of elastomeric modified binder applied at 10–12 kg per 10 m^2 with 0.1 m^3 of 11.2 mm aggregates.

Structural analysis using IITPAVE indicates that the calculated tensile and compressive strains are well within the allowable limits, confirming the adequacy of the proposed pavement crust. Additionally, tensile strain at the bottom of the CTB layer and cumulative fatigue damage due to axle load spectrum were evaluated and found to be within permissible limits. Hence, the proposed pavement crust thickness is considered satisfactory for the design

conditions.

Recycling of Pavement

Pavement recycling involves reclaiming and reusing existing pavement materials after reprocessing for resurfacing, repaving, or reconstruction, depending on pavement condition and material characteristics. This approach is environmentally beneficial as it conserves natural aggregates and reduces waste disposal, while also being economically advantageous by reusing the existing bitumen and reducing the need for costly virgin materials. For the project, recycling of the existing bituminous pavement will be carried out using a milling machine and recycling plant, and the reclaimed material will be incorporated into the new CTB/CTSB layers in accordance with IRC:120-2015. The recycling proposal covers approximately 50% of the total project length, with a salvage value of 20% considered in the analysis.

Junctions Details:

The details of major and minor junctions are provided in Table 3.3.

Table 3.3: List of Major and Minor Junctions of RBB Road Section

S.No	Chainage	Type	Side	Direction	Type of Junction
1.	0+000	T	Start Point	NH-217	Minor
2.	0+650	T	LHS	Village	Minor
3.	1+000	T	LHS	Bajong Bazaar	Minor
4.	1+125	T	RHS	Village	Minor
5.	1+390	T	RHS	Village	Minor
6.	1+420	T	RHS	Bajeng – Rongsai Rd	Minor
7.	1+525	T	RHS	Village	Minor
8.	1+900	+	-	Bajengdoba	Minor
9.	2+050	T	LHS	Village	Minor
10.	2+200	T	RHS	Village	Minor
11.	2+250	Y	LHS	Village	Minor
12.	2+325	T	RHS	Village	Minor
13.	2+600	Y	LHS	Village	Minor
14.	2+925	Y	LHS	Bajeng W Road	Minor
15.	3+150	T	RHS	Village	Minor
16.	3+250	Y	LHS	Bajeng Road	Minor
17.	3+500	T	LHS	Village	Minor
18.	3+700	T	RHS	Village	Minor
19.	5+150	Y	RHS	Village	Minor
20.	6+150	Y	LHS	Village	Minor
21.	7+500	T	RHS	Village	Minor

S.No	Chainage	Type	Side	Direction	Type of Junction
22.	8+180	Y	RHS	Gosingpita	Minor
23.	8280	+	-	Gosingpita	Minor
24.	9950	T	RHS	Village	Minor
25.	10120	Y	RHS	Village	Minor
26.	10300	+	-	Village	Minor
27.	10680	T	LHS	Village	Minor
28.	11250	T	RHS	Rangagora	Minor
29.	12920	T	RHS	Bolsong	Minor
30.	13650	+	-	Bolsong	Minor
31.	14400	Y	RHS	Bolsong	Minor
32.	14500	T	LHS	Village	Minor
33.	14940	T	RHS	Village	Minor
34.	16225	Y	LHS	Chiram Aga	Minor
35.	17100	T	RHS	Chiraragre	Minor
36.	17625	T	LHS	Village	Minor
37.	17700	Y	RHS	Chiraragre	Minor
38.	17900	Y	RHS	Borjhora	Minor
39.	18274	T	-		Minor

Details of Breast wall: Details of breast wall is given in 3.4.

Table 3.4**:** Summary of breast wall

SL. No	From	To	Length	TCS Type	TCS Description
1	3960	4580	620	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
2	4980	5340	360	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
3	6340	6740	400	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
4	7180	8280	1100	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
5	8500	9060	560	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
6	10830	11070	240	TCS-4	Widening/Reconstruction of intermediate lane with retaining

					wall LHS and Breast Wall RHS
7	11340	12000	660	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
8	12420	12660	240	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
9	13030	13440	410	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
10	15790	16600	810	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
11	16920	17030	110	TCS-4	Widening/Reconstruction of intermediate lane with retaining wall LHS and Breast Wall RHS
12	1620	2500	880	TCS-2	Widening/Reconstruction of intermediate lane with retaining wall RHS and Breast Wall LHS
13	5340	5860	520	TCS-2	Widening/Reconstruction of intermediate lane with retaining wall RHS and Breast Wall LHS
14	15150	15480	330	TCS-2	Widening/Reconstruction of intermediate lane with retaining wall RHS and Breast Wall LHS

3.4.2 PROPOSED ROAD CROSS SECTIONS

The Rongsai–Borjhora–Bajengdoba (RBB) Road traverses gently undulating to moderately rolling terrain with elevations ranging from 100 m to 300 m amsl. The alignment largely follows the natural ground profile, requiring only localized earthwork. Minor cutting is needed between Chainage 8+500 to 9+300, where the road runs close to riverbanks and eroding slopes, necessitating bench cutting and slope protection such as gabion and retaining walls. Embankment raising is proposed at low-lying stretches CH 0+600 (300 mm raise with box culvert), CH 1+300 (250 mm raise due to monsoon submergence), and CH 9+950 (1–2.5 m near Didrum River) to prevent flooding and improve drainage. Overall, the corridor requires moderate earthwork, with no major cutting, and incorporates suitable drainage and slope stabilization measures to ensure long-term stability and all-weather connectivity.

A total of 07 Typical Cross-Sections (TCS) has been proposed in the DPR (**Annexure 3.1**) for the 18.27 km road stretch. These TCSs vary, with some sections incorporating intermediate lanes, and are specifically designed to address the terrain and infrastructure requirements of the corridor, including provisions for road widening, slope stabilization, drainage, and utility corridors.

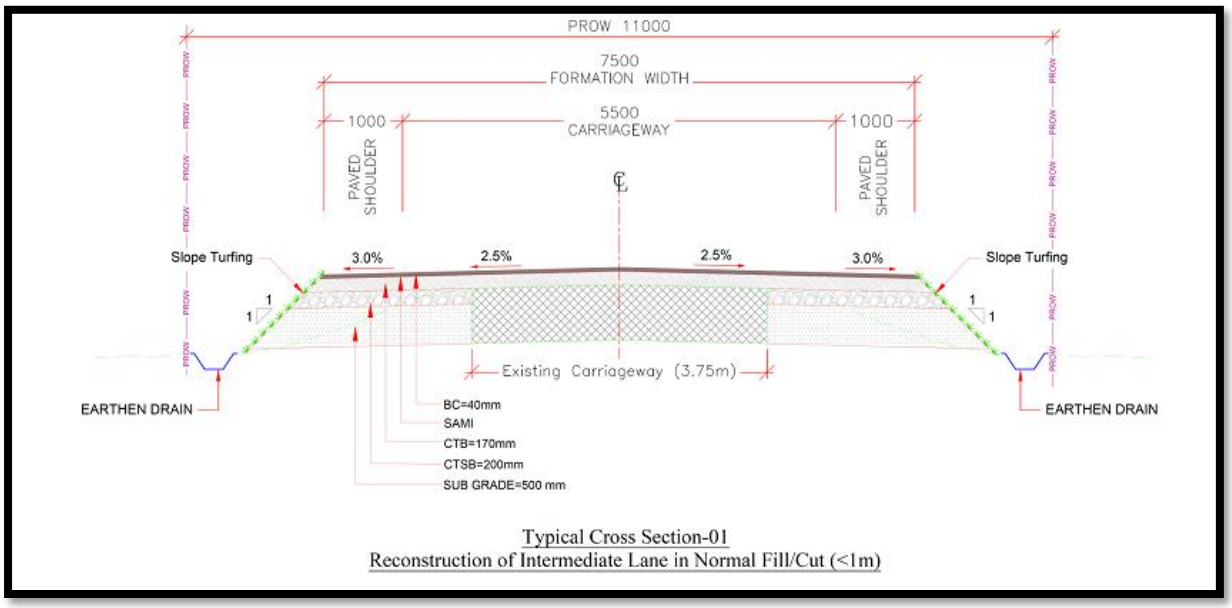
Based on these cross-sections, certain environmental and social impacts may arise, including additional land requirements, tree cutting, and disruption to local ecosystems, biodiversity loss, and alterations to the natural landscape

Details of the 90 different cross-sections, along with the chainage-wise designs adopted, are provided in **Annexure 3.1**. Design details are given in Figure 3.5**.**

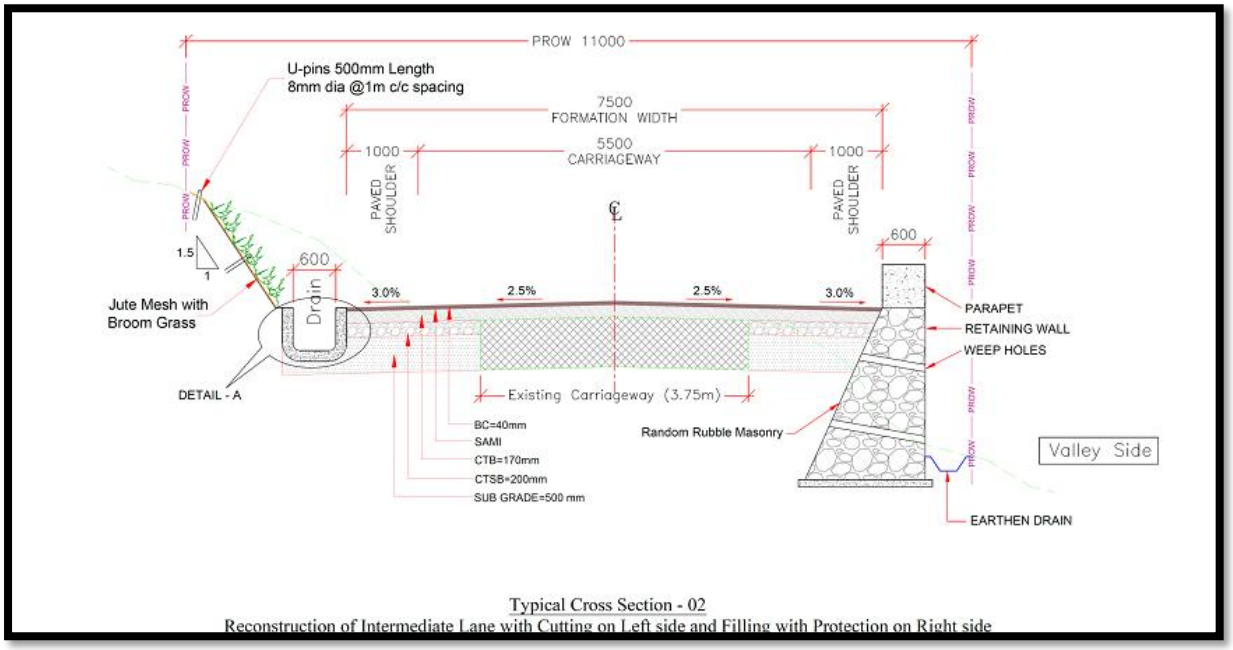
Table 3.5: TCS Types and their relevant Chainages

Sl.	TCS Type	Chainages

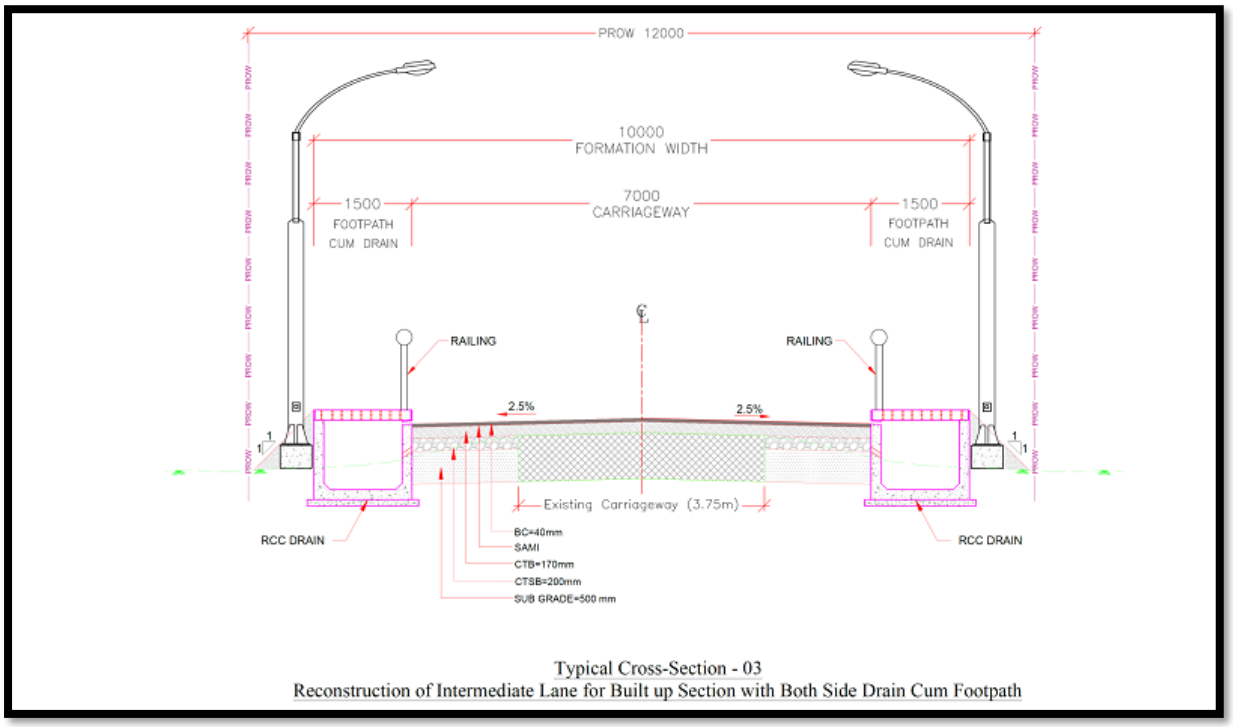
No.		
1	TCS-1	0.680–0.940, 1.660–1.900, 2.080–2.500, 2.900–3.220, 3.275–3.980, 4.450–4.655, 4.666–5.000, 5.140–5.316, 5.324–5.525, 5.600–5.860, 6.650–6.990, 7.040–7.180, 7.610–7.725, 7.965–8.620, 8.680–8.940, 10.200–10.840, 11.320–11.490, 11.580–11.850, 11.980–12.430, 13.370–13.760, 14.030–14.340, 14.560–15.030, 15.570–15.860, 16.600–17.020
2	TCS-2	14.340–14.560, 15.150–15.506
3	TCS-3	0.000–0.250, 1.280–1.660, 1.900–1.980, 2.500–2.900, 17.720–18.247
4	TCS-4	3.980–4.450, 5.860–5.960, 6.332–6.650, 7.180–7.610, 7.725–7.965, 8.940–9.090, 11.490–11.580, 11.850–11.980, 12.430–12.640, 13.060–13.370, 15.860–15.980, 16.311–16.600
5	TCS-5	0.250–0.324, 0.394–0.503, 0.516–0.680, 0.940–1.049, 1.117–1.280, 1.980–2.080, 3.220–3.275, 5.960–6.080, 6.091–6.195, 8.620–8.680, 9.090–9.159, 9.185–10.200, 10.950–11.139, 11.159–11.320, 12.640–12.747, 12.755–12.958, 12.966–13.060, 13.760–14.030, 15.030–15.105, 15.115–15.150, 15.514–15.570, 17.600–17.631, 17.640–17.720
6	TCS-6	17.020–17.108, 17.116–17.600
7	TCS-7	5.000–5.140, 5.525–5.600, 6.195–6.323, 6.990–7.040, 10.840–10.950, 15.980–16.302
8	Structures (MNB/MJB)	MJB: 0.324–0.394; MNB: 0.503–0.516, 1.049–1.117, 4.655–4.666, 5.316–5.324, 6.080–6.091, 6.323–6.332, 9.159–9.185, 11.139–11.159, 12.747–12.755, 12.958–12.966, 15.105–15.115, 15.506–15.514, 16.302–16.311, 17.108–17.116, 17.631–17.640



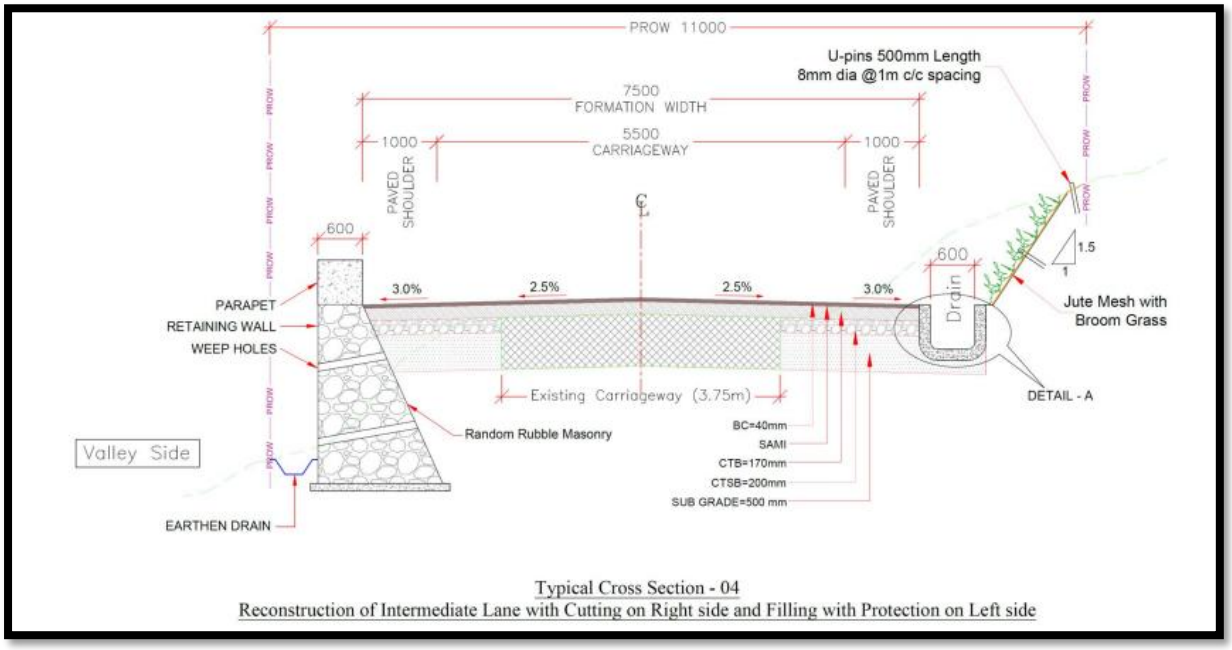
Typical Cross Section-01
Reconstruction of Intermediate Lane in Normal Fill/Cut (<1m)



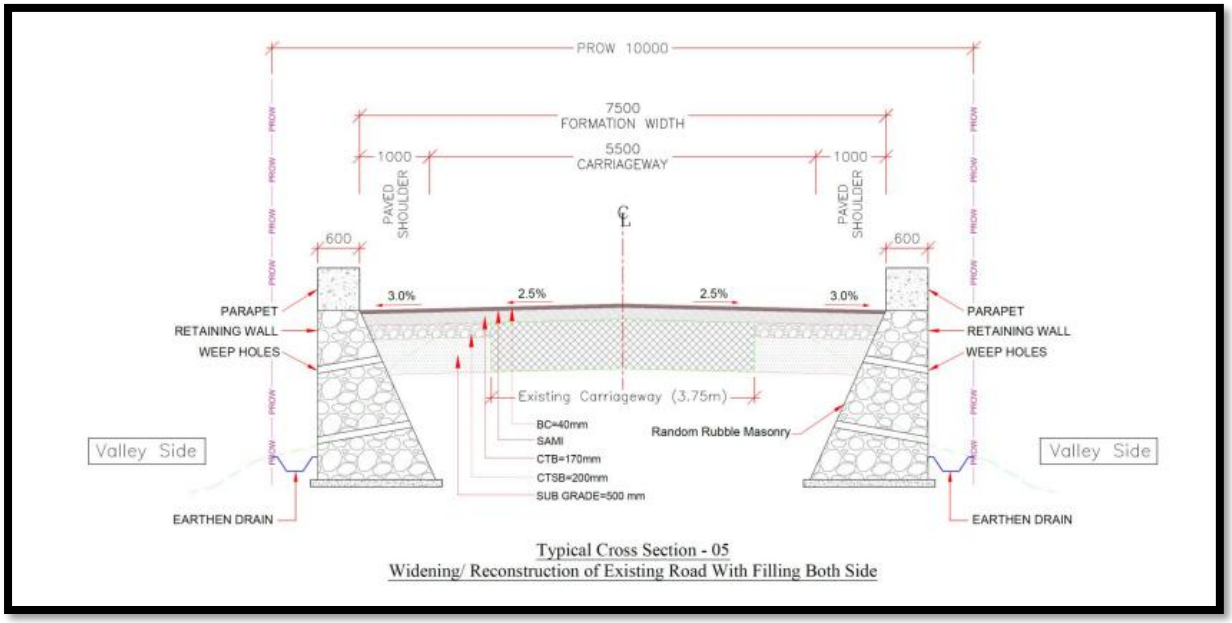
Typical Cross Section - 02
Reconstruction of Intermediate Lane with Cutting on Left side and Filling with Protection on Right side



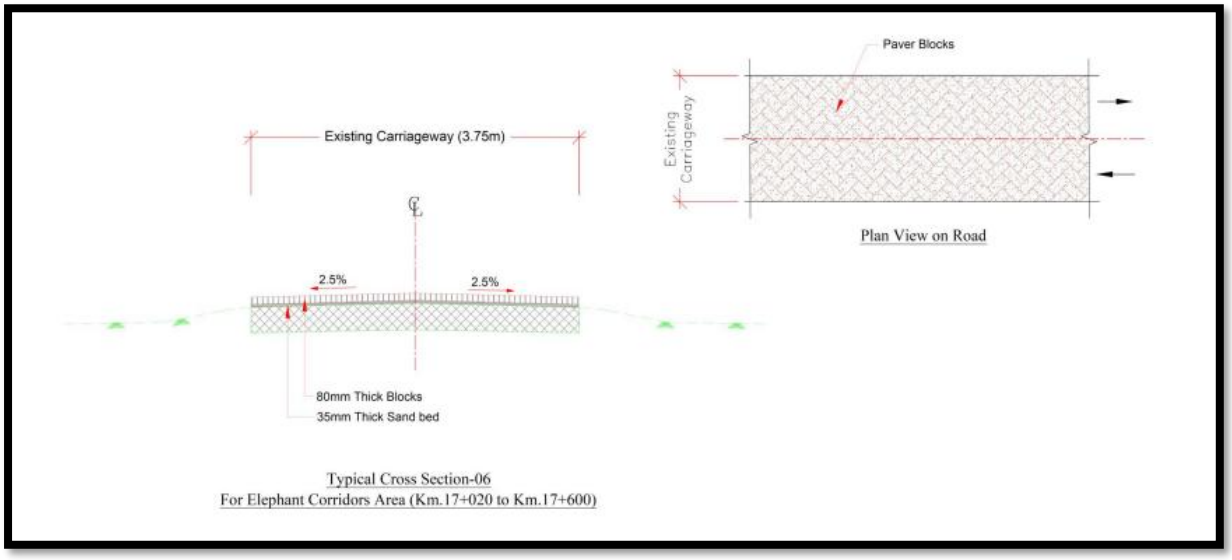
Typical Cross-Section - 03
Reconstruction of Intermediate Lane for Built up Section with Both Side Drain Cum Footpath



Typical Cross Section - 04
Reconstruction of Intermediate Lane with Cutting on Right side and Filling with Protection on Left side



Typical Cross Section - 05
Widening/ Reconstruction of Existing Road With Filling Both Side



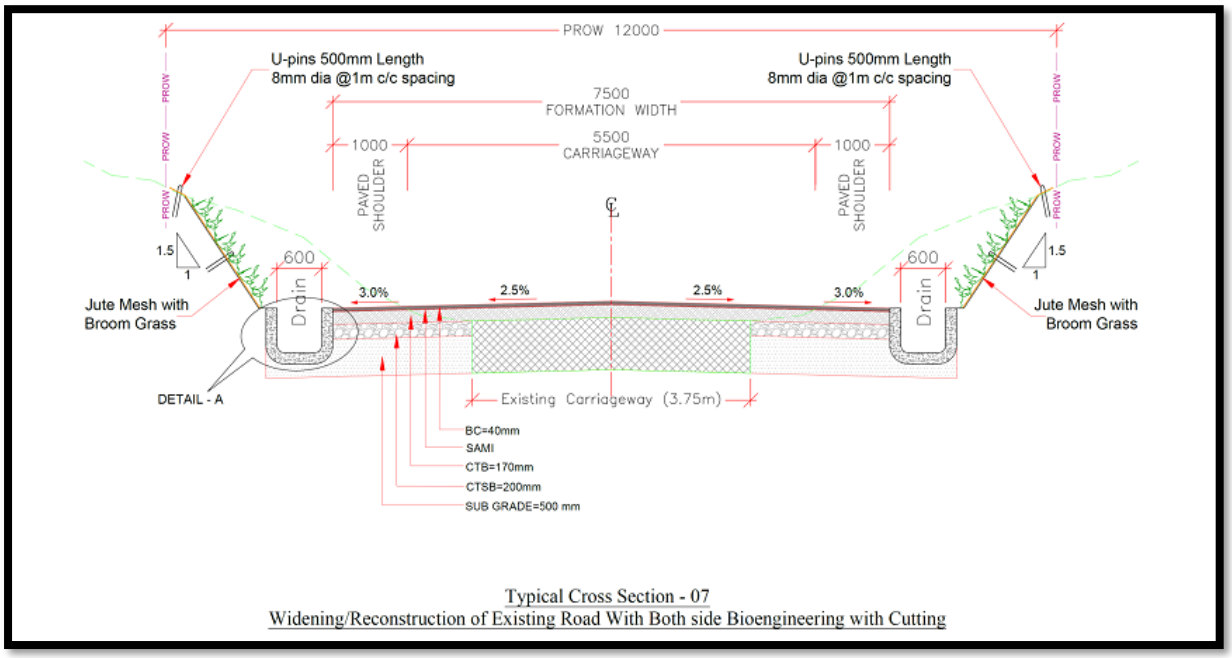


Figure 3.2: TCS Drawing

3.4.3 SETTLEMENTS AND CORRIDOR CHARACTERISTICS

3.4.3.1 Settlements:

The RBB Road passes through hilly terrain, rural settlements and towns. The project incorporates a comprehensive drainage system to ensure proper surface runoff management along the corridor. . The details of the settlements along the stretch are presented in Table 3.6 below.

Table 3.6: Chainage wise List of 17 Habitations/ 6 villages along the project road

Sl. No.	Chainage		Habitation	Village Name
1.	00+00	00+800	Kosi Junction	

2.	00+800	01+200	Moamari	
3.	01+200	01+400	Omorpur	
4.	01+400	01+600	Omor Bazaar	
5.	01+600	02+600	Bajengdoba	
6.	02+600	02+800	Upper Bajengdoba	Bajengdoba
7.	02+800	05+000	Line Ading	Bakenang Songma
8.	05+000	05+400	Rongbang	
9.	05+400	06+800	Mansingre	Mansingre
10.	06+800	08+800	Gosinpita	
11.	08+800	09+600	Bongbanchi	Gosinpita
12.	09+600	11+200	Aneaga	
13.	11+200	12+200	Rangagora	
14.	12+200	12+600	Sembalgre	Bolsong
15.	12+600	14+200	Bolsong	
16.	14+200	17+200	Waramgre	Borjhora
17.	17+200	18+270	Borjhora	

Details of Protection work

The proposed works include 61 locations of earthen drains, 5 locations of footpath-cum-drains in built-up sections, and 20 PCC roadside drains to facilitate efficient storm water disposal. In addition, adequate drainage arrangements are proposed at bridge locations. In case of bridges across a river, runoff from the bridge deck will be discharged directly into the riverbed through properly designed drainage spouts in accordance with IRC standards. A cross slope of 2.5% has been adopted on the bridge deck to ensure effective drainage of rainwater. Further, retaining walls are proposed to provide slope stability and protection, with a total length of 40 m on the left-hand side (LHS) and 28 m on the right-hand side (RHS).

Along the sub project road, a total of 17 existing bus stops are presently available to cater to public transportation needs. To enhance commuter convenience and improve accessibility, 9 new bus stops are proposed at suitable locations based on traffic demand and settlement patterns. The provision of new bus stops/sheds has been incorporated based on agreements reached with the community during the FPIC process. These facilities are additional to and go beyond the initial design provisions, reflecting community preferences and ensuring improved accessibility and convenience along the project corridor.The proposed bus stops will be designed with appropriate lay-bys, shelters, and pedestrian access to ensure passenger safety and smooth traffic flow. This improvement will strengthen public transport infrastructure along the corridor and provide better facilities to road users.

Details of Drain and rest areas are given in Table 3.7.

Table 3.7: Details of Drain and Rest area

Sl. No.	**TCS Type**	**Chainages (From – To)**
1	**TCS-1**	0.680–0.940, 1.660–1.900, 2.080–2.500, 2.900–3.220, 3.275–3.980, 4.450–4.655, 4.666–5.000, 5.140–5.316, 5.324–5.525, 5.600–5.860, 6.650–6.990, 7.040–7.180, 7.610–7.725, 7.965–8.620, 8.680–8.940, 10.200–10.840, 11.320–11.490, 11.580–11.850, 11.980–12.430,

		13.370–13.760, 14.030–14.340, 14.560–15.030, 15.570–15.860, 16.600–17.020
2	**TCS-2**	14.340–14.560 (RHS), 15.150–15.506 (RHS)
3	**TCS-4**	3.980–4.450, 5.860–5.960, 6.332–6.650, 7.180–7.610, 7.725–7.965, 8.940–9.090, 11.490–11.580, 11.850–11.980, 12.430–12.640, 13.060–13.370, 15.860–15.980, 16.311–16.600 (All LHS)
4	**TCS-5**	0.250–0.324, 0.394–0.503, 0.516–0.680, 0.940–1.049, 1.117–1.280, 1.980–2.080, 3.220–3.275, 5.960–6.080, 6.091–6.195, 8.620–8.680, 9.090–9.159, 9.185–10.200, 10.950–11.139, 11.159–11.320, 12.640–12.747, 12.755–12.958, 12.966–13.060, 13.760–14.030, 15.030–15.105, 15.115–15.150, 15.514–15.570, 17.600–17.631, 17.640–17.720
2.	**Footpath cum Drains**	
1	**TCS-3**	0+000–0+250, 1+280–1+660, 1+900–1+980, 2+500–2+900, 17+720–18+247
3.	**PCC Roadside Drains**	
1	**TCS-2**	14.340–14.560 (LHS), 15.150–15.506 (LHS)
2	**TCS-4**	3.980–4.450, 5.860–5.960, 6.332–6.650, 7.180–7.610, 7.725–7.965, 8.940–9.090, 11.490–11.580, 11.850–11.980, 12.430–12.640, 13.060–13.370, 15.860–15.980, 16.311–16.600 (All RHS)
3	**TCS-7**	5.000–5.140, 5.525–5.600, 6.195–6.323, 6.990–7.040, 10.840–10.950, 15.980–16.302
4.	Rest areas	
1.	**Bus Stop (existing)**	2+490, 2+950, 3+700, 7+410, 12+215, 12+850, 13+150, 14+020, 14+930, 17+050, and 18+230 (All LHS) 1+385, 1+915, 10+460, 11+645, 13+620, and 14+350(All RHS)
	Bus Stop (Proposed)	0+050, 0+650, 6+200, 8+200, 10+000, 10+800, 12+000, and 17+600 (Both) 12+900 (RHS)
2.	**Public Toilet (proposed0**	**5**

Bio-engineering

For cutting sections, bio-engineering measures are proposed on both left and right sides where slope heights range from about 1.0 m to 3.0 m. These measures are primarily intended for stabilization of cut slopes, prevention of surface erosion, and protection against rain-induced soil washout. Grass turfing and vegetative cover are provided over the shaped cut slopes to ensure long-term slope stability and minimize erosion.

Bio-engineering measures are proposed for cut-slope stabilization, erosion control, and environmental integration. The treatment includes the installation of biodegradable erosion control mats/jute mesh combined with broom

grass planting to prevent surface erosion and promote vegetation growth. The slope will be formed at a stable inclination, and the mat will be securely anchored using U-pins. The erosion control mat/jute mesh provides additional reinforcement, particularly for higher cut slopes. Toe drainage will be integrated with the pavement to ensure safe disposal of surface runoff. Overall, these measures will enhance slope stability, reduce maintenance requirements, and improve the environmental and visual quality of the project area. **Details of Cutting is given in Table 3.8**

Table 3.8: Details of Cutting

Left Hand Side (Cutting Section)			
From	**To**	**Length**	**Height**
5020	5080	60	-2.0
10860	10920	60	-2.0
15280	15300	20	-2.0
16000	16040	40	-2.0
Total		**180**	
Right Hand Side (Cutting Section)			
5000	5100	100	-3.0
5540	5560	20	-1.0
6400	6480	80	-1.0
6560	6580	20	-2.0
7760	7840	80	-1.0
7920	7960	40	-2.0
11460	11540	80	-2.0
11680	11760	80	-1.0
11860	11880	20	-1.0
12480	12500	20	-1.0
13180	13200	20	-1.0
15900	15920	20	-2.0
16000	16040	40	-2.0
16180	16220	40	-2.0
16340	16420	80	-2.0
16460	16580	120	-2.0
16940	17000	60	-2.0
Total		**920**	

Protection work:

In addition to the protective measures for road works, gabion-type retaining walls have been proposed, covering a cumulative length of 1180 m across all structures within the project. Details are given in table 3.9.

Table 3.9: Proposed protective measures for road works, gabion-type retaining walls

Sr no.	Location of wall	Design chainage	Total length	Roadside	Remarks
1	AT MJB	0+359	200	BHS	Bridge Approach Protection
2	AT MNB	0+509	60	BHS	Bridge Approach Protection
3	AT MJB	1+083	200	BHS	Bridge Approach Protection

4	AT MNB	4+660	60	BHS	Bridge Approach Protection
5	AT MNB	5+320	60	BHS	Bridge Approach Protection
6	AT MNB	6+085	60	BHS	Bridge Approach Protection
7	AT MNB	6+327	60	BHS	Bridge Approach Protection
8	AT MNB	9+172	60	BHS	Bridge Approach Protection
9	AT MNB	11+149	60	BHS	Bridge Approach Protection
10	AT MNB	12+751	60	BHS	Bridge Approach Protection
11	AT MNB	12+962	60	BHS	Bridge Approach Protection
12	AT MNB	15+110	60	BHS	Bridge Approach Protection
13	AT MNB	16+306	60	BHS	Bridge Approach Protection
14	AT MNB	17+112	60	BHS	Bridge Approach Protection
15	AT MNB	17+635	60	BHS	Bridge Approach Protection
Total Length (m)			**1180**		

Where natural streams or drains run parallel and in close proximity of the roadway, appropriate protection measures such as retaining walls, gabion structures with rivet mattress shall be provided to prevent erosion, scouring, and undermining of the road formation, thereby ensuring long-term stability and safety of the highway infrastructure. Details are given in table 3.10.

Table 3.10 Protection Works for Streams Parallel to Road

Protection Works for Streams Parallel to Road				
Sl. No	**Chainage**		**Length**	**Side**
	From	**To**		
1	7565	7610	45	LHS
2	8560	8620	60	LHS
3	8660	8680	20	LHS
4	8880	8940	60	LHS
5	9040	9080	40	LHS
6	9920	10100	180	RHS
7	11180	11320	140	LHS
8	12430	12640	210	LHS
9	12750	12940	190	LHS
10	13140	13230	90	LHS

UTILITY DETAILS

The project road corridor, classified as an Other District Road (ODR) with a total length of approximately 18.27 km, is equipped with several essential utility infrastructures. Electric poles, overhead electric lines, and Optical Fiber (OFR) cables run parallel to the road alignment. These utilities are critical for ensuring uninterrupted power supply and communication services in the project area and will be duly considered during road improvement and construction activities to avoid any disruption or damage.

A total of 177 electric poles, 7 transformers, and 70 electric line crossings are identified along the RBB road corridor for shifting. A total of 91 OFC pillars is identified for shifting along the RBB road corridor, comprising 66 on the LHS and 25 on the RHS. Details of utilities are given in **Annexure1.1.**

3.4.3.2 Corridor Characteristics

The salient features of the RBB road are summarized in Table 3.11 below.

Table 3.11: Current Salient features of the RBB Road

Sl. No.	Characteristics	Features
1	Name of Road	Upgradation of Rongsai Borjhora Bajengdoba (RBB) Road from single to intermediate lane
2	Project Road Length	18.27 km
3	District	North Garo Hills
4	Villages/settlements enroute	6 Villages
5	Terrain	Hilly/Rural
	Existing	▪ The road is affected by various surface damages, including potholes, cracks, and other deterioration. ▪ The section from chainage 12+900 to 12+200 does not have a proper paved or unpaved road; it is currently a human trail
6	Proposed treatment	Intermediate/ configurations, with or without paved shoulders, where required.
7	Bridges	No. of Major Bridge: 02 No. of Minor Bridges – 15
8	Culverts	100
9	Forests / environmentally sensitive areas	• The project stretch between Chainage 17+020 and 17+600 passes through community land with vegetation. The land in this section is classified as community-owned land with natural vegetation, and it does not include agricultural cropland, plantations, or cultivated fields. The vegetation mainly consists of naturally grown shrubs, grasses, and trees typical of community land. • The proposed road improvement works will be carried out within the available Right of Way (ROW). Local communities are not economically dependent on this vegetation for livelihood activities such as fuelwood collection, grazing, or cultivation. As the design strictly utilizes the existing corridor, no impact on community vegetation or local land use is anticipated in this stretch. • Elephant corridors at **CH 17+020 and CH 17+600**
10	Religious Structures Affected	Nil
	Impacted Structures (including Partially physically displaced Structures)	150
11	Major CPR Impacted	No direct impact on CPR

12	Fifth/Sixth Scheduled Areas	Sixth Schedule Area
13	River crossings	02 river crossings (Didram River)
14	Water bodies / ponds	2 Streams, 1 pond (6+200)
15	Sensitive receptors	2LP School, 1 UP School, 1 Senior Secondary School, PWD office and Rest house, 1vPetrol Pump, 1 JJM, 2 community centers. (Chainage details are given in **Table 5.31**). There is no direct impact on any of these CPR.
16	Transshipment areas/truck parking locations	Nil
17	Other features / issues if any	Nil
18	Land Requirement	The total Land requirement that will be acquired permanently for this sub project is 0.133 Ha. For the purpose of Spoil disposal, 1.1420 Ha of land will be required temporarily which has been jointly verified by the Community Members, PWD and independent consultants. Refer to Table 3.16 and 3.17 for details. No additional land is required for the development of community amenities. As confirmed through the Free, Prior and Informed Consent (FPIC) process, all such amenities will be implemented within the available Right of Way (ROW).

3.4.4 TREES

The vegetation along the project road comprises a diverse mix of trees, shrubs, herbs, climbers, ferns, and grasses. Approximately 70 trees are likely to be impacted or require removal due to the proposed widening. Major trees impacted are Jackfruit, Mango, Arecanut, Teak, Sal, Neem, Peepal, Bargad, Siris, Guava, Ber, Moringa, etc. Chainage wise list of trees is given in Table 3.12.

Table 3.12:Chainage wise list of Trees

Sl. No.	Chainage(km)	LHS/RHS	Girth (in cm)	Common Name/ Local Name	Scientific name
1.	0+400	RHS	200	Rain tree	*Samanea saman*
2.	0+500	RHS	190	Neem	*Azadirachta indica*
3.	0+505	LHS	240	Bolbok	*Tetrameles nudiflora*
4.	4+050	RHS	88	Indian Jujubee	*Ziziphus mauritiana*
5.	4+080	RHS	134	Indian Jujubee	*Ziziphus mauritiana*
6.	4+900	RHS	230	Indian Jujubee	*Ziziphus mauritiana*
7.	6+080	LHS	130	Acacia	*Acacia auriculiformis*
8.	7+500	RHS	310	Banyan	*Ficus benghalensis*
9.	8+000	LHS	100	Indian Jujubee	*Ziziphus mauritiana*
10.	8+570	LHS	100	Maytree	*Delonix regia*
11.	8+600	LHS	250	Rain Tree	*Samanea saman*
12.	9+300	RHS	200	Sal	*Shorea robusta*
13.	9+320	RHS	100	Indian Jujubee	*Ziziphus mauritiana*
14.	9+285	RHS	250	Rain Tree	*Samanea saman*
15.	9+340	LHS	80	Indian Jujubee	*Ziziphus mauritiana*
16.	10+650	RHS	100	Rain Tree	*Samanea saman*
17.	10+670	LHS	200	Rain Tree	*Samanea saman*
18.	11+150	RHS	100	Neem	*Azadirachta indica*
19.	11+160	RHS	350	Bolbok	*Tetrameles nudiflora*
20.	11+170	RHS	270	Indian Jujubee	*Ziziphus mauritiana*
21.	11+880	LHS	160	Rain Tree	*Samanea saman*
22.	12+330	LHS	80	Ashok Tree	*Saraca asoca*
23.	12+400	RHS	60	Maytree	*Delonix regia*
24.	12+770	RHS	160	Rain Tree	*Samanea saman*
25.	12+775	RHS	100	Rain Tree	*Samanea saman*
26.	12+780	RHS	260	Neem	*Azadirachta indica*
27.	12+785	RHS	100	April Tree	*Cassia fistula*
28.	12+790	RHS	260	Neem	*Azadirachta indica*
29.	12+795	RHS	180	April	*Cassia fistula*
30.	12+800	RHS	80	Indian Jujubee	*Ziziphus mauritiana*
31.	12+805	RHS	80	Indian Jujubee	*Ziziphus mauritiana*
32.	12+810	RHS	180	Jambu	*Syzygium cumini*

33.	12+850	RHS	210	Rain Tree	*Samanea saman*
34.	14+610	RHS	60	Rain Tree	*Samanea saman*
35.	14+615	RHS	130	Rain Tree	*Samanea saman*
36.	14+620	RHS	230	Rain Tree	*Samanea saman*
37.	14+625	RHS	180	April Tree	*Cassia fistula*
38.	16+410	RHS	80	Acacia	*Acacia auriculiformis*
39.	16+085	RHS	100	Rain Tree	*Samanea saman*
40.	17+720	LHS	100	Sal	*Shorea robusta*
41.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
42.	4+800	LHS	42	Betel Nut Palm	*Areca catechu*
43.	4+800	LHS	35	Betel Nut Palm	*Areca catechu*
44.	4+800	LHS	30	Betel Nut Palm	*Areca catechu*
45.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
46.	4+800	LHS	45	Betel Nut Palm	*Areca catechu*
47.	4+800	LHS	49	Betel Nut Palm	*Areca catechu*
48.	4+800	LHS	48	Betel Nut Palm	*Areca catechu*
49.	4+800	LHS	55	Betel Nut Palm	*Areca catechu*
50.	4+800	LHS	45	Betel Nut Palm	*Areca catechu*
51.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
52.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
53.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
54.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
55.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
56.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
57.	4+800	LHS	50	Betel Nut Palm	*Areca catechu*
58.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
59.	4+800	LHS	60	Betel Nut Palm	*Areca catechu*
60.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
61.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
62.	4+800	LHS	55	Betel Nut Palm	*Areca catechu*
63.	4+800	LHS	35	Betel Nut Palm	*Areca catechu*
64.	4+800	LHS	30	Betel Nut Palm	*Areca catechu*
65.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
66.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
67.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
68.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
69.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*
70.	4+800	LHS	40	Betel Nut Palm	*Areca catechu*

Source: EIS Field Survey

To mitigate the ecological impact of tree loss, plantation at the ratio of 1:10 will be carried out. These mitigation measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP).

3.4.5 SLOPE PROTECTION WORKS

The project corridor in North Garo Hills, Meghalaya, encounters significant challenges due to its rugged terrain, characterized by high hills and deep valleys. The topographic profile of the Rongsai–Borjhora–Bajengdoba (RBB) Road indicates a gently undulating to moderately rolling terrain, with elevation ranging between 100 m and 300 m above mean sea level (amsl). The alignment traverses through a series of low hillocks and intervening valleys typical of the Meghalaya plateau. Overall, the terrain shows three major elevation peaks and two depressions along the 18.27 km stretch, suggesting alternating cut and fill sections. The highest elevation zones occur near the mid and terminal sections of the corridor, whereas the lowest points are located in valley sections characterized by seasonal drainage or stream crossings. This topographical variation implies moderate earthwork requirements during construction, particularly in sections with steeper gradients. The general slope direction varies locally but follows the natural drainage pattern towards adjacent valleys, indicating the need for adequate drainage and slope protection measures. To address these issues, slope stabilization measures are essential to enhance the safety and resilience of the corridor, particularly given the district's susceptibility to landslides and the complexity of the topography. The sub-project proposes geotechnical solutions designed to stabilize both hillside cuts and valley-side slopes.

Location wise slope protection works proposed along with project is given in Table 3.13 below.

Table 3.13: Slope protection works

Chainage	Side	Existing Angle of Repose (°)	Height of Cut (m	Modified Angle of Repose (°)	Slope Protection work proposed
8+600	LHS	9.1°	0.96	**26.6°**	Toe wall/Protection works proposed due to soil erosion in the river on left side (LHS)
9+100	LHS	12.2°	1.29	**26.6°**	Protection work/Protection Works required due to soil erosion in the river on left side (LHS). Gabion and Retaining wall is Proposed.
9+200	LHS	20.1°	2.19	**26.6°**	River training work due to erosion in bridge foundation
9+950	RHS	5.3°	0.56	**26.6°**	Protection works at Didrum riverbank on right side (RHS)

3.5 COMPONENTS & ACTIVITIES OF THE PROPOSED PROJECT

The development of the road would necessarily entail the following three stages. Each of the stages would have several activities and sub-activities. The three stages are

3.5.1 DETAILED DESIGN AND PRE-CONSTRUCTION STAGE

- Carrying out ESIA studies & preparation of ESMP and other Environmental and Social management

instruments such as RAP, IPDP, LMP, SEA/SH plan and OHS plan

- Finalization of alignment with incorporation of environmental, social and community concerns in addition to the design and safety aspects
- Community consultation for land identification for borrow areas, disposal sites, water availability, siting of camps, tree felling permission
- Identification of sources of construction material
- Contractor mobilization
- Setting of Construction Camp

3.5.2 CONSTRUCTION STAGE

- Site clearing & construction camp establishment
- Construction Material procurement & transportation
- Earthwork, hillside cutting, if required, embankment construction, GSB, WBM, operation of equipment, plant and machinery
- Structure demolition & construction work, if required
- Disposal site management
- Surfacing and shoulder protection & road furniture

3.5.3 POST-CONSTRUCTION, OPERATIONS & MAINTENANCE STAGE

- Decommissioning and restoration of camp area, removal of Construction & demolition waste, Restoration of borrow area, disposal sites.
- Operation of vehicles and safety of road users

3.6 RESOURCE REQUIREMENTS

The district of North Garo Hills has come into existence in the year 2012 only. Details of construction material required for this project, their Source and Lead are given in Table 3.14.

Table 3.14: Source and Lead of Construction Materials

S.no	Item	Unit	Quarry Name	Lead Km		RBB Length		Total lead up to Plant
				Road	Katcha			
1	Earth work	cum	Local Area			0.000	18.250	
2	Fine Sand	cum	AMPT Road	33		0.000	18.250	42
3	Coarse sand	cum	AMPT Road	33		0.000	18.250	42
4	Aggregate	cum	Agia Medhipara Phulbari Tura	77	1	0.000	18.250	86
5	Bitumen	MT	Guwahati IOCL refinery	144		0.000	18.250	153

6	Emulsion	MT	Haldia to Site	1031		0.000	18.250	1040
7	TMT Bars	MT	Guwahati SAIL	136		0.000	18.250	145
8	Cement	MT	Guwahati	141		0.000	18.250	150

Assessing the availability of suitable construction materials near the project road is crucial for a road project. Surface water from the Didram river can be used for road construction with prior permission from the water Resource Department Govt. of Meghalaya.

3.6.1 VOLUME OF CIVIL WORKS

The volume of civil works for MLCIP will be influenced by the type of construction methods, typical cross sections and specific materials used in the sub-project area. These civil works are essential for ensuring the highway's stability, safety and environmental sustainability thereby contributing to the long-term success of the road project. List of materials used such as Bituminous Concrete (BC), Dense Bituminous Macadam (DBM), Prime Coat (PC), Tack Coat (TC), Granular Sub Base (GSB), Wet Mix Macadam (WMM), and Shoulder treatments are included in the DPR. This comprehensive range of materials ensures the road's strength, durability and overall performance.

Based on the information provided in the DPR, the embankment protection measures are designed according to the height of the embankment to ensure slope stability and minimize erosion. For embankments having a height of less than 2.0 m, turfing with suitable broom grass species will be carried out on the side slopes to prevent soil erosion and maintain surface stability. For embankments with heights ranging between 2.0 m and 3.0 m, a retaining wall is proposed at the base of the slope to provide additional structural support and prevent scouring at the toe. In cases where the embankment height exceeds 3.0 m, a retaining wall will be provided on the fill side to retain the earth mass, while a breast wall will be constructed on the cut side to support the excavated slope and prevent slope failure. These protective measures have been proposed as per standard engineering practices and IRC guidelines to ensure the durability and safety of the road embankment structure.

As per the earthwork estimation for the project corridor, the total fill quantity is 17469 m^3, and the cut quantity is 60088 m^3. After balancing cut and fill requirements, there remains a surplus of approximately 46,880.9 m^3 of excavated material. This excess earthwork shall be disposed of or utilized by the contractor only at designated and pre-approved disposal sites identified by the Meghalaya Public Works Department (MPWD), in accordance with environmental management and safety norms.

The additional land required for the proposed road improvement works is approximately 0.61 hectares, while an estimated 1.14 hectares of land will be required separately for Spoil disposal purposes. The Consultants along with the officials of the PWD and members of the Village Community including the Nokma jointly identified a total of Nine (9) disposal sites has been identified along the project stretch.

As per the approved BoQ (Page no154) of Chapter 8 of Vol 1 main DPR and Bill no. 13 in BOQ, the scope includes excavation of unsuitable soil, Spoil/debris removal, loading, transportation, and disposal at identified dumping locations, along with spreading, leveling, and compaction at disposal sites. The total quantity covered under the BoQ for disposal is 46880.9 m^3, out of which recyclable material such as suitable excavated earth and granular material will be reused for embankment formation, shoulder filling, and low-lying area backfilling as per site suitability. Only the balance non-recyclable and excess Spoil is proposed for disposal at the identified chainages. Details of spoil disposal site is given in Table 3.15. Spoil disposal will be carried out using benching and gabion structures to ensure stability and prevent erosion.

Table 3.15: Details for the Spoil disposal sites

S. No.	Location	Ownership of Land	Area in Square meter	Volume (Cum)	Latitude	Longitude
1	1st Km	Community land	600	300	25.8963519	90.508565
2	4th Km	Community land	2400	14400	25.891389	90.411389
3	4th Km	Community land	3000	18000	25.891667	90.494444
4	4th Km	Community land	210	210	25.891832	90.49417
5	15th Km	Community land	10	10	25.974876	90.466387
6	15th Km	Community land	1575	7875	25.975013	90.465351
7	17th Km	Community land	600	1020	25.983504	90.462304
8	18th Km	PWD land	625	937.5	25.998268	90.452797
9	NH 51	Community land	2400	1200	25.867017	90.488181
		Total	11420	43952.5		

Further, recycling and reuse of existing pavement materials shall be carried out as per MoRTH Specifications for Road and Bridge Works (latest revision) and IRC:120 guidelines. This approach promotes cut-and-fill optimization, reduces the requirement for fresh borrow materials, minimizes construction waste, and ensures compliance with the Solid Waste Management Rules, 2016 and Environmental (Protection) Act, 1986.

3.7 LAND REQUIREMENTS

Out of the total road length of 18.27 km proposed for sub project road, approximately 13.163 km will be improved within the available ROW (12m) and therefore will not require additional land. For the remaining road length which is 5.163 km, 0.133 Ha of land is required where the available ROW is insufficient to accommodate proposed road improvements. No additional Land is required for community infrastructure part of the FPIC agreement. As these facilities will be constructed within the available ROW. Details of land requirement is given in Table 3.16

The proposed Sub project will also require 1.142 ha of land for spoil disposal on a temporary basis. The required land for spoil disposal site will be taken on lease and will be returned to the land owner after project completion and after having redeveloped in accordance to the community requirements. The Consultants along with the officials of the PWD and members of the village community including the Nokma jointly identified 9 locations for dumping of spoils.: Details of Land requirement for proposed activities is given in Table 3.17.

Table 3.16:Details of Land requirement for proposed activities

	Land required Chainage Wise										
1	Rongbang	5.000	5.140	140	8.5	3.5	12	0.0490	Private	Lekjoni B Marak (Patta available)	Agricultural land
2	Rongbang	5.800	5.900	100	9	1	10	0.0100	Private	Nerilla R Marak (Patta available)	Agricultural land
3	Sembalgre	12.200	12.400	200	9	2	11	0.0400	Private	Christina R Marak (Patta available)	Agricultural land
4	Bolsong	12.600	12.640	40	10	1	11	0.0040	Private	Cartilla Marak (Patta available)	Agricultural land
5	Bolsong B Mahal	15.050	15.150	100	10	1	11	0.0100	Private	Premoni R. Marak (Patta available)	Agricultural land
6	Bolsong B Mahal	15.150	15.250	100	10	1	11	0.0100	Private	Piol R. Marak (Patta available)	Agricultural land
7	Bolsong B Mahal	15.400	15.450	50	9	2	11	0.0100	Private	Piol R. Marak (Patta available)	Agricultural land
	Total Length			**730.000**				**0.1330**			

Table 3.17: Details of proposed activities agreed in the FPIC

Sl. No.	FPIC Agreed Infrastructure / Activity	Description	Land Requirement
1	Improvement of Existing Road	Improvement of the existing road to Intermediate Lane with provision of safety measures, drainage, and protection works in habitation and market areas, subject to technical feasibility	0.133 ha
2	Passenger Waiting Sheds	Construction of passenger waiting sheds at specific village locations along the project road	No additional land required (with in ROW)
3	Drain cum Footpath	Construction of drain cum footpath near settlement areas for pedestrian safety and proper drainage	No additional land required (with in ROW)
4	Boundary Walls	Construction of 30m Boundary wall boundary walls for new Community Hall at km 2+545 to km 2+585.	No additional land required (with in ROW)
5	Public Toilets	Construction of separate toilet facilities for males and females at selected locations	No additional land required (with in ROW)
6..	Disposal Site	Identification and use of designated Spoil disposal sites for safe disposal of excavated materials, with proper stabilization and environmental management measures	1.142 Ha (Land will be leased)

3.8 WATER REQUIREMENTS

The overall water requirement of the project is 24.46 KLD, of which 19.96 KLD will be used for construction activities and 4.5 KLD is required for domestic purposes. Details of Water requirement is given in Table 3.18.

Table 3.18: Water Requirement for Construction Works

Activity	Daily Demand (Liters/km)	Total for 18.27 Km (Liters/day)	Remarks
Concreting and curing	1009.52	18444	Concrete mixing, compaction, culverts, drains.
Dust Suppression at Work Zone	82.19	1514.58	Reduced due to frequent rain; use only on dry days.
Domestic Purpose	-------	4500	For 50 workers (drinking, cooking, sanitation).
Total	—	**24458 Liters/day**	—

Source of water Didram River and permission will

3.9 MANPOWER REQUIREMENT AND IMPLEMENTATION SCHEDULE FOR THE SUB PROJECT

The workforce requirement, as per consultations with the DPR, will vary during different stages of construction, with peak manpower estimated at about 86 persons. Around 65–70% of the labour force is expected to be sourced locally, while skilled personnel such as machine operators, concrete casting crews, supervisors, and engineers may be engaged from outside the project area and accommodated in construction camps. The project construction period for 18.27 km subproject stretch is considered as 36 months. The total estimated cost of the project is approximately 132.32 Crore (as per DPR).

4. ANALYSIS OF ALTERNATIVES

4.1 INTRODUCTION

In line with best practices for managing environmental and social impacts, several alternative approaches have been considered for the proposed road widening and upgrade project. The design is being refined to enhance safety, improve the road structure, and accommodate both current and future traffic demands. This chapter presents an analysis of the potential impacts under the "With Project" and "Without Project" scenarios.

4.2 WITH AND WITHOUT PROJECT ALTERNATIVES

Alternative analysis was carried out for the project stretch vis-à-vis design scenarios and one scenario of without project. These are described in the following sections.

4.2.1 WITHOUT PROJECT SCENARIO

The road traverses areas with high population densities, particularly in Bajengdoba, as well as hilly and rural stretches where traffic is frequently disrupted due to poor road conditions and the demand for efficient through-traffic movement.

The continued growth in population, rising traffic volumes, and expanding economic activity along the corridor are likely to exacerbate the existing challenges. Without the proposed upgrades, current road safety hazards and adverse environmental impacts along the route are expected to persist and worsen. Additionally, the limited socioeconomic development of these remote and underdeveloped areas would remain constrained. Therefore, halting the project would not be practical or justified, as it would impede essential improvements and limit the potential for economic growth in the region.

4.2.2 WITH PROJECT SCENARIO

The "With Project" scenario is expected to generate positive long-term impacts across social, environmental, economic, and financial dimensions. Key interventions include widening the existing roadway to intermediate lanes, in line with the project's objectives.

From an economic perspective, the project is viable and is anticipated to substantially improve current conditions, supporting the development goals set by the Government of Meghalaya and enhancing the region's growth potential.

While the project promises multiple developmental benefits, it is important to recognize that, like all infrastructure initiatives, it may also result in certain impacts on the environment and local communities.

Potential environmental and social impacts can be mitigated through the adoption of best environmental management and social development practices. Where impacts cannot be fully avoided, suitable mitigation measures will be implemented to minimize and offset adverse effects. A detailed comparison of the "With Project" and "Without Project" scenarios, along with the anticipated benefits of the proposed project, is presented in Table 4-1 below

Table 4.1: "With and Without" Project Scenarios – A Comparative Assessment

Component	"With" Project Scenario	'Without" Project Scenario
Highway Geometry	Intermediate lane with shoulder and paved surface is being developed with geometric improvements	Existing Single/Intermediate lane carriageway with poor geometry
Design Speed	(30-50 kmph for Intermediate Lane)	30-40 kmph entire project section.

Component	"With" Project Scenario	'Without" Project Scenario
Congestion in Settlements	Improved carriageway with good surface and separated footpath with railing in built-up area reduces interaction of pedestrians with through traffic resulting in reduction of vehicular emissions, reducing travel time and vehicle operating cost. This in turn contributes to lowering of GHG emission; and may improve people/public health due to no or low exposure period.	Lack of road or lack of good road surface with shoulder and foot path, congestion and frequent vehicle stoppage due to mixing of local, pedestrian and through traffic will increase localized accumulation of vehicular emission with potential impacts on human health and contribute to generation of GHG emission.
Felling of roadside trees	Felling of both old and young trees. Old and weak trees near the road edge shall be a road hazard and shall be felled. Ten times of felled trees, the number of new young and healthy saplings to be planted as compensatory afforestation	No Felling of trees hence maintaining the healthy local ecology.
Pedestrian safety	Pedestrian facilities in the form of footpath, lightning, etc. are to be provided in built-up area locations.	Lack of dedicated pedestrian facilities such as footpaths and adequate lighting making it unsafe for pedestrians.
Road Safety Measures	Provision of proper road markings, zebra crossings, crash barriers and improvement of geometry to reduce accidents.	Accident incidents will rise with an increased traffic volume.
Environmental Quality	Development of roads in hilly and urban settlements improves environmental quality within the urban areas due to lowered pollution levels and relieving of congestion. Besides, an aggressive tree plantation and provision of enhancement features shall not only provide aesthetics but also improve the quality of air.	Poor in settlement areas due to non-motorable road conditions, congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion.
Drainage	Will be improved due to reconstruction of culverts / bridges/ side drains with adequate hydraulics.	These issues remain un-addressed without the project
Roadside Amenities	Appropriate roadside amenities to be provided at various locations along the corridor.	Not adequate in the present scenario.
Wayside Facilities	Wayside facilities are proposed at several locations, where necessary like rest areas, with appropriate facilities for recreation, road public toilets, telephones etc.	Not of adequate standards, quality and number in present scenario.
Environmental Enhancement	Enhancement of landslides/water bodies, community and cultural properties	No enhancement measures involved.
Social Development	Higher potential for social development due to improvement in access and	Social development activities are likely to be significantly constrained due to the severe

Component	"With" Project Scenario	'Without" Project Scenario
	consequent increase in connectivity.	inadequacy of infrastructure.
Financial and Economic Analysis	Project financially viable for upgrading from existing lane configuration to intermediate lane configuration.	The cost of maintenance while catering to the projected higher traffic, accident cost, Vehicle operating cost & travel time cost shall be higher.

4.3 ENVIRONMENTAL AND SOCIAL ALTERNATIVES CONSIDERED FOR THE PROPOSED STRETCH

Various avoidance measures have been developed to minimize environmental and social impacts and to protect sensitive features along the proposed sub-project road. The land requirement has been minimized as the road improvement will be undertaken within the available Right of Way (ROW) to the maximum possible extent. The total available length of the available Right of Way (ROW) along the project corridor is 13.163 km. For the remaining 5.163 km, approximately 0.133 ha of additional land will be required to maintain the proposed 12 m ROW. Table 4.2 summarizes the measures adopted to offset these impacts, and a detailed description of each measure is presented in the following sections.

Table 4.2: Alternative considerations for Minimization of Environmental and Social Impacts

Sr. No.	Observation of RBB Road	Compliance / Proposal in DPR
1	Drains with footpath and railing required at Kosi Bazaar (Chainage 0.00 Km).	From Km 0+000 to Km 0+250, footpath-cum-drain has been provided.
2	Road submerged at Km 0.600; embankment to be raised with new culvert. Toe walls required to protect paddy fields. Footpath.	FRL raised by 1.0 m at Km 0+600. Toe wall proposed from Km 0+610 to Km 0+670.
3	Drains with footpath required at Omon Bazaar (Km 1.30).	Footpath-cum-drain provided from Km 1+280 to Km 1+660. Bus Shed (RHS) proposed for repair at Km 1+400.
4	Road between Km 1.20–1.30 submerged during heavy rains; level to be raised with culvert.	FRL raised at Km 1+200. New Box Culvert proposed at Km 1+310.
5	Toe walls required at Km 1.80 due to paddy fields and road expansion.	As per design, toe wall not required.
6	Retaining walls required at Km 2.90 and 3.20 to protect houses.	As per design, retaining wall not required.
7	Drains with footpath required at Kristo Jyoti HSS and Govt. LP School (Km 3.50). Zebra crossings, speed calming, cycle parking, separate toilets required.	Zebra crossings and speed calming measures proposed.
8	Cross drainage works required at Km 4.10 with protection works.	New Pipe Culvert proposed at Km 4+150. Gabion Wall proposed from Km 3+990 to Km 4+090.
9	At Mansinggre locality (Km 5.40–7.60), toe walls along paddy fields and uphill protection works required.	435 m protection works proposed between Km 5+400 to Km 7+600.

10	Retaining wall required at Km 12.50.	Gabion Wall proposed from Km 12+430 to Km 12+490.
11	610 m approach road required to Waramgre village (Km 17.60).	Zebra crossings and speed calming measures proposed
12	In 17+020 to 17+600 Elephant corridor and Community vegetation falls under this location.	The Existing Blacktop will be maintained only with no further improvement. speed restrictions (rumble strips/table-top crossing), signages and timed movement restrictions at night, if necessary, to ensure safe passage and reduce human–elephant conflict. Installation of AI-based camera systems (as per RDSO specifications, RDSO/SPN/TC/65/2021) along identified elephant movement zones to continuously monitor and detect elephant presence. TCS 6 is designed for the Elephant crossings.

The Environmental and Social Impact Assessment conducted during the pre-design stage helped identify and mitigate potential negative impacts of the project. While the project is expected to provide numerous benefits, the assessment highlighted potential adverse effects associated with widening the road within the proposed 12 m right-of-way. Along these stretches, roadside communities are likely to be directly and immediately affected by construction activities, potentially experiencing losses of land, assets, and livelihoods. In line with the mitigation hierarchy for managing environmental and social risks, alternative analyses were conducted to minimize direct negative impacts. Based on these analyses, the design team was advised to limit road widening to within the existing right-of-way.

Mitigation measures primarily focus on settlements along the project road, particularly villages and towns or areas with the highest potential impacts. Stakeholder recommendations have been incorporated into the designs wherever feasible.

The following is a summary of the considerations incorporated into the road design to mitigate environmental and social impacts:

- Widening of the road within the available ROW in order to avoid the significant loss of land, structures and livelihood.
- Curve improvements will be taken up wherever feasible to minimize impacts that may affect the local settlements especially in built up areas.
- Paved shoulders will be provided wherever possible to accommodate non-motorized traffic.
- Displacement will be avoided by adjusting the alignment, narrowing the impact zone, or tailoring designs to meet both rural and urban cross-section requirements.
- Safety features, including speed control measures near schools, healthcare facilities, religious institution, built up areas and other sensitive areas have been incorporated in the DPR.
- Ensure continuous access to businesses and residential properties throughout the construction period.

Project specific

- Elephant crossing at Ch17+020 to 17+600 has been recorded at this sub project and validated by the state forest department. Maintenance of existing pavement will be undertaken on this stretch.
- Footpath-cum-drain with railing provided from Km 0+000 to Km 0+250 at Kosi Bazaar.
- FRL raised by 1.0 m at Km 0+600; toe wall proposed from Km 0+610 to Km 0+670 for protection of paddy fields.

- Footpath-cum-drain provided from Km 1+280 to Km 1+660; bus shed (RHS) proposed for repair at Km 1+400.
- FRL raised at Km 1+200 and new box culvert proposed at Km 1+310.

5. BASELINE ENVIRONMENT

5.1 GENERAL

This chapter presents the existing environmental and social conditions of the RBB project area, compassing natural, physical, biological, cultural, and socio-economic components. Based on this baseline scenario, potential impacts of the proposed sub-project will be identified. The approach and methodology for baseline data collection are detailed in Section 1.3 of Chapter 1

5.2 NATURAL ENVIRONMENT (METEOROLOGY)

This section describes the current meteorological conditions of the area, including climate, temperature, rainfall, and relative humidity.

5.2.1 CLIMATIC CONDITIONS

The climate in the project area is moderate and highly humid, with three distinct seasons: summer, rainy, and winter. The summer season occurs from March to May, followed by the southwest monsoon, which lasts until September. The winter season begins in November and continues through February

5.2.2 TEMPERATURE

In North Garo Hills, winter generally begins in mid-November, with January being the coldest month. During this period, maximum temperatures range from 24–26°C, while minimum temperatures can drop to 10–12°C. Summer starts in March, with July and August typically being the hottest months. During summer, maximum temperatures range between 30–33°C, and minimum temperatures are around 22–24°C. The monthly mean maximum and minimum temperatures for the nearest location, Shillong, as recorded by the India Meteorological Department (IMD), are presented in Table 5.1.

Table 5.1: Monthly Mean Maximum and Minimum Temperature

Month	Maximum Temperature in °C	Minimum Temperature in °C
January	24.5	12.5
February	25.0	13.0
March	30.0	18.0
April	31.0	20.5
May	32.5	22.0
June	31.5	23.5
July	33.0	25.0
August	32.8	25.2
September	32.0	24.0
October	30.5	21.5
November	28.5	17.0
December	25.5	13.5

Source: Climatological Table, 2020

Temperature Projection and Implications for RBB Road

According to the Meghalaya State Action Plan on Climate Change (SAPCC, 2022), the Garo Hills region including the North Garo Hills District is projected to experience an increase in mean annual temperature of approximately 1.8–1.9°C by the mid-century period (2021–2050) relative to the 1975 baseline, based on the HadRM3 (PRECIS) regional climate model under the A1B scenario. This gradual warming trend is expected to intensify surface heat exposure and increase the frequency of hot days. For the Rongsai–Borjhora–Bajengdoba (RBB) Road corridor, such temperature rise may accelerate bituminous pavement softening, rutting, and surface deformation, particularly in low-lying or exposed segments. To enhance climate resilience, it is recommended to adopt temperature-resistant

bitumen grades (higher Performance Grade or polymer-modified binders), ensure adequate pavement compaction, and improve roadside drainage and vegetative cover to mitigate thermal stress. The integration of these measures will align the road design and maintenance strategies with future climate projections for the region.

5.2.3 RAINFALL AND HUMIDITY

North Garo Hills experiences a subtropical monsoon climate with high humidity throughout the year. Pre-monsoon showers occur during April and May, often accompanied by thunderstorms and occasional hailstorms, followed by a brief dry spell. The southwest monsoon typically begins in late May or early June, with peak rainfall occurring between June and August. The hilly terrain, particularly in the southern and central parts of the district, receives the heaviest rainfall, which contributes to slope instability and increases the risk of landslides along the road corridor. The average annual rainfall during 2018-2020 is presented in Table 5.2, while Table 5.3 provides the month-wise relative humidity for the year 2020 (nearest location: Shillong, IMD data).

Table 5.2: Last 5 years rainfall data for North Garo Hills District

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall
2018	15.2	18.0	50.0	80.0	200.0	400.0	350.0	320.0	250.0	80.0	20.0	10.0	1,693.2
2019	10.0	12.0	40.0	90.0	310.0	380.0	370.0	300.0	240.0	100.0	15.0	5.0	1,872.0
2020	12.0	15.0	55.0	100.0	320.0	420.0	360.0	330.0	260.0	90.0	10.0	8.0	2,020.0

Source: Customized Rainfall Information System, Hydromet Division, IMD

Table 5.3: Month-wise Relative Humidity

Month	08.30 Hrs	17.30 Hrs
January	88	75
February	85	70
March	80	65
April	82	73
May	87	78
June	93	90
July	92	88
August	90	85
September	88	82
October	85	78
November	83	73
December	87	75

Rainfall Projection and Implications for RBB Road

The Meghalaya State Action Plan on Climate Change (SAPCC, 2022) indicates that the Garo Hills region, including North Garo Hills District, is projected to experience an overall increase in annual rainfall by about 10–15% by mid-century (2021–2050) compared to the 1975 baseline, under the HadRM3 (PRECIS) regional model using the A1B scenario. While total monsoon rainfall is expected to rise, the distribution pattern will likely become more erratic, with intensified short-duration rainfall events and longer dry spells. Such changes could exacerbate surface runoff, soil erosion, and waterlogging along the Rongsai–Borjhora–Bajengdoba (RBB) Road corridor, particularly in low-lying and hilly sections. To address these risks, the project should incorporate enhanced cross-drainage capacity, lined roadside drains, bioengineering for slope protection, and rainwater outlet management to reduce erosion and flooding. The design must also ensure maintenance-friendly drainage infrastructure capable of handling increased peak flow intensities projected for the mid-century climate scenario.

For bridge/cross drainage hydrology analysis, observed hourly rainfall records and local IDF (Intensity–Duration–Frequency) curves are presently unavailable for the project area. Therefore, in the absence of observed short-

duration rainfall records, shorter-duration rainfall estimates required for hydrological assessment have been derived using standard hydrological conversion procedures and provisions of IRC SP:13-2022, together with conservative engineering assumptions.

District wise Daily Rainfall Data in the project corridor

A number of rain gauge stations were installed in Meghalaya under the hydrometeorological modernization programme of the Indian Meteorological Department (IMD) during 2009, supported through World Bank and Central Government funding initiatives. Daily rainfall data from IMD rain gauge stations located in West Garo Hills, South Garo Hills, East Garo Hills, and North Garo Hills were analyzed for the period 2009–2025 and attached as Annexure I. The maximum observed one-day rainfall values from the available 16-year record are summarized below:

District	Date	1 day (24 hr) Max Rainfall in mm
West Garo Hills	31-05-2021	245.83
South Garo Hills	15-06-2021	248.71
East Garo Hills	15-06-2021	231.56
North Garo Hills	31-05-2021	237.68

The observed rainfall data is available only for a limited period of 16 years. Therefore, IMD Gridded Rainfall Data (0.25° × 0.25° resolution), available for approximately 110 years, was also studied for regional assessment. The IMD Gridded data series also have 1 day (24hr) rainfall data. The maximum one-day rainfall of year 1980 to 2025 has been attached as Annexure II.

However, a major limitation of the IMD gridded rainfall data (0.25° × 0.25° resolution),in Meghalaya is the highly complex topography and localized microclimatic conditions of the state. Due to steep terrain and orographic effects, adjacent regions often experience significantly different rainfall intensities. Consequently, regional-scale gridded rainfall data may not accurately represent localized extreme rainfall events required for hydrological design. Similar inconsistencies were observed during comparison between observed rain gauge data and IMD gridded rainfall data.

Considering the above, the design rainfall corresponding to 24-hour duration and 100-year return period has been adopted from the CWC Flood Estimation Report, which represents standard engineering practice for hydrological design of bridges and cross-drainage structures in ungauged catchments in India.

Further, historical IMD daily rainfall observations from nearby districts indicate that observed extreme one-day rainfall events are generally lower than the adopted regional design rainfall values, supporting the conservative nature of the selected design rainfall for hydrological assessment.

As per the CLIMATE CHANGE VULNERABILITY AND PROJECTIONS FOR PROJECT MITP (MEGHALAYA) annex1, it is recommended that the climate change factors shall be applied to "increase *in **1-day maximum rainfall (Rx1day)** is a critical hydrological variable for calculating **design discharge, flood levels, and flow velocity**, and must therefore be used as the **climate change adjustment factor** in the design of road and bridge infrastructure."*

The MITP report recommends climate adjustment factors of approximately:

- +15% for drainage systems,
- +25% for culverts and minor bridges, and
- up to +35% for major bridge hydrological design parameters,

Accordingly, climate resilience considerations have been incorporated in the adopted design rainfall through application of the recommended climate adjustment factor, enhanced hydraulic capacity, additional freeboard above expected flood levels, and sensitivity assessment for future extreme rainfall scenarios.

Estimation of One Hour Rainfall for hydraulic assessment

100 Year Return Period rainfall for 24 hr,	=	360	mm
(CWC Flood Estimation Report for Sub Zone 2b)			
As per MITP Report Climate change factor for rainfall	=	1.252	
Considering Climate Change 100 year 24 hr Rainfall	=	450.7	mm
Adopted 100 year 24 hr Rainfall	=	450.7	mm
Intensity of Rainfall Ic for tc=24hr (Considering 100 year 24 hr rainfall)			
Ic = (F/T) x((T+1)/(tc+1))	=	234.75	mm/hr
Conversion ratio for 1 hrs as per CWC Flood Estimation Report	=	0.48	
100 year maximum 1 Hr Rainfall	=	216.336	mm/hr

The project catchments are steep and hilly with short flow paths, resulting in low time of concentration, generally less than one hour. Such catchments respond rapidly to intense rainfall and generate high peak runoff within a short duration. Therefore, the Critical Intensity Method as per IRC SP:13–2022, Clause 4.7.6 has been adopted for estimation of design discharge.

The critical intensity is given by:

$$I_c = \frac{F}{T}\left(\frac{T+1}{t_c+1}\right)$$

$$I_c = I_o\left(\frac{2}{t_c+1}\right)$$

The time of concentration is calculated using:

$$t_c = 0.87\left(\frac{L^3}{H}\right)^{0.385}$$

The calculated 1-hour rainfall intensity of 234.75 mm/hr is nearly equivalent to the maximum observed 24-hour district rainfall of approximately 245 mm, reflecting a highly conservative design approach. Accordingly, the adopted short-duration rainfall values and supplementary hydraulic safety provisions adequately account for extreme rainfall conditions, future climate variability, and uncertainties associated with projected extreme storm events. The incorporation of these conservative hydraulic and climate resilience measures is expected to enhance the long-term safety, reliability, and performance of the infrastructure under future hydrological extremes.

Adequacy Check as per IRC SP 13:2022

After incorporating the resilience factor into the design rainfall, the adequacy of both existing and proposed bridges was evaluated using the methodology explained below. Bridges found to be inadequate have been proposed for

reconstruction, while those meeting the required capacity criteria have been recommended for retention.

Considering that the average catchment area is ranging between 1.5 to 3 sq.km and the existing bridge widths range between 7 m and 15 m, a detailed adequacy check was performed. The analysis indicated that at many locations, the existing bridge sizes were adequate; accordingly, the proposed bridge dimensions have been kept the same and revised accordingly. The details are provided in the inventory.

The detailed adequacy check is given below:

Example for Discharge calculation and adequacy check proposed box type MNB

Catchment Area (A) = 1.61SQKM =161 ha

Length of Longest stream (L) = 2

Rational Formula

Design Discharge Q 100Design Discharge Q 100 =0.028 x Px f xA xIc

H- Elevation Difference between critical point to the structure= 75 m

Time of Concentration tc is given by Eq 4.9 = (0.87 x L3/H)0.385

= (0.87 x 1.1^3x75) ^0.385

= 0.20 hrs

Design Rainfall = 45.072 cm

From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic = 45.072/ 24 x ((24+1)/0.2+1)

= 39.10 cm/hr

From IRC SP 13, Spread Factor "f" from f curve fig 4.2From IRC SP 13, Spread Factor "f" from f curve fig 4.2 = 0.99

From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics

P = 0.4

Design Discharge Q 100 = 0.028 x Px f xA xIc =0.028 x0.4 x 0.99 x 161 x 39.10

= **69.80 Cumecs**

Adequacy check for Box type bridge

size of box - 10.60m x 2.178m

IRC SP 13 clause 19.2.8

Area 23.0868 Sqm

Wetted Perimeter, P = 14.956 m

R= A/P 1.54

As RC SP:13 Clause 19.2.8

Entry loss Ke= 0.572 $R^{0.3}$ 0.65

Friction loss -0.035 $L/R1^{.25}$ 0.461

λ -$A/(1+ke+kf)^{1/2}$ 15.88

Height of box 2.178 m

Q capacity =$\lambda*(2gH)^{0.5}$ =**103.82 Cumecs**

or

By Mannings formula =Ax 1/n x $R^{2/3}$ x $S^{0.5}$ =

= 1/0.013 x $1.54^{0.66\,x}$ x $(1/750)^{0.5\,x}$ 23.0868

=86.1 Cumecs

n for concrete 0.013, s slope for box type of bridge can be adopted between 500-1000 in std practice

Q design=69 < Q capacity= 103cumecs

Based on both methods, the box culvert is hydraulically adequate to safely convey the design discharge

Adequacy check for deck type proposed bridge

The longitudinal slope of the stream has been obtained from the surveyed longitudinal section (L-section), while the cross-section has been established based on detailed topographical survey data. The High Flood Level (HFL) has been assumed considering the design discharge and site conditions, and the corresponding cross-sectional flow area has been determined. Using the computed longitudinal slope and hydraulic parameters, the discharge has been evaluated using Manning's equation. The discharge thus obtained has been compared with the discharge estimated using the Rational Method, and the higher of the two values has been adopted for design to ensure a conservative approach. Based on the assessed HFL, the soffit level of the proposed bridge has been fixed by providing the requisite freeboard in accordance with relevant codal provisions.

The longitudinal slope calculated based on survey =0.069

The cross-section at the bridge location has been developed based on the actual bed levels of the nala/stream obtained from topographical survey (indicated in blue). The High Flood Level (HFL) has been marked in red at the bridge location on the cross-section, as depicted below.

HFL= 264.250m

Cross - Sectional Area of Flow, A = 12.830 Sqm

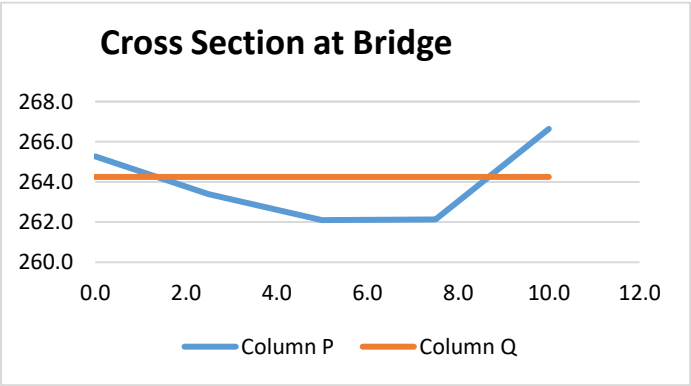
Wetted Perimeter , P = 20.264 m

Hydraulic Mean Radius, R = A / P = 0.633 m

Longitudinal Slope (as calculated), S = 0.069

n 0.030

V=1/n x $R^{2/3}$ x $s^{1/2}$= 6.462m/s



Q= V x A = 6.642 x 12.833

Discharge = 82.905 cumecs

at the bridge location, the discharge corresponding to the assumed High Flood Level (HFL) of 264.25 m has been found to be greater than the estimated design discharge of 69 cumecs. Hence, the adopted HFL is considered adequate for safely passing the design flood. The same HFL has been used for fixing the soffit level of the proposed bridge

In a similar manner, the hydraulic capacity of the existing bridge has also been assessed using the same methodology to evaluate its adequacy in safely conveying the design discharge.

Adequacy check for deck type existing bridge

Rational Formula

Design Discharge Q_{100} Design Discharge Q 100	=	0.028 x Px f xA xI_c	
Catchment area	=	121	Ha
H- Elevation Difference between critical point to the structure=		40	m
Time of Concentration tc is given by Eq 4.9	=	$(0.87 \times L^3/H)^{0.385}$	
	=	0.18	hrs
100 years return period rainfall for 24hrs as per CWC flood estimation report Subzone 2b			
	=	45.072	cm
From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic	=	45.072/ 24 x (24+1)/0.18+1)	
	=	39.89	cm/hr
From IRC SP 13, Spread Factor **"f" from** f curve fig 4.2From IRC SP 13, Spread Factor **"f" from** f curve fig 4.2	=	0.995	
From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics			
P	=	0.4	
Design Discharge Q_{100}	=	0.028 x P x f x A x I_c	
	=	**53.79 cumecs**	

Existing size of box	10.60	x 2.971
IRC SP 13 clause 19.2.8		
Area	31.4926	Sqm

Wetted Perimeter , P =	16.542	m
R=	1.90	
Entry loss Ke= 0.572 $R^{0.3}$	0.69	
Friction loss -0.035 $L/R^{1.25}$	0.355028	
λ -$A/(1+ke+kf)^{1/2}$	22.00126	
Height of box	2.971	m
$Q=\lambda*(2gH)^{0.5}$	**167.976**	Cumecs

Discharge carrying capacity of box is more than calculated discharge therefore it is safe

Design calculations justifying consideration of Climate resilience factor in design of hydrology for culverts is attached below:

Hydrology at CA CH-0+600 RBB Road								
	HYDROLOGY OF Culvert AT KM 0+600							
1	Name of River / Stream / Nala	=	Local					
2	Catchment Area (**A)**	=	0.22	SQKM				
3	Length of Longest stream (L)	=	0.091	KM				
4	Point Rainfall in mm	=	36	cm				
5	CWC Subzone	=	2b					
6	**Modified rainfall after application of Climate resilience factor 1.252**	=	45.072	cm				
A	**Estimation of Design Discharge by Emperical Formula as per**							
	IRC SP-13-2004, Article 4							
1	**Dickens Formula**							
	Q	**=**	**CA^(3/4)**					
	C =14-19 where annual rainfall is more than 120cm							
	For 1500mm rainfall	=	18					
			=18x0.091^ (3/4)					
	Q	=	5.78	Cumecs				
B	**Rational Formula**							
	Design Discharge Q_{100}	=	0.028 x Px f xA xI_c					
	Rational can be used for small culverts with basin upto 15 Sqkm							
		=	22	Ha				
	H- Elevation Difference between critical point to the structure=		4.14	m				
	Time of Concentration tc is given by Eq 4.9	=	$(0.87 \times L^3/H)^{0.385}$					
			= (0.87 x 0.091^3x4.14)^0.385					
		=	0.03	hrs				
	100 years return period rainfall for							

	24hrs as per CWC flood estimation report Subzone 2b and application of climate resilience factor	=	45.072	cm				
	From IRC SP 13 eq. 4.10a Intensity of rainfall , Ic	=	45.072/ 24 x (24+1)/0.03+1)					
		=	45.39	cm/hr				
	From IRC SP 13, Spread Factor **"f"** from f curve fig 4.2	=	0.995					
	From IRC SP 13, table 4.1, coefficient of runofff for the catchment characterstics							
	P	=	0.6					
	Design Discharge Q_{100}	=	0.028 x Px f xA xI_c					
		=	**16.69**	Cumecs				
D	**Design Discharge : (Refer IRC - SP : 13 - 2004, Clause : 6.2)**							
	Discharge by Dicken's Formula =	5.78	m^3/s					
	Discharge by Rational Formula =	16.69	m^3/s					
	Maximum Discharge =	16.69	m^3/s					
	Hence, Design Discharge =	**8.67**	m^3/s					
	Design discharge from observed flood	8.67	Cumecs					
	Dimension of Culvert	1	m dia.					
	Area of flow (A)	0.7854	m^2					
	Perimeter of flow	3.1416	m					
	Slope of flow	0.454945						
	Hydraulic mean depth (R) = A/P	0.250001	m					
	Rugosity coefficient (n)	0.033						
	Conveyance factor (λ) = (A.R^2/3)/n	9.440687						
	Capacity of culvert	6.367707	m^3/s					

		Revise						
	Revised section of Culvert due to lower capacity of Culvert. Revision in design discharge calculation are mentioned below							
	Dimension of Culvert	1 x 5 x 2.8	m Box					
	Area of flow (A)	11.9000	m^2					
	Perimeter of flow	9.7600	m					
	Slope of flow	0.028867						
	Hydraulic mean depth (R) = A/P	1.219262	m					
	Rugosity coefficient (n)	0.033						
	Conveyance factor (λ) = (A.R^2/3)/n	411.5853						
	Capacity of culvert	69.9296	m^3/s					
		Safe						

Note: The additional structures proposed on the project roads to address climate-resilient design considerations have been incorporated in the submitted Final Detailed Project Report under Chapter 6, Clause 6.19, Page No. 132. Kindly refer to the attached image below.

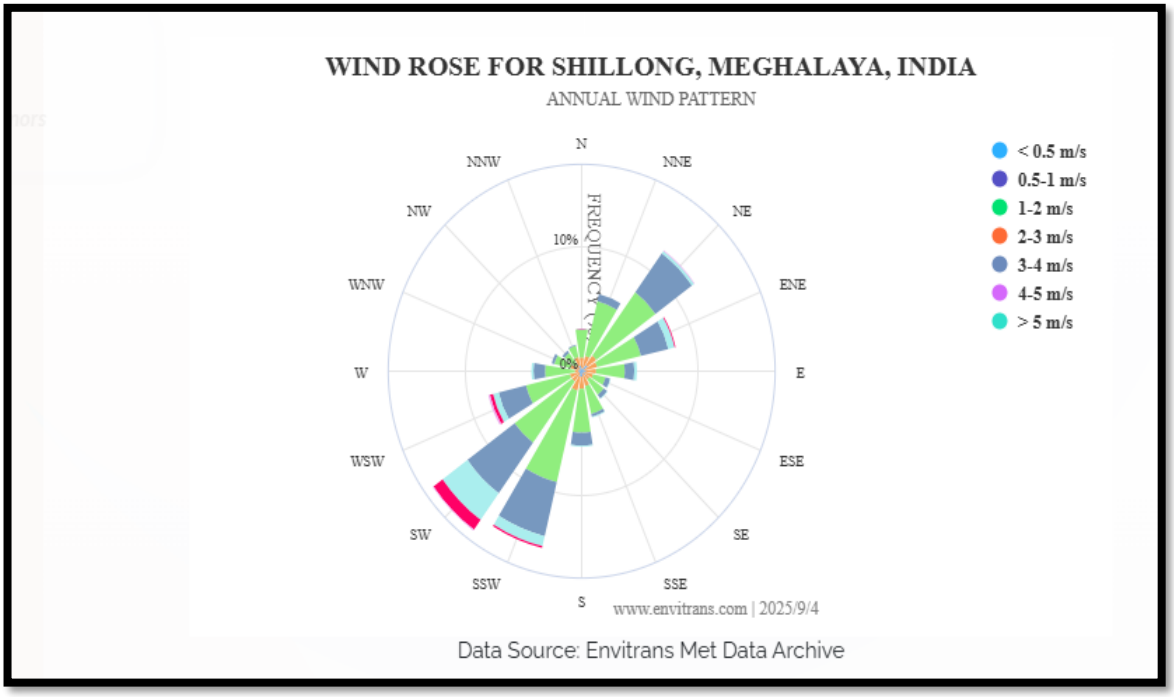
6.19 Climate Resilient Feature

Climate-Resilient Design		Upgradation of Rongsai Borjhora Bajengdoba Road from single to intermediate lane. (RBB)
1.Climate Vulnerability Assessment During Design	Roads and bridges undergo systematic climate vulnerability assessments early in design to identify hotspots prone to extreme rainfall, flooding, erosion, waterlogging, landslides and submergence.	Based on the findings of these assessments, climate-resilient design measures have been incorporated into the project. The design discharge for bridges and culverts has been increased by 25.2%, and the design discharge for cross-drainage structures has been enhanced by 14.5% as per (Shared Socioeconomic Pathways) SSP 5-8.5 data from IITM (Indian Institute of

Climate-Resilient Design		Upgradation of Rongsai Borjhora Bajengdoba Road from single to intermediate lane. (RBB)
		Tropical management) Pune in consultation with MITP to account for projected increases in rainfall intensity under future climate scenarios.
		Considering future climate vulnerability and
2. Enhanced Drainage & Flood Management	Larger culverts,	At critical locations where the existing culvert dimensions were found to be insufficient, the size of the culverts has been increased by converting 2 Pipe culverts to Box Culverts and additional 15 no. of Pipe culverts have been proposed for improving drainage. These measures have been adopted to improve hydraulic capacity, prevent flooding and damage to the road, and ensure uninterrupted connectivity, thereby achieving an all-weather road.
	cross-drainage structures,	Specific provisions for cross-drainage structures are made to enhance hydraulic efficiency, prevent clogging, and ensure the stability of both the structures and their approaches. These provisions include floor aprons, cut-off walls, quadrant pitching, stream-protection works, return walls, and retaining walls.
	properly graded roadside drains prevent waterlogging and lower flood damage.	Proper gradient to road side drain are provided parallel to road and their connectivity with existing and newly proposed culverts are done to avoid any kind of flooding on the road section.
	Road designs incorporate improved cross-drainage systems, culverts, and surface water management to remain serviceable during intense monsoon rainfall common in Meghalaya's wet	Improved Cross Drainage system

5.2.4 WIND SPEED AND DIRECTION

Wind Rose diagram was prepared for 1 year, for the wind data recorded at Shillong (nearest station taken) is given in Figure 5.1. Average Wind speed of 1.6 m/s in the direction of NE to South west is observed.



Source: Envitrans

Figure 5.1: Wind rose Diagram

5.3 LAND ENVIRONMENT

5.3.1 PHYSIOGRAPHY AND ELEVATION

North Garo Hills District, the northern extension of the Garo Hills in Meghalaya, is characterized by hilly and undulating terrain interspersed with valleys and riverine tracts. The district is drained by several important rivers, including the Damring, Dudhnoi, Krishnai, Didram, Rongkhu, and Rongreng, all of which flow northward and eventually join the Brahmaputra. Elevation in the district ranges from approximately 100m above mean sea level in the northern plains adjoining Assam to over 1,000m in the southern highlands and ridges, with the central hilly belt generally lying between 300 and 600m. The district's physiography is defined by forested hills and sloping terrain that gradually descends northwards, giving North Garo Hills its distinct landscape[4].

Baseline Scenario for RBB Road

As per elevation map of North Garo Hills District, the RBB project road stretch lies in the range of 100-300 m. The proposed road of 18.27 km length, where the terrain is comparatively stable. Out of the total length, approximately 15–16 km of the alignment runs along the flat terrain with elevations ranging between 100 m and 300 m above mean sea level. . Cutting will be carried out along 1,180 m on the LHS and 920 m on the RHS of the proposed road alignment. In addition to the protective measures proposed for the road works, gabion-type retaining walls have been recommended to stabilize vulnerable sections. These structures will cover a cumulative length of 1,180 m across all locations within the sub project road to prevent slope instability and erosion. The Sub Project road

[4] District Census Handbook, North Garo Hills

elevation map of the project stretch is given in Figure 5.2.

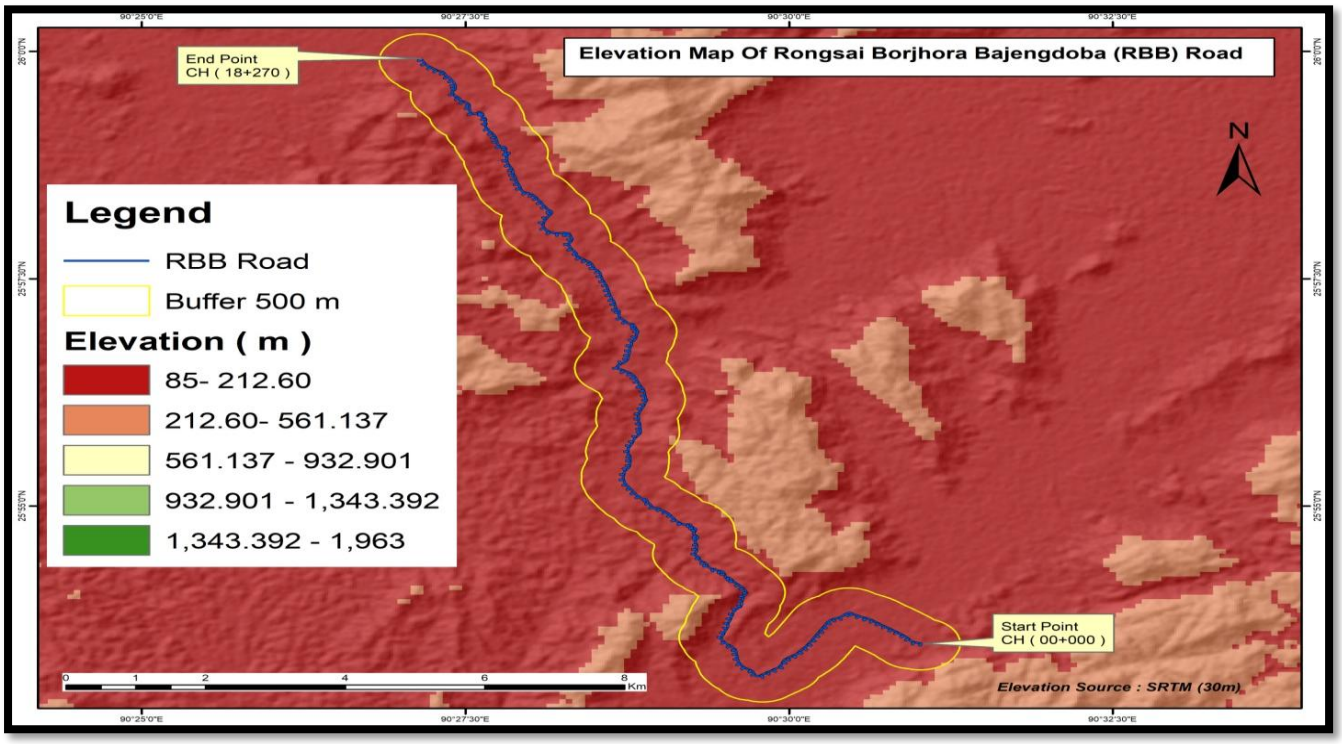


Figure 5.2: Elevation map of the RBB project area (Elevation Source: SRTM (30m)

5.3.2 GEOLOGY

Baseline Scenario for Sub- Project Road

Geology of the Sub Project Road

- Dominated by Precambrian crystalline basement rocks (gneiss, granite, quartzite).
- Patches of Gondwana sediments with coal measures are found along valleys and river sections.
- Alluvial deposits occur in the plains.
- The terrain is rugged and hilly in the south, gently sloping towards the north.
- Economic geology: Small coal deposits (Siju–Dudnai belt), building stones, laterite, and minor limestone.

Seismicity

- Corridor lies in **Seismic Zone V** (IS 1893 zoning). Use **importance factor per IRC:6**; detail retaining walls, culverts, and bridges for seismic earth pressures and bearings for PGA ≈ **0.36 g** design basis.

Environmental & construction notes

- **Monsoon window:** Avoid deep cuts/excavations Jun–Sep; stage construction with temporary drains & silt traps.
- **Spoil management:** Designated tips on stable benches (>10 m from drainage), compacted in layers, with toe bunds.
- **Biodiversity:** Riparian buffers at stream crossings; avoid borrow from natural slopes with dense canopy.

The geology of the RBB Road is depicted in Figure 5.3, below.

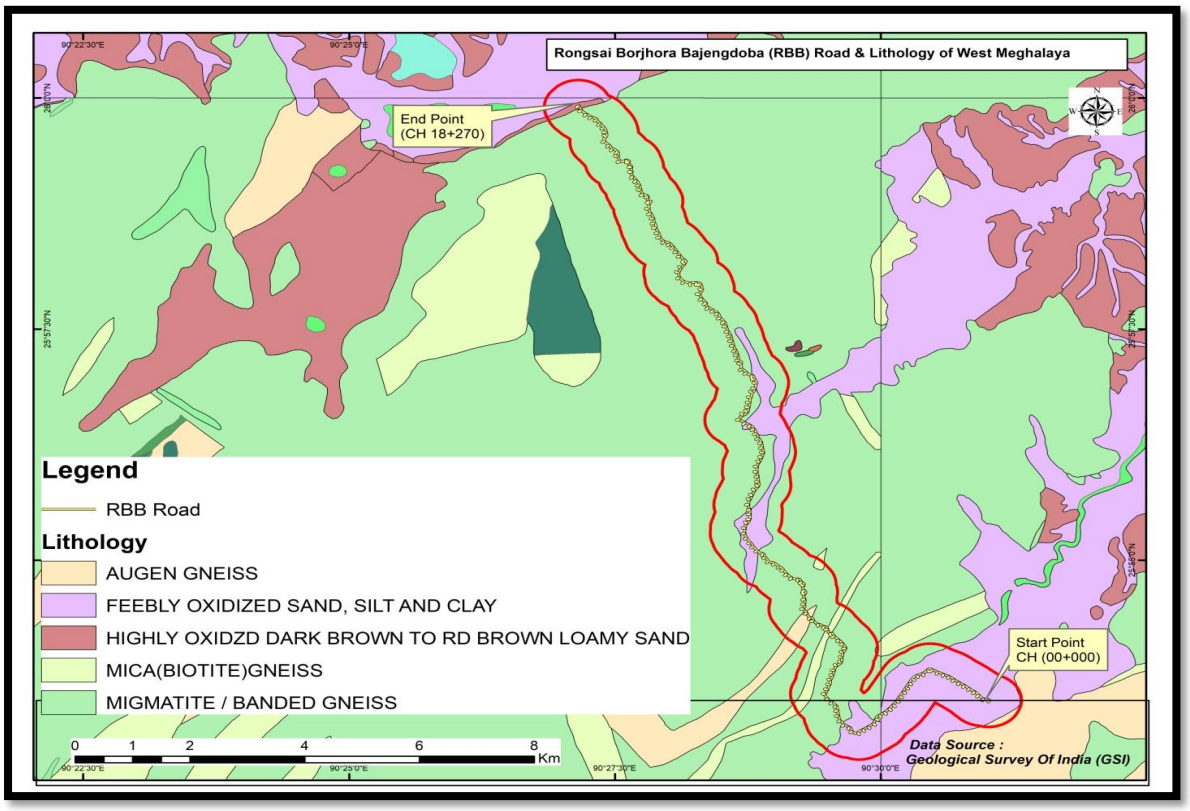


Figure 5.3: Local geology of the road stretch of sub Project Road RBB

5.3.3 GEO-MORPHOLOGY AND SOILS

Geomorphologically, the North Garo Hills District, through which the RBB Road traverses, can be classified into six physiographic domains: structural hills and valleys, structural plateau, active floodplain, older floodplain, younger alluvial plain, and pediment–pediplain complex. The road corridor predominantly passes through hilly and undulating terrain dominated by structural hills and valleys, gradually transitioning into plateau regions and floodplains in certain stretches.

Soils along the project road are predominantly laterite and lateritic in nature, with high acidity as a defining characteristic. In the hilly sections, where the parent rocks weather slowly and are frequently subjected to heavy rainfall, soils tend to be more acidic compared to the relatively low-lying plains. Soil texture varies from sandy loam to clay loam, with patches of lateritic red soil. These soils are rich in organic matter and nitrogen due to their relatively undisturbed and virgin condition. However, lateritic soils are susceptible to erosion and leaching during intense monsoonal rainfall, which can lead to degradation and slope instability in certain sections of the road.

Given the terrain and soil characteristics, the RBB Road requires adequate slope stabilization, drainage, and erosion-control measures such as check walls, bio-engineering techniques, and roadside plantation to minimize soil loss and maintain road stability While the soil's acidity and high organic content support a variety of crops, the lack of adequate irrigation limits the successful cultivation of all crops[5].

Table 5.4: North Garo Hills District - Block wise major soil class area in Ha. and Land Slope

Name of the Block	Soil Type	Land Slope (%)

[5]District Irrigation Plan 2016–2020, North Garo Hills, Government of Meghalaya.

	Major Soil Classes	Major Soil Type	Area (Ha)	0-3% (Ha)	3-8% (Ha)	8-25% (Ha)	>25% (Ha)
Bajengdoba Development Block (North Garo Hills)	Sandy loam to clay loam	Laterite & Lateritic soils	69,500	4,500	11,000	19,000	35,000

Source: District Irrigation Plan 2016–2020, North Garo Hills, Government of Meghalaya

Geomorphological map of North Garo Hills district is depicted in the Figure 4.4 below.

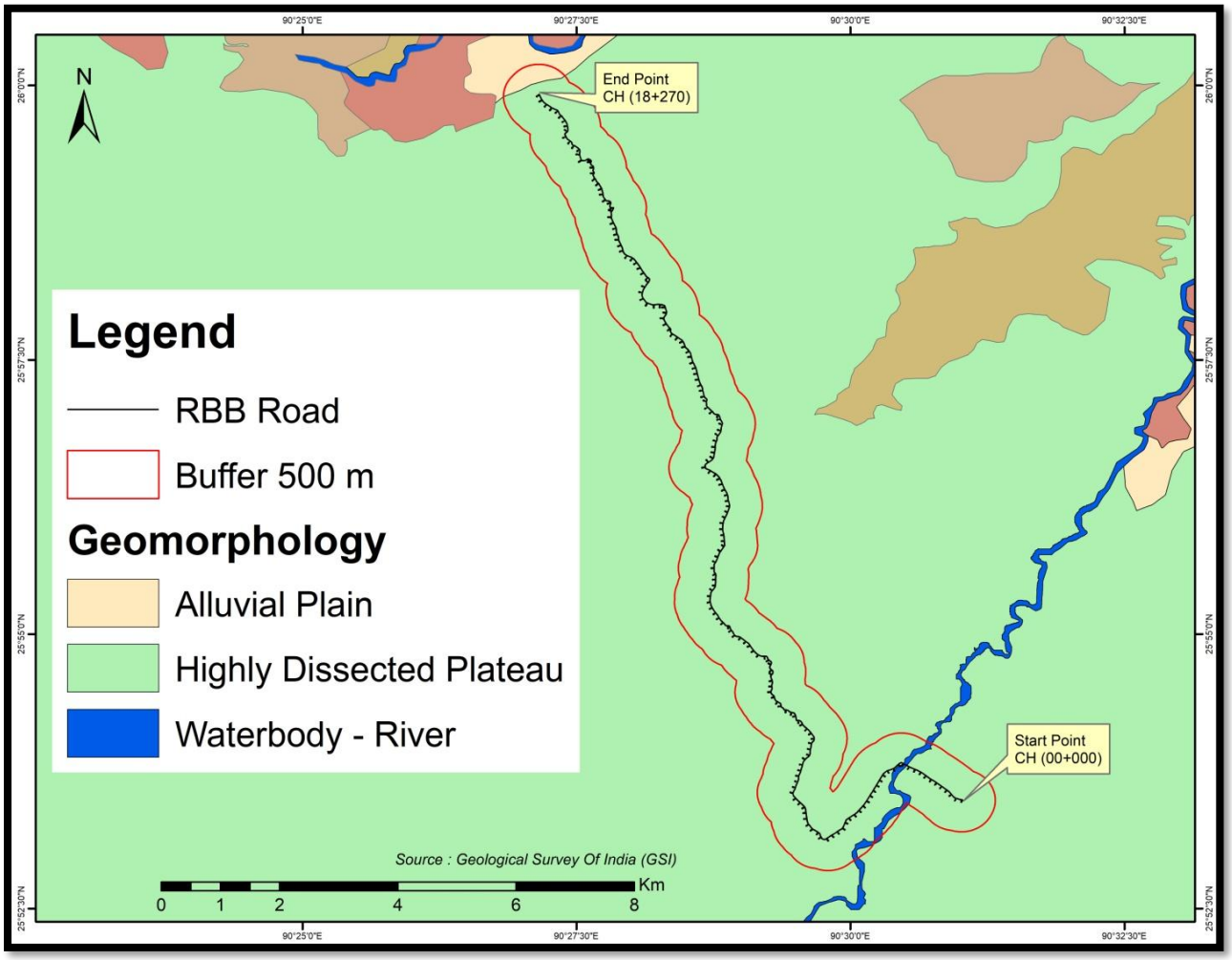


Figure 5.4: Geomorphological map of North Garo Hills district

5.3.4 LAND USE PATTERN

The LULC map[6] of 500m reveals that the RBB stretches area comprises of 53% un-classed forest, 24% built up. The remaining 23% includes water bodies (3%), crop land (16%), and shifting cultivation areas (4%), etc. The LULC map of 500m on either side of the road is presented in Figure 5.5 below

[6] LULC Data source: NRSC: LULC (10 k) SIS-DP Phase-2: 2018-23

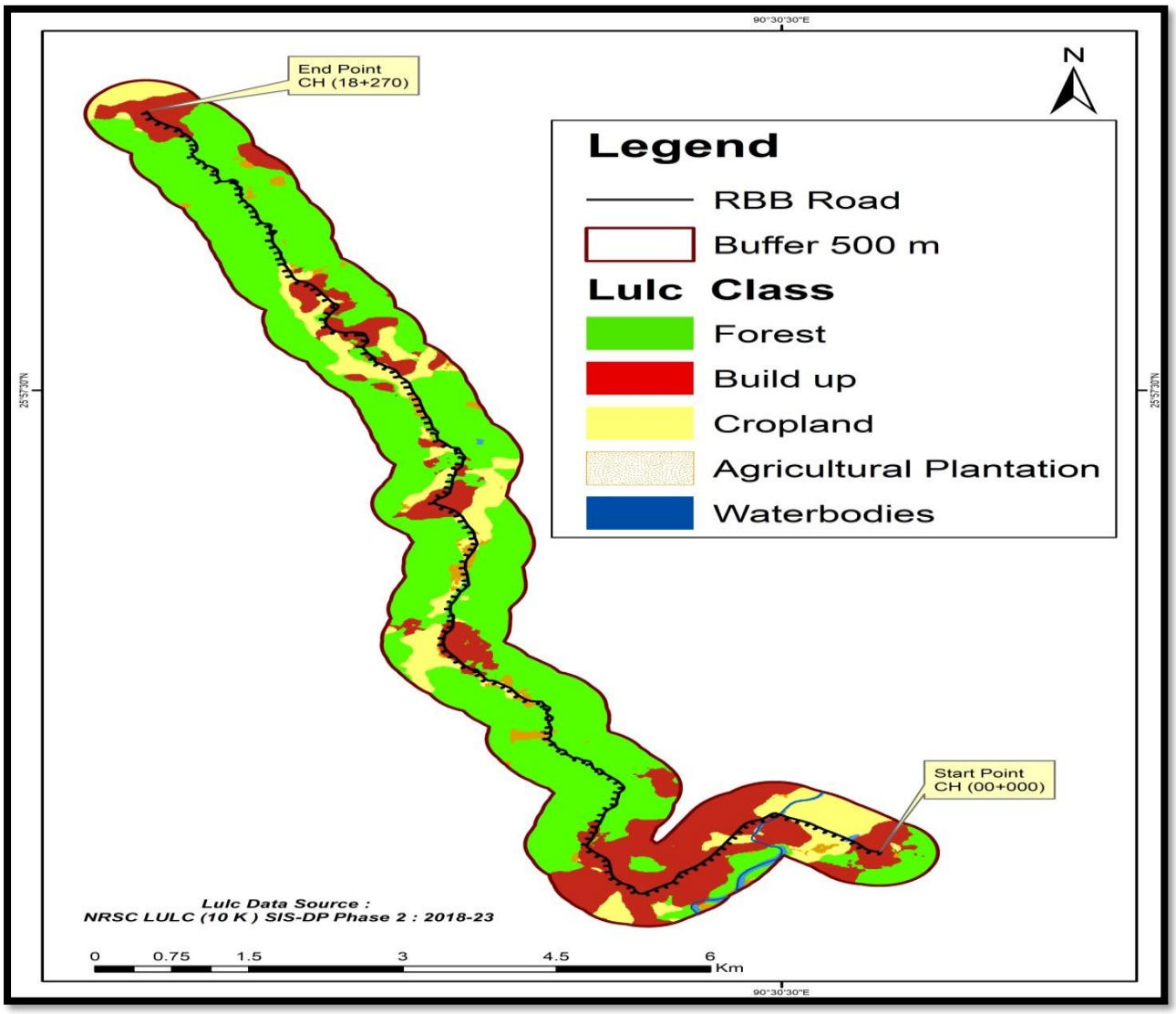


Figure 5.5: Land Use / Land Cover map of RBB road corridor

5.3.5 AGRICULTURE

Baseline Scenario in Project Corridor Area

According to the consultations that was organized with Indigenous communities, the majority of the population in the sub-project area relies on agriculture as their primary source of livelihood, with Jhum cultivation being the predominant farming practice among local communities. Key crops grown in the RBB road area include paddy, maize, sesame, cauliflower, cabbage, chilly, bitter gourd, tomatoes, lettuce, pumpkin, betel nut, betel leaf, pineapple, and banana. Farmers primarily sell their products in local markets, while surplus yields are supplied to other districts or states through vendors.

5.3.6 SOIL QUALITY

Details of the soil sampling locations are presented in Table 5.5 and shown in Figure 5.6. The collected soil samples were analyzed for various parameters in an NABL-accredited laboratory. The soil monitoring results are presented in the Table 5.6**.**

Table 5.5: Soil Monitoring Locations

Sl.No.	Details of Road	Monitoring Locations	Location Code	Latitude	Longitude
1	Sub Project Road RBB 18.27 km stretch	Bajongdoba Agriculture field	SQ1	25°54'50.20"N	90°29'9.23"E
2		Bolsong paddy field	SQ2	25°56'59.63"N	90°28'45.43"E
3		Borjhora Agriculture Field	SQ3	25°59'43.07"N	90°27'21.48"E

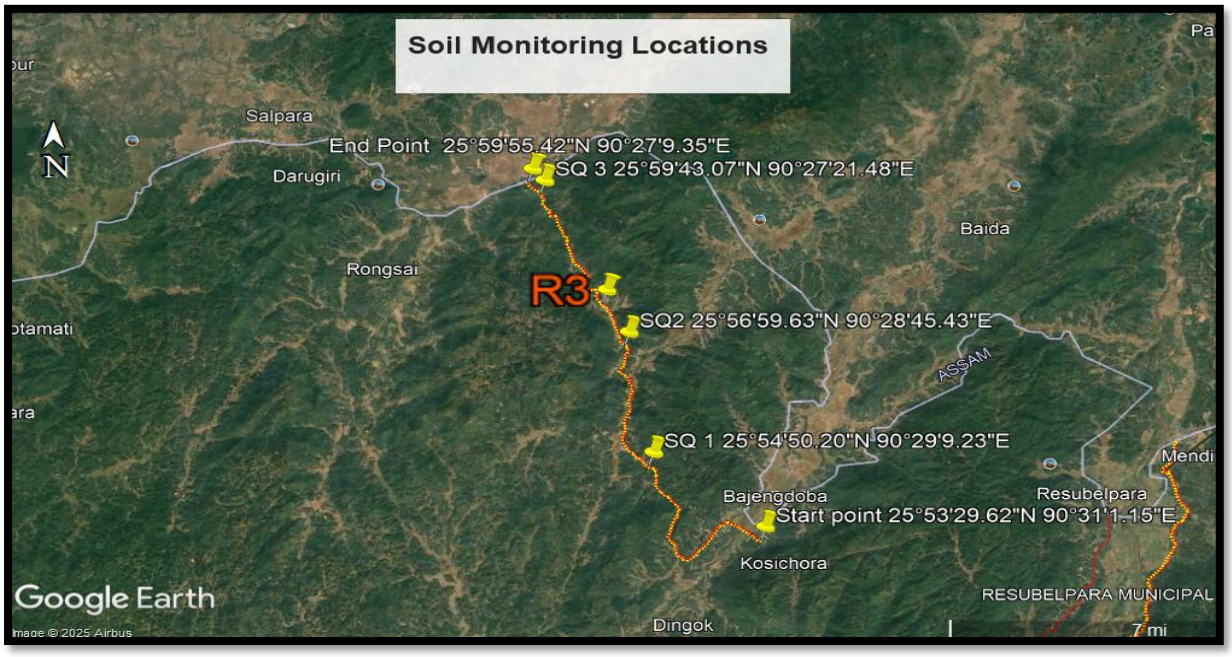


Figure 5.6: Soil monitoring locations

Table 5.6: Soil Monitoring Results in the sub-project area

Sl. No.	Parameters	Units	SQ1	SQ2	SQ3	Test Method
1	Colour		Brown	Brown	Brown	STRL/STP/SOIL/01
2	Textural Class		Sandy Loam	Sandy Loam	Sandy Loam	IS2720 (P-4),1985 (Reaff: 2015)
3	Bulk Density	gm/cm^3	1.30	1.29	1.33	IS 14765: 2000, RA 2010
4	Water Holding Capacity	%	29.4	29.6	27.8	STRL/STP/SOIL/01
5	Sand	%	54.0	53.1	59.0	IS2720 (P-4),1985 (Reaff: 2015)
6	Silt	%	27.8	25.9	22.1	IS2720 (P-4),1985 (Reaff: 2015)
7	Clay	%	18.2	21.0	18.9	IS2720 (P-4),1985 (Reaff: 2015)
8	pH (1:2 Suspension)	-	5.98	5.85	6.12	IS:2720 (P-26), 1987 (Reaff:2011)
9	Electrical Conductivity (1:2)	µmhos/cm	225.0	238.5	231.8	IS: 14767(2000), RA 2016
10	Organic Matter	%W/W	3.32	3.48	3.10	STRL/STP/SOIL/01
11	Exchangeable Calcium	mg/kg	1270.0	1218.5	1195.2	IS 2720 (Part 24): 1976, RA 2010
12	Exchangeable Magnesium	mg/kg	510.4	488.2	465.6	IS 2720 (Part 24): 1976, RA 2010
13	Copper	mg/kg	10.5	9.8	11.2	IS 2720(Part-27): 1977
14	Nickel	mg/kg	7.4	8.1	9.4	IS 2720(Part-27): 1977
15	Chromium	mg/kg	10.8	9.4	9.9	IS 2720(Part-27): 1977
16	Iron	mg/kg	78.5	84.6	91.2	IS 2720(Part-27): 1977
17	Lead	mg/kg	0.2	0.3	0.4	IS 2720(Part-27): 1977
18	Sulphate	mg/kg	13.2	15.1	17.5	IS 2720(Part-27): 1977
19	Nitrogen (as N)	Kg/Ha	238.0	229.4	205.8	IS: 10158:1982, RA 2009
20	Phosphorous	Kg/Ha	105.6	99.8	94.2	IS: 10158:1982, RA 2009
21	Exchangeable Potassium	Kg/Ha	52.4	56.8	61.5	STRL/STP/SOIL/01

Soils along the RBB Road corridor are sandy loam, well-drained and moderately acidic (pH 5.85–6.12), which is typical for the region's high rainfall conditions. Organic matter levels are moderately high, reflecting good natural leaf-litter enrichment. Major nutrients (N & P) are moderate, whereas Potassium is slightly low due to natural leaching. No heavy metal contamination is observed, indicating the soil is suitable for plantation and greenbelt development.

5.4 WATER ENVIRONMENT

Water bodies in the RBB project area of 18.27 kms stretch are mainly Didram river, 01 ponds (within 50m), and 02 streams were observed during the field study. Several small perennial and seasonal streams intersect or run adjacent to the Rongsai–Borjhora–Bajengdoba (RBB) Road corridor in North Garo Hills District. These streams serve as vital sources of domestic water, livelihood support for nearby communities, and ecosystem linkages within the local drainage network. Local villages use the stream water primarily for washing, bathing, small-scale irrigation, and livestock watering, particularly during the dry months when groundwater availability is low. In some sections, community fish rearing and bamboo growth are also supported by these watercourses. The streams contribute to local groundwater recharge and wetland formation, enhancing biodiversity along riparian stretches. However,

unregulated runoff from roads and nearby settlements occasionally leads to siltation and turbidity, affecting water quality and downstream use. The project design therefore emphasizes protection of natural flow channels, provision of cross-drainage structures, and controlled discharge of construction runoff to prevent any disruption or contamination of these locally significant water bodies. The below section describes the Surface and Ground water conditions in the sub-project area as well as the relevant water quality standards.

5.4.2 SURFACE WATER

02 Surface water samples have been selected from sources present along the project roads to ascertain the baseline conditions of the surface water quality. The surface water samples collected in the Month of October from the pond and river. Location details of the surface water samples are presented in Table 5.7 and shown in Figure 5.7.

Table 5.7: Surface Water Monitoring Locations

S. No	Source of Sample	Sample Code	Geographical Coordinate	
			Latitude	Longitude
1	Pond	SW1	25°53'32.44"N	90°29'37.68"E
2	Dridam River	SW2	25°53'49.88"N	90°30'30.01"E

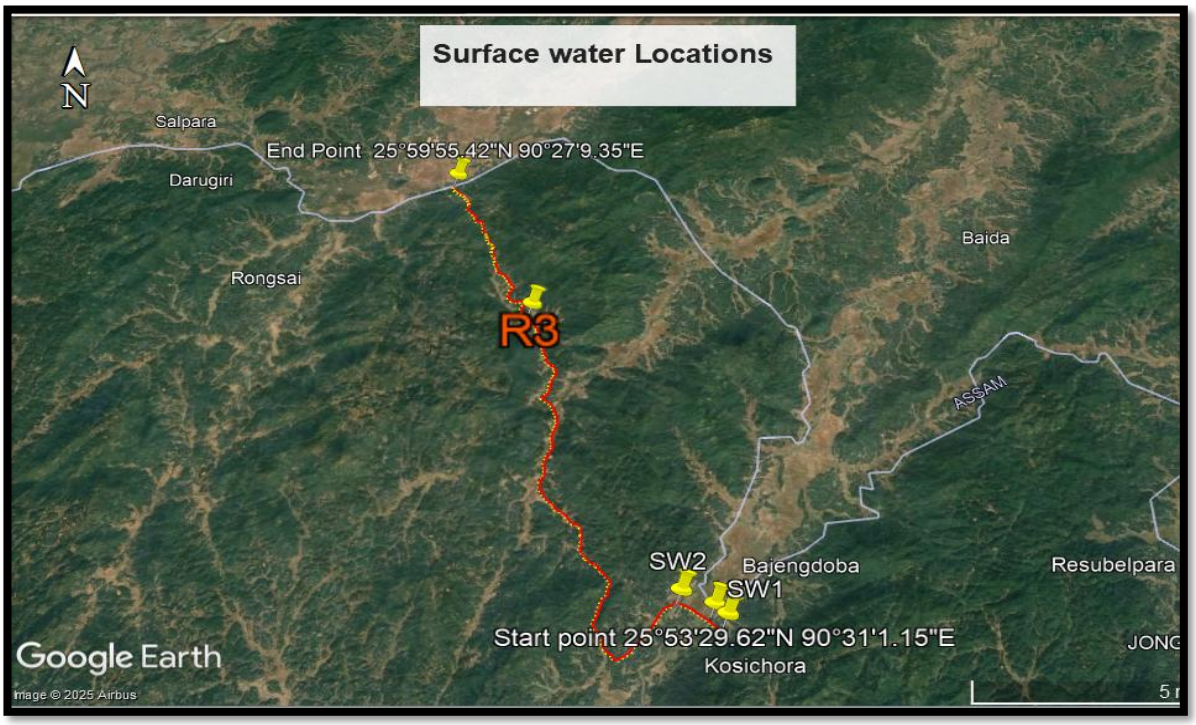


Figure 5.7: Surface Water monitoring locations

pH values in the surface water samples were observed in the range of 7.1 to 7.6, indicating neutral to slightly alkaline nature. Dissolved Oxygen (DO) levels were found between 6.2 to 7.4 mg/L, showing adequate oxygen availability. The Biochemical Oxygen Demand (BOD) remained low, ranging from 1.8 to 3.2 mg/L, reflecting low

organic pollution. Nitrate concentration was recorded between 0.6 to 1.4 mg/L, which is within permissible limits for Class C water quality. Heavy metals (such as Pb, Cd, Cr, Hg) were found below detectable limits, indicating absence of industrial contamination..

Table 5.8: Surface Water Quality Monitoring results in the project area

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C) Tolerance Limit	SW-1	SW-2	Test method
1	pH	-	6.5 -8.5	7.21	7.20	IS: 3025(Pt-11)1983, RA. 2002
2	Temperature	°C	-	16.3	17.3	APHA 23nd Edn.2017-2550 B
3	D.O	mg/l	Minimum -4	7.40	7.80	IS 3025(Part-38): 2006
4	BOD	mg/l	30	5.30	5.80	IS 3025(Part-44):1993, RA 2009
5	Colour	Hazen	300	5	5	IS: 3025 (Pt-4) 1983, RA 2017
6	Odour	-	-	Agreeable	Agreeable	IS: 3025(Pt-5)
7	TDS	mg/l	1500	231.5	240.8	IS 3025(Part-16): 1984, RA 2006
8	TSS	mg/l	-	22.0	28.0	IS 3025(Part-17)
9	TKN	mg/l		2.2	2.8	IS: 3025(Pt-34)1988, RA. 2003
10	Ammonical Nitrogen	mg/l		0.46	0.48	IS: 3025(Pt-34)1988, RA. 2003
11	Nitrate (as NO3)	mg/l	50	2.1	3.3	IS: 3025(Pt-34)1988, RA. 2003
12	Free Ammonia	mg/l		<0.1	<0.1	IS: 3025(Pt-34)1988, RA. 2003
13	Chlorides (as Cl)	mg/l	600	30.2	26.8	IS 3025(Part-32): 1988
14	Sulphates (as SO4)	mg/l	400	31.3	25.8	IS 3025(Part-24):1986, RA 2003
15	Fluoride (as F)	mg/l	1.5	0.42	0.58	APHA 21st Ed., 4500F(D)
16	Oil & Grease	mg/l	0.1	<0.1	<0.1	IS 3025(Part-39):1991, RA 2009
17	Phenolic Compound (as C6H5OH)	mg/l	0.005	<0.001	<0.001	5530-B, C&E, APHA 23nd 2017

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C) Tolerance Limit	SW-1	SW-2	Test method
18.	Arsenic	mg/l	0.2	<0.1	<0.1	3110- B, APHA 23nd Ed. 2017 (AAS)
19	Mercury (as Hg)	mg/l	-	<0.001	<0.001	3110- B, APHA 23nd Ed.2017
20	Lead (as Pb)	mg/l	0.1	0.02	0.02	3110- B, APHA 23nd Ed. 2017 (AAS)
21	Cadmium (as Cd)	mg/l	0.01	0.001	0.002	3110- B, APHA 23nd Ed. 2017 (AAS)
22.	Chromium (as Cr+6)	mg/l	0.05	0.02	0.03	IS 3025(Part-52): 200
23.	Copper (as Cu)	mg/l	1.5	0.12	0.21	3110- B, APHA 23nd Ed. 2017 (AAS)
24.	Zinc (as Zn)	mg/l	15	0.18	0.22	3110- B, APHA 23nd Ed. 2017 (AAS)
25	Selenium (as Se)	mg/l	-	<0.1	<0.1	IS: 3025 (P- 56)
26.	Anionic detergents (as MBAS)	mg/l	1.0	<0.1	<0.1	Annexure K Of IS 13428
27.	Iron (as Fe)	mg/l	50	0.43	0.36	3500-Fe- B, APHA 23nd Ed. 2017
28.	Sulphide (as H2S)	mg/l	-	0.17	0.26	IS-3025 (P-29)
29.	Phosphate (as PO4)	mg/l	-	5.21	6.40	APHA 22nd Edn.2012-4500-P C
30.	Cyanide (as CN)	mg/l	0.05	<0.1	<0.1	4500-CN-B, C & E, APHA 23nd Ed.2017
31.	Manganese (as Mn)	mg/l	-	0.03	0.04	3110- B, APHA 23nd Ed.2017
32.	COD	mg/l	-	22.2	16.4	IS 3025(Part-58): 2006

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C) Tolerance Limit	SW-1	SW-2	Test method
33.	Total Coli form	MPN/100ml	5000	650	1450	IS: 1622-1981

5.4.3 GROUND WATER

03 ground water samples from sub Project Road RBB have been collected in the Month of October along the sub-project roads to ascertain the baseline conditions of the ground water quality. The sampling locations were selected based on the land-use pattern and competitive uses in the sub-project areas. Location details of the groundwater samples are presented in Table 5.9 and shown in Figure 5.8 and results are presented in Table 5.10**.** Ground water samples have been analyzed in accordance with the Drinking Water Quality Standards of IS 10500:2012.

Table 5.9: Ground Water Sample Locations in the sub-project area

Sl. No	Project Area	Monitoring Location	Sample Code	Geographical Co-ordinates	
				Latitude	Longitude
1	Sub Project Road RBB 18.27 km stretch	GW at Bajengdoba Multi facility center	GW1	25°53'21.30"N	90°30'4.96"E
2		GW at Bolsong Kamagre Sub Center	GW2	25°57'4.60"N	90°28'42.38"E
3		GW at Gosingpita Songma U,P School and high School	GW3	25°58'1.81"N	90°28'8.15"E

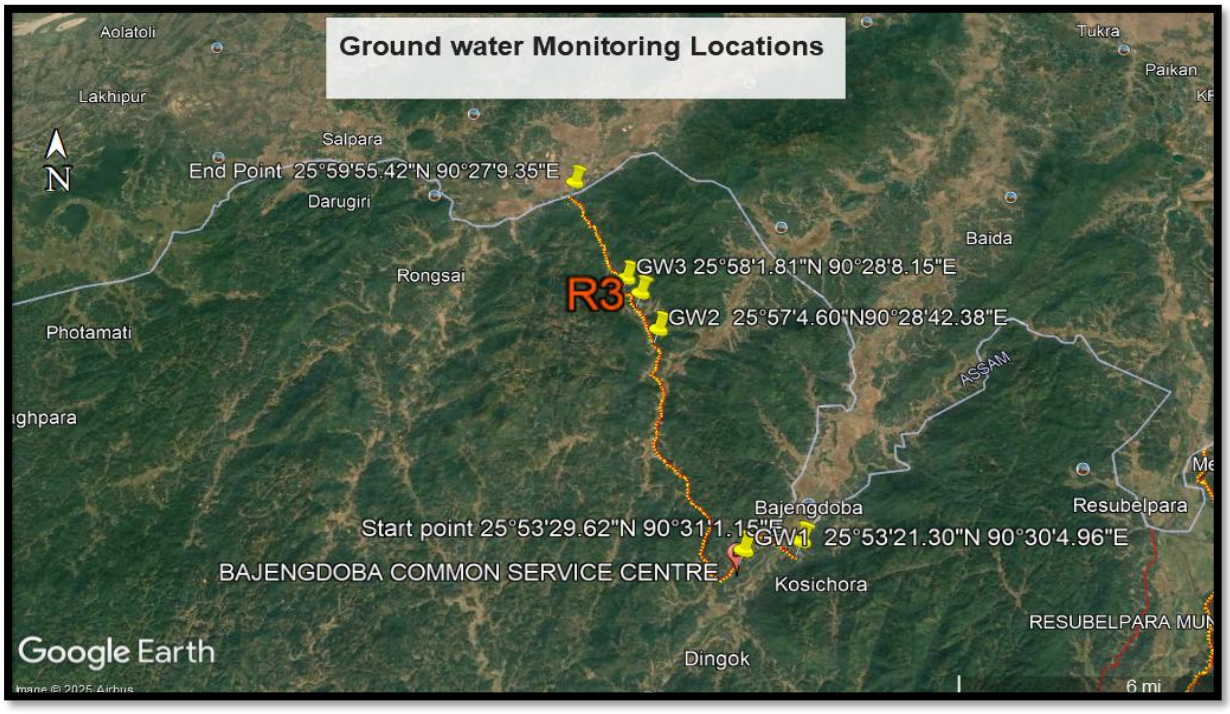


Figure 5.8: Ground Water monitoring locations

Groundwater samples GW-1, GW-2 and GW-3 were found to be clear, odourless and with acceptable taste, and turbidity remained below 1 NTU. The pH was within the desirable range (7.23–7.32). Total Hardness (121–123 mg/L), TDS (258–262 mg/L), Calcium, Magnesium, Chloride, Sulphate, and Nitrate were all well within desirable limits of IS 10500:2012. Slight Iron exceedance was observed (0.34–0.54 mg/L) compared to the desirable limit of 0.3 mg/L. All heavy metals such as Chromium, Arsenic, Aluminum, and Copper were below detectable limits, indicating no contamination from industrial or geogenic sources. Overall, the groundwater quality is suitable for drinking purposes after minimal treatment for iron removal.

Table 5.10: Ground Water monitoring results in the project area

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	Test method
			Desirable Limit	Permissible Limit				
1	Color	Hazen	5	15	<5	<5	<5	IS: 3025(Pt-4)
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS: 3025(Pt-5)
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS: 3025(Pt-8)
4	Turbidity	NTU	1	5	<1	<1	<1	IS 3025(Part-10)
5	pH	-	6.5-8.5	No Relaxation	7.25	7.32	7.23	IS: 3025(Pt-11)
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	123	121.8	122.4	IS 3025(Part-21)
7	Iron (as Fe)	mg/l	0.3	No Relaxation	0.44	0.34	0.54	3500-Fe- B,
8	Chlorides (as Cl)	mg/l	250	1000	19.8	23.1	20.4	IS 3025(Part-32)
9	Fluoride (as F)	mg/l	1	1.5	0.38	0.42	0.48	4500-F-(D),
10	TDS	mg/l	500	2000	258.5	261.1	262.2	IS 3025(Part-16)
11	Calcium (as Ca^{2+})	mg/l	75	200	27.3	13.3	28.5	IS 3025(Part-40)
12	Magnesium (as Mg^{2+})	mg/l	30	100	10.2	15.3	14.2	3500- Mg B, APHA 23nd Ed.2017
13	Sulphate (as SO_4)	mg/l	200	400	12.3	13.2	11.8	IS 3025(Part-24)
14	Nitrate (as NO_3)	mg/l	45	No Relaxation	14.2	8.4	9.2	IS: 3025(Pt-34)
15	Total Chromium (as Cr)	mg/l	0.05	No Relaxation	<0.01	<0.01	<0.01	3110- B, APHA 23nd Ed.2017
16	Alkalinity as	mg/l	200	600	141.2	126.6	138.4	IS 3025(Part-23)
17	Aluminium (as Al)	mg/l	0.03	0.2	<0.01	<0.01	<0.01	IS 3025(Part-55)
18	Total Arsenic (as As)	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	3110- B, APHA 23nd Ed2017
19	Copper (as Cu)	mg/l	0.05	1.5	<0.05	<0.05	<0.05	3110- B, APHA
20	Manganese (as	mg/l	0.1	0.3	<0.01	<0.01	<0.01	3110- B, APHA
21	Zinc (as Zn)	mg/l	5	15	0.22	0.16	0.22	3110- B, APHA
22	Ammonia (as	mg/l	0.5	No Relaxation	<0.1	<0.1	<0.1	4500-NH3-B &C,
23	Anionic	mg/l	0.2	1	<0.1	<0.1	<0.1	Annexure K of IS-
24	Boron (as B)	mg/l	0.5	1	<0.5(BDL)	<0.5(BDL)	<0.5(BDL)	IS: 3025(Pt-57)
25	Mineral Oil	mg/l	0.5	No Relaxation	<0.1	<0.1	<0.1	IS 3025(Part-39)
26	Phenolic	mg/l	0.001	0.002	<0.001	<0.001	<0.001	IS 3025(Part-44)
27	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.002	<0.002	<0.002	3110- B, APHA

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	Test method
			Desirable Limit	Permissible Limit				
28	Cyanide (as CN)	mg/l	0.05	No Relaxation	<0.1	<0.1	<0.1	4500- CN-B, C &
29	Lead	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	3110- B, APHA
30	Mercury (as Hg)	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	3110- B, APHA
31	Nickel (as Ni)	mg/l	0.02	No Relaxation	<0.02	<0.001	<0.001	3110- B, APHA
32	Residual Free	mg/l	0.2	1.0	<0.2	<0.02	<0.02	4500-Cl-B, APHA
33	Molybdenum	mg/l	<0.05	0.07	No	<0.2	<0.2	3110- B, APHA
34	Polynuclear	mg/l	<0.0001	0.0001	No	No	No	APHA 6440,23nd
35	Poly chlorinated	mg/l	<0.0001	0.0005	No	No	No	APHA 6430,23nd
Microbiological Parameters								
36	Total Coli form	MPN/	Shall not be detectable in		<1	<1	<1	IS: 1622-1981
37.	E.Coli	E.Coli/	Shall not be detectable in		Absent	Absent	Absent	IS: 1622-1981

5.5 AIR ENVIRONMENT

5.5.1 AIR QUALITY

The Project has the potential to impact air quality, and while these impacts can be managed through mitigation measures outlined in the ESMP and adherence to good international practices, there remains a possibility of significant residual impacts

Residential and other sensitive locations proximity to roads were the criteria used for selecting the sample locations. Parameters like Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Carbon Monoxide (CO) were monitored. Map showing monitoring locations are given in Table 5.11 & Figure 5.9.

Table 5.11: Ambient Air Quality Monitoring Locations

Sl. No.	Monitoring Locations	Location Code	Latitude	Longitude
1	Bajengdoba	AQ1	25°53'45.31"N	90°30'27.85"E
2	Bolsong	AQ2	25°57'3.08"N	90°28'41.54"E
3	Borjhora	AQ3	25°59'49.16"N	90°27'13.53"E

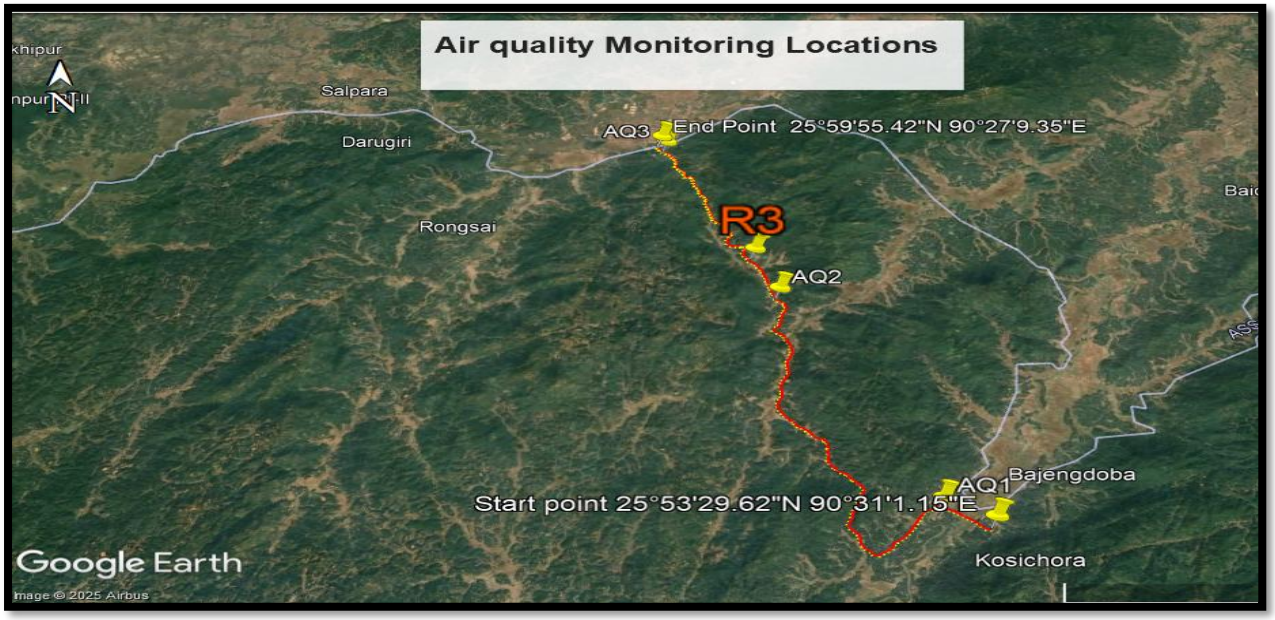


Figure 5.9: Air Quality monitoring locations

The Ambient Air quality results are presented in Table 5.12. The monitored ambient air quality along the corridor at Bajengdoba, Bolsong and Borjhora shows that PM10 (43.4–46.2 µg/m³) and PM2.5 (18.2–21.6 µg/m³) remain well below the CPCB standards (100 µg/m³ and 60 µg/m³ respectively). Levels of SO_2 (5.9–6.4 µg/m³) and NO_2 (7.8–8.9 µg/m³) are also significantly lower than the permissible limit of 80 µg/m³, indicating minimal combustion-related emissions. CO concentrations (0.260–0.300 µg/m³) are negligible compared to the limit of 2000 µg/m³. Overall, the air quality in the project corridor is good and within National Ambient Air Quality Standards, suggesting no immediate air pollution concerns in the area.

Table 5.12: Ambient Air Quality Monitoring Results within project influence area

Sl. No.	Project Area	Location	Sample Code	Latitude (North)	Longitude (East)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Sulphur Dioxide (SO_2) ($\mu g/m^3$)	Nitrogen Dioxide (NO_2) ($\mu g/m^3$)	Carbon Monoxide (CO) ($\mu g/m^3$)
1	18.27 km stretch	Bajengdoba	AQ 1	25°53'45.31"N	90°30'27.85"E	46.2	21.6	6.1	8.9	0.260
2		Bolsong	AQ 2	25°57'3.08"N	90°28'41.54"E	43.4	18.2	5.9	7.8	0.280
3		Borjhora	AQ 3	25°59'49.16"N	90°27'13.53"E	45.6	19.4	6.4	8.6	0.300
National Ambient Air Quality Standards, Central Pollution Control Board, 2009						100	60	80	80	2000
Test Methods						IS:5182 (P-23): 2006	SOP1/ STRL/ Ambient Air/ Gravimetric method	IS:5182 (P-2): 2006	IS:5182(P-6): 2006	IS:5182(P-10):199, RA-2003

5.6 NOISE ENVIRONMENT

The principal sources of construction noise and vibration anticipated during the Project include:

- Delivery and movement of staff, materials, construction plant, and machinery;
- Site preparation works, including establishment of construction camps;
- Hill cutting and excavation activities;
- Removal of existing road pavement and structures; and
- Restoration and finishing works.

Most of these activities are expected to occur in proximity to the existing road alignment. Night-time construction is not generally proposed, except under special circumstances where continuity of work is essential (e.g., critical traffic management needs or safety considerations). This section describes the noise quality standards and the existing ambient noise levels, including the locations of the monitoring stations.

To compute the average Noise Level dB (A), noise level was monitored over a period of 24 hour by the authorized NABL laboratory. The noise monitoring has been conducted in October,2025 for determination of noise levels at 03 locations for (Figure 5.10) in the direct impact area as per Table 5.13 below.

Table 5.13: Ambient Noise Monitoring Locations

S. No.	Locations	Monitoring code	Latitude	Longitude
1	Bajengdoba Market	NQ1	25°53'45.31"N	90°30'27.85"E
2	Bolsong Village	NQ2	25°57'3.08"N	90°28'41.54"E
3	Borjhora Village	NQ3	25°59'49.16"N	90°27'13.53"E

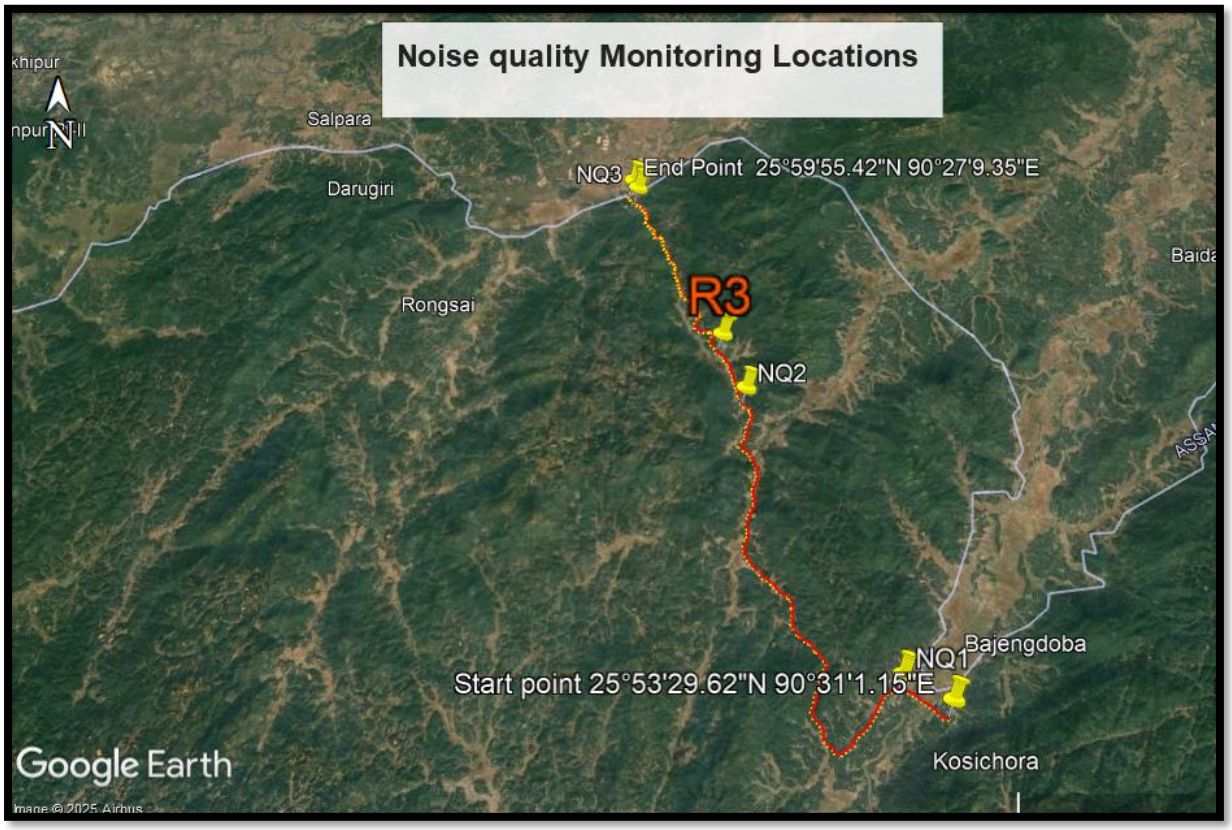


Figure 5.10: Noise quality monitoring locations

Average Ambient Noise Monitoring Results is given in Table 5.14.

Table 5.14: Average Ambient Noise Monitoring Results in the sub-project area (RBB Road)

Sl. No.	Location	Sample Code	Type of area	Equivalent Noise Level, Leq (Day*) dB (A)	Equivalent Noise Level, Leq (Night**) dB (A)	CPCB Day Limit	CPCB Night Limit
1	Bajengdoba Market	NQ1	Commercial	47.3	38.5	65	55

2	Bolsong Village	NQ2	Residential	42.4	34.6	55	45
3	Borjhora Village	NQ3	Residential	43.7	36.6	55	45

The monitored noise levels at all three locations are found to be well within the CPCB prescribed limits for their respective land-use categories. At Bajengdoba Market (NQ1), categorized as a commercial area, the recorded noise levels are 47.3 dB(A) during the day and 38.5 dB(A) during the night, which remain significantly lower than the commercial limits of 65 dB(A) (day) and 55 dB(A) (night). This indicates that commercial activities and vehicular movement in the market area are moderate and do not create any substantial noise disturbance.

In Bolsong (NQ2) and Borjhora (NQ3) villages, both classified as residential zones, the recorded daytime noise levels of 42.4 dB(A) and 43.7 dB(A) respectively, and nighttime levels of 34.6 dB(A) and 36.6 dB(A), are comfortably below the residential limits of 55 dB(A) (day) and 45 dB(A) (night). These results reflect a quiet rural acoustic environment where noise is limited mainly to routine household activities and occasional vehicular movement. Noise barriers are not required along the RBB road as the recorded noise levels at monitoring locations are well within the CPCB permissible limits for both day and night. The surrounding area has low traffic density and minimal sensitive receptors, ensuring no significant noise impact. Therefore, additional mitigation through barriers is not considered necessary.

Overall, the baseline acoustic environment in the study area is calm and stable, with no existing noise stress on the community. The present noise scenario does not indicate any adverse impact, and any future rise in noise, if associated with project activities, will need to be managed to maintain the current acceptable noise conditions.

5.7 BIOLOGICAL ENVIRONMENT

5.7.1 BIODIVERSITY IN NORTH GARO HILLS DISTRICT

The project influence area has been delineated with a buffer of up to 10 km from the periphery of the proposed RoW to identify environmentally sensitive features such as protected areas, wildlife sanctuaries, national parks, wetlands, and wildlife corridors. 10 km Buffer area for project road is presented in Figure 5.11. Map showing distance from Ecosensitive Zones w.r.t Project Road is presented in Figure 5.12.

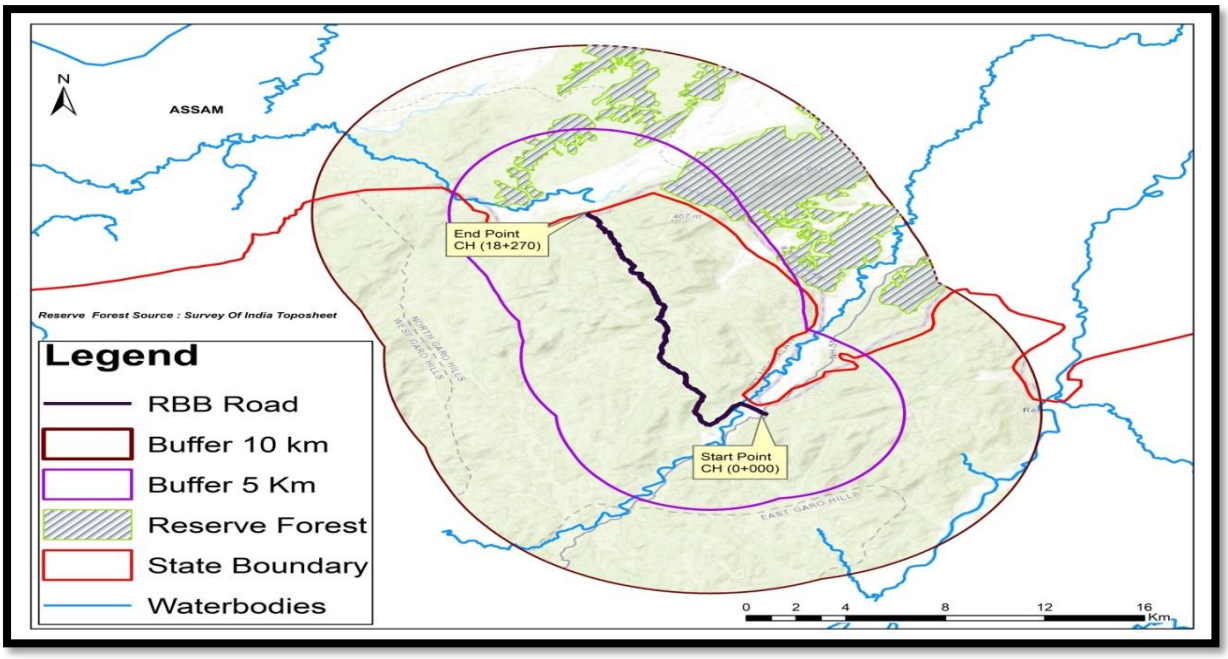


Figure 5.11: 10km Buffer area for project road

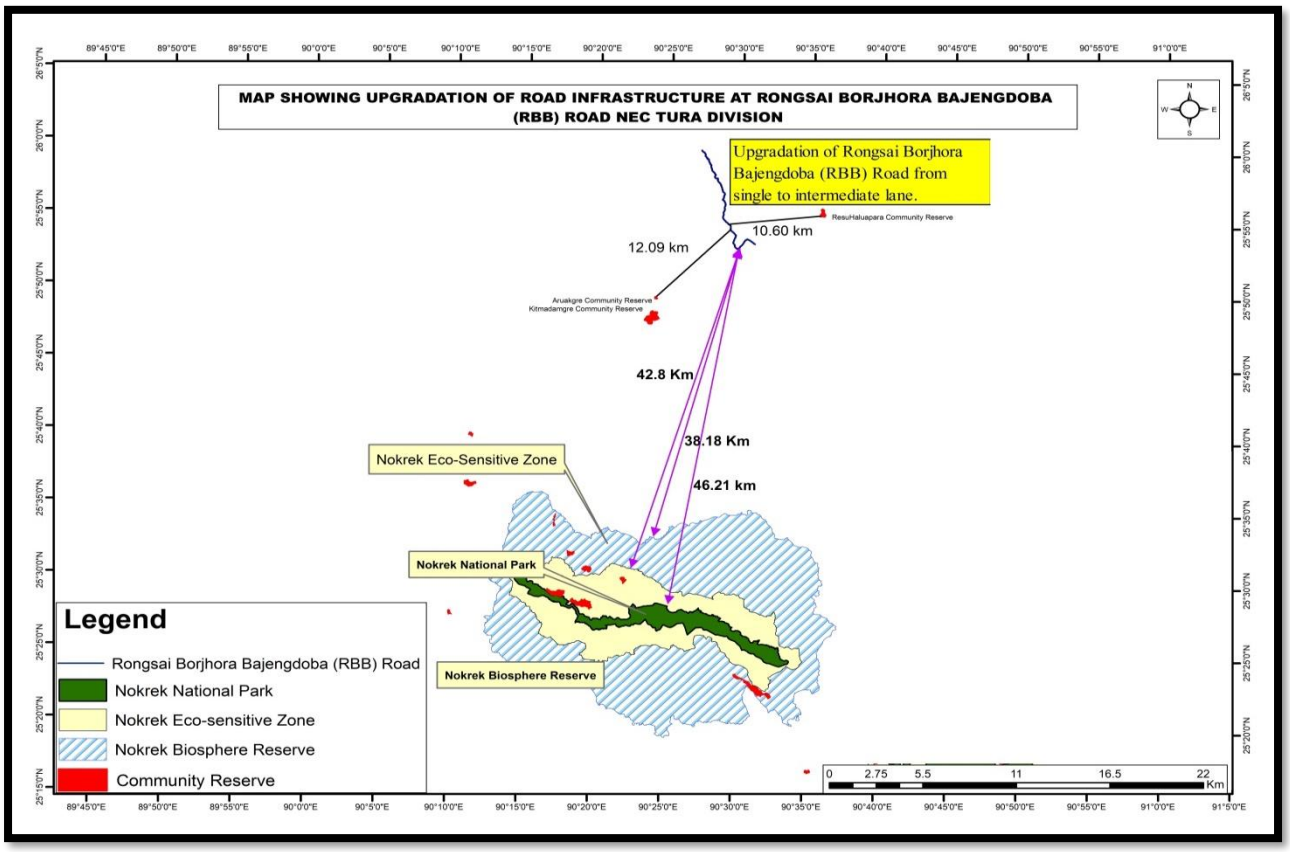


Figure 5.12: Map showing distance from Ecosensitive Zones w.r.t Project Road.

Along the roadside, common plantation trees include Jackfruit, Arecanut, and Mango tree. In some stretches, Banana, Bamboo, and Areca Nut palms are also planted by villagers. Shrubs commonly observed include Lantana,

Eupatorium, Hibiscus, Clerodendrum, and various Bamboo plants. In moist patches, ferns and thickets of Ardisia and Strobilanthes are also common. Common herbs along the roadside include grasses Mint, Wild Ginger, Turmeric, Broom grass etc.

A primary biodiversity survey was conducted during the field visit in August 2025. The primary survey specifically recorded 23 tree species, 7 shrub species, 9 herb species, 3 fern species, and 7 grass species. In terms of fauna, the primary survey documented 10 bird species, 3 mammal species, 2 reptile species, 1 amphibian species, and 5 butterfly species.

The biodiversity survey from both Primary and secondary source documented a total of 119 floral species, comprising 68 tree species, 10 shrubs, 23 herbs, 11 ferns, and 7 grasses. Additionally, 18 species of aquatic biodiversity were recorded. Faunal diversity included 11 mammal species, 52 bird species, 19 reptile species, 2 amphibian species, 25 butterfly species, and 12 fish species.

The methodology adopted for biodiversity assessment is attached as **Annexure 5.1.**

Detailed list of flora, fauna, and aquatic biodiversity, along with their conservation status, is provided in **Annexure 5.2**.

During the field survey and consultations with local communities and forest department officials, no evidence of wild animal hunting was recorded within the Direct Impact area of the Project Road corridor roads. However, improved connectivity after construction may increase the risk of hunting and illegal wildlife trade

In the North Garo Hills district of Meghalaya, traditional medicine remains central to primary healthcare among Garo communities, and alongside plants, animal by-products are also used for zootherapeutic remedies. While detailed, district-wide inventories are still scarce, evidence from the Garo Hills and neighboring Northeast India indicates that a variety of wild species are targeted for medicinal use and bushmeat, with pangolins and primates among the species of concern. Robust, site-level documentation from North Garo Hills is still limited, underscoring the need for focused surveys to map hunting hotspots and species affected within the district.

Given these findings, our study underscores the importance of conservation-driven infrastructure planning, ensuring that developmental activities in North Garo Hills align with ecological sustainability and biodiversity protection. The following sections provide a detailed breakdown of the biodiversity recorded, emphasizing species conservation status and the ecological significance of different taxonomic groups

5.7.2 BIODIVERSITY AND CRITICAL HABITAT IN SUB-PROJECT STRETCH PIA

Critical habitat screening was conducted based on the “Critical Habitat” criteria outlined by World Bank’s ESF.The biodiversity screening indicates that although several threatened and Endangered species, that, are known to occur in the broader Garo Hills landscape, their likelihood of significant impact from the project is low to moderate. Therefore, all listed species have been screened out, as the project is unlikely to cause adverse impacts on their populations or habitats. Details are provided in Table 5.15

Table 5.15: Critical Habitat analysis

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
Gavialis gangeticus (Gharial)	CR	No	Full Migrant	Large perennial rivers	Low	This area is already disturbed the	Out

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
				(Ganga–Brahmaputra system)		possibility of a habitat within the RoW is low.	
Pangshura sylhetensis (Assam Roofed Turtle)	CR	Yes (Eastern Himalaya & NE India)	Non-migrant	Slow-flowing rivers and floodplains	Low	Pangshura sylhetensis (Assam Roofed Turtle) is not found along the RBB road due to the absence of suitable perennial riverine habitats with clean, slow-flowing water and undisturbed basking sites in the project area.	Out
Nilssonia nigricans (Black Softshell Turtle)	CR	Yes (Assam & adjoining states)	Non-migrant	Temple ponds, lowland rivers	Low	Habitat absent in upland Garo Hills	Out
Laticilla cinerascens (Swamp Grass-babbler)	EN	Yes	Non-migrant	Tall wet grasslands in Brahmaputra floodplains	Low	Habitat absent; no wet grassland or marsh areas	Out
Melanochelys tricarinata (Tricarinate Hill Turtle)	EN	Yes	Non-migrant	Hill forests of NE India	Moderate	General hill forest species; no critical habitat fragmentation	Out
Hoolock hoolock (Western Hoolock Gibbon)	EN	Yes	Non-migrant	Evergreen forests of NE India	Moderate	These are arboreal species and require contiguous forest cover for movement[7]. There is no contiguous forest cover along the road. Thus the habitat does not exist in the project areas	Out

[7] https://neprimateconservancy.org/western-hoolock-gibbon/

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
Elephas maximus (Asian Elephant)	EN	No	Non-migrant (seasonal mover)	Forests and corridors in Garo Hills	Moderate	Landscape species; project involves minor road improvement without corridor obstruction	Out
Indotestudo elongata (Elongated Tortoise)	CR	No	Non-migrant	Forest floor dweller in moist forests	Low	Indotestudo elongata (Elongated Tortoise) is not found along the RBB road due to habitat disturbance and lack of intact forest cover with suitable leaf-litter and moist undergrowth required for its survival.	Out
Morenia petersi (Indian Eyed Turtle)	EN	No	Non-migrant	Rivers, ponds, wetlands	Low	Limited aquatic connectivity near corridor	Out
Manis pentadactyla (Chinese Pangolin)	CR	Yes	Non-migrant	Forested slopes, secondary growth	Moderate	Known from Garo Hills; minor works will not affect species viability	Out
Nycticebus bengalensis (Bengal Slow Loris)	EN	No	Non-migrant	Evergreen and semi-evergreen forests	Moderate	Simialr to the Hollock Gibbon these are also arbeoral species and will not be affected	Out
Hardella thurjii (Crowned River Turtle)	EN	No	Non-migrant	Large river systems	Low	Absent in upland terrain	Out
Geoclemys hamiltonii (Spotted Pond Turtle)	EN	No	Non-migrant	Wetlands and slow rivers	Low	No large ponds or lakes near corridor	Out
Cuora mouhotii (Keeled Box Turtle)	EN	No	Non-migrant	Forest floor species	Moderate	*Cuora mouhotii* (Keeled Box Turtle) is not found along the	Out

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
						RBB road due to insufficient undisturbed moist forest habitat and limited availability of clean, slow-moving streams required for its survival.	
Batagur dhongoka (Three-striped Roofed Turtle)	CR	Yes	Non-migrant	Large riverine stretches	Low	It is not found along the RBB road due to the absence of large, perennial river systems with sandy nesting banks and minimal disturbance, which are essential for its habitat.	Out
Manis crassicaudata (Indian Pangolin)	EN	No	Non-migrant	Dry forests, scrubland	Moderate	No new forest clearance is proposed. so habitat destruction/ impact is unlikely.	Out
Cuon alpinus (Dhole)	EN	No	Non-migrant	Forests, scrubland	Moderate	Cuon alpinus (Dhole) is not found along the RBB road due to habitat fragmentation, human disturbance, and insufficient contiguous forest with adequate prey base required for its survival.	Out
Sarcogyps calvus (Red-headed Vulture)	CR	No	Congregatory	Open forests, settlements	Moderate	There are no bird hotspots in the study area . The nearest	Out

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
						hotspot is urpad beel Beel [8](18.20 km) from Bajendogoba site and Nokrek is 38.18 km . There are no nesting cliffs or other habitats in the project area.	
Nilssonia hurum (Indian Peacock Softshell Turtle)	EN	No	Non-migrant	Rivers and wetlands	Low	Major Riverine habitat absent	Out
Varanus flavescens (Yellow Monitor)	EN	No	Non-migrant	Semi-aquatic, open wetlands	Low	No suitable wetland habitat	Out
Nilssonia gangetica (Indian Softshell Turtle)	EN	No	Non-migrant	Rivers, ponds	Low	Unsuitable terrain	Out
Axis porcinus (Hog Deer)	EN	No	Non-migrant	Grasslands, floodplains	Low	Grassland habitat absent	Out
Sterna acuticauda (Black-bellied Tern)	EN	No	Migratory	River sandbars, wetlands	Low	No large river habitat	Out
Haliaeetus leucoryphus (Pallas's Fish Eagle)	EN	No	Migratory	Large water bodies, lakes	Low	Unsuitable upland terrain	Out
Aquila nipalensis (Steppe Eagle)	EN	No	Full Migrant	Open landscapes, migratory flyways	Low	Transient winter visitor only	Out
Emberiza aureola (Yellow-breasted Bunting)	CR	Yes	Full Migrant	Wet paddy fields, reed beds	Low	Occasional migrant; no significant habitat available	Out
Calidris tenuirostris (Great Knot)	EN	Yes	Full Migrant	Coastal wetlands	None	Marine species; no inland habitat	Out

[8] https://ebird.org/hotspots

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
Gyps bengalensis (White-rumped Vulture)	CR	No	Congregatory	Forest edges, open country	Moderate	There are no bird hotspots in the study area . The nearest hotspot is Urpad Beel [9](18.20 km) from Bajendogoba site and Nokrek is 38.18 km . There are no nesting cliffs or other habitats in the project area.	Out

Project Influence Area (Within 10 km):

Critical habitat assessment was conducted based on the "Critical Habitat" criteria outlined by World Bank's ESF The details of the presence of critical habitat within PIA are summarized in Table 5.16.

Table 5.16:Biodiversity and critical habitat assessment-based on field survey and GIS analysis for the Direct Impact Area (10 km)

Sl. No.	Habitat (includes natural or modified)	Observation	Remarks
I.	(a) Habitats protected by national and state legal regulations		
	(i) Pas – Wildlife Sanctuary, National Park, conservation reserve or community reserve, Tiger reserve and corridor and Eco-sensitive zone (As notified under the Wildlife Protection Act, 1972)	Not present	
	(ii) Reserve Forest (As notified under India Forest Act, 1927)	Present	Dipkai R.F is at 2.27 Km, Ajagar Hill R.F at 3.64 km, Gandabari R.F at 5.81 km, Zengrazangsa R.F at 9.06 km in Assam from the Project Road
	(iii) Protected wetland of Meghalaya	Not Present	-
II.	b) Habitat of significant importance to Critically Endangered or Endangered species		
	(i) Species listed under Schedule I of the Wildlife (Protection) Act, 2022	Not sighted	A total of 28 species are listed under Schedule I of the Wildlife Protection

[9] https://ebird.org/hotspots

Sl. No.	Habitat (includes natural or modified)	Observation	Remarks
			Act, 2022. Although none of these species were recorded during the field surveys conducted in the study area, their presence has been indicated through secondary information sourced from the IBAT Tool. Details are provided in **Annexure 4.2**
	(ii) Species listed under Schedule III of the Wildlife (Protection) Act, 2022	Not sighted	Schedule III species are not observed during the field survey.
	(ii) Species notified as "threatened species" by the Govt. of Meghalaya under the Meghalaya Biodiversity Rules 2010	Not sighted	No threatened species were observed during the field surveys conducted within the project road corridor
	(iii) Critically Endangered/Endangered species as listed by the IUCN Red List of Threatened species	Present	Field observations confirm the presence of teak, which is categorized as Endangered according to the IUCN Red in 10 km study area.
III.	c) Habitats of significant importance to endemic or restricted-range species d) Habitats that support globally or nationally significant concentrations of migratory or congregator species e) Highly threatened or unique ecosystems		
	(i) Biosphere Reserve (Core Area)	Not present	
	(ii) Ramsar Site	Not present	
	(iii) Important fish & Key Biodiversity Area	Yes, present	• Dridam River @ chainage 1+100. • *The Didram River and adjoining water bodies in North Garo Hills support a diverse freshwater fish community, including economically important species such as carps (Labeo rohita, Catla catla), barbs (Puntius sophore, Raiamas bola), and native species like the Garo Stone Loach (Aborichthys garoensis) and Garo Spineless Eel (Garo khajuriai). These species inhabit a range of environments, from fast-flowing hill streams to rivers, ponds, and reservoirs, and are currently classified as Least Concern in terms of conservation.* • *(Rec.Zool.Surv.India.72 Page 1-22 1977)*
	(iv) Habitat of Appendix I – Endangered migratory species as per the Convention on the	Not present	No such species were observed during the field survey.

Sl. No.	Habitat (includes natural or modified)	Observation	Remarks
	Conservation of Migratory Species (CMS)		
	(v) Notified Elephant Reserve and Corridor	Not present	non notified Elephant crossings were recorded at Chainage 17+062 and 17 +600 .
	(vi) Natural habitats	Not Present	The habitats in the project area are modified for agricultural purposes, and the degraded forest is primarily dominated by bamboo species, Banana and Arecanut.

5.7.3 SUMMARY OF BIODIVERSITY ASSESSMENT AND RISKS

Most of the flora and fauna present within the Direct Impact Area fall under the Least Concern category as per the IUCN Red List of Threatened Species (IUCN, 2024).

A total of 28 species are listed under Schedule I of the Wildlife Protection Act, 2022. Although none of these species were recorded during the field surveys conducted in the study area, their presence has been indicated through secondary information sourced from the IBAT Tool. This suggests that the project area or its surrounding ecological landscape may fall within the broader distribution range or potential habitat of these high-conservation-value species. Therefore, while no direct sightings were made, due consideration has been given to their possible occurrence, and appropriate mitigation and conservation measures will be planned to avoid any potential adverse impacts on these protected species.

The presence of 5 Schedule-I species identified through the Integrated Biodiversity Assessment Tool (IBAT) indicates the potential distribution range of these species within the broader landscape based on global biodiversity databases such as the International Union for Conservation of Nature (IUCN) and World Database on Protected Areas (WDPA). However, IBAT outputs represent modelled habitat suitability or regional occurrence data, not necessarily confirmed site-specific presence along the exact project corridor. During the field reconnaissance and ecological assessment conducted for the DPR/EIA study, no direct evidence such as sightings, tracks, nests, or habitat use of Schedule-I wildlife species was recorded within the immediate project influence area. Therefore, while IBAT highlights that the wider landscape may support Schedule-I species (including potential elephant movement corridors), the absence of confirmed field observations within the project stretch indicates that critical wildlife habitat is not directly present within the road alignment, though precautionary mitigation measures such as signage and speed regulation at the two potential elephant crossing locations are recommended.

A transit walk was carried out by the EIS team along the entire project corridor during the Enumeration Block (EB) survey to verify on-ground conditions, identify environmental and social sensitivities, validate inventory data, and cross-check community-reported issues.

Field surveys, consultations with local communities, and studies by the Forest Department indicate the absence of critical habitats, endangered fauna, or hunting threats within the Direct Impact Area.

A community land with vegetation falls within the Direct Impact Area of the project road between chainages 17+020 to 17+600. An elephant crossing (not notified) is also located within the same stretch at chainage 17+020 and 17+600. The typical herd size recorded in this landscape ranges between 6–12 individuals, including adult females, juveniles, and occasionally sub-adult males.As informed by the Forest Range Officer, Elephant movement has been regularly observed along the project corridor, primarily between Waramgre village on the eastern side and the areas of Borjhora and Phokirmara towards the west. According to local information, elephants cross the road

approximately seven to eight times each year, with peak activity occurring between October and March. The primary reason for their movement is foraging, as elephants travel between forest patches in search of food and water.

As per the discussion with Forest range officer, no elephant road-kill incidents have been reported along this specific stretch. The presence of regular elephant crossings highlights the need for precautionary mitigation measures such as speed calming provisions, cautionary signage, pavement markings, and awareness measures for drivers.

5.8 SOCIO ECONOMIC PROFILE

The baseline study assessed the socio-economic profile of households and families within the Project Influence Area that may be affected by the project. The assessment covered various parameters, including education levels, ethnicity, religion, sources of livelihood, and income levels of the affected families.

The proposed project site is located in the North Garo Hills District of Meghalaya. Established in 2012 from the erstwhile East Garo Hills, the district covers an area of approximately 1,113 sq. km, with its administrative headquarters at Resubelpara. It shares boundaries with Assam to the north and east, East Garo Hills district to the south, and West Garo Hills district to the west.

Government and Administration: North Garo Hills is administered under the Government of Meghalaya and operates in accordance with the provisions of the Sixth Schedule of the Indian Constitution. This empowers the Garo Hills Autonomous District Council (GHADC) to manage matters related to land, forests, and customary practices, while law enforcement and other major state functions remain under the purview of the Meghalaya Government. The district is divided into five Community and Rural Development (C&RD) Blocks, including Resubelpara, Bajengdoba, and Kharkutta. The administrative headquarters is located at Resubelpara, which also serves as the main center for governance and coordination of developmental activities.

5.8.1 SOCIO-ECONOMIC PROFILE OF THE PROJECT ROADS

The socio-economic details of the RBB Road are discussed below. The methodology for data collection is detailed in section 1.3 of chapter 1.

5.8.2 DEMOGRAPHY

5.8.2.1 POPULATION

The project corridor passes through 6 villages namely Bakenang Songma, Bajengdoba, Mansinggre, Gosingpita, Bolsong, and Borjhora. Based on the population size, it may be mentioned that smaller rural settlements such as Bakenang Songma (176), which have relatively lower populations. Overall, the gender distribution is generally balanced; however, certain settlements such as Bajengdoba and Gosingpita have a higher female-to-male ratio. Larger settlements like Gosingpita (736) and Bajengdoba (501) play a key role in shaping the region's demographic profile, highlighting variations in population density along the corridor. The population distribution of the sub-project affected villages is presented in Table 5.17.

Table 5.17: Population distribution of the sub-project affected villages

Total Population			
Village Name	Male	Female	Total
Bakenang Songma	92	84	176
Bajengdoba	248	253	501
Mansinggre	147	145	292
Gosingpita	361	375	736
Bolsong	155	146	301
Borjhora	191	162	353

Source: Census 2011

5.8.2.2 SEX RATIO

The sex ratio across the project-affected villages shows notable variation according to Census 2011. Gosingpita (1,038) and Upper Bajengdoba (1,020), indicating a higher proportion of females. Mansinggre (986) and Bakenang Songma (913) reflect near-balanced ratios, though slightly skewed towards males. Bolsong (941) also shows a relatively lower female proportion, while Borjhora, with a sex ratio of 848, has the lowest among the listed villages. Overall, the sex ratio ranges from 848 to 1,123, reflecting significant inter-village differences in gender balance. Detailed sex ratio data for the project-affected villages and two towns are presented in Table 5.18.

Table 5.18: Sex ratio in the villages along the sub-project road

Sl. No.	Village Name	Sex Ratio
1.	Bakenang Songma	913
2.	Bajengdoba	1020
3.	Mansinggre	986
4.	Gosingpita	1038
5.	Bolsong	941
6.	Borjhora	848

Source: Census 2011

5.8.2.3 SCHEDULED TRIBE POPULATION

The district is predominantly inhabited by Scheduled Tribe (ST) communities such as Garos, Rabhas and Hajongs. Along the project road corridor, ST populations are mainly concentrated in smaller rural settlements. Gosingpita (717) and Bajengdoba (495) record the highest ST populations, underscoring their demographic significance within the corridor. Medium-sized settlements such as Borjhara (353) and Bolsong (301) also exhibit a notable ST presence, while smaller village like Bakenang Songma (173) have comparatively lower ST populations. Gender distribution is generally balanced across the villages; however, some locations such as Upper Bajengdoba (249 females), Gosingpita (365 females), and Salinggre (89 females) have a slightly higher number of females than males. A detailed distribution of the ST population along the project corridor is provided in Table 5.19.

Table 5.19: Population distribution of the sub-project affected villages

	ST Population				
Sl. No.	**Village Name**	**Male**	**Female**	**Total**	**Percentage**
1.	Bakenang Songma	91	82	173	98.2
2.	Bajengdoba	246	249	495	98.80
3.	Mansinggre	147	144	291	99.66
4.	Gosingpita	352	365	717	97.42
5.	Bolsong	155	146	301	100.00
6.	Borjhora	191	162	353	100.00

Source: Census 2011

5.8.2.4 WORKFORCE POPULATION

The Garo communities residing along the RBB road corridor are primarily engaged in agriculture and horticulture activities, including cultivation of paddy, maize, banana, and arecanut. In addition, some households are involved in livestock rearing, wage labour, and small-scale local trade for supplementary income. The occupational structure of the project corridor villages reflects a predominantly agrarian economy supplemented by wage labour and small-scale trade activities. To better understand the workforce composition, a detailed analysis of main and marginal

workers across the study area villages is presented in Table 5.20. This table highlights not only the overall workforce distribution but also gender-wise participation, providing insights into the socio-economic dynamics of the corridor settlements.

Table 5.20:Workforce Population in the Project road corridor area

Area	Main Workers (No.)			Marginal Workers (No.)			Total Workforce (No.)			
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Percentage
Bakenang Songma	17	5	22	0	0	0	17	5	22	12.50
Bajengdoba	77	42	119	5	6	11	82	48	130	25.95
Mansinggre	50	12	62	4	46	50	54	58	112	38.36
Gosingpita	149	19	168	7	117	124	156	136	292	39.67
Bolsong	54	9	63	2	23	25	56	32	88	29.24
Borjhora	85	8	93	3	2	5	88	10	98	27.76

Source: Census 2011

5.8.3 EDUCATION

In Sub Project Road RBB, literacy levels vary across the villages. Bakenang Songma has a total literate population of 157, with 82 males and 75 females. Upper Bajengdoba shows higher literacy, with 413 literates comprising 203 males and 210 females. Mansinggre has 161 literates, including 91 males and 70 females, while Gosingpita leads with 470 literates, consisting of 250 males and 220 females. Bolsong records 249 literates, including 129 males and 120 females, and Borjhora has 273 literate individuals, comprising 148 males and 125 females. Overall, Gosingpita and Upper Bajengdoba exhibit the highest literacy levels, whereas Salinggre has the lowest.

The detailed distribution of literate and illiterate populations in the sub-project affected villages is provided in Tables 5.21.

Table 5.21: Literate Population in the Project road corridor area

	Literate Population				
Sl. No.	Village Name	Male	Female	Total	Percentage
1.	Bakenang Songma	82	75	157	89.20
2.	Bajengdoba	203	210	413	82.44
3.	Mansinggre	91	70	161	55.14
4.	Gosingpita	250	220	470	63.86
5.	Bolsong	129	120	249	82.72
6.	Borjhora	148	125	273	77.34

Source: Census 2011

5.8.4 WAGES AND BENEFITS

Public consultations with local communities revealed that wages in the project area are lower than in urban centers, and workers often do not receive benefits such as healthcare, pensions, or paid leave. According to the Department of Rural Development (2023–24), the notified wage rate for unskilled labor in these corridors is Rs. 541, as per the

latest Meghalaya notification effective from 1 April 2025 (dated 21st July 2025). While the lower cost of living partially offsets these lower wages, achieving financial stability remains a challenge for many workers

5.8.5 SEASONAL EMPLOYMENT

Initial consultations with communities along the RBB road in North Garo Hills indicated that agriculture and allied activities remain the primary sources of livelihood, including shifting cultivation, horticulture and livestock rearing. Community members reported that employment opportunities are largely seasonal, linked mainly to agricultural cycles and occasional local wage labour. During lean agricultural periods, households often experience underemployment and income fluctuations, prompting some individuals to seek temporary work in nearby towns or other districts. Improved road connectivity under the project is expected to enhance access to markets, services, and alternative livelihood opportunities for these settlements.

5.8.6 POVERTY

In this sub project road, poverty rates are higher in rural areas compared to urban centers. Households in remote villages, where road connectivity is still developing, largely depend on subsistence farming. Limited access to markets, credit, and financial services further constrains their economic opportunities, contributing to the higher prevalence of poverty in these areas.

5.8.7 SOCIAL VULNERABILITIES

5.8.7.1 MIGRATION

Consultations with villagers indicate that residents prefer to remain within their local areas, primarily engaging in agriculture and commercial activities within their villages. Community members noted that while some individuals occasionally seek temporary or seasonal employment outside the village, long-term migration is limited, and livelihoods continue to be largely locally anchored.

5.8.7.2 CRIME

In sub project road, most disputes in the villages are resolved locally through traditional mechanisms, with the Nokma (village headman) playing a central role in dispute resolution. Only cases that cannot be settled at the community level or require legal intervention are escalated to and officially recorded by the police. Table 5.22 presents the major crime cases registered at Bajengdoba Police Station over the years. During consultations with police officials, it was reported that crime levels in Sub Project Road RBB are very low, and no specific crime-related data was shared.

Table 5.22:Crime records over the years (2019-2024) from Bajengdoba Police Station

Year/ Major crime	Crime against property	Robbery	Theft	Murder	Kidnapping	Others	Total cases Register
2019	9	1	8	1	3	17	39
2020	4	0	2	3	2	13	24
2021	3	0	2	1	2	11	19
2022	1	0	0	0	1	4	6
2023	1	0	0	1	1	10	13
2024	1	0.5	0	1	1	9.5	13

Source : Field Survey

5.8.7.3 GENDER BASED VIOLENCE

According to records from the Bajengdoba Police Station, no general Gender-Based Violence (GBV) cases have been

reported in Sub Project Road RBB, indicating a relatively safe environment for women. However, two kidnapping cases involving women were recorded in 2023 and June 2024, highlighting isolated incidents that require attention. Additionally, cases under the Protection of Children from Sexual Offences (POCSO) Act have been registered over the years, including two cases in 2010 and single cases in 2019, 2022, 2023, and 2024. Consultations in Sub Project Road RBB revealed that no such cases were reported in the current year.

5.9 SOCIO-ECONOMIC PROFILE OF PROJECT AFFECTED HOUSEHOLDS

Socio-economic data of project-affected households were collected through census and socio-economic surveys, systematically tabulated and analyzed to assess the extent of adverse impacts on land, structures, and livelihoods. A structured, pretested questionnaire was used as the primary tool for conducting these surveys. The survey has been conducted in September 2025.

5.9.1 DEMOGRAPHY

The total number of project-affected households is 156**.** The Table 5.23 below summarizes the gender distribution of the Head of the Household.

Table 5.23:Gender Distribution of PAHs

Gender	Sub Project Road RBB	Percentage
Male	112	71.8
Female	44	28.2
Total	**156**	100

5.9.1.1 GENDER DISTRIBUTION OF PROJECT-AFFECTED PERSONS

Out of a total of 419 Project Affected Persons (PAPs), 241 are male (57.53%) and 178 are female (42.48%), indicating an almost equal distribution between male and female beneficiaries. Gender Distribution of Project-Affected Persons (PAPs) is given in Table 5.24.

Table5.24:Gender Distribution of Project-Affected Persons (PAPs)

Gender	Project Affected Persons	Percentage
Male	241	57.52
Female	178	42.48
Total	**419**	**100**

5.9.1.2 ETHNICITY

The detailed distribution of ethnic groups in corridor wise is given in Table 5.25 below. In Sub Project road, a total of 156 PAHs belong to different communities. The majority are Garo (130 persons, 83.34%), followed by Rabha (12 persons, 7.69%), Muslims (10 persons, 6.41%), and Others (4 persons, 2.56%).

Table 5.25:Community Wise Distribution of PAHs

Communities	Sub Project Road RBB	Percentage
Garo	130	83.34
Rabha	12	7.69
Muslim	10	6.41

Communities	Sub Project Road RBB	Percentage
Others	4	2.56
Total	**156**	**100**

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5.9.2 IMPACT TO VULNERABLE HOUSEHOLDS

Vulnerable group of households include women-headed households, below-poverty-line, physically disabled, and elderly population (60+ years). Table 5.26 below describes the distribution pattern of vulnerable group in the study area.

Table 5.26: Distribution of Vulnerable Group (PAHs)

Vulnerable Category	PAHs
Aged persons above 60 years	8
Below Poverty Line	0
Woman Headed Household	44
Physically Challenged	0

5.9.3 ECONOMIC PROFILE

5.9.3.1 PRIVATE BUSINESS/ ENTREPRENEURSHIP DOMINANCE

Among the 156 Project Affected Households (PAHs), the majority (110) are engaged in private business such as small shops, grocery outlets, roadside kiosks and local trade etc, while 38 depend on agriculture. Only 8 households are involved in government or private service. Details are provided in Table 5.27.

Table 5.27: Occupation pattern of PAHs in sub-project area

Sl. No.	Occupation	PAHs
1	Agriculture	38
2	Private Business	110
3	Service (Govt./Pvt.)	8
Total		**156**

5.9.3.2 INCOME

Out of the total households surveyed, a majority (79 households, 52.7%) reported a monthly income of less than ₹25,000. This was followed by 33 households (22%) earning between ₹25,000 and ₹50,000 per month. The remaining 38 households (25.3%) reported monthly incomes in the range of ₹50,000–₹1,00,000. Details are provided in Table 5.28.

Table 5.28: Monthly Income Range of PAHs

Sl. No.	Monthly Income Range of HH	Sub Project Road RBB	
		No. of PAHs	Percentage

Sl. No.	Monthly Income Range of HH	Sub Project Road RBB	
		No. of PAHs	Percentage
1	less than 25000	83	52.7
2	25000- 50000	33	22
3	50000-100000	39	25.3
4	>100000	1	
Total		**156**	**100**

5.9.4 EDUCATION

In the Sub-Project Road area, education levels among the 4193 Project Affected Persons (PAPs) show participation across all schooling categories. The majority of PAPs (251 persons) have studied up to high school level (Class 5–10). This is followed by 45 persons with primary education, 39 with higher secondary education, and 16 graduates or above. A total of 31 persons is illiterate, while 37 children are below six years of age. Overall, male (233) and female (186) PAPs are represented across education categories, indicating broad access to basic education within the affected population. Details are provided in Table 5.29.

Table 5.29: Education Level of PAPs

Sl. No	Education	Sub Project Road RBB		
		Male	Female	Total
1	Children below 6 years	21	16	37
2	Primary (Class 1 to 4)	20	25	45
3	High School (Class 5-10)	142	109	251
4	Higher Secondary (Class 11-12)	25	14	39
5	Graduate and above	8	8	16
6	Illiterate	17	14	31
	Total	**233**	**186**	**419**

5.9.5 HEALTH STATUS

The predominant waterborne diseases in the study area include diarrhea, typhoid, and cholera, which pose significant health risks, particularly in regions with limited access to clean water and healthcare services as per public consultation with KII (Table 7.1). Poor sanitation and contaminated water sources further contribute to illnesses such as hepatitis A and typhoid fever. In addition, communicable diseases like dengue fever and respiratory infections continue to be prevalent concerns in the area (Table 7.1).

As per community consultation, RBB settlements have made significant progress in sanitation. However, some households still lack access to well-constructed toilets with proper sewage disposal systems. The absence of public toilets and washrooms remains a critical issue, especially for individuals working in open or shared spaces.

Bajengdoba PHC serves as the primary healthcare facility, supported by Resubelpara CHC within the Project Influence Area (PIA), The National Health Mission (NHM) Meghalaya supports these via the 108-ambulance helpline

and 14410 health query line.

5.9.6 IMPACT TO STRUCTURES

The project corridor wise details of the impacted structures are given in below Table 5.30. Chainage wise details are provided in **Annexure 5.3**. No structures are affected on the additional land (0.133 Ha) that is required for the sub project. However, a total of 150 structures located within the existing Right of Way (ROW) are partially affected along the project corridor.

These include 27 commercial structures, 3 residential-cum-commercial structures, and 18 residential structures, that are partially affected - primarily affecting boundary walls, gates, bamboo fencing, and GI sheet extensions. These structures extend into the existing ROW from adjoining land parcels and are classified as encroachments. Accordingly, all such affected persons are categorized as encroachers in accordance with the RPF. The impacts are limited to secondary structures and do not result in physical displacement.

In addition, 102 roadside kiosks located within the ROW operated by Non-Title Holders will be relocated and are categorized as squatters as per the RPF. These structures are associated with livelihood activities, and their impact will result in economic displacement.

A 30-day notice period will be provided to all Project Affected Persons (PAPs) whose structures fall within the project ROW, allowing them sufficient time to salvage materials and relocate. Additionally, roadside kiosks/vendors will be provided with shifting/transport allowance, and relocation grant as per the entitlement matrix. The format of the notice issued to affected households is given in Annexure 4 of the RAP and the list of structures is given in Annexure 5.3.

Table 5.30: Type of Impact on Project Affected Household

Type of Affected Assets	Type of Impact	PAH Category	No of PAHs	No of PAPs	% of impact
Commercial Structures (bamboo and GI Sheet fencing of Shops)	Loss of structure (partial impact)	Encroachers	27	76	<10
Residential Cum Commercial structures (Gate, Concrete Boundary wall)	Loss of structure (partial impact)	Encroachers	3	8	<10
Residential structures (GI shade and boundary walls of houses)	Loss of structure (partial impact)	Encroachers	18	60	<10
Roadside Kiosks	Temporary Economic Displacement	Squatters (NTH)	102	249	<10
Land	Loss of fallow land	Land Owner	6	26	<10
Total			**156**	**419**	

5.9.7 TREES in ROW

A total 40 trees are situated within the existing Right of Way (RoW) on both sides of the road. In the additional land required for this sub-project, a total of 30 arecanut trees located on private land belonging to a single individual will be affected. During the survey, the affected owner informed the consultants that the trees are not the primary source of livelihood and are mainly used for household consumption and supplementary income generation. An amount of ₹1,47,000 has been included in the RAP budget towards compensation at replacement cost for the

affected trees/crops, based on the valuation rates provided by the Horticulture Department, Government of Meghalaya (GoM) (Chapter 8, Table 8.1 of the RAP). Altogether there are 70 no of trees to be cut.

To mitigate the ecological impact of tree felling, compensatory plantation (@1:10)/ as suggested by Forest Department should be carried out, in accordance with applicable environmental regulations and guidelines. Taking a cue from the MITP, the survival of the trees should be monitored. These measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP).

5..9.8 COMMON PROPERTY RESOURCES

The Common Property Resources (CPR) assessment classifies structures into two categories: government facilities and community/public facilities. Government structures, comprising 14 minor structures such as compound walls (CWs) of government buildings, schools, and community halls, are situated away from the proposed ROW. Since they are outside the direct influence zone, no adverse impacts are anticipated. A summary of CPRs is provided in Table 5.31.

Table 5.31: Common Property Resources located within 50 m of the ROW

Sl. No.	Type of CPR Structures	Chainage	Distance from the COI	Impact and mitigation Measures
1.	Bajengdoba PHC	Ch.01+400	50 m RHS	No direct impact; design speed reduced to 20 km/h with improved signage to enhance road safety. .
2.	Post office	Ch.01+900	17 m RHS	
3.	Assistant Executive Engineer Office	Ch.02+300	50 m from center line LHS	
4.	PWD Roads Transit Rest House	Ch.02+400	50 m from center line LHS	
5.	Hostel	Ch.02+662	30 m from center line RHS	
6.	LP School	Ch.02+200	20 m from Center line LHS	No direct impact; design speed reduced to 20 km/h with improved signage to enhance road safety. Speed restriction signs before and after school (Both side of the school)
7.	LP School	Ch.03+200	20 m RHS	
8.	LP School	Ch.03+540	30 m from Centre line RHS	
9.	SSA School	Ch 10+200	20 m LHS	
10.	Church	Ch 10+400	6 m RHS	No direct impact; design speed reduced to 20 km/h with improved signage to enhance road safety.
11.	Community Hall	Ch 10+500	30 m from Centre line RHS	
12.	Church	Ch 02+914	30 m from Centre line RHS	
13.	Holy Family House	Ch 02+557	20 m from center line LHS	
14.	Bajendoba Baptist Church	Ch 1+800	50 m RHS	

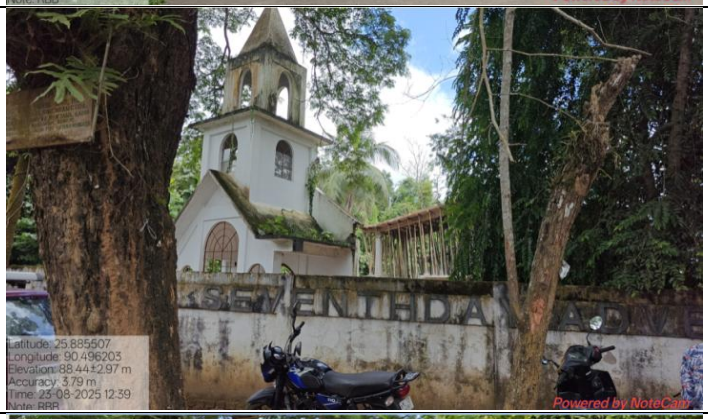
An illustrative view of the CPRs / Other important locations, along with their respective distances from the centerline, is presented in Figure 5.13 below.

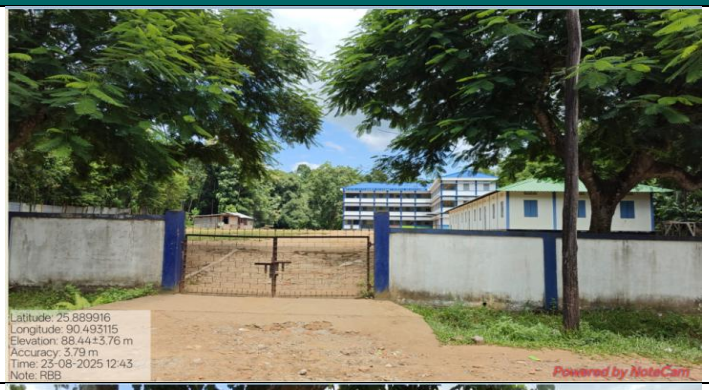
Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos

Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
00+000	-	Starting Point Traffic congested conditions. T- junction improvement is proposed. Details are given in Table 6.2.	
18+300	-	End Point	
02+200	LHS at 20 m distance from Center line	School	

Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
00+188	LHS at 24 m distance from Center line	Community Storage Shade	
01+400	RHS at 50 m distance from Center line	Bajengdoba PHC	
1+800	RHS at 50 m distance from Center line	Bajendoba Baptist Church	

Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
01+900	RHS at 17 m distance from Center line	Post office	
03+200	RHS at 20 m distance from Center line	School	
02+300	LHS at 50 m from center line	Assistant Executive Engineer Office	
02+400	LHS at 50 m distance from center line	PWD Roads Transit Rest House	

Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
02+557	LHS at 20 m distance from center line	Holy Family House	
02+662	RHS at 30 m distance from center line	Hostel	
02+914	LHS at 30 m distance from center line	Church	
10+500	RHS at 30 m distance from Centre line	Community Hall ane aga	

Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
03+540	RHS at 30 m distance from Centre line	School	
01+765	RHS	Paddy Field	
10+200	LHS at 20 m from the Center line	SSA School	

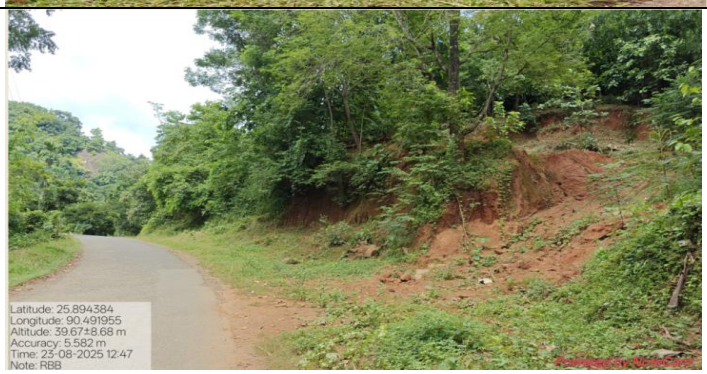
Ch No.	LHS/RHS with distances	Structure / Details	Geo tagged photos
10+400	RHS at 6 m from the center line	Church	
17+080	LHS	Elephant Passing	
17+020 to 17+600	_	Community land with vegetation	

Figure 5.13: Illustrative view of the road features in Sub Project Road RBB

5.10 HAZARD AND VULNERABILITY PROFILE

The Hazard and Vulnerability profile of the RBB Road area and North Garo Hills district includes landslide hazards, flash flood, earthquake, etc. The drought, group clash, fire incidents, etc. also occur in the district. The seasonal hazard analysis of the North Garo Hills District[10] is given in **Table 5.32** below.

[10] District Disaster Management Plan for Meghalaya, 2024

Table 5.32: Hazard analysis

Type of Hazards	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Landslide			◄							►		
Earthquake	◄											►
Flash flood		◄								►		
Storm			◄			►						
Fire Accident	◄											►
River Erosion				◄					►			
Industrial Hazard	◄											►
Road Accident	◄											►

5.10.1 EARTHQUAKE ZONES

The project road stretches fall under Zone – V, which is at Very High risk and intensity is IX. Seismic Zone details of North Garo Hills is presented in Table 5.33.

Table 5.33: Seismic Zone details of North Garo Hills

District	Seismic Zone	Notable Faults	Recent Earthquakes
North Garo Hills	Zone V (lower)	Internal faults like Dudhani, Darugiri	—

5.10.2 Climate Reslient Features

The upgradation of the Rongsai–Borjhora–Bajengdoba (RBB) Road from a single lane to an intermediate lane has been designed by incorporating climate-resilient measures to address the region's high rainfall, hilly terrain, and associated risks such as flooding, erosion, and landslides. A climate vulnerability assessment was carried out during the design stage, and the findings were integrated into the engineering design to enhance the road's durability and serviceability under present and future climate conditions. Key measures include improved drainage systems, slope stabilization, resilient pavement materials, and integrated safety provisions to ensure long-term functionality and all-weather connectivity. Climate Resilient design features are given in Table 5.34.

Table 5.34:Climate Resilient design

Climate-Resilient Design		Upgradation of Rongsai Borjhora Bajengdoba Road from single to intermediate lane (RBB)
1. Climate Vulnerability Assessment During Design	Roads and bridges undergo systematic climate vulnerability assessments early in design to identify hotspots prone to extreme rainfall, flooding, erosion, waterlogging, landslides and submergence.	Based on the findings of these assessments, climate-resilient design measures have been incorporated into the project. The design discharge for bridges and culverts has been increased by 25.2%, and the design discharge for cross-drainage structures has been enhanced by 14.5% as per Shared Socioeconomic Pathways SSP 5-8.5 data from IITM Pune in consultation with MITP, to account for projected increases in rainfall intensity under future climate scenarios.
	This assessment informs alignment choices, drainage design, slope	Considering future climate vulnerability and existing stream scouring pathways,

	protection measures and prioritisation of resilient interventions.	appropriate alignment decisions and resilient interventions have been incorporated into the design. Stream training works and slope protection measures have been provided where streams run parallel to the road alignment to control erosion and reduce flood and scour risks. In addition, upstream and downstream protection measures have been incorporated for culverts in accordance with IRC SP:13 to prevent scouring of approaches and the bed around the structures. These measures demonstrate that the climate vulnerability assessment has directly informed drainage design, slope protection strategies and prioritisation of resilience-enhancing interventions.
2. Enhanced Drainage & Flood Management	Larger culverts.	At critical locations where existing culvert dimensions were found to be insufficient, the size of culverts has been increased by converting 2 pipe culverts into box culverts, and 15 additional pipe culverts have been proposed to improve drainage. These measures have been adopted to enhance hydraulic capacity, prevent flooding and damage to the road, and ensure uninterrupted connectivity, thereby achieving an all-weather road
	Cross-drainage structures:	Specific provisions for cross-drainage structures are made to enhance hydraulic efficiency, prevent clogging and ensure the stability of both the structures and their approaches. These include floor aprons, cut-off walls, quadrant pitching, stream protection works, return walls and retaining walls.
	Roadside drains: properly graded roadside drains prevent waterlogging and lower flood damage.	Proper gradient roadside drains have been provided parallel to the road and connected to existing and newly proposed culverts to prevent waterlogging and reduce flood damage.
	Road designs incorporate improved cross-drainage systems, culverts, and surface water management measures to ensure that the road remains serviceable during intense monsoon rainfall, which is common in Meghalaya's wet climatic conditions. These provisions help in effective drainage of stormwater, prevent waterlogging, and enhance the resilience of the road infrastructure during heavy rainfall events.	Improved Cross Drainage system
3 Slope Stabilisation & Erosion Control	Bioengineering measures such as vegetation, geotextiles, and structural	Bioengineering using local Broom Grass, Vetiver/Jetty grass has been proposed.

	retaining systems are used to reduce landslide risks	Turfing is provided on embankment slopes for erosion control
	Earthwork design also considers increased rainfall intensity in hilly terrain.	
	In hilly terrains, bio-engineering measures are used to stabilise embankments and slopes (e.g., vegetation, geotextiles).	
	Structural measures like retaining walls, gabion walls and breast walls protect roads from landslides and soil erosion.	Retaining walls up to 3.0 m height are proposed, while bioengineering measures are used for slopes above 3.0 m height.
4 All-Weather Surface Materials	Use of durable pavement materials that resist damage from heavy rainfall, moisture ingress and temperature fluctuations.	CTB/CTSB (Cement Treated Base/Sub-Base) layers are proposed as they provide higher structural stiffness, better load distribution and improved resistance to moisture damage, erosion and rutting compared to DBM/BC layers.
5 Design with Safety & Maintenance Objectives	Climate-resilient road design integrated with safety measures such as improved road geometry, traffic signage, crash barriers and delineators.	Considering the high rainfall and hilly terrain of Meghalaya, paved shoulders are proposed instead of hard shoulders to prevent water ingress, reduce erosion and avoid pavement edge failures, thereby improving durability and safety.

6. ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

6.1 INTRODUCTION

The project is expected to generate both positive and adverse environmental and social impacts along the 18.27 km priority roads in Sub Project Road RBB. This chapter analyzes the potential impacts arising from the implementation of project activities. The impacts differ in type, nature, magnitude, extent, timing, duration, certainty, and reversibility.

The assessment takes into account the nature of the project, the scope of activities, and the potential magnitude of impacts across different environmental and social components, namely:

- **Physical Environment:** air quality, water resources, noise levels, and soil
- **Biological Environment:** flora and fauna
- **Socio-economic Components:** property removal, land acquisition, ASI-protected sites, and influx of labor

6.2 IMPACTS IDENTIFICATION AND EVALUATION

The potential impacts were identified in three main steps:

1. Identification of project activities/aspects causing impacts;
2. Establishing affected environmental and social components (valued receptors). These were determined to include vegetation, water bodies, soil, land stability, water quality and quantity, ambient air quality, employment and livelihoods, vulnerable groups, infrastructure, public safety and occupational health and safety;
3. Determining potential environmental and social impacts in an impact Identification Matrix

Based on the understanding of the project information as outlined in chapter 3 and baseline environmental conditions detailed in chapter 5, the anticipated impacts of the MLCIP project are identified and discussed in the subsequent sections. The potential environmental and social impacts (both adverse and positive) of the MLCIP project activities during the Design, Construction and Operational Phases were identified and evaluated through the Leopold Matrix, where the interactions between relevant project activities and the natural/physical environmental components and the social components were considered to determine whether or not the interaction may create potential impacts.

6.3 IMPACT ANALYSIS USING LEOPOLD MATRIX (MAGNITUDE/IMPORTANCE CLASSIFICATION)

The Leopold Matrix is a comprehensive checklist designed for the identification, evaluation, assessment and analysis of environmental impacts on the development project following the interaction matrix analysis approach by Leopold. The Leopold Matrix developed for the road upgradation project is provided as **Table 5.1**. The checklist interaction matrix for environmental impact assessment was obtained by placing identified existing environmental components in the columns and the proposed project activities in the rows of the matrix. The process is summarized as follow:

6.3.1 IMPACT EVALUATION MATRIX

In order to assess the impacts of the proposed project, the impacts analysis across the project phases was done as

follows.

1. Pre-Construction Phase
2. Construction Phase
3. Operational Phase

The description of the project activities and magnitude of the impacts for the various environments and social components for this project are presented in the below table. These impacts further have been categorized as per the World Bank's Environmental and Social Standards (ESSs) applicable to the project.

Table 6.1: Impact Evaluation Matrix

Project Activity Relevant WB ESS	Air Quality	Noise	Water Resources	Soil Stability	Flora & Fauna	Public Health	Community Safety	Cultural Heritage	Hazardous Material Risk	Drainage	Road Safety
Pre-Construction Phase											
Site Clearance (Tree Felling, Vegetation removal, utility relocation)	MN	MN	N	MN	MN	LN	LN	LN	N	N	LN
Labour Camp Siting & Mobilization	MN	MN	MN	N	Low	MN	MN	N	MN	LN	N
Site identification for construction plants, quarrying, material storage	HN	HN	HN	MN	HN	HN	HN	MN	HN	HN	HN
Earthworks (Excavation, Filling)	MN	HN	MN	HN	MN	MN	LN	LN	MN	MN	MN
Grading, Levelling and Surface laying	HN	HN	MN	MP (Improved Stability)	MN	MN	LN	LN	MN	MN	MN
Drainage & Culvert Installation	N	LN	MP (Improved Drainage)	MP (Improved Stability)	LP	LP	LP	N	N	MP	LP
Slope Stabilization & Bioengineering	N	N	LN	MP (Improved Slope Stability)	MP	LP	LP	N	N	MP	LP
Construction Water Usage	LN	N	MN	LN	LN	LN	LN	N	N	LN	LN
Operation of Construction Plants	HN	HN	HN	N	MN	MN	MN	N	HN	MN	MN

Waste Generation and Disposal	MN	N	MN	MN	MN	HN	MN	N	HN	HN	MN
Fuel and Hazardous Material Handling	MN	N	MN	N	LN	HN	MN	N	HN	N	N
Construction Traffic & Machinery	HN	HN	LN	LN	LN	MN	MN	N	MN	N	HN
Health & Safety Training and OHS Implementation	HP	HP	HP	N	N	HP	MP	N	MP	N	MP
Decommissioning of Construction Sites, Plants, Labour Camps	MN	MN	MN	MN	LN	MN	LN	N	MN	LN	LN
Operational Phase											
Operational Traffic Flow	LN	LN	LN	LN	LN	MP (Improved Access to Health Services)	MP(Improved Connectivity)	LN	LN	MP (Improved Drainage)	MP (Improved Road Safety)
Transportation of Hazardous Materials	MN	LN	LN	LN	MN	HN	HN	MN	HN	MN	HN
Compensatory Plantation	HP	N	MP	MP	HP	MP	MP	LP	N	MP	HP
Monitoring & Community Engagement	-	—	—	—	—	MP	MP	N	N	N	LP

HN – High Negative Impact, MN – Moderate Negative Impact, LN – Low Negative Impact, N – Neutral Impact, LP – Low Positive Impact,MP – Moderate Positive Impact, HP – High Positive Impact

Interpretation of Impact Assessment Matrix

The **Table 5.1** presents the environmental and social significance ratings of various project activities during the pre-construction, construction, and operational phases of

the RBB Road sub-project.

Pre-Construction Phase

Activities such as site clearance, tree felling, and utility relocation are assessed as having moderate to minor (MN–LN) environmental and social impacts due to localized vegetation removal and possible disturbance to cultural or community assets. Labour camp siting and mobilization) exhibit moderate risks, primarily associated with worker welfare, land use conflicts, and sanitation. Identification of sites for construction plants, quarrying, and material storage represents a high-risk (HN) activity, as it can significantly affect land stability, noise, dust, and habitat quality if not properly managed.

Construction Phase

The earthworks, grading, and surface laying have moderate to high impacts (MN–HN) due to soil disturbance, erosion, dust generation, and safety concerns, although they also produce positive impacts (MP) through improved slope stability and road quality. Drainage and culvert installation and slope stabilization with bioengineering are considered moderately positive (MP) activities, improving overall stability and flood resilience of the corridor. Construction water usage, waste generation, and fuel handling have low to moderate impacts, mainly localized and temporary in nature. Health and safety measures and OHS implementation result in high positive impacts (HP) by improving worker welfare and reducing accident risks. Decommissioning of construction sites and labour camps carries minor to moderate residual impacts, which can be mitigated through site restoration and waste clearance.

Operational Phase

During operation, the road will yield several positive outcomes, including improved connectivity, access to health and education services, better drainage, and enhanced road safety. Compensatory plantation contributes high positive (HP) environmental benefits, supporting biodiversity restoration and slope stabilization.Finally, monitoring and community engagement ensure long-term sustainability and social inclusion, producing moderate to low positive impacts through participatory oversight and grievance redress.

6.4 ENVIRONMENTAL IMPACTS

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project. The analysis predicts the nature and significance of the expected impacts. The following sections provide a detailed analysis of the project's environmental and social impacts across its various phases in detail. Corresponding mitigation measures have been incorporated into the sub-project ESMP and sub-project RAP, IPDP, including project- level plans (LMP, Work Site safety Plan (OHS plan), SEP, and SEA/SH Prevention and Response Plan). Based on this indicative ESMP, contractor will prepare contractor's environment and social management plan (C-ESMP) and get it approved by MPWD before starting the pre-construction work.

6.4.1 IMPACTS DURING PRE-CONSTRUCTION PHASE

The project envisages upgrading the existing single-lane carriageway to an intermediate lane configuration to enhance the capacity and extend the service life of the Rongsai–Borjhora–Bajengdoba (RBB) Road. While most construction activities are proposed within the existing Right of Way (RoW), minor land requirement at specific locations for curve correction, embankment raising, drainage improvement, and slope protection.

Pre-construction activities will primarily include:

- Site clearance and reconstruction/improvement of approach roads for movement of plant and machinery,
- Establishment of contractor's camp, material storage, and construction yard, and
- Planning for material sourcing and finalization of work methodology. The contractor shall as part of the material procurement identify the quarry from which the sourcing would take place. Along with the process of approval of the material, they would submit the copy of the EC, CTO to the CSC/PMU. If these documents are identified to be correct then the CSC/PMU would provide an approval of the quarry as part of the material approval. During construction, material can only be procured from these quarries. The royalty payment challans for the material procured would be submitted to the CSC/PMU along with the bills by the contractors.

The impact on the different environmental components is discussed in detail in the following sections:

Ecological and Environmental Impacts

During the pre-construction phase, potential impacts are anticipated from site clearance, vegetation removal, tree felling, material sourcing, labour camp establishment, and utility relocation. The RBB corridor passes mostly through agricultural areas and community land, River. Some of the associated activities e.g establishment of the construction camp, storage of material, staging of equipment which will require land outside the RoW these activities outside the RoW have potential to disturb the sensitive ecology. During field visit, no bird nest has been observed on road side trees. A total of 70 trees will be felled along the corridor, leading to localized loss of vegetation and minor habitat disturbance

Mitigation Measures:

- Avoid locating construction camps, material storage areas, machinery staging areas, and disposal sites near streams, productive community land, floodplains, or within/adjacent to natural habitats. The siting of all such facilities shall be subject to prior review and approval by the Construction Supervision Consultant (CSC). In addition, prior informed consent of the concerned community members and village heads shall be obtained before finalizing these locations. A total of nine (9) disposal site locations have been jointly identified in consultation with the community members, the Public Works Department (PWD), and the

Independent Consultants, ensuring that site selection is socially acceptable and environmentally appropriate.

- The Environmental specialist of CSC shall undertake the visit of the probable sites (at the prospecting stage of the site) and shall provide his opinion on the suitability and also protection measures (within 7 days of such request being made by Contractor) which need to be taken to ensure suitability.
- Restrict vegetation clearing to the minimum area required for works.
- The trees can only be felled with the permission of the Forest Department, Government of Meghalaya. Compensatory plantation at a ratio of 1:10, (or as mandated by the Forest Department shall be carried out. Native species tolerant to local climatic and pollution conditions shall be planted.
- The scheduling of the plantation should be carried out so that plantation activities are undertaken before the monsoon season. The location of the plants shall be georeferenced and reported to a PIU on georeferenced platform provided by the PMU,
- Greenbelt shall be developed at the camp as directed by the MSPCB.
- Maintain a buffer of at least 100 m from natural drainage channels or water bodies.
- Implement soil erosion control measures (silt fencing, sediment traps, and slope turfing).
- Prohibit hunting, fishing, or collection of forest produce by workers.
- Awareness and sensitization of labourers on local wildlife and biodiversity conservation.
- Schedule noisy operations (rock breaking, heavy equipment use) away from bird nesting seasons (March–July).
- Site-specific Environmental Management Plans (EMP) may be developed by the contractor in consultation with the Environment Officer of PMU if any of the location of the construction activities have sensitive ecology to minimize biodiversity loss.
- An environmental monitor should be present on-site during tree felling activities to supervise the process and respond promptly to any wildlife that may be injured, killed, or require relocation due to disturbance, including birds and cavity-nesting animals.

Occupational Health and Safety (OHS)

The road construction activity involves operation of equipment, vehicle and machinery which poses OHS challenges. The construction activities also involve the use of hot bitumen, and working with hazardous material i.e. molten bitumen spray. In addition, the construction activity would take place when the traffic is operational on the road. This poses an additional challenge for the workers. To ensure safe working conditions, the Contractor needs to carry out a detailed Hazard Identification and Risk Assessment (HIRA) will be conducted for each task A preliminary Hazard Identification and Risk Assessment have been carried out (Annexure 6.3) and some mitigation measures suggested and included in the Labour Management Plan for the project. The work methodology will define activity sequencing and associated occupational and community health and safety (OHS/CHS) risks. It will be reviewed by the PIU- PWD under the oversight of ESMU prior to approval of Work Methodology.

Mitigation Measures:

- Develop and implement a site-specific OHS Plan conforming to World Bank Environmental, Health and Safety (EHS) Guidelines.

- The OHS Plan shall be submitted along with the Method statement. The PIU–PWD & CSC shall review the OHS Plan and provide their comments within 15 working days. Once these comments have been addressed and the OHS Plan approved the Method Statement shall be approved. The Method statement shall not be approved by CSC unless the OHS Plan has been approved
- Arrange for PPE (helmets, safety shoes, high-visibility vests, gloves) to all workers.
- Develop tie-up with hospitals for the regular health check-up and Health Emergency and Accidents.
- Ensure proper sanitation, adequate potable water (minimum 5 liters per person per day), and waste disposal facilities in camps.

- All lifting equipment should have the appropriate certification and construction equipment should meet the emission requirement specified in MoRTH emission standards specified in GSR 144.
- Engage trained personnel for operating machinery and working at height or confined spaces.

Engage trained personnel for operating machinery and working at height or confined spaces.

Community Health and Safety

The project is not expected to result in significant adverse impacts on ecosystem services.

Construction works along existing habitations and roadside markets can pose safety risks to pedestrians and road users. The improvement works will largely be confined within the existing Right of Way (ROW). No diversion of forest land or large-scale removal of vegetation is involved. However, minor and temporary impacts may occur during construction, such as localized disturbance to roadside vegetation, increased sediment runoff affecting nearby surface water, and temporary obstruction of natural drainage during earthworks.

Mitigation Measures:

- Prepare and implement a work site specific Traffic Management Plan to regulate vehicle movement, material haulage, and diversions. The Traffic Management Plan shall indicate the locations for diversions, work zones, transition zones. It shall define the safety precautions and the signages etc, in conformance to IRC SP 55: 2014. The Traffic Management Plan shall also be submitted along with the Method Statement and shall state the process for implementation and notification for inspection of the traffic safety measures.
- Make arrangement for New Jersey barriers/ Water filled barrier, MS steel barricades (2 m high) , signage, and warning lamps at work sites.
- Prepare a Community Health and Safety Plan (CHS Plan) ensuring public segregation from work zones. The Generic CHS Plan will be submitted along with the Work Statement and should be considered an integral part of the Work Methodology and Work Plan. The Work Plan should not be approved without an approved CHS Plan. The site-specific management plan should present the additional measures which have to be to be implemented. Every RFI should be accompanied with a site specific OHS, CHS and Traffic Safety Plan, which should define the site-specific measures which were implemented. Without these plans being implemented the works should not be approved.
- The material transport route through existing network of roads should be planned and approved by the local transport authorities. Possible risk areas need to be identified along with sensitive receptors and their time of sensitivity. The Traffic Management Plan shall be developed accordingly
- Schedule high-risk activities during off-peak hours to minimize traffic congestion.
- Develop posters for Community Awareness. Conduct community awareness campaigns before any temporary road closure or service disruption.

The OHS Plan, CHS Plan, and Traffic Safety Plan must be reviewed and approved by CSC/MPWD before initiation of construction. To mitigate these ecosystem service risks, appropriate measures have been incorporated in the design and Environmental and Social Management Plan (ESMP). These include provision of adequate cross-drainage structures and roadside drains to maintain natural water flow, slope stabilization and protection works (gabion walls, retaining walls) in vulnerable stretches, controlled construction practices to prevent sediment runoff, and restoration of disturbed areas through turfing and plantation. These measures will ensure that the quality of freshwater, soil stability etc. roadside vegetation, There will be some impact due to tree felling which is anticipated to be long term but would not irreversible because the plantation will be undertaken by the project.

Construction Camp and Site Selection

The location of the construction camp can have adverse impacts while its design and layout would influence the impacts during the operations stage. The establishment of labour camps and construction support facilities may exert localized pressure on water availability, sanitation systems, and waste management infrastructure. Appropriate provisions for safe drinking water, adequate sanitation, drainage arrangements, and solid waste disposal must be made to prevent health and hygiene issues. To avoid these unwanted impacts the following mitigations are proposed. There will be No constructional camp, material storage area setup upto100 m on both sides from Elephant pass (At Ch 17+020 and Ch 17+620).

Mitigation Measures

- Contractor's camps, stockpile, and equipment yards will be located at least 500 m from settlements and 100 m from water bodies or forest areas.
- Camps should follow **IFC/World Bank Labour Accommodation Guidelines** and local environmental norms.
- The measures suggested in the BCOW rules shall also be included in the plan and implemented.
- The layout of camps will be reviewed and cleared by the Environment Officer, PMC prior to establishment.
- No construction camp, material storage area, will be setup 100 m on both sides from Elephant pass (At Ch 17+020 and Ch 17+620).

Disposal of Construction Debris and Waste

Limited C&D waste (excavated material, asphalt fragments, scrap metal) will be generated. However, haphazard disposal of such debris can lead to both environmental and social issues.

Mitigation Measures:

- Segregate reusable and non-reusable debris.
- Reuse topsoil for slope stabilization and landscaping.
- Dispose of debris only at approved low-lying barren areas located at least 1 km downwind of settlements and away from drainage lines.
- The waste shall be disposed in predesignated location Jointly identified by the PWD/Community. Details of Spoil disposal site is given in Table 3.15.
- Avoid dumping in water bodies, wetlands, or near agricultural fields.
- Regularly monitor disposal sites to prevent contamination and visual pollution.

Shifting of Utilities

A total of 177 electric poles, 7 transformers, and 70 electric line crossings are identified along the RBB road corridor for shifting. A total of 91 OFC pillars is identified for shifting along the RBB road corridor, comprising 66 on the LHS and 25 on the RHS.

Mitigation Measures:

- Coordinate with line departments (MePDCL, PHE, Telecom) for planned relocation prior to construction.
- Provide prior notice to local communities about any temporary service disruption.
- Restrict utility shifting to daytime hours to avoid safety risks at night.
- The scheduling of the construction works will be shared with the line department (MePDCL, PHE and Telecom Departments) for ensuring uninterrupted services during construction.

- Provision of utility ducts for underground pipelines shall be incorporated into the design to ensure safe and organized routing of essential services, minimize future excavation, and facilitate maintenance without disrupting road infrastructure

Plant, Machinery, and Vehicle Selection

Early-stage stakeholder engagement and to prevent pollution from the different activities during the construction phase preparation of a Contractor's Environmental and Social Management Plan (C-ESMP) will be essential. The following are envisaged:

- The C-ESMP shall apply the mitigation hierarchy—prioritizing avoidance, then minimization, and finally offsetting and restoration through design improvements, slope stabilization, compensatory plantation, and safety training. Implementation of these measures during the pre-construction stage will ensure environmentally responsible preparation and minimize potential social disruptions before commencement of construction works. The CESMP will be submitted along with the Method Statement. The PMU and CSC will review it as stated above for the other plans and shall provide its observations. Once these observations are addressed the CESMP will approve. The Method Statement will not be approved without the approval of the CESMP. Hence the Contractor cannot undertake any works on site till the time the C-ESMP, OHS Plan, Traffic Management Plan, CHS Plans are approved.

- All construction equipment and vehicles shall comply with MoRTH emission standards (GSR 144[11]) and have valid Pollution Under Control (PUC) certificates. The contractor shall maintain equipment in good working condition to minimize noise and air pollution.
- Conduct air quality monitoring according to the EMP. This will be carried out before the works and will be considered as a reference baseline

Sourcing of Construction Materials

The sourcing of materials such as aggregates, sand, and stone may cause adverse impacts on land, air, and water quality if not properly managed. Sourcing material from unauthorized quarries and not operating them as per the specification can lead to unwanted impacts on the environment.

Mitigation Measures:

- The contractor shall as part of the material procurement identify the quarry from which the sourcing would take place. Along with the process of approval of the material, they would submit the copy of the EC, CTO to the PMU. If these documents are identified to be correct then the PMU would provide an approval of the quarry as part of the material approval.
- In the case of any change / alteration of the borrow or quarry area the same process shall be applied.
- During construction, material can only be procured from these quarries. The royalty payment challans for the material procured would be submitted to the PMU along with the bills by the contractors.
- No borrowing shall be allowed within forest areas or near habitations.
- Borrow area restoration to be certified by the Environmental Officer of CSC before final payment.
- Borrow areas, required to, comply with **MoEF&CC Standard Operating Procedures (SOP 2022)** for rehabilitation and closure.
- If contractor procures any material (such as ready-mix concrete, asphalt/macadam, aggregates etc.), from third party agencies, contractor shall ensure that such agencies have all necessary clearances/permissions

[11] https://morth.nic.in/sites/default/files/notifications_document/GSR%20598%20%28E%29%20dated%2030%20September%202020%20Seperate%20emission%20norms%20for%20agriculture%20tractors%20and%20CEV.pdf

as required under the law; these include CTE/CTO from MSPCB, environmental clearance, etc.; contractor shall collect the copy of these certificates and submit to PMU; PIU will approve the source only after all the certificates are submitted.

Water Requirement

Construction water will be required for concrete mixing, dust suppression, and domestic use. Overextraction of natural resources can lead to unwarranted impacts. To prevent this the following mitigations are proposed.

Mitigation Measures:

- Obtain permission for groundwater abstraction from the State Water Resources Department or Surface water from Irrigation Department. appropriate Agency.
- Prefer use of surface water from local streams or treated water from nearby sources.
- Extraction from community wells or structures used by community is prohibited unless it is allowed on cases by case basis.
- Maintain drainage around storage and batching areas to prevent stagnation.
- In the case that water is sourced by tankers the Contractor shall submit the permission of the borewell to the PMU before the sourcing of water.
- Maintain record of the water extracted or sources by tankers

6.4.1.1 IMPACTS DURING CONSTRUCTION PHASE

Major Activities during the construction phase involves earthworks, grading, drainage works, cutting of slopes, slope protection, disposal of cut material, and culvert construction, laying of bitumen, transportation of material. , These activities are expected to cause significant short-term adverse impacts on air quality, noise, water resources, and soil stability. Occupational health and safety (OHS) risks including accidents, exposure to dust and noise, handling of heavy machinery, and potential landslides require robust safety protocols.

Most of the adverse environmental impacts are related to construction works which are inevitable but are manageable through good engineering and construction practices which have mostly been well defined and standardized. The negative environmental effects can be taken care of at an early stage through proper construction planning, sensitization of workforce and supervision and oversight by the works supervisor.

The associated activities of road construction works would involve operation of plant, movement of machinery laying of bituminous mixtures, handling of hazardous materials like bitumen, diesel, etc., dumping of unusable debris materials, transportation of materials from production site to construction site, and other constructional activities and associated works like mobilization of construction equipment, setting up of construction plants, setting up of workforce camps, quarrying, material storage etc. These activities have certain impacts of various magnitudes on different components of the environment.

The anticipated impacts due to all these activities have been described below:

IMPACTS ON PHYSIOGRAPHY

The sub-project area comprises an existing road traversing hilly terrain. Land use along the road stretches includes agricultural areas, unclassed forest, dense vegetation, and shifting cultivation. The same alignment will generally be followed for upgrading the road from existing single/intermediate lanes to an intermediate configuration with paved shoulders and geometric corrections at selected locations. The existing ground profile will be maintained, with minor profile adjustments at certain locations. Rehabilitation and upgradation will generally be restricted to the existing right-of-way (ROW) in settlement areas. The existing ground profile will be maintained, with minor profile adjustments at certain locations. Rehabilitation, and upgradation, will generally be restricted to the existing right-of-way (ROW) in settlement areas.

The Rongsai–Borjhora–Bajengdoba (RBB) Road traverses gently undulating terrain with elevations ranging from 100 m to 300 m amsl. To maintain gradient of the road and obtain adequate RoW for construction hill cutting is required. The total estimated cut quantity is 1,01,540.6 m^3 and fill quantity is 25,506.16 m^3, resulting in a surplus of approximately 76,034 m^3 of excavated material to be disposed of at MPWD-designated sites. Cutting of hill, can lead to slope instabilities and Environmental impacts such as soil erosion due to toe failure. The following chainages were identified during the technical designs and areas prone to land instabilities about 300 mm at chainage 0+600 and 250 mm at chainage 1+200.

FRL has been raised at Km 0+600 has been raised by 1m. Toe wall has been proposed at Km 0+610 to Km 0+670.New Bus Shed (LHS/RHS) at Km 0+650 has been proposed. From Km 1+280 to Km 1+660 footpath cum drain has been provided. FRL has been raised at Km 1+200, New Box Culvert has been proposed at Km 1+310. Summary of breast wall is given in Table 3.4. This approach ensures effective earthwork management while minimizing environmental impacts and maintaining slope stability and disposal of excavated material along the project corridor.

Mitigation Measures

The project has identified the 09 disposal sites. Additional 1.14 ha land is required for Spoil disposal. Details are given in Table 3.15.

To prevent environmental impacts in the disposal sites, the following needs to be kept in mind during disposal:

- Clear the debris from construction sites. Unusable Debris are to be carried by trucks/dumpers to the identified dumping yards. Covers should be placed on the trucks during the transportation of material. Usable construction and demolition waste/ debris should be stored separately outside the RoW at a designated place for usage.
- The locations of dumping sites should be selected with following considerations.
- Unproductive/wastelands shall be selected for dumping sites.
- These should be away from residential areas and located at least 1km downwind side of these locations,
- These sites shall be finalized such that they do not lie within any designed forest or other eco-sensitive areas, do not affect natural drainage courses and no endangered/rare flora is impacted by such disposal.
- The lowlands, natural depressions which are natural sinks will not be used for dumping as these are natural sinks.
- Drainage channels should not be used for dumping
- Local Authorities should be consulted about the location of debris disposal sites before finalizing the locations.
- Dumping sites should not contaminate water sources.
- Dumping sites should have adequate capacity for the amount of debris generated. Design of dumping site is given in Annexure 6.1 Dump site Stabilization plan.

6.4.2.1 IMPACTS ON GEOLOGY

The construction of RBB Roads will require different materials such as earth, aggregate, boulders, and sand that occur naturally and whose formation process is slow and takes years. Minimizing the construction footprint on natural resources is a fundamental design principle for pavement and structures. The sourcing of material from unlicensed quarries can also have unwarranted impacts.

With an estimated surplus of approximately 46,880.9 m^3 of excavated material after balancing cut and fill, the DPR emphasizes reuse of suitable cut and excavated earth for embankment formation, slope dressing, and construction of protection works such as toe walls, gabion retaining walls, and river training structures at critical erosion-prone locations, particularly near chainage 8+600, 9+100, 9+200, and 9+950. In addition, stone and granular materials recovered from dismantling of existing pavement and drainage structures will be recycled and reused for sub-base layers, shoulder construction, and filter media where technically feasible, thereby reducing dependence on new quarry material. These practices not only conserve natural resources but also minimize environmental impacts from

material extraction, transportation, and waste disposal. Only unsuitable or non-recyclable materials will be disposed of at MPWD-designated disposal sites in accordance with environmental management guidelines. To prevent unwarranted impacts the following measures are proposed:

Mitigation Measures

- The aggregate, sand and other construction material shall be supplied form quarries approved by the PMU (indicated in the Pre-Construction stage)
- The challans for the royalty paid against the material used shall be included in the IUFR / Bills submitted for payments.

6.4.2.2 Impact on soil

Contamination of soil during the construction stage may happen primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping near water bodies.

Topsoil loss may occur in land parcels used for short-term purposes (e.g., borrow areas, construction camps) as well as in areas permanently impacted due to road rehabilitation, unless measures for preservation are adopted. Project activity involves tree cutting and vegetation removal from the COI followed by construction and strengthening of the present carriageway.

Since the project involves upgrading an existing road alignment rather than developing a Greenfield corridor, substantial removal of topsoil is not anticipated. However, localized topsoil disturbance may occur during shoulder widening, drainage improvement, and embankment raising activities. To mitigate this, the ESIA prescribes specific topsoil management measures to be implemented during construction. The alignment passes through areas which have sandy loam with varying amounts of clay, typically exhibiting low to medium plasticity. These soils are light textured and are thus prone to erosion by winds and during rain and consequent slides can occur due to hilly slopes of the area. Additionally, the movement and operation of vehicles, construction equipment, and material transport during project execution may cause soil compaction, particularly in borrow areas, temporary storage sites, and parking zones if not properly managed. Soil compaction reduces permeability and soil fertility, affecting natural drainage and vegetation growth.

Improper operation of borrow areas can also impact the soil environment. Adjacent properties may also be impacted, or it can also lead to erosion. Additionally, the associated activities e.g. haul roads may deteriorate due to movement of overloaded trucks, facilities e.g. culverts or embankment may also get damaged.

6.4.2.3 BORROW AREAS AND QUARRIES

Construction materials required for the project road will be transported from Quarries. Details of Quarries site is given in Table 3.14 of Chapter 3.

Opening of a new borrow pit creates the following impact:

- The borrowing of earth in an unregulated manner may lead to unstable slopes, erosion, loss of fertility, inundation of water, breeding areas for mosquitos and an unhygienic environment. Fertile topsoil may be wasted if not preserved for backfilling.
- The transportation of earth from borrows and quarry areas in open/uncovered trucks can increase the dust levels and overloaded borrow transportation material may cause spillage of material on road causing dust, high emission, vehicle wear and tear, road surface damage due to overloading.

- Haul roads may develop surface damage due to plying of trucks and if left unattended may cause problems to other pedestrians and commuters on the road.
- Open borrow pits abandoned without proper restoration may lead to accidents and risks of social nuisance.

. The earthwork details in the project area are listed in Table 6.2 below.

Table 6.2: Earthwork details in the project area

Sub Project Road	Fill (m^3)	Cut (m^3)
RBB	17469	60088

From the above table it is calculated that after balancing cut and fill, the remaining quantity of 46880.9 cu.m earthwork will be dumped/disposed by the contractor only at a place designated and authorized by the MPWD. The details of Spoil disposal sites are provided in **Table 3.15**. Average height should be 1.5 m to 2 m.

In addition, waste from off-spec hot-mix as wells as from the regular operations of the machinery e.g. layers and bitumen sprayers during the surfacing of the roads. The concrete wastes from the batching plant and transit mixer wash would also be generated.

The labour camps would be setup for construction which would generate municipal solid waste and hazardous waste (waste oil from the maintenance and operation of machinery). These wastes have potential to contaminate the soil around the site if it is not properly stored, handles and disposed.

If these excess excavated material, construction and demolition wastes are disposed on agricultural land or adjoining properties it may result in loss of productivity of land and can also impact the ecology.

Mitigation Measures

PREVENTING COMPACTION OF SOIL

- To minimize this impact, all construction activities and machinery movement will be strictly confined within the designated Right of Way (RoW) and approved working areas.
- Parking and servicing of vehicles and equipment will be allowed only in designated hard-surfaced zones,
- Contractor has to obtain the permission of the PMU after submitting the EC, CTE, CTO any quarry area

Borrow Area Management

- Contractor has to obtain the permission of the PMU after submitting the EC, CTE, CTO any quarry area. The Contractor should submit the EC, a copy of agreement with the landowner, borrow area management and closure plan before initiating any kind of borrowing activities.
- No material shall be procured from the PWD before extraction of material from any borrow area
- Borrow area should be located at a minimum distance of 300m from the residential/ settlement area, public road. Proper barricading should be provided and access to the borrow areas should be restricted to the unauthorized persons.
- The Borrow are should comply with the conditions set in the EC/ SoP from MoEF&CC.
- Topsoil up to a depth of 150 mm from all areas of cutting, filling, and temporary construction zones, shall be stripped and preserved as indicated in the MoEF&CC SoP / MoRTH Orange Book: Specification for Road and Bridge Works;
- Topsoil will be stored separately in designated stockpiles with proper slope protection and sediment barriers to prevent erosion;

- Reuse stored topsoil for median greening, roadside plantation, and slope turfing after construction; and
- Prohibit disposal of topsoil at dumping sites.
- These measures shall be monitored through the supervision consultant to ensure effective implementation during the construction phase.
- For sitting location

Spoil Disposal

The Spoil disposal should be carried out at the site identified and in and the following precautions taken

- Spoil disposal sites shall be located on stable, non-erodible terrain away from water bodies and agricultural land. The edges of the Spoil disposal area should be contained with gabion/ masonry wall at the periphery.
- Dumping will be done in compacted layers (≤1 m thick) with retaining walls, drainage channels, and slopes maintained within the natural angle of repose (30°–35°).
- Each site will be protected with toe walls, sediment traps, and vegetative cover for stabilization.
- The contractor shall operate only at approved locations under supervision and maintain the site until full rehabilitation is achieved.
- The site should incorporate proper retaining structures, such as toe walls and catch drains, to prevent sliding and erosion.
- Adequate drainage must be provided through surface and subsurface channels to control runoff.
- Spoil should be deposited in layers, compacted, and stabilized using vegetation or geo-textiles to minimize dust and erosion.
- Access roads should be provided to ensure safe transport of Spoil, and the site should be fenced and clearly demarcated.
- Environmental safeguards, including periodic monitoring and rehabilitation plans, must be integrated into the design to ensure long-term stability and ecological compliance.

The typical design of the Spoil disposal site will be incorporated into the DPR. Dumpsite Stabilization Plan is attached as **Annexure 6.1.**

Waste Disposal

- The storage, handling and disposal of Municipal Solid Waste, Hazardous Waste and construction demolition waste the Contractor should follow all the provision of the respective rules. The guidance for storage of these wastes is presented in Annexure 6.2 The same guidance (storage of Hazardous Waste) may be used for storage of hazardous materials (oil, lubricants)

6.4.2.4 AMBIENT AIR QUALITY

Construction stage impacts will have adverse impacts on the workers as well as the settlements adjacent to the road, especially those in the downwind direction. There are two types of pollution, i.e. dust pollution and pollution from harmful gases.

Impacts from Generation of dust

- Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense;
- Transportation of raw materials from quarries and borrow sites
- Stone crushing, handling, and storage of aggregates at on-site asphalt mixing plants are integral to the RBB Road Corridor project. These activities generate significant dust and noise.
- Site levelling and vegetation clearing, including the removal of trees and topsoil, are being carried out along the alignment to prepare for subgrade laying. These operations are critical but environmentally impactful, especially near forested or community areas.
- Concrete batching plants and asphalt mix plants are being set up along the corridor to support continuous construction. These facilities involve the mixing of aggregates with bitumen, releasing particulate matter, hydrocarbons, and heat, which may affect local air quality and nearby settlements
- Construction of structures and allied activities

Impacts from Generation of polluting gases including SO_2, NO_x and CO

- Large construction equipment, trucks and asphalt producing and paving equipment
- The movement of heavy machinery, oil tankers etc.
- Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

The impacts are expected to be temporary (limited to construction period) and confined within construction areas.

Table 6.3: Mitigation Measures for Ambient Air Quality

Impact Source	Mitigation Measures
Transportation and tipping of cut material; site levelling and excavation	Regular water sprinkling (at least 3 times in a dry season) on haul roads, excavation areas, and disposal sites to suppress dust. Limit vehicle speeds to 25 km/h on unpaved roads. A log book of the sprinkling has to be mantaiend. The Contractor should take into consideration the requirement of water for sprinkling which undertakeing the planning of works. A grievance system should be communicated to the population along the road so that they can also intimate any dust pollution related issues.
Transportation of raw materials from quarries and borrow sites	Cover all vehicles carrying loose materials with tarpaulin; avoid overloading and ensure proper loading/unloading to prevent spillage.
Stone crushing, batching, and asphalt plants	Locate plants at least 500 m from settlements and sensitive receptors; install dust extraction, bag filters, and stack emission controls. Regularly maintain equipment to minimize emissions. The emission has to be monitored asper the monitoring plan specified in the ESIA Report. A log of the maintenance should also be maintained by the Contractor. The measures suggested in the CTE and CTO shall be maintained
Site clearing, vegetation removal, and handling of topsoil	Restrict vegetation clearance to the required RoW; immediately stabilize exposed soil using mulching, water spraying, or temporary turfing.
Concrete and asphalt	Use pre-mixed bitumen and maintain mixing temperature within permissible limits to

Impact Source	Mitigation Measures
mixing operations	reduce hydrocarbon release. Avoid fuel adulteration.
Operation of heavy machinery and transport vehicles	Maintain all equipment and vehicles regularly; prohibit use of old or poorly maintained machinery; use low-sulphur fuel.
Generation of gaseous pollutants (SO_2, NOx, CO)	Ensure all machinery meets CPCB emission norms/ MoRTH emission standards (GSR 144); • Prohibit idling of vehicles; • Schedule material transport to avoid congestion.
Worker and community exposure to dust and fumes	Provide PPE (dust masks, goggles) to workers; display warning and awareness signs; avoid high-emission activities near schools or dense settlements.
Monitoring and compliance	Conduct periodic ambient air quality monitoring (PM_{10}, $PM_{2.5}$, SO_2, NOx, CO) at identified locations and ensure compliance with CPCB National Ambient Air Quality Standards. The Monitoring plan presented in the ESIA Report shall be adhered to.

6.4.2.5 NOISE

. During construction, particularly in residential and commercial areas, ambient noise levels may temporarily exceed statutory limits within about 50 m of active work zones due to operation of heavy machinery, material transport, and equipment use. The main noise sources will include excavators, graders, vibratory rollers, and transport vehicles, which typically generate levels above 70 dB(A). Vibration from rollers may also affect nearby structures depending on soil type, structural age, and construction quality.

These impacts will be intermittent, short-term, and localized, as all construction activities will not occur simultaneously along the corridor. Sensitive receptors such as schools, hospitals, and religious places located near the project road may experience temporary disturbance during high-noise activities. However, impacts will attenuate with distance and can be effectively mitigated through equipment maintenance, scheduling of high-noise works during daytime, and strict adherence to CPCB noise standards.

The scale of construction required for upgrading the RBB Road is moderate and confined mostly within the existing Right of Way (RoW). The primary sources of noise emissions include construction equipment, material transport vehicles, stone crushers, and asphalt plants. These activities are temporary, localized, and limited to the construction period. Noise levels are expected to rise intermittently during operations such as excavation, compaction, and pavement laying, especially near settlements and sensitive receptors like schools and health centers. However, with proper scheduling of high-noise activities during daytime, maintenance of equipment, and adherence to CPCB noise standards, the impacts will remain within acceptable limits. Consequently, the overall scale of works and the expected marginal increase in post-construction traffic are not anticipated to result in any significant or lasting adverse impacts on ambient air quality or noise levels.

Ambient noise level may increase temporarily in the close vicinity of various construction activities, maintenance workshops, and vehicles and earthmoving equipment. These construction machineries are expected to generate noise levels in the range of 80 – 95 dB(A) at about 1m from the source; while the actual ambient noise level experienced at surrounding receptors will depend on distance, terrain, and intervening structures.

Mitigation Measures

- Staging of construction equipment and unnecessary idling of machinery within noise-sensitive areas shall be avoided wherever possible.
- All plants and equipment used in construction (including third-party units) must conform to MoEF&CC/CPCB noise standards.
- All vehicles and equipment used in construction shall be fitted with effective exhaust silencers.
- Servicing of all construction vehicles and machinery shall be done regularly; during routine servicing, the effectiveness of exhaust silencers shall be checked and replaced if defective.
- Construction activities shall be restricted to daytime hours (6 AM–10 PM). Night-time work may be carried out only in emergencies, following all prescribed mitigation measures for night operations.
- Unnecessary honking at construction sites shall be strictly prohibited.
- Temporary barricading shall be installed around active construction zones, especially near settlements, schools, or hospitals, to minimize noise propagation.
- Noise monitoring shall be carried out at construction sites as per the approved monitoring schedule, and results shall be submitted to the Project Management Consultant (PMC) and Project Management Unit (PMU) for review and compliance verification.

DG Set Noise Control Standards

To minimize noise from generator operations during construction, the following measures shall be implemented:

- The contractor must use silent DG sets as prescribed by the Central Pollution Control Board (CPCB).
- Each DG set shall be provided with a proper exhaust muffler to further reduce noise emissions.
- The DG set shall be properly sited to minimize its noise impact beyond the premises, ensuring compliance with ambient noise standards at the nearest receptor.
- A routine and preventive maintenance schedule shall be prepared and followed in consultation with the DG set manufacturer to ensure that noise levels do not deteriorate with use.

At the outset, it should be noted that unavailability of exact information on the construction methodology, hours of work, no. of equipment and their ratings / fuel consumption, construction schedule, etc. are the limiting factors while estimate the construction noise for this subject project;

6.4.2.6 SURFACE WATER QUALITY AND SILTATION

For the Upgradation of Rongsai–Borjhora–Bajengdoba (RBB) Road, the potential impacts on surface water due to the construction of bridges and cross-drainage structures have been assessed and addressed in the design stage. The project corridor involve perennial Dridam river; small seasonal streams and natural drainage channels intersect the alignment. During construction, temporary impacts such as increased turbidity, siltation, and localized disturbance to natural drainage may occur due to excavation, earthwork, and material handling. However, these impacts will be short-term and mitigated through measures such as silt traps, sedimentation pits, controlled excavation, avoidance of debris disposal in water bodies and proper diversion of runoff during construction. The design also includes adequately sized cross-drainage structures, stream protection works, and apron/cut-off walls to maintain natural drainage patterns and prevent scouring. Therefore, the project is not expected to cause any significant or long-term adverse impact on surface water flow, quality, or hydrological connectivity along the RBB road corridor. Construction activities such as earthworks, material storage, and operation of construction camps may temporarily affect surface water quality along the RBB Road corridor. Proposed sub project road run parallel to Didram river up to 2 km (Between Chainages, 1+100 to 3+100. Earth Runoff from exposed soil surfaces, stockpiles, and construction zones can carry suspended solids, oils, and debris into nearby streams or drainage channels, leading to increased turbidity and siltation. Additionally, improper disposal of construction wastewater or accidental spills of fuels and lubricants may also contribute to localized water pollution. Fishing is practiced in the Didram River, which intersects the RBB Road corridor. Construction activities such as bridge works, river training, and slope protection may temporarily increase turbidity and sediment load in the river, potentially affecting local fish habitats

and water quality. These effects are expected to be localized and short-term, primarily during active construction near the river crossing. Also, construction would also generate some effluents e.g. dewatering of excavation on the bed, washing of machinery etc, which also can pollute the waterbody unless managed.

Labour camps and site facilities will generate domestic wastewater and sewage, which, if discharged untreated, may degrade nearby water bodies.

Mitigation measures

Labour Camp and Construction Yard

- Temporary construction/fabrication yard / labour camp (with no more than 10 labour) can be proposed at the cross-drainage construction site (will all facilities mentioned above) with the permission of the CSC/PMU.
- To prevent this, sewage treatment through septic tanks and soak pits or mobile bio-toilets shall be provided at all camps.
- Construction runoff shall be managed through temporary drainage channels, sediment traps, and silt fencing, ensuring that no untreated discharge enters natural watercourses.
- . Runoff from the camp shall be passed through an oil-water separator. All peripheral drains shall be linked to the oil water separator
- The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into river or any other nearby water bodies by passing wastewater to sedimentation tank to be considered as part of the EM plan and Contractor's responsibility.
- Stagnation of water should not be allowed at any place near the campsite as a precaution against vector-borne disease.
- The wash water from the concrete mixer/ batching plant/ miller should only be disposed at a pit developed in construction camp

Water Pollution from Fuel and Lubricants

- Spill Prevention and Control: Store fuel and lubricants in bunded areas (110% capacity of the largest container) with proper spill kits (sand, absorbents). Immediately clean up any spills or leaks.
- Impervious Flooring: Provide impermeable flooring (e.g., compacted clay or concrete base with HDPE lining) in storage areas for materials such as bitumen, fuel, cement, and chemicals to prevent seepage into soil and groundwater.
- Transfer of fuel by decantation is prohibited, Fuel Pump (manual or electric) should be used
- Storm water Management: Construct peripheral drains around storage yards to collect and divert runoff to sedimentation pits before discharge. Prevent mixing of clean storm water with contaminated runoff.
- Regular Inspection: Conduct routine checks for leakages, cracks, or improper containment in fuel and chemical storage zones. construction sites.
- Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a way that spillage of fuels and lubricants does not contaminate the ground. Only fuel pumps will be used for the transfer of fuel during refueling.

Pollution from construction activities

- The runoff from the construction material storage yard must be channelized through peripheral drains

connected to sedimentation tanks (holding tanks excavated in the ground) of adequate capacity

6.4.2.6 IMPACTS ON NATURAL DRAINAGE AND WATERSHED MANAGEMENT (FLOODING)

Along the rivers and streams crossed by the road, bank protection measures are required to prevent accelerated sedimentation, which can disrupt drainage patterns and negatively impact riverine habitats. The road alignment generally follows the existing topography, except at the locations of cross-drainage structures. Within the project stretch of 18.27 km, there are 2 major bridges and 15 minor bridges exist. A total of 100 culverts are proposed for reconstruction and rehabilitation, including 1 slab culvert, 2 box culverts, 78 pipe culverts and 19 new pipe culverts.

If the existing culverts are not adequately strengthened during road widening and rehabilitation, they may fail structurally, leading to disruptions in water flow, increased flood risk, potential damage to the road, and safety hazards for road users and nearby communities.

Mitigation Measures:

- The contractor will ensure that no construction materials/debris shall disposed off or block the flow of water of any water course and cross drainage channels.
- The stockpiled material must be prevented from erosion and deposition in the drainage channel from sites where these are stocked for construction.
- The runoff from the construction material storage yard must be channelized through peripheral drains connected to sedimentation tanks (holding tanks excavated in the ground) of adequate capacity
- All sedimentation tanks and peripheral drains must be cleaned before the monsoon.

6.4.2.7 GROUND WATER QUALITY

The road construction projects are water intensive and demand a large volume of water during the entire project's construction period however in this project the works are rehabilitation in nature, the quantum of water require will be minimal. However, surface water RBB project road stretch will require 54.5 Cum/day. Although the actual water requirement may vary depending on the contractor's construction methodology and equipment usage. As discussed with the DPR team, the primary source of water for construction will be the Didram River. The availability of surface water is sufficient. Hence demand for the construction is proposed to be met from the surface water sources. The demand for construction is proposed to be met from surface water sources. The project area is not classified as critical, semi-critical or overexploited by CGWB. It is "safe" area for ground water abstraction.

There is no pressure on ground water resources as most of the water requirement will be fulfilled by surface water.

Mitigation Measure

- Peripheral drains and temporary drainage channels will be provided at the construction site to safely divert stormwater runoff and prevent water accumulation.
- Silt traps/sedimentation pits and soak pits will be constructed to capture sediments and allow runoff water to infiltrate, supporting groundwater recharge and preventing contamination.
- Construction water will not be procured from any unauthorized wells or existing wells. The permission of CGWB would be obtained in case new wells are sunk;
- The Contractor shall install a meter at the point of extractor and keep a log of the water extracted
- All the measures suggested in the permission for Borewell shall be adhered to
- In case the water is sourced from third parties the Contractor shall only source it from sources cleared by PMU. In such cases also eh shall maintain a log of the water procured.

- Water usage for construction work would be reduced by adopting following best practices:
    - Use buckets etc. to wash tools instead of using running water;
    - Use of auto shut off taps (without sensors) in labour accommodation;
    - Install water metres with main supply pipes/water tanks/bore well to assess quantity of consumed water

6.4.2.7 CONSTRUCTION AND DEMOLITION WASTE

Construction and demolition (C&D) waste from major demolitions is not expected along the proposed RBB alignment because no Pucca structures will be removed. Only temporary structures with masonry or light walls (e.g., temporary kiosks, sheds, boundary walls) will be dismantled where absolutely necessary to establish the right-of-way. Even these limited removals, if not handled correctly, can obstruct natural drainage, cause siltation of nearby waterbodies, generate dust, and create temporary traffic inconveniences or health nuisances. To avoid such impacts, all temporary-structure debris will be managed through a contractor-led waste handling plan that emphasizes source segregation, timely removal, reuse/recycling where feasible, controlled transport, and disposal at authorized sites.

Key mitigation measures

- **Avoidance & minimization:** limit removals to only those temporary walls/structures that are unavoidable for construction; explore minor realignments or temporary protection works to retain structures where possible.
- **Segregation on site:** separate inert masonry/brick, concrete, metal, wood and mixed waste at designated temporary collection points to maximize reuse/recycling.
- **Reuse & recycling:** priorities reuse of intact masonry/brick and concrete as backfill or for temporary access tracks; recover metal and timber for reuse.
- **Designated storage & timely removal:** store debris in covered areas away from drains and surface water; remove to authorized disposal/recycling facilities within agreed short timeframes to prevent runoff and scavenging.
- **Dust control:** dampen stockpiles and vehicle loads, cover trucks during transport, and restrict demolition/dismantling operations during high-wind conditions.
- **Drainage protection:** install silt traps/sediment control (e.g., sandbags, temporary settling pits) at nearby drains and around stockpiles to prevent siltation of water bodies.
- **Traffic & public safety:** schedule dismantling works off-peak where possible, use flaggers and signage, and maintain clear pedestrian/vehicular passage around work areas.
- **Permits & authorised disposal:** ensure waste is transported only to licensed C&D disposal or recycling facilities and that manifests/receipts are retained.
- **Contractor responsibilities & training:** the contractor shall prepare the C&D waste handling plan, train workers on segregation and pollution prevention, and maintain daily records of waste quantities and destinations.
- **Monitoring & reporting:** include C&D waste management in construction supervision checklists; undertake

fortnightly inspections and submit waste disposal receipts as part of monthly compliance reports.

6.4.2.8 MUNICIPAL SOLID WASTE

RBB road corridor will generate approximately 12 to 15 kg of municipal solid waste per day during the construction stage, this is estimated based on approximately 35 working people in the project site. This waste if not disposed of properly, may lead to littering in the immediate vicinity of the camp sites and contamination of ground water as well as air pollution due to unauthorized burning.

Mitigation measures

- Disposal of sanitary wastes and excreta shall be into septic tanks. If bio-toilets will be used the excreta could be converted to manure.
- The camp shall implement a two-bin system and the workers made aware about the segregation of waste
- Poster and leaflets will be done to make the camp residents aware of the segregation and process of segregation
- Kitchen wastewater shall be disposed into soak pits/kitchen sump located preferably at least 15 m from any water body. Sump capacity should be at least 1.3 times the maximum volume of wastewater discharged per day. The bottom of the pit should be filled with coarse gravel and the sides shored up with board, etc. to prevent erosion and collapse of the pit. New soak pits shall be made ready as soon as the earlier one is filled.
- Solid wastes generated in the kitchen shall be reused if recyclable or disposed of in landfill sites.
- Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed of hygienically as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of Project Authority.
- The camping area should be periodically sprayed with Bleaching powder and other disinfectants.

6.4.2.8 HAZARDOUS WASTE

Approximately 140 cum. of scarified bituminous material will be generated from the project road during pavement rehabilitation. Improper disposal may cause localized soil and water contamination due to leaching of hydrocarbons; therefore, its reuse and handling shall follow MoRTH (5th Revision) guidelines.

As per MoRTH Clause 517 and Clause 305.2.2.2, the scarified bituminous material shall be recycled and reused in Granular Sub-Base (GSB), Wet Mix Macadam (WMM) layers, or for pavement shoulders, after appropriate screening and blending to achieve the required gradation. The reclaimed mix can also be incorporated in hot or cold recycling processes depending on site conditions and equipment availability.

Any quantity of scarified bitumen found unsuitable for reuse shall be disposed of at designated locations approved by the Engineer-in-Charge, with proper base lining and containment to prevent leachate migration and protect soil and water quality. This approach promotes resource recovery, cost efficiency, and environmental compliance in line with MoRTH and CPCB sustainability principles.

Corridor wise scarifying existing bituminous surface in the project area is listed in Table 6.4 below.

Table 6.4: Amount of expected Scarified Bituminous material

Sl. No.	Description	Unit	Quantity
			Corridor-3
1.	Scarifying existing bituminous waste	cum	140

A small quantity of hazardous substances (such as diesel, petroleum products, and other chemicals) will be used or stored during the project. If not stored properly, these substances may cause leakage or spillage, leading to soil and water contamination. During the construction phase, used batteries are also likely to be generated, which must be disposed of in compliance with the Battery Waste Management Rules, 2022. Improper disposal of lead-based batteries can result in leakage of lead, causing soil and water pollution.

Mitigation Measures:

- The Contract shall obtain Authorization for Generation, Storage and Handling of Hazardous Waste from MPSCB.
- The Hazardous Waste shall be stored as per the provisions specified in the rules (Segregated and access Controlled space, Covered, Impervious floor, bounded for 110% capacity)
- The Contractor shall maintain records of the generation, storage and disposal as per the provisions using the forms specified in the Hazardous Waste rules.
- The Waste shall be disposed of to Authorized recyclers or Aggregators and the records maintained in Form V of the Hazardous Waste Rules.

6.4.2.9 NATURAL DISASTER

Based on the satellite image processing study on landslides and hazard assessment conducted under the Meghalaya State Action Plan on Climate Change (SAPCC) (2022), several hazard-prone and vulnerable zones have been identified across the state of Meghalaya. The review of the available hazard mapping indicates that the proposed sub-project corridor does not fall within the high-risk landslide or hazard-prone zones identified under the SAPCC assessment.

Detailed field reconnaissance and site verification was undertaken along the project alignment to assess potential geotechnical and hydrological risks. During the inspection, no direct evidence of flooding or prolonged waterlogging was observed along the project road. However, certain stretches of the alignment run in close proximity to river channels and streams, making these locations susceptible to localized bank erosion and soil instability, particularly during periods of high discharge and seasonal runoff. Roads in hilly areas, particularly other district road and its connecting roads, are highly vulnerable to landslides and debris slides during extreme rainfall events. Lack of proper drainage system exacerbates waterlogging, leading to structural damage. Along the project stretch, issues of water accumulation and submergence are observed at multiple locations. On the project road, At chainage 0+300, the area experiences submergence during the monsoon, while at 0+600, waterlogging is reported. Further, between chainage 1+300 and 1+600, recurring submergence is noted during the monsoon season, particularly pronounced near chainage 1+350 to 1+600.

Temperature fluctuations and high wind velocity contribute to gradual deterioration of road surfaces, especially asphalt roads. Over time, these conditions increase maintenance costs. Riverbank erosion is a significant concern along the stretch. At chainage 8+600, soil erosion is observed on the left-hand side (LHS) of the river. Further downstream, riverbank erosion is also noted at chainage 9+200 and 9+950, indicating recurring instability along this section of the river. Details of protection work are given in Table 3.9 and Table 3.10.

6.4.2.10 DISRUPTION OF COMMUNITY SERVICES

During road construction, local infrastructure such as water supply lines, irrigation channels, drainage systems, and access roads may be affected. These facilities are essential for domestic water use, agricultural activities, and community mobility. Improper or incomplete restoration of these services can lead to adverse impacts on local livelihoods and may also affect the integrity and progress of the road works.

6.4.2.11 IMPACTS ON OCCUPATIONAL HEALTH & SAFETY

During the construction phase of the road project, workers are continuously exposed to various occupational and environmental hazards. These include prolonged exposure to dust and gaseous emissions from equipment, vehicles, and material handling. In addition, there are significant safety risks associated with activities such as hill-side cutting, benching, excavation, embankment formation, operation of heavy machinery, and protection works along eroded riverbanks. Specific risks also arise from working near waterlogged or submerged sections, culvert and bridge construction, and sharp curves or junction improvements, where vehicular movement poses added danger. Electrocution, work at heights, slips, trips, and falls, as well as tree cutting and vegetation clearance, further contribute to potential safety concerns. Proper use of personal protective equipment (PPE), adherence to standard operating procedures (SOPs), traffic and work-zone safety management, and regular safety training will be critical to prevent accidents and ensure worker well-being throughout the construction period.

Mitigation Measure

- A Hazard Risk Identification and Assessment (HIRA) carried out by the Contractor during the Pre-construction for the activities which will be included in the road component of the Meghalaya Logistics and Connectivity Improvement Project. The Occupational Health and Safety Plan attached as Annexure 6.3 shall be implemented by the Contractor.
- The Contractor will provide adequate resources for its implementation.

6.4.2.12 DIVERSION OF TRAFFIC

Since the road upgradation works will be carried out on the existing alignment, there will be a direct interface with road traffic. Short-term impacts during construction will include traffic diversions wherever feasible and management challenges, potentially causing hindrance to the existing traffic flow. There is also a risk of accident hazards during this phase. Although such diversions do not directly impact the natural environment, poorly planned diversions can lead to adverse effects. Rapid restoration of diverted services can help minimize the severity of impacts resulting from the disruption of existing services.

6.4.2.13 WORK SITE SAFETY

During the construction activities the exiting road would be used by traffic. The risk of accident and collisions are very high because of the constricted width of the road, use of road by both construction vehicle and equipment and the local people for commuting. Thus, pedestrian, vehicles are susceptible to danger.

Labour camps and site operations pose community health and safety risks, including sanitation, water access, and increased traffic hazards. Labour influx may exacerbate these risks if not well managed.

The following mitigation measures are thus proposed:

Mitigation Measures

Safety in Construction

- RFI will be raised for all excavation or cutting. The CSC will not approve any RFI for more than 500 m at one

go or continuous stretch. The RFI for excavation on both sides of the carriageway shall not be issued at any time. The subsequent RFI for the adjoining chainages should be issued only when the levelling and back filling is done

- Barricade the construction area using hard barricades (of 2 m height MS Steel Barricades/ New Jersey Barrier/ Water filled barriers) where the drop in level is more than 0.3 m.
- Initiate site clearance and excavation work only after barricading of the site is done.
- Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes, etc.,), to the barricaded area
- Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area
- Undertake the work section wise, a 500m section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones
- In case of settlement areas Steel / wooden Planks of sufficient capacity should be provided to cross over the trench.
- The Work zone safety signages shall be placed as per IRC : SP 55. All the safety measreus stated in MoRTH Circular RW/NH-36098/25/2022-S&R (P&B)/pt. dated 16.03.2023 shall be applied.
- Construction material must be stored in the barricaded area. If temporary storage is required (for 1-2 days) outside the demarcated construction area, the same must be discussed with the community.
- Retroreflective tapes shall be fitted on all sides of equipment
- Reverse horns must be placed on all vehicles and equipment. In case of rotating equipment rotation alarm must also be fixed on the equipment.
- Preferably machinery should not be parked beside the carriageway. If machinery is parked on the roadside the area should be barricaded by water filled New Jersey barrier. Retroreflective tape must be fixed on the barrier for easy visibility. Solar LED blinkers shall be placed on the machinery for easy visibility.

Labour Influx related

- The project will prioritize the engagement of local workforce to the extent possible during the construction phase. Contractors will be encouraged to hire unskilled and semi-skilled labour from nearby villages along the project corridor. This approach will not only support local livelihood opportunities but also promote community participation in project activities. Skilled labour may be sourced externally if not available locally; however, preference will be given to local workers wherever feasible.
- Labour camp will be set up as per WB guidance (Annexure 6.2).
- The Project Board shall be installed at the beginning /start of the package. The Project Board should provide the critical information about the project including the grievance mechanism.
- The construction zone must be access controlled, and the workers must be provided valid identification cards to allow entry.
- The Contractor shall provide, explain, and obtain signed acknowledgement of the Worker Code of Conduct from all workers as part of the employment agreement. Time to time orientation programme on Code of conduct to be organized with the workers by the contractor.

6.4.2.14 ROAD SAFETY MEASURES

Road construction activities may affect road safety for commuters, pedestrians, students, women, and elderly persons using the corridor. Since sections of the sub-project alignment pass through landslide-prone areas, there is a risk of periodic landslides and rockfall affecting traffic movement and public safety during construction.

Although animal crossings have not been reported along the current project stretch, the possibility of wildlife or livestock movement during the construction phase cannot be ruled out; therefore, appropriate mitigation measures shall be incorporated into the Contractor's C-ESMP.

In addition, sensitive receptors such as schools are located close to the Sub Project Road, specifically at Ch. 02+200, Ch. 03+200, Ch. 03+540, Ch. 10+200, will require enhanced traffic safety management measures during construction, including speed control, signage, safe pedestrian access, and coordination with school authorities.

Mitigation Measures

The road Safety measures suggested in IRC SP 55 need to be implemented.

- The following additional road safety measures have to be implemented include:
- Suitable safety measures in the form of safety barriers along valley side has been proposed throughout the mountainous terrain of the project stretch.
- For lane decision making, thermoplastic reflective road markings, traffic signage, has been proposed to ensure night visibility.
- Crash barriers have also been proposed along critical stretches of the project corridor to enhance road safety by preventing vehicles from leaving the carriageway and minimizing the severity of run-off road accidents.

Traffic Management

- Speed reduction measures to be taken near Ch 12+900
- Safety measures shall be implemented to avoid any damage to the school infrastructure and to ensure the safety of students, staff, and the surrounding community during all phases of construction at Ch 12+430, Ch 12+490 and Ch 17+600
- At Ch 17+020) and Ch 17+600 (Elephant crossings): Access roads should not be damaged or obstructed during construction activities; necessary precautions must be taken to maintain uninterrupted access for local residents and emergency services

6.4.2.15 ANTICIPATED IMPACTS ON BIOLOGICAL ENVIRONMENT

The Rongsai–Borjhora–Bajengdoba (RBB) Road project is a road improvement activity confined to the existing alignment, with no widening or diversion through undisturbed habitats. Although several Endangered and Critically Endangered species occur regionally within the 10 km Study area, the project does not intersect or significantly influence any critical habitat as defined under World Bank ESS6 Paragraph 27–29. Hence, no species or habitat within the project's area of influence qualifies as Critical Habitat. All species are therefore screened out from Critical Habitat consideration.

A total of 28 species is listed under Schedule I of the Wildlife Protection Act, 2022. Although none of these species were recorded during the field surveys conducted in the study area, their presence has been indicated through secondary information sourced from the IBAT Tool. Details are provided in Table 5.15.

As per the design, the construction activities would also involve felling of 70 nos of trees. In addition, there would

be clearing of the undergrowth and, bushes and shrubs. The unplanned removal would impact the impact on habitats of birds and animals unless the removal of vegetation in planned and limited. The following mitigation measures are required:

Mitigation Measures for Biodiversity Management

The proposed Ampati to Purakhasia Road (AP) Road improvement project passes through a modified landscape interspersed with secondary vegetation, agricultural fields, and small forest patches. Although no critical habitat is present, the area supports regionally important biodiversity. To minimize ecological impacts during project implementation, the following mitigation and enhancement measures will be adopted.

- No tree felling should be carried out without permission of the Forest Department, GoM.
- Clearing and uprooting should be avoided beyond that which is directly required for construction activities.
- If any termite mound is found adjacent to the highway, precaution will be taken, the mound would not be disturbed, and the Bio-diversity specialist of the PMU would be intimated to ascertain the presence of Chinese pangolin and Indian Pangolin. Pipe culvert will be constructed at a location identified by the Bio-diversity specialist. Additionally, the mitigation measures suggested by the specialist will be adopted.
- Kerosene / LPG should be preferably used to avoid felling of the trees or provide community kitchen for the labour camps for cooking.
- Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation
- Compensatory Afforestation 1: 10 would be carried out by the Contractor. As indicated in the ESMF an app-based monitoring of the plantation would be carried out.
- All the workers will need to be oriented and monitored by the contractor so as not to cause any harm to the flora and fauna.
- Hunting and fuel wood collection will be strictly prohibited
- **Elephant corridor management and monitoring:** In areas of known elephant movement, adopt measures such as speed restrictions (rumble strips/table-top crossing)**,** signages and timed movement restrictions at night if necessary, to ensure safe passage and reduce human–elephant conflict. Installation of AI-based camera systems (as per RDSO specifications, RDSO/SPN/TC/65/2021) along identified elephant movement zones to continuously monitor and detect elephant presence. These cameras, equipped with thermal and optical sensors and AI-based analytics, will enable early warning and real-time alerts to project authorities and nearby communities, thereby minimizing the risk of elephant–vehicle collisions and ensuring safe wildlife movement across the corridor

Impacts on Aquatic Ecology:

During the construction phase, aquatic ecology may be affected by increased silt inflow into surface water bodies and the discharge of liquid wastes or untreated sewage from construction and labour camps.

Mitigation Measures:

- Disposal of construction material or debris into rivers or streams will be strictly prohibited.
- Regular monitoring of water quality will be conducted to ensure compliance with environmental standards
- The dewatering carried out from the excavated pits will not be discharged directly into the river. It will be transferred into a sedimentation tank of adequate size and residence time before discharge.
- A silt curtain will be provided across the river to prevent sediments from flowing downstream.
- Any works affecting aquatic habitat will be done during low flow (when water depth is less than 5 m) and when banks would be dry
- No Solid waste should be discharged into any waterbody
- Where any GI wire mesh gabions are used; all GI wire ends need to be folded inside.
- Ensure that no construction activities will be carried out during monsoon and the fish breeding season

Environmental impacts such as soil erosion (8+600) and riverbank erosion (9+200 and 9+950) will be addressed through toe wall protection works and river training measures. At 9+100, issues of drain/nalla submergence and erosion will be tackled with improved drainage management and erosion control structures. A damaged culvert at

11+780 requires replacement with a new structure to restore proper water flow. Details are given below in Table 6.5**.**

Table 6.5**:** Drainage management and erosion control structures

Chainage (km)	Issue / Environmental Impact	Type of Work Envisaged	Detailed Design Interventions / Description
8+600	Soil erosion along road slope / embankment	Toe wall & slope protection works	• Construction of RCC toe wall (0.6–1.0 m thick, M20–M25 concrete) with weep holes and filter media • Regrade and compact slope to stable gradient (2H:1V or flatter). • Provision of stone pitching (150–300 mm) or riprap over geotextile. • Application of vegetative turfing or vetiver grass for long-term stabilization. • Installation of subsurface drains/trench for seepage control.
9+100	Drain / nalla submergence and local erosion	Drainage improvement & erosion control structures	• Reprofiling and desilting of the drain to maintain free flow • Replacement of undersized culvert/pipe with adequate capacity (25–50 yr design storm). • Provision of inlet–outlet aprons, baffle blocks, stilling basin for energy dissipation. • Stabilization of banks with gabion revetment / riprap.
9+200	Riverbank erosion (near approach)	River training & bank protection	• Provision of riprap or gabion revetment on riverbank with geotextile underlay. • Construction of RCC toe wall or stone apron (keyed 1.0–1.5 m below bed level). • Installation of spurs/groynes at suitable angle (30°–60° upstream) to deflect flow. • Application of vegetative measures (coir rolls, willow staking) on upper bank.
9+950	Severe riverbank erosion close to	Comprehensive river training measures	• Construction of gabion retaining wall and toe protection

Chainage (km)	Issue / Environmental Impact	Type of Work Envisaged	Detailed Design Interventions / Description
	roadway		• Provision of rock spurs and bank revetment to redirect flow away from embankment. • Strengthening of upper bank with bio-engineering measures • Inclusion of monitoring provision for post-monsoon inspection and maintenance.
11+780	Damaged culvert affecting drainage flow	Culvert replacement & flow restoration	• Replacement of existing damaged culvert with RCC box culvert designed for 25–50 yr flood. • Provision of head walls, wing walls, and apron at inlet/outlet. • Proper bedding, filter layer, and backfill compaction. • Install riprap apron to prevent scour • Maintenance of freeboard and proper slope alignment for unhindered discharge.

6.4.2.16 IMPACTS ON ARCHAEOLOGICAL, HISTORICAL AND CULTURAL SITES

There are no historical and cultural sites of importance observed in the project stretch.

The other key potential impacts during the construction of the Project may be related to the risk of partial or total removal or destruction of unknown heritage assets (undiscovered archaeological sites) due to ground removal, which implies the need for setting mitigation approach.

During the construction works, as part of the Contractor's project CESMP, a "chance-find" procedure will be developed and implemented. A guidance note for the protocol on the "chance find procedure" is to be incorporated in the indicative ESMP as part of this ESIA. Workers need to be trained in the use of this procedure. Cultural Heritage Monument Conservation Plan is attached as Annexure 6.6.

6.4.3 IMPACTS DURING OPERATIONAL PHASE

During the operation stage, the main environmental impacts are expected from increased traffic volume and speed, which may elevate safety risks, particularly in rural areas. However, no sudden or significant increase in traffic is anticipated, as the road already exists and is open to public use.

The project also offers opportunities to restore vegetation around the road corridor and worksite through a compensatory plantation program. This initiative will enhance the aesthetic quality of the area and contribute to

soil stabilization and reclamation.

During the operation phase, moderate increases in air and noise pollution may occur due to higher vehicular movement (ESS4). Nevertheless, the overall impacts are largely positive, with enhanced road safety, reduced travel time, and improved connectivity supporting local economic development. Landscaping, replantation, and slope bioengineering measures will improve local biodiversity, stabilize embankments, and enhance the corridor's visual aesthetics.

6.4.3.1 Impacts on Water Quality and Resources

During the operation phase, the likelihood of water quality degradation is very low. Potential impacts on surface water may arise only from accidental spills. However, the probability of such incidents is minimal, as the road design incorporates safety enhancements, including curve improvements, road widening, and pedestrian facilities, which collectively reduce the risk of accidents.

6.4.3.2 Impact on Air Quality

Vehicular emissions are the principal source of pollution during the operation stage. The RBB project road being mostly located adjacent to open agricultural land and un-classed forest, adequate dispersion of gaseous pollutants is expected.

6.4.3.3 Impact on Noise Quality

Impact due to increased noise level and vibration is anticipated due to increased vehicular movement upon improvement of existing road condition. Road side plantation will act as a noise barrier and is likely to reduce the noise quality during the operational phase and any further mitigation is beyond the control of the project authority.

6.4.3.4 Accidents Involving Hazardous Materials

Accidents involving hazardous chemicals may generally be catastrophic to the environment, though the probability of occurrence is low. Prevention of an accident involving hazardous material is a better way of minimizing the impacts. The provisions mandated by 'The Hazardous Wastes (Management and Handling) rules, 1989 and "Manufacture Storage and import of Hazardous Chemicals Rules" 1989 under the Environmental (Protection) Act, 1986 will be complied with. Vehicles delivering hazardous substances will be expected to have printed warning signs on the vehicles and measures to contain any hazardous spillage on the road.

In case of spillage, the report to relevant departments will be made and instructions will be followed in taking up the contingency measures immediately as per the Emergency Management Plan of the contractor's OHS plan.

6.5 SOCIAL RISKS & IMPACTS

The construction of the road is expected to intersect various areas of significant social and economic value, which necessitates careful consideration and management. Key areas of concern include impacts on agricultural lands and residential communities. The route traverses along agricultural land that are important for local food production, livelihoods and eco system services in general. Disruption to these areas could result in economic losses for farmers and reduced agricultural output. Mitigation measures, including design optimization, compensation, and community engagement, have been incorporated to minimize adverse effects and ensure that the project contributes positively to the socio-economic landscape. This has been outlined in the Resettlement Action Plan.

The proposed subproject road of 18.27 km has been designed to minimize land acquisition. Approximately 13.163 km of the alignment will be improved within the Right of Way (ROW) of 12 m. For the remaining 5.163 km, 0.133 Ha of additional land will be required in locations where the available ROW is insufficient. This additional land is required primarily for minor road widening to achieve intermediate lane configuration, construction of drainage and safety features.

This land belongs to 6 Project Affected Households (PAHs) and involves partial loss of agricultural land affecting 26 PAPs although the agricultural land is not in use. No residential or commercial structures are impacted on this additional land, and therefore no physical displacement is anticipated. No additional land is required for community infrastructure under the FPIC agreement, as these facilities will be constructed within the available ROW.

No additional Land is required for community infrastructure part of the FPIC agreement as these facilities will be constructed within the available ROW. Details of land requirement is given in Table 3.16

The proposed Sub project will also require 1.142 ha of land for spoil disposal. The required land for spoil disposal side will be used temporarily and will be returned to the land Owner after project completion and after having redeveloped in accordance to the community requirements. The Consultants along with the officials of the PWD and members of the village community including the Nokma jointly identified 9 locations for dumping of spoils. Details of Land requirement for proposed activities is given in Table 3.17.

A significant proportion of the affected population comprises 102 households (249 PAPs) operating roadside kiosks, which fall under the category of squatters (Non-Title Holders). These are small, informal, and subsistence-level commercial activities such as tea stalls, vegetable vendors and repair shops which are moveable structures. The project will require removal of these moveable kiosks from within the ROW, resulting in disruption to their existing business locations. Affected persons will shift their moveable kiosks to nearby alternative locations as decided by the Headman in consultation with the affected persons and continue their activities there, and are not expected to return to the current sites within the project corridor after construction. While the nature of livelihood activities will remain the same, the impact involves loss of the existing business location and associated income during the transition period. Given the small scale of operations, impacts on any hired labour or additional workers are expected to be limited and short-term.

A 30-day notice period will be provided to all Project Affected Persons (PAPs) whose structures fall within the project ROW, allowing them sufficient time to salvage materials and relocate, along with other entitlements as per the Entitlement matrix provided in the RPF and RAP. The format of the notice issued to affected households is provided in Annexure 4 of the RAP. FPIC was carried out as the project will result in loss of assets and cause relocation of IP's.

Overall, the project does not result in any physical displacement. The impacts are primarily associated with relocation of informal commercial activities, partial loss of agricultural land (not in use), and minor impacts on secondary structures within the ROW. No permanent loss of livelihood is anticipated, as affected persons are expected to continue their existing occupations following relocation or adjustment. The impacts are localized and can be managed through appropriate compensation, livelihood support, and construction-phase management measures.

The road alignment requires minimal additional land (0.133 Ha), as most mitigation and improvement works are confined within the existing paved road. Key interventions along the alignment include:

- **Chainage 0+00:** T-junction improvements can be executed within the current road width.
- **Chainage 0+300 to 1+600:** Measures such as new bridge construction, road raising (250–300 mm), and provision of drains and footpaths will require only minor widening along the alignment.
- **Chainage 2+150:** Installation of school safety signage within the existing right-of-way.
- **Chainage 2+700 to 2+950:** Curve corrections and speed signage will be implemented within the existing right-of-way.
- **Chainage 8+600 to 9+950:** Erosion control works, including toe walls and riverbank **protection**, may require small land strips adjacent to riverbanks for construction access.

- **Chainage 11+780:** Replacement of the damaged culvert will be carried out within the existing footprint.
- **Chainage 17+062 to 17+600:** Passing through community land with vegetation and elephant passes, no widening will occur; mitigation measures such as speed calming and warning signs will be installed within the existing roadway.

To mitigate these social impacts, household surveys, meaningful stakeholder consultations and FPIC consultations were carried out to understand the concerns and needs of affected communities. The Free, Prior, and Informed Consent (FPIC) process was followed in a culturally appropriate manner to ensure meaningful engagement with Indigenous Peoples, securing their consent through transparent and participatory consultations [See IPDP for details]. Additionally, community engagement programs have been conducted to provide clear information about the project, address misconceptions, and explore opportunities for local benefits, such as job creation and infrastructure improvements. Contractors will be required to ensure that access to residences, shops, agricultural land, and public amenities is maintained throughout the construction period.

The Project recognizes the critical importance of addressing Sexual Exploitation, Abuse, and Harassment (SEA/SH) both within the workplace and in interactions between workers and the local community. To address these concerns, SEA/SH Prevention and Response Action Plan has been prepared for the project which will be implemented during the sub-project implementation.

Social impacts associated with the project have been assessed across the pre-construction, construction, and operation phases of the project lifecycle.

6.5.1 PRE-CONSTRUCTION PHASE

Nature of Impacts

During the pre-construction phase, social impacts are primarily associated with land requirements, impacts on structures, and livelihood disturbance arising from project preparation activities. The proposed RBB road alignment requires approximately 0.133 ha of additional land and is expected to affect about 150 structures, most of which are located within the existing Right of Way (RoW). These impacts are largely partial in nature and include roadside kiosks, boundary walls, fencing, gates, and small commercial extensions. Such impacts may result in loss of assets and temporary livelihood disruption, particularly for small roadside vendors.
The project affects Indigenous Peoples (IPs) residing along the corridor, requiring culturally appropriate consultation and consent processes prior to implementation.

Mitigation Measures

Mitigation during the pre-construction phase focuses on planning and compensation measures. Household surveys, stakeholder consultations, and the Free, Prior, and Informed Consent (FPIC) process have been conducted to ensure meaningful participation of affected communities. Compensation for affected assets, livelihood assistance, and relocation support where required will be implemented through the Resettlement Action Plan (RAP). Community amenities identified through consultations with Indigenous Peoples have been incorporated into the Indigenous Peoples Development Plan (IPDP). Continued disclosure and consultation will be undertaken through the Stakeholder Engagement Plan (SEP). Project design has minimized land acquisition by confining most works within the available RoW.

6.5.2 CONSTRUCTION PHASE

Nature of Impacts

The construction phase is expected to generate mostly temporary social impacts. Construction activities may

restrict access to residences, agricultural land, shops, and public facilities along the project corridor. These disruptions may affect daily mobility and reduce customer access to roadside businesses for short periods. Furthermore, construction related activities may result in property damages along the corridor.

Construction activities may also increase pressure on local ecosystem resources due to the presence of workers in the project area. Vulnerable groups — including elderly persons, women-headed households, and economically weaker households — may face additional mobility and safety challenges during construction.
The project may require a limited number of workers from outside the project area, creating potential risks related to labour influx, worker–community interaction, communicable diseases, and SEA/SH risks. Occupational health and safety risks for workers are also anticipated during this phase.

Mitigation Measures

Construction-phase impacts will be managed through measures included in the Environmental and Social Management Plan (ESMP) and project level Labour Management Procedure (LMP). Contractors will maintain alternative access routes, schedule works in phases, provide advance notice of construction activities, and install safety signage and temporary crossings to ensure continued access to residences, shops, and public facilities. Contractors will be required to source materials responsibly and avoid dependence on local forest resources. Special attention will be given to vulnerable groups by maintaining access to healthcare facilities, schools, and markets through temporary walkways and crossings where necessary. Further, contingencies will be made to ensure that any construction related damages to property are compensated by the contractors. Moreover, information on grievance mechanisms must be clearly displayed and function effectively to address any grievances from the community members and workers at the site.

Labour-related risks will be managed through implementation of the Labour Management Procedure (LMP), worker codes of conduct, labour camp management provisions, occupational health and safety measures, and worker grievance mechanisms. The SEA/SH Prevention and Response Action Plan will be implemented during construction to address risks related to worker–community interaction. Monitoring of these measures will be carried out as part of ESMP implementation.

6.5.3 OPERATION AND POST-CONSTRUCTION PHASE

Nature of Impacts

No significant adverse social impacts are anticipated during the operation phase. Instead, the improved road infrastructure is expected to generate positive social and economic outcomes for communities along the corridor. Improved connectivity will enhance access to markets, healthcare facilities, schools, and administrative services. Road safety improvements and better drainage infrastructure will improve mobility and travel reliability, particularly during the monsoon season.

Enhancement and Monitoring Measures

During the operation phase, the focus will be on sustaining project benefits and ensuring road safety. Community awareness programs on road safety and maintenance of road infrastructure will support long-term project sustainability. Improved connectivity is expected to contribute to local economic development, improved service access, and poverty reduction in the project area. Efforts should also be made to ensure non-discriminatory employment practices, particularly in the inclusion of women. Over the long term, the project is expected to contribute positively to poverty reduction and overall community development.

7. STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE

This chapter provides an overview of the stakeholder consultations carried out as part of the Environmental and Social Impact Assessments (ESIA) for the proposed Meghalaya Logistics and Connectivity Improvement Project (MLCIP). These consultations were aimed at ensuring a participatory approach to identifying and addressing potential environmental and social impacts associated with the project.

Relevant stakeholders were mapped and can be categorized under three broad categories as shown in below Table 7.1.

Table 7.1: List of relevant stakeholders

Category of stakeholder	Type of stakeholder
Project-Affected Parties	• Village community • Street side Shop Owners • Shop owners (NTH) • Residential structure owners • Road Users
Interested Parties	**A. Government agencies** ▪ Public Works Department (Roads), Meghalaya (PWD-R) ▪ Garo Hills Autonomous District Council (GHADC) ▪ Meghalaya Forests & Environment Department ▪ Meghalaya State Pollution Control Board (MSPCB) ▪ Meghalaya State Biodiversity Board (MSBB) ▪ Land Records & Revenue Department, Meghalaya ▪ Meghalaya State Disaster Management Authority (MSDMA) ▪ Meghalaya Energy Corporation Limited (MeECL) (for electricity & power supply) ▪ Public Health Engineering (PHE) Department (Water supply & sanitation) ▪ Agriculture Department, Meghalaya ▪ Irrigation Department, Meghalaya ▪ Transport Department, Meghalaya ▪ Urban Affairs Department, Meghalaya (instead of Town Committee) ▪ Health & Family Welfare Department, Meghalaya (including AIDS Control Society functions) ▪ Department of Arts & Culture, Meghalaya (instead of Directorate of Archaeology, Meghalaya) ▪ District Social Welfare Office (North Garo Hills) ▪ District Legal Services Authority ▪ District Child Protection Unit ▪ Office of the Child Development Project Officer ▪ Jawahar Navodaya Vidyalaya, Bajengdoba, North Garo Hills. **B. Civil society organizations: Local NGOs such as** ▪ Bethany Society – strong presence of Community based work in the entire Garo Hills Region. ▪ ACHIK Youth Council / Achik Holistic Awakening Movement (AHAM) – strong socio-cultural and community development organisation in Garo Hills ▪ North Garo Hills Women's Self-Help Group Federations – grassroots women's groups working on livelihood and welfare ▪ Church-based Organisations (Baptist / Catholic Missions) – significant role in

Category of stakeholder	Type of stakeholder
	education, health, and social services across villages **C. Community based Organization** ▪ Bio-Diversity Management Committee
Vulnerable groups	▪ Women Headed Household (WHH), ▪ PAPs falling under Below Poverty Line (BPL), ▪ Scheduled Tribe (ST) categories, ▪ Persons with disabilities

During ESIA, consultations were conducted with representatives from all three categories of stakeholders. The consultations conducted with government agencies, communities, & other organizations with representation from vulnerable groups were undertaken. Special attention was given to engaging with communities from sub-project locations that are likely to experience significant impacts, such as impact on residential and commercial structures etc.

Representatives from interested parties were consulted to incorporate their concerns and expertise to align the project with broader developmental objectives associated with economic and environmental goals. Key discussions during the consultations were focused on potential displacement, loss of livelihoods, environmental degradation, law & order issues in project area, forest land related issues, irrigation related, structural issues such as Cross Drainage Structures, etc., and related mitigation measures, ensuring that the concerns and suggestions of all stakeholders were documented and considered in project planning. The consultations provided valuable insights into the priorities and concerns of affected local community, helping to shape mitigation measures for minimizing adverse impacts.

Through public participation in consultations, stakeholder's viewpoints and suggestions were captured as an input to the technical design, which were duly considered, and all the suggestions were incorporated in the project design to the extent feasible and /or warranted.

Additionally, **Annexure 7.1** provides a summary of consultations with project-affected parties from local communities and institutional stakeholders from government agencies.

The project has prepared a project level Stakeholder Engagement Plan (SEP) which details out the procedures of stakeholder engagement during the project cycle. The SEP outlines the process, methods and frequency of engagement with various stakeholders and will be accordingly implemented during the project period.

Disclosed Stakeholder Engagement Plan link on MPWD website is **https://www.megpwd.gov.in/pdf/2025/MLCIP/DRAFT%20STAKEHOLDER%20ENGAGEMENT%20PLAN%20(SEP)%20MLCIP.pdf.**

7.1 Public Consultation

Public consultations were a key component of the Environmental and Social Impact Assessment (ESIA) process. These consultations were conducted to ensure that the views, concerns, and suggestions of local communities and other stakeholders were effectively considered in project planning and decision-making. The process was guided by the principles of transparency, inclusiveness, and participation, in line with the requirements of the World Bank's Environmental and Social Standard 10 (ESS10) on Stakeholder Engagement and Information Disclosure. Consultations were organized at different stages of the project to inform stakeholders about the project objectives, potential environmental and social impacts, and proposed mitigation measures, while also providing an opportunity for them to share feedback and local insights. The outcomes of these consultations were incorporated into the project design and environmental and social management plans to enhance the project's sustainability and community acceptance.

7.1.1 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were carried out to ensure that the perspectives, concerns, and expectations of all relevant stakeholders particularly the project-affected persons, IPs, and vulnerable groups were effectively captured and integrated into project planning and decision-making. The details of consultations along the project road are presented in **Table 7.2**.

Table 7.2: Summary of consultations

Stakeholders	Dates of Consultation	No of Participants	Summary of Key Feedback
Divisional Forest Officer (DFO), East & North Garo Hills	21 August 2025	4 nos	Road alignment passes through community vegetation and elephant routes; habitat/clearance concerns.
Forest Ranger Office East & North Garo Hills	23 August 2025	3 nos	List of Floral and faunal species predominant in RBB Road and details about Elephant movement.
PCCF, Shillong	28 August 2025	4 nos	Elephant crossings; HWC & safety; governance/dependence.
6 meaningful consultations with Local residents	23 August 2025- Omor Bazaar 23 August 2025- Kosi Junction 2 September Borjhora & Bakenang Songma 5 September Mansinggre & Bolsong	Omor Bazaar (15 male and 05 Female), Kosi Junction (15 male), Borjhora (14 male), Bakenang Songma (13 Male, 2 Female), Mansinggre (13 male, 4 Female) and Bolsong (12 Male and 6 Female).)	Participants highlighted that the poor condition of the existing road is causing serious commuting difficulties, which is negatively affecting children's access to education. They also reported that the deteriorated road condition has led to frequent road accidents, raising safety concerns among the local community.
Street vendors	16 September 2025	20 Nos (Male – 12 Female – 8)	Construct smoother roads to enhance accessibility and improve transportation.
Village Nokma	16 September 2025	01 Nos	Waterborne diseases such as typhoid and cholera are prevalent due to unsafe drinking water and poor sanitation. The community stressed the need for improved water supply and health awareness.
Youth Groups	15 & 23 September 2025	13 Nos (Male – 8 Female – 5)	Limited skill/jobs; risky migration; want entrepreneurship & better goods/service connectivity.

Stakeholders	Dates of Consultation	No of Participants	Summary of Key Feedback
Women FGD, Laitsohum, Mawrapad, Mawkasai	19 & 25 September 2025	10 Nos	Low skill access; norms restrict mobility/work; no childcare; poor scheme awareness; keen on cooperatives & local enterprise.
Consultations held during FPIC for Priority Projects			
Community Members & Project Affected Households & Families	09, 19 & 25 September, 10 December, 2025	4 Consultations 148 Nos (Male – 127 Female – 21)	**Major key Agreements:** • Improvement of the existing road to Intermediate Lane with provision of safety measures, drainage, and protection works in habitation and market areas, subject to technical feasibility. • Construction of passenger waiting sheds at specific village locations • Construction of drains cum footpath near settlement areas etc. • Construction of separate toilets for males and females

7.1.2 FPIC PROCESS

As per the requirements of the World Bank's Environmental and Social Standard 7 (ESS7), Free, Prior, and Informed Consent (FPIC) is required where project activities affect lands and natural resources traditionally owned or used by Indigenous Peoples, result in their relocation, or have significant impacts on their cultural heritage. For the proposed Rongsai–Borjhora–Bajengdoba (RBB) road sub-project, FPIC was triggered under the first condition, as the intervention involves the use of land and natural resources traditionally used by Indigenous communities, including vegetated community land. Accordingly, a structured FPIC process was undertaken to ensure culturally appropriate engagement with Indigenous communities and their traditional institutions, including Nokmas, village councils, and community representatives. Consultations as part of FPIC were conducted in the local Garo language using accessible formats and covered key aspects of the project such as alignment, design, anticipated environmental and social impacts, and proposed mitigation measures, with particular attention to land use, vegetated community land, water sources, livelihoods, and community assets.

The FPIC process was carried out in a phased and participatory manner through multiple rounds of consultations, allowing adequate time for internal deliberations in accordance with customary decision-making systems. The process ensured inclusive participation of women, youth, and vulnerable groups, and was undertaken in good faith, free of coercion or external influence. The outcomes reflect broad community support for the RBB sub-project, subject to agreed mitigation measures and design considerations, which have been incorporated into the project design. These measures, along with the detailed record of the FPIC process and continued engagement framework, are presented in the Indigenous Peoples Development Plan (IPDP) prepared specifically for the RBB sub-project.

Documentation of the FPIC process, including signed minutes of meetings and attendance records endorsed by Community Leaders, is provided in the Indigenous Peoples Development Plan (IPDP) prepared for the sub-project.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT, MONITORING AND REPORTING PROGRAMME

8.1 GENERAL

Monitoring and reporting are critical components in the implementation of the project. Monitoring involves periodic checks to determine whether activities are being carried out in accordance with the proposed mitigation plans. It provides essential feedback to project management, helping ensure that project objectives are achieved on schedule. The reporting system ensures that environmental and social mitigation measures are implemented as planned. Together, monitoring and reporting support the proper implementation of the Environmental and Social Management Plan (ESMP).

The broad objectives of monitoring and reporting on E&S management are:

- To evaluate the performance of mitigation measures proposed in the ESMP and in other mitigation plans.
- To evaluate the adequacy of environmental and social assessment.
- To suggest improvements in ESMP and other mitigation plans based on the monitoring and to devise fresh monitoring based on the improved ESMP.
- To enhance environmental quality and social development through proper implementation of suggested mitigation measures.
- To meet the requirements of the existing environmental and social regulatory framework and community obligations.

8.2 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) has been prepared in accordance with the World Bank's Environmental and Social Framework (ESF) to ensure that the potential environmental and social impacts identified during the assessment are effectively managed during the design, construction, and operation phases of the project. The ESMP outlines specific mitigation, enhancement, and monitoring measures; defines institutional responsibilities; and provides a framework for capacity building and reporting. It serves as a practical tool to guide the implementation of mitigation measures, ensuring compliance with applicable national regulations and the World Bank's Environmental and Social Standards (ESSs), while promoting sustainable and inclusive project outcomes.

Table 8.1:Environment and Social Management Plan

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
PRE-CONSTRUCTION							
1	Consents/ Permits/ Approvals/ Compliances	Regulatory Compliance	Non-compliance to various Environmental/ social/ regulatory requirements pertaining to the proposed project could lead to legal Implications	➢ Obtain all necessary statutory clearances (CTE, CTO, Labour License, Fire NOC, Tree Cutting Permission, Hazardous Waste Authorization etc.) ➢ Obtain necessary insurance and indemnities as specified in the Contract Agreement or a necessitated by law. ➢ The CSC will not allow any construction activity without these being completed ➢ Renew permits before expiry. ➢ The conditions mentioned	Contractor/ MPWD	CTE, CTO, Labour License, Fire NOC, Tree Cutting Permission Insurance and indemnities to be submitted and tracked	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				in the permit need to be maintained. ➢ Reports and Returns need to provided.			
2	Land Procurement	Asset and Livelihood	Loss of Land/ Livelihoods	➢ RPF and RAP shall be followed. MPWD division, Village Council and concerned authorities shall coordinate implementation. Compensation records shall be maintained; grievances resolved. Civil works shall commence only after written confirmation from PMU/MPWD that RAP compensation, assistance, and site handover have been completed for the relevant stretch.	MPWD division, and Village Council and concerned authorities	Compensation records maintained; Grievances resolved	MPWD/CSC/NGO
3	Preparation of Works Methodology Contractor's ESMP (CESMP)		Inadequate preparation and implementation of CESMP by Contractor can leave environmental and social issues	➢ The contractor needs to follow the project ESMP to formulate the CESMP aligned with its work methodology. ➢ The CESMP shall be submitted with the Work Plan and Method Statement. ➢ The CSC shall review it and	Contractor	Approved CESMP including TMP, LMP and other relevant plans, and implemented;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			unattended	provide one set of consolidate comments within 15 days and the plan shall be approved once these are compiled to by the Contractor. The Work Plan and Method Statement will be approved by MPWD only when the CESMP, Traffic Management Plan, OHS Plan is prepared and approved by the CSC .			
4	Identification of land for material storage yard/ construction camp/ labour camp	Land use and ecology	Discharges from Yards/ Camps to pollute the surroundings and lead to social tension.	➢ Contractor needs to identify suitable land for storage yard/ construction camp/ labour camp ➢ The land shall not be closer to the water bodies, waterlogged areas or wetlands. ➢ The land will be handed back to the owner in the same condition as it was prior to the commencement of project activities, once the project is completed. ➢ Contractor to produce the lease agreements, NOC etc. for these lands.	Contractor	Approved site location; Lease/NOC copies;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Avoid construction camps and material storage near streams or unclassed forest on community land, flood plain, encroachment into natural habitats. ➢ Restrict vegetation clearing to the minimum area required for works. ➢ Maintain a buffer of at least 100 m from natural drainage channels or water bodies. ➢ Implement soil erosion control measures (silt fencing, sediment traps, and slope turfing). ➢ Prohibit hunting, fishing, or collection of forest produce by workers. ➢ Awareness and sensitization of labourers on local wildlife and birds. ➢ The guidance for the preparation, construction and operation of the labour camp shall comply			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				with the World Bank Group12 Guidance on Labour Accommodation			
5	Supply of Construction Material	Physiography	Sourcing materials from unauthorized sources.	➢ The Contractor will submit the EC, CTE, CTO of the aggregate and sand quarry to the PMU for the approval at the beginning of the project. ➢ Procurement of construction material only from approved quarries and sites and licensed/ authorized vendors/ manufacturers. ➢ Contractor to produce approvals and receipts of the payment of royalty for all the material procured along with the bill / IUFR.	Contractor	EC, Permits, challans, Material source approval copies;	MPWD/CSC
6	Water	Groundwater and Surface Water	Abstraction and Pollution of surface and groundwater sources.	➢ The Contractor will be responsible for arranging adequate supply of water for the entire construction period. ➢ In case of own borewell the Contractor shall	Contractor	Permission for Water source; Usage records; Wastewater management measures	MPWD/PMC/CSC

[12] Workers' accommodation: processes and standards

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				obtain a permission of abstraction form CGWB/ SWID. ➢ He shall arranged for a meter to be fixed at the borewell and the log of the water extracted will be maintained. ➢ Measures suggested in the permission will also me maintained ➢ The contractor will minimize the pollution and wastage of water during construction. The labour camp shall be provided with adequate number of toilets as specified in BCOW Act/ WBG Guidance on Labour accommodations. The toilets have to be provide with soal pits , septic tank or be linked to a mobile treatment unit. Bio-toilets can also be considered as an option ➢ The Construction Camp, Construction material storage yard will be provide with peripheral			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				drain which shall be linked to a sedimentation tank. ➢ The vehicle repair area , oil storage area shall be impervious , the runoff form these areas shall be sent to a drain and the same is connected to an oil water separator of adequate capacity			
7	Appointment of Environment, Social and Safety Officers		Inefficient and incompetent supervision by contractors may lead to negative impacts on environment, Social, health and safety.	The contractor will appoint qualified and experienced Environment. Social and Safety personnel to ensure implementation of CESMP and occupational health and safety issues at the camps and construction work sites. The Environmental Officer along with hethe other key members of the tram team shall be responsible for the preparation of the Plans and also obtaining the statutory permits	Contractor	To be mobilized before construction; approved OHS plan	MPWD/PMC/CSC
8	Identification of OHS Hazard and Risk Categorization	Occupational Health & Safety	May cause physical harm, injury, illness, or death to workers.	➢ Develop a site- specific Hazard Identification and Risk Assessment (HIRA) and develop mitigation measures . The Contractor	Contractor	OHS hazard register; Inspection reports;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				shall prepare an OHS Plan containing the HIRA and submit it as part of the Work Plan and Methodology. The Work Plan shall be approved only when the OHS Plan is satisfactory. ➢ Arrange for PPE (helmets, safety shoes, high-visibility vests, gloves) to all workers. ➢ Develop tie up with local Hospital Hospital/ PHCs/ CHCs for Health Checkups of labours and also to handle to any accident cases. ➢ Ensure proper sanitation, adequate potable water (minimum 5 litres per person per day), and waste disposal facilities in camps. ➢ Consulting with workers to identify hazards that may not be obvious to employers or safety professionals. ➢ Reviewing safety data sheets (SDSs) to collect			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				information about the hazards of chemicals and other substances used in the workplace. ➢			
9	Other Construction Vehicles, Equipment and Machinery	Pollution Management	Vehicles and equipment not complying with regulations may lead to pollution of environment.	➢ The contractor will maintain records of fitness and Pollution Under Control (PUC) certificates for all vehicles and generators used during the contract period.. These certification shall be renewed and always maintained. The certificate shall be submitted with the IUFR's (if necessary) ➢ All lifting should have the appropriate certification and construction equipment should meet the emission requirement specified in MoRTH emission standards specified in GSR 144. ➢ Engage trained personnel for operating machinery and working at height or confined spaces. ➢ Crushers, hot-mix and	Contractor	Records of valid PUC / fitness; Inspection log	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				batching plants shall be located at least 1000m (1km) away from residential/ settlements, forests, wildlife movement areas, and commercial establishments, preferably in the downwind direction. ➢ The crushers , batching plant and all other equipment shall meet the specification which are likely to be mentioned by MSPCB in the consent. .			
10	Tree Cutting	Ecology	Loss of green cover and biodiversity	➢ Maximum efforts shall be made to minimize the number of trees to be felled. ➢ The requirement or specifics to fell trees shall be notified to the Forest Department in advance. ➢ Tree felling shall only be carried out when permission has been obtained from the Forest Department. ➢ Tree cutting and disposal shall be done as per the	Contractor	Records of trees cut and saved.	MPWD/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				Forest Dept.			
11	Joint field verification	Community Engagement	The impacts may not have been identified in time.	➢ The MPWD and the Contractor shall carry out joint field verification to ascertain the local complaints/suggestions and to confirm the need for additional protection measures or changes in design/scale/nature of protection measures including the efficacy of enhancement measures suggested in the ESMP. ➢ Contractor shall provide advance notice to communities and village councils prior to road closures, diversions, or major construction activities. ➢ The MPWD shall maintain proper documentation and justifications/reasons in all such cases.	Contractor	Verification reports;	MPWD
12	Identification of Borrow Area	Damage to existing eco-system due to borrowing activities	Indiscriminate borrowing activities may damage the eco-system and lead to	➢ Borrow area should be located at a minimum distance of 300m from the residential/ settlement area. Preferably, non-agricultural land and	Contractor	Borrow area EC copy; Approved management and closure plan	MPWD /CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			unproductive environment	barren lands shall be used Proper barricading should be provided and access to the borrow areas should be restricted to the unauthorized persons. ➢ The Contractor will have to obtain the Environmental Clearance for borrow areas. ➢ The borrow area will be operated as per the MoEFCC guidelines[13] issued by the concerned SEAC and SEIAA.			
13	Identification of construction material transportation route	Community Health and Safety	Inconveniences and safety issues to the public due to the material transport vehicles.	➢ The material transport route through existing network of roads should be planned and approved by the local transport authorities. ➢ Possible risk areas need to be identified along with sensitive receptors and their time of sensitivity. The Traffic Management Plan shall be developed accordingly.	Contractor	Approved route plan; Community consultation record	MPWD/CSC

[13] https://parivesh.nic.in/publicdocument/UPLOAD_OM_NOTIFICATION/IA_DOCS/1001_19032025024958.pdf

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ The local communities need to be consulted with prior information on any likely inconveniences.			
14	Identification of sites for debris disposal or wastes generated from construction camps and site offices	Land and Water environment	Pollution due to indiscriminate dumping of wastes. Wastes entering water bodies and groundwater causing pollution	➢ MPWD Division and the Contractor are responsible for identifying a suitable area in consultation with local administration to dispose of the wastes from labour camps, construction sites and site offices. ➢ The locations of dumping sites should be selected with following considerations i) Unproductive/wastelands preferred , ii) away from residential areas (at least 1km downwind side), iii) are not designed forest or other eco-sensitive areas, Iv) do not affect natural drainage courses , v) no endangered/rare flora is impacted vi) are not lowlands, natural depressions which are natural sinks ➢ Drainage channels should	Contractor	Approved disposal site and its management plan; NOC, Agreement with landowner; Waste disposal records;	MPWD/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				not be used for dumping ➢ Local Authorities should be consulted about the location of debris disposal sites before finalizing the locations. ➢ The topsoil of 15cm shall be removed before any works are carried out Reuse topsoil for slope stabilization and landscaping. ➢ Dispose of debris only at approved low-lying barren areas located at least 1 km downwind of settlements and away from drainage channels. ➢ Avoid dumping in water bodies, wetlands, or near agricultural fields. ➢ Regularly monitor disposal sites to prevent contamination and visual pollution.			
15	Relocation of Utility and Common Property Resources (CPR)	Utility Service	Loss of services from utilities and common property resources for the public	➢ When the utilities/ Common Property Resources need to be shifted, they will be shifted in consultation with the communities and	Contractor/ Divisional offices of MPWD	Records of Relocation completion.	MPWD/ PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				with least inconvenience to the public. ➢ If any displacement of Utility/CPRs is required, they will be relocated with prior approval of the concerned agencies. The relocation site identification will be in accordance with the choice of the community. ➢ Restrict utility shifting to daytime hours to avoid safety risks at night. ➢ The scheduling of the construction works will be shared with the line department (MePDCL, PHE and Telecom Departments) for ensuring uninterrupted services during construction. ➢ Provision of utility ducts for underground pipelines shall be incorporated into the design to ensure safe and organized routing of essential services, minimize future excavation, and facilitate maintenance without			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				disrupting road infrastructure			
16	Planning for Worksite and Work Zone Safety	Community Health and Safety	Accidents and inconvenience to communities	➢ Make arrangement for New Jersey barriers/ Water filled barrier , MS steel barricades (2 m high) , signage, and warning lamps at work sites. ➢ Prepare a Generic Community Health and Safety Plan (CHS Plan) along with the Work Methodology and Work Plan. The Work Plan should not be approved without an approved CHS Plan. ➢ Schedule high-risk activities during off-peak hours to minimize traffic congestion. ➢ Develop posters for Community Awareness. Conduct community awareness campaigns before any temporary road closure or service disruption. ➢ Every RFI should be accompanied with a site specific OHS, CHS and	Contractor	Community Health Safety Plan	MPWD/PMU

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				Traffic Safety Plan, which should define the site-specific measures which were implemented. Without these plans being implemented the works should not be approved.			
CONSTRUCTION							
1	Crushers, Hot mix Plants & Batching Plants	Air Pollution	Impacts due to establishment and operation of plants and equipment	➢ The Contractor shall submit a detailed layout plan for all such sites and seek prior approval before entering into a formal agreement with a landowner for setting-up such sites. ➢ Specifications of crushers, hot mix plants, and batching plants shall comply with the technical requirements of the contract and prior Consent / NOC for all such plants shall be obtained. ➢ No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority	Contractor	Approved layout plan; Valid NOCs/Consents; Dust suppression records; Air quality monitoring reports	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ The emission have to be monitored asper the monitoring plan specified in the ESIA Report. ➢ The plant has to be maintained as per the specification of the manufacturer. A log of the maintenance should also be maintained by the Contractor..			
2	Operation of Borrow Areas	Topsoil and land	Impacts due to improper operation and closing of borrow areas	➢ Borrow areas shall be seletedselected as spefced specified in the guidance in The Contractor should submit the EC, a copy of agreement with the landowner, borrow area management and closure plan before initiating any kind of borrowing activities. ➢ The Borrow are should comply with the conditions set in the EC/ SoP from MoEF&CC. ➢ Topsoil up to a depth of 150 mm from all areas of cutting, filling, and temporary construction	Contractor	EC and lease copies; Approved Borrow area restoration and Closure plan	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				zones, shall be stripped and preserved as indicated in the MoEF&CC SoP / MoRTH Orange Book: Specification for Road and Bridge Works; ➢ Topsoil will be stored separately in designated stockpiles with proper slope protection and sediment barriers to prevent erosion; ➢ Reuse stored topsoil for median greening, roadside plantation, and slope turfing after construction; and ➢ Prohibit disposal of topsoil at dumping sites.			
3	Operation of Quarries	Physiography and Geology	Impacts due to improper management, operation and closing of quarries	➢ The Contractor shall only source material from quarries approved by PMU(indicated in the Pre-Construction stage) ➢ The challans for the royalty paid against the material used shall be included in the IUFR / Bills	Contractor	Quarry permit, EC; Safety inspection report; Haul road maintenance record, dust suppression measure, geotagged photos	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				submitted for payments. ➢ In case of new quarry fo the project the Contractor has to obtain EC and other relevant permits and licenses. ➢ Inca se of Blasting , A Blasting Management Plan shall be prepared in addition to the Blasting Permit, ➢ No quarry or associated plants can be set-up within 1000m from the residential/ settlement locations ➢ Contractor shall prepare a haul road network for quarry transport and ensure the suitability of such haul roads from the safety of residents, biodiversity and other environment points of views.			
4	Dismantling of Bridges/ Culverts/ Structures, Hill Cutting	Landuse and Land quality	Impacts due to improper dismantling and disposal	➢ All necessary precautions shall be taken while working near cross-drainage channels, to prevent earthwork, stonework, construction	Contractor	Debris disposal/reuse records; Approved Site restoration plan;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				materials from obstructing cross-drainage at rivers, streams, and drainage systems, or from causing flooding. ➢ Any material which has spilled into the river/ drainage channel or road shall be removed by end of day . ➢ In case of hill cutting if any debris cannot be removed by end of day the and shall be demarcated with, crash barrier and traffic safety beacons. However, such sites cannot be left for more than 2 days. ➢ Reusable materials (e.g., steel, stones, bricks) shall be segregated and stored properly for reuse or recycling. ➢ Non-recyclable debris and waste materials shall be transported to approved disposal sites identified and approved by the concerned authority. ➢ dampen stockpiles and vehicle loads, cover trucks		Photographic documentation.	

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				during transport, and restrict demolition/dismantling operations during high-wind conditions. ➢ Only sites which have been approved by the PMU/PMC/CSC shall be used for dumping. ➢ Temporary barriers or silt fences shall be provided to prevent debris from entering watercourses. ➢ Dumping will be done in compacted layers (≤1 m thick) with retaining walls, catch and chute drains, and slopes maintained within the natural angle of repose (30°–35°). ➢ Each site will be protected with toe walls of adequate height, sediment traps, and vegetative cover for stabilization. ➢ The contractor shall operate only at			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				approved locations under supervision and maintain the site until full rehabilitation is achieved. ➢ The site should incorporate proper retaining structures, such as toe walls and catch drains, to prevent sliding and erosion. ➢ Adequate drainage must be provided through surface and subsurface channels to control runoff. Temporary barriers or silt fences shall be provided to prevent debris from entering watercourses. ➢ Spoil should be deposited in layers, compacted, and stabilized using vegetation or geo-textiles to minimize dust and erosion. ➢ Access roads should be provided to ensure safe transport of Spoil, and the site should be			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				fenced and clearly demarcated. ➢ Upon completion, the associated disposal sites shall be restored to their original condition or as directed by the Engineer			
5	Road scraping and dismantling	Bituminous waste disposal	Impacts due to hazardous wastes	➢ The contractor shall maintain records of quantities generated, transported, and disposed of, along with details of the disposal site and approvals obtained. ➢ Bituminous waste shall be collected and stored temporarily in impermeable, lined containers or areas to prevent leaching or contamination of soil and groundwater. ➢ Scrapped Bituminous Material shall be reused in asphalt mix design/ subbase, strengthening of shoulders as directed by CSC. other lower order roads ➢ The disposal of bituminous wastes shall	Contractor	Records of Waste reused/disposed; Details of approved disposal site; Photographic documentation.	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				be carried out by the Contractor at secure landfill sites approved by the concerned government authorities. ➢ No bituminous waste shall be disposed of in water bodies, open lands, agricultural fields, or along the roadside ➢ Periodic inspections shall be carried out to ensure compliance with waste management guidelines.			
6	Storage of Fuel and Repair of vehicles	Soil pollution due to Oil and fuel spills from construction equipment and plants or storage of Hazardous waste.	. Contamination of Soil	➢ Construction plants, workshops, and fuel storage areas shall be located at least 500 m away from any surface water body and environmentally sensitive locations. ➢ Oil interceptors shall be installed at construction camps, vehicle parking, and washing areas to trap oil and grease before wastewater is discharged. ➢ All fuel and lubricant storage tanks shall be	Contractor	Spill log; Waste oil disposal records; Fuel storage inspection record. Photographic documentation.	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				placed on impermeable platforms or within bunded (contained) areas. ➢ The Storage area should be covered and have restricted access ➢ The area should be bunded to contain 110% of the capacity of storage. ➢ The area should be provided with ABC type fire extinguishers as per the IS codes (IS 1641, IS 1642 and IS 1643, etc) ➢ Transfer of fuel by decantation is prohibited , Fuel Pump (manual or electric)should be used ➢ Regular maintenance and inspection of construction equipment and vehicles shall be carried out to prevent leakage of oil, fuel, or hydraulic fluids. ➢ Spill control kits (absorbent pads, sand, and containment booms) shall be available at all fuel storage and handling locations. ➢ Records of fuel usage,			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				storage, and waste oil disposal shall be maintained and made available for inspection. ➢ Stormwater runoff from fuel and equipment storage areas shall be directed through oil-water separators before discharge.			
7	Operation of Plant , Machinery and equipment	Generation of Hazardous Waste	Contamination of land and soil	➢ Used oil and lubricants shall be collected, stored in labelled, leak-proof containers, and handed over only to authorized aggregators/recyclers for disposal in compliance with applicable hazardous waste regulations. ➢ Records of waste oil generation and disposal shall be maintained and made available for inspection. ➢ Returns shall be submitted to comply with the Hazardous Waste Permit.	Contractor	Hazardous waste permits, records and returns	PMC/CSC
8	Operation of Vehicles and earthwork during	Air Pollution - Dust Generation	Dust generation will cause air pollution and will have impacts on	➢ Vehicles delivering materials should be covered to reduce spills and dust blowing off the	Contractor	Air quality monitoring reports; Dust suppression log;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
	construction		health and safety.	load. ➢ Water should be sprinkled regularly (3 time a day) on the work sites. ➢ Plying of vehicle on unpaved surface should be prohibited.. ➢ Speed limits shall be enforced for construction vehicles within and near project sites to reduce dust generation. ➢ Personal protective equipment (PPE) such as masks shall be provided to all workers exposed to dusty environments. ➢ Air quality monitoring shall be conducted periodically to ensure compliance with prescribed air quality standards. ➢ Community complaints related to dust shall be recorded, and addressed promptly. ➢ The Conractor should keep a records of cummity grievances due to dust , runoff separately and		PPE compliance records	

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				mitigations adopted.			
8	Operation of Vehicles, plant, and machinery	Emissions	The emissions from vehicles and construction equipment will pollute the air causing health and safety issues as well.	➢ Fitness and PUC of the vehicles and equipment's need to be ensured. ➢ Maintain all equipment and vehicles regularly; prohibit use of old or poorly maintained machinery; use low-sulphur fuel ➢ Dust extraction, collection and control systems shall be installed at batching plants, crushers, and material handling areas to minimize particulate emissions ➢ Ensure all machinery meets CPCB emission norms/ MoRTH emission standards (GSR 144); prohibit idling of vehicles; schedule material transport to avoid congestion.	Contractor	Valid PUC certificates; Equipment maintenance log; Emission test results	MPWD/PMC/CSC
9	Operation of construction Camp and construction activities	Contamination of Surface / Ground Water	Discharges from construction activities and construction camps/ labour will lead	➢ All the debris resulting from construction activities and labour camp shall be removed from the site and disposed at approved sites (by CSC/	Contractor	Water quality monitoring report; Waste disposal records; Camp	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			to surface/groundwater pollution.	PMC/ PMU) away from water bodies, on a regular basis to prevent them from getting into surface runoff. ➢ The Contractor shall mantian the sanitation facility in good conditions. Covered and enclosed facility shall be provided for washing and bathing. ➢ The sanitation facility and waste management facility to be shall be maintained in construction camp. ➢ Construction labours should be restricted from polluting the water sources or misusing the sources. ➢ Bentontie slurry is prohibited during piling work. ➢ Any slurry used in piling works should be in a closed systems. It should not be allowed, to enter waterways. The residual slurry shall only be disposed of in lined pits , It		inspection records. Photographic documentation.	

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				should not be dumped near agriculture lands.			
10	Air Quality	Deteriaoration of Air Quality	Emission	➢ LPG shall be used as fuel for cooking of food at construction labour camp instead of fuel wood. ➢ DG sets should meet the specification mentioned by CPCB from time to time			
11	Sourcing Water for project	Surface Water resources	Over extraction or exploitation of ground/surface water will lead to water scarcity.	➢ Contractor to ensure optimum and judicious use of water; ➢ The Contractor shall install and keep the water meter running at the point of extraction, main consumption areas. A log of water abstraction and ➢ Discourage labour from wastage of water and applicable prior approvals shall be obtained from concerned authorities. ➢ Rainwater harvesting structures shall be installed at construction camps and plant sites to promote sustainable use of water.	Contractor	Water consumption log; Permission for water source; Installation of Rainwater harvesting structure	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Awareness programs shall be conducted for laborers and staff on responsible water use and conservation practices. ➢ Records of daily water consumption shall be maintained as part of regular reporting.			
12		Coffer dam to make dry working space for bridge work	Change in the flow pattern and quality of water, effect on local habitat	➢ Selecting the right location for the cofferdam to minimize its impact on the environment. ➢ Using environmentally friendly materials to construct the cofferdam eg. Biodegradable/ reusable materials can be used instead of concrete. ➢ estoring the environment after construction. This may involve replanting vegetation and removing any debris.	Contractor	Worksite inspection record; Restoration completion record	MPWD/PMC/CSC
13	Operation of Vehicle, Plant and Machinery	Noise	Noise from construction vehicles, plant and equipment will lead to noise pollution and cause	➢ Staging of construction equipment and unnecessary idling of machinery within noise-sensitive areas shall be avoided wherever possible.	Contractor	Noise level test report; PPE usage record; Complaint register; vehicles,	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			health and safety issues	➢ All plants and equipment used in construction (including third-party units) must conform to **MoEF&CC/CPCB noise standards**. ➢ All vehicles and equipment used in construction shall be fitted with effective exhaust silencers. ➢ Servicing of all construction vehicles and machinery shall be done regularly; during routine servicing, the effectiveness of exhaust silencers shall be checked and replaced if defective. ➢ Construction activities shall be restricted to **daytime hours (6 AM–10 PM)**. Night-time work may be carried out only in emergencies, following all prescribed mitigation measures for night operations.		plants and equipment maintenance records.	

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Unnecessary honking at construction sites shall be strictly prohibited. ➢ Temporary **barricading** shall be installed around active construction zones, especially near settlements, schools, or hospitals, to minimize noise propagation. ➢ Noise monitoring shall be carried out at construction sites as per the approved monitoring schedule, and results shall be submitted to the Project Management Consultant (PMC) and Project Management Unit (PMU**)** for review and compliance verification.			
14	Operation of DG Sets	Noise and Air	Noise	➢ The contractor must use silent DG sets as prescribed by the Central Pollution			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				Control Board (CPCB). ➢ If a silent DG set is not available, noise shall be controlled by providing an acoustic enclosure or acoustically treated housing. ➢ The acoustic enclosure shall be constructed with suitable materials of adequate thickness, supported by a structural or sheet-metal base, and insulated with fire-retardant acoustic foam. ➢ The acoustic enclosure/acoustic treatment shall be designed to provide a minimum 25 dB(A) insertion loss or to meet ambient noise standards, whichever is higher. ➢ Each DG set shall be provided with a proper exhaust muffler to further			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				reduce noise emissions. ➢ The DG set shall be properly sited to minimize its noise impact beyond the premises, ensuring compliance with ambient noise standards at the nearest receptor. ➢ A routine and preventive maintenance schedule shall be prepared and followed in consultation with the DG set manufacturer to ensure that noise levels do not deteriorate with use.			
15	Tree Felling	Loss of trees and Plantation works	Cutting of trees can lead to loss of biodiversity.	➢ No tree felling should be carried out without permission of the Forest Department, GoMM. ➢ Clearing and uprooting should be avoided beyond that which is directly required for construction activities.	Contractor	Tree felling register; Plantation record;	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Kerosene / LPG should be preferably used to avoid felling of the trees or provide community kitchen for the labour camps for cooking. ➢ Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation ➢ Compensatory Afforestation 1: 10 would be carried out by the Contractor. As indicated in the ESMF an app based monitoring of the plantation would be carried out.			
16	Removal of Vegetation	Terrestrial Flora and Fauna	Construction activities and workers may cause harm to flora and fauna.	➢ All the workers will need to be oriented and monitored by the contractor so as not to cause any harm to the flora and fauna. ➢ Hunting and fuel wood collection will be strictly prohibited	Contractor	Worker awareness attendance; Wildlife sighting log	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
17	Discharges from Construction	Aquatic Fauna	Construction activities and workers may cause harm to fauna.	➢ Disposal of construction material or debris into rivers or streams will be strictly prohibited. ➢ Regular monitoring of water quality will be conducted to ensure compliance with environmental standards ➢ Any works affecting aquatic habitat will be done during low flow (when water depth is less than 5 m) and when banks would be dry. ➢ Where any GI wire mesh gabions are used; all GI wire ends need to be folded inside. ➢ Ensure that no construction activities will be carried out during monsoon and the fish breeding season.	Contractor	Work timing records; Site inspection checklist	MPWD/PMC/CSC
18	Construction Activities	Occupational Health and Safety	When Occupational Health and Safety are compromised the associated risks from accidents and incidents	➢ The Contractor would prepare OHS plan and other required plans as per the WBs guidelines. ➢ All the laborers to be engaged for construction works shall be screened	Contractor	Approved OHS plan; OHS training log; PPE checklist; Awareness programme and Health inspection	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			could affect health and safety of the workers and others on constriction/ project sites. Improper first aid facilities on the sites could affect health and safety of workers and others.	for health and adequately treated before issue of work permits. ➢ Periodic health check-up of construction workers. ➢ Prevention of mosquito breeding need to be ensured at the project site and other ancillary areas ➢ The contractor's Environment and Safety personnels, shall ensure implementation of CESMP including Occupational health and safety issues at the camp, construction work sites ➢ All workers and staff should be provided with Personal Protective Equipment (PPE) appropriate to their job on-site and their use shall be ensured. ➢ All construction sites should be barricaded properly. ➢ Smoking should be prohibited near areas of fire or explosion risk. ➢ Sufficient supply of		reports	

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				potable water should be ensured for all workers and employees on-site. ➢ Ensure a First Aid room at the camp and first aid kits are available in all work areas. ➢ Safe working techniques will be followed up and all the workers will be trained. ➢ An Emergency Response system in case of any incidence will be developed and implemented. ➢ The Contractor will conduct awareness programmes on EHS, HIV/AIDS and other sexually transmitted diseases for workers at least once in a quarter and the record of such training programme must be recorded. ➢ Conduct regular safety audits on safety measures adopted during construction.			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
19	Community Health and Safety	Community Safety	The safety aspects like (i) safety of road users including pedestrians and cyclists (ii) safety of cattle; (iii) safety of local community (iv) unsafe/ hazardous traffic conditions due to construction vehicle movement need to be considered during the construction stage. Children are most vulnerable to injury due to vehicular accidents.	➢ Plants and equipment will be installed sufficiently away from the settlements. ➢ Proper caution signage, barricading, delineators, lightings etc. will be installed at construction zone and temporary diversions. ➢ Hard barricading will be provided at construction zone near habitation area and public roads, and the same will be maintained throughout the construction period. ➢ Proper traffic management will be ensured near roads of the Construction zone. ➢ Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken. ➢ Speed restrictions shall be imposed on project vehicles to control speeding.	Contractor	Safety signage installed; Community complaint register; Traffic control records; access maintained	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Installation of temporary speed bumps to control speed near designated pedestrian crossing areas/school areas/ market places/ religious places/ human habitations. ➢ The general public/ residents shall not be allowed to any of the risk areas of the project, e.g., excavation sites, construction sites and areas where heavy equipment is in operation. ➢ In the consideration of risk at civil works, each labour should be covered under ECA 1923 insurance until completion of work. ➢ Contractor shall maintain continuous access to residences, shops, agricultural land, and community facilities during construction. ➢ Temporary walkways or alternate access routes shall be provided where needed.			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				➢ Special attention shall be given to safety of children, elderly persons, and persons with disabilities near work zones.			
20	Emergency Response system	Emergency Response system	Absence may result to increased incidents, injury, economic loss etc.	➢ Develop and implement ERS ➢ Train personnel and Establish communication channels ➢ Systematic planning and training for emergencies.	Contractor	Approved ERP; Emergency drill and training report; Incident response record	MPWD/PMC/CSC
21	Health Management	Health Management – Communicable Diseases	The water fringe areas provide suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water-borne diseases.	➢ There would be possibility of the transmission of communicable diseases due to migration of labour population from other areas at the construction site. ➢ Agreement shall be made with nearby health center or hospital for emergency treatment. ➢ Special Measures for COVID 19 should be strictly followed at the camp and construction site.	Contractor	Health screening record; Awareness session log; Medical report; Agreement with nearby hospital	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
22	Risk of Natural Hazards	Risk of Natural Hazards	The project area is at risk from floods and Earthquakes.	➢ Protection of Agriculture Land near roads/ bridges. ➢ The mitigation measures should be adopted as per norms of State Disaster Management Authority, Government of Meghalaya.	Contractor	Site assessment report; Record of Compliance with SDMA norms	MPWD/PMC/CSC
		Risk of Force measure	These unforeseen risks can have both adverse environmental and social impacts	➢ All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. ➢ All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work. ➢ Contractor has to prepare a response plan before start of construction works	Contractor	Force majeure preparedness plan; Emergency contact list	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
23		Hygiene	Impacts related to unhygienic surroundings	➢ At every workplace, good and sufficient water supply shall be maintained to avoid waterborne diseases to ensure the health and hygiene of workers. ➢ Adequate drainage, mobile toilets shall be provided at workplace. ➢ Preventive Medical care shall be provided to workers. ➢ Proper Hygiene shall be maintained	Contractor	Sanitation inspection record; Hygiene logbook	MPWD/PMC/CSC
24		Traffic Management	Unplanned and unmanaged traffic diversion and detours can result in public nuisance.	➢ Before start of the construction, proper traffic management plan will be prepared and submitted to MPWD for approval. Secure assistance from local police for traffic control during the construction. ➢ Necessary signage and barricading will be provided for safety of road users. ➢ Contractor will ensure that no construction materials and debris are	Contractor	Approved TMP; Signage/barricade checklist; Traffic incident register; geotagged photos	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				lying on the road. It will be collected and disposed of properly. ➢ Unnecessary parking and sound pollution to be strictly avoided near settlements and sensitive receptor such as schools, hospital and cultural centers. ➢ The contractor will ensure that the diversion/ detour is always maintained in running conditions, particularly during the monsoon to avoid disruption to traffic flow.			
25		GBV-SEAH Risks	GBV-SEAH risks may arise due to labor influx	➢ Ensure labor camps are away from settlement areas ➢ Ensure that every worker working in the project has been given an orientation on the Worker's Code of Conduct, especially on GBV and SEAH, and has signed the Code of Conduct. ➢ Conduct periodic awareness programs targeted at women	Contractor	Signed CoC register; GBV training log; GBV complaint record	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				laborers and women and children of communities residing close to the work sites for reporting incidents of GBV- SEAH ➢ Ensure complaints of GBV-SEAH are recorded and addressed with urgency. Ensure that name(s) of complainant(s) are kept in confidence and enable anonymous reporting of complaints. ➢ Activate GBV Grievance Redressal Committee immediately on receipt of any GBV- SEAH complaint. Take action on recommendation of the GBV Grievance Redressal Committee within 24 hours of submission of the report.			
26	Works carried out near the Archeological Properties or Monoliths , chance finds	Chance Finds	There is a possibility of Cultural relics, Chance finds at the construction sites. Without proper plan these artefacts may be	➢ If any cultural remains of geologic or archaeological interest are found, Stop work immediately. ➢ CSC and MPWD shall be immediately informed of such discovery and carry out the instructions for	Contractor	Chance find report; Notification records	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
			misused by contractor/ workers.	dealing with the same ➢ No construction related activity not limited to the following storage of material or debris, establishment of labour camp, staging of plant equipment or vehicle, parking of vehicle etc shall be carried out in the vicinity of the Monoliths			
27	Engagement of labour	Compliance to Labour Welfare Laws and reporting	Workplace accidents and injuries, unsafe working condition, loss of productivity etc.	➢ Establish a policy and ensure the compliance within the organization, from the top to the lowest-level employee, understands the importance of complying with labour laws and reporting. ➢ Employees should be trained on their rights and responsibilities under labour laws. ➢ Employees should have a way to report violations of labour laws without fear of retaliation. This could be a hotline, an email address, or a suggestion	Contractor	Labour law compliance record; Training attendance record; Worker GRM register; Age verification records	MPWD/PMC/CSC / Labour Inspectors, Govt of Meghalaya

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				box. ➢ Investigating and taking action on violations. This could include disciplinary action against the violator, or even legal action. ➢ Employees should be kept updated on the organization's compliance with labour laws. This could be done through regular training sessions, newsletters, or other communication channels. ➢ Contractor shall establish and maintain a Worker GRM consistent with the LMP. Worker grievances shall be recorded and resolved within defined timelines. ➢ Anonymous reporting shall be permitted and retaliation prohibited. Employment of child labour and forced labour is prohibited. Age-verification records shall be maintained.			

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
28	Engagement of Labour	Labour Influx	Strain on infrastructure, such as housing, healthcare, and education; social tension, as new arrivals compete with locals for jobs and resources.	➢ Proper plan for labour influx by investing in infrastructure and social services. ➢ Governments can regulate the flow of labour to ensure that it is orderly and sustainable. ➢ Local communities can engage with new arrivals to help them understand the local culture and customs. ➢ Maximum use of local labours ➢ Workers shall receive orientation on local customs and behavioural expectations. Workers shall not enter nearby settlements unnecessarily. Contractor shall coordinate with village authorities regarding labour camp establishment.	Contractor	Labour License and registration records; Local labour hiring records; Orientation logs;	MPWD/PMC/CSC Labour Inspectors, Govt of Meghalaya
29	Site-specific stakeholder engagement and	Community participation, transparency, and inclusion of affected	Lack of information sharing, unresolved grievances, and reduced community	Establish and implement a structured system of regular consultation meetings at the site level in line with ESS10 and FPIC requirements under ESS7.	Contractor/ CSC/ PWD	Meetings conducted per month Attendance records with representation	MPWD/ PMC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
	consultation	persons, including Indigenous communities (FPIC compliance)	participation in project activities	Conduct meetings at least twice a month with PAPs, Nokmas/traditional leaders, women and youth groups, and local institutions. Share project information, discuss construction-related impacts, review implementation of mitigation measures, and address concerns through the GRM. The process will also be used to track adherence to agreed FPIC commitments and ensure culturally appropriate engagement throughout project implementation.		of Indigenous communities, women, and vulnerable groups Number of issues raised and resolved Availability of documented meeting records (MoMs)	
30	Grievance Redressal	GRM	Increased impunity, conflict and violence; Loss of trust and confidence	➢ Establish a grievance redressal mechanism ➢ Ensure that the mechanism is impartial and independent ➢ Provide adequate support to people who use the mechanism ➢ Communicate effectively with people about the mechanism	Contractor	GRM register; Grievance resolution records	MPWD/PMC/CSC
31	Monitoring and Reporting	Monitoring and Reporting (Monthly/	Monitoring environmental	➢ The parameters to be monitored, frequency and duration of monitoring as	Contractor	Monthly/quarterly ESMP compliance	MPWD/PMC/CSC

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
	Mechanism	Quarterly)	attributes like (Air, Water, Noise & soil microbiology) and proper reporting are important for the successful ESMP implementation Weak safeguard tracking	well as the locations to be monitored will be as per Monitoring Plan prepared. ➢ Serious social incidents, community conflicts, labour unrest, or SEA/ SH allegations shall be reported to MPWD within 48 hours. ➢ Regular submission of CESMP implementation monitoring report		report; Incident register; Monitoring data records.	
	Operation Phase						
1		Debris and Waste from Clearing/ Closure of Construction Site, Labor Camps, Disposal Sites, and Borrow Areas	Land and soil contamination due to improper waste disposal; Aesthetic degradation; Health risks to nearby communities	➢ Contractor shall prepare and implement a Site Restoration Plan approved by the Engineer. ➢ On completion of works, all temporary structures, debris, and wastes shall be cleared. ➢ Disposal pits and sanitation trenches shall be filled, compacted, and sealed. ➢ Topsoil removed during construction shall be re-spread to aid vegetation regrowth. ➢ Native grass or trees shall	Contractor	Site clearance restoration records and closure NOC; Geotagged photos	MPWD

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				be planted to stabilize restored areas and improve aesthetics.			
2		Soil Erosion due to Runoff over Steep Slopes and Embankments	Loss of fertile topsoil; Siltation of nearby water bodies; Slope instability or road damage	➢ Regularly inspect slopes and embankments for erosion signs. ➢ Implement bioengineering measures like turfing, hydroseeding, and vegetation planting. ➢ Provide stone pitching, retaining walls, or gabions where needed. ➢ Maintain effective drainage systems to reduce concentrated runoff.	Contractor	Reports on Erosion inspection; implementation of mitigation measures; Drain maintenance log	MPWD
3		Water Pollution from Road Runoff and Drainage into Water Bodies	Deterioration of surface and groundwater quality; Sediment and oil contamination in nearby streams or waterbodies	➢ Conduct regular water quality monitoring during operation phase. ➢ If pollutants exceed prescribed limits, install silt traps, or sedimentation chambers. ➢ Ensure roadside drains are cleaned and desilted regularly. ➢ Conduct public awareness to discourage waste disposal into water bodies.	Contractor	Water quality monitoring results; Drain cleaning records	MPWD

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
4		Dust Generation from Vehicular Movement	Deterioration of ambient air quality; Nuisance to roadside residents and vegetation; Reduced visibility	➢ Establish and maintain roadside plantation to serve as dust barriers. ➢ Maintain smooth road surfaces to minimize dust generation. ➢ Install signage discouraging over-speeding, which increases dust levels.	Contractor	Air quality results; Plantation survival record	MPWD
5		Air Pollution from Vehicular Emissions	Increased levels of NOx, SO_2, CO, and PM; Health impacts on local population; Deterioration of roadside vegetation	➢ Conduct ambient air quality monitoring at sensitive locations. ➢ Maintain green buffers along the corridor. ➢ Organize awareness campaigns for drivers on emission reduction and vehicle maintenance.	Contractor	Air quality results; Plantation survival record ; Awareness records	MPWD
6		Noise Pollution from Increased Traffic Movement	Noise nuisance to residents; Disturbance to schools, hospitals, and wildlife	➢ Conduct periodic noise level monitoring. ➢ Provide noise barriers, dense plantation near sensitive receptors. ➢ Enforce “No Horn” zones near schools and hospitals. ➢ Maintain road surface to minimize noise due to uneven pavement.	Contractor	Noise monitoring results; Maintenance records	MPWD

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
7		Road Safety and Accident Risks	Traffic congestion; Increased likelihood of road accidents; Risk to pedestrians and local communities	➢ Install and maintain proper signage, reflectors, and road markings. ➢ Ensure adequate lighting at intersections and pedestrian zones. ➢ Provide speed control measures and pedestrian crossings in settlement areas. ➢ Conduct community road safety awareness programs.	Contractor	Accident record; Safety audit report; Awareness records	MPWD
8		Maintenance Waste from Roadside Maintenance, Drain Cleaning, or Repairs	Soil and water contamination from indiscriminate disposal; Visual pollution and clogging of drains	➢ Collect and dispose of maintenance waste at designated locations. ➢ Prohibit dumping into drainage channels or low-lying areas. ➢ Reuse or recycle suitable materials (e.g., asphalt, concrete, metal).	Contractor	Waste logbook; Disposal reccords	MPWD
Site Specific mitigation							
1.	Elephant crossing(At Ch17+020 and Ch 17+600).	Wild life management	Man and elephant conflict	➢ No construction camp, material storage larea, will setup 100 m on both sides from the Elephant crossings (At Ch17+020 and Ch	Contractor	Approved site location	MPWD/ PMC/ Forest Department

Sl. No.	Activity	Environmental/Social Aspects	Impacts	Mitigation/ Management Measures	Implementation	Indicator	Supervision/ Monitoring
				17+600). ➢ Installation of AI-based camera systems (as per RDSO specifications, RDSO/SPN/TC/65/2021) along identified elephant movement zones to continuously monitor and detect elephant presence. These cameras, equipped with thermal and optical sensors and AI-based analytics ➢ Three tier Plantation			

8.3 PERFORMANCE INDICATORS

Environmental and social components identified in affecting the environment and social conditions at critical locations have been suggested as performance indicators (PIs). For example, near the construction site, a thick layer of dust over the nearby vegetation/leaf is an indication that the dust control measures are not effective. The performance indicators shall be evaluated under three heads as;

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution.
- Environmental and social management indicators to determine compliance with the suggested environmental and social management measures. Social monitoring indicators will be indicated as part of the Resettlement Action plan (RAP)/Indigenous People Development Plan (IPDP).
- Operational performance indicators have also been devised to determine efficacy and utility of the proposed mitigation measures.

The performance indicators and monitoring plans prepared for the road stretch are given in **Annexure 8.1**. Details of the performance indicative parameters for each of the component will have to be identified and reported during all stages of the implementation.

8.4 MONITORING PLAN FOR ENVIRONMENTAL CONDITIONS

Environmental monitoring involves regular checking of the environmental management issues detailed in the ESMP and to ascertain whether the mitigation measures are achieving their objectives, according to the ESMP, with the progress of the works. It provides the necessary feedback for Project management to keep the programme on schedule.

For each environmental condition, the Monitoring Plan specifies the parameters to be monitored, the locations of monitoring sites, and the frequency and duration of monitoring. It also outlines the applicable standards, as well as the responsibilities for implementation and supervision. The Monitoring Plan, along with details of monitoring locations for environmental condition indicators during the construction and operation stages of the project, is presented in Table 8.1.

The monitoring will be carried out by Contractor through the NABL accredited agency and will be supervised by the Environment Specialists of the CSC/PMC and E&S cell MPWD.

8.5 MONITORING PLAN FOR SOCIAL CONDITIONS

The social monitoring plan is designed to track and evaluate the effectiveness of social safeguard measures implemented under the Environmental and Social Impact Assessment (ESIA). It ensures compliance with national and international social safeguard frameworks, including the Resettlement Action Plan (RAP) and the Indigenous Peoples Development Plan (IPDP). The monitoring plan for social condition indicators of the sub-project during the construction stage is presented in Table 8.2.

Table 8.2: Environmental Monitoring Plan for Environmental condition indicators (Air, Water, Noise and Soil)

Environmental Attribute	Timing	Parameter	Standards	Frequency	Duration	Location	Total no. of Samples during construction and operation stage.	Implementation
Air	Construction	CO, NOx, PM10, PM2.5 and SO2	CPCB Guidelines (NAAQMS/ Volume- I/2013-14)	3 locations for 3 Seasons* for 2 consecutive years	24 hours sampling	3 locations (Construction Plant Sites, settlements and Work Zones)	18	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			3 locations for 3 Seasons for 1 Year		At 3 locations during operation stage where monitoring had been done during construction stage	9	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
Water	Construction	As per Drinking Water Standards	Indian standards for inland surface waters (IS:2296,1982) and for drinking water (IS:10500-2012)	(Surface water at 2 locations for 3 Seasons for 2 consecutive years. ground water at 2 locations for 3 seasons for 2 consecutive years	As per Grab Sampling guidelines	Drinking water samples from the labour camps and from hand pumps. Surface water from the water courses near the work site and River.	24	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			Surface water 2		At 4 locations	12	Contractor through

Environmental Attribute	Timing	Parameter	Standards	Frequency	Duration	Location	Total no. of Samples during construction and operation stage.	Implementation
				locations for 3 Seasons for 1 years. Water (Ground water) at 2 locations for 3 Seasons for 1 years.		during operation stage where monitoring had been done during construction stage		NABL accredited Laboratory and supervised by Construction Supervision Consultant
Noise	Construction	Noise Levels on dB (A) scale	Noise rules 2000 by CPCB	3 locations for 3 Seasons for 2 consecutive years.	Leq in dB(A) of daytime and night-time	Near the working zones, sensitive receptors and construction plant sites.	18	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			3 locations for 3 Seasons for 1year.		At 03 locations during operation stage where monitoring had been done during construction stage	9	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
Soil	Construction	Monitoring of Pb, SAR and Oil and Grease	(IS): 2720 for 'Method of Test for Soils'	2 locations for 3 Seasons for 2 consecutive years.	Grab Sampling	Soil at 2 location 3 times a year for 24 Months At 2 locations	12	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			2 locations for 3 Seasons for 1Year			6	Contractor through NABL accredited

Environmental Attribute	Timing	Parameter	Standards	Frequency	Duration	Location	Total no. of Samples during construction and operation stage.	Implementation
						During operation stage where monitoring had been done during construction stage		Laboratory and supervised by Construction Supervision Consultant

*Except Monsoon

Social Monitoring will be done during Construction stage of the proposed Project as per the details provided in Table 8.2.

Table 8.3: Social Monitoring Plan

Indicator Category	Responsibility	Performance Indicators	Data Collection Method	Frequency
Resettlement & Livelihood Restoration	RAP Implementation consultant/ MPWD	• % of affected households receiving compensation & assistance; livelihood restoration progress	Household surveys, payment records, RAP monitoring reports	Quarterly
		• RAP implementation completion certification for civil-works stretches; livelihood restoration status of vulnerable households • Number of PAPs surveyed and compensated (by category). • Compensation disbursed and structures restored. • Households relocated prior to construction. • Livelihood program enrollment. • GRM usage and resolution rate. • Timeliness of compensation relative to displacement.		
Labour & Working Conditions	Contractor/ CSC/ MPWD	• Compliance with fair and equal wages, working hours, safety, Working conditions & worker rights: • Non-payment, delayed or unequal wages; denial of benefits (overtime, leave, maternity, bonus); • discrimination in hiring/promotion/termination; unclear employment terms; restrictions on organizing; absence of grievance mechanism.	Labour camp inspections, interviews	Monthly
		• % of local workforce employed in project • Worker GRM functioning	Contractor reports	Quarterly

		and resolution status; labour camp inspection compliance; OHS training coverage (%)		
Community Health & Safety	Contractor / CSC / MPWD	• Number of accidents/incidents affecting communities; traffic safety compliance; public safety measures at worksites; access-continuity complaints recorded/resolved; safety compliance near settlements/schools	Beneficiary tracking	Quarterly
Social Inclusion & Gender Stakeholder Engagement & Grievance Redressal	RAP Implementation consultant/ Contractor/ MPWD RAP Implementation consultant/ Contractor/ CSC/MPWD	• Participation of women in consultations and % of women engaged in livelihood activities • SEA/SH awareness training coverage (% workers trained) • Percentage of women among total project workforce, disaggregated by skilled, semi-skilled, and unskilled categories. • Data of average daily wages paid to women and men for comparable work (wage parity index) • Number of days women are engaged compared to men in similar roles. • Growth in women's income due to project participation. • Reduction in women's migration days (if they previously migrated for work). • Number of women gaining new market-oriented and employable skills. • Number of women accessing government schemes, agricultural interventions, or entitlements. • Improvement in women's asset ownership (productive and household assets).	Beneficiary tracking, Consultation records	Bi-annually

		• Percentage of women trained under the project, disaggregated by road safety training, livelihood enhancement training, and project-related technical or non-technical skills. • Percentage of women participants in stakeholder consultations, including consultations with Indigenous Peoples and FPIC processes where applicable under ESS7. • Percentage of women beneficiaries reporting improved mobility, perceived safety, and access to essential services, measured through periodic beneficiary feedback surveys. • Number and percentage of GBV/SEA/SH-related grievances received, resolved, and resolved within the stipulated timeframe, disaggregated by complainant gender and grievance type. • Increase in women's participation and leadership in local institutions and decision-making processes (membership, management roles, committees, etc.). • Improvement in women's representation in consultations and project-related decision forums.		
		• No. of community consultations held	GRM logs	Quarterly
Indigenous Peoples & Cultural Heritage Indigenous Peoples &	RP Implementation consultant/ Contractor/ MPWD	• % of grievances resolved within timeline; average grievance resolution time	Meeting records, video/audio	Ongoing

Cultural Heritage	RP Implementation consultant/ Contractor/ MPWD		evidence	
		• Summary of affected IPs by impact type, gender, age, village, income, status, and household vulnerability including female-headed households. • Documentation of consultations with Indigenous communities and traditional institutions, FPIC meetings & community agreements • Number of meaningful consultations with IP, trainings, and IEC materials (e.g., brochures, flyers) disseminated. • % of IP women participants; vulnerable IPs attending • Documentation of negotiation process, participants, locations, and correspondence. • Evidence of broad support from community records of process, participants, and agreements. • Whether consultations were inclusive, gender-sensitive, free from coercion, and respectful of IP customs and languages.	Site inspections, community feedback	Annually
Supply Chain/ Contractor Compliance	Contractor/ PMC/ CSC/ MPWD	• Confirmation of no child labour or forced labour in supply chain; contractor ESMP compliance reporting	Contractor audits, compliance reports	Annually
SEA/SH Risk Management	Contractor / PMC/ CSC / MPWD	• SEA/SH Code of Conduct compliance; SEA/SH complaints recorded and referred through survivor-centred GRM; SEA/SH awareness sessions conducted • Risks of SEA/SH to community members, particularly women and children by contractors'	Training records, GRM records, supervision reports	Quarterly

		workers during construction period; • Risks of workplace SH at all establishments by co-workers under the project		

8.6 REPORTING SYSTEM

Effective monitoring and supervision would require regular reporting of the implementation of the E&S Management measures by the contractor. The E&S Non-conformance / non-performance needs to be flagged and followed up on regularly so that performance improves. Repeated non-conformance / non-performance needs to be brought to the notice of decision makers for contractual action and management decision. These aspects will be monitored and reported through the Concurrent Monitoring and Reporting.

The more strategic aspects of E&S Performance Monitoring, Gap Analysis, and documentation of good and bad practices, which would guide the management to have a review and provide direction, will be done through the Periodic Monitoring. The Mid-Term and End-Term audits will be carried out through specialized Third-Party Agencies to be hired under the project. The findings and recommendations of these studies, along with the analysis of the concurrent monitoring, will be used by the Officers of the E&S Cell to brief the Management during the review. Details are given in section 9.1 of Chapter 9 of ESMF

8.7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN BUDGET

An amount of Rs. **1,49,42,296** have been marked for ESMP budget. The detailed budget for the same have been presented in Table 8.4.

Table 8.4: ESMP Budget

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
A.	**Monitoring Measures**						
1	Air quality monitoring	Construction	No.	18	9,000	1,62,000	Civil works contract
		Operation	No.	9	9,000	81,000	Civil works contract
2	Noise levels monitoring	Construction	No.	24	7,000	1,68,000	Civil works contract
		Operation	No.	6	7,000	42,000	Civil works contract
3	Soil quality monitoring	Construction	No.	18	3,000	54,000	Civil works contract
		Operation	No.	9	3,000	27,000	Civil works contract
4	Ground and Surface Water	Construction	No.	12	6,000	72,000	Civil works contract
		Operation	No.	6	6,000	36,000	Civil works contract
	Subtotal (A)					**6,42,000**	
B.	**Capacity Building**						
1	EMSP implementation (1 days)	On Award of Contract	lump sum			Included in project	PIU Cost

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
						safeguards capacity building	
2	Plans and Protocols Orientation (1 day)	At Beginning of Construction	lump sum			Included	PIU Cost
3	Experiences and best practices sharing	Once every Year for 2nd yr, 3rd yr , 4th yr , 5th yr	lump sum			Included	PIU Cost
4	Contractors Orientation to Workers on ESMP implementation and refresher program	Once every year or as directed by the PIU	Lump sum			Included	Civil works contract
5	Water Sprinkling Measures for Dust Suppression	Construction	Trips	No of trips to be decided by the Contractor (work areas and haul roads to be sprinkled as two times every day or as directed by the Engineer)	-	0	Civil works contract
6	Silt Fence along Water Bodies	Construction	Rm	2000	331	---------	Civil works contract
7	Installation of AI-based camera systems (as per RDSO specifications, RDSO/SPN/TC/65/2021) along	Construction	Lumpsum	-	-	20,00,000	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	identified elephant movement zones to continuously monitor and detect elephant presence. These cameras, equipped with thermal and optical sensors and AI-based analytics						
	Subtotal (B)					----------	**Civil works contract**
C.	**Construction Contractor ESMP Implementation**						
1	Providing, fixing, maintaining, shifting & refixing, barricading of minimum 2.0 mtr height at stipulated active site of the same project site, made with angle iron frame of 50x50x5mm and GI sheet of 0.63mm thick including primer painted initially, painting, lettering & border with reflective paint at the time of every shifting, traffic diversion arrangement, safety guard, suitable lightning arrangement during night, complete in all respect till completion of the project as per technical specification and direction of Engineer-In-charge and same shall be possessed by the contractor after	Construction	to be provided at each of the active sites by the Contractor (i.e. till the completion for the works)	To be decided by the contractor as per his schedule of works	-	0	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	completion of the Project						
2	Supplying and fixing of cautionary and or information signs boards including the cost of posts, fixtures, fixing, foundation, fitting and fixing. Sheeting will be made of encapsulated lens type of retro-reflective type and message / borders will be screen printed complete as per screen specification in IRC SP 55: 2001. To be made available at all time at the work sites as required and directed by the engineer	Construction	Numbers	To be decided by the contractor as per his schedule of works (every worksite to have cautionary boards as described by the Engineer)	-	0	Civil works contract
3	Supplying and fixing of flashing beacon warning lights including the cost of posts, fixtures, fixing, foundation, fitting and fixing, cost of material, labour, loading, unloading, lead, lift, shifting, transportation etc. and as per specification in IRC SP 55: 2001	Construction	Numbers	To be decided by the contractor as per his schedule of works (every worksite to have flashing beacons to warn the approaching train as directed by the Engineer)	-	0	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
4	Provision and maintenance of Bio toilets with 1 male and 1 female units including cost of material, labour, loading, unloading, lead, lift, transportation, shifting etc. And shall be made available at worksite at the direction of the PIU. The facility shall complete with water arrangement, privacy, lighting arrangement. The WC and /urinals should be made of stainless Steel and the partitions should be made of aluminums framework with FRP panels. The bio-digester tank should be approved by Defence Research & Development Organization (DRDO) or any other competent agency. The whole toilet shall be mounted on MS framework with skids; Overhead water tank shall be made of HDPE with proper arrangement of ball cock and mosquito proof cover. These should also be provided with two dustbins for wet and dry waste. The bio-digester toilets shall be mounted on skids and shall not require any creation of permanent structure so that they can be shifted	Construction	Numbers			----------	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	from one worksite to another						
5	Provision of Helmets (IS CODE 2925 : 1984) , Safety Shoes (IS CODE 5852 : 1996), Googles (•IS CODE 5983 : 1980), Reflective Jackets, mitten/ gloves (IS 2573) , safety nose masks to all personnel (including temporary labour) involved in the worksites	Construction	Lumpsum			----------	Civil works contract
6	Provision of First Aid Kits for worksites	Construction	Nos	--	---	----------	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
7	Provision and maintenance of waste collection bins in sets of 2 (blue and green) for collection of municipal solid waste generated at the worksite including cost of material , labour, loading, unloading, lead, lift, shifting, transportation etc.	Construction	Nos	---	----	----------	Civil works contract
8	Environment, Health & Safety Engineer/Supervisor having Bachelors in Env Science / Management/ B.Tech (Env Engg.) Diploma in Central Labour Institute / Regional Labour Institute (Mandatory)	Construction	Nos	---	---	----------	Civil works contract
9	Tree Plantation (Afforestation) (1:10 ratio)	Construction	Nr.	400	2020	8,08,000	Civil works contract
10	Three tier plantatation for Elephant Corridor	Construction				-------	Civil works contract
11	Worker Code of Conduct orientation, labour awareness sessions, and OHS refresher training	Construction	Lumpsum	-		Included in the Contract	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	Sub Total (C)					**8,08,000**	**Civil works contract**
D	**Social Safeguards Implementation (Framework Instruments)**						
1	Stakeholder engagement, consultations, disclosure, and GRM implementation (SEP)	Construction & Operation	-	-		5,00,000	As per SEP
2	Indigenous people development plan (IPDP)	Construction & Operation	-	-		94,53,000	As per IPDP of the Sub Project
3	Resettlement action Plan (RAP)	Construction	-	-		35,39,296	As per RAP of the Sub project
4	Safeguards capacity building and training (ESMF)	Construction	-	-	-	As per ESMF	Project
5	Labour Management Plan Budget	Construction				As Per LMP	Project
	Sub Total (D)					**1,34,92,296**	
E	**PIU ESMP Implementation cost**						
	Environmental Expert at PIU	Construction and Operation	Salary	0	-	0	PIU Cost
	Social cum Tribal Development Expert at PIU	Construction and Operation	Salary	0	-	0	PIU Cost

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	Labour / OHS Expert at PIU	Construction and Operation	Salary	0	-	0	PIU Cost
	Gender Expert at PIU	Construction and Operation	Salary	0	-	0	PIU Cost
	Biodivesity Expert at PIU	Construction and Operation	Salary	0	-	0	PIU Cost
	ESMP Supervision Cost	Construction and Operation	per month	0	-	0	PIU Cost
	Equipment	Construction and Operation	(Noise Meter 1 nos, Cameras 1 nos)	lumpsum		0	PIU Cost
	Sub Total (E)					**0**	
	Grand Total (A+B+C+D+E)					**1,49,42,296**	

8.7 INSTITUTIONAL FRAMEWORK OF THE PROJECT

The Meghalaya Infrastructure Development and Finance Corporation (MIDFC) acts as the nodal agency for planning, financing, and coordinating major infrastructure projects, with the PMU providing overall strategic and policy oversight. The Project Implementation Unit (PIU) under PWD executes road and connectivity works, ensuring technical quality, environmental and social safeguards, and coordination with local institutions. An E&S Cell within PIU manages safeguards, including tribal land rights, biodiversity, and community engagement, supported by specialized experts. Project Management Consultants (PMC) provide technical, managerial, and E&S support, while Construction Supervision Consultants (CSC) ensure on-site compliance with quality, safety, and safeguard standards. Divisions of PWD supervise field-level execution, facilitate grievance redressal, and monitor ESMP implementation. This structure aligns with Meghalaya's institutional framework and Sixth Schedule provisions to integrate sustainability and positive social-environmental outcomes. Details are provided in chapter 7 of ESMF.

9. GRIEVANCE REDRESSAL MECHANISM

9.1 INTRODUCTION

An effective grievance redressal mechanism fosters good governance, accountability, and transparency in addressing project-related environmental and social concerns. An integrated system, featuring Grievance Redressal Cells (GRCs), will be established at the MIDFC Project Management Unit (PMU), supported by designated officers and dedicated procedures. Grievances may be lodged in person, in writing, via email, or by telephone, with overall coordination managed by the PMU's Social and Environmental Expert. The mechanism will become operational from the commencement of R&RAP and construction activities, adopting a two-tier structure at the site and state (PMU) levels, and incorporating regular platforms and meetings to facilitate timely and amicable resolution.

The project follows a two-tiered Grievance Redress Mechanism (GRM). Tier I operate at the project/site level, chaired by the Village Head with PWD, CSC, and contractor representatives, aiming to resolve grievances within 15 days. Tier II functions at the State/PMU level, chaired by the Secretary of Planning, addressing unresolved or escalated grievances within 15 days. Complaints can be submitted via toll-free helplines, WhatsApp, email, in-person at DPIU/PMU offices, project sites, grievance boxes, or social media. All complaints are logged, categorized, acknowledged within 2 days, investigated, and actions taken by the respective GRCs. Feedback is collected post-resolution, and reparations, if applicable, are documented. Training on grievance handling, stakeholder engagement, and gender sensitivity is conducted every six months. Complainants can escalate to Tier II or pursue legal remedies at any stage. A confidential and survivor-centred grievance channel for Sexual Exploitation, Abuse, and Harassment (SEA/SH) complaints will be established as part of the GRM, ensuring safe reporting, referral to appropriate support services, and handling by trained personnel in accordance with the SEA/SH Prevention and Response Action Plan. Details are provided in Chapter 7 of ESMF. The grievance mechanism for workers will be setup by the contractors prior to convening of civil works. The grievance mechanism process has been described in detail in the Labor Management Procedures.

10. CONCLUSION AND RECOMMENDATIONS

10.1 CONCLUSION

An Environmental and Social Impact Assessment Study was conducted to assess the potential environmental and social impacts of the project. Primary information about the project influence area was gathered using an Environmental and Social Screening Checklist to evaluate the extent of environmental and social impacts resulting from project interventions. Environmental and social baseline data were collected from secondary sources to depict the existing conditions of the project area accurately. This information serves as a foundation for assessing potential environmental and social impacts, as well as enhancing the accuracy of impact predictions. Additionally, public consultations and FPIC were held with stakeholders to incorporate their inputs and concerns. The key findings of the ESIA are summarized as follows:

- Proposed project will ease the traffic flow and create safe and smooth mobility to motor vehicles as well as pedestrians. The proposed road improvement can reduce travel time from the farthest section of the road to the nearby market from one hour to just 30 minutes. The project is imperative for encouraging more trade and commercial activity (including public transport) in the district of North Garo Hills.
- The environmental and the social impact assessment have been conducted in accordance with World Bank ESF and National & State regulations. All the potential impacts were identified in relation to pre-construction, construction, and operation phases.
- The proposed project alignment does not pass through any Wildlife Sanctuary/National Park/Biosphere Reserve/Tiger Reserve. However, two non-notified elephant crossings are present at Chainage 17+062 and at 17+600.
- No ASI Protected monuments found within 0.5 km from the project site.
- Approximately 70 nos. of trees are located within the existing Right of Way (RoW) along both sides of the road. To mitigate the ecological impact of tree felling, compensatory plantation at 1:10 ratio for each tree cut should be undertaken in line with applicable environmental regulations and guidelines.
- The project requires approximately 0.133 ha of additional land and is expected to affect about 156 Project Affected Households (PAHs), primarily through partial impacts on structures located within the existing Right of Way and additional land required for improvement of Road. These impacts will be addressed through compensation and assistance measures outlined in the Resettlement Action Plan (RAP).
- The project road is expected to have some environmental and social impacts due to construction activities along the corridor, its proximity to culturally important sites such as community center, church, school, etc. and potential effects on Project-Affected Persons (PAPs) arising from access-related issues.
- Stakeholder Consultations were conducted to assess the perception of the people about the proposed project. The outcome of the consultations suggested that people are in general with the project because it will improve the present road conditions and connectivity. However, they also raised the requirement for the road safety measures; road furniture's (including streetlights, signage's, speed breaker etc.) and proper compensation for the loss of their assets.
- Occupational health and safety measures for both workers and the local community shall be ensured through the preparation and implementation of a comprehensive Labour Management Plan (LMP), in compliance with the World Bank's Environmental and Social Standard ESS2 on Labor and Working Conditions

- The mitigations will be further assured by a program of environmental and social monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environmental and social conditions has stipulated or protected. This will include observations on- and off- site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported by the contractor to the MPWD.
- The ESMP shall be included in the bidding document along with appropriate contractual clauses for safeguarding the environment and social impacts during the project construction and operation (maintenance period).
- An overall project level and also construction stage level Grievance Redress Mechanism (GRM) will be formed to receive, feedback, suggestions and complaints, if any, from affected parties and addressing them during the construction stage and operation stage.
- The prepared ESMP will assist the Contractor and MPWD in mitigating the Environmental and Social impacts and guide them in the environmentally sound execution of the proposed project.

A copy of the updated ESMP shall be always kept on-site during the construction period. As per the World Bank policy requirements, the prepared safeguard documents shall be disclosed in the World Bank website.

During the field survey, as well as consultations with the Detailed Project Report (DPR) team and the Public Works Department (PWD), several key issues were identified. For each observation, appropriate mitigation measures have been proposed to minimize adverse impacts and ensure smooth project implementation.

The ESIA Consultant's field observations along the RBB road corridor have been effectively integrated into the DPR through chainage-specific design interventions, ensuring a balanced approach towards engineering adequacy, environmental safeguards, and community safety.

Key concerns related to waterlogging and submergence identified at Km 0+600 and Km 1+200–1+310 have been addressed through raising of formation levels and provision of new cross-drainage structures, ensuring improved resilience during heavy rainfall events. In settlement stretches such as Km 0+000–0+250 (Kosi Bazaar) and Km 1+280–1+660 (Omon Bazaar), the DPR incorporates footpath-cum-drains, directly responding to ESIA recommendations for pedestrian safety and drainage.

Site-specific protection needs highlighted by the ESIA, particularly in agricultural and vulnerable zones, have been addressed through toe walls (Km 0+610–0+670) and gabion/protection works (Km 3+990–4+090, Km 5+400–7+600, Km 12+430–12+490), ensuring slope stability and protection of adjoining land uses. Recommendations near sensitive receptors such as schools at Km 3+500 have been incorporated through zebra crossings and traffic calming measures.

While certain locations (e.g., Km 1+800 and Km 2+900–3+200) were assessed and structural interventions like retaining walls were found technically unnecessary, the DPR justifies these decisions based on detailed design analysis, reflecting an optimized and need-based approach.

Importantly, in the ecologically sensitive elephant corridor (Km 17+020–17+600), ESIA recommendations have been adopted through a minimal intervention strategy, retaining the existing road condition and integrating wildlife-friendly measures such as speed restrictions, rumble strips, signage, and AI-based monitoring systems, ensuring safe wildlife movement and reduced human–elephant conflict.

Overall, the DPR demonstrates strong alignment with ESIA observations, translating field-level concerns into practical, sustainable, and approval-ready design solutions, thereby ensuring environmental compliance, enhanced road safety, and long-term infrastructure resilience.

10.2 RECOMMENDATIONS

- The Contractor shall prepare a site-specific contractor's Environmental and Social Management Plan called as C-ESMP based on final design and identifications of locations of construction camps, quarries and borrow areas etc. within one month from the date of entering into the contract.
- MPWD shall conduct regular stakeholder consultations including local residents, village councils, and public representatives, and maintain records of each consultation and meeting. These consultations are to be carried out during the pre-construction and construction phases to ensure stakeholder concerns are addressed and documented.
- MPWD shall organize training for the capacity development of concerned staff of ESMU/PMC and district level MPWD engineers on ESHS policies, regulations, implementation, monitoring and reporting about the ESMP implementation before construction activities.
- Contractors will engage qualified and experienced ES&HS Staff for ESMP implementation as well as to ensure imparting induction, work-specific and other required trainings to the workers;
- MPWD shall ensure implementation of the Resettlement Action Plan (RAP) and provide compensation and assistance to Project Affected Households (PAHs) in accordance with RAP provisions.
- Contractor/ MPWD to ensure the compliance of applicable laws at state/national level and relevant policies and best practices.
- The shifting of public utilities will be planned in coordinated in advance to maintain supply of electricity and telephone services to people without or minimum disruptions, with prior intimation through Media, newspaper and other mode of communication.
- MPWD to monitor the ESMP implementation, RAP implementation and redress of grievances on a regular basis
- The contractor to ensure safe access and mobility for vulnerable people such as elderly persons, children, and people with disabilities during the construction stage.
- The project shall implement the Labour Management Procedure (LMP) and Occupational Health and Safety (OHS) Plan to ensure safe working conditions.
- The SEA/SH Prevention and Response Action Plan shall be implemented during construction, including worker training, code of conduct enforcement, and survivor-sensitive grievance handling.
- The Grievance Redress Mechanism (GRM) shall remain functional throughout construction and operation phases.