DRAFT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Upgradation of Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road (0- 58+100 Km) for Meghalaya Logistics and Connectivity Improvement Project (MLCIP),

funded by the World Bank

Submitted To

Meghalaya Infrastructure Development & Finance Corporation Ltd

Meghalaya Infrastructure Development Finance Corporation (MIDFC) Ltd.

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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

List of Abbreviations

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
DSSPS	:	Dkhiah - Sutnga - Saipung - Pala upto Semmasi
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
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
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
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
NABET	:	National Accreditation Board for Education and Training
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
OHS	:	Occupational Health and Safety
OIP	:	Other Interested Parties
PAP	:	Project Affected Person
PBR	:	People's Biodiversity Register
PESO	:	Petroleum and Explosives Safety Organization

PIA	:	Project Influence Area
PM	:	Particulate Matter
POSH	:	Prevention of Sexual Harassment
PPE	:	Personal Protective Equipment
PROW	:	Proposed Right of Way
PUC	:	Pollution Under Control
PWD	:	Public Works Department
R&R	:	Resettlement and Rehabilitation
RAP	:	Resettlement Action Plan
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
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

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.

MLCIP includes 10 Roads and 5 Bridges totaling to approximately 300 km respectively. The proposed DSSPS sub project road has a total length of 58+100 km, starting from Dkhiah at chainage 0+000 and extending up to Semmasi at chainage 58+100, where the project road concludes.

The sub-project involves reconstruction and upgradation of the existing pavement from a single-lane carriageway to an intermediate lane, incorporating climate-resilient design measures suited to the high rainfall conditions of Meghalaya. Based on FPIC consultations, several location-specific interventions have been integrated into the DPR to address community concerns and site vulnerabilities. These include erosion protection through toe walls at identified chainages (e.g., Ch 31.755 – Ch32.040, Ch 43.595 - Ch 43.895). Retaining and protection walls have been proposed at multiple locations to safeguard houses and infrastructure, while slope stabilization measures are included to mitigate risks. Community infrastructure demands have been addressed through provision of Bus waiting Sheds, toilets and Street Lights are proposed. To improve safety and riding comfort, geometric improvements such as slope flattening and shoulder strengthening have been proposed

E.2 PROJECT DESCRIPTION AND NEED

The existing project road has a right of way ranging from 10m to 12m. However, a 14m row has been proposed in locations where cutting and slope stability measures are required. 1.902 ha additional land will be acquired for the proposed road project, and for spoil disposal, 2.64 ha of land is required temporarily. 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 East Jaintia Hills, with no critical habitats significantly impacted by the project. The area also falls under a high seismic zone (Zone VI), 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 Rangbah Shnong managing land and resources. Livelihoods are mainly dependent on agriculture, small businesses, and daily wage activities. The project affects a number of households (37 PAHs), with 138 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. Community infrastructure proposed under FPIC will also be accommodated within the existing RoW.

The project will temporarily require 2.64 Ha of land for spoil disposal, identified across 3 locations in consultation with PWD officials and local communities, including the Rangbah Shnong. These sites will be taken on lease and will be restored and returned to landowners after construction. In total, 37 PAHs comprising 138 PAPs will be affected, with impacts being largely minor, partial, and localized. A significant portion includes 37 households (138 PAPs), 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, which will be mitigated through appropriate planning and community engagement.

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

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

An amount of Rs. **4,40,34,682** have been marked for ESMP budget.

E.9 STACKHOLDER CONSULTATIONS

During the ESIA, consultations were carried out with representatives from all three stakeholder categories, including government agencies, communities, and other organizations, with particular attention to vulnerable groups. Special focus was given to communities located in sub-project areas likely to experience significant impacts, such as effects on residential and commercial structures or on common property resources. Key common property resources identified include religious structures, public utilities, and other community assets critical to local livelihoods and cultural heritage.

Representatives from relevant stakeholders were consulted to incorporate their concerns and expertise, ensuring that the project aligns with broader developmental, economic, and environmental objectives. Key discussions focused on potential displacement, loss of livelihoods, environmental degradation, law and order issues, irrigation impacts, structural matters such as cross-drainage structures, and corresponding mitigation measures. These consultations helped document and integrate the priorities and concerns of affected communities, providing valuable input to shape strategies for minimizing adverse impacts.

Through public consultations, stakeholders' viewpoints and suggestions were captured and considered as inputs to the technical design. All suggestions were incorporated into the project design to the extent feasible and warranted.

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

Disclosed Stakeholder Engagement Plan link on MPWD website is https://megpwd.gov.in/pdf/2026/ESMF/Stakeholder%20Engagement%20Plan%20MLCIP.pdf.

E.10 CONCLUSION

The proposed upgradation of the DSSPS road is a strategically important infrastructure intervention that will significantly enhance regional connectivity, accessibility, and socio-economic development in East Jaintia Hills. The ESIA indicates that while the project traverses environmentally sensitive areas, 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, 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. A total of 37 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.

MLCIP includes Roads and Bridges totaling to approximately 300 km. The proposed DSSPS sub project road has a total length of 58+100 km, starting from Dkhiah at chainage 0+000 and extending up to Semmasi at chainage 58+100, where the project road concludes.

The sub-project involves reconstruction and upgradation of the existing pavement from a single-lane carriageway to an intermediate lane, incorporating climate-resilient design measures suited to the high rainfall conditions of Meghalaya. Based on FPIC consultations, several location-specific interventions have been integrated into the DPR to address community concerns and site vulnerabilities. These include erosion protection through toe walls at identified chainages (e.g., Ch 31.755 – Ch32.040, Ch 43.595 - Ch 43.895). Retaining and protection walls have been proposed at multiple locations to safeguard houses and infrastructure, while slope stabilization measures are included to mitigate risks. Community infrastructure demands have been addressed through provision of Bus waiting Sheds, toilets and Street Lights are proposed. To improve safety and riding comfort, geometric improvements such as slope flattening and shoulder strengthening have been proposed.

1.2 Scope for conducting the ESIA Study

As per the screening study, the sub-project road has been classified as “High Risk”, as it involves substantial cutting and filling operations and associated debris disposal, the presence of cultural resources (monoliths) along the alignment, location at elevations exceeding 1,000 m above mean sea level (AMSL). In addition, the project affects approximately 37 Project Affected Households (PAH), leading to livelihood concerns.1. Based on this assessment, the scope of the ESIA study was defined, and the following activities were undertaken for the detailed assessment.

Literature review and data compilation

- Baseline environmental and social assessment
- Identification of potential impacts
- Stakeholder identification and consultation
- Preliminary climate and cumulative impact assessment
- Environmental and Social Management Plan (ESMP) preparation
- Monitoring framework

1.3 Approach & Methodology

The approach and methodology included impact identification through surveys, baseline data collection, impact assessment, and mitigation planning. The following table summarizes the approach adopted for undertaking the ESIA study.

[1] The project has obtained a total score of 31 out of 32, corresponding to 96.8%. As per the screening matrix classification, the sub-project falls under the High Risk Category. The social risk is categorized as High risk since there will be impact on 37 nos. of PAH and involved additional land requirement of 1.902 ha.

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.
2.	Public Consultation for Scoping Report	Identified key issues to understand stakeholder concerns and inform about sub-project design and build awareness on the project including the Free, Prior, and Informed Consent (FPIC) process. This involved engaging with affected Indigenous communities through meaningful consultations in a transparent and participatory manner in order to make them aware of the project activities.. An attendance sheet was maintained to record the presence of villagers who participated in the consultation meeting including geo tagged photographs as evidence of the same. These were the first rounds of consultations for FPIC.
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. The Forest Department, GoM, provided the maps demarcating the legally protected forest including "community forest". 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 DSSPS 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) 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 attached in IPDP.
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, 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, IDPD) 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.

Sl. No.	Stages	Activities Done
8.	Final ESIA Report	The draft ESIA report and mitigation plans (ESMPs, RAP, and 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 1.1: Source and methodology for primary and secondary data collection

Parameters	Source
	Environment
Air	**Primary survey** Primary monitoring **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 **Secondary Source** 1. District Survey Report, East Jaintia Hills District, 2019 (https://eastjaintiahills.gov.in/) 2. CGWB Data 2024 (https:// www.cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Meghalaya/East%20jaintia%20hills%20_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/2017/20170615051517683-1.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 3.Faunal assessment was conducted using Visual encounters, sign survey, line transect, and netting survey method 4.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. Disaster Management Plan 2024-2025, East Jaintia Hills District (https://eastjaintiahills.gov.in/document/disaster-management-plan-2024-2025/) 2. Meghalaya State Disaster Management Authority (MSDMA)(https://msdma.gov.in/ddmp/DDMP-Shillong.pdf)
Natural Environment	**Secondary Source** 1. Customized Rainfall Information System, Hydromet Division, IMD (https://hydro.imd.gov.in/) 2. District Census Handbook, East Jaintia Hills (https://www.census2011.co.in/) 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/2017/20170615051517683-1.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
Land, Livelihood and Common Property Resources	**Primary survey** 1.Census/Household Survey (PAH: 37) 2.Focus Group Discussions (3) 3.Key Informants Interviews (10) 4.Field Observations **Secondary Source** Census 2011 (https://www.census2011.co.in/)
	Other Socio-Economic Parameters
Ethnicity	**Primary survey** Consultation

	Secondary Source Census 2011 (https://www.census2011.co.in/)
Gender	**Primary survey** Focus Group Discussions (2) Interviews (2) **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 (Seng Samla Kynthei, Seng Longkmie) **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	SUB PROJECT ROAD DESCRIPTION
Chapter 4	ANALYSIS OF ALTERNATIVES
Chapter 5	BASELINE ENVIRONMENT
Chapter 6	ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS
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 define the scope of the environmental and social assessment for the proposed road improvement works, relevant laws, legislation, and policies at both national and state levels were reviewed. The findings are summarized in **Table 2.1**, which also includes a review of the legal and institutional framework applicable to indigenous and tribal communities as part of a 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 and DG set during construction stage	Consent to Establish before Construction and Consent to Operate (Before Operation) 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 labour camp	Consent to Establish before Construction and Consent to Operate (Before Operation) through Contractor	Meghalaya State Pollution Control Board (MSPCB)
5.	Noise Pollution	The ambient noise standards for day and	Noise emission from proposed activities	Regulatory clearance not	MSPCB

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	(Regulation and Control Act) 2000 and amendment till date	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	during construction stage like operation of DG sets, equipment and concrete mixers should be within applicable standards	required but noise monitoring results should be below applicable standard as per CPCB .	
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	Permission will be required by Contractor.	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	Permission will be required Contractor needs to submit plan for reuse or safe disposal	Village Council, Municipal Boards
9	Vehicle Act 1988 Central Motor Vehicle Rules	To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and	Transportation of manpower and material will involve vehicular movement. Vehicles must have valid Pollution Under Control (PUC)	PUC and fitness certificates, Insurance. Driving License, Fitness Certificate should be submitted to the PMU before	State Transport Authorities approved PUC certificate providers

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	1989	check vehicular air and noise pollution.	certificates, Insurance, Fitness Certificate. Driver should have valid Driving License.	the vehicle is mobilized in the project.	
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 (Development and Regulation) Act, 1957	For development and regulation of mines and minerals in a sustainable manner. The rules regulate the mining of mineral and dealerships for mining and trading.	The construction of works will require stones, aggregates, sand, earth, etc.	The mining permit, EC and CTO has to be submitted to the PMU for clearance .No material shall be procured without the approval .For material procured during the construction the e-transit pass would be submitted along with IUFR.	Mines and Mineral Department
12	Wildlife protection Act 1972, 2022	Protection of wildlife in the state of Meghalaya	Wildlife impact is not anticipated in this project.	No	State Forest Department
13	Meghalaya Tree (Preservation) Act, 1976, and	Conservation of forest and controlled felling of trees	Approx. 32 nos. of tree are falling within the ROW.	Permission for felling of trees. No tree felling shall be felled without permission from the	State Forest Department

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	the Meghalaya Tree Felling (Non-Forest Areas) Rules, 2006			Forest Department.	
14	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 VI 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
15	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	Meghalaya State Disaster Management Authority (MSDMA)/MPWD
16	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
17	E-Waste Management	Protection of environment against improper handling storage and disposal	E-waste generation from replacement of instrumentation. Safe disposal as per	No. Proper segregation and	MSPCB

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	Rules, 2016 and amended thereof	of hazardous waste.	Rules	handing over of e-waste to the MSPCB authorized agencies/Recyclers	
18	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 underground or 1,000 liters aboveground in drums/tanks) requires license/approval.	License for storage from PESO (Petroleum and Explosives Safety Organization); NOC from District Authority/Fire Department.	PESO, Nagpur (through Regional Office) & District Magistrate/Chief Controller of Explosives.
19	Ground Water Regulation (Central Ground Water Authority – CGWA Guidelines, 2017, adopted by States)	Governs the extraction of groundwater for industrial, infrastructure, or commercial use. Requires NOC/permission prior to abstraction.	Applicable (if groundwater extraction proposed) Groundwater extraction for construction, camp use, or dust suppression requires prior permission.	NOC for groundwater abstraction.	CGWA or State Ground Water Authority (if notified).
20	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.	Permission/Allocation order for surface water abstraction.	Water Resources/Irrigation Department, Government of Meghalaya.
SOCIAL REGULATIONS					
1	Article 244(2) & 275(1) of the Constitution of India - The Sixth	Article 244(2) establishes Autonomous District Councils (ADCs) in tribal areas, granting them legislative and administrative powers, empowering	Applicable in designated tribal areas under the Sixth Schedule	No	Government of India, Autonomous District Councils

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	Schedule	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			
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).	No	Revenue Department; Village Councils- Autonomous District Councils (ADCs)
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	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, Jaintia Hills Autonomous District Council The Sixth Schedule establishes the ADC or VC as institutional mechanisms for

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
		Castes and Scheduled Tribes.			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 with Disabilities	Ensures that the Persons with Disability (PWD) enjoy the right to equality, life with dignity, and respect for his or her	For the entire project road corridor where PWD are present and affected, and for designing the project in an inclusive	No	Department of Social Welfare, Government of

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	Act, 2016	own integrity equally with others.	manner.		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)
LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK					
1	Building and	It regulates the employment and	Applicable for all building or other	Establishment Registration	Labour Commissioner,

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	conditions of service of building and other construction workers and provides for their safety, health and welfare.	constructions works under the project that employs 10 or more workers.	is required	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,	It prohibits employment of children in specified hazardous occupations and processes and regulates the working	There should not be any child labour (less than 14 years) in any project activity and adolescents (above 14 and less than 18	No	Labour Commissioner, Meghalaya/ Department of Social Welfare, Government

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
	2016	conditions in others.	years) in any hazardous activity.		of Meghalaya
6	Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act)	It mandates every organization having more than ten employees to constitute an Internal Complaints Committee (ICC) in the prescribed manner to receive and address the complaints of any sort of sexual harassment from women in a time-bound and extremely confidential manner	Applicable to all implementing agencies	No	District Officer (District Magistrate or Additional District Magistrate) District Social Welfare Officer, Govt. of Meghalaya
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	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	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
	Meghalaya 1972	employer			
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
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

Sl. No.	Relevant Acts and Policies	Mandate of the Act/ Policy	Reason for applicability/ Non-applicability	Regulatory Clearance Requirement	Authority
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 Commissioner, 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 Commissioner, 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 Commissioner, 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 GoM.					

2.2 IRC & 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.**

2.3 Land Revenue Governance and Administration In JHADC

The Jaintia Hills Autonomous District Council (JHADC), constituted under the Sixth Schedule of the Constitution of India, is empowered under Paragraph 8 of the Sixth Schedule, to assess and collect land revenue and levy taxes within its jurisdiction. Under Paragraph 3 of the Sixth Schedule, the Council also holds legislative authority over specified matters, including land allotment and land use. The jurisdiction of JHADC encompasses the entire East Jaintia Hills District.

The sub-project falls in Jaintia Hills Autonomous District Council (JHADC).

The traditional land tenure management systems practiced by the Jaintia are summarized in **Table 2.2**.

Table 2.2: Traditional systems for Land Tenure Management amongst Jaintias

Category	***Jaintias***
Basis of classification	Purpose or ownership of land
Type of land	2 core types of use 5 sub-categories of ownership or use
Control and Management	Doloi[2] administer the private land, clan land, forests and sacred groves.
Inheritance	Women inherit and own property[3]: The largest share of the property, including the ancestral house of the female head, is inherited by daughters. Khatduh (youngest daughter). She also has the responsibility to take care of the house and the family.
Records	The British introduced land records and surveys so they issued land records of Hali lands (permanently cultivated terraced wet rice land). For remaining types of land, Pattas existed from British period which have got converted into and Land Holding Certificates after the formation of the Autonomous District Council
Systems for sale/purchase/ mortgage	For any selling of land, it is the family which decides together, and a majority vote of the siblings is taken into consideration. The rate for selling of the land is generally based on the location and the fertility of the land. These lands, however, can be sold to the tribals only and the *Rangbah Shnong* stands as a witness to the sale. This process of buying and selling of land undergoes a process which requires an official statement from the *Rangbah Shnong, Doloi* and the District Council.
Managing private property	The *kni* (maternal uncle) has the authority to manage the property. Few private properties are being managed by the family and the power of *kni* did not extend to those lands.
Managing community property	The *Durbar kur* or *Durbar raid* is in charge of making decisions for the clan or community lands. For village level decisions, *Durbar Shnong* take the charge for community land.

Source: mbma.org.in/project_doc/

[2] Doloi is the traditional customary chief and principal functionary, head of the elaka (largest political unit amongst the Jaintias)

[3] If there are no daughters in the family, sons inherit property from his mother. However, the priorities will again be given to his daughters to inherit his property.

3. SUB PROJECT DESCRIPTION

3.1 DSSPS Sub Project Road

The Dkhiah – Sutnga – Saipung – Pala up to Semmasi Road corridor in Meghalaya serves as an important intra-district connectivity route in the East Jaintia Hills District. This road primarily connects the rural and semi-urban settlements of Dkhiah, Sutnga, Saipung, and Pala, extending up to Semmasi, thereby facilitating movement across the southern parts of the district. The proposed DSSPS project road has a total length of 58+100 km, starting from Dkhiah at chainage 0+000 and extending up to Semmasi at chainage 58+100, where the project road concludes. The proposed road existed before the formation of Meghalaya State and ROW is limited only up to the existing Drain.

3.2 Location Details of the DSSPS Road

The project road traverses a diverse landscape, encompassing hilly terrains, agricultural fields, scrublands, and built-up areas, local markets while passing through fifteen villages along its alignment. This DSSPS road plays a vital role in enhancing regional connectivity by linking economic hubs and facilitating access to industrial centers as well as tourism destinations. **Table 3.1** presents the chainage-wise details of the corridor and the alignment of the road is shown in **Figure 3.1**.

Table 3.1: Chainage wise DSSPS Road stretches details

Sl. No.	Starting Chainage	End Chainage	Project	Project length
1	0+000	58+100	DSSPS road	58+100

Source: DPR

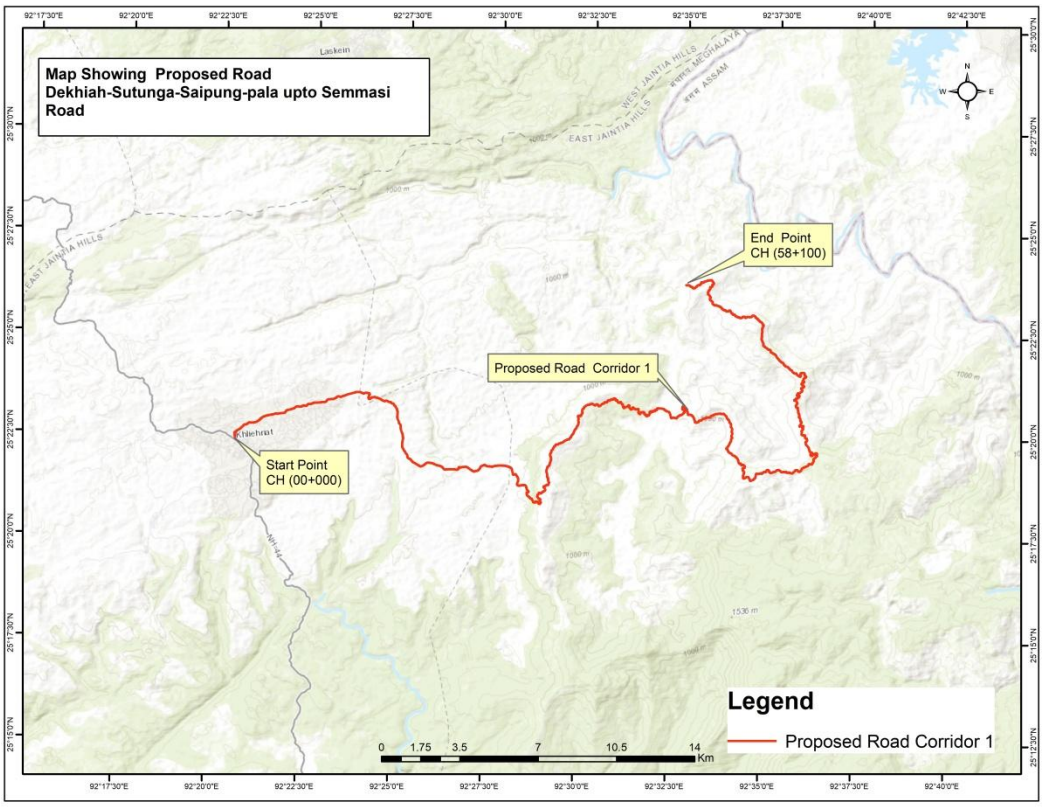


Figure 3.1: Road alignment map for DSSPS Road

3.3 Project Study Area (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 impactof the road stretch and to minimize potential environmental and social risks. Three tiers are given below

1. 10 m of ROW for Direct Impact (6m from Centre line) i.e. Corridor of Direct Impact (CoI)
2. 500 m buffer on either side of the RoW for indirect impact area[4] i.e. Corridor of Indirect Impact
3. 10 km of study area (Project Influence Area)

The existing Right of Way (10 m) 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. In stretches where the proposed RoW extends beyond the existing RoW to accommodate hill cutting or slope stabilization measures, the socio-economic assessment has been undertaken based on the actual proposed RoW.

The indirect impact area has been delineated as 0.5 km on either side of the proposed RoW from the Center 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 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.

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 DSSPS Road

The key existing conditions along the DSSPS project road, together with the proposed improvements, are outlined in the following sub-sections. These have been described based on findings from the primary field surveys as well as details provided in the Detailed Project Report (DPR).

3.4.1 Right of Way, Carriage Width, Pavement Conditions and Junctions

The existing Right of Way (RoW) for the project road is 10 m, while the existing road width varies between 3.75 m and 7.0 m. Details of the existing carriageway (CW) are summarized in **Table 3.2**. The pavement along the project stretch is bituminous, with its overall condition ranging from fair to poor, and most sections being in poor condition. Earthen shoulders of about 1.0 m width are provided on both sides; however, their condition has also been observed to be poor.

Table 3.2: Details of Existing Carriage way

S. No.	Chainage in Km		Length in km	Existing Carriageway width in (m)	Proposed Carriageway width in (m)
	From	To			
1	0.000	17.650	17.650	7.000	7
2	17.650	58+100	40.450	3.750	5.5
Total Length			**58+100**		

[4] 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.

Source: DPR

Pavement Details:

The existing pavement along the project stretch is bituminous. Its general condition ranges from fair to poor, with most sections observed to be in poor condition as per finding from the DPR and field observations. Earthen shoulders are provided on both sides, with a width of about 1.0 m; however, their condition is also assessed as poor.

For the MLCIP project, the pavement design adopts a multi-layered approach, utilizing materials of specified thicknesses to ensure durability and performance. The conventional pavement composition for 20 MSA, design traffic and 8% CBR is given in Table 3.3.

Table 3.3: Conventional Pavement Design

Chainage (km)	Design Traffic (msa)	CBR (%)	Bitumen Grade	BC (mm)	DBM (mm)	SAMI (mm)	CTB (mm)	CTSB (mm)	WMM (mm)	GSB (mm)	Total Thickness (mm)
0.00 – 17.62	20	8	VG 30	30	90	–	–	–	170	200*	490
17.62 – 30.100	20	8	VG 30	40	50	–	200	–	–	200	490
30.100 – 61.600	20	8	VG 30	30	50	–	150	200	–	–	430
61.600 – 63.203	20	8	VG 30	40	50	–	200	–	–	200	490

Junctions Details:

Along the project stretch, there are 3 major intersections and 26 minor intersections. The details of these junctions are provided in **Table 3.4**.

Table 3.4: List of Junctions Dkhiah - Sutnga - Saipung - Pala upto Semmasi section

S.No	Chainage	Side	Direction	Type of Junction
1.	0.000	Both	Shillong-Shilchar Road	**Major**
2.	0.600	RHS	Village Road	Minor
3.	1.070	RHS	Village Road	Minor
4.	5.360	RHS	Umlawang	Minor
5.	6.960	LHS	Sutnga Bypass	**Major**
6.	8.890	LHS	Village Road	Minor
7.	9.590	LHS	Football Ground	Minor
8.	10.370	LHS	BDO Office	Minor
9.	10.940	RHS	Lamyrsiang Road	Minor
10.	13.260	RHS	Tluh Village Road	Minor
11.	13.620	Both	Tluh Village Road	Minor
12.	13.700	RHS	Latyrke	Minor
13.	14.400	RHS	Village Road	Minor
14.	16.050	LHS	Lamyrsiang Road	Minor
15.	19.250	RHS	Tluh Road	Minor
16.	19.950	RHS	Village Road	Minor
17.	23.100	RHS	Shnongrim Village Road	Minor
18.	23.880	RHS	Shnongrim Village Road	Minor

Table 3.4: List of Junctions Dkhiah - Sutnga - Saipung - Pala upto Semmasi section				
S.No	**Chainage**	**Side**	**Direction**	**Type of Junction**
19.	24.610	LHS	Village Road	Minor
20.	25.250	LHS	Village Road	Minor
21.	30.200	LHS	Village Road	Minor
22.	42.440	RHS	Saipung Village Road	Minor
23.	42.960	RHS	Lura Village Road	**Major**
24.	51.480	LHS	Khahnar Village Road	Minor
25.	52.670	Both	Khahnar-Mynthning Road	Minor

Details of Breast wall: Details of breast wall is given in 3.5.

Table 3.5: Summary of Breast Walls

Sr. No.	Start Chainage	End Chainage	Length (m)	Side	Structure Height (m)	Cutting Height (m)
1	19285	19905	620	RHS	1.50	2.00 to 3.00
2	20395	20945	550	RHS	1.50	2.00 to 3.00
3	25330	25440	110	LHS	2.50	2.50 to 5.00
4	26370	26570	200	LHS	1.80	2.50 to 4.00
5	28490	28690	200	LHS	1.80	2.00 to 3.00
6	31050	31155	105	LHS	2.50	3.00 to 5.00
7	33225	33670	445	LHS	2.00	3.00 to 4.00
8	33830	34070	240	LHS	2.00	3.00 to 4.00
9	35275	35375	100	LHS	1.50	2.00 to 3.00
10	35580	35675	95	LHS	1.80	3.00 to 4.00
11	36080	36390	310	LHS	2.50	3.00 to 5.00
12	41680	41980	300	LHS	2.00	3.00 to 4.00
13	42985	43360	375	LHS	1.50	2.00 to 3.00
14	47190	47295	105	LHS	1.80	3.00 to 4.00
15	47650	48580	930	RHS	1.50	2.00 to 3.00
16	50990	51060	70	LHS	1.80	3.00 to 4.00

Details of toe walls is presented in Table 3.6.

Table 3.6: Summary of Toe Walls

Sr. No.	Start Chainage	End Chainage	Length (m)	Side	Height (m)
1	31755	32040	285	LHS	1.2
2	43595	43895	300	RHS	1.0
Total			**585**		

Summary of Retaining Wall is presented in Table 3.7.

Table 3.7: Summary of Retaining Wall

Sr. No.	Start Chainage	End Chainage	Length (m)	Side	Height (m)
1	8410	8550	140	RHS	2.50
2	22455	22555	100	LHS	2.00
3	23500	23600	100	RHS	3.00
4	24810	24870	60	RHS	2.50
5	29980	30100	120	RHS	3.00
6	30100	30260	160	RHS	2.00
7	31545	31575	30	RHS	3.00
8	31755	32040	285	RHS	2.50
9	38330	38390	60	LHS	2.00
10	39080	39185	105	LHS	2.50

11	43595	43895	300	RHS	2.00
12	45270	45370	100	RHS	3.00
13	46790	46895	105	RHS	2.50
14	49360	49480	120	LHS	2.00
15	51690	51750	60	RHS	3.50
16	52300	52340	40	RHS	2.00
17	52440	52500	60	RHS	2.00
18	56295	56370	75	RHS	2.00
19	57270	57395	125	RHS	3.00

3.4.2 Proposed Road Cross Sections

The Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road traverses terrain ranging from 561 m to 1343 m above mean sea level. Based on the earthwork analysis as presented in Table 5.2 in Chapter 5, the total quantity of material to be excavated (cut) along the project corridor is 251100 m^3, while the total fill requirement is 189279 m^3. It is evident that the filling quantity exceeds the cut quantity, indicating a need for borrow material. This approach ensures effective earthwork management while minimizing environmental impacts and maintaining slope stability along the project corridor.

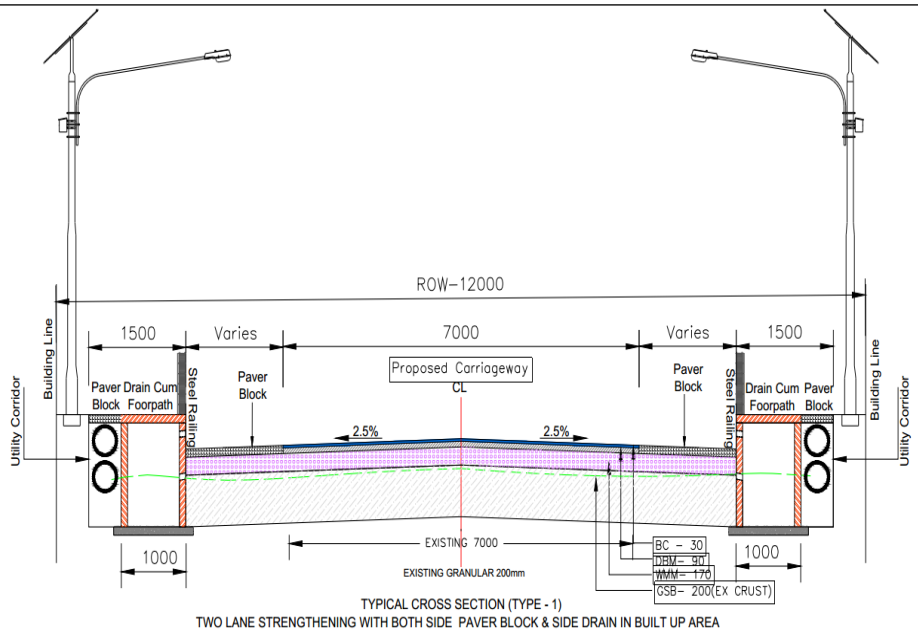
A total of nine Typical Cross-Sections (TCS) has been proposed in the DPR for the 58+100 km project road. These TCSs vary across the alignment, with certain sections incorporating intermediate lanes. Each cross-section has been designed to address the specific terrain and infrastructure requirements, including provisions for slope stabilization, drainage, and utility corridors. Implementation of these cross-sections may also lead to environmental and social impacts, such as tree cutting, alteration of natural landscapes, potential biodiversity loss, and disruption of local ecosystems.

The details of different cross-sections, along with the chainage-wise cross-section designs adopted, are provided in **Annexure 3.1.** A total of Nine Typical Cross-Sections (TCS) has been presented in **Figure 3.2.**

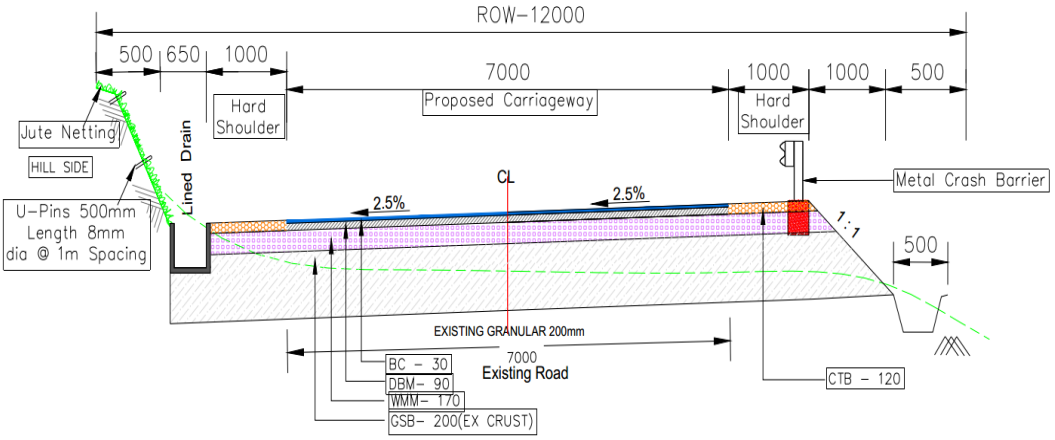
Table 3.8: TCS-Wise Consolidated Chainage

Sl. No.	TCS Type	Chainages (From – To)
1	**TCS-1**	0–1100, 3900–4600, 8010–8410, 15710–16660,
2	**TCS-2**	1100–3900, 4600–8010, 8550–15710, 16660–17620
3	**TCS-4**	23945-24295, 42180 - 42875 and from 52250 - 52600.
4	**TCS-6**	17620–19285, 19905–20395, 20945–22455, 22555–23500, 23600–23945, 24295–25330, 25440–26370, 26570–28490, 28690–29980, 30260 to 31050, 35375 to 35580, 42875 to 42985, and 48580 to 49360; from 31155 to 31545, 35675 to 36080, 43360 to 43595, and 49480 to 50990; from 31575 to 31755, 36390 to 38330, 43895 to 45270, and 51060 to 51690; from 32040 to 33225, 38390 to 39080, 45370 to 46790, and 51750 to 52250; from 33670 to 33830, 39185 to 41680, 46895 to 47190, and 52600 to 56295; from 34070 to 35275, 41980 to 42180, 47295 to 47650, and 56370 to 57270; and from 57395 to 58100.
5	**TCS-7**	19285–19905, 20395–20945, 25330–25440, 26370–26570, 28490–28690, 31050 to 31155, 36080 to 36390; from 33225 to 33670, 41680 to 41980; from 33830 to 34070, 42985 to 43360; from 35275 to 35375, 47190 to 47295; from 35580 to 35675, 47650 to 48580; and from 50990 to 51060.

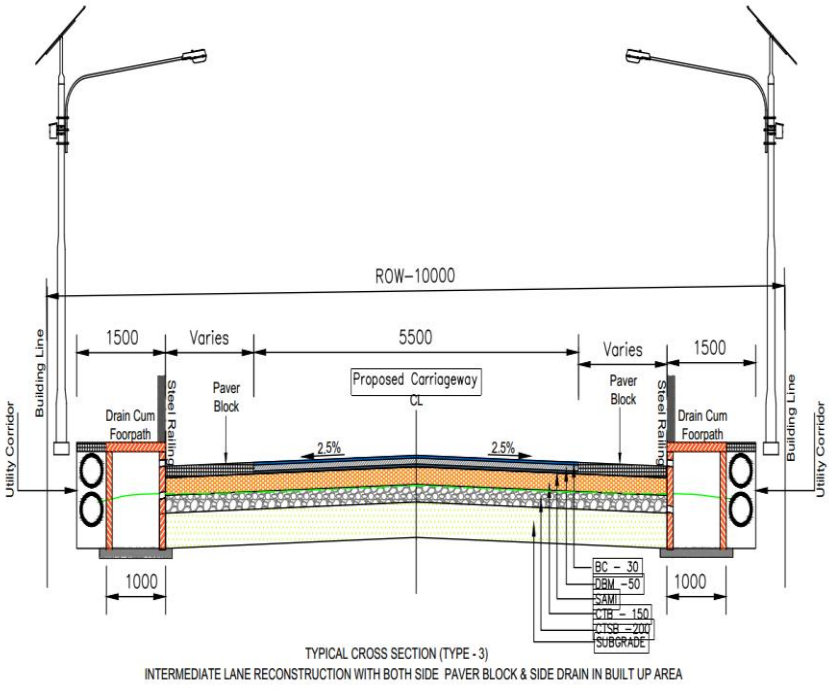
6	**TCS-8**	22455–22555, 23500–23600, 29980–30100, 30100 to 30260 and 45270 to 45370; from 31545 to 31575 and 46790 to 46895; from 31755 to 32040 and 49360 to 49480; from 38330 to 38390 and 51690 to 51750; from 39080 to 39185 and 56295 to 56370; and from 43595 to 43895 and 57270 to 57395.
7	**TCS-9**	8410 - 8550



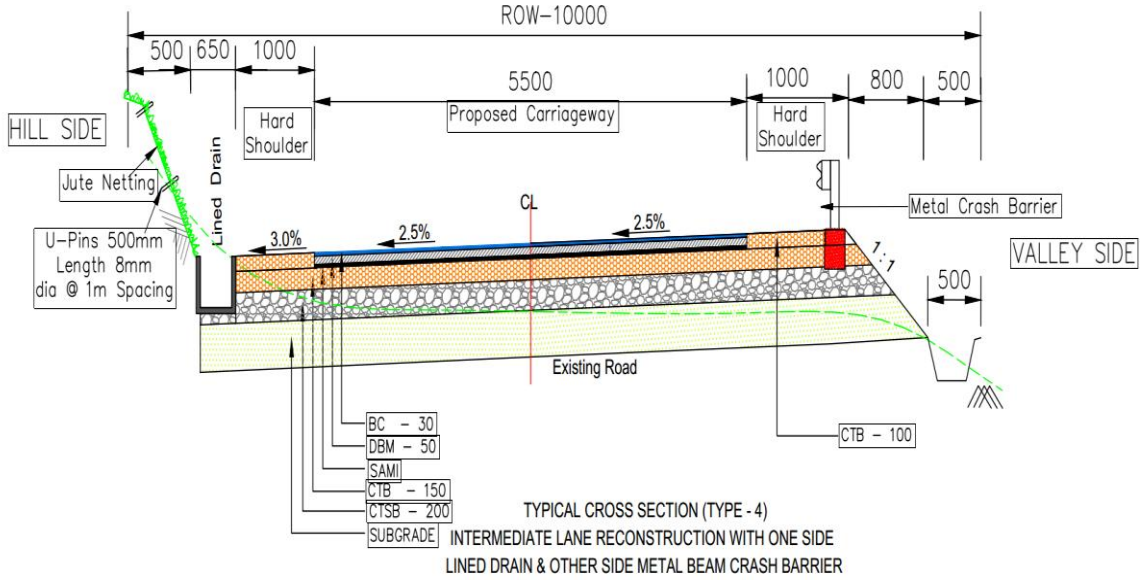
TYPICAL CROSS SECTION (TYPE - 1)
TWO LANE STRENGTHENING WITH BOTH SIDE PAVER BLOCK & SIDE DRAIN IN BUILT UP AREA



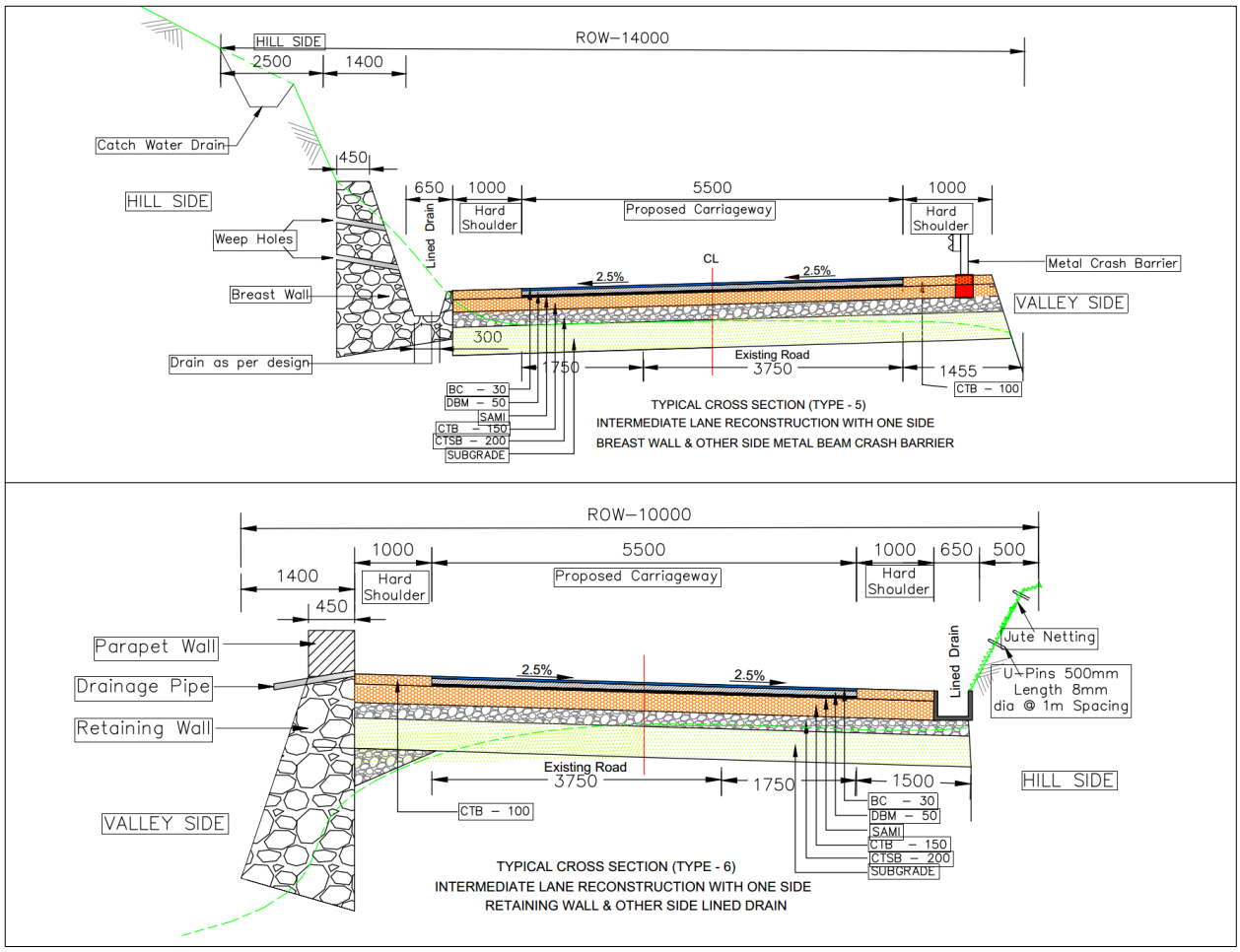
TYPICAL CROSS SECTION (TYPE - 2)
TWO LANE STRENGTHENING WITH ONE SIDE
LINED DRAIN & OTHER SIDE METAL BEAM CRASH BARRIER

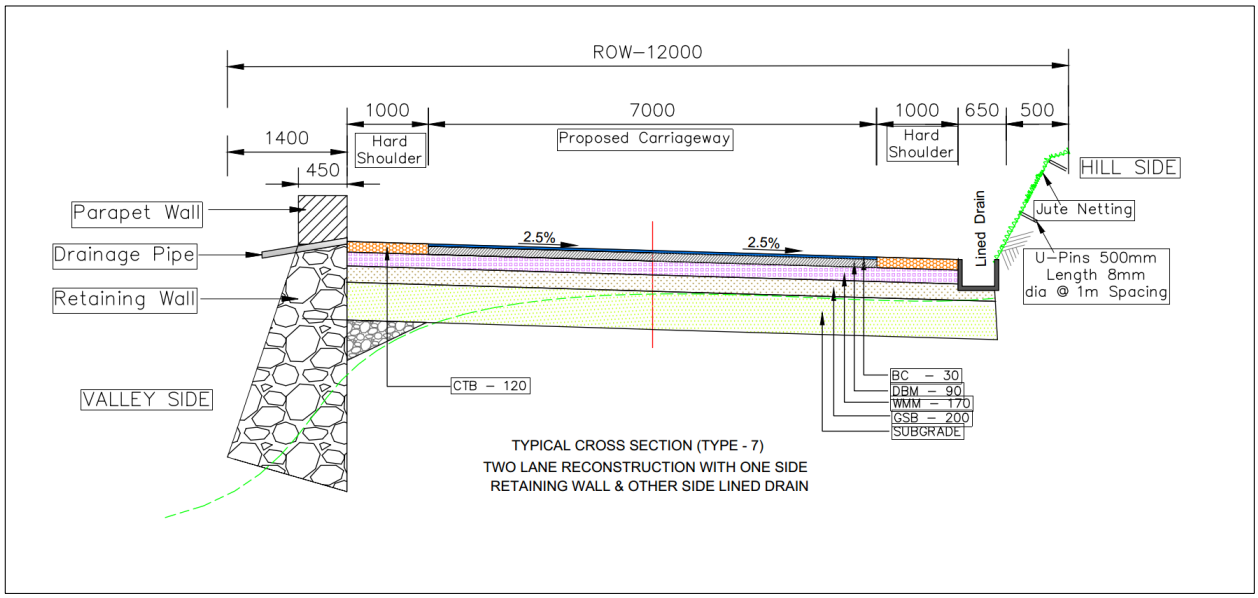


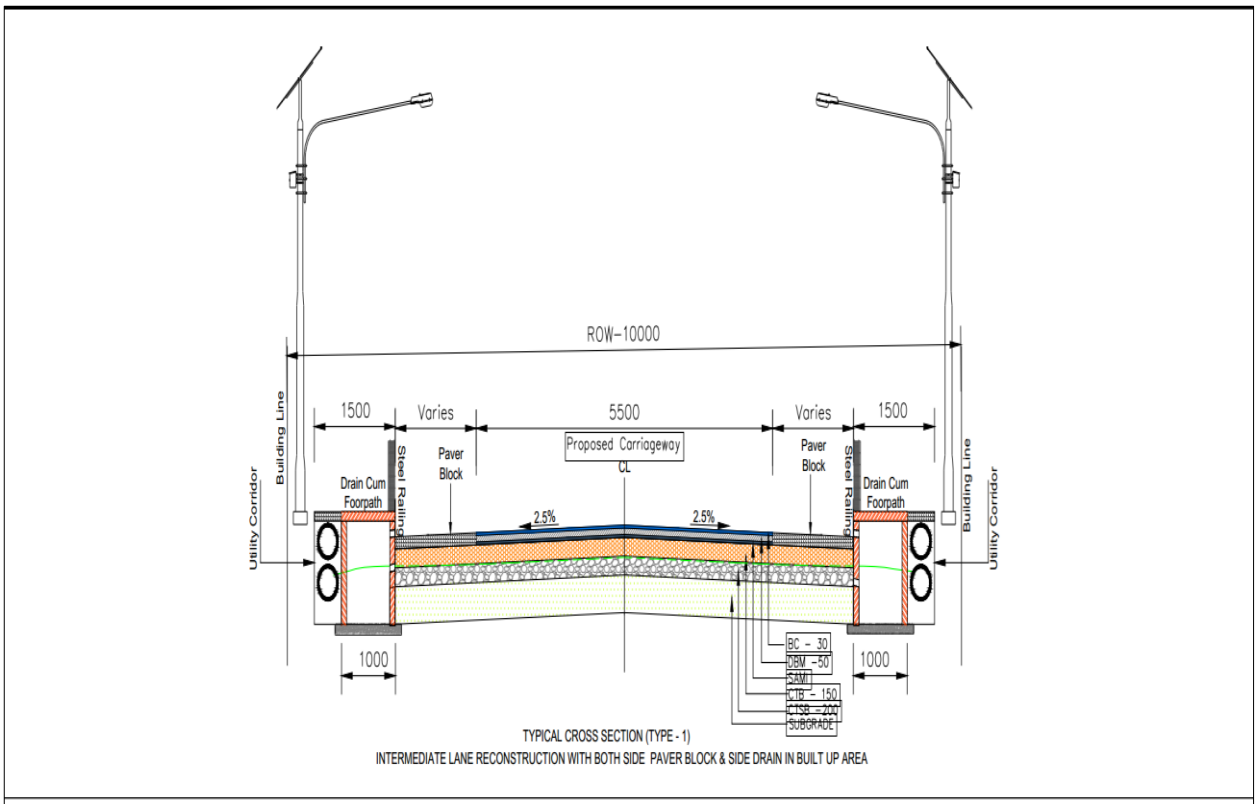
TYPICAL CROSS SECTION (TYPE - 3)
INTERMEDIATE LANE RECONSTRUCTION WITH BOTH SIDE PAVER BLOCK & SIDE DRAIN IN BUILT UP AREA



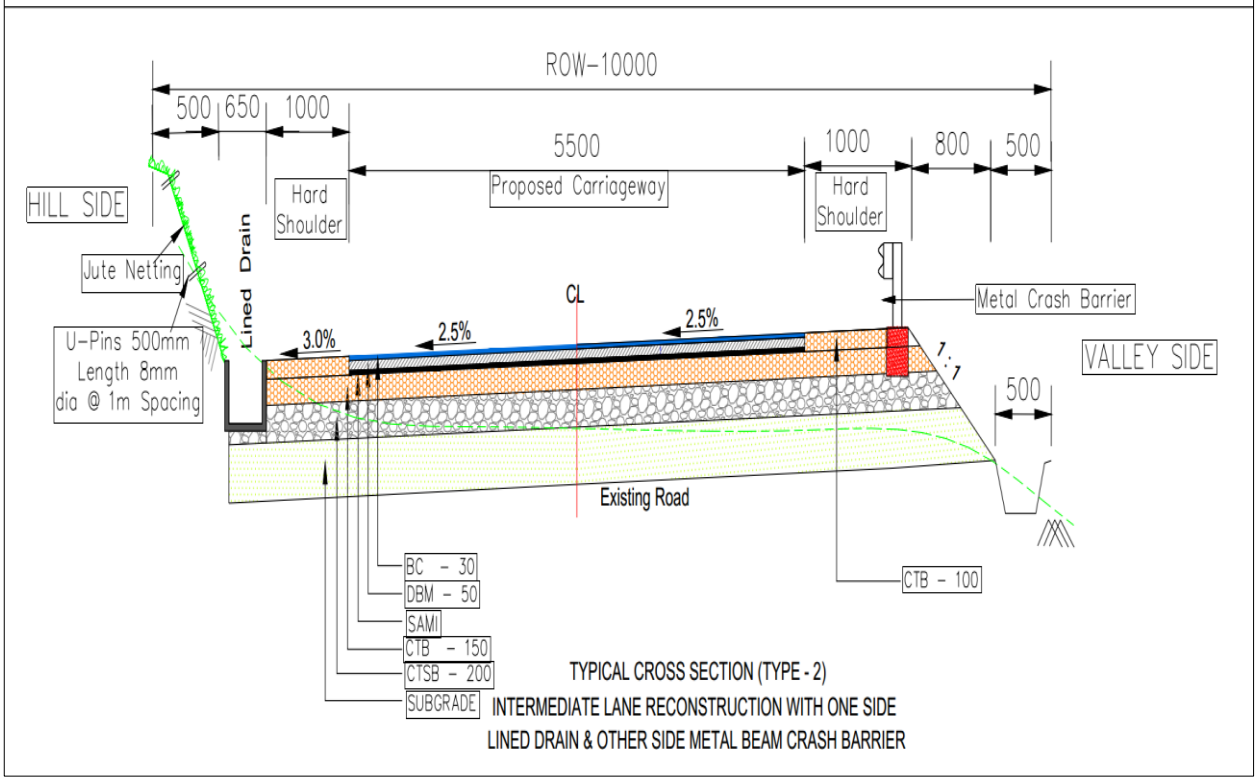
TYPICAL CROSS SECTION (TYPE - 4)
INTERMEDIATE LANE RECONSTRUCTION WITH ONE SIDE
LINED DRAIN & OTHER SIDE METAL BEAM CRASH BARRIER


HILL SIDE
ROW–14000
2500
1400
Catch Water Drain
450
650
1000
5500
1000
Hard Shoulder
Proposed Carriageway
Hard Shoulder
Lined Drain
HILL SIDE
Weep Holes
Breast Wall
Drain as per design
CL
2.5%
2.5%
Metal Crash Barrier
VALLEY SIDE
300
1750
Existing Road
3750
1455
CTB – 100
BC – 30
DBM – 50
SAMI
CTB – 150
CTSB – 200
SUBGRADE
TYPICAL CROSS SECTION (TYPE - 5)
INTERMEDIATE LANE RECONSTRUCTION WITH ONE SIDE
BREAST WALL & OTHER SIDE METAL BEAM CRASH BARRIER
ROW–10000
1400
1000
Hard Shoulder
5500
Proposed Carriageway
1000
Hard Shoulder
650
500
450
Parapet Wall
Drainage Pipe
Retaining Wall
VALLEY SIDE
2.5%
2.5%
Lined Drain
Jute Netting
U–Pins 500mm Length 8mm dia @ 1m Spacing
Existing Road
3750
1750
1500
HILL SIDE
CTB – 100
BC – 30
DBM – 50
SAMI
CTB – 150
CTSB – 200
SUBGRADE
TYPICAL CROSS SECTION (TYPE - 6)
INTERMEDIATE LANE RECONSTRUCTION WITH ONE SIDE
RETAINING WALL & OTHER SIDE LINED DRAIN


ROW–12000
1400
1000
Hard Shoulder
7000
Proposed Carriageway
1000
Hard Shoulder
650
500
450
HILL SIDE
Parapet Wall
Drainage Pipe
Retaining Wall
VALLEY SIDE
2.5%
2.5%
Lined Drain
Jute Netting
U–Pins 500mm Length 8mm dia @ 1m Spacing
CTB – 120
BC – 30
DBM – 90
WMM – 170
GSB – 200
SUBGRADE
TYPICAL CROSS SECTION (TYPE - 7)
TWO LANE RECONSTRUCTION WITH ONE SIDE
RETAINING WALL & OTHER SIDE LINED DRAIN



TYPICAL CROSS SECTION (TYPE - 1)
INTERMEDIATE LANE RECONSTRUCTION WITH BOTH SIDE PAVER BLOCK & SIDE DRAIN IN BUILT UP AREA



TYPICAL CROSS SECTION (TYPE - 2)
INTERMEDIATE LANE RECONSTRUCTION WITH ONE SIDE
LINED DRAIN & OTHER SIDE METAL BEAM CRASH BARRIER

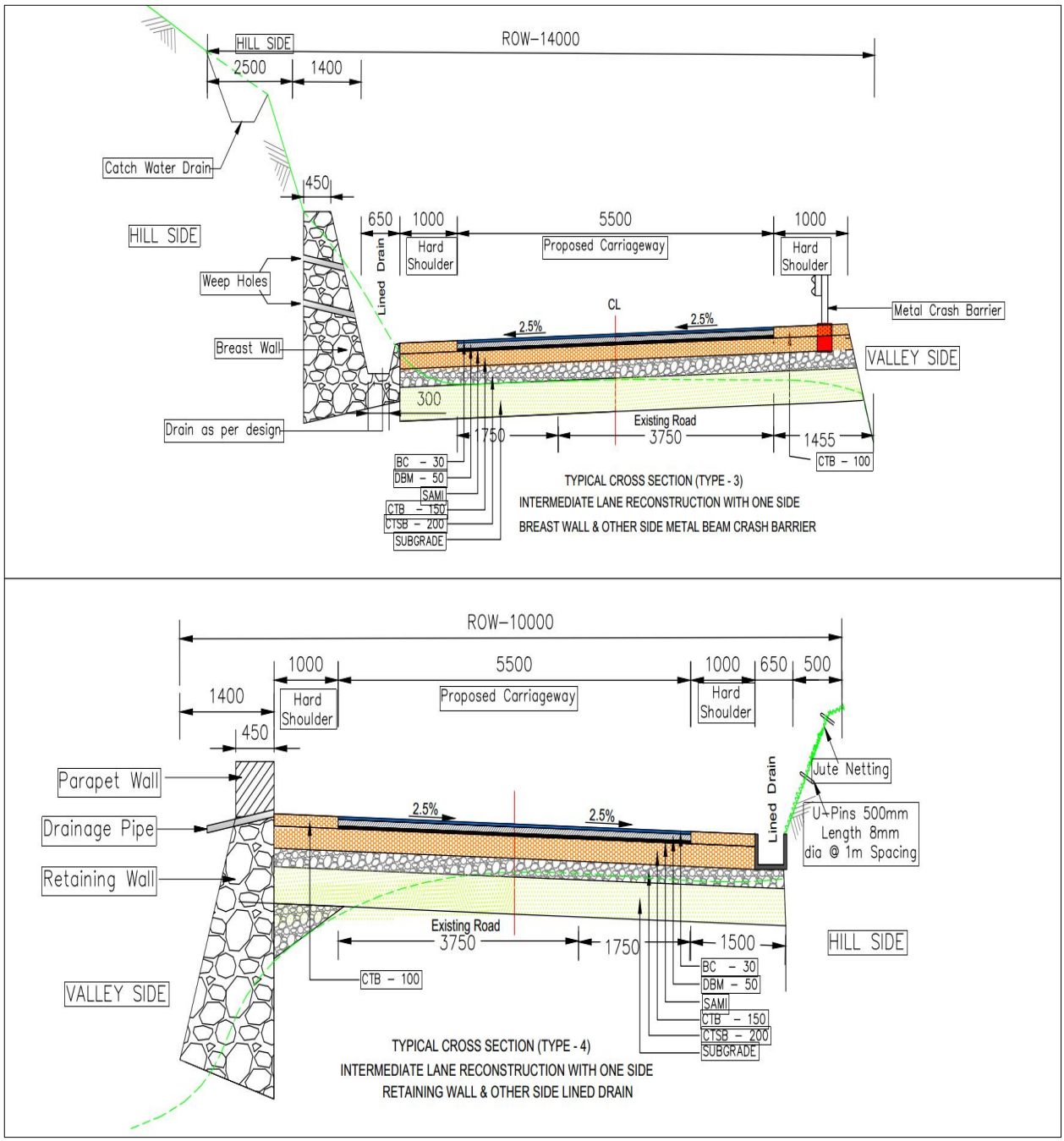


Figure 3.2: Typical Cross Sections

3.4.3 Settlements and Corridor Characteristics

3.4.3.1 Settlements:

The DSSPS 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 villages along the stretch are presented in **Table 3.9**.

Table 3.9: List of villages along project road

Village Name	Chainage in Km		Length
	Start Point	End Point	
Dkhiah	0	1.1	1.1
Sookilo Market	3.9	4.6	0.7
Moopala	5.5	6.4	0.9
Sutnga	8	9.6	1.6
Mookympad	9.6	11	1.4
Tluh	12.2	13.5	1.3
Latyrke	13.5	14.3	0.8
Moolamylliang	14.4	14.8	0.4
Umpleng Market	16	16.6	0.6
Khaidong	23.9	24.9	1
Moolasngi	27.3	27.7	0.4
Lumchyrngan	33.2	33.7	0.5
Daistong	35.5	35.7	0.2
Bamkhoosngi	37.9	39.1	1.2
Saipung	42.2	44	1.8
Ngaibang	46.8	47.2	0.4
Khahnar	50.9	52.7	1.8

3.4.3.2 Cross Drainage Details

The cross-drainage details for the sub project are presented in Table 3.10.

Table 3.10: Cross drainage details for the sub project road

Sl. No.	Category	Description	Nos.
A	Major Bridge	—	Nil
B	Minor Bridge	Up to 30 m waterway	1
C	Minor Bridge	More than 30 m waterway	Nil
D	Culverts (Total)	—	260
(i)	Culverts	Pipe Culverts	267
(ii)	Culverts	Slab Culverts	6
(iii)	Culverts	Stone Masonry Culverts	89

3.4.3.3 Retaining Structure Details

The retaining structure details for the sub project are presented in Table 3.11.

Table 3.11: Retaining structure details for the sub project road

Sl. No.	Structure Type	Length (m)
A	Breast Wall	4755
B	Gabion Wall	Nil
C	Retaining Wall	2145
D	Toe Wall	1215

3.4.3.4 Cutting Details

Earthwork details in the project area is presented in Table 3.12.

Table 3.12: Earthwork details in the project area

Sub Project Road	Fill (m^3)	Cut (m^3)
DSSPS	189279	251100

3.4.3.5 Bus Shelter and Street Lights

Bus Shelter & Public Toilet facilities have been proposed at Ch. 0.040, Ch. 5.800, Ch. 8.140, Ch. 9.560, Ch. 11.890, Ch. 13.810, Ch. 14.600, Ch. 19.900, Ch. 23.100, Ch. 24.110, Ch. 25.200, Ch. 27.050, Ch. 27.310, Ch. 33.110, Ch. 36.440, Ch. 37.800, Ch. 38.200, Ch. 38.550, Ch. 42.830, Ch. 44.600, Ch. 46.680, Ch. 50.920, Ch. 51.650, Ch. 52.515, Ch. 58.200, Ch. 62.150, Ch. 62.700, and Ch. 62.400. A total of 29 Bus Shelter & Public Toilet units and 206 Street Lights have been proposed under this sub-project road. These provisions have been incorporated based on consultations with local communities and are outcomes of the FPIC process.

3.4.3.6 Bioengineering

Bioengineering using local Broom Grass, Vetiver/ local grasses has been proposed. Turfing is provided on embankment slopes for erosion control and Jute net is proposed. Details of bio engineering measures are provided in Table 3.13.

Table 3.13: Details of bioengineering measure

Sr. No.	Start	End	Length (kms.)	Side
1	19285	19905	620	RHS
2	20395	20945	550	RHS
3	25330	25440	110	LHS
4	26370	26570	200	LHS
5	28490	28690	200	LHS

6	31050	31155	105	LHS
7	33225	33670	445	LHS
8	33830	34070	240	LHS
9	35275	35375	100	LHS
10	35580	35675	95	LHS
11	36080	36390	310	LHS
12	41680	41980	300	LHS
13	42985	43360	375	LHS
14	47190	47295	105	LHS
15	47650	48580	930	RHS
16	50990	51060	70	LHS

Details of Cutting is provided in Table 3.14.

Table 3.14: Details of Cutting

Sr. No.	Start	End	Length (m)	Side
1	19285	19905	620	RHS
2	20395	20945	550	RHS
3	25330	25440	110	LHS
4	26370	26570	200	LHS
5	28490	28690	200	LHS
6	31050	31155	105	LHS
7	33225	33670	445	LHS
8	33830	34070	240	LHS
9	35275	35375	100	LHS
10	35580	35675	95	LHS
11	36080	36390	310	LHS

12	41680	41980	300	LHS
13	42985	43360	375	LHS
14	47190	47295	105	LHS
15	47650	48580	930	RHS
16	50990	51060	70	LHS

3.4.3.7 Protection work:

In addition to the protective measures for road works, retaining walls have been proposed, covering a cumulative length of 520 m across all structures within the project. Details are given in Table 3.15.

Table 3.15: Proposed protective measures for road works, gabion-type retaining walls

Sr. No.	Start	End	Length (kms.)	Type	Side
1	8410	8550	140	R wall	RHS
2	22455	22555	100	R wall	LHS
3	23500	23600	100	R wall	RHS
4	24810	24870	60	R wall	RHS
5	29980	30100	120	R wall	RHS
6	30100	30260	160	R wall	RHS
7	31545	31575	30	R wall	RHS
8	31755	32040	285	R wall	RHS
9	38330	38390	60	R wall	LHS
10	39080	39185	105	R wall	LHS
11	43595	43895	300	R wall	RHS
12	45270	45370	100	R wall	RHS
13	46790	46895	105	R wall	RHS
14	49360	49480	120	R wall	LHS
15	51690	51750	60	R wall	RHS
16	52300	52340	40	R wall	RHS
17	52440	52500	60	R wall	RHS
18	56295	56370	75	R wall	RHS

19	57270	57395	125	R wall	RHS

3.4.3.8 Corridor Characteristics

The salient features of the DSSPS road are presented in **Table 3.16** below.

Table 3.16: Salient features of the DSSPS Road

Sl. No.	Characteristics	Details
1	Name of Road	Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road
2	Project road corridor road Length	58+100 km
3	District	East Jaintia Hills District
4	Villages/settlements enroute	17 villages
5	Terrain	Hilly
	Existing	Road width varies from 3.75 m to7.0 m
6	Proposed treatment	Brownfield, Improvement of sharp curves within the RoW, reconstruction of weak and damaged/ new culverts and bridges, rehabilitation and strengthening of existing pavement to intermediate lane and protection works.
7	Bridges	No. of Major Bridge – 0 No. of Minor Bridges – 01
8	Culverts	314
9	Forests / environmentally sensitive areas	Within 0.5 km of the project road, habitats include a mix of natural and modified ecosystems influenced by hilly terrain and human activities. Natural habitats feature with bamboo and degraded grasslands.
10	Religious Structures Affected	No religious structure is affected
11	Fifth/Sixth Scheduled Areas	Sixth Schedule Area

Page | 38

Table 3.16: Salient features of the DSSPS Road

Sl. No.	Characteristics	Details
12	River crossings	River crossings: • at 16+000 • at 31+000
13	Water bodies / ponds	3 Rivers, Community Fish Pond at 10+800 & 1 Community Pond at 30+440
14	Sensitive receptors	04 nos. of churches and 03 nos. of School.
15	Transshipment areas/truck parking locations	Nil
16	Common Property Resources	Boundary wall of water well at Ch 42+800 (LHS) will be impacted. Refer Table 5.33 for chainage wise details of CPR.
17	Other features / issues if any	Nil
18	Land requirement	The total Land requirement that will be acquired permanently for this sub project is 1.902 Ha. For the purpose of Spoil disposal, 2.640 Ha of land will be required temporarily which has been jointly verified by the Community Members, PWD and independent consultants. Refer to Table 3.24 and 3.25 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).

Page | 39

3.4.4 Trees

32 nos. of trees are situated within the existing Right of Way (RoW) on both sides of the road. The chainage wise details of trees are presented in **Table 3.17**.

Table 3.17: Chainage wise list of Trees

Sl. No.	Chainage (km)	LHS/RHS	Common Name	Botanical Name	Girth at Breast Height (cm)
1.	6+339.28	LHS	Dieng Sohot (Wild Cherry)	*Prunus cerasoides*	20
2.	6+339.28	LHS	Pine tree	*Pinus kesiya*	25
3.	6+992.93	LHS	Pine tree	*Pinus kesiya*	85
4.	8+571.48	LHS	Dieng Sohot (Wild Cherry)	*Prunus cerasoides*	60
5.	9+035.55	LHS	Dieng Ngan (Alder)	*Alnus nepalensis*	75
6.	9+035.55	RHS	Pine tree	*Pinus kesiya*	18
7.	8+980.71	LHS	Pine tree	*Pinus kesiya*	90
8.	9+807.60	LHS	Dieng Ngan	*Alnus nepalensis*	70
9.	10+300	LHS	Dieng Ngan	*Alnus nepalensis*	82
10.	10+300	LHS	Dieng Ngan	*Alnus nepalensis*	78
11.	10+590	RHS	Pine tree	*Pinus kesiya*	88
12.	10+590	RHS	Dieng Ngan	*Alnus nepalensis*	76
13.	10+642.85	LHS	Dieng Ngan	*Alnus nepalensis*	72
14.	10+642.85	LHS	Dieng Ngan	*Alnus nepalensis*	69
15.	12+827.07	RHS	Pine tree	*Pinus kesiya*	28
16.	13+546.46	RHS	Pine tree	*Pinus kesiya*	92
17.	13+522.61	RHS	Dieng Ngan	*Alnus nepalensis*	74
18.	13+465.46	RHS	Pine tree	*Pinus kesiya*	95
19.	14+622.50	LHS	Pine tree	*Pinus kesiya*	89
20.	15+773.73	LHS	Dieng Ngan	*Alnus nepalensis*	77

21.	16+917.67	LHS	Pine tree	*Pinus kesiya*	25
22.	18+506.80	RHS	Pine tree	*Pinus kesiya*	93
23.	18+813.20	LHS	Dieng Ngan	*Alnus nepalensis*	80
24.	20+127.83	RHS	Pine tree	*Pinus kesiya*	94
25.	20+249	LHS	Dieng Ngan	*Alnus nepalensis*	79
26.	21+308	LHS	Dieng Ngan	*Alnus nepalensis*	73
27.	24+577	LHS	Pine tree	*Pinus kesiya*	96
28.	24+336	RHS	Pine tree	*Pinus kesiya*	23
29.	24+284	RHS	Pine tree	*Pinus kesiya*	91
30.	24+248	RHS	Dieng Ngan	*Alnus nepalensis*	78
31.	24+223	RHS	Pine tree	*Pinus kesiya*	21
32.	24+577	LHS	Pine tree	*Pinus kesiya*	94

To mitigate the ecological impact of tree felling, compensatory plantation (@1:10) would be carried out, in accordance with applicable environmental regulations and guidelines. These measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP).

3.4.5 Utility Details

A total of 128 nos. of electric poles and 1 no. of transformer (LHS) is identified along the DSSPS road corridor for shifting. Of these, 74 poles are on the LHS and 54 on the RHS. Details of utilities are given in Annexure 5.2.

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

For the proposed road project, assessing the availability of suitable construction materials in the vicinity of the project road is essential. The major materials required include soil, sand, aggregates, bitumen, steel, and cement. Surface water will be utilized for construction purposes, subject to prior permission from the Irrigation/Water Resources Department. Details of the construction materials, their sources, and corresponding lead distances from start and end point of the project road are provided in Table 3.18 and Table 3.19 respectively. Details of construction material is presented in Table 3.20.

Table 3.18: Details of construction material, sources along with the lead form start point (at Dkhiah East, Lad Sutnga, Khliehriat)

Material	Source	Lead (in km)	Surfaced Road	Unsurfaced Graveled Road	Kutcha Road
Building Stone/ Boulders	19th Km of DSSMH Road	20.00	19.00	0.00	1.00
Stone Metal/ Aggregates/ GSB/ Filter Material/	19th Km of DSSMH Road	20.00	19.00	0.00	1.00
Stone Chips	11th Km of Shillong Jowai Road	83.00	83.00	0.00	0.00
Hill Sand/ Blindage/ Binding Materials	12th Km of DSSMH Road	13.00	12.00	0.00	1.00
River Sand	10th Km of Laskein Barato Road	50.00	49.00	0.00	1.00
Borrow pits for Embankment Soil	27th Km of DSSMH Road	4.00	3.00	0.00	1.00
Cement	Khliehriat	1.00	1.00	0.00	0.00
HYSD bar	Khliehriat	1.00	1.00	0.00	0.00

Table 3.19: Details of construction material, sources along with the lead form end point

(at Brimanar Bridge Point, Semmasi)

Sr. No.	Material	Unit	Quantity	Source	Lead (in km)	Surfaced Road	Unsurfaced Gravelled Road
1	Building Stone/ Boulders	Cum	20980	19th Km of DSSMH Road	31	30	1
2	Stone Metal/ Aggregates/ GSB/ Stone Chip/ Filter Material/	Cum	178423	19th Km of DSSMH Road	31	30	1
3	Sand/ Blindage/ Binding Materials	Cum	134194	10th Km of Laskein Barato Road	50	49	1
4	Cement	MT	20067	Khliehriat	27	27	0
5	HYSD bar	MT	717	Khliehriat	27	27	0

Table 3.20: Details of Construction material

Sr. No.	Item	Unit	Estimated Quantity
1	Total Muck Generated	m^3	251100
2	Earthwork (to be fill)	m^3	189279
3	Surplus cut (to be disposed	m^3	61821
4	Fine Sand	m^3	28724
5	Coarse Sand	m^3	86170
6	Aggregate (Coarse aggregate)	m^3	174741
7	Bitumen	MT	3640
8	Emulsion	MT	777
9	TMT Bars	MT	716
10	Cement	MT	17694

3.6.1 Volume of Civil Works

The volume of civil works for MCLIP will depend on the construction methods employed, the typical cross-sections, and the specific materials used within the sub-project area. These civil works are critical to ensuring the highway's

stability, safety, and environmental sustainability, thereby contributing to the long-term success of the road project. Details of the materials used to include Bituminous Concrete (BC), Dense Bituminous Macadam (DBM), Prime Coat (PC), Tack Coat (TC), Granular Sub Base (GSB), and Wet Mix Macadam (WMM) treatments are provided in **Annexure 3.3**. The use of this comprehensive range of materials ensures the road's strength, durability, and overall performance.

The total quantity of material to be excavated (cut) along the project corridor is 251100 m^3, while the total fill requirement is 189279 m^3. Surplus cut (to be disposed) is 61821 m^3. Details for the borrow land site is presented in Table 3.21 and Details for the muck disposal site is presented in Table 3.22. Average height for the muck dumping site should be 1.2 m to 1.5 m.

Table 3.21: Details for the borrow land site

S.No.	Location	Distance from DSSPS road (m)	Area of borrow land site (ha)	Borrow material (cu.m)	GPS Coordinate	Type of land
1	Moolasngi New at Ch 30+300	5	0.68	24672.490	25°21'36.87"N 92°33'19.79"E	Community land

Table 3.22: Details for the Spoil disposal site

S.No.	Location	Distance from DSSPS road (m)	Area of disposal site (ha)	GPS Coordinate	Type of land
1	Moolamylliang village Ch 18+450	5	0.400	25.328998° 92.492071°	Community land
2	Bamkhoosngi village Ch 39+300	10	1.130	25.330579° 92.596650°	Community land
3	Bamkhoosngi village at Ch 39+400	5	1.110	25.329451° 92.596829°	Community land

Further, recycling and reuse of existing pavement materials shall be carried out as per MoRTH Specifications for Road 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. The details for recycling and reuse of existing pavement materials ar per IRC:120 guidelines is presented in **Table 3.23**.

Table 3.23: Recycling and reuse of existing pavement materials ar per IRC:120

Details	Unit	Length	Existing Road Width	Milling Thickness	Qty in Cum
TCS-1	Cum	7800.00	7.50	0.05	**2632.50**
TCS-2, TCS-3, TCS-4, TCS-5, TCS-6, TCS-7	Cum	1600.00	5.50	0.05	**396.00**
Credit of Bituminous Surface Material @	Cum				3028.50
Take 80% Material Obtained From Dismantalling of Flexible Pavement for Reuse in DBM					**2422.80**
Total DBM Required in Project	Cum				8043.00
DBM Reclaimed (30% used Recycled Material)					8076.00

3.7 Land Requirements

The existing project road has a right of way ranging from 10m to 12m. However, a 14m row has been proposed in locations where cutting and slope stability measures are required, as indicated in TCS-7. Therefore, additional land of 1.902 Ha. is required in the alignment improvement sections brief details showing in Table 3.24. The land ownership for the all the sections where land is required is community.

Table 3.24: Details of land requirement

Sr. No.	Start Chainage	End Chainage	Length (km)	Existing ROW (m)	Proposed ROW (m)	Additional Land (ha)
1	19.285	19.905	0.620	10	14	2480
2	20.395	20.945	0.550	10	14	2200
3	25.330	25.440	0.110	10	14	440
4	26.370	26.570	0.200	10	14	800
5	28.490	28.690	0.200	10	14	800
6	31.050	31.155	0.105	10	14	420
7	33.225	33.670	0.445	10	14	1780
8	33.830	34.070	0.240	10	14	960
9	35.275	35.375	0.100	10	14	400
10	35.580	35.675	0.095	10	14	380
11	36.080	36.390	0.310	10	14	1240
12	41.680	41.980	0.300	10	14	1200

13	42.985	43.360	0.375	10	14	1500
14	47.190	47.295	0.105	10	14	420
15	47.650	48.580	0.930	10	14	3720
16	50.990	51.060	0.070	10	14	280
			4.755 km			1.9020

For spoil disposal, 2.64 ha of land is required. This required land for spoil disposal sites 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 Rangbah Shnong jointly identified 3 locations for dumping of spoils. The Details for the same is presented in Table 3.25.

Table 3.25: Details of land requirement for dumping yard

Sr. No.	Land	Lat.	Long.	Area in Ha.	Location in Ch.
1	Dumping Yard	25.330579°	92.596650°	1.13	39.350 (LHS)
2	Dumping Yard	25.329451°	92.596829°	1.11	39.350 (RHS)
3	Dumping Yard	25.328998°	92.492071°	0.4	18.45
				2.64	

During the implementation of the project necessary documentation will be developed s mentioned in the ESMF.

3.8 Water Requirements

The overall water requirement of the project is 104.952 KLD, of which 77.952 KLD will be used for construction activities and 27.0 KLD is required for domestic purposes. Details of the water requirement assessed for the project road are presented in **Table 3.26.**

Table 3.26: water requirement assessed for the project road are presented in

Activity	Daily Demand (Liters/km)	Total for 58.1 Km (Liters/day)	Remarks
Concreting and curing	1259.5	73176.95	Concrete mixing, compaction, culverts, drains.
Dust Suppression at Work Zone	82.19	4775.24	Reduced due to frequent rain; use only on dry days.
Domestic Purpose	-------	27000	For 300 workers (drinking, cooking, sanitation).
Total	—	**104952.19 Liters/day**	—

3.9 Manpower Requirement and Implementation Schedule for the Sub Project Road

The manpower requirement will vary over the construction period depending on the scope and type of work. The peak manpower is estimated to be approximately 300 personnel. Skilled manpower, primarily machine operators and the concrete casting crew, will generally be migrant worker accommodated in the construction camp. It is

estimated that about 65–70% of the workforce will be sourced locally, while the remaining skilled workers, operators, supervisors, and engineers may be recruited from outside the area. The contractor will mobilize the required manpower according to the construction schedule. The construction period for the 58.1 km project stretch is planned for 48 months. The total estimated cost of the project as per the DPR is approximately INR 349.2 crore.

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 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 Sub Project Alternatives

An alternative analysis was conducted for the project stretch, considering various design scenarios as well as a "Without Project" scenario. These are described in the following sections.

4.2.1 Without Sub Project Scenario

The road traverses areas with high population densities, particularly in Dkhiah and Sutnga, 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. This situation is further exacerbated by land-use conflicts, including uncontrolled development along the route and encroachments within the designated right-of-way.

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 Sub Project Scenario

The "With Project" scenario is expected to generate positive long-term impacts across social, environmental, economic, and financial dimensions. Key interventions include upgradation of 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" Sub 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.
Congestion in Settlements	Improved carriageway with good surface and separated footpath with railing in	Lack of road or lack of good road surface with shoulder and foot path, congestion and

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

Component	"With" Project Scenario	'Without" Project Scenario
	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.	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 compensation.	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 road public toilets, street lightsetc.	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 consequent increase in connectivity.	Social development activities are likely to be significantly constrained due to the severe inadequacy of infrastructure.
Financial and	Project financially viable for upgrading	The cost of maintenance while catering to the

Table 4.1: "With and Without" Sub Project Scenarios – A Comparative Assessment		
Component	**"With" Project Scenario**	**'Without" Project Scenario**
Economic Analysis	from existing lane configuration to intermediate lane configuration.	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. **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 Impacts

Sr. No.	Village Name	Location Chainage	ESIA Observation	Compliance / Proposal included in DPR	Reference in DPR
1	Dkhiah East	From Km. 0.000 to 1.100	Waiting Sheds, Cemented Footpath cum side drains including Railing and Street Lights are required	Bus Shelter, Toilet, Drain cum Footpath with Railing and Street Lights have been propsed	Main Report, Table 6.24, Page-122. Main Report, Table 6.26-B, Page-123
2	Moopala	From Km. 5.500 to 6.400	Footpath with Railings, Bus Shelter and Street Lights are required	Complied, Footpath with Railings included in DPR.	Main Report, Table 6.25-B, Page-122. Main Report, Table 6.24, Page-122. Main Report, Table 6.26-B, Page-123
3	Bangla	From Km. 24.810 to 24.870	Retaining Walls wall near Playground to be provided	Complied, Retaining Wall included in the DPR	Main Report, Table 6.20, Page-120
4	Shnong thymme	Ch. 26.400 to Ch. 26.600	Treatment for Land Slide area along the road	Complied, Land Slide Treatment Proposed in DPR	Main Report 6.2.9 Erosion Control and Land Slide Correction
5	Daistong	From Km. 36.080 to 36.390	Retaining Wall/Breast wall to be provided in the built-up areas to prevent landslips.	Complied, Breast Wall included in the DPR	Main Report, Table ES.17, Page-19

6	Daistong	From Km. 36.080 to 36.390	Road furnitures like Signboards, Speed Breakers and Zebra Crossings are required	Complied, Sign Board proposed as per Road safety Standards and Guidelines to State Highways.	At various locations as per site requirements Main Report, Table 9.3, Page 149
7	Khahnar	From Km. 50.990 to 51.060 & Km. 51.690 to 51.750	Retaining Wall/Breast wall to be provided in the built up areas to prevent landslips.	Complied, Retaining Wall/Breast included in the DPR	"Main Report, Table 6.20-B, Page-124 Main Report, Table ES.17, Page-19"

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 upgradation of the road within the proposed 10 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 upgradation 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:

- No construction camps will be established within 100 m of the Monolith. Instead, the DPR proposes beautification measures around the Monolith to enhance its cultural and aesthetic value. The layout for the improvement is presented in figure 4.1.

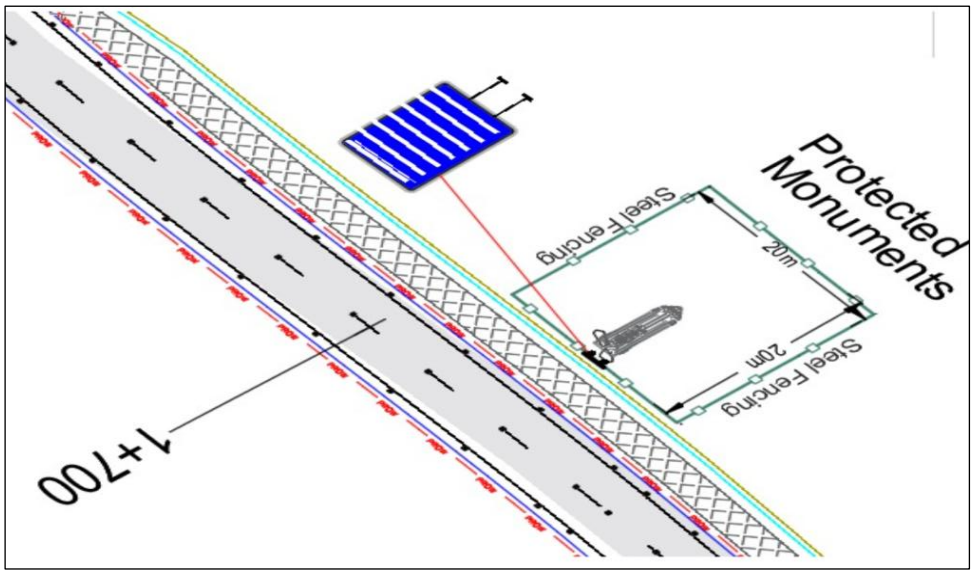


Figure 4.1:Layout for the improvement works along the Monolith

- Curves and bends will be smoothed to improve geometric design; where adjustments may affect local settlements, road realignment has been proposed.
- Paved shoulders will be provided wherever possible to accommodate non-motorized traffic.
- Unnecessary displacement will be avoided by adjusting the alignment, narrowing the impact zone, or tailoring designs to meet both rural and urban cross-section requirements.
- Design speed will be reduced in densely populated areas to enhance safety.
- Impacts on existing shrines and places of worship will be minimized.
- Safety features, including speed control measures near schools and healthcare facilities, will be incorporated.
- Road elevation in settlement areas will be minimized to prevent water seepage into adjacent properties.
- Ensure continuous access to businesses and residential properties throughout the construction period.
- Minimize land clearance to reduce the loss of public and private assets, including wells, tree plantations, and other community resources within the project area.
- Provision of roadside drains along with suitable cross-drainage (CD) structures to ensure proper storm water management, minimize waterlogging, and protect adjacent land and structures

5. BASELINE ENVIRONMENT

5.1 General

This chapter provides an overview of the existing environmental and social conditions of the project area, covering natural, physical, biological, cultural, and socio-economic components. Based on this baseline scenario, the potential impacts of the proposed sub-project have been identified. The approach and methodology adopted for baseline data collection are outlined in Section 1.3 of Chapter 1.

5.2 Climate

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

5.2.1 Climatic Conditions

East Jaintia Hills District experiences a humid subtropical monsoon climate, with distinct seasonal phases: Summer (late March–mid May) brings moderate warming and pre monsoon rains beginning to intensify. The monsoon season (mid-May/June–September) accounts for the majority of the district's rainfall—annual totals reach approximately 6,742 mm, significantly above India's average—often resulting in hazards like flash flooding and erosion. Autumn (October–November) is brief, showing reduced rainfall and improving clarity. Winter (December–February) is dry and cool. This intense monsoonal precipitation, combined with hilly terrain, makes the district prone to climate related risks.

5.2.2 Temperature

In East Jaintia Hills, winter generally begins in November, with January being the coldest month. During this period, minimum temperatures may drop to around 2–3 °C, while daytime conditions remain pleasant with sunshine—though exact average maximums are not well documented. Summer begins from March onwards, with July and August being the warmest months, especially under monsoon influence. Though specific temperature ranges are not recorded, the warmest periods are likely characterized by moderate daytime warmth, while nights remain relatively cool.

Table 5.1 below presents the monthly mean maximum and minimum temperatures recorded at Shillong (Nearest IMD Station), which has been considered as the nearest representative location for the project area.

Table 5.1: Monthly Mean Maximum and Minimum Temperature

Month	Maximum Temperature (°C)	Minimum Temperature (°C)
January	18.6	2.2
February	21.2	3.7
March	25.6	6.8
April	27.1	10.1
May	27.0	11.8
June	27.1	14.7
July	27.4	16.3

August	27.3	16.2
September	26.9	14.8
October	25.2	10.9
November	22.8	7.1
December	20.1	4.0

Source: India Meteorological Department – Shillong Climatological Normals, (1991–2020)

Temperature projection and implications for project road:

According to the Meghalaya State Climate Action Plan, the East Jaintia Hills District is projected to experience an increase in average annual temperature of approximately 1.6°C to 1.7°C by 2050 (relative to the 1970s baseline), along with higher rainfall variability and a rise in extreme precipitation events. These climatic changes are expected to intensify slope instability, flash floods, erosion, drainage congestion, and pavement deterioration along the Dkhiah – Sutnga – Saipung – Pala up to Semmasi road corridor, which traverses steep terrain, mined landscapes, and high-rainfall zones. To enhance climate resilience, the project design incorporates improved cross-drainage and longitudinal drainage systems, strengthened retaining and breast walls, slope stabilization through bio-engineering and structural measures, and climate-resilient pavement materials suitable for high-intensity rainfall. These interventions aim to minimize vulnerability to rain-induced hazards, protect the structural integrity of the road, and ensure reliable connectivity and long-term serviceability under changing climatic conditions in East Jaintia Hills.

Source: Meghalaya State Climate Action Plan

5.2.3 Rainfall and Humidity

East Jaintia Hills experiences a humid subtropical monsoon climate highly influenced by its elevation (around 1,200 m) and south-facing escarpments. Pre-monsoon showers typically occur during April and May often accompanied by thunderstorms and occasional hail followed by a short dry interval. The southwest monsoon generally sets in by late May or early June, bringing extremely heavy rainfall, with June to August emerging as the wettest months.

The average annual rainfall as recorded at the Shillong IMD station (Nearest IMD Station), is presented in **Table 5.2**, which provides the year-wise rainfall distribution.

Table 5.2: Monthly Rainfall Data

Month	**Average rainfall (mm)**
January	12.6
February	15.4
March	42.7
April	131.4
May	244.5

June	423.7
July	402.0
August	328.4
September	270.1
October	197.2
November	24.7
December	7.2
Annual total	**2,099.9**

Source: India Meteorological Department – Shillong Climatological Normals, (1991–2020)

Rainfall projection and implications for project road

According to the Meghalaya State Climate Action Plan (2022), rainfall patterns in the East Jaintia Hills District are projected to become increasingly erratic, with a rise in extreme precipitation events and short-duration, high-intensity rainfall by 2050. The region, which already receives very high monsoonal rainfall, is expected to experience further increases in seasonal rainfall intensity. This will heighten the risks of surface runoff, soil erosion, slope failures, and localized flooding along the Dkhiah – Sutnga – Saipung – Pala up to Semmasi road corridor, particularly in areas with steep gradients, unstable slopes, and sections affected by mining disturbances.

Such climatic conditions may lead to overloading of drainage systems, accelerated pavement deterioration, blockage of natural water channels, and disruption of traffic movement during peak monsoon periods. To address these climate-related vulnerabilities, the project design incorporates enhanced cross-drainage structures, adequately sized longitudinal drains with proper outfalls, bio-engineering and structural slope stabilization measures, and well-engineered muck disposal sites to prevent downstream sedimentation and waterlogging. These interventions aim to strengthen storm water management, reduce erosion, and ensure long-term stability and connectivity of the road under projected rainfall variability and extreme weather conditions in East Jaintia Hills.
The East Jaintia Hills district in Meghalaya experiences high humidity levels throughout the year, characteristic of its subtropical highland climate. Throughout the year, the average relative humidity in East Jaintia Hills is approximately 86%, indicating consistently high moisture levels in the air.

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 are installed in Meghalaya under the hydrometeorological modernization programme of IMD. Daily rainfall data from stations in the project area (East Meghalaya) were analysed and the maximum observed one-day rainfall values are summarized below:

District / Region	1-Day (24 hr) Max Rainfall (mm)
East Meghalaya	440 (CWC Subzone 2b, 50-year)

The IMD Gridded Rainfall Data (0.25° × 0.25° resolution), available for approximately 110 years, was also studied for regional assessment. However, a major limitation of the IMD gridded rainfall data in Meghalaya is the highly complex topography and localized microclimatic conditions. 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.

IMD Data

Station / Location	Station Index	Years of Data	Overall Highest MAXRF (mm)	Date & Hour of Peak
SHILLONG	42516	39	108.3 mm	17-07-2007 | 08–09 hrs IST
MAWSYNRAM	42514	2	80.0 mm	21-06-1969 | 19–20 hrs IST
SOHRA (CHERRAPUNJI)	42515	26	207.0 mm	10-10-1994 | 08–09 hrs IST

Considering the above, the design rainfall corresponding to 24-hour duration and the relevant 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,	=	440	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	=	550.88	mm
Adopted 100 year 24 hr Rainfall	=	560	mm
Intensity of Rainfall Ic for tc=24hr (Considering 100 year 24 hr rainfall)			
Ic = (F/T) x((T+1)/(tc+1))	=	291.667	mm/hr
Conversion ratio for 1 hrs as per CWC Flood Estimation Report	=	0.48	
100 years maximum 1 Hr Rainfall	=	268.80	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 268.80 mm/hr is more than the maximum observed 24-hour district rainfall of approximately 207mm (Sohra) ,108.3mm (Shillong) & 80mm (Mawsynram) 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 maximum up to 4 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:

	Input Data			
	HYDROLOGY OF Culvert AT KM 0+600			
1	Name of River / Stream / Nala	=	Local	
2	Catchment Area (A)	=	0.007	SQKM
3	Length of Longest stream (L)	=	0.035	KM
4	Point Rainfall in mm	=	44	cm
5	CWC Subzone	=	2b	
6	Modified rainfall after application of Climate resilience factor 1.252	=	56	cm
A	Estimation of Design Discharge by Empirical 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	=	19	
			=19x0.007^ (3/4)	
	Q	=	0.46	Cumecs
B	Rational Formula			
	Design Discharge Q 100	=	0.028 x Px f xA xIc	
	Rational can be used for small culverts with basin upto 15 Sqkm			
		=	0.7	Ha
	H- Elevation Difference between critical point to the structure=		16.576	m
	Time of Concentration tc is given by Eq 4.9	=	(0.87 x L3/H)0.385	
			= (0.87 x 0.035^3x16.576) ^0.385	

		=	0.007	hrs
	100 years return period rainfall for 24hrs as per CWC flood estimation report Subzone 2b and application of climate resilience factor			
		=	56	cm
	From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic	=		
		=	57.927	cm/hr
	From IRC SP 13, Spread Factor "f" from f curve fig 4.2	=	0.95	
	From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics			
	P	=	0.8	
	Design Discharge Q 100	=	0.028 x Px f xA xIc	
		=	0.86	Cumecs
D	Design Discharge: (Refer IRC - SP: 13 - 2004, Clause: 6.2)			
	Discharge by Dicken's Formula =	0.46	m3/s	
	Discharge by Rational Formula =	0.86	m3/s	
	Maximum Discharge =	0.86	m3/s	
	Hence, Design Discharge =	0.86	m3/s	
	Design discharge from observed flood	0.86	Cumecs	
	Dimension of Culvert	1.0	m dia.	
	Area of flow (A)	3.14	m2	
	Perimeter of flow	3.14	m	
	Slope of flow	0.0001		
	Hydraulic mean depth (R) = A/P	1	m	
	Rugosity coefficient (n)	0.014		
	Conveyance factor (λ) = (A. R^2/3)/n	76.923		
	Capacity of culvert	0.714	m3/s	
		Revise		
	Dimension of Culvert	1.5x1.5	m Box	
	Area of flow (A)	2.25	m2	
	Perimeter of flow	4.5	m	
	Slope of flow	0.0001		
	Hydraulic mean depth (R) = A/P	0.5	m	
	Rugosity coefficient (n)	0.013		
	Conveyance factor (λ) = (A. R^2/3)/n	109.0316		
	Capacity of culvert	1.090	m3/s	
		Safe		

Hydrology of Slab Culvert at CA CH-8+335				
	Input Data			
	HYDROLOGY OF Culvert AT KM 0+600			
1	Name of River / Stream / Nala	=	Local	
2	Catchment Area (A)	=	0.243	SQKM
3	Length of Longest stream (L)	=	0.350	KM
4	Point Rainfall in mm	=	44	cm
5	CWC Subzone	=	2b	
6	Modified rainfall after application of Climate resilience factor 1.252	=	56	cm
A	Estimation of Design Discharge by Empirical 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	=	19	
			=19x0.243^ (3/4)	
	Q	=	6.576	Cumecs
B	Rational Formula			
	Design Discharge Q 100	=	0.028 x Px f xA xIc	
	Rational can be used for small culverts with basin upto 15 Sqkm			
		=	24.3	Ha
	H- Elevation Difference between critical point to the structure=		22	m
	Time of Concentration tc is given by Eq 4.9	=	(0.87 x L3/H)0.385	
			= (0.87 x 0.35^3x22) ^0.385	
		=	0.086	hrs
	100 years return period rainfall for 24hrs as per CWC flood estimation report Subzone 2b and application of climate resilience factor	=	56	cm
	From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic	=	56/ 24 x (24+1)/0.086+1)	
		=	57.835	cm/hr
	From IRC SP 13, Spread Factor "f" from f curve fig 4.2	=	0.9	
	From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics			
	P	=	0.5	
	Design Discharge Q 100	=	0.028 x Px f xA xIc	
		=	20.02	Cumecs
D	Design Discharge: (Refer IRC - SP: 13 - 2004, Clause: 6.2)			
	Discharge by Dicken's Formula =	6.576	m3/s	
	Discharge by Rational Formula =	20.020	m3/s	
	Maximum Discharge =	20.020	m3/s	

	Hence, Design Discharge =	20.020	m3/s	
	Design discharge from observed flood	20.020	Cumecs	
	Culvert Span	4x4	m (Poor Condition)	
	Area of flow (A)	16	m2	
	Perimeter of flow	12	m	
	Slope of flow	0.0002		
	Hydraulic mean depth (R) = A/P	1.14	m	
	Rugosity coefficient (n)	0.013		
	Conveyance factor (λ) = (A. R^2/3)/n	1343.115		
	Capacity of culvert	18.99	m3/s	
		Revise		
	Revised section of Culvert due to lower capacity of Culvert. Revision in design discharge calculation are mentioned below			
	Culvert Span	5x5	m slab	
	Area of flow (A)	25	m2	
	Perimeter of flow	15	m	
	Slope of flow	0.001		
	Hydraulic mean depth (R) = A/P	1.66	m	
	Rugosity coefficient (n)	0.013		
	Conveyance factor (λ) = (A. R^2/3)/n	6410.256		
	Capacity of culvert	40.0147	m3/s	
		Safe		

5.2.4 Wind Speed and Direction

The annual Windrose diagram for Shillong (nearest IMD station) is presented in **Figure 5.1**. The average wind speed is about 4.9 km/hr, predominantly blowing from the southwest direction.

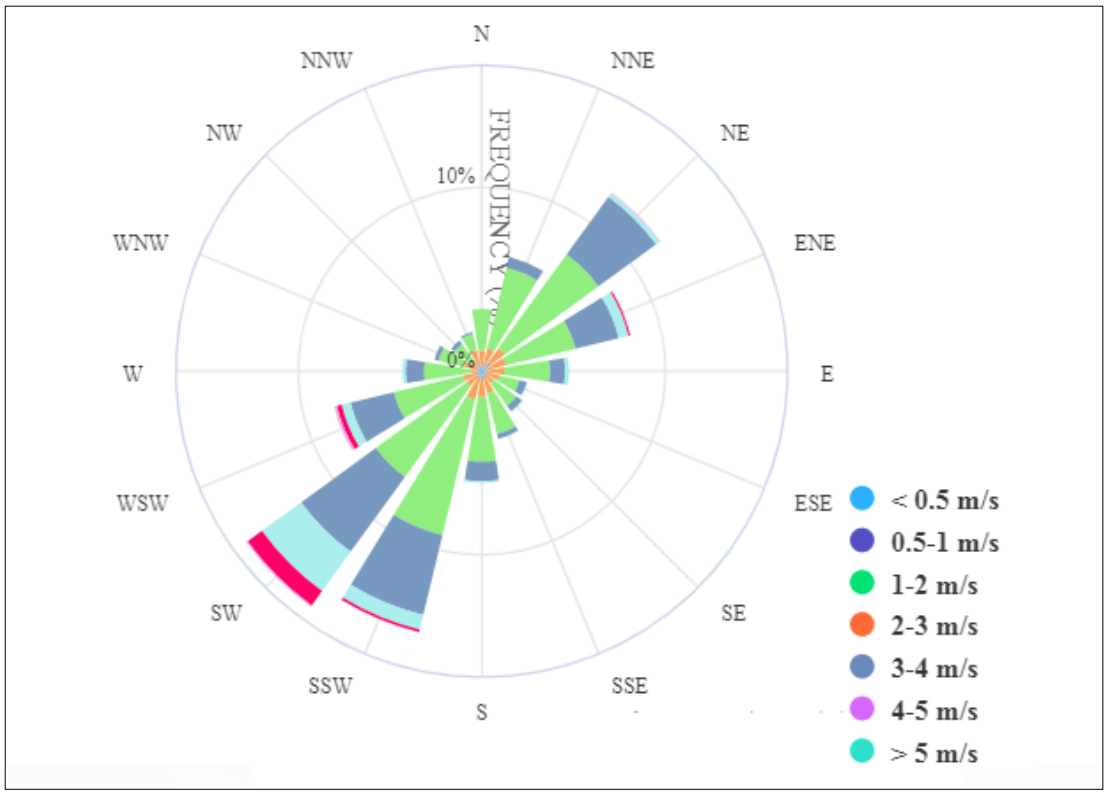


Figure 5.1: Wind rose Diagram for Shillong (IMD)

Source: IMD Climatological Tables for 1991–2020

5.3 Land Environment

This section describes the key characteristics of the project area including its Physiography, Elevation, Geology, Geomorphology and soils, land use pattern, agriculture and soil.

5.3.1 PHYSIOGRAPHY AND ELEVATION

East Jaintia Hills district in Meghalaya features rugged, forested terrain composed primarily of sandstone and limestone, with deeply dissected hills, plateau remnants, and intermontane valleys. Numerous rivers including the Myntdu, Lukha, and Kupli along with their tributaries drain the region and support both agriculture and local water supply. Elevations range from approximately 150 m in the southern lowlands to over 1,500 m in the upland areas, particularly around the Saipung and Khliehriat regions. The district receives very high monsoonal rainfall, influenced by its location adjacent to extreme rainfall zones like Mawsynram and Sohra (Cherrapunji). This contributes to frequent landslides, flash floods, and significant surface runoff all critical considerations for road alignment and infrastructure planning in the region.

Source: CGWB District Profile – East Jaintia Hills

Baseline Scenario for DSSPS Road

According to the elevation map, the Dkhiah - Sutnga - Saipung - Pala upto Semmasi road traverses terrain ranging from 561 m to 1343 m above mean sea level. This variation in elevation necessitates careful road alignment and

implementation of slope stabilization measures during construction. The elevation profile of the project stretch is shown in **Figure 5.2**. Total length of the project is 58+100 Km. Project have 4.572 km longitudinal slope, where vertical profile has been improved with cutting and filling. Steep slopes are located at various locations the details are presented in **Table 5.3.**

Table 5.3: Detail of Longitudinal slopes

Sr. No.	Start (m)	End (m)	Length (m)	Grade In (%)	Grade Out (%)	Remarks
1	7435.641	7485.641	50	-0.962	-9.27	Built-Up
2	7527.277	7577.277	50	-9.270	-3.3	Built-Up
3	7595.852	7655.852	60	-3.261	-9.35	Built-Up
4	7690.929	7750.929	60	-9.351	-5.9	Built-Up
5	7873.184	7923.184	50	-1.031	-7.44	Built-Up
6	7953.855	7993.855	40	-7.439	-3.1	Built-Up
7	10566.81	10626.81	60	-4.373	-7.39	Built-Up
8	10664.27	10784.27	120	-7.392	1.2	Built-Up
9	11667.08	11727.08	60	-7.114	-1.82	Built-Up
10	12347.52	12407.52	60	-5.230	-7.3	Built-Up
11	12455.55	12525.55	70	-7.28	-1.24	Built-Up
12	17752.04	17792.04	40	3.24	8.00	Built-Up
13	17856.78	17901.78	45	8.01	2.50	Built-Up
14	17918.59	17969.06	50.472	2.50	7.90	Built-Up
15	18359.17	18579.17	220	7.94	0.16	Hill Area (8–9%)
16	18708.66	18788.66	80	0.16	7.70	Hill Area (8–9%)
17	18873.20	19123.20	250	7.67	8.01	Hill Area (8–9%)
18	19188.91	19594.88	405.976	8.01	7.10	Hill Area (8–9%)
19	19784.16	19934.16	150	7.14	7.36	Hill Area (8–9%)
20	20017.61	20109.69	92.081	7.36	3.90	Hill Area (8–9%)
21	22493.49	22543.49	50	-1.42	7.57	Hill Top

Sr. No.	Start (m)	End (m)	Length (m)	Grade In (%)	Grade Out (%)	Remarks
22	22550.29	22600.29	50	7.57	4.80	Hill Top
23	24562.54	24662.54	100	-2.48	-7.19	Hill Top
24	24689.28	24749.28	60	-7.19	-5.00	Hill Top
25	25328.43	25398.43	70	-2.56	-7.43	Existing Improved
26	25448.42	25518.42	70	-7.43	-6.50	Existing Improved
27	25718.03	25778.03	60	-3.32	-7.34	Hill Area
28	25846.82	25906.82	60	-7.34	-5.40	Hill Area
29	26411.68	26481.68	70	-1.06	-7.55	Hill Area
30	26537.44	26617.44	80	-7.55	-4.60	Hill Area
31	27869.76	28019.76	150	-3.39	-7.37	Hill Area
32	28132.46	28202.46	70	-7.37	1.50	Hill Area
33	28463.73	28583.73	120	-4.80	-7.75	Hill Area
34	28784.97	28984.97	200	-7.75	-3.80	Hill Area
35	32148.47	32238.47	90	2.97	7.53	Hill Area
36	32262.18	32332.18	70	7.53	2.80	Hill Area
37	33129.63	33179.63	50	3.14	7.80	Improved
38	33192.13	33242.13	50	7.80	4.30	Improved
39	33772.65	33812.65	40	5.58	7.75	Improved
40	33836.26	33876.26	40	7.75	3.90	Improved
41	35611.27	35681.27	70	3.36	8.73	Improved
42	35695.78	35745.78	50	8.73	4.00	Improved
43	36073.90	36123.90	50	2.81	8.20	Improved
44	36133.25	36183.25	50	8.20	4.20	Improved
45	37674.42	37714.42	40	4.09	8.14	Improved

Sr. No.	Start (m)	End (m)	Length (m)	Grade In (%)	Grade Out (%)	Remarks
46	37747.00	37787.00	40	8.14	2.30	Improved
47	37909.33	37959.33	50	6.65	7.38	Improved
48	38007.61	38071.68	64.06	7.38	-2.30	Improved
49	38210.79	38250.79	40	-2.33	-7.30	Existing
50	38264.91	38324.91	60	-7.30	4.20	Existing
51	42612.00	42667.00	55	6.97	-7.50	Built-Up
52	42713.00	42773.00	60	-7.50	-5.40	Built-Up
53	59467.55	59517.55	50	-3.17	-7.75	Junction
54	59542.68	59592.68	50	-7.75	-2.30	Junction
55	60913.27	60963.27	50	-1.66	-7.45	Improved
56	61012.01	61062.01	50	-7.45	-3.60	Improved
57	61242.56	61332.56	90	-3.18	-8.04	Improved
58	61536.08	61626.08	90	-8.04	-5.20	Improved

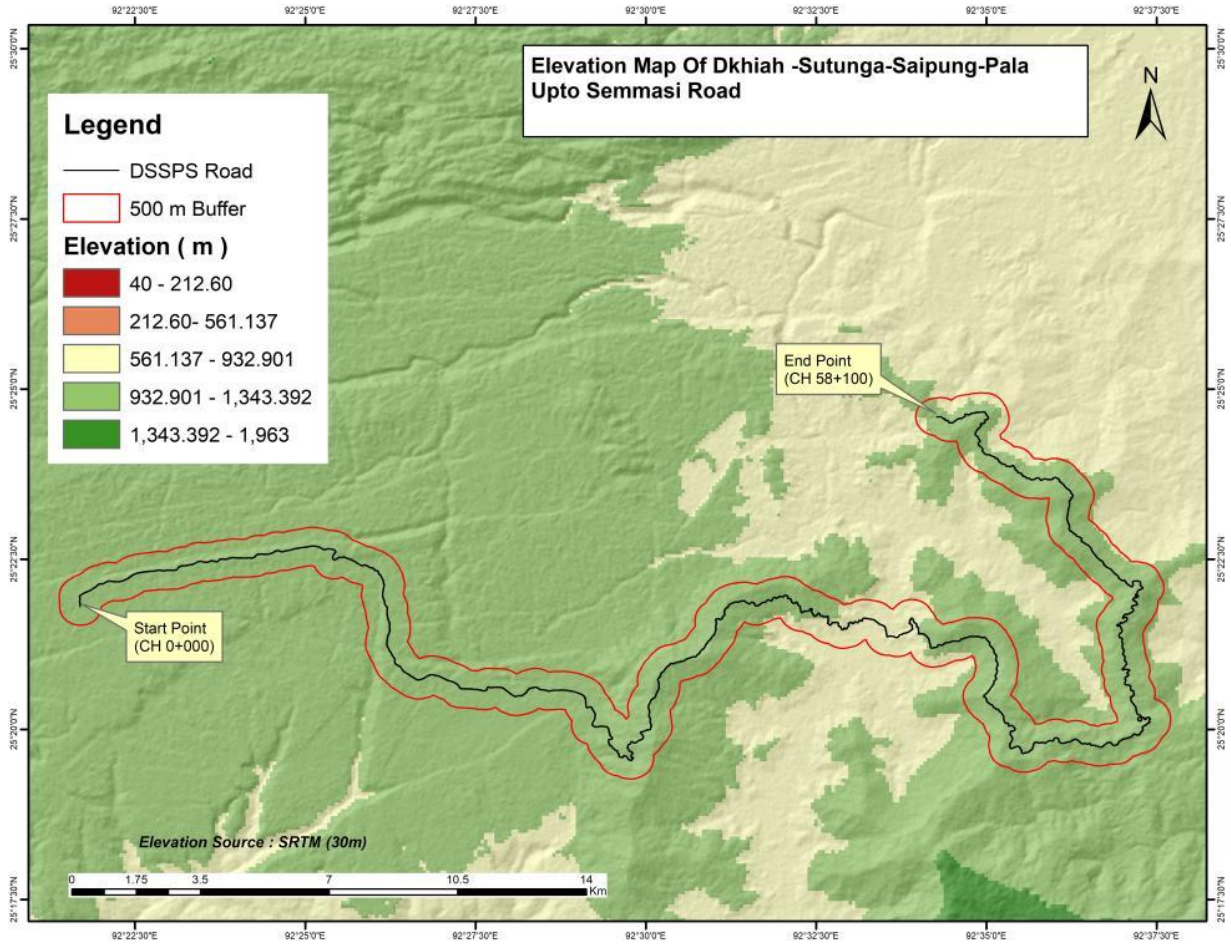


Figure 5.2: Elevation map of the project road (Elevation Source: SRTM (30m)

5.3.2 Geology

Baseline Scenario for Project Road: The sub project road traverses diverse geological formations of East Jaintia Hills. At the starting stretch near Dkhiah, the alignment passes through a sequence dominated by arkose and gritty sandstone interbedded with coal, fireclay, and shale, which form part of the coal-bearing measures typical of this region. Moving eastward, the corridor enters extensive bands of fossiliferous limestone and calcareous shale–sandstone, which are of particular significance given the presence of cement-grade limestone deposits in the district. While these strata generally provide strong foundation conditions, the potential for karstic features or quarrying-related disturbances must be considered. Further along the alignment, towards Saipung and the eastern section near Semmasi, the road passes through mixed sandstone and carbonaceous shale formations with occasional conglomerate and limestone intercalations. These units show variable strength, with sandstone being more competent and carbonaceous shale more prone to weathering and erosion. The terminal stretches of the corridor also encounter a lithological mix of sandstone, shale, siltstone, limestone, and conglomerate, reflecting the complex sedimentary environment of the region. Overall, the geological setting of the alignment indicates that while limestone and sandstone zones provide relatively stable foundations, coal- and shale-rich areas demand careful geotechnical assessment and slope management to ensure long-term stability of the road.

The geology of the project road is depicted in **Figure 5.3**.

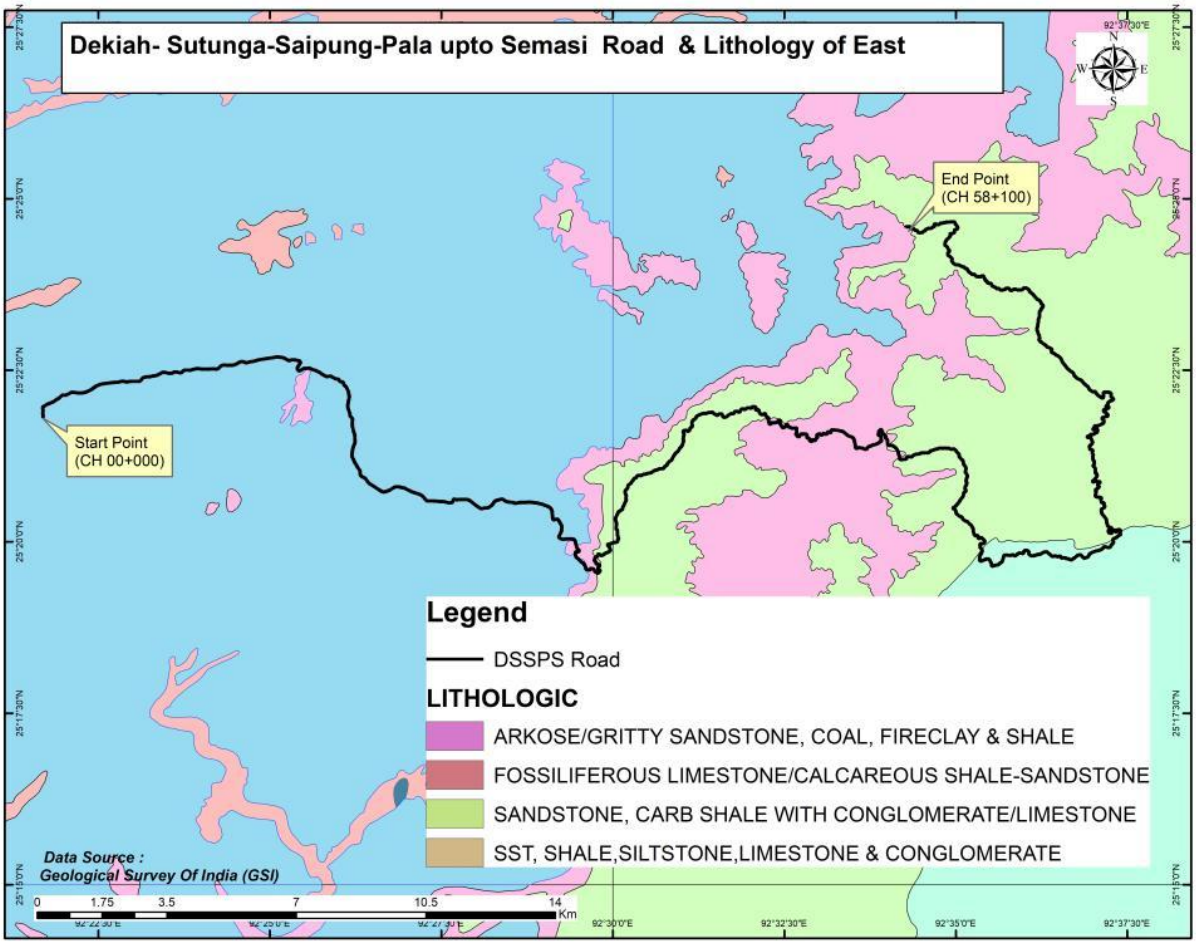


Figure 5.3 Local geology of the project road

5.3.3 Geo-Morphology and Soils

The region is shaped by **tectonic forces** and **erosional processes**, with its landscape being highly dynamic due to active faulting, erosion, and sediment deposition.

Key geomorphological features:

1. **Hilly Terrain**: The region consists of **hilly and undulating landforms**, with the elevation varying significantly. Steep slopes are common, especially in the southern parts.
2. **River Valleys**: Major rivers like the **Umngot** and **Myntdu** flow through the region, cutting through the hills and creating deep valleys. These rivers have formed narrow, deep gorges, contributing to the area's ruggedness.
3. **Karst Features**: Some areas exhibit **karst topography**, especially in limestone regions. Features like caves, sinkholes, and limestone outcrops are prevalent.
4. **Erosion and Landslides**: The steep slopes, combined with heavy rainfall, make the region prone to **soil erosion** and **landslides**, particularly during the monsoon season.

Soil:

The soil types in East Jaintia Hills are influenced by the varied topography, rock types, and climatic conditions. The soils are predominantly **loamy to sandy**, with high organic content in certain areas, especially where vegetation is dense.

The block-wise soil type and land slope is given in below **Table 5.4**.

Table 5.4: District/Block wise major soil area and Land Slope for East Jaintia Hill

District/Block	Soil Type	Area(ha)	Land Slope		
			3-8% (ha)	8-25% (ha)	>25% (ha)
East Jaintia Hills	Fine Loam	98999	22188	93763	83986

***Source**: District Irrigation Plan, East Jaintia Hills (2016-2020)*

Baseline Scenario for Sub- Project Road

The Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road section in East Jaintia Hills district soils are predominantly acidic red and yellow soils—sandy, reddish-brown to yellow-brown loamy textures—derived from weathered sandstones and other sedimentary formations of the Jaintia Hills region. The district spans approximately 204,000 ha, with steep slopes (>25%) likely covering a substantial portion, moderate slopes (8–25%) occupying a significant area, gentle slopes (3–8%) forming a smaller fraction, and flat land (0–3%) making up only a minimal extent (exact hectare breakdown not presently published). Given the fragile, highly leached soils combined with steep and rugged terrain, implementing slope stabilization, effective drainage, and bioengineering measures is essential for sustainable road and infrastructure development.

Geomorphological map of the project road is depicted in the **Figure 5.4**.

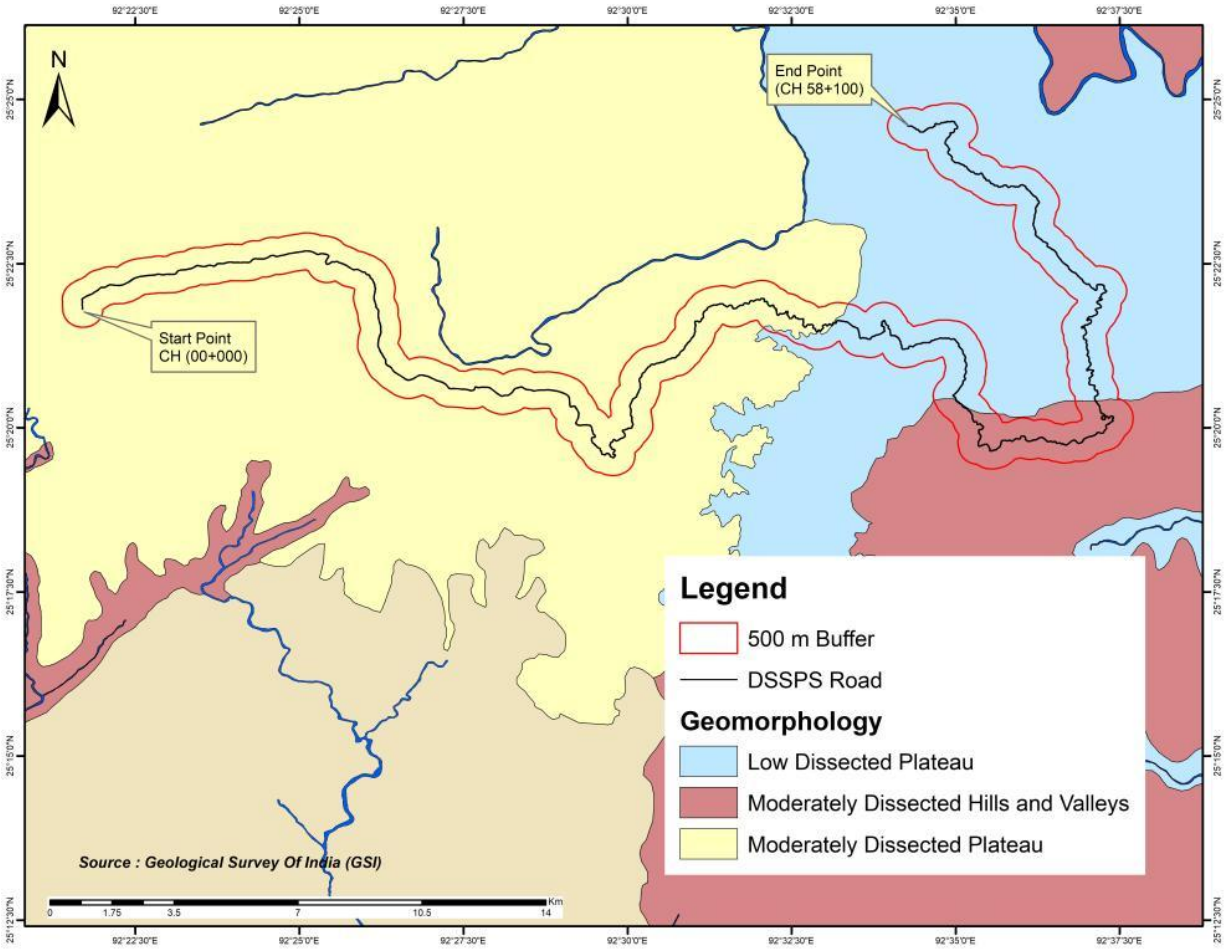


Figure 5-4: Geomorphological map of East Jaintia Hills

5.3.4 LAND USE PATTERN

Baseline Scenario of the DSSPS Road

The Land Use and Land Cover (LULC) within 500 m of Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road (0- 58.100 Km) is dominated by scrubland land (62%), followed by unclassed forest (8%), plantation (16%), settlement (7%), Industry/Quarry (1%), cropland (3%) and the water bodies (3%) comprising crop land, water bodies, shifting cultivation and fallow areas. The alignment does not pass through any Forest area, Protected Area, National Park, Wildlife Sanctuary or Wetland. The Land Use/Land Cover map of the project road corridor is presented in **Figure 5.5**.

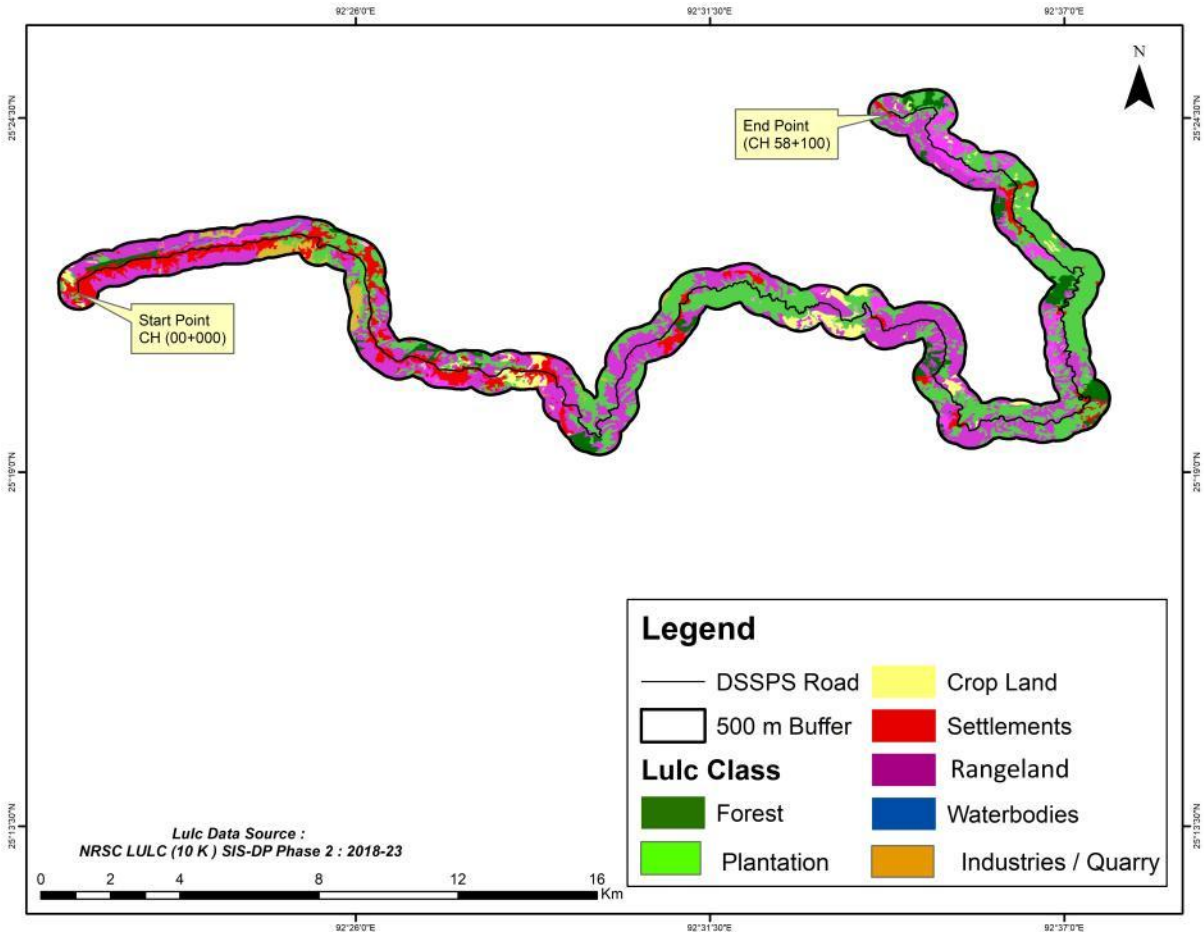


Figure 5.5: Land Use/Land Cover map of project road corridor

5.3.5 AGRICULTURE

Baseline Scenario in Project Corridor Area

According to the consultations that was organized with the Indigenous communities, it was found that agriculture remains the main livelihood practice. The traditional practice of shifting cultivation (jhum) is still present among local households, particularly on steeper slopes and marginal lands, though it is not the dominant or primary form of farming for the majority of households in the area. Key crops grown in the DSSPS road area include paddy, maize, sesame, millet, jowar, cauliflower, cabbage, chilli, 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

The soils of East Jaintia Hills District are predominantly loamy and lateritic, and are generally acidic in nature. These soils are mostly found in hilly and sloped terrains and are highly prone to erosion during the heavy monsoon rains. In the valley bottoms and along river plains, more fertile alluvial soils occur, supporting intensive agricultural activities.

Soil monitoring was conducted at 05 locations in the month of October, 2025. 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.	Project Area	Monitoring Location	Sample Code	Geographical Coordinate	
				Latitude	Longitude
1	DSSPS Road	Dkhiah (Agriculture field)	SQ1	25°21'53.95"N	92°21'42.05"E
2		Tluh (paddy field)	SQ2	25°20'35.04"N	92°28'18.06"E
3		Moolasngi (Agriculture Field)	SQ3	25°21'50.78"N	92°32'14.88"E
4		Saipung (Agriculture Field)	SQ4	25°20'11.28"N	92°37'15.39"E
5		Samasi (Agriculture Field)	SQ5	25°24'1.10"N	92°33'0.01"E

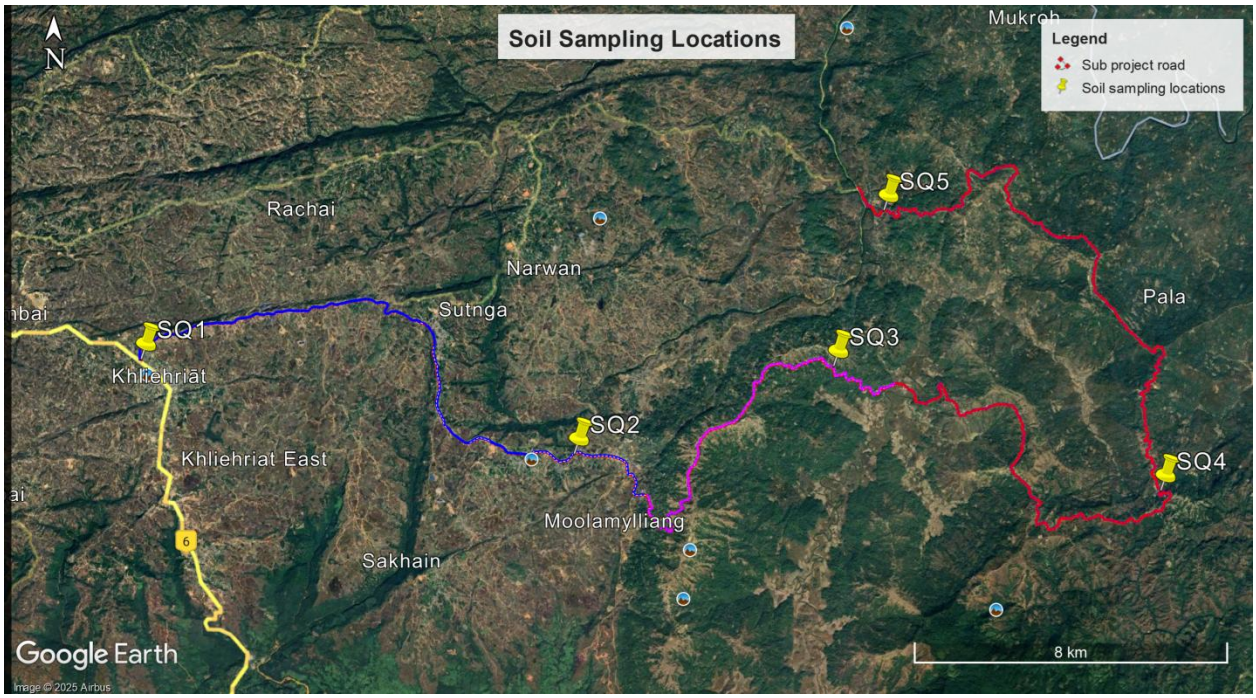


Figure 5.6: Soil monitoring locations

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

Sl. No.	Parameters	Units	SQ1	SQ2	SQ3	SQ4	SQ5	Test Method
1	Colour		Brown	Brown	Brown	Brown	Brown	STRL/STP/SOIL/01
2	Textural Class		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	IS2720 (P-4),1985 (Reaff: 2015)

Sl. No.	Parameters	Units	SQ1	SQ2	SQ3	SQ4	SQ5	Test Method
3	Bulk Density	gm/cm^3	1.7	1.5	1.9	2.1	2.5	IS 14765: 2000, RA 2010
4	Water Holding Capacity	%	21.0	24.6	22.6	20.5	23.8	STRL/STP/SOIL/01
5	Sand	%	50.6	51.6	54.4	53.0	53.7	IS2720 (P-4),1985 (Reaff: 2015)
6	Silt	%	23.8	22.8	22.2	20.8	21.5	IS2720 (P-4),1985 (Reaff: 2015)
7	Clay	%	25.6	25.7	23.4	26.2	24.8	IS2720 (P-4),1985 (Reaff: 2015)
8	pH (1:2 Suspension)	-	2.8	3.0	2.9	1.5	2.2	IS:2720 (P-26), 1987 (Reaff:2011)
9	Electrical Conductivity(1:2)	µmhos/cm	218.6	231.7	241.3	239.9	240.6	IS: 14767(2000), RA 2016
10	Organic Matter	%W/W	1.2	1.9	1.4	1.5	1.1	STRL/STP/SOIL/01
11	Exchangeable Calcium	mg/kg	812.6	842.4	736.4	735.0	735.7	IS 2720 (Part 24): 1976, RA 2010
12	Exchangeable Magnesium	mg/kg	237.6	207.4	287.4	286.0	286.7	IS 2720 (Part 24): 1976, RA 2010
13	Copper	mg/kg	1.4	1.6	1.8	1.9	2.1	IS 2720(Part-27): 1977
14	Nickel	mg/kg	0.9	0.6	1.2	1.7	1.4	IS 2720(Part-27): 1977
15	Chromium	mg/kg	1.1	0.3	0.9	1.2	1.7	IS 2720(Part-27): 1977
16	Lead	mg/kg	0.3	0.4	0.4	0.3	0.6	IS 2720(Part-27): 1977
17	Sulphate	mg/kg	13.2	13.7	16.2	14.8	15.5	IS 2720(Part-27): 1977
18	Total Nitrogen (as N)	%	0.2	0.2	0.3	0.4	0.4	IS:10158:1982, RA 2009
19	Available Phosphorous	mg/kg	7.6	8.4	6.4	5.0	5.7	IS:10158:1982, RA 2009
20	Exchangeable Potassium	mg/kg	92.6	85.4	78.4	77.0	77.7	STRL/STP/SOIL/01

5.3.6.1 SUMMARY OF RESULTS

The soil samples (SQ1–SQ5) from the study area were uniformly brown in colour and classified as Sandy Loam, with sand content ranging between 50.6–54.4%, silt 20.8–23.8%, and clay 23.4–26.2%. Bulk density varied from 1.5 to 2.5 g/cm³, while water-holding capacity ranged between 20.5–24.6%. Soil pH was found to be highly acidic (1.5–3.0), and electrical conductivity remained low to moderate (218–241 µmhos/cm). Organic matter content was generally low (1.1–1.9%). Exchangeable calcium and magnesium ranged from 735–843 mg/kg and 207–287 mg/kg, respectively. Trace metals such as copper (1.4–2.1 mg/kg), nickel (0.6–1.7 mg/kg), chromium (0.3–1.7 mg/kg), and lead (0.3–0.6 mg/kg) were present in low concentrations. Nutrient levels indicated low fertility, with total nitrogen (0.2–0.4%), available phosphorus (5.0–8.4 mg/kg), and exchangeable potassium (77–93 mg/kg). Overall, the soil is sandy loam with very acidic pH, low organic content, and low nutrient status.

5.4 WATER ENVIRONMENT

This section describes the Hydrogeology of East Jaintia Hills district, Surface and Ground water conditions and relevant water quality standards in the sub-project area.

5.4.1 HYDROGEOLOGY

Impacts on water quality, including surface water and groundwater, as well as flood risks, are expected to occur primarily during the construction phase. These impacts are typically linked to ground disturbance, dewatering activities, accidental release of pollutants, or works near or within watercourses. Such effects are common in road construction projects, and well-established mitigation measures are available. It is proposed that avoidance strategies, good international practices, and project-specific mitigation measures will be incorporated into the ESMP. These measures are considered effective in mitigating impacts on sensitive receptors, ensuring that no significant adverse effects arise from the project. Additionally, key hydrological features, such as river crossings and open streams, will be mapped and described in the ESIA report to identify potential issues and inform appropriate mitigation strategies.

Water bodies along project road corridor are primarily represented by Kwai, Letein and waikh as observed during field studies. Surface water quality testing will be conducted in the river and other key sensitive ponds and streams to ensure water safety and identify any potential contamination. If required, the contractor will be instructed to implement appropriate mitigation measures to maintain water quality during construction. (refer to ESMP and Section 6.4.2.7)

Road construction projects are water-intensive, requiring a substantial volume of water throughout the construction period. As discussed with the DPR team, surface water is proposed as the primary source for construction purposes, subject to prior permission from the competent authority. In exceptional cases where surface water is unavailable, groundwater resources may be utilized. The project area has been classified as 'safe' by the CGWB; therefore, no further detailed groundwater assessment is required within the scope of this ESIA study.

5.4.2 Ground Water Quality

Three ground water samples have been selected from sources present along the project road to ascertain the baseline conditions of the ground water quality. The Ground water samples were collected in the month of October. Location details of the surface water samples are presented in Table 5.7 and shown in Figure 5.7. Results of the Surface water quality are shown in Table 5.8.

Table 5.7: Ground Water (Tap water) Monitoring Locations

Sl. No.	Project Area	Monitoring Location	Sample Code	Geographical Coordinate	
				Latitude	Longitude
1	DSSPS road	Dkhiah	WQ1	25°21'53.45"N	92°21'44.65"E
2		Tluh	WQ2	25°20'35.24"N	92°28'18.18"E
3		Moolasngi	WQ3	25°21'50.58"N	92°32'13.43"E
4		Saipung	WQ4	25°20'11.18"N	92°37'16.56"E
5		Samasi	WQ5	25°24'1.39"N	92°33'1.27"E

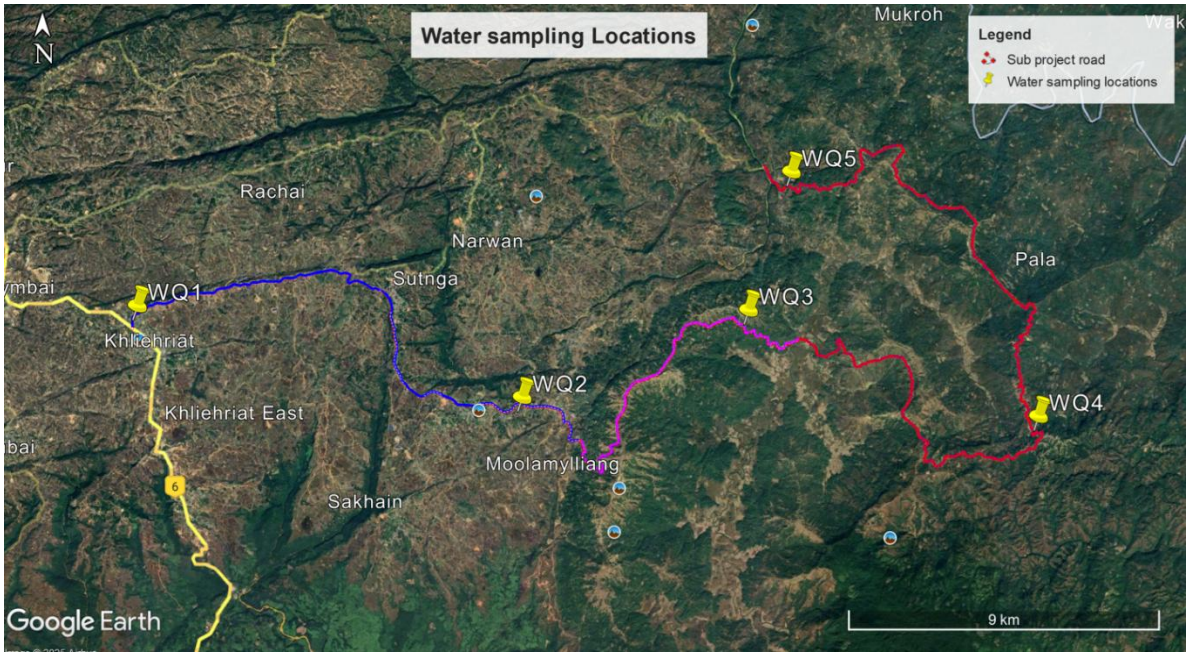


Figure 5.7: Water monitoring locations

Table 5.8: Ground Water sampling results in the project area

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	GW-4	GW-5
			Desirable Limit	Permissible Limit					
1	Color	Hazen	5	15	<5	<5	<5	<5	<5
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	1	5	<1	<1	<1	<1	<1
5	pH	-	6.5-8.5	No Relaxation	6.5	6.9	6.7	7.1	6.6
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	131	123	118	127	136
7	Iron (as Fe)	mg/l	0.3	No Relaxation	0.10	0.17	0.23	0.25	0.20
8	Chlorides (as Cl)	mg/l	250	1000	19.2	21.7	20.5	22.8	23.6
9	Fluoride (as F)	mg/l	1	1.5	BDL	BDL	BDL	BDL	BDL
10	TDS	mg/l	500	2000	171	183	188	174	162

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	GW-4	GW-5
			Desirable Limit	Permissible Limit					
11	CALCIUM (as Ca2+)	mg/l	75	200	20.8	23.2	19.7	18.9	21.7
12	MAGNESIUM (as Mg2+)	mg/l	30	100	18.4	15.6	14.9	13.8	15.3
13	Sulphate (as SO_4)	mg/l	200	400	10.2	14.3	12.9	13.6	15.8
14	Total Chromium (as Cr)	mg/l	0.05	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
15	Alkalinity as $CaCO_3$	mg/l	200	600	123.2	119.5	127.6	130.8	112.6
16	Aluminium (as Al)	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01	<0.01
17	Total Arsenic (as As)	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
18	Copper (as Cu)	mg/l	0.05	1.5	<0.05	<0.05	<0.05	<0.05	<0.05
19	Manganese (as Mn)	mg/l	0.1	0.3	<0.01	<0.01	<0.01	<0.01	<0.01
20	Zinc (as Zn)	mg/l	5	15	0.16	0.15	0.12	0.19	0.25
21	Ammonia (as NH3-N)	mg/l	0.5	No Relaxation	<0.1	<0.1	<0.1	<0.1	<0.1
22	Anionic Detergents (as MBAS)	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1	<0.1
23	Boron (as B)	mg/l	0.5	1	<0.5(BDL)	<0.5(BDL)	<0.5(BDL)	<0.5(BDL)	<0.5(BDL)
24	Mineral Oil	mg/l	0.5	No Relaxation	<0.1	<0.1	<0.1	<0.1	<0.1

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	GW-4	GW-5
			Desirable Limit	Permissible Limit					
25	Phenolic Compound (as C6H5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
26	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.002	<0.002	<0.002	<0.002	<0.002
27	Cyanide (as CN)	mg/l	0.05	No Relaxation	<0.1	<0.1	<0.1	<0.1	<0.1
28	Lead	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
29	Mercury (as Hg)	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
30	Nickel (as Ni)	mg/l	0.02	No Relaxation	<0.02	<0.001	<0.001	<0.001	<0.001
31	Residual Free Chlorine	mg/l	0.2	1.0	<0.2	<0.02	<0.02	<0.02	<0.02
32	Molybdenum (Mo)	mg/l	<0.05	0.07	No Relaxation	<0.2	<0.2	<0.2	<0.2
33	Polynuclear Aromatic Hydrocarbons	mg/l	<0.0001	0.0001	No Relaxation	No Relaxation	No Relaxation	No Relaxation	No Relaxation
34	Poly chlorinated biphenyl	mg/l	<0.0001	0.0005	No Relaxation	No Relaxation	No Relaxation	No Relaxation	No Relaxation
35	Nitrate	mg/l	45	No Relaxation	9.1	8.6	8.9	8.0	10.5
36	Sodium (as Na^+)	mg/l	-	-	20.8	19.6	18.6	18.9	21.2
37	Potassium (as K^+)	mg/l	-	-	5.1	7.7	7.2	7.0	6.8

S. No.	Parameters	Unit	Limit (IS-10500:2012)		GW-1	GW-2	GW-3	GW-4	GW-5
			Desirable Limit	Permissible Limit					
Microbiological Parameters									
36	Total Coli form	MPN/ 100ml	Shall not be detectable in any 100 ml of sample		<1	<1	<1	<1	<1
37	E.Coli	E.Coli/ 100ml	Shall not be detectable in any 100 ml of sample		Absent	Absent	Absent	Absent	Absent

5.4.3 Summary of results

Ground water

The groundwater samples (GW-1 to GW-5) generally comply with the IS 10500:2012 drinking water standards. All samples were clear (<5 Hazen), with agreeable colour, odour and taste, and turbidity <1 NTU. The pH ranged from 6.5 to 7.1, falling within the desirable limits. Total hardness (118–136 mg/L), TDS (162–188 mg/L), calcium (18.9–23.2 mg/L) and magnesium (13.8–18.4 mg/L) were well within permissible limits, indicating soft to moderately hard water. Major ions such as chlorides (19–24 mg/L), sulphates (10–16 mg/L) and alkalinity (112–131 mg/L) were also low. Fluoride was below detection in all samples.

Heavy metals including chromium, aluminium, arsenic, copper, manganese, cadmium, lead, mercury and nickel were all below detectable limits, reflecting absence of contamination. Zinc was present in low concentrations (0.12–0.25 mg/L). Nutrients such as nitrate (8.0–10.5 mg/L) and ammonia (<0.1 mg/L) were low. Parameters like anionic detergents, mineral oil, phenolic compounds, cyanide, PAHs and PCBs were not detected.

Microbiological quality was excellent, with total coliform <1 MPN/100 mL and E. coli absent in all samples. Overall, the groundwater quality in the area is good and meets drinking water standards for all key physico-chemical and biological parameters.

5.4.4 Surface Water Quality

Surface water samples have been selected from sources present along the project road to ascertain the baseline conditions of the surface water quality. The surface water samples collected included samples from river in the month of October. Location details of the surface water samples are presented in Table 5.9 and shown in Figure 5.8. Results of the surface water quality are shown in Table 5.10.

Table 5-9: Surface Water Sampling Locations

Sl. No.	Project Area	Monitoring Location	Sample Code	Geographical Coordinate	
				Latitude	Longitude
1	DSSPS road	Lumthari Ch 31+000	SW1 River Letein	25°21'24.31"N	92°33'31.88"E

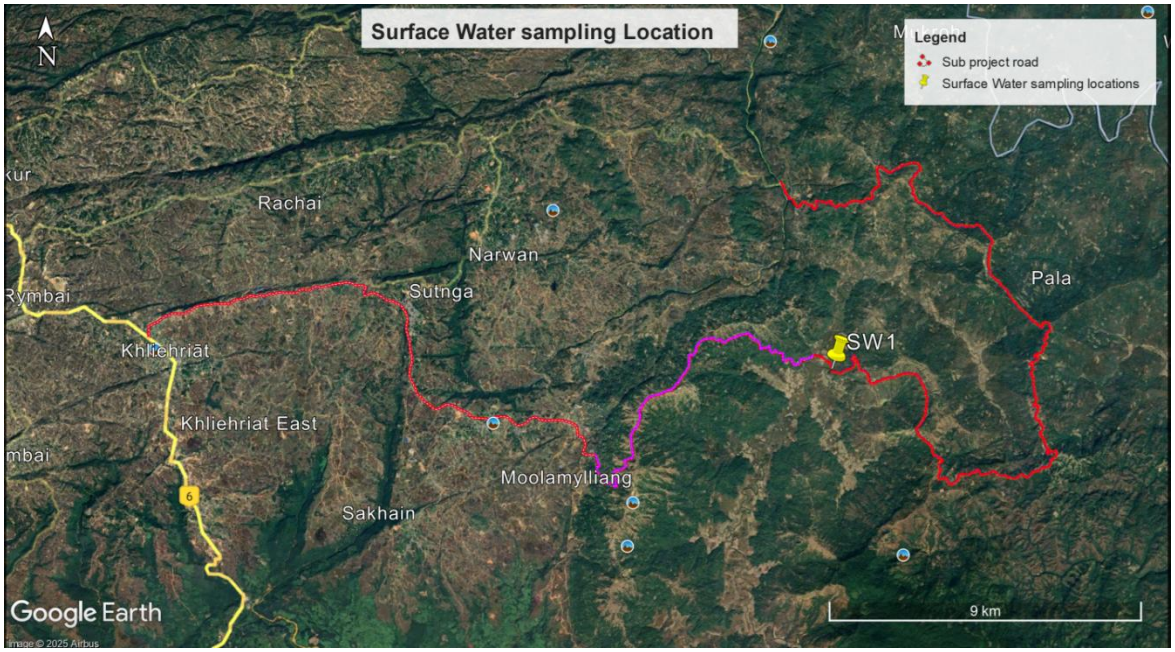


Figure 5.8: Surface Water monitoring locations

Table 5.10: Surface Water sampling results in the project area

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C) Tolerance Limit	SW-1 River Letein	Test method
1	pH	-	6.5 -8.5	7.10	IS: 3025(Pt-11)1983, RA. 2002
2	Temperature	°C	-	19.2	APHA 23nd Edn.2017-2550 B
3	D.O	mg/l	Minimum -4	6.8	IS 3025(Part-38): 2006
4	BOD	mg/l	30	5.20	IS 3025(Part-44):1993, RA 2009
5	Colour	Hazen	300	5	IS: 3025 (Pt-4) 1983, RA 2017
6	Odour	-	-	Agreeable	IS: 3025(Pt-5)
7	TDS	mg/l	1500	234.5	IS 3025(Part-16): 1984, RA 2006
8	TSS	mg/l	-	20.7	IS 3025(Part-17)
9	TKN	mg/l		2.3	IS: 3025(Pt-34)1988, RA. 2003
10	Ammonical Nitrogen	mg/l		0.48	IS: 3025(Pt-34)1988, RA. 2003

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C)	SW-1 River Letein	Test method
			Tolerance Limit		
11	Nitrate (as NO_3)	mg/l	50	2.3	IS: 3025(Pt-34)1988, RA. 2003
12	Free Ammonia	mg/l		<0.1	IS: 3025(Pt-34)1988, RA. 2003
13	Chlorides (as Cl)	mg/l	600	29.3	IS 3025(Part-32): 1988
14	Sulphates (as SO_4)	mg/l	400	33.4	IS 3025(Part-24):1986, RA 2003
15	Fluoride (as F)	mg/l	1.5	0.48	APHA 21st Ed., 4500F(D)
16	Oil & Grease	mg/l	0.1	<0.1	IS 3025(Part-39):1991, RA 2009
17	Phenolic Compound (as C_6H_5OH)	mg/l	0.005	<0.001	5530-B, C&E, APHA 23nd 2017
18.	Arsenic	mg/l	0.2	<0.1	3110- B, APHA 23nd Ed. 2017 (AAS)
19	Mercury (as Hg)	mg/l	-	<0.001	3110- B, APHA 23nd Ed.2017
20	Lead (as Pb)	mg/l	0.1	0.02	3110- B, APHA 23nd Ed. 2017 (AAS)
21	Cadmium (as Cd)	mg/l	0.01	0.001	3110- B, APHA 23nd Ed. 2017 (AAS)
22.	Chromium (as Cr^{+6})	mg/l	0.05	0.02	IS 3025(Part-52): 200
23.	Copper (as Cu)	mg/l	1.5	0.12	3110- B, APHA 23nd Ed. 2017 (AAS)
24.	Zinc (as Zn)	mg/l	15	0.14	3110- B, APHA 23nd Ed. 2017 (AAS)
25	Selenium (as Se)	mg/l	-	<0.1	IS: 3025 (P- 56)
26.	Anionic detergents (as	mg/l	1.0	<0.1	Annexure K Of IS 13428

Sl. No.	Parameters	Unit	IS: 2296 - 1992 (Class C) Tolerance Limit	SW-1 River Letein	Test method
	MBAS)				
27.	Iron (as Fe)	mg/l	50	0.45	3500-Fe- B, APHA 23nd Ed. 2017
28.	Sulphide (as H_2S)	mg/l	-	0.18	IS-3025 (P-29)
29.	Phosphate (as PO_4)	mg/l	-	5.46	APHA 22nd Edn.2012-4500-P C
30.	Cyanide (as CN)	mg/l	0.05	<0.1	4500-CN-B, C & E, APHA 23nd Ed.2017
31.	Manganese (as Mn)	mg/l	-	0.03	3110- B, APHA 23nd Ed.2017
32.	COD	mg/l	-	16.3	IS 3025(Part-58): 2006
33.	Total Coli form	MPN/100ml	5000	945	IS: 1622-1981

Summary of results

The surface water quality at location SW-1 indicates that most parameters fall well within the IS 2296 Class C (drinking water source with conventional treatment) limits. The pH (7.10) is neutral and within the acceptable range, while temperature was 19.2°C. Dissolved oxygen (6.8 mg/L) meets the minimum requirement (>4 mg/L), and BOD (5.2 mg/L) is much lower than the allowable 30 mg/L, reflecting good oxygenation and low organic pollution. Colour (5 Hazen), odour, TDS (234.5 mg/L) and TSS (20.7 mg/L) were found within desirable levels. Nutrients such as TKN (2.3 mg/L), ammonical nitrogen (0.48 mg/L), nitrate (2.3 mg/L), and phosphate (5.46 mg/L) were low, indicating limited nutrient enrichment.

Major ions including chlorides (29.3 mg/L), sulphate (33.4 mg/L) and fluoride (0.48 mg/L) also comply with standards. Oil & grease, phenols, arsenic, mercury, cadmium, chromium (VI), cyanide, and anionic detergents were below detectable or very low, suggesting absence of toxic industrial contamination. Metals such as lead (0.02 mg/L), copper (0.12 mg/L), zinc (0.14 mg/L), manganese (0.03 mg/L) and iron (0.45 mg/L) were present in trace quantities and within permissible limits. COD was moderately low at 16.3 mg/L.

Microbiological analysis showed total coliform count of 945 MPN/100 mL, which is below the Class C limit of 5000 MPN/100 mL. Overall, the water quality at SW-1 is satisfactory and suitable for Class C designated use after conventional treatment and disinfection.

5.5 AIR ENVIRONMENT

5.5.1 AIR QUALITY

While there are no major industries along the project road, coke oven plants and mining activities in the broader region may contribute to localized air quality concerns. However, based on site observations and public consultations conducted along the project corridor, no significant ambient air quality issues were observed at or near the alignment. Vehicular emissions remain the primary local source of air pollution.

Residential and other sensitive locations proximity to roads were the criteria used for selecting the sample locations (Table 5.11). Five locations were selected for air quality monitoring. Monitoring was done in the month of October. Parameters like Particulate Matter (PM 10), Particulate Matter (PM 2.5), Sulphur dioxide (SO2), Nitrogen dioxide (NO2) and Carbon Monoxide (CO) were monitored. Map showing monitoring locations are given in Figure 5.9. Ambient air quality results are given in Table 5.12.

Table 5-11: Air Monitoring Locations

Sl. No.	Project Area	Monitoring Location	Sample Code	Geographical Coordinate	
				Latitude	Longitude
1	DSSPS road	Dkhiah	AAQ1	25°21'53.23"N	92°21'43.025"E
2		Tluh	AAQ2	25°20'34.12"N	92°28'18.56"E
3		Moolasngi	AAQ3	25°21'51.42"N	92°32'15.34"E
4		Saipung	AAQ4	25°20'10.19"N	92°37'16.45"E
5		Samasi	AAQ5	25°24'1.37"N	92°33'1.26"E

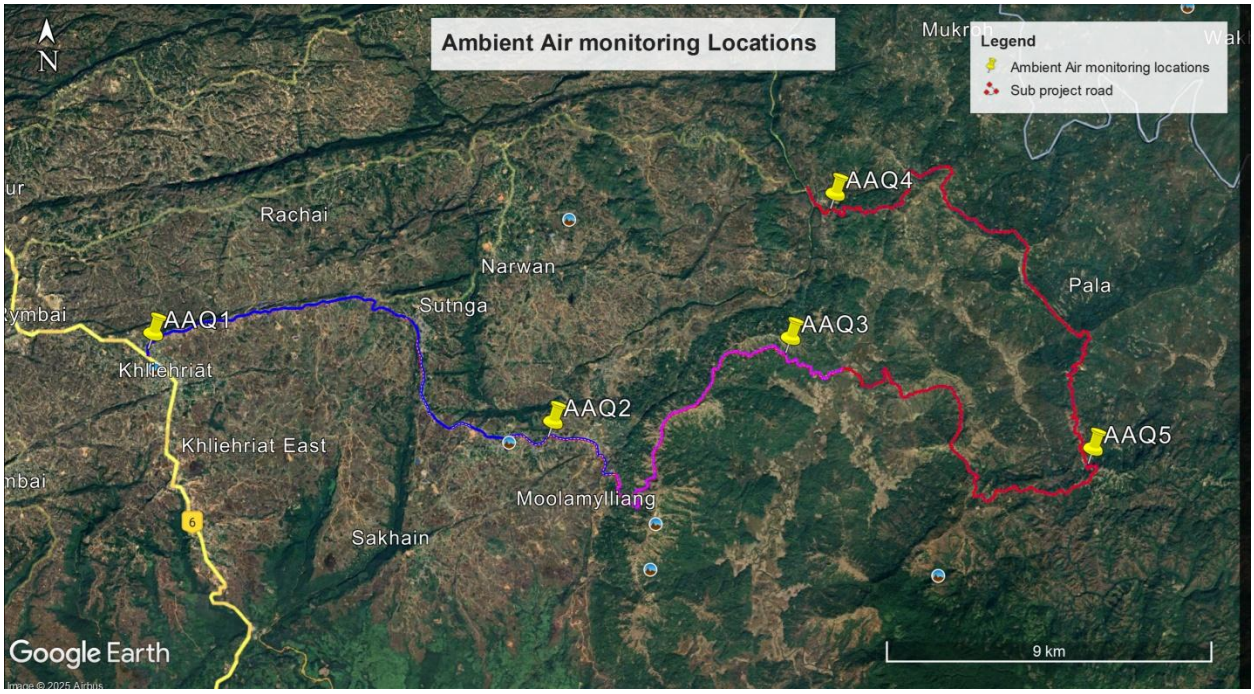


Figure 5.9: Air monitoring locations

Table 5.12: Ambient Air Quality Monitoring Results

Sl. No.	Project Area	Location	Sample Code	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	DSSPS road	Dkhiah	AAQ1	72.7	39.5	7.8	9.5	0.350
2		Tluh	AAQ2	57.4	29.2	6.7	7.9	0.240
3		Moolasngi	AAQ3	51.2	27.5	6.2	7.2	0.210
4		Saipung	AAQ4	69.8	34.7	7.3	8.5	0.290
5		Samasi	AAQ5	52.6	28.4	6.4	7.6	0.230
National Ambient Air Quality Standards, Central Pollution Control Board, 2009				100	60	80	80	2000

5.5.2 SUMMARY OF RESULTS

The ambient air quality monitored at five locations (AAQ1–AAQ5) shows that all parameters are well within the National Ambient Air Quality Standards (NAAQS, CPCB 2009). PM_{10} levels ranged from 51.2 to 72.7 µg/m³, and $PM_{2.5}$ from 27.5 to 39.5 µg/m³, both remaining below their respective limits of 100 µg/m³ and 60 µg/m³. Gaseous pollutants were observed at low concentrations: SO_2 (6.2–7.8 µg/m³) and NO_2 (7.2–9.5 µg/m³) were far below the 80 µg/m³ standard. Carbon monoxide levels (0.210–0.350 µg/m³) were also negligible compared to the limit of 2000 µg/m³. Overall, the area exhibits good ambient air quality, with no exceedance of regulatory standards.

5.6 NOISE ENVIRONMENT

There are no major industries along the project road; mining activities in the wider region may contribute to occasional background noise levels. However, based on initial site observations and public consultations along the project corridor, no significant noise issues were reported or observed near the alignment. Vehicular traffic remains the primary local source of noise.

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 is monitored over a period of 24 hour by the authorized NABL laboratory. The noise monitoring has been conducted for determination of noise levels at five locations for (Figure 5.10) in the month of October as per Table 5.13 below. Results are given in Table 5.14.

Table 5.13: Noise Monitoring Locations

Sl. No.	Project Area	Monitoring Location	Sample Code	Geographical Coordinate	
				Latitude	Longitude
1	DSSPS road	Dkhiah	NQ1	25°21'53.23"N	92°21'43.025"E
2		Tluh	NQ2	25°20'34.12"N	92°28'18.56"E

3		Moolasngi	NQ3	25°21'51.42"N	92°32'15.34"E
4		Saipung	NQ4	25°20'10.19"N	92°37'16.45"E
5		Samasi	NQ5	25°24'1.37"N	92°33'1.26"E

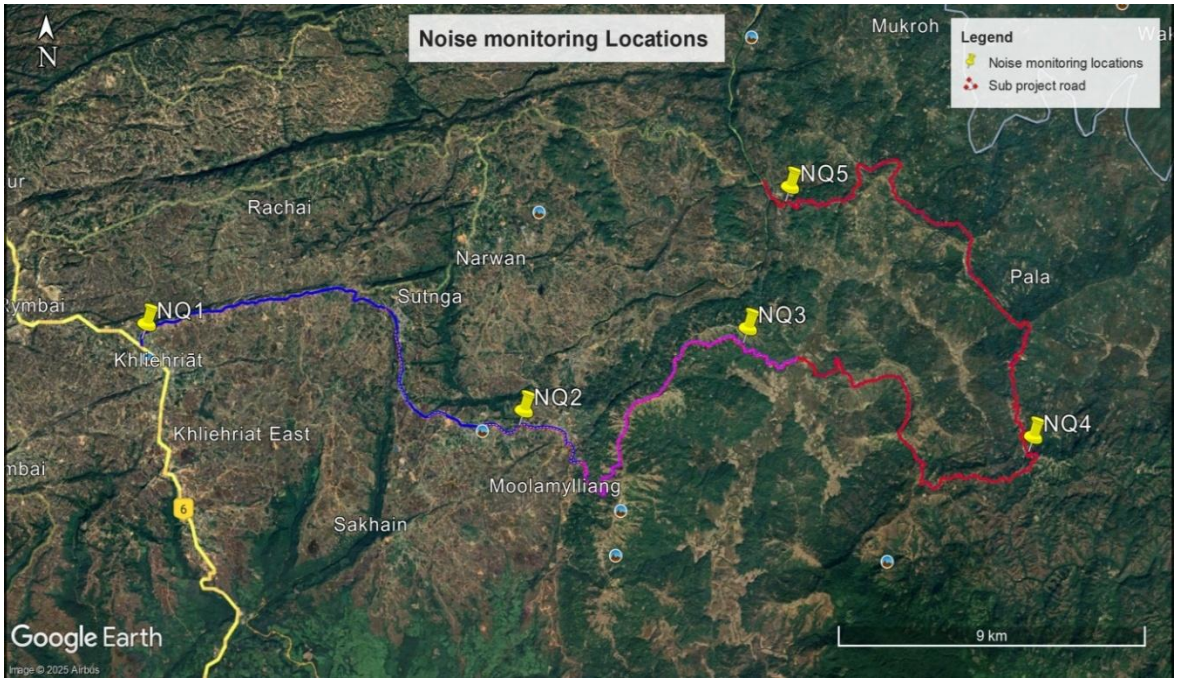


Figure 5.10: Noise monitoring locations

Table 5-14: Analysis of Noise Level Monitoring

Location	Land Use	Standards dB(A)		Day Time Leq (dB(A))	Night Time- Leq (dB(A))
		Day	Night		
Dkhiah	Commercial	65	55	59.8	39.4
Tluh	Residential	55	45	49.5	34.9
Moolasngi	Residential	55	45	50.8	36.4
Saipung	Commercial	65	55	58.9	38.8
Samasi	Residential	55	45	48.7	34.5

5.6.1 SUMMARY OF RESULTS

Ambient noise monitoring at five locations shows that both day-time and night-time noise levels remain within CPCB permissible limits for their respective land-use categories. Commercial areas such as Dkhiah and Saipung recorded day/night levels of 59.8/39.4 dB(A) and 58.9/38.8 dB(A), staying below the limits of 65/55 dB(A). Residential locations Tluh, Moolasngi, and Samasi reported day-time levels of 48.7–50.8 dB(A)

and night-time levels of 34.5–36.4 dB(A), also within the 55/45 dB(A) standards. Overall, noise levels in the study area comply with CPCB standards.

The Central Pollution Control Board (CPCB) has published Ambient Noise Standard with respect to air for different Category Area/Zone and has given limit in dB(A) for Day and Night time with respective categories. The Noise standards issued by CPCB are given in **Table 5.15**.

Table 5.15: CPCB Ambient Noise Level Standards for different Zone/Category Area

Area Code	Category of Area/Zone	Limits in dB(A) Leq	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silent Zone	50	40

5.7 BIOLOGICAL ENVIRONMENT

5.7.1 BIODIVERSITY AND CRITICAL HABITAT IN PROJECT ROAD

The biodiversity within 10 km radius of the DSSPS Road were studied based on the secondary sources followed by primary data collection in the direct impact area. Project Influence Area with 10 km buffer area is presented in **Figure 5.11**. The methodology adopted for biodiversity assessment is attached as **Annexure 5.2.**

A primary biodiversity survey was conducted along the sub project road during the field visit in October 2025. The primary survey specifically recorded 28 tree species, 2 shrub species, 4 herb species, and 6 grass species. In terms of fauna, the primary survey documented 3 bird species. The detail list of flora and fauna is attached as Annexure 5.3.

During primary and secondary survey along the sub project road, a total of 80 species of flora (36 Tree species, 6 Shrubs, 15 Herbs, 17 Fern, and 6 Grass species), 13 mammal species, 40 bird species, 5 reptile species, 3 amphibians and 9 butterfly species were recorded. The detail list of flora and fauna is attached as Annexure 4.3.

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.

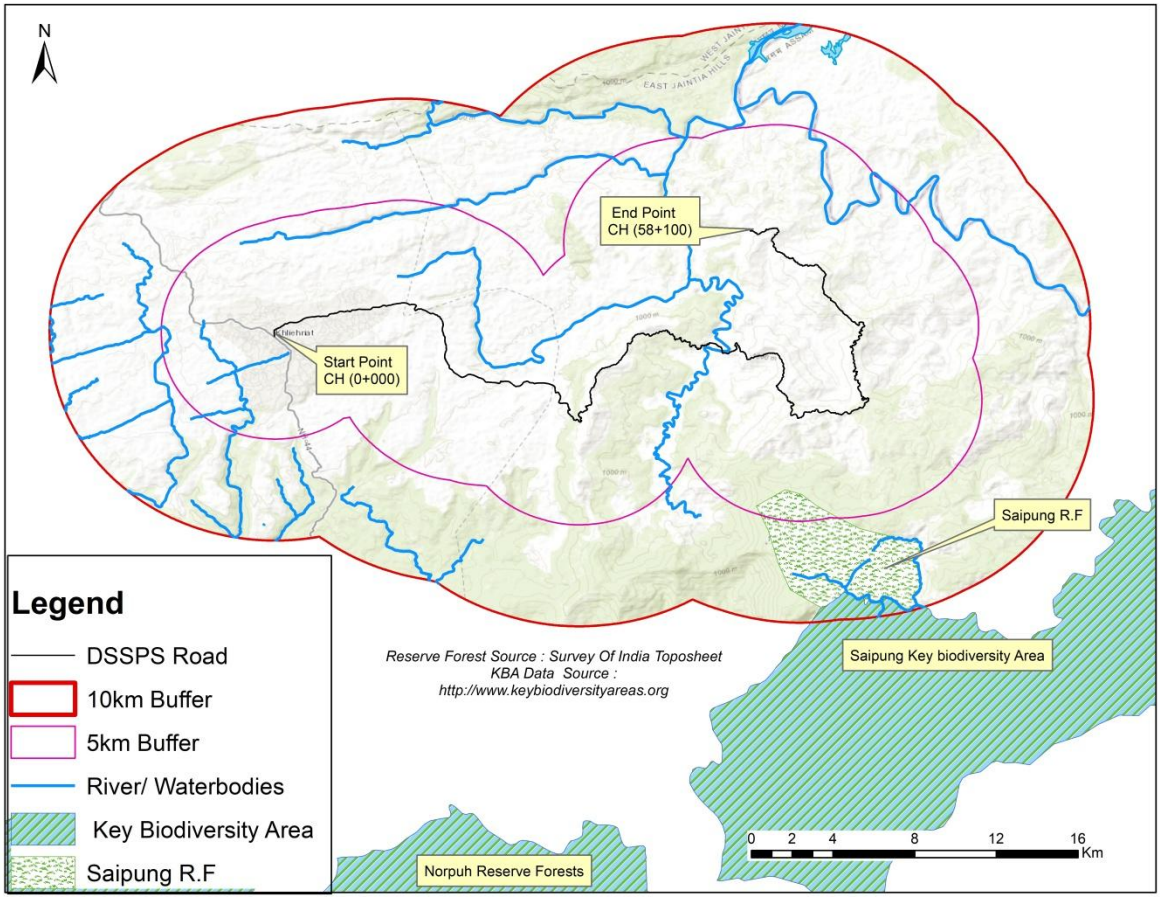


Figure 5.11: Project Influence Area with 10km buffer area for Corridor-1

5.7.2 BIODIVERSITY AND CRITICAL HABITAT IN PROJECT ROAD PIA

The biodiversity within 10 km radius of the DSSPS Road corridor-wise (refer to Section 3.3 on PIA) were studied based on the secondary sources followed by primary data collection in the direct impact area.

Project Influence Area (Within 10 km):

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 species, including the Western Hoolock Gibbon (EN), Chinese Pangolin (CR), Hispid Hare (EN), and Steppe Eagle (EN), are known to occur, 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.

Critical Habitat Screening for the Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road Project is presented in Table 5.16.

Table 5.16: Critical Habitat Screening for the Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road Project

Scientific Name	IUCN Status	Restricted Range	Migratory / Congregatory	Habitat & Distribution	Likelihood of Occurrence in Project Area	Rationale for Critical Habitat Screening	Screened In / Out
Hoolock hoolock (Western Hoolock Gibbon)	Endangered (EN)	NE India & Bangladesh	No	Semi-evergreen & evergreen forests of East Jaintia Hills	Low	These are arboreal species and require contiguous forest cover for movement. There is no contiguous forest cover along the road. Thus the habitat does not exist in the project areas	Screened Out
Neofelis nebulosa (Clouded Leopard)	Vulnerable (*VU*)	*NE India & SE Asia*	No	Dense *evergreen* forest habitats	Low	*No new forest diversion; existing road used*	*Screened Out*
Bos gaurus (Gaur)	*Vulnerable (VU)*	No	No	*Forest fringes around Saipung & Khliehriat*	Low	*No habitat loss due to RoW-based works*	*Screened Out*
Manis pentadactyla (Chinese Pangolin)	Critically Endangered (CR)	*NE India & SE Asia*	No	*Forested slopes & burrows common in Jaintia Hills*	Low	*The pangolins live primarily in forested areas and in burrows. They are elusive and are thus not found near disturbed habits. Since all the improvements are limited within the exiting right of*	*Screened Out*

						way their habitat is unlikely within the project direct impact.	
Panthera pardus (Leopard)	*Vulnerable (VU)*	No	*No*	*Forest edges across Jaintia Hills*	Low	*No direct habitat alteration*	*Screened Out*
Macaca assamensis (Assam Macaque)	*Near Threatened (NT)*	No	No	*Village edges, secondary forests*	Moderate	*Adaptable species not dependent on critical habitats*	*Screened Out*
Rucervus unicolor (Sambar Deer)	*Vulnerable (VU)*	No	No	*Hill slopes & forest valleys*	Low	*Minimal habitat modification expected*	*Screened Out*
Caprolagus hispidus (Hispid Hare)	*Endangered (EN)*	Eastern Himalayan *foothills*	No	*Patchy grassland & scrub*	Very Low	*Habitat not present along project corridor*	*Screened Out*
Accipiter badius (Shikra)	*Least Concern (LC)*	No	No	Common raptor across region	Moderate	*Not dependent on critical habitat*	*Screened Out*
Aquila nipalensis (Steppe Eagle)	*Endangered (EN)*	Migratory	Yes	*Winter migrant; occasional presence*	Very Low	*No roosting or congregation zones*	*Screened Out*
Cynopterus sphinx (Indian Flying Fox)	*Least Concern (LC)*	No	Yes	*Orchards, village groves*	Low	No large roosting trees impacted	*Screened* Out

CR: Critically Endangered, EN : Endangered

The screening of the Priority Species in the IBAT as presented above indicate indicate that there are no endangered, critically endangered, near threatened species in the project influence are. The details of environmentally sensitive area within PIA are summarized in Table 5.17.

Table 5.17: Biodiversity and critical habitat assessment-based on field survey and GIS analysis for the Direct Impact Area (500 m buffer)

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)	yes	Ka Khloo Wah Kwai Moolamylliang Community Reserve within 500 m
	(ii) Reserve Forest (As notified under India Forest Act, 1927)	Not Present	
	(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	
	(ii) Species listed under Schedule III of the Wildlife (Protection) Act, 2022	Not Sighted	
	(ii) Species notified as "threatened species" by the Govt. of Meghalaya under the Meghalaya Biodiversity Rules 2010	Not Sighted	
	(iii) Critically Endangered/Endangered species as listed by the IUCN Red List of Threatened species	Not Sighted	
III.	c) Habitats of significant importance to endemic or restricted-range species d) Habitats that support globally or nationally significant concentrations of migratory or congregatory 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	No	
	(iv) Habitat of Appendix I – Endangered	Not present	

Sl. No.	Habitat (includes natural or modified)	Observation	Remarks
	migratory species as per the Convention on the Conservation of Migratory Species (CMS)		
	(v) Notified Elephant Reserve and Corridor	Not present	
	(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, Pine, Jackfruit.

5.7.3 SUMMARY OF BIODIVERSITY ASSESSMENT AND RISKS

As per the Champion and Seth (1968) classification, vegetation along the corridor in East Jaintia Hills is predominantly represented by Sub-tropical Wet Hill Forest, reflecting the region's high rainfall and undulating to hilly terrain. These forests are characterized by dense evergreen and semi-evergreen broad-leaved species with a moderately developed understory. In disturbed and transitional stretches, particularly along roadsides and near habitations, the vegetation grades into East Himalayan Moist Mixed Deciduous Forest, interspersed with secondary growth such as bamboo brakes, scrub, and regenerating forest patches. Overall, the area exhibits a mosaic of natural forest and secondary vegetation typical of the wet hill ecosystems of the Jaintia Hills.

A transect walk was conducted during the month of October 2025 along the sub-project road to document the existing biological environment, including vegetation types, floral composition, and habitat conditions, and to identify ecologically sensitive areas along the project corridor. A total of 80 species of flora (36 Tree species, 6 Shrubs, 15 Herbs, 17 Fern, and 6 Grass species), 13 mammal species, 40 bird species, 5 reptile species, 3 amphibians and 9 butterfly species were recorded during the field survey along the sub project road. The detail list of flora and fauna is attached as **Annexure 5.3.** A total of 07 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.

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, source of livelihood and income levels of affected families.

The project corridor is predominantly inhabited by Scheduled Tribe communities, who constitute the majority of the population across all districts. The Jaintia tribe along with the Biate Sub tribes, Muslim community and Hindu community, reside along the project corridor.

These communities maintain rich cultural traditions, including matrilineal social structures among the Jaintias, indigenous festivals, and belief systems that often coexist with Christianity. This ethnic and cultural diversity underpins East Jaintia District's societal identity and strongly influences local governance, land use practices, and community-based natural resource management.

As per the 2011 census, the demographic profile, literacy rates, and tribal population of the project district are presented below, with detailed demographic data provided in **Table 5.18**.

Table 5.18: Demographic profile of Jaintia district as Per 2011 Census

District	Total Pop	Male Pop	Female Pop	Rural Pop	Urban Pop	Literacy Rate Overall	Male	Female
East Jaintia Hills	122,939	61,993	60,946	110,653	12,286	60.44%	62.37%	58.47%

Source: *Census 2011*

Socio-Economic baseline of the project roads

The project road provides a vital link for numerous settlements, supporting communities that depend on the corridor for daily mobility, economic activities, and access to essential services. The region's socio-economic activities are closely intertwined with the natural and cultural landscape, making the road a critical component of local livelihoods and overall development.

Population:

The project corridor passes through fifteen villages. Among all settlements, Sutnga is the most populous village with 3,608 persons, accounting for a significant share of the total population, followed by Dkhiah East (2,019) and Saipung (1,431). Mid-sized villages include Latyrke (1,120), Tluh (953), and Moo Kympad (829), while several villages such as Ngaibang (90), Khaidong (179), and Lumchyrngan (194) have relatively small populations. Overall, the settlement pattern reflects a mix of highly concentrated population centers and smaller dispersed habitations, which is typical of the region. The gender composition across most villages remains fairly uniform, suggesting no significant gender imbalance at the micro-level.

The population distribution of the sub-project affected villages is presented in **Table 5.19**.

Table 5.19: Population Distribution along the Project Road

	Total Population			
Sl No	Village Name	Male	Female	Total
1.	Dkhiah East	981	1038	2019
2.	Tluh	466	487	953
3.	Moolamylliang	372	361	733
4.	Latyrke	559	561	1120
5.	Khaidong	100	79	179
6.	Moolasngi New	197	188	385
7.	Saipung	731	700	1431
8.	Ngaibang	46	44	90

	Total Population			
Sl No	**Village Name**	**Male**	**Female**	**Total**
9.	Moo Pala	209	234	443
10.	Lumchyrngan	103	91	194
11.	Daistong	311	285	596
12.	Sutnga	1817	1791	3608
13.	Moo Kympad	410	419	829
14.	Bamkhoosngi	125	111	236
15.	Khahnar	329	329	658

Source: *Census 2011*

SEX RATIO

The sex ratio along the project road shows considerable variation. Moo Pala (1,120) have notably higher female-to-male ratios, while Khaidong (790), and Lumchyrngan (884) show significantly lower ratios. Most other villages exhibit relatively balanced sex ratios close to or slightly above 1,000, indicating an overall fair gender balance in the population, with a few exceptions reflecting localized demographic disparities. Detailed sex ratio data for the project-affected villages and two towns are presented in **Table 5.20**.

Table 5.20: Sex Ratio in the Villages along the DSSPS road

Village Name	Sex Ratio
Dkhiah East	1058
Tluh	1045
Moolamylliang	970
Latyrke	1004
Khaidong	790
Moolasngi New	954
Saipung	958
Ngaibang	957
Moo Pala	1120
Lumchyrngan	884

Village Name	Sex Ratio
Daistong	916
Sutnga	986
Moo Kympad	1022
Bamkhoosngi	888
Khahnar	1000

Source: *Census 2011*

Scheduled Tribe population:

The Scheduled Tribe (ST) population along the project road is substantial, with total numbers varying widely across villages. Sutnga has the highest ST population at 3,577, followed by Saipung (1,411), reflecting larger village sizes and higher concentration of tribal communities. The gender distribution is generally balanced across most villages, indicating relatively even male and female representation within the ST communities. A detailed distribution of the ST population comprising of Jaintia (Pnar), Biate tribes along the project corridor is provided in **Table 5.21**.

Table 5.21: ST Population in the Project road corridor areas

ST Population				
Village Name	**Male**	**Female**	**Total**	**Percentage**
Dkhiah East	936	998	1934	95.79
Tluh	463	481	944	99.06
Moolamylliang	369	359	728	99.32
Latyrke	555	552	1107	98.84
Khaidong	98	76	174	97.21
Moolasngi New	182	174	356	92.47
Saipung	722	689	1411	98.60
Ngaibang	46	44	90	100
Moo Pala	207	230	437	98.65
Lumchyrngan	103	91	194	100
Daistong	309	279	588	98.66
Sutnga	1794	1783	3577	99.14
Moo Kympad	395	413	808	97.47
Bamkhoosngi	123	111	234	99.15
Khahnar	328	327	655	99.54

Source: *Census 2011*

Education:

The educational scenario in the project corridor reveals notable variations in literacy levels across rural areas. Sutnga and Dkhiah East lead in literacy rates, while villages like Lumchyrngan and Ngaibang show minimal literacy levels. Gender imbalances persist, with Females generally exhibiting higher literacy rates; however, some villages such as Moo Kympad and Khahnar demonstrate more balanced gender participation.

The detailed distribution of literate populations in the sub-project affected villages is provided in **Tables 5.22**.

Table 5.22: Literate Population in Villagte along the sub project road

Literate Population				
Village Name	**Male**	**Female**	**Total**	**Percentage**
Dkhiah East	606	637	1243	61.57
Tluh	241	285	526	55.19
Moolamylliang	163	208	371	50.61
Latyrke	284	353	637	56.88
Khaidong	72	53	125	69.83
Moolasngi New	147	138	285	74.03
Saipung	552	503	1055	73.72
Ngaibang	31	36	67	74.44
Moo Pala	133	167	300	67.72
Lumchyrngan	5	8	13	6.7
Daistong	66	101	167	28.02
Sutnga	1152	1216	2368	65.63
Moo Kympad	260	256	516	62.24
Bamkhoosngi	37	49	86	36.44
Khahnar	151	167	318	48.33

Source: *Census 2011*

Total workforce:

The workforce distribution along the project road shows variation in both main and marginal workers across villages. Overall, male workers dominate main work in most villages, while female participation is higher in some marginal work categories. Total workforce numbers range from as low as 39 in Ngaibang to 1,100 in Sutnga, reflecting differences in village population size and economic activity. The detailed workforce of the project affected villages is given in **Table 5.23**.

Table 5.23: Workforce Population of the Village along the sub project Road

Area	Main Workers (No.)			Marginal Workers (No.)			Total Workforce (No.)			Percentage
	Male	Female	Total	Male	Female	Total	Male	Female	Total	
Dkhiah East	288	210	498	83	118	201	371	328	699	34.62
Tluh	184	148	332	0	1	1	184	149	333	34.94
Moolamylliang	159	138	297	1	2	3	160	140	300	40.93
Latyrke	100	49	149	141	37	178	241	86	327	29.20
Khaidong	44	3	47	2	34	36	46	37	83	46.37
Moolasngi New	47	20	67	9	33	42	56	53	109	28.31
Saipung	314	255	569	9	26	35	323	281	604	42.21
Ngaibang	19	19	38	0	1	1	19	20	39	43.33
Moo Pala	80	27	107	1	1	2	81	28	109	24.60
Lumchyrngan	45	4	49	3	36	39	48	40	88	45.36
Daistong	134	57	191	4	66	70	138	123	261	43.79
Sutnga	622	369	991	74	35	109	696	404	1100	30.49
Moo Kympad	1	8	9	40	41	81	41	49	90	10.86
Bamkhoosngi	40	43	83	15	9	24	55	52	107	45.34
Khahnar	149	119	268	2	1	3	151	120	271	41.19

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 DSSPS road in East Jaintia 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 the DSSPS road most cases in the villages are resolved through traditional mechanism, with the village defence party and the intervention of the Rangbah Shnong (village headman) playing a central role in dispute resolution. Only cases that cannot be settle as the level of the Shnong (village) or require legal intervention are usally escalated and reported to the police. Crime cases in East Jaintia District for year 2023 is presented in Table 5.24.

Table 5.24: Crime cases in East Jaintia District

Sl. No	Head of Crime	2023
1	Murder	9
2	Culpable Homicide (Not Amounting to Murder)	0
3	Causing Death by Negligence	8
4	Dowry Deaths	0
5	Attempt to Commit Murder	4
6	Miscarriage / Infanticide / Foeticide / Abandonment	0
7	Hurt	10
8	Assault on Women (Modesty)	0
9	Kidnapping & Abduction	3
10	Human Trafficking	0

11	Rape	6
12	Attempt to Commit Rape	0
13	Unnatural Offences	0
14	Offences Against State	0
15	Riots	0

Source: Meghalaya Police (2023), District Crime Statistics Report

5.8.7.3 GENDER BASED VIOLENCE

No general Gender-Based Violence (GBV) cases have been reported in Sub Project Road, indicating a relatively safe environment for women. Additionally, cases under the Protection of Children from Sexual Offences (POCSO) Act have been registered over the years. Consultations in Sub Project Road 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 structures and livelihoods. A structured, pre-tested questionnaire served as the primary tool for these surveys, which were conducted in September 2025.

5.9.1 DEMOGRAPHY

The total number of project-affected households in terms of structures are 37 comprising of a total of 138 PAPs. Among these, 31 households (83.8%) are male-headed, while 6 households (16.2%) are female-headed. **Table 5.25** below summarizes the gender distribution of the heads of households.

Table 5.25: Gender Distribution of PAHs

Gender	PAH	Percentage
Male	31	83.8
Female	6	16.2
Total	**37**	100.0

Source: primary survey – 2025

5.9.1.1 Gender Distribution of Project-Affected Persons

The gender distribution of Project-Affected Persons (PAPs) of 37 project-affected households shows a nearly balanced composition, with a slightly higher proportion of males. Out of a total of 138 PAPs, 70 individuals (50.7%) are male, while 68 individuals (49.3%) are female. The gender distribution of PAPs is presented in **Table 5.26**.

Table 5.26: Gender Distribution of Project-Affected Persons (PAPs)

Gender	PAP	
	Project Affected Persons	Percentage
Male	70	50.7
Female	68	49.3
Total	**138**	**100.0**

Source: primary survey – 2025

5.9.1.2 Ethnicity

Along the project road, the Jaintia (Pnar) community constitutes the majority, representing 35.14% of settlements, followed by the Islam community at 32.42%, Hindu community at 27.03% and Biate community at 5.41%. The detailed distribution of community along the project road is provided in **Table 5.27**.

Table 5.27: Community Wise Distribution of PAHs

Communities	PAH	Percentage
Jaintia (Pnar)	13	35.14
Biate	2	5.41
Hindu	10	27.03
Islam	12	32.42

Source: primary survey – 2025

5.9.2 Impact to Vulnerable Households

Census and socio-economic surveys identified vulnerable groups among the households, including women-headed households, below-poverty-line families, and the elderly population (60+ years). **Table 5.28** presents the distribution of these vulnerable groups within the study area.

Table 5.28: Distribution of Vulnerable Group

Vulnerable Category	PAH	Percentage
Aged persons above 60 years	6	30
Below Poverty Line	8	40
Woman Headed Household	6	30
Physically Challenged	0	0
Total	**20**	

Source: primary survey – 2025

5.9.3 Economic Profile

EMPLOYMENT PATTERNS

5.9.3.1 Agricultural Dominance

Along the project road, the majority of people are engaged in agriculture (15), business (14), service sector (7) and other (non-working) (1) play a smaller role, reflecting a predominantly agrarian and informal local economy. The occupational pattern of project-affected households (PAHs) in the area is presented in **Table 5.29**.

Table 5.29: Occupation pattern of PAHs in project area

Sl. No.	Occupation	PAH
1	Agriculture	15
2	Business	14
3	Service Sector	7
4	Others (non-working)	1
Total		**37**

Source: primary survey – 2025

5.9.3.2 Income

Along the project road, 57% of households earn less than ₹25,000 per month, while 43% earn between ₹25,000–50,000. The monthly income range of project-affected households (PAHs) is presented in **Table 5.30**.

Table 5.30: Monthly Income Range of PAHs

Sl. No.	Monthly Income Range of HH	No. of PAHs	Percentage
1	less than 25000	21	57.0
2	25000- 50000	16	43.0
3	50000-100000	0	0.0
4	More than 100000	0	0
Total		**37**	**100.0**

Source: EIS primary survey – 2025

5.9.4 Education

The educational profile of the population along the project road indicates that a majority have attained high school education (55 individuals), followed by graduates and above (35). There are still 42 illiterate persons, highlighting gaps in basic education. Early childhood (below 6 years) and higher secondary

students constitute smaller proportions, reflecting a young and moderately educated community with scope for literacy and skill development initiatives. The education levels of Project-Affected Persons (PAPs) are presented in **Table 5.31**.

Table 5.31: Education Level of PAPs

Sl. No	Education	Project Road		
		Male	Female	Total
1	Children below 6 years	3	5	8
2	Primary (Class 1 to 4)	10	7	17
3	High School (Class 5-10)	28	31	59
4	Higher Secondary (Class 11-12)	8	9	17
5	Graduate and above	9	7	16
6	Illiterate	12	9	21
	Total	70	68	138

Source: primary survey – 2025

5.9.5 Health Status

The health status of East Jaintia Hills District has improved over the years due to targeted government initiatives; however, significant challenges remain. Rural-urban disparities, limited healthcare infrastructure, and the increasing prevalence of lifestyle-related diseases are major concerns. The district continues to face a dual burden of communicable diseases, such as malaria, dengue, and diarrheal illnesses, alongside a rising incidence of non-communicable diseases (NCDs), including hypertension, diabetes, and cardiovascular conditions. Improving overall health outcomes requires a multi-pronged approach that emphasizes healthcare accessibility, nutritional support, health education, disease prevention, and early diagnosis across both rural and urban areas.

The Sutnga Community Health Centre (CHC) and Saipung Primary Health Centre (PHC) are critical healthcare hubs in the East Jaintia Hills district of Meghalaya. They provide medical care, diagnostic lab services, and maternal health programs to remote and hard-to-reach communities in the region.The Khliehriat Community Health Centre (CHC) also serves as the main hub, acting as a referral point for 4 sub-centres. Outreach efforts are also made via Mobile clinics and weekly outreach sessions deliver routine care, vaccinations, and maternal services despite 1–2-hour hikes in rain. 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 proposed improvements along the project corridor are expected to partially impact (less than 10% of the structure) approximately 37 structures associated with Project Affected Households (PAHs), all belonging to the encroacher category. The impacts are minor in nature and limited to structural components without causing full displacement. The affected structures include 26 Commercial Structures (such as tin sheds, tin shades, GI sheet sheds, shades and gates), 3 Residential Structures (such as concrete compound walls), and 8 tenant-occupied structures. Overall, the impacts are partial and confined to ancillary portions of the structures only.

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. The format of the notice issued to affected households is given in RAP. List of structure is given in Annexure 5.3. Type of Impact on Project Affected Household are presented in Table 5.27.

The proposed improvements along the project corridor are expected to impact approximately thirty-two structures are expected to be affected by the project, including twenty-six temporary shops with compound walls and sheds, one standalone temporary shop, and five residential compound walls. Details of the impacted structures by project corridor are presented in **Table 5.32**.

Table 5.32: Type of Impact on Strucutures

Type of Impacts	Type of Impact	PAH Category	No of PAHs	No of PAPs	% of impact
Residential Structures (Such as concrete compound walls)	Loss of structure (partial impact)	Encroachers	3	14	<10
Commercial Structures (Such as tin shade, tin shed)	Loss of structure (partial impact)	Encroachers	34	124	<10
Total			**37**	**138**	

Source: EIS primary survey – 2025

5.9.7 Loss of Trees

32 nos. of trees are situated within the existing Right of Way (RoW) on both sides of the road. To mitigate the ecological impact of tree felling, compensatory plantation (@1:10) should be carried out, in accordance with applicable environmental regulations and guidelines. These measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP). The details of affected trees are preented in Table 3.17 of Chapter 3.

5.9.8 Common Property Resources

The Common Property Resources (CPRs) assessment classifies structures into government and community/public facilities. Construction induced Impacts on these CPRs will be limited to the construction phase. Boundary wall of water well at Ch 42+800 (LHS) will be impacted. Details of the CPRs along the project road are presented in **Table 5.33**.

Table 5.33: Common Property Resources

CPR Structures	Number
Churches	**04 Churches** (Ch 10+250 RHS, Ch 24+200 RHS, Ch 40+ 600 RHS & Ch 42+700 LHS) **01 Prayer House:** Ch 40+600 LHS
School	**03 Schools** (Ch 05+800 LHS, Ch 10+800 RHS & Ch 13+500 LHS)
Community Sacred site	**01 Community Sacred site** (Ch 10+800 RHS)
TOTAL	**9**
Shrines/ Tree Shrines	0

Memory Stone	**03 Monolith** (Ch 01+700 LHS, Ch 10+800 RHS & Ch 11+600 LHS)
Cave	**01 Cave** (Ch 22+500 LHS)
TOTAL	**4**
Grand Total	**13**

Source: EIS primary survey – 2025

5.10 Cultural Property

No ASI Protected monuments found within 0.5 km from the project site. However, **Monolith:** Ch 01+700, Ch 10+800 & Ch 11+600 and **Cave:** Ch 22+500 LHS are present within 500m from the project Road. The access to these Monolith will not be impacted. No construction camps will be established within 100 m of the Monolith. Instead, the DPR proposes beautification measures around the Monolith to enhance its cultural and aesthetic value. The layout for the improvement is presented in figure 4.1 of Chapter 4.

5.11 Hazard and Vulnerability Profile

The hazard and vulnerability profile of the DSSPS road area and East Jaintia Hills district includes landslides, flash floods, earthquakes, among others. Other hazards such as droughts, group clashes, and fire incidents also occur in the district. A seasonal hazard analysis of East Jaintia Hills district is presented in **Table 5.34**.

Table 5.34: Hazard analysis

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

5.11.1 Landslide Prone Areas

The list of landslide-prone areas in East Jaintia Hills district is provided in **Table 5.35**. Based on inputs from the ground survey and the DPR team, two landslide-prone locations have been identified along the road at

chainages 26+400 and 58+600. Additionally, the stretch from chainage 28+500 to 30+000 is prone to submergence, requiring the road level to be raised by 1.5 m. Other areas where hill slopes are made of soft and highly weathered rocks, earthen boulders etc. and the cut slopes fail by slumping, sliding and toe failures due to erosion such as 19.285–19.905 km, 20.395–20.945 km, 25.330–25.440 km, 26.370–26.570 km, 28.490–28.690 km, 31.050–31.155 km, 33.225–33.670 km, 33.830–34.070 km, 35.275–35.375 km, 35.580–35.675 km, 36.080–36.390 km, 41.680–41.980 km, 42.985–43.360 km, 47.190–47.295 km, 47.650–48.580 km, and 50.990–51.060 km. Such spots are identified and toe protection of slopes is proposed by constructing the breast walls.

Table 5.35: List of landslide prone areas in East Jaintia Hills District

S.No.	Name of block/sub division	Name of the locations
1	Saipung	Wah Kdait Muallian Road, Syrbang Sumer Sutnga PWD Road, Tongseng, Diastong, Shongrim, Tangnub, Pala
2	Lumshnong	Lumshnong, Kuliang, Pyrtakuna, Shymplong, Tongseng, Sonapyrdi, Kuliang, Pyrtakuna, Donaskul, Dona Umbluh, Ratacherra
3	Wapung	Rymbai, Wapung, Mookhep, Ladrymbai, Khliehriat East

Source: Disaster Management Plan 2024-2025

5.11.2 Flood Zones

The list of flash flood-prone areas in East Jaintia Hills district is provided in **Table 5.36**. Notably, no flood-prone areas have been identified along the project road.

Table 5.36: List of flash flood prone areas in East Jaintia Hills District

Name of Block/Sub-Division	Flash Flood Prone Locations
Saipung	Shyrwang, Umkyrpong,
Khliehriat	Byndihati, Lumshnong, Mynkre, Umtyra
Wapung	Lumshnong, Supur, Umkiang

Source: Disaster Management Plan 2024-2025

5.11.3 EARTHQUAKE ZONES

Earthquakes

- **High Seismic Risk**: The region falls under **Seismic Zone V**, the most severe category in India.
- Caused by the region's location near the Himalayan tectonic plate boundary and Shillong Plateau faults.

The project road stretches fall under Zone – V, which is at Very High risk and intensity is IX. Seismic Zone details of East Jaitia Hills is presented in **Table 5.37.**

Table 5.37: Seismic Zone details of East Jaintia Hills

District	Seismic Zone	Notable Faults	Recent Earthquakes
East Jaintia Hills	Zone V (Very High Damage Risk Zone)	Kopili Fault, Barapani–Shella Fault, and associated NE–SW and N–S shear zones influencing Jaintia Hills tectonics	The district has experienced several low to moderate earthquakes (Magnitude 3.5–5.1), with notable tremors recorded in 2019 (Mw 4.0, near Khliehriat) and 2021 (Mw 4.1–4.3 in the Jaintia Hills region).

Source: Meghalaya State Disaster Management Authority

5.11.4 Climate Resilient Features

The upgradation of 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 5.38.

Table 5.38: Climate Resilient design- DSSPS

Climate-Resilient Design		Upgradation of DSSPS
1. Climate Vulnerability Assessment During Design	Roads 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 culverts has been increased by 25.2%, and the design discharge of drains 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 protection measures and prioritisation of resilient interventions.	Considering future climate vulnerability and existing stream scouring pathways, 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, protection measures have been incorporated for culverts in accordance with IRC SP: 13 (2022) to prevent scouring of approaches and the bed around the structures. These measures

Climate-Resilient Design		Upgradation of DSSPS
		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 replacing Total 315 nos. of HP culvert (234 Nos.), Slab Culvert (5 Nos.), Masonry Culvert (76 Nos.), 9 additional pipe culverts and 9 Nos. of Box culvert (New climate driven addition) have been proposed to improve drainage. Selected culverts will be reconstructed with enhanced hydraulic capacity. Majority of existing CD works are stone masonry culverts which are vulnerable under extreme rainfall and higher runoff. 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 and retaining walls. Majority of existing CD works which are vulnerable under extreme rainfall and higher runoff.
	Roadside drains: properly graded roadside drains prevent waterlogging and lower flood damage.	Proper gradient of 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	Improved Cross Drainage system, culverts will be reconstructed with enhanced hydraulic capacity. Surface-water management measures: On-road features that help manage

Climate-Resilient Design		Upgradation of DSSPS
	conditions. These provisions help in effective drainage of stormwater, prevent waterlogging, and enhance the resilience of the road infrastructure during heavy rainfall events.	surface water include: • Paved side drains and kerbs that channel runoff away from the road surface. • Sloped pavement (camber) and well-graded shoulder drainage so water flows quickly off the carriageway into the drains. Taken together, these measures keep the road "serviceable" (usable and safe) through heavy rains by: • Draining stormwater efficiently, • Preventing ponding and waterlogging, and • Protecting the structural layers of the road from saturation and erosion.
3 Slope Stabilisation & Erosion Control	Bioengineering measures such as vegetation, geotextiles/ jute net, and structural retaining systems are used to reduce landslide risks	Bioengineering using local Broom Grass, Vetiver/ local grasses has been proposed. Turfing is provided on embankment slopes for erosion control, Jute net is proposed
	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, jute net).	
	Structural measures like retaining walls, gabion walls and breast walls protect roads from landslides and soil erosion.	Breast walls up to 2.50m height are proposed, while bioengineering measures are used for slopes above 2.5m 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	Design Rationale Meghalaya's hilly terrain and higher

Climate-Resilient Design		Upgradation of DSSPS
	signage, crash barriers and delineators.	rainfall demand robust road features to handle water runoff and soil instability. Paved shoulders provide a sealed surface that directs water away from the pavement edge, minimizing ingress into sub-layers and reducing erosion risks. Considering the moderately higher 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 (sustainable practices). Paved shoulders offer a smart adaptation for Meghalaya's challenging conditions compared to traditional hard shoulders. Durability Benefits The continuous paved surface extends pavement life by preventing cracks and potholes from water infiltration, especially on slopes where runoff is intense. Safety and Sustainability Paved shoulders improve emergency stopping areas through better erosion control and reduced maintenance needs.

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 road corridor. This chapter presents an analysis of the potential impacts arising from the implementation of project activities. These impacts vary in type, nature, magnitude, extent, timing, duration, certainty, and reversibility. The assessment takes into account the nature of the project, the types of activities involved, and the scale of potential impacts across various environmental and social components, including:

- Physical Environment: Air quality, water resources, noise levels, and soil
- Biological Environment: Flora, Fauna and
- Socio-economic components: Property removal, Land requirement, ASI sites, Influx of labour

6.2 Impacts Identification and Evaluation

The potential impacts were identified through a three-step process:

1. Identification of project activities/aspects that could generate impacts;
2. Establishing the affected environmental and social components (valued receptors), which 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. Determination of potential impacts through the preparation of an Impact Identification Matrix.

Based on the project information presented in Chapter 3 and the baseline environmental conditions described in Chapter 4, the anticipated impacts of this sub project were identified and analyzed. The potential environmental and social impacts both adverse and positive arising from project activities during the Design, Construction, and Operational Phases were evaluated using the Leopold Matrix. This approach considered the interactions between project activities and both natural/physical environmental components and social components to determine whether such interactions could result in 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 project road is provided as **Table 6.1**. 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.

Interpretation of Impact Assessment Matrix

As per the impact evaluation matrix the environmental and social screening indicates that during the pre-construction phase, potential impacts are expected to be low to moderate, mainly due to site clearance, vegetation removal, and establishment of labour camps or material storage areas. These may temporarily affect air quality, noise levels, and local soil stability, but impacts will remain localized and reversible if proper site selection, vegetation management, and waste disposal measures are followed.

During the construction phase, impacts may intensify, particularly concerning air and noise pollution, waste generation. Activities such as excavation, grading, and drainage could also temporarily affect water resources and slope stability. However, these impacts are temporary and manageable through effective implementation of the Environmental and Social Management Plan (ESMP), including dust suppression, proper waste and fuel handling, and strong occupational health and safety (OHS) protocols.

In the operational phase, environmental and social risks are expected to be low to moderate, mainly linked to traffic movement, community safety, and road drainage maintenance. The project will also yield positive benefits, including improved road safety, slope stability, drainage efficiency, and local accessibility, along with biodiversity gains through compensatory plantation.

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)	ESS1, ESS6, ESS8	MN	MN	N	MN	MN	LN	LN	LN	N	N	LN
Labour Camp Siting & Mobilization	ESS1, ESS2, ESS4	MN	LN	MN	LN	LN	MN	MN	LN	MN	LN	N
Site identification for construction plants, quarrying, material storage	ESS2, ESS3, ESS4, ESS6	HN	HN	HN	MN	HN	HN	HN	LN	HN	HN	HN
Construction Phase												
Earthworks (Excavation, Filling)	ESS1, ESS3, ESS4	MN	HN	MN	HN	MN	MN	LN	MN	MN	MN	MN
Grading, Levelling and Surface laying	ESS2, ESS3, ESS4	HN	HN	MN	MP (Improved Stability)	MN	MN	LN	MN	MN	MN	MN
Drainage & Culvert Installation	ESS3, ESS4	N	LN	MP (Improved Drainage)	MP (Improved Stability)	LP	LP	LP	HN	N	MP	LP
Slope	ESS3, ESS4,	N	N	LN	N	MP	LP	LP	N	N	MP	LP

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
Stabilization & Bioengineering	ESS6											
Construction Water Usage	ESS3, ESS4	LN	N	MN	LN	LN	LN	LN	N	N	LN	LN
Operation of Construction Plants	ESS2, ESS3	HN	HN	HN	N	MN	MN	MN	N	HN	MN	MN
Waste Generation and Disposal	ESS3, ESS4	MN	N	MN	MN	MN	HN	MN	N	HN	HN	MN
Fuel and Hazardous Material Handling	ESS2, ESS3, ESS4	MN	N	MN	N	LN	HN	MN	N	HN	N	N
Construction Traffic & Machinery	ESS2, ESS4	HN	HN	LN	LN	LN	MN	MN	N	MN	N	HN
Health & Safety Training and OHS Implementation	ESS2, ESS4	HP	HP	HP	N	N	HP	MP	N	MP	N	MP
Decommissioning of Construction Sites, Plants, Labour Camps	ESS2, ESS3	MN	MN	MN	MN	LN	MN	LN	N	MN	LN	LN
Operational Phase												
Operational Traffic Flow	ESS4, ESS10	LN	LN	LN	LN	LN	MP	MP	LN	LN	MP	MP
Transportation of Hazardous	ESS4	MN	LN	LN	LN	MN	HN	HN	MN	HN	MN	HN

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
Materials												
Compensatory Plantation	ESS6	HP	N	MP	MP	HP	MP	MP	LP	N	MP	HP
Monitoring & Community Engagement	ESS10	-	—	—	—	—	MP	MP	N	N	N	LP

Below is an explanation of the rating undertaken for the Leopold compliance matrix.

Short Form	Full Form
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

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 subproject'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 DSSPS Road. While all the construction activities are proposed within the existing Right of Way (RoW).

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/PIU. If these documents are identified to be correct then the CSC/PIU 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 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 DSSPS corridor passes mostly through agricultural areas and community land, streams. 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 32 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 (3) 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 trees 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 has 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 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.

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 (2m high), signage, and warning lamps at work sites.
- Prepare a **Community Health and Safety 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

Contractor's camps, stockpile, and equipment yards will be located at least 500 m from settlements and 100 m from water bodies or forested areas. Camps should follow **IFC/World Bank Labour Accommodation Guidelines** and local environmental norms. The layout of camps will be reviewed and cleared by the Environment Officer, CSC prior to establishment. **No construction camp, material storage area, will be setup 100 m on both sides from the Monolith (Ch 01+700, Ch 10+800 & Ch 11+600).**

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 forested 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 theplan and implemented.
- The layout of camps will be reviewed and cleared by the Environment Officer, CSC prior to establishment.
- There will be no construction camp during construction period upto100 m on both sides from the Monolith (At Ch 1+700 ,10+800 and Ch 11+600).
- Construction debris and waste shall be segregated, stored, transported, and disposed of at approved disposal locations in accordance with applicable regulations.

Disposal of Construction Debris and Waste

Limited C&D waste (excavated material, asphalt fragments, scrap metal) is expected to 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 channels.
- The waste shall be disposed in predesigned 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

Significant utility shifting is required prior to the commencement of construction works. A total of 128 nos. of electric poles and 1 no. of transformer (LHS) is identified along the DSSPS road corridor for shifting. Of these, 74 poles are on the LHS and 54 on the RHS. Utility relocation activities may temporarily disrupt local services and traffic movement, and therefore must be planned and executed in coordination with respective line departments, ensuring safety and minimal community inconvenience.

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.

Plant, Machinery, and Vehicle Selection

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 1445) 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

All aggregates, sand, and stone shall be sourced only from **approved quarries** having valid environmental clearance and consent to operate. Sourcing material from unauthorised querries 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 CSC/PIU. If these documents are identified to be correct then the CSC/PIU 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 PIU 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, CSC before final payment.
- Borrow areas, if required, shall 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 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 CSC/PIU; CSC/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. Over extraction of natural resources can lead ot unwarranted impacts. To prevent this the following mitigations are proposed.

Mitigation Measures:

- Obtain permission for groundwater abstraction from the Central/State Ground Water Authority or Surface water from Statre water Resources Department.
- Prefer use of surface water from local streams or treated water from nearby sources.
- Avoid extraction from community wells.
- Maintain drainage around storage and batching areas to prevent stagnation.

[5] 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

- In the case that water is sourced by tankers the Contractor shall submit the permission of the borewell before the sourcing of water.
- Maintain record of the water extracted or sources by tankers.

6.4.2 IMPACTS DURING CONSTRUCTION PHASE

The construction phase involves earthworks, grading, drainage works, slope protection, and culvert installation, which are expected to cause significant short-term adverse impacts on air quality, noise, water resources, and soil stability (ESS2, ESS3, ESS4). 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 certain tested and known environment friendly practices. The negative environmental effects can be taken care of at an early stage through proper engineering designs and through the contract during construction practices. The standard road construction works involved are site clearance, excavation, filling of earth materials and subgrade materials, 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.

Environment assessment of the proposed road corridor identified the presence of sensitive receptors and community assets along the alignment. These include monoliths at chainages Ch 01+700, Ch 10+800 and Ch 11+600, religious and cultural sites such as four church (Ch 10+250 RHS, Ch 24+200 RHS, Ch 40+ 600 RHS & Ch 42+700 LHS), Community Pillar (Ch 03+600) and caves (Krem lambit at 22+500), as well as educational institutions including three schools (Ch 05+800 LHS, Ch 10+800 RHS & Ch 13+500 LHS). A Community Sacred Site at 10+800 and two community ponds at (Ch 10+950, Ch 30+440) were also noted. Mitigation measures have been proposed to safeguard these features, such as maintaining buffer zones around monoliths, ensuring uninterrupted access to caves, safety and pollution control measures near schools and ponds, regulated access near the church, and speed management at bends. Beautification has been recommended around monoliths. Overall, the aseesment highlights the need for careful planning to protect cultural, educational, and community resources during road construction.

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 Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road traverses terrain ranging from 561 m to 1,343 m above mean sea level. The total quantity of material to be excavated (cut) along the project corridor is 251100 m^3, while the total fill requirement is 189279 m^3. After balancing the cut and fill volumes, surplus cut (to be disposed) is 61821 m^3. . Further, recycling and reuse of existing pavement materials shall be carried out as per MoRTH Specifications for Road Works (latest revision) and IRC: 120 guidelines. This approach ensures effective earthwork management while minimizing environmental impacts and maintaining slope stability along the project corridor.

Environmental impacts such as soil erosion due to toe failure at Ch 19.285, Ch 20.395, Ch 25.330, Ch 26.370, Ch 28.490, Ch 31.050, Ch 31.76, Ch 33.225, Ch 33.830, Ch 35.275, Ch 35.580, Ch 36.080, Ch 41.680, Ch 42.985, Ch

43.60, Ch 47.190, Ch 47.650, Ch 50.990 will be addressed through toe wall protection works and breast walls. The summary of breast walls is presented in **Table 6.2** and summary of toe walls is presented in **Table 6.3**.

Table 6.2: Summary of Breast walls

Sr. No.	Start Chainage	End Chainage	Length (m)	Side	Structure Height (m)	Cutting Height (m)
1	19285	19905	620	RHS	1.50	2.00–3.00
2	20395	20945	550	RHS	1.50	2.00–3.00
3	25330	25440	110	LHS	2.50	2.50–5.00
4	26370	26570	200	LHS	1.80	2.50–4.00
5	28490	28690	200	LHS	1.80	2.00–3.00
6	31050	31155	105	LHS	2.50	3.00–5.00
7	33225	33670	445	LHS	2.00	3.00–4.00
8	33830	34070	240	LHS	2.00	3.00–4.00
9	35275	35375	100	LHS	1.50	2.00–3.00
10	35580	35675	95	LHS	1.80	3.00–4.00
11	36080	36390	310	LHS	2.50	3.00–5.00
12	41680	41980	300	LHS	2.00	3.00–4.00
13	42985	43360	375	LHS	1.50	2.00–3.00
14	47190	47295	105	LHS	1.80	3.00–4.00
15	47650	48580	930	RHS	1.50	2.00–3.00
16	50990	51060	70	LHS	1.80	3.00–4.00

Table 6.3: Summary of Toe Walls

Sr. No.	Start Chainage	End Chainage	Length (m)	Side	Height (m)
1	31755	32040	285	LHS	1.20
2	43595	43895	300	RHS	1.00
Total			**585**		

Mitigation Measures

The project has identified the 03 disposal sites. Additional 2.64 ha land is required temporarily for Spoil disposal. Details are given in Table 3.25 The following needs to be kept in mind during disposal:

- Clear the debris from construction sites. Unusable Debris's are to be carried by trucks/dumpers to the identified dumping yards. 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.

6.4.2.1 IMPACTS ON GEOLOGY

The construction of DSSPS 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.

As per the engineering design, the estimated quantities of other construction materials that are required for construction of the sub-project area are attached as **Annexure 3.3.**

To prevent unwarranted impacts the following measures are proposed:

Mitigation Measures

- The aggregate, sand and other constrction amtrail shall be supplied from quarries approved by the PIU (indicated in the pre-constrction stage)
- The challans for the royalty paid against the material used shall be included in the 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.

Loss of topsoil: The topsoil on the land parcels, which is either used for short term (e.g., borrow areas, construction camps etc.) or permanent use (expansion of the road alignment), would be lost unless the same is preserved. Project activity involves tree cutting and vegetation removal from the PRoW 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.

6.4.2.2.1 BORROW AREAS AND QUARRIES

Construction materials required for the project road will be transported from Borrow area and Quarries. Details of Quarries site is given in Table 3.18 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 6.4 below.

Table 6.4: Earthwork details in the project area

Corridor	Fill (m^3)	Cut (m^3)
DSSPS	189279	251100

The total quantity of material to be excavated (cut) along the project corridor is 251100 m^3, while the total fill requirement is 189279 m^3. Surplus cut (to be disposed / reused) 61821 m^3. Average height should be 1.2 m to 1.5 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 and submit CTE and CTO to PWD before deciding any quarry area

Borrow Area Management

- Contractor have to obtain and submit CTE and CTO to PWD before deciding 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 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 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

Muck Disposal

- Muck disposal sites shall be located on stable, non-erodible terrain away from water bodies and agricultural land.
- 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.
- Muck 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 muck, 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 muck disposal site will be incorporated into the DPR. Dumpsite Stabilization Plan is attached as Annexure 5.1.

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 are presented in Annexure 6.2 The same guidance (storage of Hazardous Waste) may be used for storage of hazardous materials (oil, lubricants)

6.4.2.3 AMBIENT AIR QUALITY

Construction-stage activities are likely to have adverse impacts on both workers and settlements adjacent to the road, particularly those located downwind. The main types of pollution anticipated are dust pollution and emissions from harmful gases from the construction plant and equipment.

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
- Site leveling, clearing of trees
- Construction of structures and allied activities

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

- Hot mix plants
- 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. Mitigation Measures for Ambient Air Quality is presented in Table 6.5.

Table 6.5: Mitigation Measures for Ambient Air Quality (ESS3)

Impact Source	Mitigation Measures
Transportation and tipping of cut material; site levelling and	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

excavation	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.
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 as per the monitoring plan specified in the ESIA Report. A log of the maintenance should also be mantaiend by the Contractor.
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 mixing operations	Use pre-mixed bitumen and maintain mixing temperature within permissible limits to 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.

6.4.2.4 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, use of temporary noise barriers, scheduling of high-noise works during daytime, and strict adherence to CPCB noise standards.

The scale of construction required for upgrading the DSSPS Road is moderate and 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, use of noise barriers or temporary screens near sensitive locations, 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 activities are expected to generate noise levels in the range of 80 – 95 dB(A) at about 1m from the source.

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 MoEFCC/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 or noise barriers 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;

6.4.2.5 SURFACE WATER QUALITY AND SILTATION

For the Upgradation of sub project 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. Construction activities such as earthworks, material storage, and operation of construction camps may temporarily affect surface water quality along the DSSPS Road corridor. Proposed sub project road cross the river at Chainage 16+000, 31+000,. 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. 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.

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

- 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. Oil-water separator with adequate residence time to be provided before the outfall of these.
- 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.

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 that could alter drainage patterns and affect riverine habitats. The road alignment generally follows the existing topography, except at locations of cross-drainage structures. The project road stretch includes a total of one major bridge, two minor bridges and three hundred seventeen culverts. Many of the existing culverts, if not adequately strengthened during the proposed upgradation, could fail structurally, leading to disruptions in water flow, increased flood risk, and potential damage to the road. Such failures may also pose safety hazards to 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. Project road stretch will require total 121.9 KLD. The demand for construction is proposed to be met from surface water sources. However, in extreme cases, where surface water is not available, it is proposed to use groundwater resources. The project area is not classified as critical, semi-critical or overexploited by CGWB. It is "safe" area for ground water abstraction.

Untreated discharge from the labour camp may lead to contamination of ground water sources in the vicinity of the camp.

Mitigation Measure

- Construction water will not be procured from any unauthorised 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 form third parties the Contractor shall only source it from sources cleared by PIU. In such cases also eh shall maintain a log of the water procured.
- Construction materials such as cement, chemicals, fuels, and lubricants should be stored in designated covered areas with impervious flooring to prevent seepage into the soil and groundwater.
- Refueling and maintenance of construction machinery should be carried out in designated areas with spill containment arrangements to avoid accidental leakage into the ground.
- Wastewater generated from equipment washing, construction activities, or camps should be collected in sedimentation tanks or soak pits after treatment, ensuring that untreated wastewater does not percolate into the ground.
- 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

6.4.2.8 CONSTRUCTION AND DEMOLITION WASTE

Construction and demolition (C&D) waste from major demolitions is not expected along the proposed DSSPS alignment because no permanent structures will be removed. Only temporary structures with masonry or light walls (e.g., temporary kiosks, sheds, compound 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 water bodies, 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

1 **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.

2 **Segregation on site:** separate inert masonry/brick, concrete, metal, wood and mixed waste at designated temporary collection points to maximize reuse/recycling.

3 **Reuse & recycling:** priorities reuse of intact masonry/brick and concrete as backfill or for temporary access tracks; recover metal and timber for reuse.

4 **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.

5 **Dust control:** dampen stockpiles and vehicle loads, cover trucks during transport, and restrict demolition/dismantling operations during high-wind conditions.

6 **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.

7 **Traffic & public safety:** schedule dismantling works off-peak where possible, use flaggers and signage, and maintain clear pedestrian/vehicular passage around work areas.

8 **Permits & authorized disposal:** ensure waste is transported only to licensed C&D disposal or recycling facilities and that manifests/receipts are retained.

9 **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.

10 **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.

6.4.2.9 MUNICIPAL SOLID WASTE

The project corridor is expected to generate approximately 120 to 150 kg of municipal solid waste per day during the construction stage, based on an estimated 300 workers at the project site, assuming an average waste generation of 0.4 to 0.5 kg per person per day. 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 mde aware about the segregation of wate.
- 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.

6.4.2.10 HAZARDOUS WASTE

Approximately 2466.8 cu.m. of bituminous material is expected to 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.

The corridor-wise details of existing bituminous surface to be scarified in the project area are presented in **Table 6.6**.

Table 6.6: Amount of expected Bituminous Material

Sl. No.	Description	Unit	Quantity
1.	Scarifying existing bituminous waste	cum	2466.8

A small quantity of hazardous substances, such as used oil, diesel, petroleum products, and other chemicals, will be used or stored during construction. If these substances are not stored properly, leakage or spillage may occur, potentially causing contamination of soil and water.

During the construction phase, used batteries are expected to be discarded and must be disposed of in accordance with the Battery Waste Management Rules, 2022. Lead-based batteries, if not properly managed, may contaminate soil and water through the leakage of lead.

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.

DISRUPTION OF COMMUNITY SERVICES

Local services, including water supply lines, irrigation channels, drainage systems, ditches, and streets, are often disrupted during road earthworks. These services are essential for crop production, drinking water supply, and local access, and their damage can also affect road construction activities. Details of utilities, such as electric poles, are provided in **Annexure 5.2**.

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-constrction 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 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 Sensitive Receptors

Environment Screening of the proposed road corridor identified the presence of sensitive receptors and community assets along the alignment. These include monoliths at chainages Ch 01+700, Ch 10+800 and Ch 11+600, religious and cultural sites such as four church (Ch 10+250 RHS, Ch 24+200 RHS, Ch 40+ 600 RHS & Ch 42+700 LHS), Community Pillar (Ch 03+600) and caves (Krem lambit at 22+500), as well as educational institutions including three schools (Ch 05+800 LHS, Ch 10+800 RHS & Ch 13+500 LHS). A Community Sacred Site at 10+800 and two community ponds at (Ch 10+950, Ch 30+440) were also noted.

Environment Screening of the proposed road corridor identified the presence of sensitive receptors and community assets along the alignment. These include monoliths at chainages 23+100 and 41+500, religious and cultural sites such as a church (43+000) and caves (Mawjyngbuin at 33+740 and Krem Puri at 39+160), as well as educational institutions including Jawahar Navodaya Vidyalaya (32+100) and SSA Schools (43+520 and 46+600). A pipeline at 26+650 and a hairpin bend at 29+650 were also noted.

Mitigation measures for Monolith:

- Maintain a buffer zones around monoliths as described earlier. (100 m on either sides will not have any material storage, construction camp, vehicle parking or repairs, temporary structures
- These areas should not be used by the construction crew for any purpose. The workers should be sensitized about these elements on the project road
- Clear Do's and Do nots would be provided to them about these locations
- Beautification works has been recommended around monoliths. The layout for the same is presented in figure 4.1 of Chapter 4.

- **Mitigation measures for Community Properties/**
  - Ensure uninterrupted access to caves, educational institutions, schools, religions institutions such as churches. The access in front of these institutions shall be kept in motorable condition at all times.
  - Excavation / works in front of these institutions would be scheduled in consultation with the authorities
  - Pipeline protection through ducts and crossovers, safety and pollution control measures near schools, regulated access near the church, and speed management at hairpin bends. Overall, the screening highlights the need for careful planning to protect cultural, educational, and community resources during road construction.

6.4.2.14 Work Zone 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 (ESS2, ESS4), 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 contigious stretched. 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. Retrorefletive 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 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 6.4).
- 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.

6.4.2.15 ROAD SAFETY MEASURES

Road Construction activity will impact safety on the road for commuters, pedestrians, students, women and elderly people. In addition to this, sub project stretch being in landslide prone areas, there will be chances of landslide/rock fall on the road from time to time. Animal crossings, although not reported in the current stretch, can yet be a possibility during the construction stage and mitigation measures may have to be incorporated in the Contractor's C-ESMP. There are schools at chainages Ch 05+800 LHS, Ch 10+800 RHS & Ch 13+500 LHS.

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 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

- Traffic calming (Tranverse Bar Marking signage): Ch. 0+015, 8+350, 10+250, 10+800, 12+700, 13+500, 24+200, 38+200, 42+700, 43+400, 44+600
- Pedestrian safety (crossings / footpath): Ch. 0+015, 5+800, 8+350, 10+250, 10+800, 12+700, 13+500, 24+200, 38+200, 42+700, 43+400, 44+600, 52+000, 58+100
- Signage & TBM: Ch. 1+700, 5+800, 10+250, 11+800, 13+500, 22+500, 24+200, 38+200, 42+700, 43+400, 44+600, 58+100
- Junction improvements: Ch. 13+600, 22+500, 58+100–58+200
- Drainage (side drains): Ch. 0+015, 10+250, 10+800
- Protection of sensitive structures (monolith / water bodies): Ch. 1+700, 10+800, 11+800, 13+550, 10+950, 52+000
- Bus stops: Ch. 38+200, 44+600
- Construction phase restrictions: Ch. 10+950, 13+550, 22+500

6.4.2.16 ANTICIPATED IMPACTS ON BIOLOGICAL ENVIRONMENT

The proposed Dkhiah - Sutnga - Saipung - Pala upto Semmasi Road involves widening beyond the existing Right of Way (RoW) with no diversion of forest land or habitat alteration. A species wise screening was carried out and it was assessed that, none of the identified species meet the threshold for Critical Habitat criteria under IFC PS6 or World Bank ESS6. Hence, all species have been screened out nd further critical habitat assessment was not carried out.

A total of 7 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 5.16

As per the design, the construction activities would also involve felling of 32 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:

- 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.
- 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

6.4.2.17 IMPACTS ON AQUATIC ECOLOGY

Impacts on aquatic ecology during construction include increased silt inflow into surface water bodies and the potential discharge of liquid wastes and untreated sewage from construction and labour camps, spillage of fuel and other constriction material or waste into drainage channels or waterbodies.

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

6.4.2.18 Impacts on Archaeological, Historical and Cultural Sites

No ASI-protected monuments are located within 0.5 km of the project site. However, three Monolith (at Ch 01+700, Ch 10+800 & Ch 11+600) and cave at (Ch 22+500) are situated within 500 m of the project road. No construction camps will be established within 100 m on either side of the Monolith during the construction period.

Another key potential impact during project construction is the risk of partial or total destruction of previously unknown heritage assets, such as undiscovered archaeological sites, due to ground excavation. This highlights the need for a defined 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 notes 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 5.8.

Mitigation Measures

- 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 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

6.4.3 Impacts during Operational Phase

During the operation stage, the main sources of environmental impacts are the increased traffic volume and speed. The increase in traffic volume and speed may enhance the safety risk especially in the rural area. No sudden change in the volume of traffic is expected due to this road as the road is already existing and opened for public traffic. The project also provides opportunities for the restoration of vegetation around the vicinity of the worksite and roads by implementing the compensatory plantation programme, which will not only enhance the aesthetic view but can also help in reclamation of soil.

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 (ESS6) will improve local biodiversity, stabilize embankments, and enhance the corridor's visual aesthetics.

Various impacts during operation phase are discussed below:

6.4.3.1 Impacts on Water Quality and Resources

During the operation phase, the possibility of degradation of water quality is very remote. The impact on the surface water quality during operation can be expected due to accidental spillage. However, the probability of such accidents is minimal since enhancement of road safety measures such as improvement of curves and other pedestrian facilities are taken care of in the design stage.

6.4.3.2 Impact on Air Quality

Vehicular emissions are the principal source of pollution during the operation stage. The project road being mostly located adjacent to open agricultural land, 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 heavy 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.

6.4.3.5 Impact on Ecology

During the operational phase, significant impacts on aquatic ecology are not anticipated; although the alignment crosses a river, appropriate mitigation measures such as sediment control, construction of temporary diversion structures, and proper wastewater management will minimize potential adverse effects.

To address the potential impacts on biodiversity, a comprehensive set of mitigation measures have been developed and incorporated into the ESMP

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, residential communities, and culturally significant sites. The route traverses along agricultural land that is 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 re-alignment and access to community benefit programs have been considered 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 assessment of impacts on structures along the project corridor indicates that the effects are largely minor and localized in nature, primarily involving partial damage to existing assets. A total of 37 Project Affected Households (PAHs) comprising 138 Project Affected Persons (PAPs) are expected to experience impacts.

The proposed improvements along the project corridor are expected to partially impact (less than 10% of the structure) 29 structures associated with 37 Project Affected Households (PAHs), all belonging to the encroacher category. The impacts are minor in nature and limited to structural components without causing full displacement. The affected structures include 26 Commercial Structures (such as tin sheds, tin shades, GI sheet sheds, shades and gates), 3 Residential Structures (such as concrete compound walls), and 8 tenant-occupied structures.

Importantly, all identified impacts are less than 10% of the affected structures, indicating that the severity of impact is minimal and does not involve complete loss of assets or large-scale displacement. Overall, the findings suggest that the project will have limited and manageable socio-economic impacts, which can be effectively mitigated through appropriate compensation and livelihood restoration measures. (Refer to Table 5.32). 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. FPIC was carried out as the project will result in loss of assets and cause relocation of IPs.

The existing project road has a right of way ranging from 10m to 12m. However, at certain locations, cutting and slope stability measures are required, as indicated in TCS-7. Therefore, additional land of 1.902 Ha is required in the alignment improvement sections. For spoil disposal, 2.64 Ha of land is temporarily required. This required land for spoil disposal sites 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 Rangbah Shnong jointly identified 3 locations for dumping of spoils. The Details for the same is presented in Table 3.22of Chapter 3.

To mitigate these social impacts, household surveys and extensive meaningful stakeholder consultations and FPIC consultations were carried out to understand the concerns and needs of affected communities. The FPIC process was followed in a culturally appropriate manner to ensure meaningful engagement with indigenous peoples, securing their consent through transparent and participatory consultations. Additionally, community engagement programs have been conducted to provide clear information about the project, address misconceptions, and explore opportunities for local benefit, 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. Considering the potential risk of Gender-Based Violence associated with labour influx and construction activities, a site specific GBV Action Plan has been prepared and is provided as Annexure 6.3.

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 impacts on structures, and livelihood disturbance arising from project preparation activities. For this sub project road about 29 structures associated with 37 Project Affected Households (PAHs), are expected to be impacted, which are located within the existing Right of Way (RoW). These impacts are largely partial in nature and include compound walls, shade, shed and gates. Such impacts may result in loss of assets and temporary livelihood disruption.
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 and livelihood assistance 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).

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.

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. The project level Labour Management Plan (LMP) and Work site safety plan (OHS Plan) outlines strategies for managing these risks. Labour Management Plan is attached as attached as Annexure 6.4. Occupational Health and Safety plan is attached as Annexure 6.5.

Mitigation Measures

Construction-phase impacts will be managed through measures included in the Environmental and Social Management Plan (ESMP). 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.

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.

6.6 CLIMATE-RELATED IMPACT

Climate change poses a significant challenge to the State of Meghalaya, with its diverse ecosystems, high biodiversity, and socio-economic dependence on agriculture, forestry, and natural resources. The state is highly vulnerable to the impacts of climate change due to its unique geographic and climatic conditions.

Rising temperatures have further contributed to ecological imbalances, affecting agricultural productivity, forest health, and water resources. Additionally, the district lies in Seismic Zone V, and the interplay of climate-induced hazards and geophysical risks adds further complexity to its vulnerability.

Due to the uneven climatic behavior, it is essential that climate mitigation and adaptation plans to combat the impacts of climate change are factored in the development process to avoid economic burden of adaptation in the long run, and gain from new opportunities that will be thrown up along the way. The Potential impacts of Climate Change trend on road transport infrastructure is provided in **Table 6.7**. A detailed preliminary assessment has been undertaken to assess climate disaster risks, details of which are available in **Annexure 5.6.**

Table 6.7: Potential impacts of Climate Change trend on road transport infrastructure

Climate Trend / Parameter	Observed Pattern	Impact on Road Infrastructure
High Rainfall	1200 mm	- Increased risk of flooding leading to submersion of roads. - Erosion of road embankments and landslides in hilly terrains. - Structural damage to culverts and bridges.
Low Rainfall	- Significant drop in annual rainfall -Reduced annual rainfall correlates with reduced soil moisture and vegetation	- Dry soil conditions may cause cracks in asphalt roads. - Lower soil stability, leading to uneven settling of road foundations. - Loss of vegetation can weaken slopes and lead to landslides in hilly areas like East Jaintia Hills. - Roads may face increased dust and reduced traction due to dry conditions.
Rising Temperatures	- Maximum temperature rising from 20.4°C to 23.5°C	- Higher temperatures cause thermal expansion of road materials, leading to surface cracks. - Softening of asphalt during hot days can cause deformation and rutting.
Landslide Risk	- Frequent rainfall and runoff events increase landslide susceptibility in the district's terrain	- Roads in hilly areas may face closures due to landslides. - Increased repair costs for damaged road sections and disrupted connectivity to remote areas.

7. STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE

This chapter presents an overview of the stakeholder consultations conducted as part of the Environmental and Social Impact Assessment (ESIA) for the proposed MLCIP. These consultations were intended to ensure a participatory approach in identifying and addressing potential environmental and social impacts of 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	Project Stakeholder
Project-Affected Parties	▪ Village community ▪ Street side Shop Owners ▪ Shop owners (NTH) ▪ Residential structure owners ▪ Dorbar Shnong
Interested Parties	**Government agencies** • Public Works Department Meghalaya • Jaintia Hills Autonomous District Council (JHADC) • Meghalaya Forests & Environment Department • Meghalaya State Pollution Control Board (MSPCB) • Meghalaya State Biodiversity Board (MSBB) • Educational Institutions **Civil society organizations** • Church-based Organisations (Baptist / Catholic Missions) – significant role in education, health, and social services across villages • Women's groups **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 the ESIA, consultations were carried out with representatives from all three stakeholder categories, including government agencies, communities, and other organizations, with particular attention to vulnerable groups. Special focus was given to communities located in sub-project areas likely to experience significant impacts, such as effects on residential and commercial structures or on common property resources. Key common property resources identified include religious structures, public utilities, and other community assets critical to local livelihoods and cultural heritage.

Representatives from relevant stakeholders were consulted to incorporate their concerns and expertise, ensuring that the project aligns with broader developmental, economic, and environmental objectives. Key discussions focused on potential displacement, loss of livelihoods, environmental degradation, law and order issues, forest land concerns, irrigation impacts, structural matters such as cross-drainage structures, and corresponding mitigation measures. These consultations helped document and integrate the priorities and concerns of affected communities, providing valuable input to shape strategies for minimizing adverse impacts.

Through public consultations, stakeholders' viewpoints and suggestions were captured and considered as inputs to the technical design. All suggestions were incorporated into the project design to the extent feasible and 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 outlines the procedures for stakeholder engagement throughout the project cycle. The SEP details the process, methods, and frequency of engagement with various stakeholders and will be implemented accordingly during the project period.

Disclosed Stakeholder Engagement Plan link on MPWD website is https://megpwd.gov.in/pdf/2026/ESMF/Stakeholder%20Engagement%20Plan%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 formed an integral part of the Environmental and Social Impact Assessment (ESIA) process. These 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. A total of six consultations were conducted as part of the Environmental and Social Impact Assessment (ESIA) process for the proposed road project. These included one preliminary public consultation, one Focus Group Discussions (FGDs) with youth, three Focus Group Discussions (FGDs) with women and one with DPR consultant. Key Informant Interviews were also conducted with PAH. The details of consultations along the project road is presented in **Table 7.2**.

Table 7.2: Summary of consultations

Sl. No.	Stakeholders	Dates of consultantion	No of Participants	Summary of Feedback
1.	Local residents at Dkhiah	21-08-2025	Male: 5	• Participants appreciated the project and acknowledged its positive impact on the community. • Highlighted concerns about non-functional streetlights
2.	Local residents at Sookilo Market	21.08.2025	Male: 4	• Participants expressed appreciation for the project and its positive community impact.
3.	Local residents at Sutnga	21.08.2025	Male: 1 Female: 2	• Maintain uninterrupted and safe access to the church for pedestrians and vehicles during construction
4.	Local residents at Umpleng Market	27.08.2025	Male: 5 Female: 2	• Maintain uninterrupted and safe access to the church for pedestrians and vehicles during construction
5.	Local residents at Daistong	27.08.2025	Male: 3 Female: 2	• Support the project
6.	Local residents at Saipung	27.08.2025	Male: 4 Female: 2	• Participants expressed appreciation for the project and its positive community impact.
7.	Youth	18.09.2025	Youth (12 nos.)	• Limited local opportunities, inadequate skill development platforms, and lack of structured guidance • Migration remains a major coping strategy, but often comes with social and economic risks
8.	FGD with Women	17.09.2025	Women 14 nos.)	• Women are eager to contribute economically but are constrained by limited opportunities, social barriers, and lack of structured support

Sl. No.	Stakeholders	Dates of consultantion	No of Participants	Summary of Feedback
9.	FGD with Women	18.09.2025	Women 15 nos.)	• There is a pressing need for inclusive, women-centric interventions that promote local entrepreneurship, skills, and connectivity
10.	FGD with Women	18.09.2025	Women 11 nos.)	• Women-focused initiatives are needed to boost local skills, entrepreneurship, and connectivity.
Consultations held during FPIC for Priority Projects				
11.	unity Members & Project Affected Households & Families	025, 17.09.2025 & 18.09.2025, 03.10.2025, 11.12.2025	No of consultation: 6, Total no. of participants: 283 (Male; 225 and Female: 58)	**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 toilets

Source: EIS

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 DSSPS 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. Accordingly, a structured FPIC process was undertaken to ensure culturally appropriate engagement with Indigenous communities and their traditional institutions, including Rangbah Shnong, village councils, and community representatives. Consultations were conducted in the local Khasi 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 DSSPS 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 DSSPS 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 DSSPS sub-project.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT MONITORING & 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 Environmental 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. Environment and Social Management Plan is presented in **Table 8.1**.

Table 8.1: Environmental and Social Management Plan

Sl. No.	Activity	Environment and Social Aspects	Impacts	Mitigation / Management Measures	Implementation	Indicator	Supervision / Monitoring
PRE-CONSTRUCTION PHASE							
1	Consents / Permits / Approvals / Compliances	Regulatory Compliance	Non-compliance with environmental, social and regulatory requirements leading to legal implications and project delays	• Obtain all necessary statutory clearances (CTE, CTO, Labour License, Fire NOC, Tree Cutting Permission, Hazardous Waste Authorization, etc.) prior to commencement of works. • Obtain necessary insurance and indemnities as specified in the Contract Agreement and applicable laws. • CSC shall not permit commencement of construction activities until all approvals are obtained. • Renew permits before expiry. • Ensure compliance with all conditions stipulated in approvals and permits. • Submit all statutory reports and returns as required.	Contractor / MPWD	Copies of permits, licenses, insurance and statutory approvals available and tracked.	MPWD / PMC / CSC
2	Land Procurement	Asset and Livelihood	Loss of land, livelihood impacts and grievances from affected persons	• RPF and RAP shall be implemented prior to commencement of civil works. • Compensation, assistance and livelihood restoration shall be completed before site handover. • Particular attention shall be given to the 37 PAHs and vulnerable households. • MPWD, Waheh	MPWD, Waheh Chnong, Doloi and concerned authorities	Compensation records maintained; grievances resolved; site handover records.	MPWD / CSC / NGO

				Chnong, Doloi and concerned authorities shall coordinate implementation. • Compensation records shall be maintained and grievances resolved through established mechanisms. • Civil works shall commence only after written confirmation from MPWD/PMU that RAP obligations have been completed for the relevant stretch.			
3	Preparation of Works Methodology and Contractor's ESMP (CESMP)	Environmental and Social Management	Inadequate preparation and implementation of CESMP resulting in unmanaged environmental and social impacts	• Contractor shall prepare CESMP based on the approved ESMP. • CESMP shall include TMP, OHS Plan, CHS Plan, Labour Management Procedures, GBV/SEA-SH measures, Waste Management Plan and Emergency Response Plan. • CESMP shall be submitted with Work Plan and Method Statement. • CSC shall review and provide comments within stipulated timelines. • Work Plan shall only be approved after approval of CESMP and associated plans.	Contractor	Approved CESMP and associated management plans.	MPWD / PMC / CSC
4	Identification of Land for Material Storage Yard / Construction Camp / Labour Camp	Land Use and Ecology	Pollution, habitat disturbance, community conflicts and impacts on cultural resources	• Camps and storage areas shall not be located near streams, wetlands, waterlogged areas, natural habitats or community forests. • Lease agreements and NOCs shall be obtained. • Sites shall be restored	Contractor	Approved camp locations; lease agreements; NOCs; inspection records.	MPWD / PMC / CSC

				after project completion. • Vegetation clearance shall be minimized. • Maintain minimum 100 m buffer from natural drainage channels and water bodies. • Implement erosion and sediment control measures. • Hunting, fishing and collection of forest produce by workers shall be prohibited. • Labour awareness programmes on biodiversity conservation shall be conducted. • Labour camps shall comply with World Bank Group Labour Accommodation Guidelines. • No camp, storage yard, parking area or construction facility shall be established within 100 m of Monoliths located at Ch. 01+700 LHS, Ch. 10+800 RHS, Ch. 11+600 LHS or the Cave at Ch. 22+500 LHS.			
5	Supply of Construction Materials	Physiography	Procurement from unauthorized or environmentally non-compliant sources	• Contractor shall submit EC, CTE and CTO of quarries and material suppliers. • Materials shall be sourced only from licensed and approved quarries and suppliers. • Royalty receipts and transport challans shall be maintained and submitted. • Procurement shall comply with all statutory requirements.	Contractor	Quarry approvals, royalty records and source approvals.	MPWD / CSC

6	Water	Groundwater and Surface Water	Water depletion and pollution of surface and groundwater resources	• Contractor shall arrange adequate water supply. • Permission shall be obtained from competent authorities before groundwater abstraction. • Water meters shall be installed and extraction logs maintained. • Wastewater management measures shall be implemented. • Labour camps shall have adequate sanitation facilities. • Construction camps and storage yards shall be provided with peripheral drainage connected to sedimentation systems. • Fuel and repair areas shall be paved and connected to oil-water separators. • Water conservation measures and rainwater harvesting shall be encouraged.	Contractor	Water abstraction permissions; consumption records; wastewater management measures.	MPWD / PMC / CSC
7	Appointment of Environment, Social and Safety Officers	Environmental, Social and Safety Management	Ineffective implementation of environmental and social safeguards	• Contractor shall appoint qualified Environment, Social and Safety Officers before mobilization. • Officers shall be responsible for implementation of CESMP, permits, compliance monitoring and reporting. • Officers shall coordinate with CSC and MPWD.	Contractor	E&S personnel appointed and mobilized.	MPWD / PMC / CSC
8	Identification of OHS Hazard and Risk Categorization	Occupational Health and Safety	Injury, illness, disability or death of workers	• Conduct Hazard Identification and Risk Assessment (HIRA). • Prepare OHS Plan prior to commencement of works. • Provide PPE to all workers. •	Contractor	Approved OHS Plan; HIRA register; PPE records.	MPWD / PMC / CSC

				Establish linkages with local hospitals and health centres. • Ensure adequate potable water, sanitation and waste management facilities. • Consult workers during risk assessment. • Review Safety Data Sheets for hazardous materials. • Establish emergency response procedures.			
9	Other Construction Vehicles, Equipment and Machinery	Pollution Management	Air pollution, noise pollution and unsafe operation of equipment	• Maintain valid fitness and PUC certificates. • Use equipment complying with applicable emission standards. • Ensure lifting equipment certification. • Deploy trained operators. • Crushers, batching plants and hot mix plants shall be located at least 1 km away from settlements, forests and sensitive receptors. • Equipment shall comply with consent conditions issued by MSPCB.	Contractor	PUC certificates; maintenance records; inspection reports.	MPWD / PMC / CSC
10	Tree Cutting	Ecology	Loss of vegetation and biodiversity	• Minimize tree cutting to the extent possible. • Obtain Forest Department approval prior to felling. • Tree cutting and disposal shall follow Forest Department procedures. • Approximately 32 trees identified for removal shall be compensated through plantation at a minimum ratio of 1:10. • Plantation monitoring shall be undertaken in accordance	Contractor	Tree felling records; plantation records; survival reports.	MPWD / CSC

				with project requirements.			
11	Joint Field Verification	Environmental and Social Risks	Failure to identify site-specific issues and mitigation needs	• MPWD and Contractor shall undertake joint verification with Waheh Chnong, Doloi and affected communities. • Verify locations requiring additional protection works, drainage improvements, slope stabilization measures and community facilities. • Verify Monoliths, Cave locations and culturally sensitive areas. • Verify FPIC commitments including bus shelters, toilets, footpaths and community safety measures. • Maintain documentation of all observations and agreed actions.	Contractor	Verification reports and consultation records.	MPWD
12	Identification of Borrow Area	Land and Ecology	Damage to ecosystems and land degradation	• Borrow areas shall preferably be located on barren or non-agricultural land. • Avoid landslide-prone areas and environmentally sensitive locations. • Maintain minimum 300 m distance from settlements. • Obtain Environmental Clearance where required. • Prepare Borrow Area Management and Closure Plan. • Consult Waheh Chnong and Doloi before finalization.	Contractor	Borrow area approvals; closure plans; EC copies.	MPWD / CSC
13	Identification of Construction	Community	Traffic hazards, accidents,	• Prepare route plan minimizing impacts on settlements and sensitive	Contractor	Approved route plan; consultation	MPWD / CSC

	Material Transportation Route	Health and Safety	community disturbance and safety risks	receptors. • Install warning signs, barricades and traffic control measures. • Maintain access to residences, agricultural land and community facilities. • Implement speed controls and road safety awareness programmes. • Provide temporary access arrangements where necessary. • Special attention shall be given to schools, markets, churches and vulnerable road users.		records.	
14	Identification of Sites for Debris Disposal and Construction Waste	Land and Water Environment	Pollution, erosion, siltation and visual impacts	• Disposal sites shall be selected in consultation with Waheh Chnong, Doloi and local communities. • Avoid forests, wetlands, drainage channels, agricultural land and ecologically sensitive areas. • Topsoil shall be stripped and reused. • Spoil shall be disposed only at approved locations. • Disposal sites shall incorporate retaining walls, toe walls, catch drains, sediment traps and stabilization measures. • Bioengineering measures shall be adopted wherever necessary. • Disposal sites shall be monitored regularly and rehabilitated after completion.	Contractor	Approved disposal sites; management plans; disposal records.	MPWD / CSC
15	Relocation of Utility and Common	Utility Services and Community	Temporary disruption of public services and	• Utilities and CPRs shall be relocated in consultation with communities and	Contractor / MPWD Divisional	Utility relocation records and	MPWD /

	Property Resources (CPR)	Assets	community inconvenience	concerned departments. • Relocation sites shall be selected with community participation. • Utility relocation shall be planned to minimize service disruption. • Utility ducts shall be incorporated into designs where feasible. • Construction schedules shall be shared with line departments.	Offices	completion certificates.	PMC / CSC
16	Planning for Worksite and Work Zone Safety	Community Health and Safety	Accidents, injuries and inconvenience to road users and local communities	• Install New Jersey barriers, barricades, warning signs and safety lighting. • Prepare Community Health and Safety Plan prior to commencement of works. • Site-specific OHS, CHS and Traffic Safety Plans shall accompany each work package. • Conduct awareness campaigns before road closures or diversions. • Schedule high-risk activities during off-peak periods. • Ensure safety of children, elderly persons and persons with disabilities near work zones. • Maintain safe access for communities throughout construction.	Contractor	Approved CHS Plan; site safety inspection records.	MPWD / PMU
CONSTRUCTION PHASE							
1	Crushers, Hot Mix Plants & Batching Plants	Air Pollution	Air quality deterioration due to emissions and dust generation	• Contractor shall submit detailed layout plan and obtain prior approval before installation. • Obtain all statutory permissions, CTE and CTO from MSPCB. • Plants shall be located	Contractor	Approved layout plan; Valid Consents; Air quality monitoring reports;	MPWD / PMC / CSC

				at least 1000 m away from settlements, schools, churches, markets, forests and environmentally sensitive locations. • Emissions shall be monitored as per ESMP monitoring plan. • Dust suppression measures shall be implemented. • Plants shall be maintained according to manufacturer specifications and maintenance records shall be maintained. • Adequate PPE shall be provided to workers.		Maintenance records	
2	Operation of Borrow Areas	Topsoil and Land	Land degradation, erosion and loss of productive soil	• Borrow areas shall operate only after obtaining required approvals and EC where applicable. • Topsoil shall be stripped, stored separately and protected from erosion. • Stored topsoil shall be reused for slope stabilization, landscaping and plantation works. • Borrow areas shall not be located in environmentally sensitive areas, unstable slopes or near settlements. • Borrow areas shall be rehabilitated upon completion. • Borrow Area Closure Plan shall be implemented.	Contractor	EC copy; Borrow Area Management Plan; Closure records	MPWD / PMC / CSC
3	Operation of Quarries	Physiography and Geology	Environmental degradation and community disturbance	• Construction material shall only be sourced from approved quarries. • Royalty receipts and transport challans shall be maintained. • New quarries shall obtain all statutory approvals before operation. • Blasting Management Plan shall be prepared where blasting is required. • No quarry or associated plant shall be established within 1000 m of	Contractor	Quarry approvals; Royalty receipts; Haul road inspection records	MPWD / PMC / CSC

				settlements. • Quarry haul roads shall be managed to minimize impacts on communities and biodiversity.			
4	Dismantling of Bridges, Culverts, Structures and Hill Cutting	Land Use, Slope Stability and Water Environment	Erosion, slope failure, drainage blockage, sedimentation and community safety risks	• Prevent construction materials and debris from entering streams and drainage channels. • Remove spilled material immediately. • Hill cutting shall follow approved excavation methodology. • Debris shall not remain on carriageway beyond 48 hours. • Reusable materials shall be segregated for reuse. • Dispose non-recyclable materials only at approved disposal sites. • Temporary silt barriers shall be installed near drainage channels. • Spoil disposal sites shall include retaining walls, toe walls, catch drains and stabilization measures. • DSSPS-specific slope stabilization measures including breast walls, retaining walls, toe walls and bioengineering shall be implemented as per approved design. • All disposal sites shall be rehabilitated after completion.	Contractor	Disposal records; Site inspection reports; Photographic documentation	MPWD / PMC / CSC
5	Road Scraping and Dismantling	Bituminous Waste Disposal	Soil and groundwater contamination from improper disposal of bituminous waste	• Bituminous waste shall be collected and stored in impermeable areas. • Reuse shall be maximized in sub-base, shoulders or approved applications. • Disposal shall only be through approved facilities. • Records of generation, reuse and disposal shall be maintained. • No disposal in water bodies, agricultural land or roadside areas. • Periodic inspections shall be undertaken.	Contractor	Waste disposal records; Inspection reports	MPWD / PMC / CSC

6	Storage of Fuel and Repair of Vehicles	Soil and Water Pollution	Contamination from oil, fuel and hazardous material spills	• Fuel storage and workshops shall be located away from water bodies. • Storage areas shall be paved, covered and bunded to contain at least 110% of storage capacity. • Oil interceptors and oil-water separators shall be installed. • Spill kits shall be available at all fuel handling locations. • Waste oil shall be collected and disposed through authorized recyclers. • Fire extinguishers shall be provided as per applicable standards. • Fuel transfer through decantation shall be prohibited. • Inspection and maintenance records shall be maintained.	Contractor	Spill records; Waste oil disposal records; Fuel storage inspection reports	MPWD / PMC / CSC
7	Operation of Plant, Machinery and Equipment	Hazardous Waste	Soil and water contamination from hazardous waste	• Used oils, lubricants and hazardous materials shall be stored in labelled leak-proof containers. • Hazardous waste shall be handed over only to authorized recyclers. • Hazardous Waste Authorization conditions shall be complied with. • Records and returns shall be maintained and submitted.	Contractor	Hazardous waste records and returns	PMC / CSC
8	Operation of Vehicles and Earthwork During Construction	Air Pollution – Dust Generation	Air pollution, nuisance and health impacts	• Vehicles transporting materials shall be covered. • Water sprinkling shall be undertaken regularly, particularly during dry periods. • Speed restrictions shall be imposed. • Construction roads shall be maintained. • Dust suppression measures shall be implemented at stockpiles and work sites. • Workers exposed to dust shall be provided with PPE. • Air quality monitoring	Contractor	Air quality monitoring reports; Dust suppression logs; Complaint records	MPWD / PMC / CSC

				shall be undertaken as per approved monitoring plan. • Community complaints regarding dust shall be recorded and addressed.			
9	Operation of Vehicles, Plant and Machinery	Air Emissions	Deterioration of ambient air quality	• Maintain valid PUC certificates and fitness certificates. • Equipment shall comply with CPCB and MoRTH emission standards. • Regular maintenance shall be undertaken. • Vehicle idling shall be minimized. • Low sulphur fuel shall be used where feasible. • Emission control systems shall be installed at crushers, batching plants and material handling facilities.	Contractor	PUC records; Maintenance logs; Emission monitoring reports	MPWD / PMC / CSC
10	Operation of Construction Camps and Construction Activities	Surface Water and Groundwater Quality	Water pollution from camps, runoff and construction activities	• Construction and camp wastes shall be disposed only at approved disposal sites. • Sanitation facilities shall be maintained in good condition. • Labour shall not be permitted to pollute local water sources. • Peripheral drains and sedimentation facilities shall be maintained. • Wastewater shall be managed appropriately. • Bentonite slurry discharge into water bodies shall be prohibited. • Slurry generated from piling works shall be managed through closed systems and disposed in lined pits. • Regular inspections shall be undertaken. • Camps shall maintain adequate drainage and wastewater management systems.	Contractor	Water quality monitoring reports; Camp inspection reports; Waste disposal records	MPWD / PMC / CSC
11	Sourcing Water for Project	Surface Water and Groundwater	Resource depletion and conflicts over	• Water shall be used judiciously and efficiently. • Water meters shall be	Contractor	Water abstraction records; Water	MPWD / PMC / CSC

		Resources	water use	installed and extraction records maintained. • Necessary permissions shall be maintained throughout the project period. • Rainwater harvesting systems shall be installed at camps and plant locations where feasible. • Awareness programmes shall be conducted on water conservation. • Daily water consumption records shall be maintained. • Water abstraction shall not adversely affect local community requirements.		consumption logs; Rainwater harvesting records	
12	Coffer Dams and Bridge Construction Works	Surface Water Hydrology and Aquatic Environment	Alteration of natural flow, increased turbidity and sedimentation	• Temporary diversion works shall be designed to minimize disturbance to natural flow. • Coffer dams shall be removed immediately after completion of works. • No disposal of debris, excavated material or waste into streams. • Sediment barriers and silt traps shall be installed downstream. • Fuel storage and equipment maintenance shall not be permitted near watercourses. • Disturbed stream banks shall be restored after completion of works. • Regular inspection shall be undertaken during monsoon periods.	Contractor	Inspection reports; Water quality monitoring records	MPWD / PMC / CSC
13	Operation of Vehicles, Plants and Machinery	Noise and Vibration	Noise nuisance, disturbance to communities and workers	• All equipment shall conform to CPCB standards. • Silencers and acoustic enclosures shall be maintained in working condition. • High-noise activities shall be restricted to daytime hours. • Noise barriers shall be provided where required near schools, churches and	Contractor	Noise monitoring reports; Equipment maintenance records	MPWD / PMC / CSC

				settlements. • Workers exposed to high noise levels shall be provided hearing protection. • Noise monitoring shall be undertaken as per monitoring plan.			
14	Operation of DG Sets	Noise and Air Quality	Elevated noise levels and emissions	• DG sets shall conform to CPCB emission and noise standards. • Acoustic enclosures shall be provided. • DG sets shall be located away from settlements and sensitive receptors. • Fuel storage and handling procedures shall be strictly followed. • Routine maintenance shall be undertaken. • Noise and emissions monitoring shall be conducted periodically.	Contractor	DG inspection reports; Monitoring records	MPWD / PMC / CSC
15	Blasting of Rocks (Where Required)	Community Health and Safety, Geology	Fly rock, vibration, noise, structural damage and safety risks	• Blasting shall be minimized and undertaken only where approved. • All statutory permissions shall be obtained before blasting. • Controlled blasting techniques shall be adopted. • Advance notice shall be provided to affected communities through Waheh Chnong and Doloi. • Vibration monitoring shall be conducted near structures and sensitive receptors. • Blast exclusion zones shall be established and enforced. • Explosives shall be stored and transported in accordance with applicable regulations. • Blasting shall not be permitted near Monoliths, Cave locations or culturally sensitive sites without specific approval and safeguards.	Contractor	Blasting records; Vibration monitoring reports; Community notification records	MPWD / PMC / CSC
16	Tree Felling and	Biodiversity and	Loss of vegetation,	• Vegetation clearance shall be	Contractor	Tree felling	MPWD /

	Vegetation Clearance	Ecology	habitat disturbance and soil erosion	limited to the approved corridor. • Tree felling shall be undertaken only after obtaining necessary approvals. • Approximately 32 trees identified for removal shall be compensated through plantation at a minimum ratio of 1:10 or as directed by Forest Department. • Cleared areas shall be stabilized immediately. • Timber and biomass shall be disposed of in accordance with Forest Department directions. • Plantation monitoring and maintenance shall be undertaken throughout the project period.		records; Plantation records; Survival monitoring reports	Forest Department / CSC
17	Protection of Biodiversity and Wildlife	Biodiversity and Critical Habitat	Habitat disturbance, wildlife stress and loss of biodiversity	• Recommendations of Biodiversity Assessment and Critical Habitat Screening shall be implemented. • Hunting, trapping and collection of flora and fauna shall be strictly prohibited. • Workers shall receive biodiversity awareness training. • Waste management measures shall be implemented to avoid attracting wildlife. • Night-time disturbance shall be minimized where sensitive habitats are present. • Vegetation outside approved work limits shall not be disturbed.	Contractor	Biodiversity inspection reports; Training records	MPWD / PMC / CSC
18	Occupational Health and Safety	Labour and Working Conditions	Injuries, occupational illness and fatalities	• Approved OHS Plan shall be implemented. • PPE shall be provided and used at all times. • Toolbox talks and safety briefings shall be conducted regularly. • First aid facilities and trained personnel shall be available at all sites. • Emergency response procedures shall be	Contractor	OHS inspection reports; Accident records; PPE records	MPWD / PMC / CSC

				displayed. • Incident reporting and investigation procedures shall be implemented. • Adequate welfare facilities shall be provided. • Safety audits shall be conducted periodically.			
19	Community Health and Safety	Community Safety	Accidents, injuries and disruption to community life	• Barricades, warning signs and safety lighting shall be installed. • Safe pedestrian access shall be maintained throughout construction. • Access to residences, schools, churches, markets and public facilities shall be maintained. • Temporary diversions shall be clearly marked. • Public awareness campaigns shall be conducted periodically. • Emergency contact information shall be displayed at work sites. • Special attention shall be given to children, elderly persons and persons with disabilities.	Contractor	CHS inspection reports; Complaint records; Awareness programme records	MPWD / PMC / CSC
20	Emergency Response System	Emergency Preparedness	Delayed response to accidents and emergencies	• Emergency Response Plan shall be implemented at all construction sites. • Emergency contact lists shall be displayed prominently. • Mock drills shall be conducted periodically. • Fire extinguishers, rescue equipment and first aid kits shall be maintained in working condition. • Linkages shall be established with local hospitals, health centres, police and emergency services. • Site personnel shall receive emergency response training.	Contractor	Mock drill records; Inspection reports; Emergency equipment inventory	MPWD / PMC / CSC
21	Health Management – Communicable	Public Health	Spread of communicable diseases among	• Labour camps shall maintain adequate sanitation and hygiene facilities. • Potable drinking water	Contractor	Health records; Camp inspection reports;	MPWD / PMC / CSC

	Diseases and Labour Camp Health		workers and communities	shall be provided. • Periodic health check-ups shall be conducted. • Awareness programmes on communicable diseases, HIV/AIDS, TB and vector-borne diseases shall be undertaken. • Waste shall be managed appropriately. • Isolation and referral procedures shall be established where necessary. • Health records shall be maintained.		Awareness programme records	
22	Community Engagement During Construction	Stakeholder Relations	Community dissatisfaction, misinformation and grievances	• Continue consultations with Waheh Chnong, Doloi, Village Durbar and affected communities throughout construction. • Inform communities in advance regarding road closures, diversions, blasting and major construction activities. • Monitor implementation of FPIC-related commitments including bus shelters, footpaths, drainage improvements, toilets and safety measures. • Consultation records shall be maintained. • Community concerns shall be addressed promptly through established mechanisms.	Contractor / MPWD	Consultation records; Community feedback records	MPWD / CSC
23	Risk of Natural Hazards	Climate Resilience, Geotechnical Stability and Community Safety	Landslides, slope failure, flooding, erosion, rockfall and damage to infrastructure	• Contractor shall prepare and implement Monsoon Preparedness Plan. • Weather forecasts shall be monitored regularly. • Excavated slopes shall be stabilized immediately through retaining walls, breast walls, toe walls, gabions, turfing and bioengineering measures. • Temporary drainage shall be maintained at all times. • Stockpiles shall be protected against erosion. •	Contractor	Inspection reports; Slope stabilization records; Monsoon preparedness records	MPWD / PMC / CSC

				Emergency response procedures shall be activated during extreme rainfall events. • Construction activities in vulnerable locations shall be suspended during severe weather warnings. • Particular attention shall be given to identified landslide-prone stretches. • Slope protection measures shall be inspected after every major rainfall event.			
24	Risk of Force Majeure Events	Disaster Risk Management	Damage to works, injuries and disruption of project activities	• Emergency preparedness measures shall address earthquakes, flash floods, severe storms, fire, landslides and other natural disasters. • Emergency communication systems shall be maintained. • Workers shall be trained on evacuation procedures. • Emergency equipment shall be available at all sites. • Site-specific contingency plans shall be prepared for critical work locations. • All incidents shall be documented and corrective actions implemented.	Contractor	Emergency preparedness records; Incident reports	MPWD / PMC / CSC
25	Hygiene and Sanitation at Work Sites and Labour Camps	Public Health and Worker Welfare	Disease transmission, poor living conditions and community health concerns	• Adequate sanitation facilities shall be maintained at all work sites and labour camps. • Separate facilities shall be provided for men and women. • Potable drinking water shall be available at all times. • Solid waste shall be collected and disposed regularly. • Labour camps shall be maintained in hygienic condition. • Vector control measures shall be implemented. • Periodic inspections shall be conducted.	Contractor	Camp inspection records; Hygiene audit reports	MPWD / PMC / CSC
26	Traffic	Community	Traffic congestion,	• Approved Traffic Management Plan	Contractor	Traffic inspection	MPWD /

	Management During Construction	Health and Safety	accidents and restricted access	shall be implemented. • Advance warning signs, barricades, flagmen and diversion boards shall be provided. • Speed limits shall be enforced. • Safe pedestrian access shall be maintained. • Access to residences, schools, churches, markets, health facilities and community assets shall be maintained. • Temporary diversions shall be clearly marked. • Traffic safety awareness campaigns shall be undertaken periodically. • Construction vehicles shall follow designated haul routes. • Additional safety measures shall be provided near schools and settlements.		reports; Complaint records; Accident records	PMC / CSC
27	Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH)	Social Risk Management	Harassment, abuse, social conflict and reputational risks	• Contractor shall implement approved GBV/SEA-SH Action Plan. • All workers shall sign and comply with Code of Conduct. • Awareness and sensitization programmes shall be conducted regularly. • Confidential grievance mechanisms shall be established. • Survivor-centred response procedures shall be maintained. • Workers violating Code of Conduct shall be subject to disciplinary action. • Regular monitoring and reporting shall be undertaken.	Contractor	Signed Codes of Conduct; Training records; GBV monitoring reports	MPWD / CSC
28	Works Near Monoliths, Cave and Chance Find Procedures	Cultural Heritage (ESS8)	Damage to Monoliths, Cave and undiscovered cultural resources	• No construction camp, material storage area, parking area or machinery yard shall be established within 100 m of Monoliths located at Ch. 01+700 LHS, Ch. 10+800 RHS and	Contractor	Inspection reports; Chance Find records; Consultation records	MPWD / CSC

				Ch. 11+600 LHS or Cave at Ch. 22+500 LHS. • Protective barricades and warning signs shall be installed where required. • Construction activities shall avoid direct and indirect impacts on cultural heritage resources. • Chance Find Procedure shall be implemented throughout construction. • If artefacts, structures or cultural remains are discovered, work shall cease immediately and competent authorities shall be informed. • Consultation shall be undertaken with Waheh Chnong, Doloi and concerned authorities before resuming works.			
29	Engagement of Labour – Labour Welfare Compliance	Labour and Working Conditions (ESS2)	Non-compliance with labour laws and poor worker welfare	• Contractor shall comply with all applicable labour laws and World Bank ESS2 requirements. • Workers shall receive appointment letters and wage payments in accordance with law. • Working hours, leave and welfare provisions shall be implemented. • Child labour and forced labour shall be prohibited. • Equal opportunity and non-discrimination principles shall be followed. • Labour welfare facilities shall be maintained.	Contractor	Labour records; Wage records; Labour inspection reports	MPWD / CSC
30	Engagement of Labour – Labour Influx Management	Community Relations and Social Risk	Social conflict, pressure on local resources and community concerns	• Preference shall be given to local employment where feasible. • Worker behaviour shall be regulated through Code of Conduct. • Awareness programmes shall be conducted for workers regarding local customs and traditions. • Labour	Contractor	Local employment records; Complaint records; Training records	MPWD / CSC

				camps shall be self-sufficient and shall not place pressure on community resources. • Interaction with communities shall be managed respectfully. • Complaints related to labour behaviour shall be addressed promptly.			
31	Site-Specific Stakeholder Engagement and Consultation	Stakeholder Engagement (ESS10)	Community dissatisfaction and misinformation	• Continue regular consultations with Waheh Chnong, Doloi, Village Durbar, affected households and community representatives throughout construction. • Inform communities in advance regarding major construction activities, road closures, diversions and blasting operations. • Monitor implementation of commitments made during consultations and FPIC processes. • Consultation records shall be maintained. • Community feedback shall be incorporated into construction planning where feasible.	Contractor / MPWD	Consultation records; Disclosure records	MPWD / CSC
32	Grievance Redressal Mechanism	Stakeholder Engagement and Social Risk Management	Unresolved complaints and community conflict	• Maintain project-level Grievance Redress Mechanism throughout construction. • Display grievance contact information at work sites and camps. • Maintain grievance registers and resolution records. • Waheh Chnong and Doloi may participate in grievance resolution where appropriate. • Complaints shall be acknowledged, investigated and resolved within prescribed timelines. • Periodic review of grievance trends shall be undertaken.	Contractor / MPWD	Grievance register; Resolution records; Monthly grievance reports	MPWD / CSC
33	Monitoring and	Environmental	Failure to identify	• Contractor shall undertake regular	Contractor	Monthly ESHS	MPWD /

	Reporting Mechanism	and Social Compliance	and correct non-compliance	environmental, social, health and safety inspections. • Monthly ESHS reports shall be submitted to CSC and MPWD. • Environmental monitoring shall be conducted as per approved monitoring programme. • Non-compliances shall be recorded and corrective actions implemented. • Community complaints and incidents shall be reported. • Monitoring shall include RAP implementation, biodiversity protection, plantation survival, Monolith and Cave protection, FPIC commitments, labour welfare and safety performance. • Records shall be maintained for audit and reporting purposes.		reports; Monitoring records; Corrective action reports	PMC / CSC
OPERATION PHASE							
OP-1	Operation and Maintenance of Road Infrastructure	Road Asset Sustainability	Deterioration of road condition, drainage failure and reduced serviceability	• MPWD shall undertake periodic inspection and maintenance of pavement, shoulders, culverts, drains, retaining walls and protection structures. • Maintenance schedules shall be implemented in accordance with MPWD standards. • Defects identified during inspections shall be rectified promptly. • Adequate budgetary provisions shall be maintained for routine and periodic maintenance.	MPWD	Maintenance records; Inspection reports	MPWD
OP-2	Maintenance of Drainage Structures and Cross-Drainage Works	Surface Water Hydrology	Waterlogging, flooding, erosion and damage to road infrastructure	• Side drains, catch drains, culverts and cross-drainage structures shall be inspected regularly, particularly before and after monsoon seasons. • Debris and sediment deposits shall be	MPWD	Drain inspection reports; Maintenance logs	MPWD

				removed periodically. • Damaged drainage structures shall be repaired immediately. • Stream training and erosion protection measures shall be maintained.			
OP-3	Monitoring of Slope Protection and Stabilization Measures	Geotechnical Stability	Landslides, slope failure, erosion and road blockages	• Retaining walls, breast walls, toe walls, gabions and bioengineering measures shall be inspected regularly. • Areas showing signs of instability shall receive immediate remedial measures. • Post-monsoon inspections shall be undertaken annually. • Emergency stabilization measures shall be implemented where required.	MPWD	Slope inspection reports; Maintenance records	MPWD
OP-4	Road Safety Management	Community Health and Safety	Traffic accidents, injuries and fatalities	• Road signs, pavement markings, guardrails, delineators and crash barriers shall be maintained in good condition. • Damaged signs and safety devices shall be replaced immediately. • Accident-prone locations shall be monitored. • Road safety awareness programmes shall be conducted periodically in consultation with local communities and educational institutions.	MPWD	Road safety audit reports; Accident statistics	MPWD / Traffic Police
OP-5	Maintenance of Community Assets and FPIC Commitments	Community Relations	Deterioration of community facilities and dissatisfaction	• Bus waiting sheds, footpaths, drainage facilities, toilets and other community infrastructure developed under the project shall be periodically inspected and maintained. • Community feedback shall be considered during maintenance planning. • Defects shall be rectified in a timely manner.	MPWD	Inspection records; Community feedback records	MPWD
OP-	Biodiversity and	Biodiversity and	Failure of	• Compensatory plantation sites shall	MPWD / Forest	Plantation survival	MPWD /

6	Plantation Monitoring	Ecology	compensatory plantation and habitat degradation	be monitored regularly. • Replacement planting shall be undertaken where survival rates are unsatisfactory. • Encroachment and damage to plantation areas shall be prevented. • Biodiversity enhancement measures shall be maintained.	Department	records; Inspection reports	Forest Department
OP-7	Protection of Monoliths, Cave and Cultural Heritage Resources	Cultural Heritage (ESS8)	Damage to cultural heritage resources	• Monoliths located at Ch. 01+700 LHS, Ch. 10+800 RHS and Ch. 11+600 LHS and Cave at Ch. 22+500 LHS shall be protected from encroachment and physical damage. • Protective measures installed during project implementation shall be maintained. • Community consultations shall be undertaken before any maintenance activity in the vicinity of cultural resources. • Any observed damage shall be reported and addressed immediately.	MPWD	Inspection reports; Community consultation records	MPWD
OP-8	Climate Resilience and Disaster Preparedness	Climate Change and Natural Hazards	Flooding, landslides, erosion and damage to infrastructure due to extreme weather events	• Climate-resilient drainage and protection measures shall be periodically assessed. • Vulnerable locations shall be monitored before and after monsoon seasons. • Emergency response arrangements shall be maintained. • Lessons learned from extreme weather events shall be incorporated into maintenance planning. • Monitoring of rainfall-induced slope instability shall be undertaken at vulnerable locations.	MPWD	Inspection records; Disaster response records	MPWD
OP-9	Community Consultation and	Stakeholder Engagement	Unresolved community concerns	• Continue stakeholder engagement with Waheh Chnong, Doloi, Village	MPWD	Consultation records; Grievance	MPWD

	Grievance Redress Mechanism	(ESS10)	and grievances	Durbar and affected communities during operation and maintenance activities. • Maintain grievance redress mechanism for road users and local communities. • Address complaints relating to drainage, safety, access, slope failures and maintenance issues within prescribed timelines. • Maintain grievance records and corrective action logs.		records	
OP-10	Environmental and Social Monitoring and Reporting	Environmental and Social Compliance	Failure to identify and address operational impacts	• MPWD shall undertake periodic environmental and social monitoring during operation. • Monitoring shall include road safety, drainage performance, slope stabilization measures, plantation survival, cultural heritage protection and community concerns. • Findings shall be documented and corrective actions implemented. • Monitoring records shall be maintained for audit and reporting purposes.	MPWD	Monitoring reports; Corrective action records	MPWD
SITE SPECIFIC							
SS-1	Construction Activities Near Monolith at Ch. 01+700 LHS	Cultural Heritage	Physical damage to Monolith and loss of cultural value	No construction camp, labour camp, storage yard, fuel storage area or vehicle parking shall be established within 100 m of the Monolith. Temporary fencing and warning signage shall be installed. Photographic documentation shall be undertaken before, during and after construction. Chance Find Procedure shall be implemented. Blasting shall not be undertaken without approval and vibration monitoring.	Contractor	No damage to Monolith; inspection records maintained	CSC / MPWD
SS-	Construction	Cultural Heritage	Physical damage to	No construction-related facilities shall	Contractor	No damage to	CSC / MPWD

2	Activities Near Monolith at Ch. 10+800 RHS		Monolith and loss of cultural value	be established within 100 m of the Monolith. Protective measures shall be installed. Construction activities shall avoid direct and indirect impacts on the site. Photographic records shall be maintained throughout construction.		Monolith; inspection records maintained	
SS-3	Construction Activities Near Monolith at Ch. 11+600 LHS	Cultural Heritage	Physical damage to Monolith and loss of cultural value	Temporary fencing and warning signage shall be installed. No material storage, parking or camp facilities shall be permitted within 100 m. Construction activities shall be supervised to avoid accidental damage.	Contractor	No damage to Monolith; inspection records maintained	CSC / MPWD
SS-4	Construction Activities Near Cave at Ch. 22+500 LHS	Cultural Heritage	Damage to Cave and associated cultural resources	No camp, storage area, fuel storage facility or parking area shall be located within 100 m of the Cave. Blasting shall not be undertaken in the vicinity without prior approval and vibration monitoring. Temporary protection measures shall be installed where required.	Contractor	No damage to Cave; inspection records maintained	CSC / MPWD
SS-5	Hill Cutting and Excavation Along Landslide-Prone Sections	Slope Stability and Geotechnical Environment	Landslides, erosion, rockfall and slope failure	Hill cutting shall follow approved methodology. Benching, retaining walls, breast walls, toe walls, gabions and bioengineering measures shall be implemented. Exposed slopes shall be stabilized immediately after excavation. Monsoon inspections shall be undertaken regularly.	Contractor	Slope stabilization completed; no major slope failure incidents	CSC / PMC / MPWD
SS-6	Operation of Approved Spoil Disposal Sites	Land and Water Environment	Siltation, erosion, drainage blockage and slope instability	Spoil disposal shall only occur at approved locations. Disposal sites shall include retaining structures, toe protection, catch drains and sediment control measures. Sites shall be progressively rehabilitated and	Contractor	Disposal sites stabilized; inspection records maintained	CSC / PMC

				stabilized through vegetation and bioengineering measures.			
SS-7	Construction Activities in Mining-Influenced Areas	Ground Stability and Water Quality	Subsidence, unstable ground conditions and water quality impacts	Contractor shall verify presence of abandoned mine pits, unstable ground and subsidence-prone areas before commencement of works. Any evidence of instability shall be reported immediately. Construction runoff shall be controlled to avoid aggravating mining-related water quality issues.	Contractor	No subsidence-related incidents; inspection reports maintained	CSC / MPWD
SS-8	Construction Activities in High Rainfall and Erosion-Prone Sections	Climate Resilience	Erosion, flooding, drainage congestion and slope instability	Pre-monsoon inspection of temporary drainage systems, spoil disposal sites, stockpiles and slope stabilization measures shall be undertaken annually. Emergency response measures shall be activated during extreme rainfall events.	Contractor	Monsoon preparedness records; drainage inspection reports	CSC / MPWD
SS-9	Implementation of FPIC Commitments Along Project Corridor	Community Infrastructure and Stakeholder Engagement	Community dissatisfaction and grievances	Bus waiting sheds, drains-cum-footpaths, toilets, safety measures and protection works identified during FPIC consultations shall be implemented and monitored. Progress shall be reviewed during consultations with Waheh Chnong, Doloi and Village Durbar representatives.	MPWD / Contractor	FPIC commitments implemented; consultation records maintained	MPWD / CSC
SS-10	Construction Near Schools, Churches, Markets and Other Sensitive Receptors	Community Health and Safety	Traffic accidents, access disruption and community disturbance	Additional traffic management measures including flagmen, barricades, warning signage and speed restrictions shall be implemented. Safe pedestrian access shall be maintained throughout construction. High-noise activities shall be restricted to daytime hours.	Contractor	No major safety incidents; inspection records maintained	CSC / MPWD

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. Sample environmental site inspection report has been attached as Annexure 8.2.

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 ESMU.

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)	6 locations for 3 Seasons* for 4 consecutive years	24 hours sampling	6 locations (Construction Plant Sites, settlements and Work Zones)	72	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			6 locations for 3 Seasons for 1 consecutive years.		At 6 locations during operation stage where monitoring had been done during construction stage	18	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 3 locations for 3 Seasons for 4 consecutive years. (ground water) at 4 locations for 3 seasons for 4 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.	84	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant

Environmental Attribute	Timing	Parameter	Standards	Frequency	Duration	Location	Total no. of Samples during construction and operation stage.	Implementation
	Operation			3 locations for 3 Seasons for 1 year. Water (Ground water) at 4 locations for 3 Seasons for 1 year.		At 7 locations during operation stage where monitoring had been done during construction stage	21	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
Noise	Construction	Noise Levels on dB (A) scale	Noise rules 2000 by CPCB	6 locations for 3 Seasons for 4 consecutive years.	Leq in dB(A) of daytime and night-time	Near the working zones, sensitive receptors and construction plant sites.	72	Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant
	Operation			6 locations for 3 Seasons for 1consecutive years.		At 06 locations during operation stage where monitoring had been done during construction stage	18	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'	6 locations for 3 Seasons for 4 consecutive years.	Grab Sampling	Soil at 6 locations 3 times a year for 24 Months. At 6 locations	72	Contractor through NABL accredited Laboratory and supervised by Construction Supervision

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		Consultant
	Operation			6 locations for 3 Seasons for 1 consecutive years.			18	Contractor through NABL accredited 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 8.3.

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/	• % of grievances resolved within timeline; average grievance resolution time	Meeting records, video/audio	Ongoing

Cultural Heritage	Contractor/ MPWD		evidence	
	RP Implementation consultant/ Contractor/ MPWD	• 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	Training records, GRM records, supervision reports	Quarterly

		children by contractors' 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 specialised 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.

8.6.1 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN BUDGET

An amount of Rs. 4,40,34,682 have been marked for ESMP budget. The detailed budget for the same have been presented in **Table 8.4**.

Table 8.4: Environmental and Social Management Plan Budget

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
A.	**Monitoring Measures**						
1	Air quality monitoring	Construction	No.	72	9,000	6,48,000	Civil works contract
		Operation	No.	18	9,000	1,62,000	Civil works contract
2	Noise levels monitoring	Construction	No.	72	3,000	2,16,000	Civil works contract
		Operation	No.	18	3,000	54,000	Civil works contract
3	Soil quality monitoring	Construction	No.	72	6,000	4,32,000	Civil works contract
		Operation	No.	18	6,000	1,08,000	Civil works contract
4	Ground and Surface Water	Construction	No.	84	7,000	5,88,000	Civil works contract
		Operation	No.	21	7,000	1,47,000	Civil works contract
	Subtotal (A)					**23,55,000**	
B.	**Capacity Building**						
1	EMSP implementation (1 days)	On Award of Contract	lump sum			Included in project safeguards capacity building	PIU Cost

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
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		1000	331	---------	Civil works contract
	Subtotal (B)					----------	**Civil works contract**
C.	**Construction Contractor ESMP Implementation**						
1	Providing, fixing, maintaining, shifting & refixing, barricading of	Construction	to be provided at	To be decided by the contractor as per his	-	0	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	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 completion of the Project		each of the active sites by the Contractor (i.e. till the completion for the works)	schedule of works			
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	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

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	engineer						
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
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	Construction	Numbers			----------	Civil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	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 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	20	3000	----------	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	100	300	----------	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	12	40000	----------	Civil works contract
9	Tree Plantation (Afforestation) (1:10 ratio)	Construction	Nr.	320	--	--	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	uction	Lumpsum	-		Included in the Contract	ivil works contract

Sl.No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost	Costs Covered By
	Sub Total (C)					---------	**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	-	-		1,64,20,000	As per IPDP of the Sub Project
3	Resettlement action Plan (RAP)	Construction	-	-		2,47,59,682	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)					**4,16,79,682**	
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)					**4,40,34,682**	

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 REDRESS 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 operates 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. Details are provided in Chapter 7 of ESMF.

10. CONCLUSION & 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. The project is imperative for encouraging more trade and commercial activity (including public transport) in the district of East Jaintia 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 project does not require environment clearance or forest clearance.
- The proposed project alignment does not pass through any Wildlife Sanctuary/National Park/Biosphere Reserve/Tiger Reserve.
- No ASI Protected monuments found within 0.5 km from the project site. However, Monolith: Ch 01+700, Ch 10+800 & Ch 11+600 and Cave: Ch 22+500 LHS are present within 500m from the project Road.
- Approximately 32 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 should be undertaken in line with applicable environmental regulations and guidelines.
- 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 monoliths and caves, and potential effects on Project-Affected Persons (PAPs) arising from access-related issues.
- 1.902 ha additional land will be acquired for the proposed road project, and for spoil disposal, 2.64 ha of land is required temporarily.
- 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 DSSPS 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.
- Site-specific protection needs highlighted by the ESIA, particularly in agricultural and vulnerable zones, have been addressed through toe walls and gabion/protection works (31755 to 32040, 43595 to 43895), ensuring slope stability and protection of adjoining land uses. Recommendations near sensitive receptors such as schools (Ch 05+800 LHS, Ch 10+800 RHS & Ch 13+500 LHS) have been incorporated through zebra crossings and traffic calming measures.
- 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 following recommendations are made in accordance with the World Bank's Environmental and Social Standards (ESS) for the proposed Dkhiah - Sutnga - Saipung - Pala upto Semmasi for Meghalaya Logistics and Connectivity Improvement Project (MLCIP), funded by the World Bank, to ensure environmentally sustainable and socially inclusive development outcomes:

- The Contractor should prepare a site-specific contractor 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 required consultations regularly or as needed with all stakeholders, 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 ESMU/PMC staff and district-level MPWD engineers on ESHS policies, regulations, and procedures for implementing, monitoring, and reporting ESMP measures. This training is to be conducted during the pre-construction phase.
- Contractors will engage the experienced ES&HS Staff for ESMP implementation as well as to ensure imparting induction, work-specific and other required trainings to the workers;
- MPWD will support Project Affected Peoples (PAP) as per RAP prepared for the project road stretch.
- 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 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.
- The contractor to ensure safe access to vulnerable people such as elderly and people with disabilities during the construction stage.
- MPWD to monitor the implementation and redress of grievances timely and amicably.