GOVERNMENT OF INDIA

MINISTRY OF ROAD TRANSPORTATION AND HIGHWAYS
NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION

GOVERNMENT OF INDIA

PREPARATORY STUDY FOR NORTH EAST CONNECTIVITY IMPROVEMENT PROJECT IN INDIA

WIDENING AND IMPROVEMENT OF NH54 (AIZAWL-TUIPANG)

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

NOVEMBER 2015
JAPAN INTERNATIONAL
COOPERATION AGENCY (JICA)

NIPPON KOEI CO.,LTD.
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TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendix

ABBREVIATIONS

BRDB	Border Roads Development Board
BRO	Border Roads Organization
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DOEF	Departments of Environment and Forests
DOF	Department of Forest
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GHG	Green House Gas
GOI	Government of India
IRC	Indian Road Congress
MLCU	Martin Luther Christian University
MOEF	Ministry of Environment & Forest
MORTH	Ministry of Road Transport & Highways
MSPCB	Mizoram State Pollution Control Board
NHAI	National Highway Authority of India
NHIDCL	National Highways and Infrastructure Development Corporation
NOC	No-objection Certificates
PAPs	Project Affected Persons
PIU	Project Implementation Unit
PUC	Pollution under Control Certificate
PWD	Public Works Department
RAP	Resettlement Action Plan
RO	Regional Offices
ROB	Road over Bridge
ROW	Right of Way
SC	Supervision consultants
SPCBs	State Pollution Control Boards

EXECUTIVE SUMMARY

The Government of India has requested the Government of Japan to provide financing for about 1,200 km of roads that enhance connectivity in North-East States. Out of 10 candidate roads and bridges, Aizawl-Tuipang section of NH54 in the State of Mizoram has been selected as one of the two priority projects (the other is Tura -Dalu section of NH51 in Meghalaya).

The project objective is to improve intra-state connectivity for North East States and regional road connectivity for Mizoram and North East India to neighboring countries. The residents of the North East Region, Bangladesh and Myanmar and countries beyond should benefit from the increased regional connectivity which is expected to result in increased trade and economic development over the longer term.

The existing road is about 381 km in length and stretches over five districts in Mizoram. NH54 is the most important road in the State, connecting Mizoram with other States of India and other countries. This is the lifeline of many Mizo people who depend on road network for the supply of essential commodities. The current condition of road, however, is poor and the road is prone to landslide and slope failures. The riding quality is poor, particularly after Lunglei district, making travelling arduous and difficult, particularly in monsoon season.

The significant environmental impacts attributable to the widening and improvement of the road pertains to clearance of roadside trees for widening and forest clearance for spoil bank and resettlement site development, temporary deterioration of ambient air quality and nose/vibration levels during construction phase from land clearing, ground shaping, and quarry and camp operations; and community and occupational health and safety. These impacts will be mitigated through compensatory afforestation; timing of construction activities to minimize fauna disturbance; control of noise, dust, wastewater, fuel combustion emissions, and construction debris generation through good construction practices; and implementation of road safety measures to separate road users from active construction fronts.

The assessment of the potential impact revealed that the project will not affect critical habitats or sensitive ecosystem as a road already exists and no new road construction is taking place inside pristine or government reserved forests. The project area is largely made up of agricultural fields and settlements.

During operation stage, the main impacts are increase in mobile emissions, road safety to motorist and pedestrian. Road safety measures will be implemented as per IRC guidelines. Road safety apputenances like information, regulatory and warning signs coupled with crash barriers will reduce

serious injuries to road users. Adequate slope protection and retaining wall as well as cross drains and side drains will be installed and maintenance will be implemented to avoid soil erosion and reduce the risk of landslide.

Several consultations were organized during the project preparation to engage major stakeholder representatives to incorporate their concerns in the overall design. These involved officials of PWD, District Officials, Forest department officials, likely affected persons and village representatives in the project area. Most of the people interviewed strongly support the project.

The NHIDCL, through its Project Implementing Unit (PIU), is the Executive Agency of the Project. It will ensure the effective implementation of the environmental management plan. There is a need for the PIU to organize its environmental unit to provide close support to the Project Director to ensure the contractors maintain environmental compliance. This EIA report is based on the preliminary design of NH54 widening and improvement, and as such, its contents will need to be updated once the final ROW drawing is established.

CHAPTER 1 INTRODUCTION

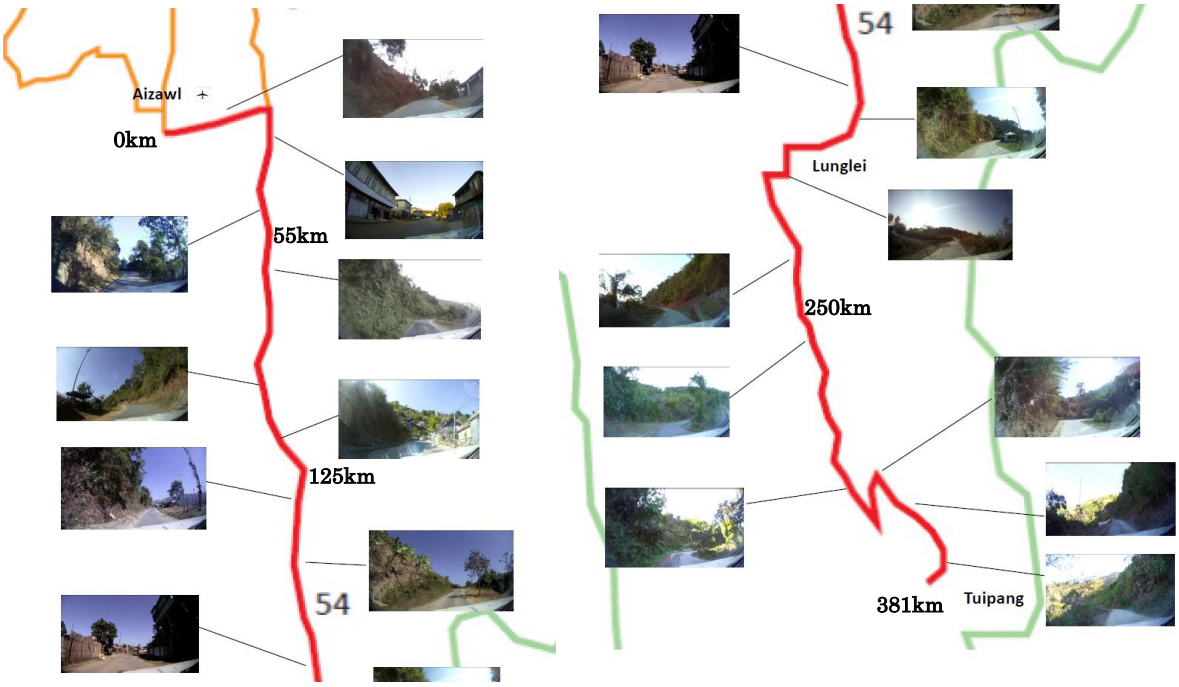
1.1 Background

India has achieved remarkable economic growth in the past decades. Rapid development of in transport infrastructures strengthened the linkage between major cities and thus contributed to the economic growth. In particular, road is one of most important modes of transportation given that road transportation constitutes 85% of passenger and 60% of freight transport in India. However, development of transport infrastructure is lagging in mountainous regions of India due to financial and technical reasons, leading to greater economic disparity between mountainous regions and plain areas of the country which have been fully benefited from improved transport network.

Only 28.5% (63.4% is average in whole country) of the road in North-East states is paved and only 53% of national highway has more than 2-lane road. This is because the North-East states are located far from mainland of India and access road to neighboring countries are underdeveloped due to security concern. Severe natural conditions such as steep mountainous geography (most of the state is located in hilly area) and prolonged monsoon season also complicates the challenge. To accelerate economic growth in this part of the country, therefore, improvement in the road network is of great importance. To this end, Government of India (GOI) launched "Special Accelerated Road Development Program for North-East" committed in "Twelfth Five Years Plan (from April, 2012 to March, 2017)" to cope with above mentioned problems by improvement of national highways that connect major cities within the North-East states, and requested Government of Japan to provide loan assistance in carrying out the improvement. Aizawl – Tuipang section of NH54 stretching over five districts of Mizoram State has been selected among a total of 10 candidate roads and bridges during the screening process in the preparatory study.

1.2 Project Location

The targeted section of NH54 starts from Aizawl in Mizoram state to Tuipang with total length of approximately 381km. The study road mainly passes on brow of variegated mountains and alignment of the study road consist of many small horizontal and vertical curves as shown in Figures below.



Source: JICA Study Team

Figure 1.1 Road Alignment and Present Road Condition of NH54

Source: JICA Study Team

Figure 1.2 Existing Road Profile of NH54

1.3 Requirement and Objective of EIA Report

As per MOEF EIA Notification dated 14.09.2006 (as amended in August 2013), any highway project falls under Category A if the project entails *i) New National Highways; and ii) Expansion of National Highways greater than 100km involving additional right of way or land acquisition greater than 40m*

on existing alignments and 60m on re-alignments and bypasses. The proposed expansion & widening of NH54 does not involve additional land acquisition beyond 40m and thus does not fall under Category A, as defined in EIA Notification. While preliminary environmental assessment was undertaken by DPR consultant during the preparation of the NH54 DPR, the project does not require environmental clearance from MOEF[1].

On the other hand, the project has been classified as Category A as per JICA's Environmental and Social Guidelines, for which a full EIA study is required. Based on this backdrop, a new EIA study has been carried out which builds on previous studies while taking into account additional requirements as per JICA's guidelines. The Environmental Checklist for road projects is attached in Appendix A. The EIA aims to:

- Review environmental assessment undertaken as part of DPR study and identify gaps to satisfy requirements under JICA Guidelines for Environmental and Social Considerations
- Study baseline conditions (physical, social and environmental) along the targeted section and influence area of NH54
- Carry out environmental analysis with respect to proposed project vis-à-vis existing condition; identify environmental impacts that may be expected to occur during design, construction and operation; and identify environmental issue/challenges that require further studies
- Carry out alternative analysis including comparison with "no project' scenario
- Assess environmental impacts of the proposed project components on natural, physical and socio-economic environments
- Develop cost effective and implementable measures for mitigating adverse environmental and social impacts and enhancing positive aspects
- Develop a practical and implementable Environmental Management Plan (EMP) for mitigation of impacts and monitoring of implementation of mitigation measures during design, construction and operation stages
- Consult and inform the project affected people (PAP) and other stakeholders, and ensure their active participation

1.4 Structure of EIA Report

The report is organized as follows:

- Chapter 2 gives key features of the project such as standards and proposed design features

[1] The project requires NOC (Consent-for-Establishment and Consent-for-Operation) from the respective State Pollution Control Board, which will be discussed in more detail Chapter 3.

- Chapter 3 discusses the Environmental legislation and policy within which the project is to be implemented. The chapter presents the clearance requirements at various levels.
- Chapter 4 describes the Environmental and Social baseline along the project area.
- Chapter 5 discusses the Alternatives considered during the project design.
- Chapter 6 gives an overview of environmental and social components that are likely to be affected during different stages of the project (Scoping)
- Chapter 7 identifies and assesses potential environmental impacts and proposes mitigation measures
- Chapter 8 discusses Environmental Management Plan and its implementation arrangement
- Chapter 9 gives an overview of the community consultation carried out during the project preparation stage

CHAPTER 2 DESCRIPTION OF PROJECT

2.1 Preparatory Study For North East Connectivity Improvement Project in India

Only 28.5% (63.4% is average in whole country) of the road in North-East states is paved and only 53% of national highway has more than 2-lane road. Poor infrastructure has been the bottleneck of the economic development of North East States. To address this challenge, the Government of India requested Government of Japan to provide loan assistance in carrying out the improvement of existing roads in eight sections, repairing of two existing bridges and construction of one new bridge within six states of North East state in India. The Preparatory Study has been carried out in response to this request with two key objectives, which are: i) to screen project and identify priority project(s) and ii) to review existing feasibility study (Detailed Project Report) prepared by Indian consultant and propose preliminary design of priority projects. After a screening process during the preparatory study, Aizawl – Tuipang section of NH54, stretching for about 381km, has been selected as one of the priority section and thus the preliminary design is proposed for its widening and improvement.

2.2 Widening and Improvement of NH54 (Aizawl – Tuipang)

The number of lanes is 1.5 lanes for the section near Aizawl and 1.0 lane for other sections. Pavement condition between Aizawl to Lunglei is fair, while section between Lunglei and Tuipang is deteriorated due to inadequate road maintenance. Existing condition of the targeted section of NH54 is shown in Table 2.1. The project involves the widening of existing one-lane road to two-lane roads with installment of proper slope protection and land slide prevention measures, drainage and traffic safety facilities. The total width of the road including carriageway and road shoulder will be 12m except for four sections for which new bypass is proposed.

Table 2.1 Present Conditions and Provisional Improvement Cost of NH54

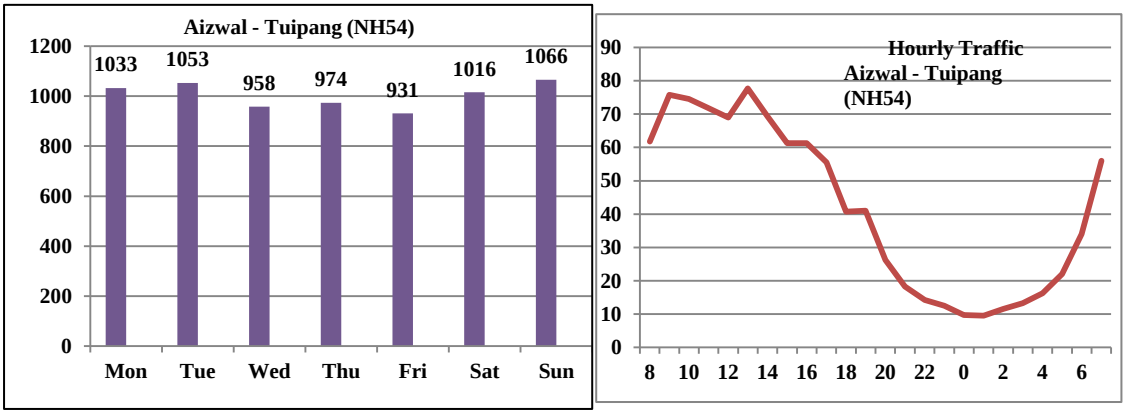
No.	Data Items	Type / Unit	Road			
			NH54 (Upper: KM distance from Aizawl, Lower: KP)			
			0-55	55-125	125-250	250-381
			181-236	236-306	306-431	431-562
1	Number of Lanes	Four (4): Carriageway Width (7m+7m), Double (2): Carriageway Width (7m/10m), Intermediate (1.5): Carriageway Width (5m/5.5m), Single (1): Carriageway Width (3.5m/3.75m) New (0)	1.5	1	1	1
2	Carriageway Width	m	5.5	3.75	3.75	3.75
3	Shoulder Width	Average in section / m	0.4	0.5	0.4	0.45
4	Shoulder Type	Paved or Unpaved	Unpaved	Unpaved	Unpaved	Unpaved
5	Average Altitude	m	714	860	724	853

6	Average Roughness	IRI	4.5	5	6.2	9.1
7	Total Area of Crack	%	6.3	7.5	25	62
8	Ravelled Area	%	6.3	10	5	4
9	No. of Pot Holes	per km	5	5	21	7
10	Edge Break Area	m2/km	50	100	50	20
11	Road Side Friction	%	50	15	10	5
12	Average Travel Speed	km/h	30	26	23	21
13	Road Capacity	PCU – IRC73-1980	5,000	1,000	1,000	1,000

14	Improvement Project Cost (W=12m: Carriageway 3.5mx2+ Shoulder 2.5mx2)	Mountainous (INR crore/km)	9	495	630	1125	1179
		Rolling (INR crore/km)	5.5	0	0	0	0
		Level (INR crore/km)	4	0	0	0	0
		Long Bridge (INR crore/km)	120	0	0	0	0
		Total (INR crore)		495	630	1125	1179

Source: JICA Study Team

The current traffic volume of NH54 is shown below.



Source: JICA Study Team

Figure 2.1 Daily (L) and Hourly (R) Variation of Traffic Volume of NH54

Traffic projections for the project road has been made based on the estimated growth rates derived from the trend of the number of vehicle registration and economic indicators in the area. As shown in Table 2.2 below, 2-laning of NH54 will be necessary to cater for future increase in the traffic volume.

Table 2.2 Projected Traffic Volume in NH54 till 2035

Road ID	Road/Section & Terrain	Unit	2020	2025	2030	2035
RD-1	**Aizawl - Tuipang (NH 54)**					
RD-1.1	Km 0 - Km 55, Mountainous	Veh.	6131	8782	12216	16541
		PCU	6090	8611	11876	16010
		No. of Lanes	2	2	>2	>2
RD-1.2	Km 55- Km125, Mountainous	Veh.	1905	2732	3802	5148
		PCU	1916	2716	3749	5057

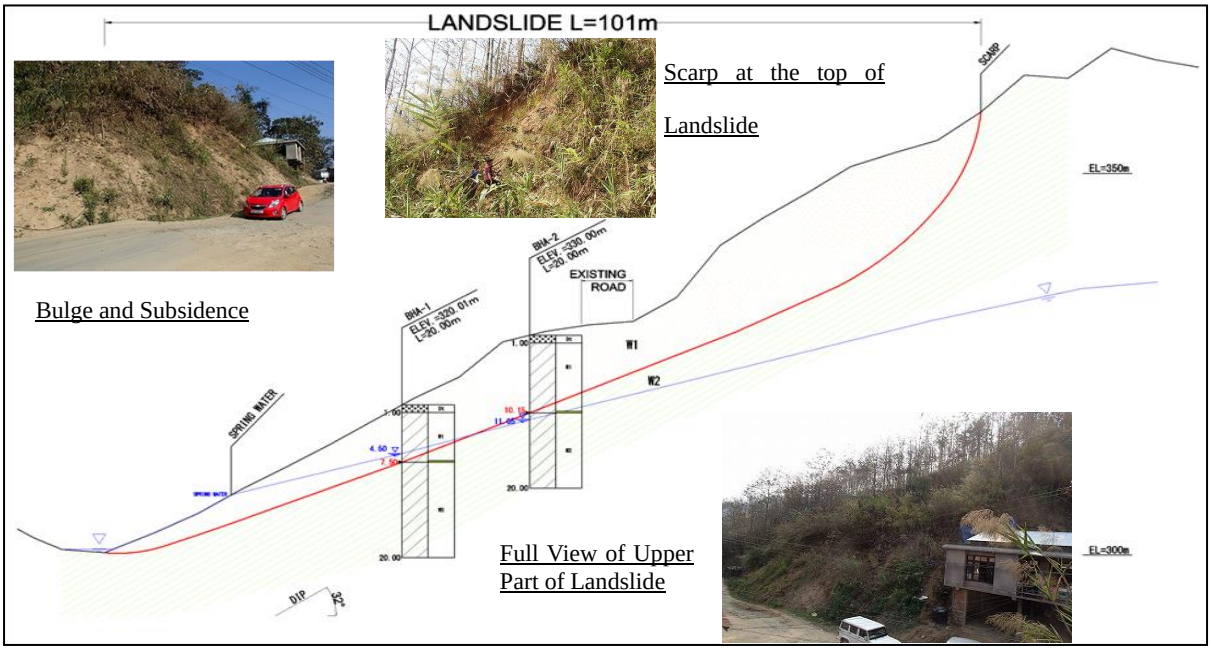
Road ID	Road/Section & Terrain	Unit	2020	2025	2030	2035
		No. of Lanes	2	2	2	2
RD-1.3	Km 125 - Km 250 , Mountainous	Veh.	1558	2237	3123	4242
		PCU	1598	2268	3142	4246
		No. of Lanes	2	2	2	2
RD-1.4	Km 250 - Km 381 Mountainous	Veh.	1882	2690	3741	5072
		PCU	1865	2646	3664	4957
		No. of Lanes	2	2	2	2

Source: JICA Study Team

Key components of widening and improvement works are summarized below.

2.2.1 Earth work, slope protection and land slide prevention

The sandstone and shale of tertiary formation distribute around NH54. Slope failure and erosion have frequently occurred. A image of typical landslide site is shown below.



Source: JICA Study Team

Figure 2.2 Geological Profile of Typical Landslide

The slope inventory survey was conducted for the purpose of topographic measurement, verification of geological and geotechnical condition, and identification of landslide risk. The road stretch was divided into four sections in the slope inventory survey, namely: section A from Aizawl to Serchhip,

section B from Serchhip to Hrangchlkawn, section C from Hrangchlkawn to Lawgtlai, and Section D from Lawgtlai to Tuipang. Locations of land slide and road deformation as identified during the inventory survey is shown below.

Table 2.3 Landslide Locations and Proposed side of Widening for Section A

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
A	01	009	2	+	555	~	2	+	600	MM	x		x		L	V	Soil retaining wall
A	02	009	2	+	770	~	2	+	800	SF	x		x		L	V	Soil retaining wall
A	03	011	3	+	555	~	3	+	585	MM	x		x		L	V	Rockfall prevention wall
A	04	016	5	+	320	~	5	+	340	MM			x		R	H	Earth removal
A	05	017	5	+	620	~	5	+	650	MM	x		x		L	V	Groundwater drainage
A	06	021	6	+	930	~	7	+	020	MM-p					L	V	Soil retaining wall
A	07	024	7	+	630	~	7	+	860	SF	x				L	V	Soil retaining wall
A	08	025	7	+	980	~	8	+	400	SF	x				L	V	Soil retaining wall
A	09	027	9	+	030	~	9	+	050	MM-p					R	V	Earth removal
A	10	034	12	+	260	~	12	+	340	MM-p			x		R	V	Soil retaining wall
A	11	039	13	+	420	~	13	+	510	MM-p					L	V	Groundwater drainage
A	13	039	13	+	640	~	13	+	680	MM	x		x		L	V	Soil retaining wall
A	14	042	14	+	380	~	14	+	410	MM	x			x	L	V	Soil retaining wall, Groundwater drainage
A	15	051	17	+	710	~	17	+	760	MM	x		x		R	H	Earth removal
A	16	062	20	+	950	~	20	+	990	SF	x		x		L	V	Soil retaining wall
A	17	063	21	+	080	~	21	+	150	MM-p	x		x		L	V	Soil retaining wall
A	18	081	29	+	470	~	29	+	520	SF	x		x		L	V	Soil retaining wall
A	19	085	31	+	150	~	31	+	180	SF			x		R	V	Soil retaining wall
A	20	115	49	+	400	~	49	+	430	MM-p					L	V	Soil retaining wall, Groundwater drainage
A	21	119	52	+	280	~	52	+	310	MM	x		x		L	V	Soil retaining wall, Groundwater drainage
A	22	119	52	+	310	~	52	+	370	MM	x		x		L	V	Soil retaining wall, Groundwater drainage
A	23	119	52	+	370	~	52	+	550	SF	x		x		L	V	Rockfall prevention wall
A	24	119	52	+	570	~	52	+	690	SF	x		x		L	V	Rockfall prevention wall
A	25	124	56	+	100	~	56	+	200	MM	x	x	x		L	H	Anchor
A	26	140	64	+	270	~	64	+	320	MM-p					L	V	- No need
A	27	151	71	+	200	~	71	+	220	MM-p					R	V	Soil retaining wall
A	28	152	71	+	770	~	71	+	830	MM	x	x	x		L	H	Earth removal, Crib work, Rock-bolt
A	29	153	73	+	990	~	74	+	020	MM	x		x		R	H	Earth removal, Soil retaining wall
A	30	178	87	+	470	~	87	+	510	MM-p					R	V	Groundwater drainage
A	31	178	87	+	510	~	87	+	670	MM-p					R	V	Groundwater drainage
A	32	186	91	+	130	~	91	+	150	SF	x		x		R	H	Soil retaining wall

Table 2.4 Landslide Locations and Proposed side of Widening for Section B

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
B	01	009	4	+	550	~	4	+	585	MM-p					R	V	Soil retaining wall
B	02	080	36	+	690	~	36	+	760	MM	x			x	L	V	Soil retaining wall
B	03	083	37	+	960	~	38	+	030	MM	x			x	L	V	Renew soil retaining wall
B	04	124	58	+	470	~	58	+	525	MM	x				R	V	Soil retaining wall
B	05	127	60	+	080	~	60	+	150	MM	x			x	L	H	Earth removal、 Soil retaining wall
B	06	133	62	+	860	~	62	+	920	SF	x	x			R	V	Soil retaining wall
B	07	134	62	+	960	~	63	+	030	MM			x	x	R	V	Counterweight fill, Groundwater drainage
B	08	161	74	+	600	~	74	+	630	MM-p					L	V	Soil retaining wall
B	09	174	80	+	230	~	80	+	340	MM			x		L	V	Soil retaining walll, Groundwater drainage
B	10	195	88	+	420	~	88	+	480	MM			x		L	V	Soil retaining walll, Groundwater drainage
B	11	196	89	+	340	~	89	+	430	SF	x				R	H	Soil retaining wall
B	12	198	90	+	040	~	90	+	100	MM			x		L	V	Soil retaining walll
B	13	214	96	+	960	~	97	+	030	MM	x	x			R	H	Groundwater drainage
B	14	216	97	+	660	~	97	+	720	MM	x			x	L	V	Soil retaining walll, Groundwater drainage
B	15	243	108	+	930	~	109	+	015	MM-p					R	V	- No need

Table 2.5 Landslide Locations and Proposed side of Widening for Section C

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
C	01	006	2	+	330	~	2	+	540	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	02	007	2	+	540	~	2	+	570	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	03	007	2	+	570	~	2	+	700	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	04	008	2	+	700	~	2	+	750	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	05	008	2	+	750	~	2	+	870	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	06	008	2	+	870	~	3	+	010	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	07	008	3	+	010	~	3	+	240	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	08	009	3	+	240	~	3	+	580	SF	x				R/L	H/V	Cut&Retaining wall, REW
C	09	031	11	+	700	~	11	+	800	MM-p					R	V	- No need
C	10	032	11	+	850	~	11	+	950	MM-p					R	V	- No need
C	11	042	15	+	470	~	15	+	520	MM	x		x		R	V	Groundwater drainage
C	12	055	20	+	520	~	20	+	530	DF	x				R	V	Box culvert
C	13	080	31	+	400	~	31	+	450	MM	x		x		R	V	Counterweight fill, Groundwater drainage
C	14	093	37	+	710	~	37	+	720	DF	x				R	V	Box culvert
C	15	097	39	+	000	~	39	+	040	MM-p					R	V	- No need
C	16	097	39	+	200	~	39	+	280	MM-p					R	V	- No need
C	17	133	54	+	730	~	55	+	020	MM		x			L	V	Groundwater drainage
C	18	140	59	+	250	~	60	+	060	SF					R	V	Rockfall prevention wall
C	19	143	60	+	350	~	60	+	400	MM-p					R	V	- No need
C	20	145	61	+	120	~	61	+	410	SF					R	V	Rockfall prevention wall

Table 2.6 Landslide Locations and Proposed side of Widening for Section D

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
D	01	004	2	+	770	~	2	+	880	MM-p					R	V	- No need
D	02	019	9	+	520	~	9	+	740	SF	x				R	V	Rockfall prevention wall
D	03	028	13	+	480	~	13	+	510	MM-p					L	V	- No need
D	04	029	13	+	750	~	13	+	800	MM	x		x		L	V	Soil retaining wall
D	05	030	14	+	100	~	14	+	190	MM-p					L	V	- No need
D	06	037	17	+	650	~	17	+	710	MM-p					L	V	- No need
D	07	040	18	+	920	~	19	+	100	MM-p					L	V	- No need
D	08	048	22	+	010	~	22	+	090	MM		x			L	V	Groundwater drainage
D	09	048	22	+	220	~	22	+	300	MM		x			R	H	Earth removal
D	10	050	23	+	350	~	23	+	420	MM		x			R	H	Anchor
D	11	052	23	+	840	~	23	+	940	MM-p					L	V	Groundwater drainage
D	12	064	29	+	540	~	29	+	790	MM-p					L	V	- No need
D	13	065	29	+	790	~	29	+	870	MM			x	x	L	V	Groundwater drainage
D	14	067	31	+	090	~	31	+	140	MM			x	x	L	V	Soil retaining wall, Groundwater drainage
D	15	071	33	+	060	~	33	+	020	MM-p		x			L	V	- No need
D	16	072	33	+	540	~	33	+	560	MM-p					L	V	- No need
D	17	076	35	+	400	~	35	+	450	MM			x		L	V	Soil retaining wall
D	18	077	35	+	620	~	35	+	705	MM	x		x		R	H	Earth removal
D	19	079	36	+	740	~	36	+	790	MM	x		x		L	V	Soil retaining wall, Rockfall prevention fence
D	20	080	36	+	950	~	36	+	970	SF	x				L	V	Rockfall prevention fence
D	21	087	40	+	150	~	40	+	190	MM	x				L	V	- No need
D	22	087	40	+	610	~	40	+	650	MM		x			L	V	Countermweight fill
D	23	115	53	+	430	~	54	+	320	SF					R	V	Rockfall prevention fence
D	24	118	55	+	120	~	55	+	170	MM		x			L	H	Anchor
D	25	119	55	+	360	~	55	+	480	MM		x			R	V	Anchor
D	26	122	56	+	540	~	56	+	600	MM		x			L	H	Anchor
D	27	139	65	+	350	~	65	+	440	MM-p					R	V	- No need
D	28	141	65	+	830	~	65	+	930	SF					R	V	Soil retaining wall
D	29	141	66	+	060	~	66	+	110	MM-p					R	V	- No need
D	30	147	68	+	980	~	69	+	050	SF					R	V	Soil retaining wall
D	31	151	70	+	540	~	70	+	620	SF	x		x		R	V	Soil retaining wall
D	32	153	71	+	790	~	71	+	860	SF	x		x		R	V	Earth removal, Soil retaining wall

Source: JICA Study Team
MM: Mass Movement, MM-p: Inactive mass movement, SF: Slope Failure, RF: Rockfall, DF: Debris Flow
R: Right side, L: Left side, H: Hill side, V: Valley side
REW: Reinforced Earth Wall

In the Detailed Project Reports prepared by several Indian consultants, road widening is planned mostly on hill side with cutting slope, resulting in huge volume of cut soil. The large volume of cut soil is not always economical comparing the retaining wall on the valley side due to cost for disposal of soil, construction of temporary access road to the top of the cut slope, and safety measures in construction for high cut slope. From the environmental point of view, generation of significant volume of surplus soil is not recommended. Therefore, the preliminary design proposes that the widening to be carried out on both hill and valley sides in case by case basis and apply land slide prevention measures at sites prone to disaster and road subsidence. The comparison of DRP and the new proposal is shown below.

Table 2.7 Slope Protection Work in DPR regarding and a New Proplsal

Item	Sec I 0~125 km*	Sec II 125~250 km**	Sec III 250 km~End**	JICA Study Team Proposal***
Widening Side	Mainly hill side	Mainly hill side	Mainly hill side	Plan to widening to both hill and valley side in case by case basis.
Cut Grade Soil Soft Rock Hard Rock	Not defined	 60° 60° 80°	 1:0.5 1:0.25 80-90°	Decide based on classification of rock and soil.
Cut Soil Amount (m3)	Unclear	23.5 million	7.1 million	Reduce by widening on valley side and balance with embankment volume.
Embankment Amount (m3)	Unclear	0.018 million	0.085 million	Will increase with widening on valley side.
Slope Protection	Retaining wall Brest wall	Nil	Retaining wall Gabon wall	Appropriately adopt on landslide risk slope.
Landslide Sites Countermeasure Plan	Not recognized. Nil	Recognized 2 sites Gabion wall Valley revetment (Wooden fence)	Recognized 4 sites Nil	Identify landslide risk sites in inventory survey and plan its countermeasures.

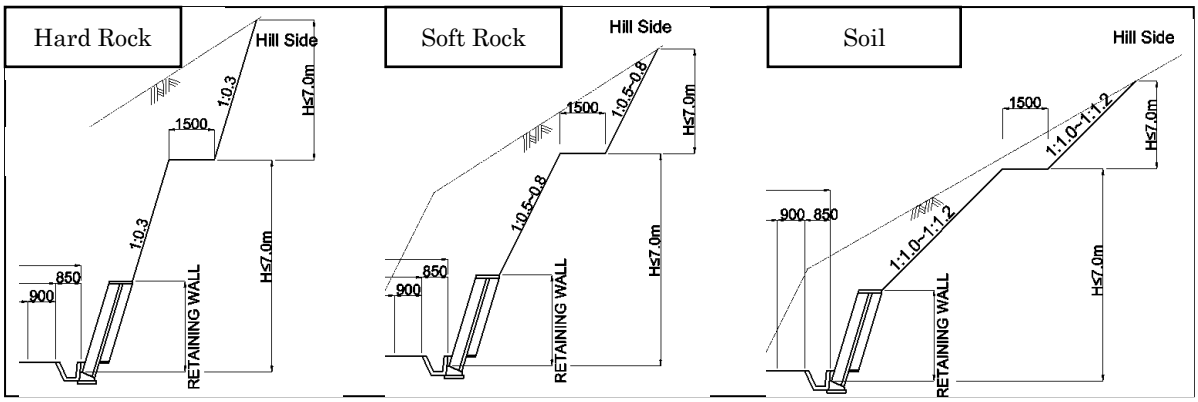
Source: *DPR as of May 2015, **DPRs as of April 2015, ***JICA Study Team

Cut grade of slope above the retaining walls along the road shall be decided based on geological and geotechnical condition of slope. Design criteria and typical cross section of cut slopes are shown below.

Table 2.8 Design Criteria of Cut Grade and Protection Work

IRC Standard*		JICA Study Team Rock/Soil Classification			Cut Grade	Slope Protection Work
Classification	Cut Grade					
Hard Rock	**80 ~ 90 degree**	Rock	Very Hard		**1:0.2**	No protection work
			Hard	No Risk	**1:0.3**	No protection work
				Landslide Risk		Crib work
Ordinary Soft Rock	**1:0.25 ~ 1:0.125**		Soft	Non-Dip Slope	**1:0.5**	No protection work
				Dip Slope	**1:0.8**	Hydroseeding (t=5 cm)
Ordinary Soil/ Heavy Soil	**1:1.0 ~ 1:0.5**	Soil	Dense Soil		**1:1.0**	Seeding and Mulching
			Loose Soil		**1:1.2**	Seeding and Mulching

*IRC: SP:48:1948 Clause 7.4
Source: JICA Study Team



Source: JICA Study Team

Figure 2.3 Typical Cross Section of Cut Slope

2.2.2 Drainage design

On the existing NH-54, large number of culvert does exist crossing under the road, out of which about 80% is slab culvert. It is necessary to that culvert or side ditch on road have adequate capacity of draining water surrounding or upstream of road to downstream properly. Specially, hill road is always suffered from large volume of water from mountain slope towards the road. It is quite important to protect the road by arranging cross drainage appropriately to satisfy the discharge from crossing water. The new drainage system is designed by based on hydrological calculation result. Based on obtained location of water crossing and water discharge, dimension and locations for drainage system are determined. It is proposed that all existing culvers to be replaced with new one based on the IRC standard. For cross drainage structure, appropriate culvert type is selected by taking account of economy, construction workability, and maintenance ability. In general, box culvert will be used for areas were large volume of water discharge is expected and pipe culvert will be used for other areas.

Photo 2.1Existing Slab Culvert (L) and GI Sheet (R) Along NH54

2.2.3 Bridge

It is necessary for bridges on NH-54 to provide function adapted to current National Highway standard. If the existing bridge is adequate for requirement of current National Highway, it can be retained with or without some repairing works. If the existing bridge is deemed to be inadequate, it should be replaced to new bridge. A review during the preparatory study found that three bridges will need to be replaced. Environmental impacts to river and river ecosystem are expected to be negligible because the bridges to be replaced are quite small and will not result in changes in water flow or altercation of riverbed. The streams almost run dry during the dry season when the engineering work will be carried out.

2.2.4 Traffic safety

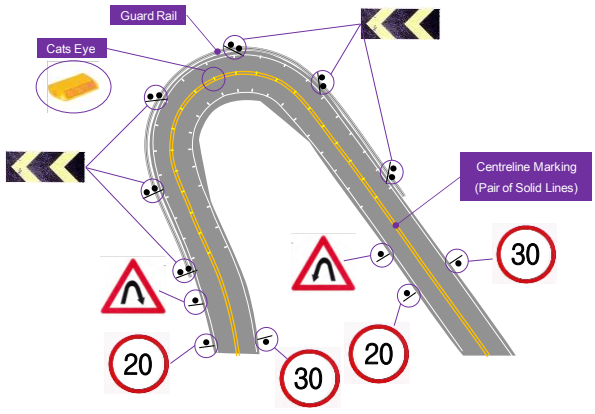
Traffic safety facilities will provided on roads or roadside to secure safety of all road users as well as nearby residents. Considering the function of existing road as rural community roads as well as usage trend, three types of safety-related facilities has been proposed in the preliminary design.

Table 2.9 Traffic Safety Facilities Proposed for NH54

No.	Item	Remarks / Related Code
1	Traffic Sign	IRC67-2001, IRC7-1971, IRC-SP-31-1992
2	Road Marking	IRC35-1997, IRC-SP-31-1992, IRC2-1968
3	Road Delineator	IRC79-1981
4	Guard Rail	
5	Street Furniture (Blinker, Road Stud/Cats Eye)	MORTH's Research Project R-63

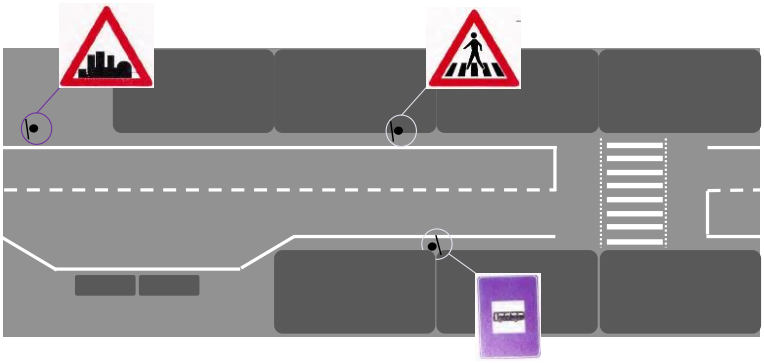
Source: JICA Study Team

Example of proposed traffic safety facilities at hair-pin curves and in built-up area is shown in Figures below.



Source: JICA Study Team

Figure 2.4 Traffic Safety Facilities to be installed at Hair-Pin Bends



Source: JICA Study Team

Figure 2.5 Traffic Safety Facilities to be installed at Built-up Area

2.2.5 Road Appurtenances

Road appurtenances are miscellaneous facilities for road users to take a rest and obtain road-related information. For road administrators, they are useful facilities for maintaining their roads efficiently. During the preparatory study, facilities listed in Table below are proposed for consideration during the detail design stage.

Table 2.10 Road Appurtenances to be Applied for NH54

No.	Item	Remarks / Related Code
1	Kilometer Stone	IRC8-1980, IRC26-1967
2	Boundary Stone	IRC25
3	Bus Bay	w/Bus Shed, IRC80-1981
4	Road Amenity	Public Toilet, Bazar Shed

Source: JICA Study Team

2.2.6 Surplus Soil Management

Based on the result of preliminary design of NH54 widening and improvement, the necessary volume of spoil bank for disposal of surplus soil has been estimated as shown below. Overall, the project will need spoil bank with the total capacity to handle about 7.3 million m^3 of surplus soil.

Table 2.11 Spoil Bank Volume Requirement

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH54	S1	Cut Soil	cu.m	3,442,909	0.9	3,098,618	2,400,495
		Fill Soil	cu.m			698,123	
	S2	Cut Soil	cu.m	3,710,629	0.9	3,339,566	2,437,522
		Fill Soil	cu.m			902,044	
	S3	Cut Soil	cu.m	3,560,596	0.9	3,204,536	2,465,129
		Fill Soil	cu.m			739,407	
	Total						7,303,146

Source: JICA Study Team

The preparatory study has identified 115 candidate locations which altogether will have sufficient capacity and satisfy conditions described below.

- To find out suitable place at every 5km length along NH-54 with following condition;
  - Ground shape with concavity topography
  - Less ground gradient than 22 degree which is assumed as average angle of spoil bank slope with necessary steps
  - No built-up area
  - Not close to National Park, Wildlife Sanctuary or other ecologically sensitive areas
- To be able to construct the spoil bank in less than 30m height

Out of 115 candidate sites, 41, 32 and 42 sites have about 2.43, 2.90 and 2.51 million m3 capacities in Section I, II and III respectively. The section-wise locations of 115 candidate sites are shown below. The final location of the spoil bank will need to be agreed upon in consultation with local community during the detailed design.

2.2.7 View Point

Along the NH54, there are some places where impressive views of mountains and/or rivers are seen against the background of the wide sky. It is, therefore, recommended to develop parking spaces for such view points along the road for the road users to enjoy natural panoramas and feel refreshed after a long drive. The below Figure is example pictures of sceneries taken from NH54.

Source: JICA Study Team

Figure 2.6 Example Pictures of Sceneries taken from NH54

CHAPTER 3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

As per the Environmental Protection Act in 1986 and its enforcement rights given to Ministry of Environment & Forest (MOEF), MOEF has overall authority for the administration and implementation of government policies, laws and regulations, sustainable development and pollution control in India. MOEF identifies the need to enact new laws and amend existing environmental legislation when required, in order to continue to conserve and protect the environment. At the state level, the Department of the Environment and the Department of Forest perform a similar role to MOEF. The acts are implemented by Central Pollution Control Board (CPCB) and respective State Pollution Control Boards (SPCBs). Policy Guidelines, Acts and Regulations pertaining to the protection and improvement of environment that are relevant to this project has been identified and discussed below.

3.1 National Level Laws and Regulations

3.1.1 The Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 is the umbrella legislation providing for the protection of environment in the country. Subject to the provisions of this Act, the Central Government, shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution. For the implementation of act Environment (Protection) Rules, had been formulated in 1986. The Rules provided for various standards for emission and discharge of environmental pollutants (Schedule I to IV). The Central Government has delegated the powers vested on it (under section 5 of the Act) to the State Govt. of Mizoram. This law is applicable to this project for environment protection in general.

3.1.2 The Forest (Conservation) Act, 1980 (amended in 1988)

The Forest (Conservation) Act, 1980 amended in 1988 pertains to the cases of diversion of forest area and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are applied for at the following levels of government:

- If the area of forests to be cleared or diverted exceeds 20ha (or, 10ha in hilly area) then prior permission of Central Government is required;
- If the area of forest to be cleared or diverted is between 5 to 20ha, the Regional Office of Chief Conservator of Forests is empowered to approve;
- If the area of forest to be cleared or diverted is below or equal to 5ha, the State Government

can give permission; and,

- If the area to be clear-felled has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the area to be cleared.

3.1.3 The Water (Prevention and Control of Pollution) Act, 1974

The Water (prevention and Control of Pollution) Act, 1974 resulted in the establishment of the Central and State level Pollution Control Boards (CPCB and SPCBs) whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of certain facilities.

3.1.4 The Air (Prevention and Control of Pollution) Act, 1981

The CPCB and the SPCBs are empowered to set air quality standards, monitor and prosecute offenders under this Act. Powers have also been conferred to give instructions for ensuring standards for emission from automobiles to concerned authority in charge of registration of motor vehicles under the Motor Vehicles Act, 1939 (Act 4 of 1939).

3.1.5 The Motor Vehicles Act, 1988

In 1988, the Indian Motor Vehicles Act empowered the State Transport Authority to enforce standards for vehicular pollution and prevention control. The authority also checks emission standards of registered vehicles, collects road taxes, and issues licenses. In August 1997, the Pollution under Control Certificate (PUC) program was launched in an attempt to crackdown on the vehicular emissions in the states.

3.1.6 The Land Acquisition Act, 1894 (Replaced by Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013)

The Land Acquisition Act 1894 has so far served as the base policy document on which the State Government passes resolution to acquire land for different projects. This act is superseded by new act (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013), which took effect on January 1st, 2014. However, the State Government of Mizoram issued Notification (No. H. 11018/8/2010-REV, dated January 5th, 2015) stating that the new Act will not be used in Mizoram on the ground that being under the Sixth Schedule of the Constitution, land in the State belongs to the individuals and not the Government. The Government is in the process of developing its own rule and has draft the Draft Mizoram (Land Acquisition, Rehabilitation and Resettlement) Bill, 2015. However, this has not yet finalized as of August 2015. The proposed Bill

generally follows the LARR 2013 but there are differences in terms of the additional benefits to rural area and solatium to be added to the compensation. In keeping view of the requirement under JICA Guidelines, it is proposed that the resettlement policy and entitlement proposed in a RAP report to be adopted in this project.

3.2 State Level Legislation and Other Acts

Apart from the new land bill discussed above, Mizoram has its own biodiversity rules (Mizoram Biodiversity Rules 2010) and forest act (the Mizoram Forest Act, 1955 and its amendment), but they do not trigger additional requirements in terms of environmental and social considerations other than those already prescribed in national-level legislation.

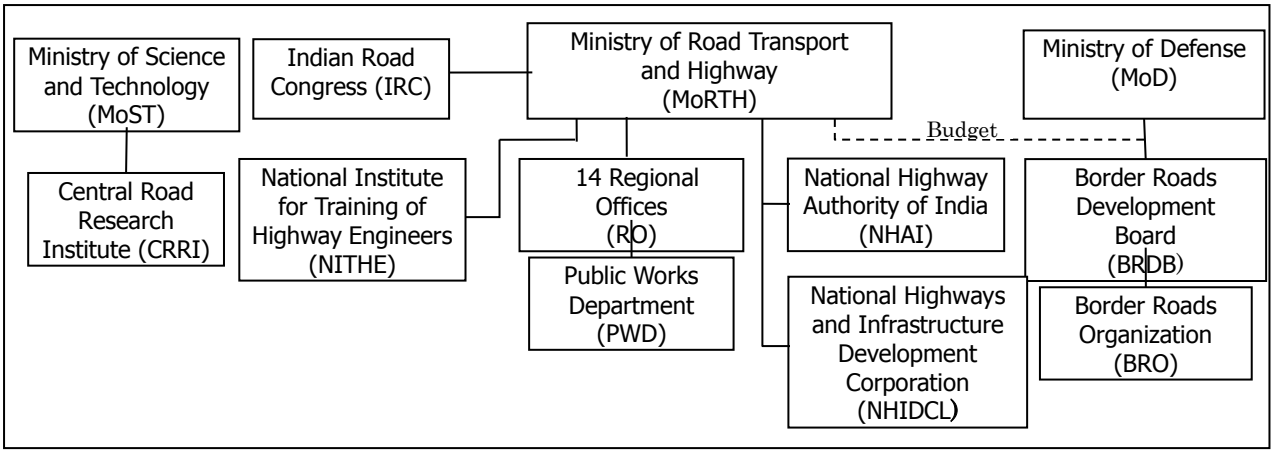
3.3 Institutional Set-up

Strengthening & widening of NH54 has been initiated and is being carried out by the NHIDCL, under the auspice of Ministry of Road Transport & Highways (MORTH). Though the primary responsibility of the project rests with the NHIDCL, a brief discussion on the various institutions involved and their level of responsibilities in the project implementation is presented in the following sections.

3.3.1 Road Sector Institutions

(1) National Level Institutions

National Highways development has been promoted by National Highway Authority of India (NHAI) and Regional Offices (RO) under Ministry of Road Transport and Highway (MORTH), and Border Roads Organization (BRO) under Border Roads Development Board (BRDB). National Highways and Infrastructure Development Corporation (NHIDCL) was established for promoting development of National Highways in North East and border area of India, and started operation from 1st January 2015. Figure 3.1 shows overall structure of organizations related to national highways development.



Source: Ministry of Road Transport and Highway (JICA Study Team modified)

Figure 3.1 Organizational Structures for National Highway Development

NHAI was set up by the National Highways Authority of India Act of 1988. It is the main nodal agency for developing, managing and maintaining India's network of National Highways. It became an autonomous body in 1995. The NHAI maintains 70,934 Km of National Highways and Expressways across India. NHIDCL started operation from 1st January 2015 and development of the target roads of this study is being promoted under NHIDCL.

NHIDCL is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes, surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner. An approximate aggregate length of 10,000 kms has been identified to begin with for development through this company. The company envisages creating customized and specialized skills in terms of addressing issues like complexities of geographical terrains and addressing extensive coordination requirements with security agencies. The company would also endeavor to undertake infrastructure projects including but not restricted to urban infrastructure and urban or city transport and to act as an agency for development of all types of Infrastructure. The company envisages working towards cross sharing of technical know-how and enhancing opportunities for business development with other nations and their agencies including the multilateral organizations and institutions.

The company also proposes to improve road connectivity and efficiency of the international trade corridor, by expanding about 500 km of roads in the North Bengal and Northeastern region of India to enable efficient and safe transport regionally with other South Asia Sub-regional economic Cooperation (SASEC) member countries.

(2) State-level Institutions

Public Works Department (PWD) Mizoram is the premier agency of the government of Mizoram engaged in planning, designing, construction and maintenance of Government assets in the field of built environment and infrastructure development. Assets in infrastructure development include Roads, Bridges, City Centers, Footpaths, New Capital Complex, and Airport, and assets in built environment include Hospitals, Schools, Colleges, Technical Institutes, Police Buildings, Prisons, Courts among others. PWD Mizoram also sustains and preserves these assets through a system of maintenance which includes amongst others specialized services like rehabilitation works, roads signage and aesthetic treatments like interiors, landscaping etc.

3.3.2 Environmental Institutions

The environmental regulations, legislation, policy guidelines and control that may impact this project, are the responsibility of a variety of government agencies. In all, as discussed in the subsequent sections, the following agencies would play important roles in this project.

(1) Ministry of Environment and Forests (MOEF)

The primary responsibility for administration and implementation of the Government of India's (GOI) policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment and Forests (MOEF). Established in 1985, the MOEF is the agency primarily responsible for the review and approval of EIAs pursuant to GOI legislation.

(2) MOEF Regional Offices

The Ministry of Environment and Forests (MOEF) has set up regional offices, with each region having an office. The office that cover North Eastern zone including Mizoram is located at Shillong, Meghalaya. This office is responsible for collecting and furnishing information relating to EIA of projects, pollution control measures, methodology and status, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, mangroves and biological reserves.

(3) Central Pollution Control Board (CPCB)

Statutory authority attached to the MOEF and located in New Delhi, the main responsibilities include inter alia the following:

- Planning and implementing water and air pollution programs;
- Advising the Central Government on water and air pollution programs;
- Setting air and water standards; and
- Coordinating the various State Pollution Control Boards.

The role of the CPCB, (for this project) will only be in an advisory capacity while the project shall adhere to the norms and standards set up by the Mizoram State Pollution Control Board (MSPCB).

(4) Departments of Environment and Forests (DOEF)

They perform the functions similar to the MOEF at the state level.

(5) Mizoram State Pollution Control Board (M-SPCB)

The M-SPCB has the mandate for environmental management at the state level, with emphasis on air and water quality. The board is responsible for:

- Planning and executing state-level air and water initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum Standards;
- Enforcing and monitoring of all activities within the State under the Air Act, the Water act and the Cess Act, etc.;
- Conducting and organizing public hearings for projects as defined by the various Acts and as stipulated by the Amendment (April 1997) to the EIA Act; and,
- Issuing No-objection Certificates (NOC) for industrial development defined in such a way as to include road projects as the Third National Highway Project.

(6) Mizoram State Forest Department

The Mizoram State Forest Department is responsible for the protection and managing the forest designated areas within the state. The Forest Department works out Forest Working Plans for the various forest divisions to manage and protect the forest resources. These plans form the basis for managing the forest resources and for chalking out specific plans and policies with respect to the conservation, protection and development of the forest areas. The Forest department will be

responsible for granting clearances for forest areas that need to be cleared for the project, according to the provisions of the Forest (Conservation) Act, 1980.

3.4 Requirements of Various Clearance in Different Stages of Project

As discussed earlier, Environmental Clearance is not required for this project as the scale of widening and land acquisition for this project is not significant enough not trigger the requirement. However, the forest clearance permit will have to be obtained prior to the commencement of construction activity, as per the requirement of the Forest Act. According to the discussions held with Department of Environment and Forests, the application will be processed at various Forest Department offices at Division, State and Central Government level depending on forest land requirement for non-forest purposes. Part 1 of the application format has to be filled in by NHIDCL, the project proponent while Part 2 of the application will be cleared by the Forest Division. Part 3 will be cleared at State Environment and Forest Department while Part 4 (at Nodal Officer under Forest Conservation Act) and Part 5 (Secretary of Department of Environment and Forest at Government of Meghalaya) will clear them before forwarding it to Ministry of Environment and Forest in Delhi for appraising and issuing Forest Clearance.

Also, various clearance will be required for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts. Clearance from the State Department of Mining is required for establishing quarries. Clearance from the Sate Ground Water Boards/Authorities is required for establishment of new tube-wells/bore-holes in case they are required during construction work. Also, the provisions as laid down in the Factories Act, 1948, Labor Act, 1988 and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 with respect to hygiene and health during the construction stage would apply for this project. With limited possibility, the provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 may also apply during the construction and the operation periods. The applicability of environmental and other relevant rules and acts is shown in Table 3.1 below.

Table 3.1 Clearance Requirements

No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Pre-Construction Stage (Responsibility: MORTH)						
2	Road-side tree cutting and clearing forest	Forest Conservation Act1980 & MOEF	Permission for Road-side tree cutting	State and Central Government	MORTH	2-3 months

		Letter Dt.18.02.1998				
3	Filling of Roadside water bodies (ponds and borrow pits)	State Fisheries Policy Draft Wetlands (Conservation & Management) Rules, 2008	Permission for filling of water bodies	State Irrigation Department State Fisheries Department State Wetlands Conservation Committee	MORT&H	2-3 months
Construction Stage (Responsibility: Contractor)						
1	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-forest abolishment	States Pollution Control Boards for respective section	The Contractor	4-6 months
2	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-for operation	States Pollution Control Boards for respective section	The Contractor	4-6 months
3	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
4	Storage of fueloil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	States Pollution Control Boards for respective section and or Local Authority (DC)	The Contractor	4-6 months
5	Quarry Operation	State Minor Mineral Concession Rules, The Mines Act of1952, Indian Explosive Act of1984, Air Act of1981 and WaterAct of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	4-6 months
6	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water foruse in road construction activities	State Ground Water Board	The Contractor	4-6 months
7	Engagement of labor	Labor Act	Labor license	Labor Commissioner	The Contractor	2-3 months

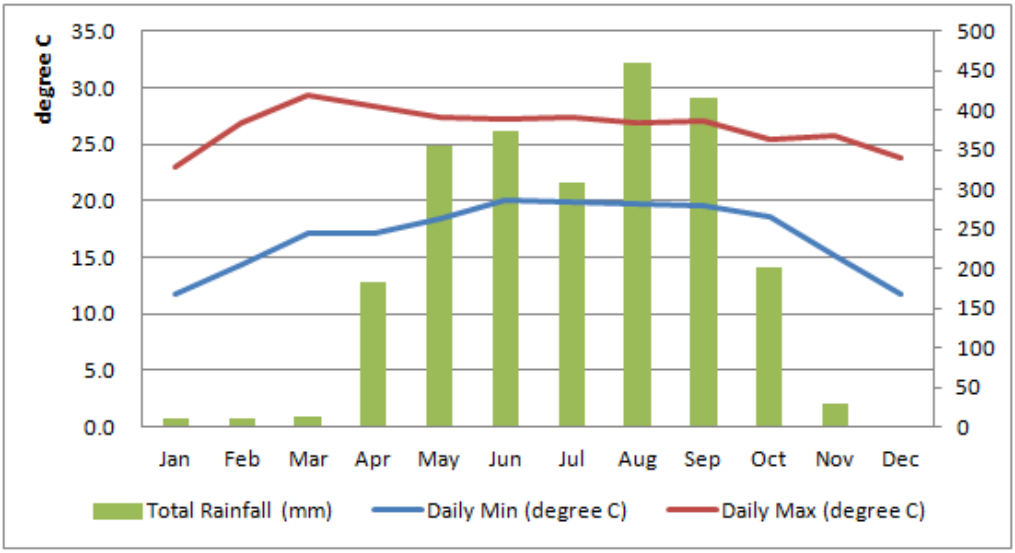
Source: JICA Study Team

CHAPTER 4 ENVIRONMENT AND SOCIO-ECONOMIC BASELINE

This chapter assesses existing environment and socio-economic conditions against which likely environmental and social impact of the project is analyzed. The baseline data presented below have been collected by monitoring surveys as well as literature reviews and interactions with local people and government officials at various levels. A more detailed socio-economic profile can be found in the RAP report prepared for this project. The Scoping Matrix that summarizes likely scale of impacts for various components is included in Chapter 6, and Environmental Checklist as per JICA Guideline is included in Appendix A.

4.1.1 Climate

Mizoram has a mild climate, relatively cool in summer 20 to 29 °C (68 to 84 °F) and winter temperatures range from 7 to 22 °C . The region is influenced by monsoons, raining heavily from May to September with little rain in the dry-season. The climate pattern is moist tropical to moist sub-tropical, with average state rainfall 254 centimeters per annum. In the capital Aizawl, rainfall is about 215 centimeters and in Lunglei, another major town of the state, about 350 centimeters.



Source: Mizoram Statistical Handbook 2014

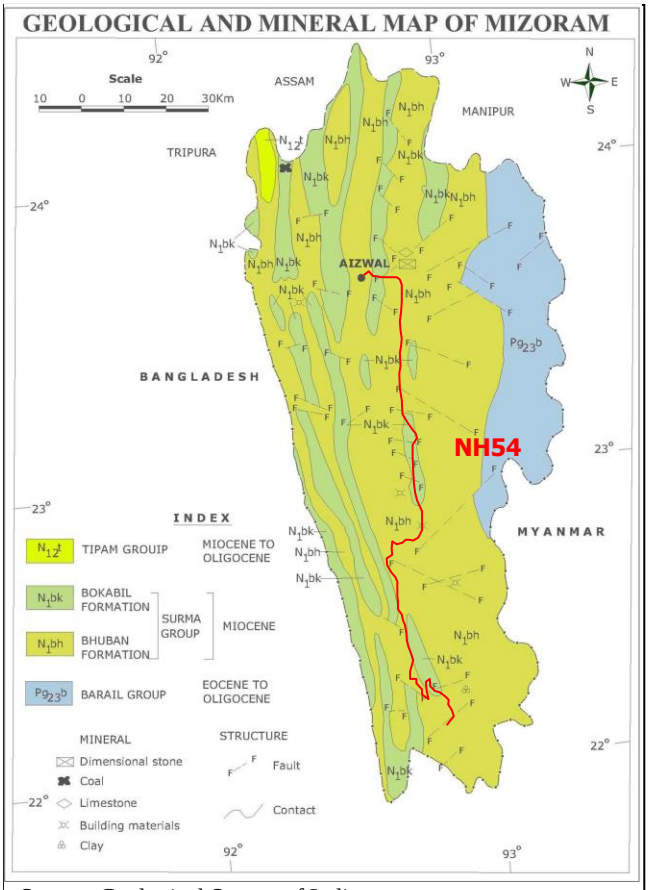
Figure 4.1 Monthly rainfall and daily maximum and minimum temperature in Aizawl (2013-2014)

4.1.2 Topography, Geology, and Soil

Mizoram has the most variegated hilly terrain in eastern part of India. Mizoram is mostly covered with hills. The hills are steep and are separated by rivers, which flow either to the north or south, creating deep gorges between the hill ranges. Eastern sector is higher than western sector. Average

height of the hills is about 900 meters. The highest peak in Mizoram is the Blue Mountain (Phawngpui) with a height of 2210 meters. Flatlands adjacent to Cachar Valley and flatlands of Champhai, Mat, Tlabung and Chamdur have immense potentials for agriculture and horticulture development.

The Geology of Mizoram consists of a repetitive succession of Neogene (Tertiary) arenaceous and argillaceous sediments occurring in a series of approximately North- south trending longitudinal plunging anticlines and synclines. The topography of the area is often a good indication of lithology and argillaceous groups of rocks occur in relatively lower altitudes as compared to arenaceous rocks. The parent materials are predominantly shales and siltstone, with a reasonable percentage of day minerals. Therefore, a certain degree of cohesiveness is evident. Further, as the rocks are relatively impermeable, the dry months provide opportunity of desiccation of the upper topsoil creating some weak bond by geo-chemical processes (laterisation, limonisation, or sometimes kaolinisation). The common rocks found are sandstone, shale, silt, stone, clay stones and slates. The rock system is weak and unstable prone to frequent seismic influence. Geological map of Mizoram is shown below.



Source: Geological Survey of India

Figure 4.2 Geological Map of Mizoram

Soil texture, in general, varies from sandy loams, clayey loams to clay. Although the soils are mature, profuse rainy spells in the region coupled with the high gradients have accelerated the problem of leaching of the loose soils. These soils are highly porous with low water holding capacity and this is the main cause of the low water table in Mizoram. The soils of Mizoram are deficient in potassium, phosphorous, nitrogen and humus. The traditional jhum cultivation has adversely affected the productivity. Although superficial greenery is observed owing to the profuse rainfall, the tract is actually in the process of fast degradation. The pH of these soils is acidic to neutral due to excessive leaching. The soil structure of the project area is summarized below.

Table 4.1 Soil Structures in Project Area

District	Soil pH	Nitrogen (Kg/ha)	Phosphorus (Kg/ha)	Potash (Kg/ha)
Aizwal	5.25	224	14	253
Serchhip	5.53	264	12	277
Lunglei	5.38	251	10	147
Lawngtlai	5.95	229	16	221
Saiha	5.94	672	6.3	478

Source: Soil Information System

4.1.3 Flora and Fauna

Mizoram is the highest forest cover state in the India, having about 90 % of the total geographical area is under forest (India State Forest Report FSI, 2013). Mizoram is a hilly region receiving heavy rainfall with soil characteristics conducive for luxuriant growth. Flora and fauna assessment were carried out for all the five districts that the targeted section of NH54 passes through. Floral/Vegetation assessment carried out through quadrate methods; for trees 10mx10m, for shrubs 5mx5m and for Herbs 1m x1m square shaped quadrates were used. Quadrates were laid randomly in the corridors upside and downside of the road. All species in the quadrates were recorded & ecological parameters such as density and frequency were calculated. Faunal species were recorded with the visual observation during site visits, secondary data from the forest department and local information from peoples. While impacts on river and river ecosystem are expected to be negligible, aquatic ecosystem of Turial River and Mat River – two major rivers that NH54 passes through – has been summarized below based on a review of literature.

Being part of India-Burma biodiversity hotspot, Mizoram is known for its rich biodiversity. Meanwhile, no pristine ecosystem remains in the areas along NH54, the main road network of the State, due to human activities. As such, there are significant differences in the level of biodiversity

and richness of flora/faunal community between in the area the proximity of NH54 and in Natural Park and Protected Areas of the State.

FLORA

Quadrate study were carried out along the road & floral elements classified in to Trees, Shrubs & Herbs. *Bombax insigne*, *Ficussemicordata*, *Schimawallichhi*,*Thysanolaena maxima*, *Melocannabaccifera*, *Biden pilosa*, *Eupatorium odaratum*, *Cynodondactylon*were the dominant species in the study area. In all, 57 tree species, 30 shrubs species & 52 herb species recorded from the study area. With the checklist of floral elements, ecological parameters like frequency, density, relative frequency, relative density, relative dominance and Important Value Index (IVI) of each species in all five districts were calculated.

Photo 4.1Vegetation Along the Road

List of Trees, Shrubs, & Herbs recorded during the study and its IUCN Redlist Category (if applicable) are listed below. NE stands for not evaluated and LC stands for Least Concern.

Trees

Botanical name	Family	IUCN Category
Acrocarpus fraxinifolius	Caaesalpiniaceae	NE
Actocarpus chama	Moraceae	NE
Alangium chinense	Alangiaceae	NE
Albizia chinensis	Mimosaceae	NE
Albizia odoratissima	Mimosaceae	NE
Albizia procera	Mimosaceae	NE
Alstonia scholaris	Apocynaceae	LC (ver. 2.3)
Anogeissus acuminata	Combretaceae	NE
Areca catechu	Arecaceae	NE
Artocarpus heterophyllus	Moraceae	NE
Balakatabaccata	Euphorbiaceae	NE

Botanical name	Family	IUCN Category
Bauhinia Variegata	Caesalpiniaceae	LC (ver. 3.1)
Bischofia javanica	Euphorbiaceae	NE
Bombax ceiba	Bombacaceae	NE
Bombax insigne	Bombacaceae	NE
Callicarpa arborea	Verbenaceae	NE
Cassia javanica	Caesalpiniaceae	NE
Cerasus cerasoides	Rosaceae	NE
Citrus sp	Rutaceae	NE
Delonix regia	Caesalpiniaceae	LC (ver. 3.1)
Derris robusta	Fabaceae	NE
Duabanga grandiflora	Sonneratiaceae	NE
Erythrina stricta	Fabaceae	NE
Eucalyptus citriodora	Myrtaceae	NE
Ficus hirta	Moraceae	NE
Ficus maclellandii	Moraceae	NE
Ficus semicordata	Moraceae	NE
Glochidion arborescens	Euphorbiaceae	NE
Gmelina arborea	Verbenaceae	NE
Jatropa curcus	Euphorbiaceae	NE
Lagerstroemia speciose	Lythraceae	NE
Lanneacoro mandelica	Anacardiaceae	NE
Leucaena leucocephala	Mimosaceae	NE
Macaranga denticulata	Euphorbiaceae	NE
Macaranga peltata	Euphorbiaceae	NE
Macropanax dispermus	Araliaceae	NE
Magnolia oblonga	Mangnoliaceae	LC (ver. 3.1)
Mangifera indica	Anacardiaceae	DD (ver. 2.3)
Melia azedarach	Meliaceae	NE
Oroxylum indicum	Bignoniaceae	NE
Parkia timoriana	Mimosaceae	NE
Phyllanthus emblica	Phyllanthaceae	NE
Pinus kesiya	Pinaceae	LC (ver. 3.1)
Prunus cerasoides	Rosaceae	NE
Psidium guajava	Myrtaceae	NE
Quercuspolystachyus	Fagaceae	NE
Quercusxylocarpus	Fagaceae	NE
Rhus chinensis	Anacardiaceae	NE
Ricinus communis	Euphorbiaceae	NE
Sauraula punduana	Actinidiaceae	NE
Schima wallichi	Theaceae	NE
Semecarpus anacardium	Anacardiaceae	NE

Botanical name	Family	IUCN Category
Spondias piñata	Anacardiaceae	NE
Sterculia villosa	Sterculiaceae	NE
Tamarindus indica	Caesalpiniaceae	NE
Tectona grandis	Verbenaceae	NE
Toona ciliata	Meliaceae	LC (ver. 2.3)
Vernicia Montana	Euphorbiaceae	NE

Source: JICA Expert Team

Shrubs

Botanical name	Family	IUCN Category
Abelmoschus manihot	Malvaceae	NE
Acacia ruinescens	Mimosaceae	NE
Amommum dealbatum	Zingiberaceae	NE
Clerodendrum infortunatum	Verbenaceae	NE
Cyathea chinensis	Cyatheaceae	NE
Debregeasia longifolia	Urticaceae	NE
Duranta erecta	Verbenaceae	NE
Imperata cylindrica	Gramineae	NE
Lantana camara	Verbenaceae	NE
Maesa indica	Myrsinaceae	NE
Manihot esculenta	Euphorbiaceae	NE
Melastoma malabathricum	Melastomaceae	NE
Melocanna baccifera	Poaceae	NE
Musa sp.	Musaceae	NE
Musa sylvestris	Musaceae	NE
Mussaenda Roxburghii	Rubiaceae	NE
Rhaphidophora glauca	Araceae	NE
Rubus ulmifolius	Rosaceae	NE
Saccharum arundinaceum	Poaceae	NE
Securinega virosa	Euphorbiaceae	NE
Solanum rudepannum	Solanaceae	NE
Solanum xanthocarpum	Solanaceae	NE
Tabernaemontana divaricata	Apocynaceae	NE
Thysanolaena maxima	Gramineae	NE
Tithonia diversifolia	Asreraceae	NE
Trichosanthes tricuspidata	Acanthaceae	NE
Urena lobata	Malvaceae	NE

Source: JICA Expert Team

Herbs

Botanical Name	Family	IUCN Category
Achyranthes bidentata	Amaranthaceae	NE
Acmella uliginosa	Asteraceae	LC (ver. 3.1)
Adiantum philippense	Adiantaceae	NE
Aeschynomene indica	Fabaceae	LC (ver. 3.1)
Ageratum conyzoides	Asteraceae	NE
Antidesma acidum	Euphorbiaceae	NE
Arisaema album	Araceae	NE
Arisaema consanguineum	Araceae	NE
Athyrium filix-femina	Athyriaceae	NE
Bauhinia scandens	Ceasalpinaceae	NE
Begonia palmate	Begoniaceae	NE
Bidens pilosa	Asreraceae	NE
Byttneria pilosa	Sterculiacea	NE
Centella asiatica	Apiaceae	LC (ver. 3.1)
Cheilocostus speciosus	Zingiberaceae	NE
Chromoleana odorata	Asteraceae	NE
Cissampelos pareira	Menispermaceae	NE
Colocasia Affinis	Aracaceae	NE
Commelina nudiflora	Commelinaceae	NE
Costus speciosus	Zingiberaceae	NE
Crassocephalum crepidioides	Asteraceae	NE
Cyanotis Cristata	Commelinaceae	LC (ver. 3.1)
Denrobium ochreatum	Orchidaceae	NE
Dicranopteris linearis	Gleicheniaceae	NE
Drymaria cordata	Caryophyllaceae	NE
Eupatorium odaratum	Asteraceae	NE
Galinsoga parviflora	Asteraceae	NE
Girardinia heterophylla	Urticaceae	NE
Ipomoea cairica	Convolvulaceae	NE
Ipomoea hederifolia	Convolvulaceae	NE
Laportea bulbifera	Urticaceae	NE
Mikania micrantha	Asteraceae	NE
Mimosa invisa	Mimosaceae	NE
Molineria capitulate	Hypoxidaceae	NE
Mucuna pruriens	Papilionaceae	NE
Paederia foetida	Rubiaceae	NE
Passiflora nepalensis	Passifloraceae	NE
Phyllanthus urinaria	Phylanthaceae	NE
Pilea symmeria	Urticaceae	NE

Botanical Name	Family	IUCN Category
Plantago major	Plantaginaceae	NE
Polygonum chinense	Polygynaceae	NE
Rhynchospora colorata	Cyperaceae	NE
Scorparia dulcis	Scrophulariaceae	NE
Sida acuta	Malvaceae	NE
Solanum nigrum	Solanaceae	NE
Solena amplexicaulis	Cucurbitaceae	NE
Sonchus arvensis	Asreraceae	NT (ver. 3.1)
Spermacoce ocymoides	Rubiaceae	NE
Stemona tuberosa	Stemonaceae	NE
Thladiantha cordifolia	Cucurbitaceae	NE

Source: JICA Expert Team

FAUNA

There is no unique faunal community within the project area. No "Endangered" species as per IUCN Red List has been identified during the field survey, but one "Vulnerable" species, Slow Loris, has been found in the project area. In addition to common species including toad, frog, crow, sparrow and myna, several insects like moths, stick insects, dragonflies, beetles, cockroaches, grasshoppers were also found. In all 8 species of Avifauna, 6 species of Mammals have been reported from study area. As shown below, none of the species found in the study area are listed as endangered (EN), vulnerable (VU) or near threatened (NT), except for "*Nycticebus bengalensis* (Slow Loris)".

Avifauna		
Zoological Name	**Local Name**	**IUCN Category**
Falco peregrinus	Falcon Mute	LC (ver. 3.1)
Psittacula krameri	Vaki	LC (ver. 3.1)
Dicrurus remifer	Vakul	LC (ver. 3.1)
Dicrurus adsimilis	Changkak	LC (ver. 3.1)
Pycnonotus cafer	Bulbul- Tlaiberh	LC (ver. 3.1)
Psilopogon franklinii	Zo-tuklo	LC (ver. 3.1)
Chalcophaps indica	Ram parva	LC (ver. 3.1)
Psittacula krameri	Vahmim	LC (ver. 3.1)

Source: JICA Expert Team

Mammals		
Zoological name	**Common/Local Name**	**IUCN Category**
Sus scrofa	Wild Boar (Sanghar)	LC (ver. 3.1)
Prionailurus bengalensis	Wild cat (Sanghar)	LC (ver. 3.1)
Caleotes vesicular	Lizard (Laiking)	NE
Callosciurusmacclellandi	Squirrels (Thehlei)	NE
Paguma larvata	Palm Civet (Sazaw)	LC (ver. 3.1)
Nycticebus bengalensis	(Bengal/Northern) Slow Loris	VU (ver. 3.1)

Source: JICA Expert Team

NH54 crosses Tuirial River and Mat River in the project area. Fish Fauna of these rivers are as follows.

Fish Fauna				
Zoological name	**Common/Local Name**	**IUCN Category**	**Tuirial River**	**Mat River**
Barilius barila	Barred baril	NE	○	
Barilius bendelisis		LC (ver. 3.1)	○	○
Barilius shacra		LC (ver. 3.1)	○	
Barilius tileo		LC (ver. 3.1)	○	
Barilius vagra		LC (ver. 3.1)	○	
Crossocheilus burmanicus	Burmese Latia	LC (ver. 3.1)	○	
Crossocheilus latius	Gangetic Latia	LC (ver. 3.1)	○	
Danio aequipinnulus		DD(ver. 2.3)	○	○
Devario naganensis		VU(ver. 3.1)	○	○
Esomus danrica		LC (ver. 3.1)	○	○
Garra annandalei	Annandale garra	LC (ver. 3.1)	○	
Garra gotyla	Gotyla	LC (ver. 3.1)	○	○
Garra lissorhynchus	Khasi garra	LC (ver. 3.1)	○	
Neolissochilus hexagonolepis	Copper mahseer	NE	○	○
Puntius conchonius	Rosy Barb	LC (ver. 3.1)	○	○
Systomus sarana	Olive barb	NE	○	○
Puntius ticto	Ticto Barb	LC (ver. 3.1)	○	
Botia dario		LC (ver. 3.1)	○	
Botia rostrata		VU (ver. 3.1)	○	
Lepidocephalus macrochir		DD (ver. 3.1)	○	
Psilorhynchus gracilis	Rainbow minnow	LC (ver. 3.1)	○	
Psilorhynchus balitora	Balitora minnow	LC (ver. 3.1)	○	
Acanthocobitis botia	Mottled Loach	LC (ver. 3.1)	○	
Balitora brucei		NT(ver. 3.1)	○	○
Schistura rupecula		LC (ver. 3.1)	○	
Schistura scaturigina		LC (ver. 3.1)	○	
Schistura vinciguerrae		LC (ver. 3.1)	○	
Erethistes pusillus		LC (ver. 3.1)	○	
Xenentodon cancila		LC (ver. 3.1)	○	
Mastacembelus armatus	Spiny eel	LC (ver. 3.1)	○	
Chanda nama	Elongate Glass Perchlet	LC (ver. 3.1)	○	
Channa orientalis	Asiatic snakehead	NE	○	
Badis badis		LC (ver. 3.1)	○	
Notopterus notopterus		LC (ver. 3.1)	○	
Semiplotus modestus	Burmese Kingfish	DD (ver. 3.1)		○
Tor tor	Mahseer	NT(ver. 3.1)		○
Glyptothorax cavia		LC (ver. 3.1)		○
Glyptothorax sinensis		DD (ver. 3.1)		○

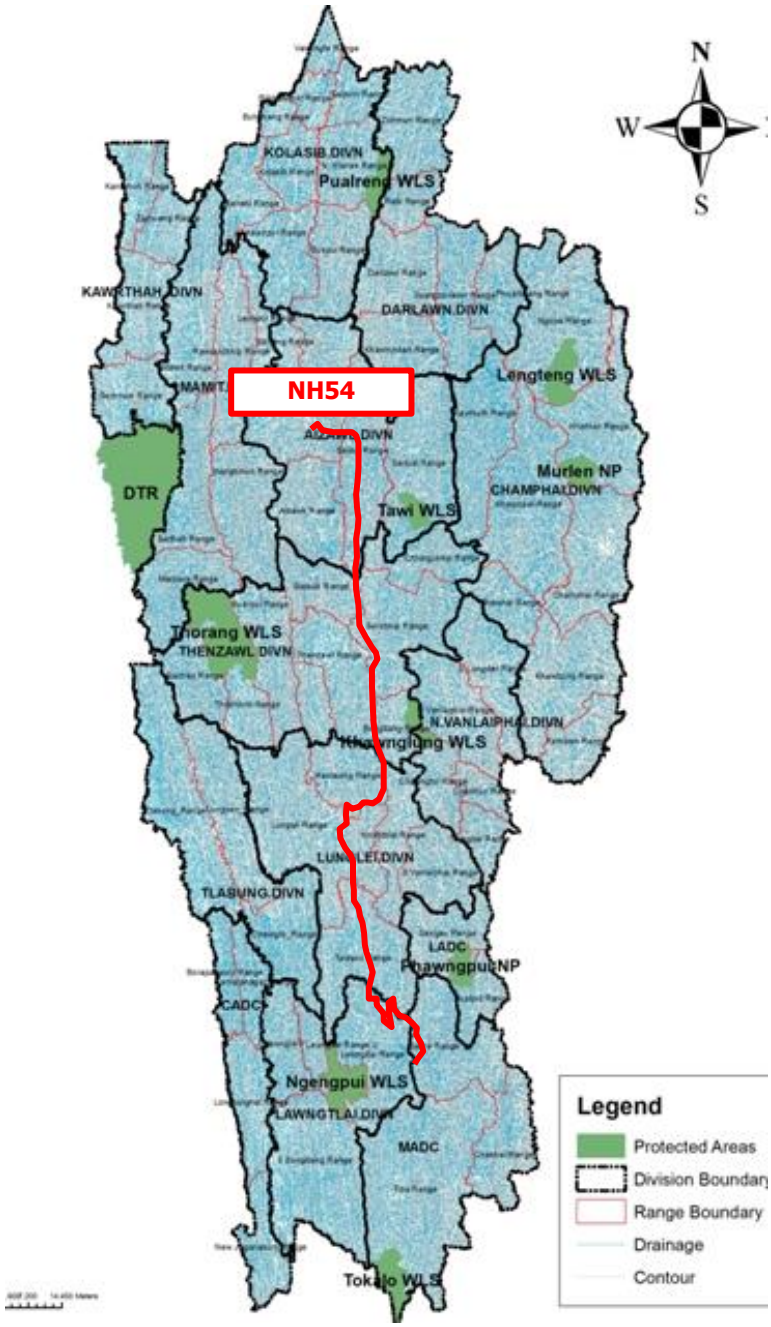
Fish Fauna				
Zoological name	**Common/Local Name**	**IUCN Category**	**Tuirial River**	**Mat River**
Glyptothorax telchitta		LC (ver. 3.1)		○

Source: "Fish fauna of Major rivers of Mizoram", Fisheries Department, Government of Mizoram. Available at: https://fisheries.mizoram.gov.in/page/fish-fauna-of-major-rivers-of-mizoram.html. Accessed October 2, 2015.

*Circle means that the species is recognized to inhabit in the river on the list of Fisheries Dept., Govt. of Mizoram.

4.1.4 Protected Area and Forest

There are a total of nine protected area (National Park, Wildlife Sanctuary, Tiger Reserve) in Mizoram, but the targeted section of NH54 does not traverse or border with any of them. According to the discussion with the official in State Environment and Forest Department, two Wildlife Sanctuaries, namely Twi WLS and Khawnglung are closest to the road but they are approximately 10km away from the road and project will not cause direct impact to WLS.



Source: Department of Environment and Forests, Government of Mizoram

Figure 4.3Protected Area in Mizoram

Similarly, no reserve forest will be affected by the project. However, the project runs through open forest, jhum land (shifting cultivation) and abandoned jhum area. Given that the forest and forest produces play an important role in local livelihood, efforts are needed to minimize deforestation and to disturbance during construction stage. The forest map of Mizoram is shown below (the darkness of green color indicates thickness of forest).

Source: Department of Environment and Forests, Government of Mizoram

Figure 4.4Distribution of Forest in Mizoram

Table 4.2 below presents the production of major forest products during the period 2004-05 to 2012-13. A significant change in bamboo production and bamboo and related products can be observed. In the year 2004-05 about 101 million bamboos was produced and by 2012 the production fell drastically to 113 thousand, whereas the production of broom sticks during the same period increased from 275 quintals (13,461 kg)to 5,787 quintals (283,274 kg). This indicates that with the fall in production of bamboos, the production of other bamboo products was stopped in favor of broom sticks, suggesting the changing relation of people and forest in recent years.

Table 4.2 Production of Forest Products – Mizoram

Year	Teak (Cu. M)	Round Timber (Cu. M)	Swan Timber (Cu. M)	Fire – Wood (Cu.M)	Bamboo ('000 Nos)	Broom Sticks (Qtls.)	Anchiri (Qtls.)
2004-05	-	-	85	-	100800	275	-
2005-06	-	-	117	-	75200	3375	-
2006-07	-	-	1924	-	72800	4430	-
2007-08	-	-	21311	-	23440	1500	-
2008-09	3672	74	1217	2115	6126	1280	3127
2009-10	-	11	605	5027	4257	9000	1078
2010-11	110	39	1203	7165	3586	1727	-
2011-12	-	6	1461	7468	452	2227	-
2012-13	1681	417	2222	73318	113	5787	-
Division-wise Production during 2012-13							
Aizawl	-	376	283	63768	29	40	-
Kolasib	-	-	140	43	30	3967	-
Mamit	-	-	186	29	3	498	-
Kawrthah (Champhai)	1681	-	192	-	2	1065	-
Thenzawl (Serchhip District)	-	-	506	41	16	15	-
Lunglei	-	-	169	125	1	-	-
Tlabung (Lunglei District)	-	-	-	-	3	60	-
Lawngtlai	-	-	-	-	-	-	-
N. Vanlaiphai (Serchhip District)	-	-	696	683	-	-	-
Champhai	-	-	45	8610	26		-
Darlawn (Aizawl District)	-	41	4	19	3	142	-

Source: Statistical Abstract of Mizoram 2013

4.1.5 River System and Hydrology

In the project area of NH54 between Aizawl to Tuipang, the project route passes several rivers and its tributaries, including following Rivers.

- Tuirial River at Aizawl District
- Mat River at Lunglei District
- Kawchaw River at Saiha District

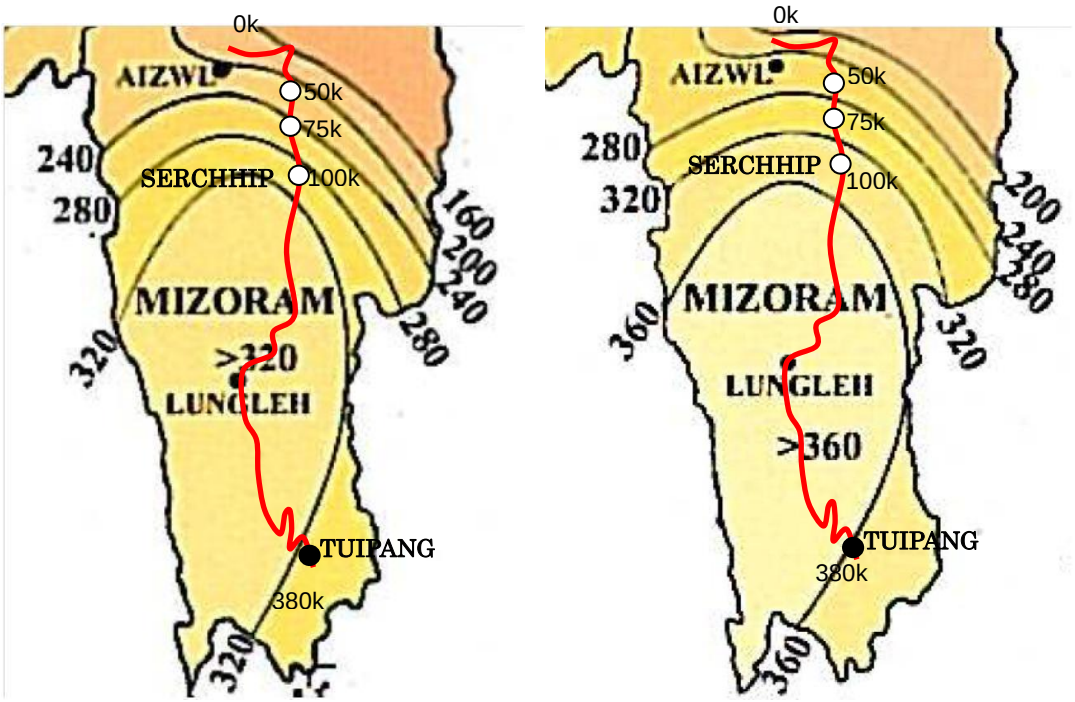
The hydrological study is conducted based on IRC:SP:13 "Guidelines for the design of small bridges and culverts" which is well used technical standard for hydrological study in Indian highway design. The analysis is conducted based on Rational Formulae for peak-off from catchment. The size of the flood are determined by factors such as rainfall intensity, distribution in time and space, duration, catchment area, shape, slope and permeability of the soil and vegetable cover.

The rainfall intensity is determined based on the ATLAS of State-wise Generalized ISOPLUVIAL MAPs of Eastern India (Part-II), published by India Meteorological Department, Government of India. The long-term rainfall intensity is modeled as shown below, which have informed the design of drainage and culverts.

Table 4.3 Rainfall Intensity for Each Section of NH54

From	To	25Years- 24hours Rainfall intensity (mm)	50Years- 24hours Rainfall intensity (mm)
Aizawl (SectionA.0k)	Tlungvel (SectionA.50k)	240mm	280mm
Tlungvel (SectionA.50k)	Chhingchhip (SectionA.75k)	280mm	320mm
Chhingchhip (SectionA.75k)	Serchhip (SectionA.100k)	320mm	360mm
Serchhip (SectionA.100k)	Tuipang (SectionD. last)	360mm	400mm

Source: JICA Study Team



Source: ATLAS of Statewise Generalised ISOPLUVIAL (Return Period) Maps of Eastern India (Part – II)

Figure 4.5 Detailed isopluvial map with project location for NH54 for 25 Years (L) and 50 Years (R)

4.1.6 Mineral Resources

Being a hilly state, Mizoram is rich in minerals. The figures on production of stone and sand are shown below. The stone and sand production is mainly concentrated in Aizawl, and in Mamit, Kolasib and Lunglei districts. Mizoram has mineral deposits of shell limestone, siltstone, clay mineral, coal seam, oil and gas. Building-quality stones are exported to Bangladesh. Numerous natural water springs in Mizoram also offers potential for manufacturing mineral water.

Table 4.4 Number of Quarry Permit Issued and Mineral Production

Year	No. of Quarry Permit Issued	Production form Quarry (Stone) (Cu.M)	Rs. in Lakhs	Sand Production (Cu.m)	Rs. in Lakhs
2005-2006	191	NA	NA	NA	NA
2006-2007	164	NA	NA	NA	NA
2007-2008	33	312797.083	37.54	36176.54	18.09
2008-2009	78	418208.316	50.19	118585.26	59.29
2009-2010	48	261488.330	31.38	62611.40	31.31
2010-2011	97	212937.325	85.18	136303.94	68.15

Source: Statistical Abstract of Mizoram 2011

Table 4.5 District-wise Number of Quarry Permit Issued and Mineral Production, 2010-11

District	No. of Quarry Permit Issued	Production form Quarry (Stone) (Cu.M)	Rs. in Lakh)	Sand Production (Cu.m)	Rs. in Lakh
Mamit	4	11087.50	4.43	1980.00	0.99
Kolasib	6	11594.90	4.64	11312.20	5.66
Aizawl	28	171776.725	68.71	67189.04	33.59
Champhai	15	4913.95	1.97	29825.70	14.91
Serchhip	8	4799.70	1.92	5435.00	2.72
Lunglei	31	8294.55	3.32	20562.00	10.28
Lawngtlai	5	470	0.19	-	-
Saiha	-	-	-	-	-
Total	**97**	**212937.325**	**85.18**	**136303.94**	**68.15**

Source: Statistical Abstract of Mizoram 2011

4.2 Living Environment

4.2.1 Air Quality

Being on hill, towns and villages along NH54 generally have good ambient air quality. The project road alignment also has no polluting industry along it. There is congestion due to traffic in major the built up. This leads to vehicular exhaust emissions and deterioration for which the proposed widening will have positive impact.

During the preparation of Detailed Project Report (DPR) by Indian Consultants, ambient air sampling was carried out in eight locations along the project road in February 2011. The monitoring data for dry season shows that all parameters are under the threshold by CPCB/MOEF. Additional monitoring for pre-monsoon season has been carried out in April 2015 to establish base line ambient air quality in the project area and surroundings. Monitoring was carried out along the project corridor at 15 locations at a frequency of twice in a month, adopting a continuous 24-hours schedule in the month of April 2015 as per guidelines of Central Pollution Control Board and MOEF requirements. The locations of ambient air quality monitoring is shown below.

Table 4.6 Locations Ambient Air Quality Monitoring

Station Code	Location	GPS
AAQ1	Puspak Junction	$23^0$44'23"N $92^0$44'30"E
AAQ2	Tuirial Village	$23^0$43'08"N $92^0$47'56"E
AAQ3	Tiungvel Village	$23^0$36'22"N $92^0$51'14"E
AQ 4	Baktawng	$23^0$32'11"N $92^0$50'57"E
AAQ 5	Chhiahtlang	$23^0$22'39"N $92^0$50'35"E
AAQ 6	Serchhip	$23^0$19'57"N $92^0$51'17"E
AAQ 7	Keitum	$23^0$13'55"N $92^0$54'40"E
AAQ 8	Rawpui	$23^0$08'44"N $92^0$53'52"E
AAQ 9	Thiltlang	$23^0$01'14"N $92^0$55'16"E
AAQ 10	Leite	$23^0$54'06"N $92^0$54'41"E
AAQ 11	S. Tawipui	$22^0$40'22"N $92^0$50'43"E
AAQ 12	Thingfal	$22^0$37'08"N $92^0$50'20"E
AAQ 13	Lawngtlai	$22^0$31'33"N $92^0$53'47"E
AAQ 14	Kawlchaw E	$22^0$24'01"N $92^0$57'28"E
AAQ 15	Zero Point	$22^0$27'48"N $92^0$57'27"E

Source: JICA Study Team

The air quality in the project area is less polluted. The AAQ of the project area is given below. The survey results indicate that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards except the particulate matter PM_{10} at Puspak Junction where the figure is slightly higher than permissible limit i.e.118 to 120µg/m^3. The maximum concentration of $PM_{2.5}$ is 52.00µg/m^3 at Puspak Junction while the minimum concentration is 20.80 µg/m^3 at Thingfal. The maximum concentration of SO_2 is 7.30 µg/m^3 recorded at Puspak Junction while minimum concentration is recorded < 4.0 µg/m^3 at various locations. The maximum & minimum concentration of NO_X is 30 µg/m^3& 8.50 µg/m^3 at Puspak Junction and Leite respectively. CO concentration is found to be well below the permissible limit.

Table 4.7 Results of Ambient Air Quality Monitoring

Station Code	**Date of Monitoring**	**Parameters (µg/m^3) & Test Method**				
		$PM_{2.5}$	**PM_{10}**	**SO_2**	**NO_X**	**CO**

		Gravimetric Method	Gravimetric Method	Improved West &Gaeke Method	Jacob &Hochheiser Modified Method	NDIR Spectroscopy Method
AQ1	15.04.15 to 16.04.15	52.00	120.50	7.30	30.00	0.6
	22.04.15 to 23.04.15	48.50	118.50	6.80	28.50	0.45
AQ2	15.04.15 to 16.04.15	32.50	65.20	<4.0	15.00	<100
	22.04.15 to 23.04.15	30.00	65.20	<4.0	12.50	<100
AQ3	16.04.15 to 17.04.15	35.00	72.50	<4.0	12.50	<100
	21.04.15 to 22.04.15	31.50	68.10	<4.0	10.00	<100
AQ4	16.04.15 to 17.04.15	38.50	72.50	<4.0	16.50	<100
	21.04.15 to 22.04.15	32.80	68.20	<4.0	15.00	<100
AQ5	17.04.15 to 18.04.15	32.50	72.50	<4.0	15.00	<100
	20.04.15 to 21.04.15	28.50	68.20	<4.0	12.50	<100
AQ6	17.04.15 to 18.04.15	36.80	80.10	5.30	20.10	0.3
	20.04.15 to 21.04.15	32.10	72.50	4.50	15.00	0.2
AQ7	18.04.15 to 19.04.15	28.10	62.10	<4.0	12.50	<100
	19.04.15 to 20.04.15	24.50	58.10	<4.0	10.00	<100
AQ8	18.04.15 to 19.04.15	28.50	58.20	<4.0	12.50	<100
	19.04.15 to 20.04.15	21.50	52.80	<4.0	9.50	<100
AQ9	24.04.15 to 25.04.15	31.50	72.50	<4.0	15.00	<100
	30.04.15 to 01.05.15	28.50	65.20	<4.0	11.50	<100
AQ10	24.04.15 to 25.04.15	23.50	56.20	<4.0	10.00	<100
	30.04.15 to 01.05.15	22.80	51.80	<4.0	8.50	<100
AQ11	25.04.15 to 26.04.15	28.50	56.20	<4.0	12.50	<100
	29.04.15 to 30.04.15	21.80	51.80	<4.0	10.00	<100
AQ12	15.04.15 to 16.04.15	25.10	68.50	<4.0	11.50	<100
	22.04.15 to 23.04.15	20.80	61.40	<4.0	8.50	<100
AQ13	15.04.15 to 16.04.15	36.50	86.50	5.10	20.10	0.35
	22.04.15 to 23.04.15	32.80	76.20	4.50	15.00	0.2
AQ14	15.04.15 to 16.04.15	23.50	52.80	<4.0	11.50	<100
	22.04.15 to	20.10	56.10	<4.0	9.50	<100

Station Code	Date of Monitoring	Parameters (µg/m^3) & Test Method				
		$PM_{2.5}$	PM_{10}	SO_2	NO_X	CO
		Gravimetric Method	Gravimetric Method	Improved West &Gaeke Method	Jacob &Hochheiser Modified Method	NDIR Spectroscopy Method
	23.04.15					
AQ15	15.04.15 to 16.04.15	31.20	81.20	4.80	18.50	0.3
	22.04.15 to 23.04.15	28.50	76.50	4.50	16.50	0.25
24 Hourly National Ambient Air Quality (NAAQ) Standards & CO (8 Hourly)		**60**	**100**	**80**	**80**	**2000**

Source: JICA Study Team

4.2.2 Ground and Surface Water Quality

The project road traverses through mountainous and steep terrains with several natural drainages such as deep gorges, depressions, etc., where perennial water and rainwater runoff are collected. River Tuirial, Tuichang, Mat, ChimTui Pui and tributaries are located within the study area. Besides, there are many nullahs and stream crossing the project road and many ponds are available near the project road.

Pre-monsoon water quality of the project corridor has been analyzed by collecting water samples along the Project road between April and May in 2015. Meanwhile, the monitoring survey for dry season (winter) was carried out in February 2011 during DPR preparation. In both seasons, parameter such as Iron, Total Coliform Organisms and Faecal Coliform Organisms are beyond permissible limits of Drinking water Standards (IS: 10500) and thus it is not fit for drinking purpose. The surface water quality monitoring location and the analysis results are shown in Table 4.5.

Table 4.8 Surface Water Quality

Parameters	Tuirial river	Tuichang river (Near Keitum village	Mat river (Near Leite village)	ChimTuiPui river (Kalchaw E)	Limits IS: 10500
pH	6.78	6.82	7.17	6.68	6.6 to 8.5
Color (Hazen unit)	1	1	1	1	-
Suspended Solid (mg/l)	11	12	<10	18	-
DO	5.4	5.6	5.6	5.2	-
BOD (mg/l)	23	20	18	25	-
COD (mg/l)	87.48	68.04	68.04	87.48	-
Total Kjeldahl Nitrogen (mg/l)	6.5	4.5	5.5	7.5	-
Total Hardness (mg/l)	40	30	20	30	300
Calcium (mg/l)	8.42	6.41	4.41	7.21	75
Magnesium (mg/l)	4.56	3.36	2.16	2.88	30

Ammonia (mg/l)	2.5	1.8	2	2.8	-
Electric Conductivity	277.7	154.3	107	169.6	-
Chloride (mg/l)	16.97	11.32	11.32	10.37	250
Sulphate (mg/l)	39	5	6	17.5	200
Phosphate (mg/l)	0.8	0.7	0.75	0.9	-
Nitrate (mg/l)	4.8	3.5	5.2	3	45
Fluoride (mg/l)	<0.1	<0.1	<0.1	<0.1	1
Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	0.05
Lead (mg/l)	<0.088	<0.088	<0.088	<0.088	-
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	0.05
Phenols (mg/l)	<0.001	<0.001	<0.001	<0.001	-
Cyanides (mg/l)	<0.05	<0.05	<0.05	<0.05	-
Total Dissolved solid (mg/l)	178	99	69	109	500
Iron (mg/l)	0.49	0.31	0.36	4.34	0.3
Total Coliform / 100 ml	1.6×10^3	1.2×10^3	1.5×10^3	1.8×10^3	
Faecal Coliform/ 100 ml	5.1×10^2	4.3×10^2	4.8×10^2	6.2×10^2	

Note: <1 indicate No Colony developed in 1 ml. Sample
<10 indicate No Colony developed in 0.1 ml. Sample
<100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

Ground water has been found to be an important source for catering to the local needs of water consumption for various purposes, mainly domestic. Therefore, any kind of deterioration in the quality of ground water owing to the developmental activities will pose threat to the concerned population and attention needs to be paid towards maintaining the quality of water using all possible tools such as monitoring with spontaneous remedial suggestions, if required. Keeping in view the importance of ground water to the local population, monitoring of ground water quality was carried out in five villages along NH54 as shown in Table 4.9.

Analysis of groundwater samples shows that the water is alkaline in nature (pH <8). The total dissolved solids (TDS) in five locations are below the permissible limit (500mg/l). Chloride concentration is well below the desirable limit (250mg/l) in all locations. This is also the case for ground water monitoring during the dry season, undertaken in DPR preparation stage. Sulphate and Nitrate concentrations are low and within the permissible limit and thus indicate low degree of organic pollution. Amongst the cations, Calcium (Ca) and Magnesium (Mg) are below the permissible limit (200mg/l). Concentration of iron is above the desirable limit of 0.3 ml/l in all samples. Groundwater in general is soft in the area and the Hardness is below the permissible limit of 600mg/l. Groundwater samples are free from heavy metals like cadmium, arsenic, lead, chromium etc. Bacterial quality of groundwater shows all samples are free form faecal coliform and total coliform and hence the water samples are suitable for human consumption after treatment process.

Table 4.9 Ground Water Quality

Parameters	Tuirel village	Keitum village	Thiltlang village	Leite village	Lawngtlai village	Desirable Limit as per BIS 10500	Permissible limit as per BIS 10500 in absence of alternate source
pH	7.02	6.25	6.69	7.34	6	6.5-8.5	No Relaxation
Color (Hazen unit)	1	1	1	1	1	-	-
Odor	Odorless	Odorless	Odorless	Odorless	Odorless	-	-
Electric Conductivity	510.9	170	461	503.1	213.3	-	-
Total Dissolved solid (mg/l)	327	109	295	322	250	500	2000
Bicarbonate (mg/l)	59.78	30.5	51.24	74.42	80	-	-
Total Hardness (mg/l)	45	40	50	60	50	300	600
Calcium (mg/l)	10.02	8.82	11.2	14.03	11.62	-	-
Magnesium (mg/l)	4.8	4.32	5.28	6	5.04	30	100
Chloride (mg/l)	14.14	16.97	17.92	10.37	15.08	250	1000
Sulphate (mg/l)	4.5	5.5	5.5	10	19.5	200	400
Phosphate (mg/l)	0.6	0.8	0.86	0.5	0.8	-	-
Nitrate (mg/l)	4.5	3.8	4	3.5	4	45	100
Fluoride (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	1.0	1.50
Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Lead (mg/l)	<0.088	<0.088	<0.088	<0.088	<0.088	0.05	No relaxation
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Phenols (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cyanides (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Iron (mg/l)	7.4	9.74	1.56	4.05	13.82	0.30	1.00
Total Colirom / 100 ml	<100	<100	<100	<100	<100	-	-
Faecal Coliform/ 100 ml	<100	<100	<100	<100	<100	-	-

Note: <100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

In addition to surface water and ground water monitoring, the water samples from three community water tanks have been collected. As shown in Table 4.10 below, the results indicates that water quality

of community water tanks is good and suitable for human consumption.

Table 4.10 Water Quality of Community Water Tank

Parameters	Serchhip	Tawpui village	Zero point	Standard (IS10500)
pH	7.49	7.47	7.38	6.5-8.5
Color (Hazen unit)	1	1	1	5
Odor	Odorless	Odorless	Odorless	Unobjectionable
Electric Conductivity	170.9	408.5	173.6	
Total Dissolved solid (mg/l)	110	262	111	500
Bicarbonate (mg/l)	29.28	50.02	29.28	
Total Hardness (mg/l)	20	30	20	300
Calcium (mg/l)	4.81	7.21	4.01	75
Magnesium (mg/l)	1.92	2.88	2.4	30
Chloride (mg/l)	7.54	7.54	12.26	250
Sulphate (mg/l)	6	30	6.5	150
Phosphate (mg/l)	0.81	0.68	0.86	
Nitrate (mg/l)	1.5	2.8	1.5	45
Fluoride (mg/l)	<0.1	<0.1	<0.1	0.6-1.2
Arsenic (mg/l)	<0.01	<0.01	<0.01	0.05
Lead (mg/l)	<0.088	<0.088	<0.088	0.1
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	0.001
Phenols (mg/l)	<0.001	<0.001	<0.001	0.001
Cyanides (mg/l)	<0.05	<0.05	<0.05	0.05
Iron (mg/l)	0.06	0.15	0.21	0.3
Total Colirom / 100 ml	<100	<100	<100	Must not be detected
Faecal Coliform/ 100 ml	<100	<100	<100	Must not be detected

Note: <100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

4.2.3 Noise Level

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. During DPR preparation, noise level monitoring was carried out in 19 locations in February 2011 (dry season). For pre-monsoon monitoring, fifteen monitoring sites were identified for to characterize the baseline noise levels in the project area. The results in both seasons shows that the ambient noise level of the project areas in some locations are over the standard prescribed by the Central Pollution Control Board, indicating the need for speed limit and other measures to reduce noise level, particularly in areas near sensitive receptors such as hospitals.

Table 4.11 Ambient Noise Level

Sr. No.	Location	Ambient Noise Level Leq.dB(A)	
		Day Time (07.00 AM to 11.00 PM)	Night Time (10.00 AM to 12.00 PM)

		L_{min}	L_{max}	L_{eq}	L_{min}	L_{max}	L_{eq}
1	Pushpak Junction	58.4	70.5	66.51	46.2	53.8	48.16
2	Tuirel village	52.5	64.2	60.22	35.1	46.3	35.28
3	Tlungvel village	52	66	61.22	36.8	47.2	38.5
4	Bktawang village	52.9	65.3	60.52	37.8	46.5	40.18
5	Chhiahtlang village	50.4	65.7	60.81	34.2	43.8	36.28
6	Serchhip (NT)	54.6	65.1	60.25	42.3	51.2	46.2
7	Keitum village	56.5	65	61.79	35.2	41.8	36.28
8	Rawpui village	55.8	64.7	61.13	34.2	48.5	38.12
9	Thiltlang village	50.4	60.4	56.78	32.5	41.8	37.5
10	Leite village	45.9	54.8	50.66	34.2	42.6	38.12
11	S. Tawipui village	53	59.1	56.48	32.5	41.5	35.18
12	Thingfal village	51	61.3	57.25	34.8	43.5	37.78
13	Lawngtlai (NT)	54.3	62.4	58.68	46.2	53.2	48.5
14	Zero point village	52.8	64.5	58.88	32.8	43.8	35.12
15	Kawlchaw village	54.8	64.5	59.63	38.5	42.5	40.18

Source: JICA Study Team

Table 4.12 Noise Level Limits of GoI [in LeqdB(A)]

Area/Class	Day Time (6.00 AM to 9.00 PM)	Night Time (9.00 PM to 6.00 AM)
	Standard	Standard
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

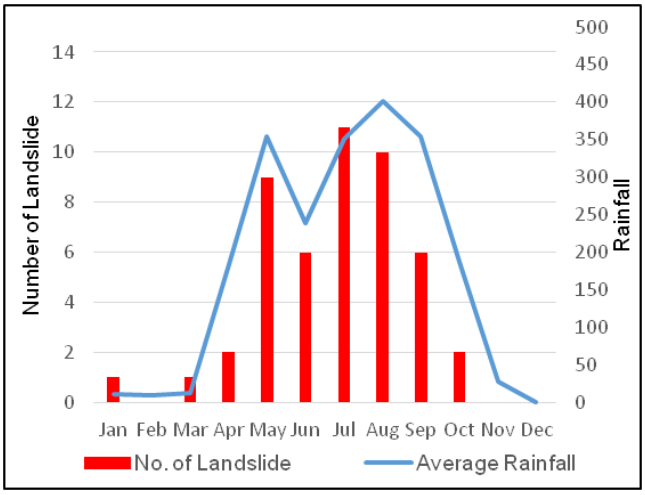
Source: CPCB

4.2.4 Hazards

With the inherently weak geology of fractured rock, the steep, unstable slops are further weakened by water flows during monsoons and result in landslides. Deforestation due to felling of trees for timber, animal fodder and removal of vegetation for jhum cultivation are also contributing to soil erosions and destabilization of slopes.

In addition to the field identification of landslide discussed in Section 2.2.1, information on past landslide disaster in and around Mizoram states has been collected to ascertain the trend of natural hazard in area. The number of landslide reported in newspapers and academic paper from 1992 to 2015 is summarized in Figure below, which clearly indicates elevalted risk of landslide in monsoon season. In September 2014, a large landslide occurred near PWD office at Laipuitang in Aizawl and killed 17 people and destroyed 15 houses including PWD office buildings. These disasters often

causing severe disruption in the lifeline, which deprive the local population along NH54 from supply of essential commodities.



Source: Mizoram Statistical Handbook 2015

Figure 4.6 Frequency of Landslide in Mizoram

4.3 Socio-Economic Conditions

4.3.1 Mizo People

Mizoram name derived from Mi (Peoples), Zo (Hills) & Ram (Land) thus Mizoram implies '*land of the hilly peoples*'. The meaning itself shows social structure of the Mizoram state. The Mizos are broadly divided into 5 major tribes and 11 minor tribes. The 5 major tribes are Lushai, Ralte, Hmar, Paite and Pawi. Mizo is the official language and most widely used language for verbal interactions, but English being important for education, administration, formalities and governance, is also widely used. The Duhlian dialect, also known as the Lusei, was the first language of Mizoram and has come to be known as Mizo language. All the tribes still have their own unique dialects which are slightly different from the dominant Mizo (Duhlian), but they can understand each other without problems. As per 2011 census, total population of Mizoram is 1,097,206. Out of these, the number of male and female are 555,339 and 541,867 respectively. The Lushai tribes constituted the majority of the Mizo population. Population density of Mizoram is 52 per km^2. The literacy rate in Mizoram is 91.33 percent as per 2011 census. District-wise and Tribe-wise population of Mizoram is shown below. Out of 8 districts, the targeted section of NH54 passes through five districts (highlighted in below Table).

Table 4.13 District-wise Population and Literacy Rate

District	Population	Density	Sex Ratio	Literacy %

	Male	Female	Total	(per Sq Km)		
Mamit	44,567	41,190	85,757	28	924	60
Kolasib	42,456	40,598	83,054	60	956	94.54
Aizawl	201,072	202,982	404,054	113	1009	98.50
Champhai	63,299	62,071	125,370	39	981	93.51
Serchhip	32,824	32,051	64,875	46	976	98.76
Lunglei	79,252	74,842	154,094	34	944	89.40
Lawngtlai	60,379	57,065	117,444	46	945	66.41
Saiha	28,490	27,876	56,366	40	978	88.41
Total	**552,339**	**538,675**	**1,091,014**	**52**	**875**	**91.85**

Source: 2011 Census

Table 4.14 Composition of Various Mizo Tribes in the State

Tribe	Number	Percentage (%)
Lushai	646,117	77
Chakma	71,283	8.5
Pawi	42,230	5
Lakher	36,018	4.3
Any Kuki tribes	21,040	2.5
Hmar	18,155	2.2

Source: 2001 Census[2]

The Mizo ancestors had no written language and the British missionaries, F.W. Savidge and J.H. Lorrain, created the Mizo alphabets based on the Roman scripts. The arrival of these two missionaries marked the formal origin of education in Mizoram. After only two and half months, Savidge started the first school on 1st April, 1894. They also prepared a Grammar and Dictionary of the Lushai language (Duhlian dialect) in 1898, which became the foundation of Mizo language. Today, Mizoram enjoys one of the highest rate of literacy in India, at 91.3%

The Mizo ancestors had no written language and were completely devoted to animism, worshipping all sorts of objects and natural phenomena. The British has to simply modernise them. The first missionary who came to Lushai hill was Rev. William Williams, a Welsh missionary for investigative visit for a week. On 11th January, 1894, F.W. Savidge and J.H. Lorrain arrived at Aizawl and this marked the origin of formal Christianity in Mizoram.

The majority of the Mizo people are Christian. The major Christian denominations are Presbyterian,

[2] 2001 Census is the latest data available as per-tribe population data is not included in 2011 Census.

Baptist, United Pentecostal Church, Roman Catholic, the Salvation Army, Congregational Church of India (Maraland), Seventh-day Adventist, among others. There are other religions like Buddhism, Hinduism, Muslim and Sikh. There are few people who practice Judaism claiming to be one of the lost Judaic tribe group Bnei Menashe and a modernized traditional Mizo religion called Hnam sakhua, which put a particular emphasis on Mizo culture and seeks to revive traditional Mizo values. There are also few tribal religions such as Lalchhungkua, Lalhnam and Nunna Lalchhungkua.

The Mizo celebrate many festivals among which the Chapchar kut and the Pawl kut are the most important. Chapchar kut is celebrated in the month of March and it is a spring festival. Pawl kut is a harvest festival celebrated in the months of December and January. They also celebrated Mim kut in the month of September. This festival is for the dead members of the family and they used to prepare foods for them. The Mizo people celebrated the festivals with many dances among which Cheraw is the most colorful dance. All the festivals are connected with agricultural activities.

The summary of each district in Mizoram is shown below.

Table 4.15 Snapshot of District in Mizoram

District	Description
Aizawl	Situated between the Tlawng River valley in the West and Tuirial River valley in the East. It is home to the Mizo tribes who are said to have migrated from Myanmar's Chin Hills 300 years ago. Being the capital city of Mizoram it is a political, commercial, educational and cultural hub of the state, housing all important government offices, the State assembly and secretariat, and tourist spots, including some beautiful churches and markets.
Lunglei	It is the biggest district (21.52 % of the total land area) bounded on the north by Mamit and Serchhip Districts, on the south by Lawngtlai and Saiha districts, on the east by Myanmar and on the west by Bangladesh, having dense forest area covering 524.63 sq.kms.
Champhai	Located near the India-Myanmar border, it serves as a gateway of all business activities between India and Myanmar. It is a fast developing venue on the Indo-Myanmar border. The famous Rihdil Lake is only about 50 kms away from the town of Champhai. Champhai valley known as "The Rice bowl of Mizoram" is located towards the base of the town. A chain of green hills encircle luxuriant rice fields, which add to the beauty of this place.
Lawngtlai	Located in the southern most part of Mizoram having common international borders with Bangladesh in the west and Myanmar in the east. It also shares common boundaries with Lunglei and Saiha District in the north and south respectively. Unlike other districts, it has two Autonomous District Councils within the District, namely the Lai Autonomous District Council (LADC) and the Chakma Autonomous District Council (CADC) with their headquarters at Lawngtlai and Kamalanagar respectively, and are administered in accordance with the provisions of the Sixth Schedule of the Constitution of India.
Mamit	Mamit District was created after bifurcation of the erstwhile Aizawl District in 1998. It is bounded on the north by Assam state, on the west by Tripura state and Bangladesh, on the south by Lunglei district, and on the east by Kolasib and Aizawl districts. It is 4th largest district in Mizoram in terms of total area. It receives abundant rainfall. The five main big rivers are Tlawng, Tut,Teirei, Langkaih and Khawthlangtuipui. Women Play major role in the society as well as in the family.

Kolasib	The District is bounded by Assam on the north and north west side, on the south and east by Aizawl, and on the south west by Mamit District. The location of the district occupies an important site as it is the main stream of road communication from other state of Mizoram. NH 54 passes through the middle of the district from north to south direction. The only Rail head in the state located at Bairabi. There are some worth visiting sites in and around the district which include Dampa Wildlife Sanctuary and Tlawng River.
Serchhip	Serchhip is located in the central part of the state of Mizoram; adjoined by Champhai District in the East, Aizawl in the North and North West, and Lunglei District in the South. The district has the highest literacy all over India. It lies between the two very important rivers of Mat and Tuikum. While River Tuikum is source for drinking water for Serchhip, River Mat is source for irrigation water for Zawlpui, the rice bowl of Serchhip. Serchhip is also the main producer of cabbages and mustards in Mizoram.
Saiha	Saiha District is situated on the southern-most fringe of the North-eastern region of India and shares border with Myanmar on the eastern and southern side. Administratively, it is divided into two blocks-Saiha and Tuipang. It is the third most developed and also the third most populous town in Mizoram State apart from the state Capital - Aizawl and Lunglei. It is also the capital of the third largest tribe - the Maras in Mizoram.

Source: JICA Study Team

4.3.2 Mizo economy

As per the data available, the Net State Domestic Product (NSDP) for the year 2012-13 was about Rs 7,556 Crores, and the Per Capita Income (PCI) during the same period was Rs. 63,413. It has also been observed that during the period 2004-05 to 2012-13 the economy of the state grew at a compound annual growth rate of 9.3%, with Primary Sector growing at 7.6%, Secondary Sector at 7.9% and the Tertiary Sector at 10.3%. During the same period the per capita income of the state grew at 6.8%. The sector-wise growth rates as well as the growth of PCI are summarized in Table 10.1.1.2.

Table 4.16 Economic Growth of Mizoram

Sector	CAGR (2004-05 to 2012-13)
Agriculture & Allied – P (Primary Sector)	7.64%
Industry - S (Secondary Sector)	7.87%
Services – T (Tertiary Sector))	10.30%
NSDP (Net State Domestic Product)	9.30%
PCI (Per Capita Income)	6.77%

Note: CAGR – Compound Annual Growth Rate

The main occupation of the people is agriculture. About 80% of the population are agriculturist. Rice is the main crop of Mizoram and besides rice, maize, potato, ginger, tumeric, black pepper, chilies and a variety of fruits are grown. In Mizoram, the ownership of land is vested with the government, which issues periodic pattas to individual cultivators. The Village Council distributes the plots of land among the villagers for cultivation every year. The agricultural system practiced is of the primitive type of 'jhum' or 'slash and burn', a practice that has been regarded as detrimental to the top layer of the soil, rendering it to become loose and soft and susceptible to frequent soil erosion. The government is

attempting to bring about a change to the practice of 'jhum' by introducing 'terrace cultivation' which is ideal for the hill slope. The main horticulture crops are fruit crops like Mandarin orange, banana, passion fruit, grapes, hatkora, pineapple, papaya, etc. and flowers like anthurium, bird of paradise, orchid, rose and other subsidiary seasonal flowers. People have also started extensive cultivation of oil palm, medicinal and aromatic plants. Anthurium is being sent for sale to places to major cities like Kolkata, Delhi, Mumbai and Hyderabad. The arecanut fibre, which is plentiful in the state, is very good for making disposable plates and saucers

CHAPTER 5 ANALYSIS OF ALTERNATIVE

5.1 Overview

The scope for alternative is limited due to hilly nature of the terrain and the nature of the project, which essentially aims to improve and widen existing road. In developing a proposed preliminary road design, three concepts of alternatives have been as shown in Table 5.1.

Table 5.1 Concepts of Alternatives

No.	Option	Contents
0	Zero-Option (without project)	Existing road and slope conditions will persist. Poor pavement condition will lead to more vehicular emissions with detrimental impacts on health and ecosystem. Also, continuation of uncontrolled encroachment will increase the risk of traffic accident in built-up areas. Poor road network continues to be a bottleneck of economic development and also undermine positive benefits of ongoing Kaladan Multimodal Transport Project, which provides additional network from Mizoram to Haldia/Kolkata ports through NH54 and Kaladan River in Myanmar.
1	Applying the same design standard across the whole stretch based on the IRC	The same standard for widening/improvement will be applied across the whole stretch irrespective to geological condition and socio-economic conditions. While the positive impact of widening is significant, the project will trigger significantly more resettlement compared with option 2. Also, geometric improvement of many hair-pin curves will trigger more cutting and filling, increasing impacts on forest and leads to higher project implementation cost. The number of traffic accident will also increase due to the increased speed of vehicles passing through built-up areas.
2	Selective widening considering social impacts	The level of widening will be minimized in heavily built-up area to reduce the scale of resettlement. This option is desirable from socio-economic point of view, but the positive impact in terms of improvement of the road network in the region may be slightly limited compared with option 1.
3	New bypass to avoid densely built-up areas	A new bypass will be constructed in densely built-up areas to avoid resettlement. The option will minimize the scale of resettlement, but the impact on forest and agricultural land (jhum) will be significant as the new road will be constructed in open forest. The bypass will be required in the longer-term to accommodate project increase in traffic demand in the future, but its environmental impact as well as economic feasibility will have to be studied in more details.

Source: JICA Study Team

The illustrative images of widening concepts are shown below.

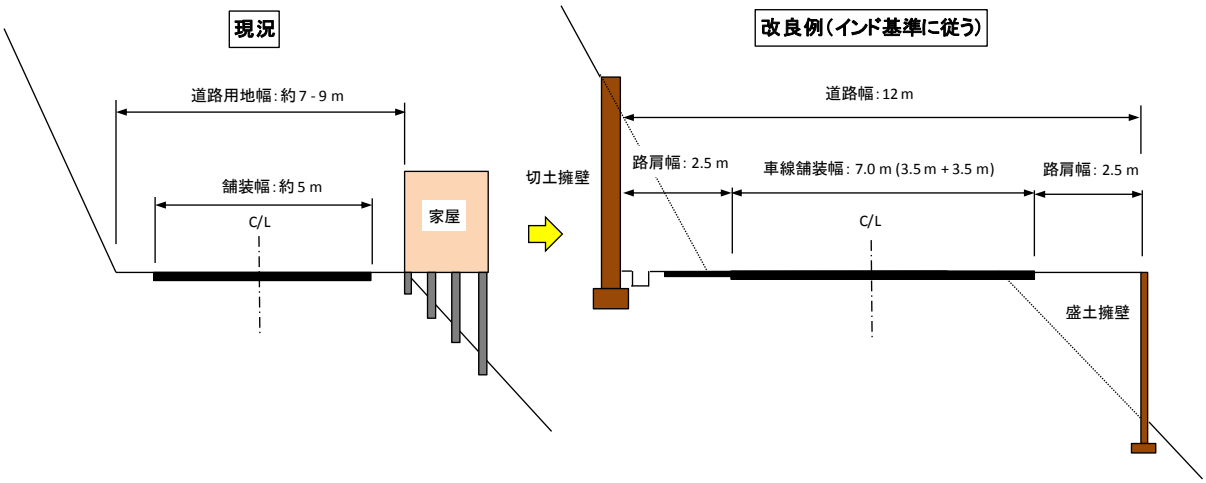


Figure 5.1 Alternative One (Widening based on IRC Standard)

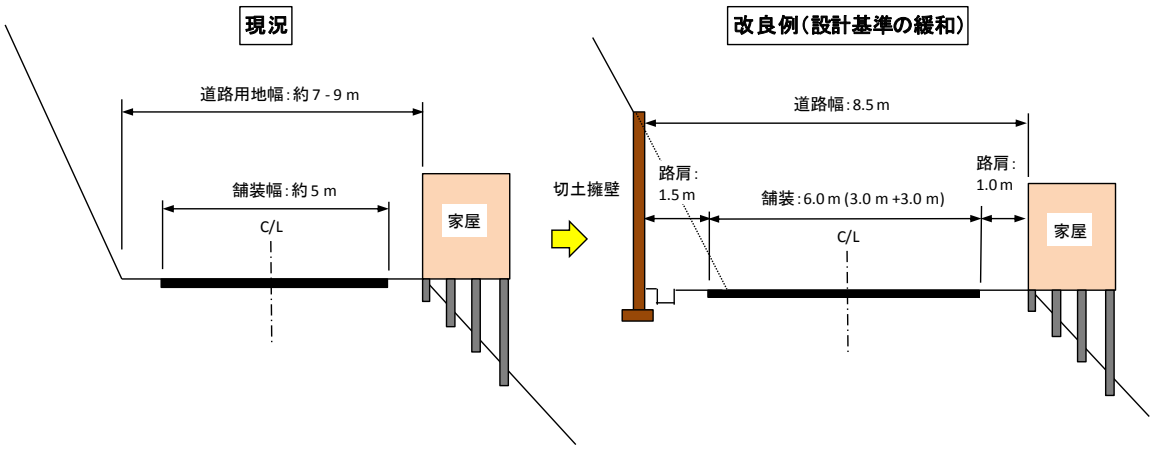


Figure 5.2 Alternative Two (Limited Widening)

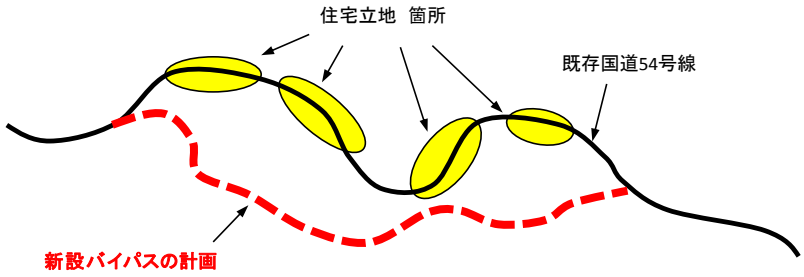


Figure 5.3 Alternative Three (New Bypass)

A comparison of three options is provided in Table 5.2.

Table 5.2 Review of Alternatives

Alternative	Zero Option	One	Two	Three
General Objective	No project. Continue business as usual without intervention.	Follow Indian standard and ensure road capacity will be sufficient over the long-run	Minimize the scale of resettlement	Avoid resettlement
Resettlement	N/A	× Trigger significant resettlement. Preliminary assessment suggest that expansion beyond 15m can result in resettlement of more than 5,000 households.	○ ROW 12m will be adopted in general, except for hair pin curves. Impact will be reduced compared with Option One. 1,937 households will be affected in total.	◎ Minimum impact, but create negative impact on natural environment
Impact on natural environment	Δ No immediate impact, but slope failure and soil erosion without proper management will eventually degrade natural environment	○ Limited impact as the engineering work will be limited in the side of existing road. Result in significant volume of spoil soil.	◎ Limited impact as the engineering work will be limited in the side of existing road. Volume of spoil soil is less than Alternative One.	× A more detailed analysis is needed to assess potential impact for new bypass to be constructed in open forest
Pollution	× No immediate impact, but poor road and growing level of congestion will lead to elevated pollution level in the long-run, particularly in built-up area	○ The option leads to least level of congestion and thus least to relatively small increase in vehicular emissions.	Δ More congestion will be expected compared with option one, but still leads to better situation compared with without project scenario.	◎ Traffic will not pass through densely built up area and thus the health impact associated with greater vehicular emission will be minimized.
Traffic Safety	× Likely to deteriorate	○ Proper safety measures inc.	○ Proper safety measures inc.	◎ The traffic does not pass

Alternative	Zero Option	One	Two	Three
	further as no safety measures will be implemented.	traffic signs will be required as the speed of vehicles passing through built-up area is likely to increase.	traffic signs will be required as the speed of vehicles passing through built-up area is likely to increase.	through densely built-up area and thus the risk of accident will be reduced.
Construction cost	N/A	△ Require significant cost associated with land acquisition and resettlement.	◎ The cost associated with land acquisition and resettlement will be less than option one.	× While the cost associated with resettlement will be least among three options, cost of constructing new bypass will be significant.
Overall Evaluation (Ranking in bracket)	**4**	**3**	1	**2**
	Given the vulnerability of existing road against landslide and the importance as the key infrastructure in the state, it is not recommended to keep the condition as it is.	The option will trigger significant resettlement. Given the limited availability of open and flat land, preparation of new resettlement site will be necessary.	The scale of widening is compromised in some areas, but this level of widening will be sufficient for caring existing and projected traffic volume in mid-terms.	The scale of resettlement will be minimum, but the high cost associated with bypass construction will undermine economic viability of the project.

Note: ◎: most desirable, best among the option; ○: desirable but better option is available; △: other option is preferable; × should be avoided

Source: JICA Study Team

5.2 Consideration of Bypass for Future Phase of the Project

Option two has been identified as the most viable option for this project. However, considerable expectation for new bypasses has been observed during consultation meetings, particularly from residents in large village in which widening is likely to trigger significant resettlement. The construction of new bypass requires various additional studies, including topographic survey and environmental assessment, particularly review of forest fauna and flora. After a review of likely resettlement impact, future traffic volume and economic viability of the project in the long-term, and feasibility from engineering g point of view, four major villages with over 4,000 population, namely: Chhiahtlang, Serchhip, Hnathial and Lawngtlai, have been selected for bypass construction. Since the detailed environmental assessment for four bypass option is outside the scope of this EIA, a separate study for proposed bypass sections, including detailed flora and fauna survey, will be carried out. Preliminary drawing of Bypass route is included in DPR Chapter 7.

For sections where bypass is under consideration, it is proposed that the project will only improve existing road (e.g. install new drainage, improve pavement) without widening. One of the main rational of constructing new bypass is to avoid disturbance to local livelihood in densely built-up area. From the traffic demand of point of view, the new bypass will have sufficient capacity to hand additional traffic volume in the future and thus widening (and resettlement associated with it) will not be necessary for section where bypass is proposed. Nevertheless, to improve traffic flow and safety, and increase resilience against natural disaster, improvement, such as installing proper drainage, will be carried out.

CHAPTER 6 SCOPING AND ASSESSMENT OF ENVIRONMENTAL IMPACT

The positive and negative impacts associated with the proposed project vary both spatially and temporally depending on the baseline environmental quality along the targeted section as well as the scale and nature of project intervention during the various stages of the project. The Scoping Matrix below summarizes various environmental and social components that are likely to be affected by the project as assessed during scoping stage. Thpis has been prepared as a generic scoping matrix that can be applicable to mountainous/hilly road in general.

Table 6.1 Generic Scoping Matrix for Hilly/Mountainous Road

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Natural Environment				
Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected as the project in this stage does not affect climate.
				C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
Topography	D	B-	D	P: No impact is expected as no change to topography will be made in this stage.
				C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
				O: Topographic condition will b stable after the completion of construction work which include slope protection and slope stabilization.
Geology	D	D	D	P, C, O: No impact is expected as the project does not change geological feature of the project area.
Soil Erosion	D	B-	B+/ B-	P: No impact is expected.
				C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
				O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
Hydrology	D	C-	C-	P: No impact is expected.
				C: Construction work may cause minor, temporary impacts on hydrology.
				O: Cutting and/or filling may result in changes in local hydrology. The impact should be managed through adequate drainage measures.
Groundwater	D	D	D/ B-	P: No impact is expected since no engineering work will be carried out at this stage.
				C: The project does not envision the use of groundwater and thus no impact is expected. If the tunnel is constructed for bypass sections, however, appropriate measures should be undertaken to avoid/minimize the impact.
				O: No impact is expected during the operation stage, but measures should be undertaken if the project involves construction of tunnel.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected as no engineering work will be carried out at this stage.
				C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work could affect mountain ecosystem and local flora and fauna including jhum and plantation.
				O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
Protected Areas/Forest	D	B-	B-	P: The highways proposed for expansion/improvement does not traverse or border with national parks. However, one of the proposed road (NH62 in Meghalaya) traverses reserve forest.
				C: By the construction work, some of the forest area will be opened up.
				O: The level of sunshine may increase due to the expansion of the open area, potentially influencing the vegetation in the edge of the forest. Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem.
Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.
Landscape	D	D	B+	P: No impact is expected as no engineering work will be carried out at this stage.
				C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
				O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region.
Natural Disaster	D	B-	B+	P: No impact is expected since the project at this stage does not alter existing condition.
				C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
				O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment				
Air Pollution	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
				O: Air pollution is expected to increase due to increase traffic volume on the road.
Offensive Odor	D	D	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
Water Pollution	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
Bottom Sediment Contamination	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
				C: Some construction materials such as cement and sand are expected to be washed out mainly by the rain, but the impacts on bottom sediment are expected to be negligible.
				O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
Soil Contamination	D	C-	D	P: No impact is expected as no engineering work is carried out at this stage.
				C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
				O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
Ground Subsidence	D	D	D	P/C/O: No impact is expected. The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.
Noise/ Vibration	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
				O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
Sunshine Obstruction	D	D	D	P/C/O: No impact is expected since the project does not involve construction of tall building that may block sunshine.
Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
				O: Waste will be generated from road users and workers of maintenance works.
Social Environment				
Involuntary Resettlement	A-	A-	A-	P: The project will result in large-scale involuntary resettlement, particularly in built-up areas where structures exist in both sides of the road. Minimizing the resettlement should be the priority for road design.
				C: Temporary relocation might be required for accommodation of construction yards and workers' camps. Resettlement may cause cultural and social conflict between resettling people and host community.
				O: Resettlement may cause cultural and social conflict between resettling people and host community.
Land Use	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
				O: Greater traffic volume may affect the use of road and surrounding area by local residents. Uncontrolled jhum (shifting cultivation) along the road may undermine the effectiveness of slope protection/ stabilization measures and increase the risk of land slide and soil erosion.
Utilization of Local Resources	D	A-	A-	P: No impact is expected.
				C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.
				O: Improvement in road infrastructure may change the flow of commodity distribution, potentially impacting the use of local resources.
General, Regional /City Plans	D	D	C+/ C-	P: No impact is expected.
				C: No impact is expected.
				O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
Social Institutions and Local Decision-making Institutions	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to affect social institutions such existing as social capital and local decision-making institutions.
				C: Existing as social capital and local decision-making institutions will be affected by the influx of resettling population and construction workers.
				O: Existing as social capital and local decision-making institutions will be affected by the influx of resettling population.
Social Infrastructure and Services	A-	A-	A-	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.
				C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
				O: The resettlement can result in prolonged disturbance in social infrastructure and services. In the long term, however, the project is expected to improve access to social infrastructure and services by providing better road network.
Local Economy and Livelihood	A-	A-	A-	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
				C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
				O: The project may trigger unintended side effect with detrimental impact on local community, e.g. influx of non-local people and more competition in business and pressure on local natural resources. Over the long term, the project is expected to have positive impact on local economy as improved road network ensures more stable supply of essential goods. However, the end of construction work may create short-term unemployment of construction workers.
Unequal Distribution of Benefit	A-	A-	A-	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
and Damage				C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage
				O: People residing along the road may accrue greater benefits compared with others, potentially increasing rich-poor gap within the community.
Local Conflicts of Interest	A-	A-	A-	P/C/O: Unequal distribution of benefit and damage may trigger and/or intensify local conflicts of interests in the community.
Water Usage, Water Rights and Communal Rights	C-	C-	D	P: Water usage and water rights of the affected households may be curtailed due to resettlement. However, irrigation is not common in the region and thus, the impact will be minor, if any.
				C: Disturbance to water usage, water rights and communal rights during construction work is expected to be minor and short-term in nature. However, communal rights and distribution should be carefully examined to avoid negative impacts.
				O: No impact is expected.
Cultural and Historical Heritage	C-	C-	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage. There are, however, several observation decks and memorial stones along the road which may be affected depending on the widening width.
				C: Several observation decks and memorial stones along the road which may be affected depending on the widening width.
				O: No impact is expected.
Religious Facilities	A-	A-	A-	P: Several memorial stones and graves are located along the road and may be affected depending on the widening width. Small religious facilities in built-up areas may also be affected.
				C/O: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	A-	A-	P: Community facilities (public halls etc.) will have to be relocated incase road widening is implemented within the built-up area.
				C: Noise and vibration during construction work may affect school and hospitals.
				O: These facilities can be affected due to noise and vibration resulting from increase in traffic volume. Also, congestion may undermine the utility of such facilities.
Poor People	A-	A-	A-	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures.
				C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
				P: In the long-term, economic development in the region is likely to benefit the poor, however, the poor may fail to benefit from the project due to the lack of skills and coping capacity
Ethnic Minorities/ Indigenous People	A-	A-	A-	P/C/O: North East States are home of diverse tribal groups (Scheduled Tribe) with distinct language and cultures. Preparation of RAP and livelihood restoration plan, therefore, must take into account this diversity.
Gender	D	C-	B+	P: No impact is expected.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
				O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
Children's Rights	D	D	D	P: No impact is expected at this stage.
				C/O：Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected at this stage.
				C: Influx of construction workers is likely to increase the health risk, particularly that of STD/STI and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
				O: An increase in traffic volume and road users may have negative impact on public health.
Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected at this stage.
				C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
				O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Other				
Accidents	D	B-	C+/ C-	P: No impact is expected as the project at this stage does not alter existing condition.
				C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
				O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
Climate Change	D	B-	B+/ B-	P: No impact is expected.
				C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
				O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
Source: JICA Study Team

Table 6.2 below shows the Scoping Matrix specific for NH54. This has been prepared based on the environmental assessment, taking into account specific project features as well as of as environmental and social conditions. The item is highlighted if likely negative impact after the assessment is found to be larger than estimated in generic scoping matrix.

Table 6.2 Scoping Matrix for NH54 Widening and Improvement

Sl.	Item	Scoping Result			Rational of Assessment
		P	C	O	
Natural Environment					
1.1	Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
1.2	Topography	D	B-	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
					O: Topographic condition will be stable after the completion of construction work which include slope protection and slope stabilization.
1.3	Geology	D	D	D	P/C/O: No impact is expected as the project does not alter geological condition of the area.
1.4	Soil Erosion	D	B-	B+/B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
					O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
1.5	Hydrology	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Construction work may cause minor, temporary impacts on hydrology.
					O: Cutting and/or filling may result in changes in local hydrology. New drainage and culvert will be installed, taking into account the likely water flow in the area.
1.6	Groundwater	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: The project does not envision the use of groundwater and thus no impact is expected. However, appropriate measures should be undertaken to properly manage effluent during construction.
					O: No impact is expected during the operation stage.
1.7	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected. No unique/endangered species have been identified during assessment.
					C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work will affect mountain ecosystem and local flora and fauna including jhum and plantation.
					O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
1.8	Protected Areas/Forest	D	B-	B-	P: The targeted section of NH54 does not traverse or border with national parks or protected forest.

					C: By the construction work, some of the forest (including plantation and village forest) area will be affected.
					O: Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem. Monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary.
1.9	Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests.
1.10	Landscape	D	D	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
					O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region. Bus bay and other road amenities also help improve aesthetic conditions of the road.
1.11	Natural Disaster	D	B-	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
					O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment (Pollution Control)					
2.1	Air Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
					O: Air pollution is expected to increase due to increase traffic volume on the road. Relevant data (e.g. actual/projected traffic volume) shall be shared with relevant State authority so that mitigation measures can be developed.
2.2	Offensive Odor	D	D	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
2.3	Water Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
					O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
2.4	Bottom Sediment Contamination	D	B-	D	P: No impact is expected.
					C: The project involves construction of new small bridges. Silt-trap will be used to avoid construction materials such as cement and sand being washed out during construction work.

					O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
2.5	Soil Contamination	D	D	D	P: No impact is expected as no engineering activity will be carried out at this stage
					C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
					O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
2.6	Ground Subsidence	D	D	B+	P/C: No impact is expected as existing conditions will not be altered.
					O: The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.
2.7	Noise/ Vibration	D	B-	B-	P: No impact is expected.
					C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
					O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
2.8	Sunshine Obstruction	D	D	D	P/C/O: No impact is expected.
2.9	Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected.
					C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
					O: Waste will be generated from road users and workers of maintenance works.
Social Environment					
3.1	Involuntary Resettlement	A-	D	D	P: The project will result in large-scale involuntary resettlement at villages along the road. Minimizing the resettlement should be the priority for road design.
					C: Resettlement will be completed before construction begins and thus no resettlement is expected during operation
					O: No impact is expected as relocation is completed before relocation.
3.2	Land Use	A-	A-	D	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.
					C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
					No impact is expected as sufficient slope protection/stabilization measures to protect land use.
3.3	Utilization of Local Resources	D	A-	D	P: No impact is expected.
					C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.

					O: No impact is expected as use of local resources is not expected during operation.
3.4	General, Regional /City Plans	D	D	D	P: No impact is expected. C: No impact is expected. O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
3.5	Social Institutions and Local Decision-making Institutions	D	D	D	P/C/O: No impact is expected as there will be no change in social institutions and local decision-making institutions such as village councils and women groups
3.6	Social Infrastructure and Services	A-	A-	B+	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services. C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles. O: The project is expected to improve access to social infrastructure and services by providing better road network.
3.7	Local Economy and Livelihood	A-	A-	B+	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area. O: The project will have positive impact on local economy as improved road network ensures more stable supply of essential goods. In the long-term, this will lead to regional economic development with more job and business opportunities. Meanwhile, it is suggested that a proposal will be made to Village/District Council to ensure that improved infrastructure network will not lead to uncontrolled development and deforestation.
3.8	Unequal Distribution of Benefit and Damage	A-	A-	D	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not. C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage. O: No impact is expected as the project is an improvement of an existing road and the road will continue as before to accrue benefits to those along the road.
3.9	Local Conflicts of Interest	D	D	D	P/C/O: No impact is expected as the project is an improvement of an existing road and structures/services will be equally restored
3.10	Water Usage, Water Rights and Communal Rights	D	D	D	P/C/O: No impact is expected as rain water is used for both household and agricultural use
3.11	Cultural and Historical Heritage	C-	D	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage. C/O: No impact is expected as the project will not affect cultural and historical heritages

3.12	Religious Facilities	A-	A-	D	P: Several memorial stones located along the road may be affected. Small religious facilities in built-up areas may also be affected.
					C: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
					O: No impact is expected as sufficient noise control measures will be implemented.
3.13	Sensitive Facilities (ex. hospital, school, precision machine factory)	B-	B-	D	P: Small community facilities (public halls etc.) may have to be relocated incase road widening is implemented within the built-up area.
					C: Noise and vibration during construction work may affect school and hospitals but the impacts are expected to be minor.
					O: Greater traffic volume is expected to increase noise and vibration level, but adequate mitigation measures will be implemented.
3.14	Poor People	A-	A-	D	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures to be included in rehabilitation plan.
					C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
					P: No impact is expected. In the long-term, economic development in the region is likely to benefit the poor.
3.15	Ethnic Minorities/ Indigenous People	A-	A-	D	P/C: Aizawl-Tuipan section is inhabited by several different clans of Mizo people. Different groups tend to live together in relatively developed part of the section between Aizawl to Lunglei, but in Lawngtlai and Saiha district, Lai and Mara people occupy majority of the population respectively. Preparation of RAP and livelihood restoration plan, therefore, must take into account this factor.
					O: No impact is expected as the project is an improvement of an existing road and lifestyles of the project affected people will not be altered
3.16	Gender	D	C-	B+	P: No impact is expected.
					C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
					O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
3.17	Children's Rights	D	D	D	P: No impact is expected.
					C/O：Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
3.18	Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
					C: Influx of construction workers is likely to increase the health risk, particularly that of STD and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
					O: An increase in traffic volume and road users may have negative impact on public health.
3.19	Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
					C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.

					O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Others					
4.1	Accidents	D	B-	B+/ B-	P: No impact is expected as the project at this stage does not alter existing condition.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
					O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
4.2	GHG emissions	D	B-	B+/B-	P: No impact is expected.
					C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
					O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
Source: JICA Study Team

CHAPTER 7 ASSESSMENT OF IMPACT AND MITIGATION MEASURES

Widening and improvement of the targeted section of NH54 involves major upgrading works including relaying of pavement and widening road width to 12 m. The proposed project will have both positive and negative impacts on the surrounding environment during different stages of the project planning and implementation. This chapter assesses the nature, type and magnitude of the potential negative impacts on the various relevant environmental and social components along the project area as identified during the Scoping stage (see Chapter 6). For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

7.1 Natural Environment

7.1.1 Climate (1.1[3])

Pre-Construction and Construction Phase

Since the proposed project is only widening and strengthening to 2 lane road, no change in the macroclimate i.e. precipitation, temperature and wind is envisaged. However, there will be localized, temporary impact due to vegetation removal and the creation of paved surface for road. There may be an increase in daytime temperature around alignment due to loss of vegetation. The impact will be more prominent at locations where the cutting of trees is in clusters.

Operation Phase

During operation phase, increased traffic plying will lead to increase in temperature levels locally along the carriageway though it will be insignificant and temporary.

7.1.2 Topography and geology (1.2, 1.3)

Pre-Construction and Construction Phase

The change in topography (that of existing) is envisaged to some extent at various places along the entire length of the road while developing 2 lane standard. The change in topography will also happen due to operation of borrow areas. The construction of material handling yards and labor camps will also alter the existing topography temporarily.

Operation Phase

During the operation phase, there will be probable induced developments in the form of tourism and

[3] The number in bracket corresponds to the serial number in Scoping Matrix (Table 6.1)

commercial establishments along the highway. During monsoon, the change in topography will also be visible due to landslide and damage to side slope and breast wall. The benefits in the form of land leveling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

Mitigation Measures

During construction phase, the existing vegetation including shrubs and grasses along the route (except within the strip directly under embankment or cutting) will be properly maintained. The borrow areas shall be operated and closed as per the specifications for road and bridge construction manual of MORTH. The borrow areas shall be filled with the rejected waste/material, spoil and then finally a layer of topsoil shall be spread over it before carrying out plantation and turfing. For turfing, plant species that are native to the area will be used.

During operation phase, maintenance of embankment will be carried out to avoid soil erosion. The slope protection/ retaining wall if damaged due to land slide will be repaired promptly. The slope protection will also be established/strengthened regularly through plantation of shrubs and vegetation.

7.1.3 Soil Erosion (1.4)

Pre-Construction and Construction Phase

Site preparation will involve demolition of building, clearing of brushwood, tree removal and temporary re-routing of utilities. This brings risks of erosion to the exposed ground and topsoil. The soil erosion in construction stage may take place at the slope of the embankments, construction sites of cross drainage structures, at borrow areas and at construction sites which will be cleared.

Operation Phase

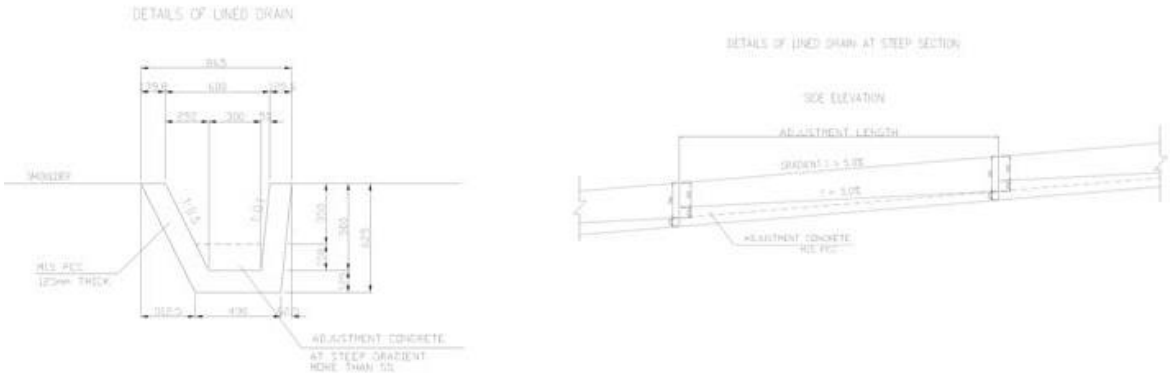
The soil erosion in operation stage may take place during operation at side slopes of road and near the approaches to bridges and interchanges. The risk is higher during monsoon.

Mitigation Measures

To control roadside soil erosion, turfing with grasses and shrubs will be carried out in accordance with the recommended practice in IRC guidelines. At the locations of steep slopes near crossings of highway with major rivers suitable protection measures such as stone pitching will be adopted. The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent erosion control measures to prevent soil erosion that will adversely affect construction

operations, damage adjacent properties or cause contamination of nearby streams or other watercourses, village ponds or water bodies etc. The green belt will be developed simultaneously along with construction activities to control the erosion process. In addition, gabion and apron concrete will be installed at the outlet of culverts to avoid soil erosion due to water runoff.

During the operation phase, the slope protection measures like sodding, turfing shall be done and monitored regularly. The green belt will be monitored and replantation for the loss of plants species will be done immediately. The side ditch on road is designed as concrete lined ditch for all section of cut side to prevent damage from water runoff. General arrangement plan for side ditch is shown in figure below.



Source: JICA Study Team

Figure 7.1 General arrangement plan for side ditch

7.1.4 Hydrology (1.5)

Pre-Construction and Construction Phase

Potential impact on hydrology will be minor, as the project does not involve diversion or re-routing of existing water resources. However, the existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

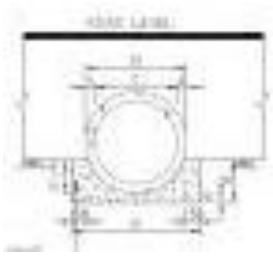
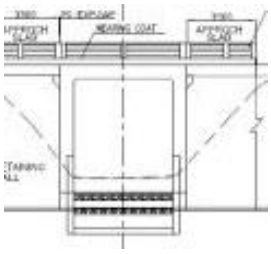
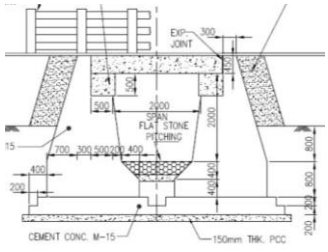
Operation Phase

The projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies.

Mitigation Measures

The new drainage system is designed by based on hydrological calculation result. Based on obtained location of water crossing and water discharge, dimension and locations for drainage system are determined. For cross drainage structure, appropriate culvert type is selected by taking account of economy, construction workability, and maintenance ability. Comparison of different culvert types is shown below. In principle, pipe culvert is used where the water discharge is comparably small. BOX culvert is proposed where the water discharge is comparable large. The size is determined to satisfy the water discharge obtained by hydrological calculation.

Table 7.1 Comparison for culver type

	Pipe culvert	BOX culvert	Slab culvert
Layout			
Economy	◎	○	△
East of Construction	◎	○	△
Durability	○	○	△
Capacity	○	◎	◎
Comment	To be applied for small discharge point	To be applied for large discharge point	Not applied

Source: JICA Study Team

7.1.5 Groundwater (1.6)

No tunnel is proposed in this project and as such, the project will not affect groundwater level or quality in the area. If contractor propose to use water from under surface water source, however, permission from the Water Resource Department and Local Administration is mandatory. The contractor is expected to properly manage effluents and waste water during the construction stage to avoid potential influence to the groundwater.

7.1.6 Ecosystem, Flora, Fauna and Biodiversity (1.7)

The main impact on flora involves the removal of trees and grubbing of vegetative cover for construction and a clear zone within the Right of Way (ROW) and for spoil bank. Widening of the 1-lane to 2 lanes would have negative impact on plant species by way of cutting the trees and shrubs

for construction activities. The types of impacts on flora can be as follows:

- Loss of trees;
- Loss of canopies;
- Compaction of vegetation, and
- Pollution and dust accumulation on vegetation.

Mitigation Measures

In addition to the efforts to minimize the scale of forest clearing and impacts associated with construction activity, following measure will be taken care during construction phase to avoid collision of wild as well domestic animals:

- It is suggested that regular monitoring by the forest department should be done;
- Anti-poaching measures during construction phase should be strengthened to check violation of existing regulations;
- Side barriers will be provided to avoid collision of animals in forest area; and

During the construction stage, signboards will be used to make sure that workers will be aware of the vulnerable and other important species. Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with State Environment and Forest Department with which the project authority will discuss potential measures to promote conservation and monitoring of ecosystem shall be carried out as was undertaken during the EIA study.

The tree plantation felled will be replaced and compensated according to the Compensatory Afforestation Policy under the Forest Conservation Act, 1980. Apart from trees earmarked for feeling, no additional tree clearing within the ROW will be allowed. All construction workers should adhere to this rule.

Plantation of shrubs and under trees in the median shall be undertaken to prevent the glare of the vehicles coming in the opposite direction. Construction vehicles, machinery and equipment will move or be stationed in the (ROW) to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil will be avoided.

Construction of road will involve removal of topsoil and cutting resulting in clearing of vegetation cover and felling of trees. However such impacts will primarily occur at the project site during initial

period of the construction phase and will be minimized through adoption of mitigation measures. It is recommended that the lost trees will be compensated at 1:3 ratio. The site of compensatory afforestation will be specified by the Forest Department during the process of obtaining forest clearance. As per its guidance, the project proponent will plant saplings (types and number to be specified) at designated location (either degraded forest or vacant/abandoned jhum area).

Following measure will be taken during construction phase.

- It is suggested that regular monitoring by the forest department should be done. In keeping view of likely increase in vehicular emissions in the future, the monitoring should include the assessment of impact due to greater air pollution;
- A suitable landscaping plan for the project road has been prepared to enhance the ecological status of the area;
- It was noticed, that the project road did not have tree cover at few locations (Jhum lands) tree plantation at these location will enhance the aesthetics as well as reduce the pollution level of the area; and
- Initiative should be taken to remove the impacted small girth size trees with the help of Forest Department and replanted them at designed place. Though cost involvement against this type of work can be high, it will save the life of growing plants.

7.1.7 Protected Areas/Forest (1.8)

Pre-Construction and Construction Phase

The project road does not traverse or border with national park, wildlife sanctuary or reserved forest. As discussed above, however, the project will cause deforestation due to removal of trees and grubbing of vegetative cover for construction and a clear zone within ROW. Based on the field survey and satellite data, forest area accounts about 60% of the area to be acquired (or 375 ha out of 625 ha).

Operation Phase

Increases in traffic volume are likely to have negative impact on forest ecosystem.

Mitigation Measures

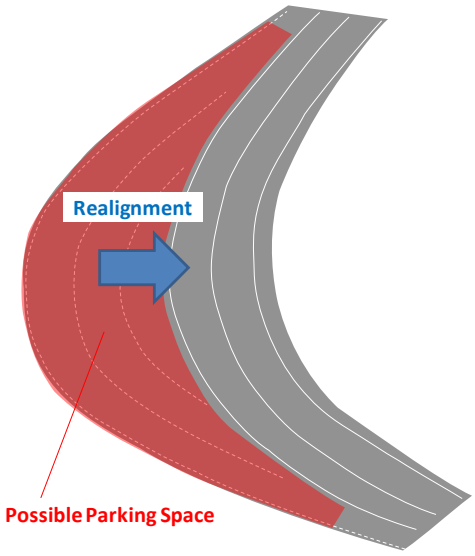
At the planning stage, efforts to avoid or minimize the number of trees to be cut have been done as part of the design for widening of the road. There will also be measures including replanting the trees at suitable location during the construction stage. Further the plantation at the Jhum lands can also be taken up as a part of plantation program for the loss of tress. See also section 7.1.6 for measures for

deforestation.

Improved road network may trigger poaching. At the moment, educational activities and removal of traps by rangers are undertaken to reduce poaching. While NHIDCL is not responsible for the control of poaching, a proposal shall be made to relevant authority regarding the potential increase in poaching and the necessity of adequate management system, such as restriction of precious wildlife trade.

7.1.8 Landscape (1.10)

For sites where good view can attract tourists, parking spaces/viewpoints can be developed utilizing flat spaces which are produced by improvement of the horizontal alignment to be made especially in sharp curves as illustrated in below Figure. In the preliminary design, about twenty such locations can be developed along NH54.



Source: JICA Study Team

Figure 7.2 Concept for Parking Site/Viewpoints Development

In addition, road and traffic markings to be installed in accordance with IRC:35-1997 will ensure smooth and orderly flow of traffic and contributes to better aesthetic condition of the road by reducing congestion. Buses standing indiscriminately on the carriageway to drop or pick-up passengers can seriously affect capacity of the roadway, besides being a source of accidents. It is, therefore, desirable that on all busy non-urban highways, consideration should be given to the construction of bus lay-byes of suitable design at required locations to ensure orderly movement of the through traffic.

For conveneince of tourists, it is also proposed that bus bay will be equipped with amenities including public toilets and bazar shed.

Table 7.2 Proposed Bus Bay Locations for NH54

No.	Section	Location	Distance from Aizawl (km)	Section Length (km)	No.	Section	Location	Distance from Aizawl (km)	Section Length (km)
1	1	Aizawl	-		22	2	Dawn	206	16
2	1	Zemabawk	4	4	23	2	Zobawk	219	13
3	1	Tuirial	22	18	24	2	Hrangchalkawn	222	3
4	1	Seling	38	16	25	2	Bualte	231	9
5	1	Thingsulthliah	42	4	26	2	Thualthu	243	12
6	1	Darlawng	53	11	27	3	Tawipui N-II	251	8
7	1	Tlungvel	57	4	28	3	Tawipui N-I	256	5
8	1	Phulmawi	61	4	29	3	Tawipui S	264	8
9	1	Khumtung	63	2	30	3	Thingfal	277	13
10	1	Baktawng	67	4	31	3	Lawngtlai	292	15
11	1	Chhingchhip	77	10	32	3	Saikah	311	19
12	1	Chhiahtlang	97	20	33	3	Paithar	314	3
13	1	Serchhip	107	10	34	3	Chawitlangpui I	316	2
14	2	Keitum	122	15	35	3	Sihtlangpui	319	3
15	2	Bungtlang	130	8	36	3	Kawlchaw	324	5
16	2	Rawpui	135	5	37	3	Zero Point	337	13
17	2	Pangzawl	148	13	38	3	Maubawk	354	17
18	2	Thiltlang	158	10	39	3	Theiva	355	1
19	2	Hnahthial	169	11	40	3	Theiri	363	8
20	2	Leite	182	13	41	3	Tuipang	379	16
21	2	Maudarh	190	8					

Source: JICA Study Team

At the moment, no regular garbage collection is carried out outside the village. Educational activities or awareness raising campaign shall be carried out to reduce littering and promote garbage collection in partnership with State Urban Development & Poverty Reduction Department (UDPA), villages near such facilities and NGOs active in this field.

7.1.9 Natural Disaster (1.11)

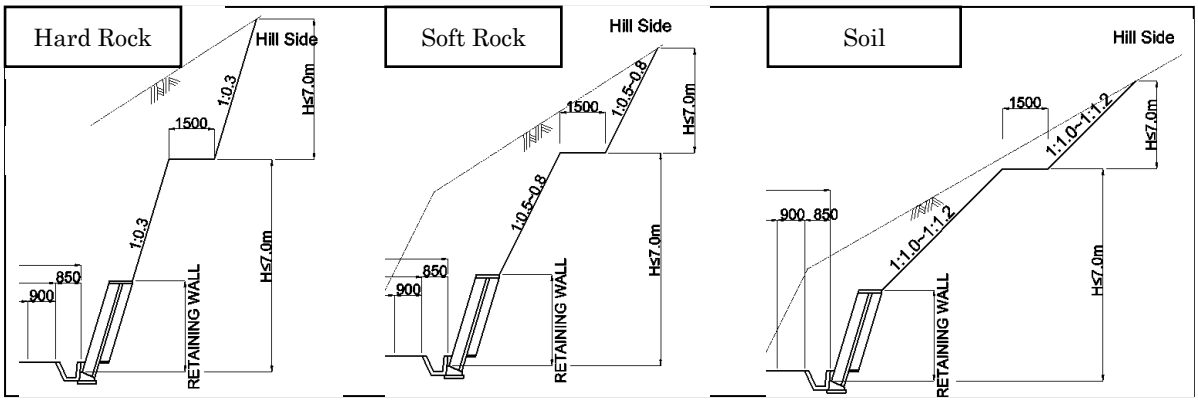
Slope along NH54 is covered by very loose quaternary alluvium. It is concerned that slope failure and erosion have frequently occurred on cut slope along NH54. Therefore, such loose soil slope shall be cut with 1:1.2 gentler than IRC standard for landslide prevention as shown below. The cut slope shall be greened by seeding and mulching consisting of jute netting including seeds which cover all over the slope and prevent erosion by rain water. See also section 7.1.3 and 7.1.4 for measures to improve road resilience against disaster.

Table 7.3 Design Criteria of Cut Slope and Slope Protection Work

IRC Standard*		JICA Study Team Rock/Soil Classification			Cut Grade	Slope Protection Work
Classification	Cut Grade					
Hard Rock	**80 ~ 90 degree**	Rock	Very Hard		**1:0.2**	No protection work
			Hard	No Risk	**1:0.3**	No protection work
				Landslide Risk		Crib work
Ordinary	**1:0.25 ~**		Soft	Non-Dip Slope	**1:0.5**	No protection work

Soft Rock	**1:0.125**			Dip Slope	**1:0.8**	Hydroseeding (t=5 cm)
Ordinary Soil/ Heavy Soil	**1:1.0 ~ 1:0.5**	Soil	Dense Soil		**1:1.0**	Seeding and Mulching
			Loose Soil		**1:1.2**	Seeding and Mulching

*IRC: SP:48:1948 Clause 7.4
Source: JICA Study Team



Source: JICA Study Team

Figure 7.3 Typical Cross Section of Cut Slope

Inproper maintenance of road facilities such as sediment deposition in culverts can cause natural disasters or exacerbate their impacts. NHIDCI will be responsbible for regular maintenance of road facilities to reduce the risk of natural disaster during the operation period.

Frequency and intensity of heavy rain is likely to increase due to climate change. In the project area, an increase of annual rainfall is predicted to be 5-15% for the period from 2021 to 2050. The design of various components of the road (slope protection, drainage etc.) takes into account likely effect of climate change. With increase of the rainfall frequency and intensity, river water and groundwater level are expected to be high, which could cause inundation and damage to the road facilities. Therefore, spring water points have been carefully studied and subsurface drainage is proposed where necessary. Flood marker was checked in site reconnaissance and interview survey for the disaster countermeasure design to inform the road design. The table below shows adaptation measures for climate change taken into consideration in this road design.

Table 7.4 Adaption Measures for Climate Change in NH54

Factor	Design Policy considering Adaptation
Side Slope	· Retaining wall is built all along the road. · Slope protection work is constructed on some weathered and loosen slopes. · Cut slope is covered with vegetation works to prevent erosion and collapse. · Replacement of subgrade and subsurface drainage are planned as

	countermeasure against sinking.
Embankment	· Drain filter is sandwiched in embankment. · Flood level is confirmed in site reconnaissance and interview survey near river bank in south of NH54.
Bridge & Drainage System	· Rainfall intensity is carefully determined based on the authorized data : ATLAS of Statewise Generalised ISOPLUVIAL MAPs of Eastern India published by Indian Meteorological Department. The isopluvial value from higher edge of counter range is applied. · The capacity of all structures is determined to be capable for the discharge of 50 years return period.
Pavement	· Super elevation is installed properly. · Pavement material is examined not to rise over 60 °C on the surface.
Road Sign	· Wind load and visibility is taken into consideration.

Source: JICA Study Team

7.3 Living Environment

7.3.1 Air Pollution (2.1)

Pre-Construction and Construction Phase

The short-term and localized degradation of air quality will occur from dust generation due to procurement and transport of raw materials from quarries and borrow pits, site clearance, use of heavy vehicles, machinery/ equipment, stone crushing handling and storage of aggregates and generation of fine particulate matter (smoke) in asphalt processing. Dust would be generated from haulage of materials and detouring of traffic on non-permanent, temporary pavement etc.

Hot mix plants contribute substantially to the deterioration of air quality due to emissions of oxides of Sulphur, Hydrocarbons and particulate matter. During the construction period, temporary impacts include generation of Odor from construction activities as well as from construction camps. During construction of road, the movement of different types of construction machinery and vehicle will be increased. This in other way increases the fuel consumption.

From the results of the ambient air quality monitoring conducted along the road, it is noticed that the monitoring parameters are within the standards as prescribed by the Central Pollution Control Board The concentration of the air pollutants will further increase during construction period but for limited period only. The impacts on air quality during construction will be mostly localized and concentrated within the ROW. The impacts due to dust generation may felt downwind of the site rather than the site itself due to local wind pattern.

Operation Phase

The project road is mostly passing through the rural areas with alluvial soil. Dust generation due to movement of vehicles is envisaged along the project road, but not in significant amount. Due to increase in speed and volumes of vehicular traffic on the project corridor, marginal increase in the air pollutant levels is expected but not significant. Widening of road will attract larger community to use this corridor which in-turn increase the fuel consumption and has direct impact on national economy and local ecosystem.

Mitigation Measures

The hot mix plants, crushers and the batching plants will be sited at least 500 m in the downwind direction from the nearest settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants will be taken up. The hot mix plant will be fitted with

dust extraction system. Asphalt and concrete plants will be operated in conformity with government pollution control legislation, and located away from the settlements as far as possible. All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. Regular monitoring of particulate Matter at crusher sites, during the construction, will be conducted. Regular water sprinkling will be done on the cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork, water will be sprayed to prevent dust emission. The vehicles delivering construction material will be covered to avoid spilling. Planting of trees/vegetation on the periphery of the construction site will be taken up.

During the operation stage of the project, vehicular emissions of critical pollutants (RSPM, CO, HC, SO_2, and NO_x) will be monitored and roadside tree plantation will be maintained. Over the long-term, projected increase in traffic volume, particularly ones of heavy trucks, may pose health threat in roadside community. The peak hourly estimated traffic volumes for the years 2020 and 2035 have been considered to project future air quality scenarios to provide an indication of long-term variations in air quality. The future level of air pollution, modeled based on the projected increase in traffic volume indicates that the level of pollution (CO and NOx levels) will remain below the standard during the projected period (2035). Nevertheless, mitigation measures such as introducing speed limit and other measures to control congestion in built-up area may be necessary in the longer term. Also, local communities should be well informed of the risk of air pollution. Awareness raising campaign may include distribution of facemask to mitigate risk of air pollution and other information kit. Finally, relevant data (e.g. actual/projected traffic volume and likely emissions) shall be shared with relevant State authority so that mitigation measures can be developed.

7.3.2 Water Pollution (2.3)

Pre-Construction and Construction Phase

There are 4 major rivers and numerous streams that cross the NH54 highway alignment under consideration. Road projects may marginally lead to increased run-off during construction stages, which will increase sediment accumulation in nearby water bodies. Though most of the natural watercourses are perennial in nature, the impacts due to the increased run-off would be negligible due to the project road. During construction, the disposal of solid and liquid waste from labor camps, fuel and lubricant spills or leaks from construction vehicles, pollution from fuel storage and distribution sites and that from hot-mix plants is likely to affect water quality unless adequate mitigation measures are designed. The existing drainage will be slightly obstructed during the construction period, but for

a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

Use of water for construction activities such as compaction, suppression, concrete work may pose pressure on local water supplies; the demand would be met from surface water bodies like ponds, canal and rivers. Municipal water supply will be used only for drinking purposes (for construction camps), if available and if permitted by the local municipal authority. No local/municipal water supply would be used for construction purpose.

Operation Stage Impacts

Road projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies. Though most of the natural watercourses are non-perennial in nature, the impacts due to the increased run-off would be negligible due to the project road and will be restricted only during monsoon and early part of post-monsoon seasons.

In the operation stage, pollutants from vehicles, and accidental fuel spills may make their way into the receiving environment. The major pollutants of concern are suspended solids, oil and grease, lead etc. All the rivers present at this road section are non-perennial surface water bodies. No adverse direct impact on the water quality (both underground and surface water bodies) is expected during the operation period. The change in natural drainage pattern is very insignificant from the present state of the project.

Mitigation Measures

To avoid contamination of the various water bodies and drainage channels, construction work close to the canals or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per the State Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to approve disposal sites.

To avoid contamination of the water body and drainage channels from fuel and lubricants, the vehicles and equipment will be properly maintained and re-fuelled only at designated places. The slopes of embankment leading to water bodies will be modified and re-canalized so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent

contamination of water.

Discharge of oil and grease is most likely from construction vehicle parking area, vehicle repair area and workshops. An oil interceptor shall be provided to ensure that all wastewater flows into the interceptor prior to its discharge. The device has a chamber for separation of oil and water and can handle 200 L/hour of wastewater. The oil float appearing on the surface is removed by periodic cleaning once a week by skimming off the oil film from the surface.

The sewage system (including septic tanks and soak pits) for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse. The workplace will have proper medical approval by local medical, health or municipal authorities. The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Due to the non-availability of water required for construction, if a new tube-well is to be bored, prior sanction and approval by the Central Ground Water Board (CGWB) will be obtained. Wastage of water during the construction will be minimized.

In most cases, effluents from existing public toilet along NH54 are discharged without any treatment. For new public toiles to be constructed in bus bays/viewpoints or replacement of existing toilets that will be affected by the road widening, septic tack or toilet with an opening for collecting night soil will be installed to reduce negative impacts.

7.3.3 Bottom Sediment Contamination (2.4)

It is proposed that three existing bridge with poor conditions to be replaced with the new ones. During engineering work of the bridges over the rivers, sediment pollution may occur. As one of the mitigation measures, silt fencing will be provided to restrict runoff into the water during construction phase.

7.3.4 Soil Contamination (2.5)

Pre-Construction and Construction Phase

The contamination of soil during construction stage is primarily due to construction and allied activities. The soil contamination may take place due to solid waste from the labor camps set- up during construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. The sites where construction vehicles are parked and serviced are likely to be

contaminated because of leakage or spillage of fuel and lubricants. The contamination of soils can also occur at the site of hot-mix plants from leakage or spillage of asphalt or bitumen. At the site of batching plants, because of spillage of cement, leakage of curing agents the soil contamination can occur. The contamination of soil may take place due to dumping of solid waste in unscientific manner, leaching of fuel/oil & grease from workshops, petrol stations and DG sets.

Operation Stage Impacts

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can belong term and irreversible depending upon the extent of spill.

Mitigation Measures

At construction yards, the vehicles/equipment will be maintained and re-fuelled in such a fashion that oil/diesel spillage does not occur and contaminate the surrounding soil. It will be ensured that the fuel storage and re-fuelling sites are kept away from drainage channels and important water bodies. At the washdown and re-fuelling areas, "Oil Water Separators" shall be provided. All spills and discarded petroleum products shall be disposed off in accordance to the Hazardous Waste Management and Handling Rules. Fuel storage and re-fuelling areas will be located at least 500 m from all water bodies near the road alignment. The fuel storage and re-fuelling areas shall not be located on agricultural lands or productive lands to avoid topsoil contamination. The earthwork will be carried out strictly in accordance with the design so that no excess earth is borrowed. The construction waste generated will be reused in the construction of highway.

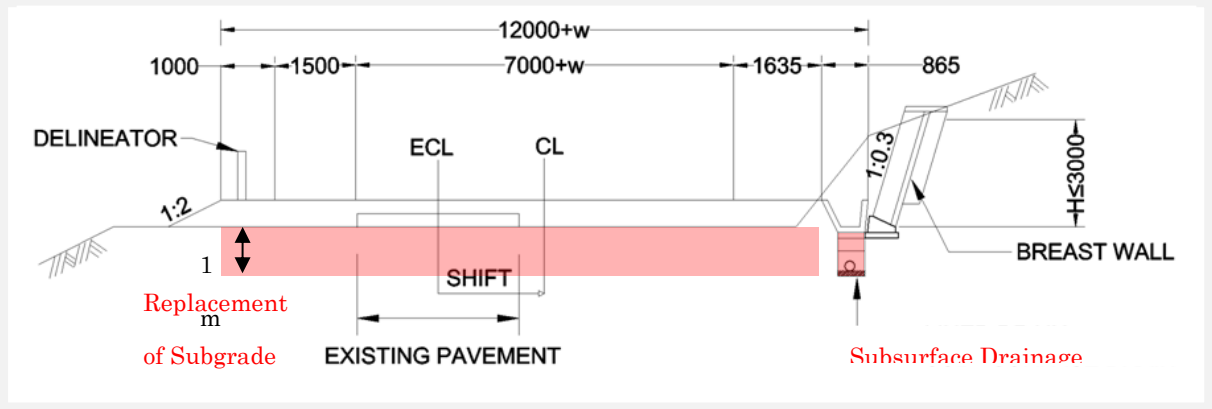
Bituminous waste will be used after milling and in case bituminous waste is required to be disposed off it shall be disposed in secured way by providing 50 mm tick clay layer. The solid waste generated during construction phase which includes municipal waste both organic & inorganic in nature which shall be stored/treated/disposed off in accordance with Municipal Solid Waste (Management & Handling) Rules. The hazardous waste may include oil waste, biomedical waste, E-waste etc. This shall be disposed off in accordance with the Hazardous Waste (Management, Handling & Transboundary Movement) Rules, Biomedical Waste (Management and Handling) Rules and E-Waste (Management and Handling) Rules respectively.

In the operation stage, the petrol pumps & vehicle washing area located along the ROW will be monitored regularly for any spillages and corrective remedial measures like spread of sand, provision of oil & greases separators for passing wash water of petrol pumps & vehicle washing area before

diverting it to water bodies shall be done regularly. The solid waste generated from the way side amenities will include Municipal Waste both organic and inorganic, hazardous waste (like used batteries), will be treated in accordance with Municipal Solid Waste (Management & Handling) Rule and Hazardous Waste (Management, Handling & Transboundary Movement) Rules.

7.3.5 Ground subsidence (2.6)

Many road subsidence sites have been identified in the slope inventory survey, which was assumed to occur due to consolidation of loosen subsurface soil and high groundwater level except for embankment sliding. Replacement of subgrade with 1.0m thick and subsurface drainage is planned as countermeasures of sinking as shown in below Figure, which will significantly improve the existing condition.



Source: JICA Study Team

Figure 7.4 Typical Cross Section of Countermeasure for Sinking

7.3.6 Noise and vibration (2.7)

Pre-Construction and Construction Phase

During the construction, the major sources of noise pollution are movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A). The major work will be carried out during the daytime. The noise levels in the project area during the construction stage will be intermittent and temporary in nature. Typical noise levels associated with the various construction activities and construction equipment are presented below.

Table 7.5 Typical Noise Levels of Construction Equipment

Construction Equipment	Noise Level dB(A)
Bulldozer	80
Front end loader	72-84
Jack hammer	81-98
Crane with ball	75-87
Crane	75-77
Bulldozer	80
Backhoe	72-93
Front end loader	72-84
Cement & Dump trucks	83-94
Jack hammer	81-98
Scraper	80-93
Welding generator	71-82
Grader	80-93
Roller	73-75
Concrete mixer	74-88
Concrete pump	81-84
Concrete vibrator	76
Paver	86-88
Truck	83-94
Tamper	74-77
Air compressor	74-87
Pneumatic tools	81-98

Source: U.S. Environmental Protection Agency, noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. 300.1. December 31, 1971

At the moment, noise level is within the desired level. The noise level will be increased during construction period, which have significant impact for a limited period on the surrounding environment. The noise levels in the working environment are compared with the standards prescribed by Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by Government of India through Model rules framed under the Factories Act. The acceptable limits for each shift being of 8 hour duration, the equivalent noise level exposure during the shift is 90 dB(A). Hence noise generated due to various activities in the construction camps may affect workers, if equivalent 8 hour exposure is more than the safety limit. ACGIH (American Conference of Government Industrial Hygienists) proposed an 8 hour Leq limit of 85 dB(A). Exposure to impulses or impact noise should not exceed 140 dB(A). The workers in general are likely to be exposed to an equivalent noise level of 80-90 dB(A) in an 8 hour shift for which all statutory precautions as per laws should be taken into consideration.

Operation Stage Impacts

During the operation stage of the project, reduction of vehicular engine noise (as a result of reduced congestion from earlier, smoother flow of traffic due to 2 separate lanes), vehicular body noise (as a result of reduced development roughness) and reduction of blowing of horns will bring the noise levels down, but as volume of traffic, mainly heavy duty traffic will be increase in future due to rapid

development and industrialization along the road corridor this may increase noise slightly.

Mitigation Measures

The high noise levels may cause discomfort to local residents and workers. Following mitigation measures shall be adopted to keep the noise and vibration levels under control.

- The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum;
- Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than90dB(A);
- In construction sites within 150 m of human settlements, noisy construction will be stopped between 10 PM and 6 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement;
- Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use as schools and hospitals;
- Near to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used;
- Phase demolition, earthmoving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately
- Construction machinery will be located away from the settlements;
- Careful planning of machinery operation and scheduling of operations can reduce the noise levels. Use of equipment, emitting noise not greater than 90 dB(A) for the eight-hour operations shift and locating of construction yards at a distance of at least 500 m from any residential areas can be adhered to;
- Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures, which should be followed by the contractors during the civil works;
- The noise control measures include limitations on allowable grades. Open-graded asphalt and avoidance of surface dressings to reduce tire noise in sensitive areas. Maintenance of proper road surface repairs also helps in reducing noise levels;

- Use of air horns should be minimized on the highway during nighttime. During daytime use of horns should be restricted at few sensitive locations. This can be achieved through the use of sign boards along the roadside;
- Future development along the road should follow correct land use norms so that sensitive receptors are not located along the road, specifically along the bypasses; and
- Development of greenbelt along the main road can also bring about considerable reduction in noise levels. The area available on both sides of the road should be used to develop green belt comprising selected species of trees with high canopy to provide added attenuation of noise

7.3.7 Wastes/Hazardous Materials (2.9)

Types of construction waste which are expected to be generated include asphalt chunks, chunks of concrete, surplus soil, construction scrap materials and organic waste generated by construction workers. The amount and percentage composition of construction waste will depend on the final design and the schedule of the construction, and thus generic mitigation measures proposed in EMP should be updated once the final ROW drawing is completed. All other construction wastes are also planned to comply with relevant Center or State laws pertaining to waste management.

Table 7.6 Required Volume for Spoil Bank

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH54	S1	Cut Soil	cu.m	3,442,909	0.9	3,098,618	2,400,495
		Fill Soil	cu.m			698,123	
	S2	Cut Soil	cu.m	3,710,629	0.9	3,339,566	2,437,522
		Fill Soil	cu.m			902,044	
	S3	Cut Soil	cu.m	3,560,596	0.9	3,204,536	2,465,129
		Fill Soil	cu.m			739,407	
	Total						7,303,146

Source: JICA Study Team

The volume of surplus soil is estimated as below. Candidate locations with sufficient and necessary conditions for spoil bank construction have been screened with following criteria:

- ❖ To minimize transport of surplus soil, spoil bank should be located at every 5km distance along NH54 with following condition;
  - Ground shape with concavity topography
  - Less ground gradient than 22 degree which is assumed as average angle of spoil bank slope

with necessary steps

- No built-up area
- No national sanctuary area

❖ To be able to construct the spoil bank in less than 30m height

Based on the above criteria, 115 locations in 381 km stretch of NH54 has been identified for spoil bank construction. There are 41, 32 and 42 spoil bank with about 2.43, 2.90 and 2.51 million cu.m capacities in Section I, II and III respectively.

7.4 Socio-Economic Environment

7.4.1 Involuntary Resettlement (3.1)

As per the preliminary ROW design, the project will affect 2,037 households (1,971 households whose houses will be affected and 66 households whose businesses will be affected). The total number of affected people is 8,230. Out of these, 1307 households (1,265 households whose houses will be affected and 42 households whose businesses will be affected) will have to be relocated. Based on the preliminary ROW design, remaining 730 households will be affected but relocation will not be necessary. More details about resettlement impact, resettlement policy and proposed compensation package can be found in the RAP report.

7.4.2 Land Use (3.2)

The project does not lead to large-scale change in land use as the engineering work will be constrained mostly along the existing road. On the other hand, development of resettlement site to accommodate relocated households and construction of spoil bank is likely to cause changes in land use pattern, potentially affecting existing agricultural and plantation activities. Also, jhum cultivation, which is practiced in roadside as in Photo below, will be affected by slope protection/embankment work. The jhum practice directly next to the road is likely to have negative impacts from the road maintenance point of view and thus measures will be developed to shift existing jhum to areas far from the road or transform jhum to other agricultura practice.

Photo 7.1 Jhum next to NH54

For sections where NH54 passes through community forest, jhum area and plantation, engineering work should be scheduled in a way that minimize disruption of access by local people. At the same time, proper management of effluent and soil erosion shall be carried out to avoid negative impact on such resources.

7.4.3 Utilization of Local Resources (3.3) and Local Economy and Livelihood (3.7)

Significant volume of local resources such as sand may be used for construction work. This could cloud out the use of such resources for other purposes in the short-term. In the long-term, the better road network may attract new business, possibly from outside the state with detrimental impact on local business/traders. While the project overall will have significant positive impacts on the local and regional economy, the better transport network may put some groups at risk at least in the short and medium-term. These potential high-risk groups should be identified in the preparation of R&R plan to ensure that they will not be in a disadvantaged position due to the project.

7.4.4 General, Regional /City Plans (3.4)

The project will create new opportunities for village and district-level development planning. In particular, the construction of spoil bank will create large area of flat land where such surface is a scarce commodity. The development of spoil bank, therefore, should be coordinated with the village/district's development plan so that the land will benefit the community. Similarly, development of resettlement site should be well coordinated with village development plan to ensure proper supply of basic utilities and integration of new sites with the existing village area.

7.4.5 Social Institutions and Local Decision-making Institutions (3.5)

Except for Lawngtlai and Saiha district where Lai and Hmar population account for the majority of the population respectively, different tribes of Mizo people co-exist across the stretch of NH54 without tribe-rooted conflicts. To minimize potential disturbance and avoid the risk of conflicts, however, the resettlement will be planned within the village where relocation takes place. Being a tribal state, district and village council and traditional community leaders have significant influence on decision-making process in the area. As such, their support and cooperation is critical in smooth implementation of the project, particularly activities related to resettlement. The implementation of EMP as well as RAP/R&R should be built on existing social institutions and will be best guided by local people, rather than outside experts.

7.4.6 Social Infrastructure and Services (3.6)

For most people residing along NH54, the highway is the only route of access to social infrastructures such as schools and hospitals. Construction activity is likely to cause temporary disturbance to their access to such infrastructure and service and therefore, schedule and timing of the engineering activity should be developed in consultation with the local community. When road blockage is necessary, e.g. for blasting, the local community should be informed in advance so that they can make alternate plan accordingly.

7.4.7 Unequal Distribution of Benefit and Damage (3.8) and Local Conflicts of Interest (3.9)

Roadside location offers critical advantages for local business (tea stalls, restaurant, petty shops). Resettlement from roadside to inner part o the village may significantly undermine the viability of these businesses, and therefore, business owners to be affected may be worse off compared with farmers to be relocated. Likewise, allocation of plot in resettlement site may become a source of conflicts among affected households who wish to be relocated to more advantageous plots. Sound arbitration and conflict resolution mechanism by local leaders should be in place for smooth implementation of RAP and R&R activity.

7.4.8 Water Usage, Water Rights and Communal Rights (3.10)

Irrigation is not practiced along the project area and thus water is not likely to become a source of conflicts in the course of project implementation.

7.4.9 Cultural and Historical Heritage (3.11)

No sites of cultural or historical significance have been identified along the project road.

7.4.10 Religious Facilities (3.12) and Sensitive Facilities (3.13)

It is expected that the project will affect 8 small churches along the road. Given the importance of religion and religious belief in the project area, the project should explore options avoid/minimize impacts to such facilities during the detailed design once additional topographic data is obtained. Also, access to these facilities, particularly Sunday mass, should not be disturbed by construction activities. Similarly, more stringent standard for noise and vibration and air quality should be adopted where sensitive facilities such as school and hospitals are located.

7.4.11 Poor People (3.14)

The baseline survey has identified gap between official poverty level and poverty level as reported by the people. R&R activity should take into account the limited coping capacity of the local community and develop measures that leads to sustainable income generation of the affected people, rather than one-off payment of compensation and assistance.

7.4.12 Ethnic Minorities/ Indigenous People (3.15)

In the state of Mizoram, the tribal (Scheduled Tribe: ST) population constitutes about 95% of the total population. Overwhelming majority of the affected people also belong to ST, and hence they are not minority. While tribal groups in project area holds traditional culture, including shifting cultivation in forest called jhum, they freely interact and share their sources of water, folklore, food, infrastructure and other belongings with the non-ST and other tribal population within and outside community. This is particularly evident in the section between Aizawl and Lunglei where differnet sub-tribe of Mizo, including Lushai, Lai and Mara and non-Mizo people co-exist peacefully without ethnicity-related tensions. Moreover, ST population in project area is not isolated from outside and they are open to new ideas such as family planning and formal education.

7.4.13 Gender (3.16)

Tribal and non-tribal women in North East States enjoy a relatively higher position in the society than what their non-tribal counterparts do, which is reflected in their high literacy rate. Mizo women are largely involved in household work, collection of forest produce, firewood collection, cultivation and other agricultural activities and thus they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in women in which options to facilitate women's participation in project implementation and various opportunities to be created by the project is discussed. In particular,

women shall have preferential access to specific types of project-related job opportunities, including light-duty work and part-time jobs that do not interfere with women's responsibility at home.

7.4.14 Public Health (sanitation and infectious diseases) (3.18) and Occupational Health and Safety (OHS) (3.19)

The health and safety measures at design, construction and operation phase are given below.

Table 7.7 Health and Safety Measures

Design Stage	
Geometric Correction at Critical Curves	Critical curves have been rectified to maintain project design speed and visibility. (IRC-86-1983 " Geometric Design for Road in Plains")
Construction Stage	
Health hazard to workers due to bad water and sanitation	At every workplace, good and sufficient potable water (as per IS) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. Adequate drainage, sanitation and waste disposal shall be provided at workplaces. Preventive Medical care shall be provided to workers.
Health/ social hazard, sexual harassment to female workers	Segregation of male and female areas in labor camp shall be executed.
Hygiene at Construction Camps	The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer. There shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act. Except in workplaces provided with water-flushed latrines connected with a well designed septic tank, all latrines shall be provided with low cost 'Twin Pit Latrine' system. The pit can be closed after the construction is over. There shall be adequate supply of water, close to latrines and urinals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.
Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees. If the quarry site is porous, it shall be used by groundwater recharging.
Risk from Operations	The Contractor is required to comply with all the precautions as

	required for the safety of the workmen as far as those are applicable to this project. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.
Risk from Electrical Equipment	Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.
Risk at Hazardous Activity	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the siteshall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.
Risk of Lead Pollution	No man below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
Risk caused by Force' Majure	All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.
Risk from Explosives	Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.
Malaria risk	The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him
Loss of Access	At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use

	of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.
Traffic Jams and Congestion	Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.
Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. All signs, barricades, pavement markings shall be as per the MORT&H specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer. Excavated pits shall be filled to avoid falling of animals/ human beings.
Operation Phase	
Dwellers in settlements may rush to high way and meet accident	Specially design urban section and footpath sections shall be applied to the necessary locations.
Vehicles parked in settlements may lead to narrow carriageway	Specially designed parking areas shall be executed at the required locations.
Fast moving vehicles may threat safety in settlements.	Specially designed pedestrian crossings shall be constructed at required locations.
Accidents involving hazardous materials.	The rules s defined Hazardous waste handling Act shall be compiled. Vehicles delivering hazardous substances shall be printed with appropriate signs. In case of spillage, the report to relevant departments will be made and instructions followed in taking up the contingency measures.
Other Safety Measures	Traffic Management plan shall be developed especially along congested locations. Traffic control measures including speed limits will be enforced strictly. Further growth of encroachment and squatting within row shall be discoursed.

Source: JICA Study Team

7.5 Other Issues

7.5.1 Accidents (4.1)

Construction Phase Impacts

The project will improve the road safety through design measures identified during the various road surveys. Road safety will be enhanced in the project through engineering (design), enforcement (safety measures, signage, etc.) and education. The issue of road safety is one of the key issues that may surface in construction stage. During the construction stage, dismantling of structure, cutting of trees, haulage material obstructing vision, spillage of lubricants on road making it slippery is generally the cause of road accidents. Similarly, in operation stage, increase in traffic and increase in speed would tend to increase in accidents. In spite of these, the social benefits from the project are quite significant.

It is likely that there will be some concern of safety for highway users during construction period, as haulage of material and other equipment would restrict movement of vehicles. Highway patrolling system with ambulance facility and crane will render assistance to users in distress and disabled vehicles which in-turn will improve the safety level.

Operation Phase Impacts

The proposed project implementation would improve the road safety for the highway users as well as locals living by the side of the road. In operation stage, increase in traffic and increase in speed would tend to increase in accidents. In-spite of these, the social benefits from the project are quite significant. In operation phase, increase in vehicle speed may cause thereof to the safety of pedestrians and for cattle for crossing road.

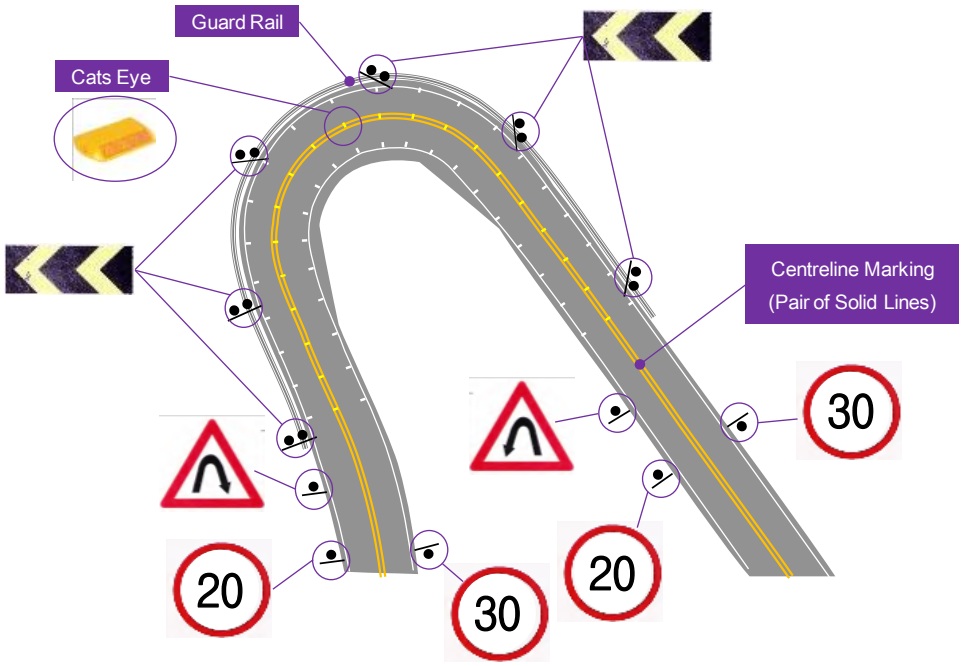
Mitigation Measures

Street furniture known as road studs, blinker or cat's eye include equipment installed on road or roadside to assist visibility of road alignment/structures. They are retro-reflective safety devices used in road marking. Generally, it consists of two pairs of reflective glass spheres set into a white rubber dome, mounted in a cast-iron housing. This is the kind that marks the center of the road, with one pair of devices showing in each direction. A single-ended form has become widely used in other colors at road margins and as lane dividers.

Since the NH54 is located in mountainous region, hair-pin bends are unavoidable from the viewpoint of cost and environmental impact. Design speed of 20km/h is applied for hair-pin bends, while design

speed of 30km/h is adopted in general. Small horizontal curves such as R20m-R25m are used in steep terrain to avoid large-scale earthwork and/or demolition of houses. At those sub-standard sections, securing traffic safety by applying combination of facilities shall be considered.

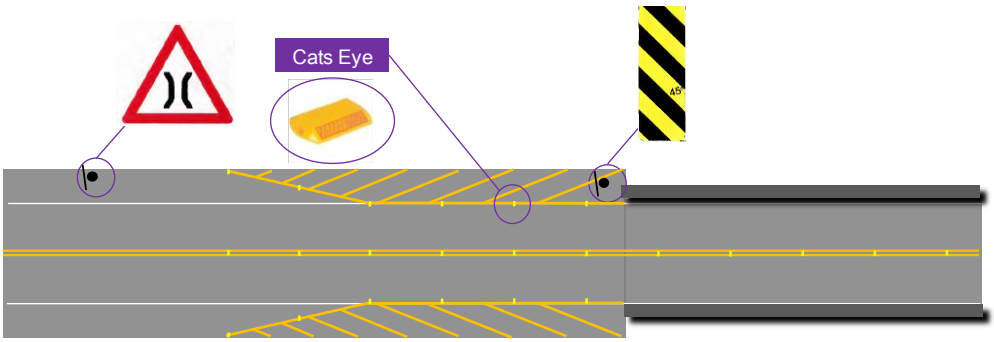
In hair-pin bends, it is difficult to secure overtaking sight distance and thus, the section shall be designated as no-overtaking section. In order to inform that to drivers, the double centre line with marking of pair of solid lines is applied. Cats eyes to delineate road alignment are to be installed on the centre line and lane edges so that drivers will be able to identify the direction he should go before entering into the curve. Furthermore, traffic signs and guard rails shall be properly equipped to avoid hazardous accidents. The Figure below shows an example of combined traffic safety facilities to be installed at hair-pin bends.



Source: JICA Study Team

Figure 7.5 Traffic Safety Facilities to be installed at Hair-Pin Bends

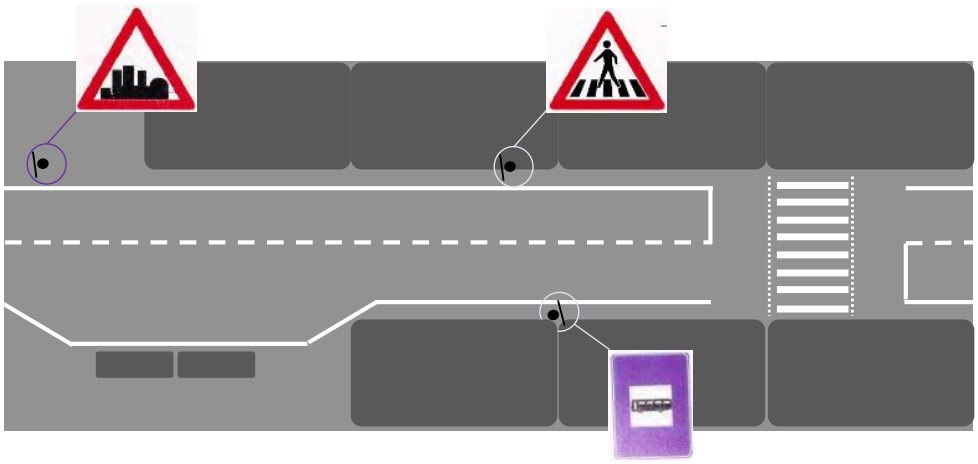
In the locations where the existing bridges are to be utilized with rehabilitation works, carriageway width becomes narrower than that of earthwork sections due to the difference in shoulder width. It is, therefore, proposed to install facilities that notify drivers the decrease in carriageway width and existence of concrete curb. The below Figure shows an example of combined traffic safety facilities to be installed at narrow bridges.



Source: JICA Study Team

Figure 7.6 Traffic Safety Facilities to be installed at Narrow Bridges

The project road passes through 48 villages and there are a lot of buildings, shops or houses at roadside as well as pedestrians going along the sidewalk and crossing the road. Furthermore, more road facilities such as bus stops are necessary than rural sections. Therefore, drivers have to handle much information on roads/traffic and decide their maneuvers in a short time at built-up areas. In order to assist road users in obtaining information, appropriate traffic signs and road markings shall be provided properly. The below Figure shows an example of combined traffic safety facilities to be installed at built-up sections.



Source: JICA Study Team

Figure 7.7 Traffic Safety Facilities to be installed at Built-up Sections

7.5.2 GHG emissions (4.2)

There is a possibility of increased GHG emission due to the operation of heavy vehicles as well as traffic jams incidental to the construction works, this impact will be temporary. On the other hand, it is expected that the GHG emission will be increase due to increase traffic volume. The increase will be mitigated by keeping good road conditions which will reduce consumption of extra fuel and

congestion, thereby mitigating GHG emissions over time.

CHAPTER 8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Overview

Descriptions of environment management measures during different stages of the project are provided in this chapter.

8.1.1 Pre-construction Stage

Required management measures during the pre-construction stage include the clearance of the ROW, plantation of trees, the measures for protecting/replacing community resources such as electric poles, public urinals and water points that are likely to be impacted. Their enhancement shall also be completed before construction work starts so that the community can start using these when the construction activity begins.

8.1.2 Construction Stage

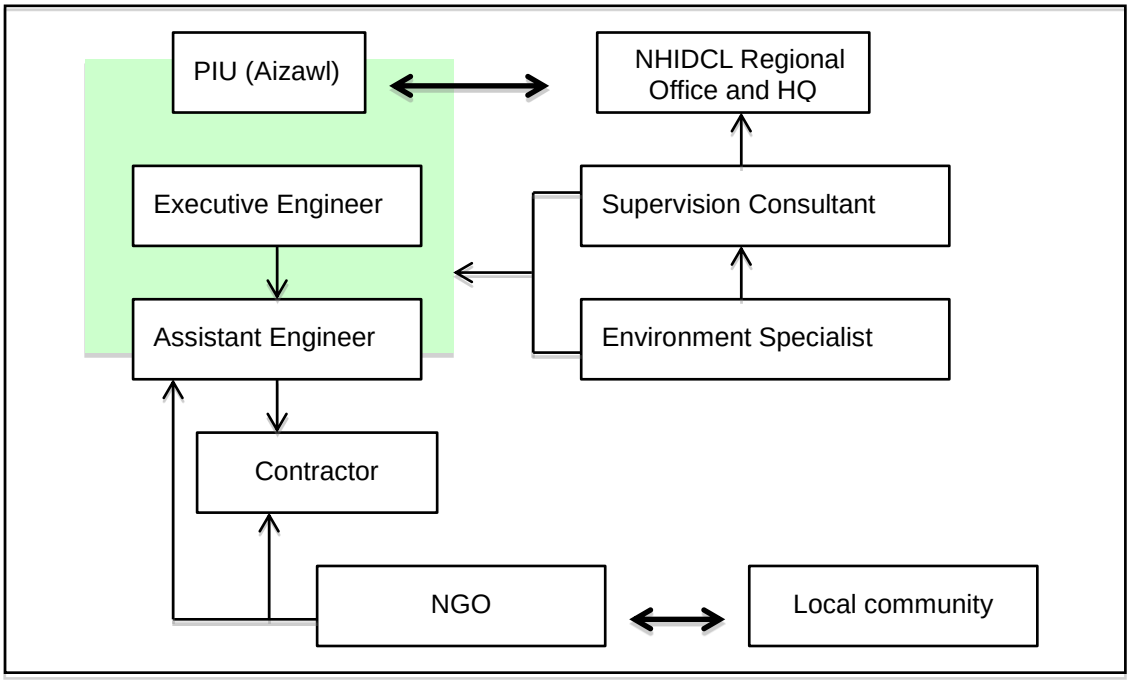
This will be most crucial and active stage for the Environmental Management Plan (EMP). In addition to the monitoring of the construction activity itself to ensure that the environment is not damaged beyond permissible limits, the enhancement of cultural and community properties, mitigation and enhancement measures for water bodies through proper treatment of spoil soils will be undertaken as the construction progresses. To facilitate implementation of the enhancement and mitigation measures suggested, working drawings of the same have been provided in the Appendices. In addition, the provision of proper risk management with respect to construction activities such as accidental spillage is critical at this stage to avoid damage to flora and fauna, agricultural land and other sensitive resources. Typical locations of concerns include the locations of hot-mix plants (spillage of fuel, bitumen etc.) and labor camp sites.

8.1.3 Operation Stage

The operation stage will essentially entail monitoring activity along the project area. In addition to checking the efficacy of the protection/ mitigation/ enhancement measures implemented, this will help verify or refuse the predictions made as a part of the impact assessment. Thus, it will complete a very important feedback loop for the project.

8.2 Environment Management Plan for Mitigation of Negative Impacts

The detailed measures adopted and/or to be adopted during different stages of the project to mitigate negative impacts and enhance positive aspects are shown in Table 9.1 to 9.3. The responsibility for implementation and supervision of EMPs are vested with three agencies, namely Contractors, PIU, and Supervision consultants (SC). The Contractors herein mean the agency hired for execution of the construction works for the respective contract packages. PIU would be implementation agency. The Figure below indicates implementation structure of the EMP.



Source: JICA Study Team

Figure 8.1 Institutional Arrangement for EMP Implementation

It has been proposed that Executive Engineer (environment) based in Aizawl will be in charge for the implementation of EIA and EMP for this project. Such an engineer will be assisted by Assistant Engineer (Environment), who will be assisted by a Junior Engineer as well as Supervision consultant (and Environment Specialist) and contractor.

The construction supervision consultant are expected to have in-house capacity to advise on and supervise the implementation of the EMP including suggesting enhancement design options and modifications, as necessary. For this purpose, the supervision consultant will employ a full-time environmental specialist.

The NGO will be one of the stakeholders in the entire project cycle with primary responsibility of facilitating the implementation of RAP and help NHIDCL/State Government in mitigating the adverse impacts of the project. Meanwhile, they can play a role in successful implementation of EMP, for example by supporting afforestation activity and awareness-raising campaign for traffic safety/risk of HIV/AIDS among others. Compensatory plantation and maintenance and protection of vegetation will be required as part of environmental mitigation and enhancement works. Likewise, spoil soils shall be used, where possible, to create community assets such as playground as per request of the community. In these types of works, the project may engage NGO such as Young Mizo Association (YMA) to liaise with local community for effective implementation of the project.

Table 8.1 Environmental Management Plan for Pre-Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P1	Relocation of Project Affected Persons (PAP)	● All requirements of the RAP as applicable shall be complete before start of construction stage. The activities broadly include acquisition of land and structures, relocation of utilities, payment of compensation and provision assistance	All areas	Before construction begins	Government of Mizoram, District Revenue authorities, Village Councils, NGO	PIU, SC
P2	Removal of vegetation	● Minimize the scale of vegetation clearing by factoring vegetation/forest cover in the final design of the road alignment process ● Removal of trees to be carried out after forest clearance is obtained ● Reforestation/replantation of trees at a term as instructed by the Forest Dept. . or by the Forest Dept. ● Activity shall be supervised to avoid poaching of animals	All areas	Before construction begins (Reforestration/replantation may extend to during/after construction)	PIU, Contractor, Forest Dept.	PIU, SC, Forest Dept.

P3	Setting up construction camps	● Camps shall be located at least 500m away from the nearest built-up area. ● Sewage system for a construction laborer's camp shall be designed, built and operated so that no pollution to ground or adjacent water bodies/ watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. ● In relation to underground water resources, the contractor shall take all necessary precaution to prevent interference with such water resources. ● All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	All construction campsite identified by the contractor and approved by SC	During Establishment, Operation and Dismantling of Such Camps.	Contractor	PIU, SC
P4	Setting up hot mix plants	● Hot mix plants and batching plants shall be located sufficiently away from habitation and agricultural operations. ● Where possible such plants will be located at least 1000m away from the nearest habitation.	All hot-mix and batching plants	During Erection, Testing, Operation and Dismantling of Such Plants.	Contractor	PIU, SC
P5	Finalizing sites for surplus soil dumping	● Location of dumping sites shall be finalized. The sites shall meet following conditions: i) dumping does not impact natural drainage courses; ii) no endangered/rare flora is impacted by such dumping	All areas identified as potential dumping sites	During mobilization	Contractor	PIU, SC
P6	Identification of hazard-prone locations	● The contractor shall identify locations sensitive to landslides (in addition to the ones that area already identified) and shall duly report these to the Supervision Consultant (SC) and to PIU.	All area	During mobilization	Contractor	PIU, SC

P7	Identify and prepare relocation sites	● Location of relocation sites shall be identified in consultation with district/village authorities and PAPs. ● Sites to be developed including provision of necessary utilities such as water and electricity.	Near villages with large-scale resettlement		PIU	PIU

Source: JICA Study Team

Table 8.2 Environmental Management Plan for Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Soil						
C1	Soil Erosion in Borrow Pits	● The depth of borrow pits shall be restricted so that sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank. (if applicable)	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C2	Loss of top soil in Borrow pits	● Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable topsoil shall be preserved and used for tree plantation. (if applicable)	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C3	Compaction of Soil	● Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil.	Throughout corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C4	Soil erosion in embankments	● Pitching shall be done for slope stabilization as per the IRC guidelines (if applicable)	At the places of embankments	Construction Stage	Contractor and Supervision Consultant	PIU
C5	Contamination of soil from fuel and lubricants	● Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be minimum. ● Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near Labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU

C6	Contamination of land from construction waste and quarry materials	● Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments. ● Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. ● Construction waste including non-bituminous and bituminous waste shall be dumped in approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.	Solid waste dump Site identified and approved by SPCB. or competent authority. Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
C7	Loss of top soil in land acquisition	● Topsoil shall be stripped, stored and shall be laid on ground for landscaping purpose. (if feasible)	Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
Water						
C8	Contamination of water by fuel/ oil spillage of vehicle	● Construction vehicles / equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage. ● Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C9	Contamination of stagnant water body by fecal matters from labor camp.	● Labor camp shall not be allowed near any of the water bodies. ● The proper sanitation facilities shall be provided.	Preapproved locations away from the water bodies.	Construction Stage	Contractor and Supervision Consultant	PIU

C10	Deposition of dust in open wells near construction site	● The mouth/opening of the well shall be covered with suitable material during any of the construction activity so as to prevent dust entering in the well.	All the wells along the project corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C11	Using drinking water for construction purpose	● The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. ● Wastage of water shall be kept minimum during construction.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C12	Hand pump close to road may get affected in widening	● All the Hand pumps shall be relocated to suitable alternate place.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C13	Wells or water stoarge system may get affected in widening	● Alternate arrangements will be made for all the Wells or water storage system.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C14	Altering flow of natural drains	● Drain shall be channelized with Slope protection - Gabion Structure.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C15	Sanitation of waste disposal in construction camps	● The construction of camps will be done with sufficient buffer from habitation. ● At construction sites and labor camps sufficient no of latrines will be provided. ● The sewage generated from the camps will be properly disposed off so that it does not affect water bodies	Wherever labor camp is located	Construction Stage	Contractor and Supervision Consultant	PIU
Air						
C16	Emission from construction vehicles and machinery.	● All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. ● Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles, equipment and machinery.	Wherever the hot mix plant and batching plant is setup.	Construction Stage	Contractor and Supervision Consultant	PIU

C17	Air pollution from various plants affecting settlements	● The asphalt plants, crushers and batching plants shall not be sited at least 500 m in leeward direction from nearest human settlement	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
C18	Air pollution may exceed the limits prescribed by Central Pollution Control Board.	● Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan.	Locations given in Environmental Monitoring Plan.	Construction Stage	Contractor and Supervision Consultant	PIU
C19	Vehicles will generate dust and suspended particles.	● The dust generated by vehicles on site shall be arrested using a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.	Wherever the plants are setup and sensitive locations as suggested in monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
Noise						
C20	Noise levels from vehicles. Asphalt plants and equipment	● The plants and equipment used for construction shall confirm to CPCB norms. ● Vehicles and equipment used shall be fitted with silencer. ● Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. ● All equipment and plants shall strictly be placed away from educational institutes and hospitals. ● Regular monitoring of noise parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan.	Wherever the plants are setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C21	Noise from blasting operations	● Blasting as per Indian Explosives act will be carried out. ● People living near such blasting operation sites shall be informed before the operational hours. ● Workers at blasting sites shall be provided with earplugs.	At the sites where the blasting is required and in quarry sites	Construction Stage	Contractor and Supervision Consultant	PIU

C22	Noise barriers	● Construction of noise barriers in the form of walls at Sensitive locations upon consultation with stakeholders..	All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located.	Construction Stage	Contractor and Supervision Consultant	PIU
Flora and Fauna						
C23	Tree cutting for widening	● Three trees shall replace each tree cut for the purpose. ● The Engineer shall approve such felling only when the NHIDCL receives a "clearance" for such felling from the MOEF, as applicable. ● Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
C24	Damage or Loss of Important Flora	● During construction, at any point of time, if a rare/ threatened/endangered flora species is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineer shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.	Throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU
Health and Hygiene						
C25	Health hazard to workers due to bad water and sanitation	● At every workplace, good and sufficient potable water (as per IS 10500) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. ● Adequate drainage, sanitation and waste disposal shall be provided at workplaces. ● Preventive Medical care shall be provided to workers.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C26	Health hazard to workers by various construction activity	● Personal protective equipment shall be provided to worker as per the Factories Act.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU

C27	Health/ social hazard, sexual harassment to female workers	● Segregation of male and female areas in labor camp shall be executed.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C28	Hygiene at Construction Camps	● The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the resident engineer. ● These shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. There shall be adequate supply of water, close to latrines and urinals. ● All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU

C28	Hygiene at Construction Camps	● On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.				
C29	Abandoned Quarry will accumulate water and act as a breading ground for disease vectors.	● Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.	All quarry locations.	Construction Stage	Contractor and Supervision Consultant	PIU
Safety						
C30	Safety of vehicles plying on road while the construction activity is going on.	● Prior arrangement/traffic diversion for safe passage of vehicles shall be made with proper direction and signage at the construction site. ● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.	Throughout the project area	Construction stage	Contractor and Supervision Consultant	PIU

C31	Risk from Operations	● The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. ● The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C32	Risk from Electrical Equipment	● Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. ● All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

C33	Risk at Hazardous Activity	● All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. ● The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day's notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product. This should comply with Hazardous Material Act.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C34	Risk of Lead Pollution	● Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. ● Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

C35	Risk caused by Force' Majure	● All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU
C36	Risk from Explosives	● Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable. ● The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. ● The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.	Place of use of Explosives	Construction stage	Contractor and Supervision Consultant	PIU
C37	Malarial risk	● The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him	All construction sites, particularly beyond Lunglei district	Construction stage	Contractor and Supervision Consultant	PIU

C38	First Aid	● At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided.	At the construction site /labor camp	Construction stage	Contractor	PIU
Disruption to Users						
C39	Loss of Access	● At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. ● The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.	Throughout the project area, particularly in built-up areas	During Construction.	Contractor	Engineer

C40	Traffic Jams and Congestion	● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. ● Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. While approving temporary diversion construction, the Engineer will seek endorsement from the PIU. ● Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. ● The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. ● The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.	Throughout Corridor	During Construction.	Contractor	Engineer

C41	Traffic Control and Safety	● The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. ● All signs, barricades, pavement markings shall be as per the MORTH specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer as per EMP. Excavated pits shall be filled to avoid falling of animals/ human beings.	Throughout the project area	During Construction.	Contractor	Engineer
Environment Enhancement						
C42	Hand pumps enhancement/relocation for ground water recharging	● Hand pumps within Right of Way shall be enhanced/relocated.	At the respective locations along the corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C43	Roadside landscape development	● Avenue plantation of foliage trees mixed with flowering trees, shrubs and aromatic plants shall be carried out where ever land is available between ditches and Right of Way.	Throughout the corridor	Construction Stage	Contractor and Supervision Consultant	PIU
C44	Providing better bus bays	● Bus shelters shall be provided at given locations	As per traffic plan	Construction Stage	Contractor and Supervision Consultant	PIU
C45	Better sitting arrangements where small space is available	● Designed sitting arrangements shall be provided.	As per the design	Construction Stage	Contractor and Supervision Consultant	PIU
C46	Landscaping of junctions	● All rotary junctions shall be landscaped suitably	As per landscape design at the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C47	Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	● The abandoned quarry locations shall be planted suitably as the plan	Wherever quarries are located and abandoned	Construction Stage	Contractor and Supervision Consultant	PIU

C48	Erosion of embankments, shoulders, side slopes, and pavement leading to deterioration and affecting stability and integrity of road	● Earth works specifications will include provision for stable slope construction, compacting and laying out turf including watering until ground cover is fully established ● Proper construction of Breast wall and retaining wall at the locations identified by the design team to avoid soil erosion ● The measures proposed for slope stabilization are: Discharge zones of drainage structures (culverts and minor bridges) provided with riprap ● Construction in erosion and flood prone areas will not be in monsoon /season. ● Side slopes will be kept flatter wherever possible, and in case of steeper slopes it will be supported by the retaining wall.	At the respective locations throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU

Source: JICA Study Team

Table 8.3 Environmental Management Plan for Operation Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
O1	Water quality degradation due to road-run-off	● Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off ● Monitoring shall be carried out as specified in the monitoring plan	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O2	Soil and water contamination from accidental spills	● Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals ● Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level by early operation stage	PIU, SPCB, Local Government Bodies	PIU

O3	Air quality degradation due to increases in traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
Q4	Increases in noise and vibration due to greater traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Install noise barrier (wall etc.) in sensitive areas, if necessary	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O5	Traffic safety	● Traffic control measures including speed limits to be enforced strictly. ● Local government bodies and development authorities will be encouraged to control building development along the highway.	All area	Throughout operation stage	PIU, Local Government Bodies	PIU
O6	Accidents involving hazardous materials	● Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including: ✓ For delivery of hazardous substances, permit license, driving license and guidance license will be required. ✓ These vehicles will only be harbored at designated parking lots. ✓ In case of spill of hazardous materials, the relevant departments will be notified at once to deal with it with the spill contingency plan.	All area	Manual/guideline to be prepared during early operation stage	PIU	PIU
O7	Roadside tree plantation, flora and fauna	● Trees planted along the corridor shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence every year for 3 years and all necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU

Source: JICA Study Team

Based on the above, the cost for implementation of EMP is estimated as below.

Table 8.4 Budget for EMP Implementation

Item	Detail	Unit	Unit	Quantity	Total (Rs)
I. Monitoring					
Air	Monitoring near hot mix plant locations approved by the Engineer as per NAAQS ,2009 CPCB	No.	5,000	80	400,000
Water	At locations specified in the monitoring plan as per IS 10,500 & IS 2296	No.	5,000	60	300,000
Noise	At equipment yards as directed by Engineer as per CPCB guideline 1989	No.	2,000	80	160,000
Flora and Fauna	Monitoring of impact on biodiversity	No.	50,000	24	1,200,000
Sub-Total (I)					2,060,000
II. Afforestation	Compensatory afforestation, in accordance with Forest Conservation Act (1980) as per guideline provided in EMP	No.	200	50,000	10,000,000
Sub-Total (II)					10,000,000
III. Institutional Cost					
Expert fees	Lump sum				6,000,000
Staff training	Lump sum				1,500,000
Ext. monitoring	Lump sum				2,000,000
Information disclosure	Lump sum				500,000
Sub-Total (III)					10,000,000
Sub-Total (I+II+III)					22,060,000
Contingency (10%)					2,206,000
Total					**24,226,000**

Source: JICA Study Team

8.3 Environment Monitoring Plan

To ensure effective implementation of the EMP, it is essential that an effective monitoring plan be designed and carried out. The environmental monitoring plan provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect. The monitoring includes: i) Visual observations; ii) Selection of environmental parameters at specific locations; and iii) Sampling and regular testing of these parameters.

Monitoring methodology covers the following key aspects: Components to be monitored; parameters for monitoring of the above components; monitoring frequency; monitoring standards; responsibilities for monitoring; direct responsibility, overall responsibility; and monitoring costs. Environmental monitoring of the parameters involved and the threshold limits specified are discussed below.

Ambient air quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM 2.5, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulphur Dioxide (SO_2) and Lead (Pb). These will be monitored at designated locations starting from the commencement of construction activity. Data should be generated at all identified locations in accordance to the National Ambient Air Quality Standards, 2009. The location, duration and the pollution parameters will be monitored and the responsible institutional arrangements are detailed out in the Monitoring Plan.

Water quality

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc and cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at all identified locations in accordance to the Indian Standard Drinking Water Specification – IS 10500: 1991.

Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized in the Table 8.4. Draft Monitoring Form for each parameter to be monitored in different stages of the project is included in Appendix B.

Table 8.5 Environmental Monitoring Plan

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M1	Air	Construction	SPM, RSMP, SO_2, NOx, CO, HC	• Dust sampler to be located 50m from the plan in the downwind direction. • Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M2		Construction	SPM, RSPM	• Dust sampler to be located 50m from the earthworks site downwind direction. Follow CPCD method for analysis	Air (P&CP) Rules, CPCB, 1994	Stretch of road where construction is underway	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M3		Operation	SPM, RSMP, SO_2, NOx, CO, HC	• Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling location specified in EIA report	Twice a year for one year	Continuous 24 hours	PIU	PIU
M4	Water	Construction	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Sample collected from source and analyze as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for three years		Contractor through approved monitoring agency	PIU
M5		Operation	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Grab sample collected • from source and analyze as per Standard Methods for Examination of Water • and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for one year		PIU	PIU
M6		Operation	Cleaning of drains and water bodies	• Choked drains, water bodies undergoing siltation and subject to debris disposal should be monitored under cleaning operations	To the satisfaction of the engineer (PWD)	All area	Post-monsoon		PIU	PIU

M7	Noise and vibration	Construction	Noise levels on dB (A) scale	• Free field at 1m from the equipment whose noise levels are being determined	Noise standards by CPCB	At equipment yard	Once every 3 Month (max) for three years, as required by the engineer	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	PIU
M8		Operation	Noise levels on dB (A) scale	• Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement	Noise standards by CPCB	At maximum 15 sites inc. those listed in EIA report for noise monitoring locations	Twice a year for 1 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	PIU	PIU
M9	Soil erosion	Construction	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall	Pre-monsoon and post-monsoon for three years		Contractor	PIU
M10		Operation	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	As directed by the engineer	Pre-monsoon and post-monsoon for one year		PIU	PIU
M11	Construction camp	Construction	Monitoring of: 1.Storage Area; 2. Drainage Arrangement 3. Sanitation in Camps	• Visual Observations and as directed by the engineer	To the satisfaction of the engineer and Water quality standards	At storage area and construction workers' camp	Quarterly during construction stage		PIU	PIU

M12	Afforestation	Construction and operation	Plant survival	• The success of tree planting. Monitor the rate of survival after six months, one year and 18 months in relation to total numbers of trees planted		All area	Minimum three years after planting		NGO, PIU	PIU
M13	Flora and Fauna	Construction and Operation	Condition of ecosystem	• Comparison to pre-project flora and fauna	As specified in TOR	As specified in TOR	Twice a year for three years		PIU	PIU

Source: JICA Study Team

CHAPTER 9 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

Stakeholder consultation is an important method of involving various stakeholders particularly, local community with reference to the proposed development initiatives. Consultations provide a platform to participants to express their views, concerns and apprehensions that might affect them positively or negatively. This process is of particular importance for this project given the high ST share among the affected population. The World Bank OP 4.10 on Indigenous Peoples emphasizes "a process of free, prior, and informed consultation with the affected Indigenous People's communities at each stage of the project, and particularly during project preparation, to fully identify their views and ascertain their broad community support for the project. Stakeholder Through participation and consultation stakeholders influence development initiatives, and decision-making process. The effectiveness of participation and consultation is directly related to the degree of involvement by the likely project affected persons and the local community and integration of outcome of consultations wherever feasible in the proposed development initiatives.

The purpose of consultations was to inform people about the project, take note of their issues, concerns and preferences, and allow them to make meaningful choices. It ensured participation of potential project affected persons (PAPs), local community and other stakeholders. People in general were informed in advance, and allowed to participate in free and fair manner. Consultations provided meaningful contributions with regard to reducing adverse impacts, address safety issues, etc. Concerns, views and suggestions expressed by the participants during these consultations were integrated into the design aspects wherever feasible. The following sections present details of the consultations.

9.1 1st Round Consultations with Communities

The first round of district level meetings was held in all the 5 districts. It witnessed participation from project affected persons, representatives from district level line departments, elected representatives, civil society, local NGOs and other opinion leaders. These consultations/meetings were used as the platform for dissemination and disclosure of key information about the project, key components, alignment, affected villages, applicable laws and policies related to environmental and social considerations etc. It also sought to capture participants' perception about project, concerns and suggestions with respect to proposed alignment and existing policies and practices for management of environmental issues. The type and number of participants to each meeting is shown below.

Table 9.1 Participation Details of 1st Round of Consultation

District	Date	Total No. of Participants			Representation (No.) from					
		Total	M	F	Govt. Dept.	Village Council	NGO	MCHP*	District Taxi Union	Affected HHs
Aizawl	14-May-15	25	22	3	4	3	3	3	1	11
Serchhip	08-May-15	90	75	15	6	12	14	8	2	48
Lunglei	05-May-15	144	110	34	7	25	22	19	2	69
Lawngtlai	16-Apr-15	46	40	6	2	11	10	6	1	16
Saiha	13-Apr-15	58	42	16	3	8	7	12	1	27

Note: * Mizo Hmeichhe Inswikhawm Pawl (MHIP) is the women groups present across Mizoram.
Source: JICA Study Team

The summary of discussion outcomes from district level stakeholder consultation/meetings is presented in the section following. The list of participants of these meeting are attached in Appendix C.

Table 9.2 Summary of 1st Round Consultations

Districts	Key Outcomes/Concerns/Suggestions from Meeting
Aizawl	*General: About Project, alignment, components and its significance* • Participants, specifically line department officials present in the meeting underscored the significance of the project and advantages that will come with widening and improvement of existing highway. • A public representative suggested that the road widening should not be uniform across the entire length, and it should also consider the habitation pattern and its density and designed accordingly. • A public VC representative from Tlangnuam, extended support of the community, despite this affecting the several houses, if it was for the benefit of the society and the state. • Another representative from Tuirial, opined that the state will any way be providing compensation for losses, so it is better that the residents prepare themselves for impacts, positive or negative. The sentiment found echo from the representatives from Tlangnuam who believed that community should also join in with their support for the project if it desires for development. *Project Concerns and Issues: Environment and Ecology* • While recognizing the benefits linked with the project and likely impacts on environment, the forest department official in the meeting hoped the project proponents will ensure minimal damage to the forest vegetation and the environment over all. • The environmental impacts need to be considered in every aspect. Proper dumping areas should be allocated for debris created because of the project. • Participants while recognizing that some deforestation will essentially be done because of the project, suggested that to offset the damage, afforestation will also need to be considered. Endangered species, if any, should be protected during project execution. • Further, natural stream and springs should not be affected by the soil debris created by the project or cutting of hills etc. *Others*

	• A representative from local drivers' union suggested that there should be coordination committee set up for the execution of the project that will also keep away greedy and opportunistic elements away from siphoning of the benefits of the project. The union will be in full support of the project. • Recognizing the benefits of the project, participants highlighted the need for awareness campaign as part of community mobilization and preparedness for the project, to make them aware about the project and its benefits. This would require rounds of public meetings and consultations, and also a sound compensation award system. In summary, the project finds a positive response from the people with broad suggestions being around engaging with local affected community, their representatives, compensation at market value, and efforts to minimize environmental impact. The affected otherwise are willing to cooperate and support the infrastructure development project.
Serchhip	*General: About Project, alignment, components and its significance* • Public representatives in general appreciated the project and significance it will have in people's life. Similar sentiments were made by other participants and specifically in the context of Serchhip town, for which they wanted it to be diverted away from the main town area. *Project Concerns and Issues: Environment and Ecology* • In relation to environmental concerns, some of the participants from New Serchhip wanted the project to secure their water source 'Tuikum' from any damage. • Participants also linked risks of landslides and soil erosion that will not only affect the safety and serviceability condition of roads but also have chain effects on the farmers (loss of crops or farmland), land (degradation due to silt/debris deposition), water (degradation of quality), vegetation (loss and impact) and on other infrastructures like reservoirs (silting). The project keeps these issues in consideration in its design and execution. *Others* • Participants in general suggested for public meeting in village to know about their opinion, concerns and suggestions related to alignment. They also wanted the alignment to minimize blind curves by construction of bridges or cutting. However, as the bottom line they also want minimal damage to environment and the ecology in their villages. In summary, the project is expected to find support among the people. Suggestions include the need to have public meeting in each village, need for fair compensation policy and practice and ensuring minimal damage to environment.
Lunglei	*General: About Project, alignment, components and its significance* • Representatives from YMA while sharing their opinion recognized the importance of the project but at the same shared their belief that the project is being executed as part country's strategic defense policy. *Project Concerns and Issues: Environment and Ecology* • Representatives from agriculture and forest department shared that the project will have very limited direct impact on the two sectors. However, there are few forest plantations proposed along the corridor which can be sorted out between the respective departments. • Suggestions were made regarding dumping of soil debris which should be done in some safe place, and not in the downside or valley side of the road which can destroy the vegetation. Forests need to preserved and protected as much as possible with least or minimal clearing of the vegetation. • On the contrary, some of the participants (from Rawpui) expressed their fear of huge deforestation that will caused because of the project and queried how does the state propose to address this issue should made known. Another participant from Thiltlang

	feared that the shifted house and land will be under constant threat of land slide, and that how will the government deal with such issues. • Suggestions were also made on improving internal link roads in the district. *Others* • Forest department representative also highlighted that the road construction needs to be of good quality and should use stone chips brought from other states as the soil and the rock type in the state is very soft in texture and strength and not suitable for construction. He cited the example one such road constructed by Tantia group in the recent past. He further suggested that adding asphalt to construction materials would add to the strength and life of the road constructed. • An ex MLA expressed his apprehension emanating from corruption that may hit the quality aspects of the project though the project in itself is about the good of people. Similar sentiments were expressed by some other participants as well, mainly identifying state administration for this practice. Participants were visibly unhappy about the road condition in the state especially when compared with the road quality in some of other Indian states. Meeting discussion suggested for over all approval and appreciation for the project. However, corruption and compensation were two major discussion points. Further, concerns around landslide, dumping of excavated soil etc too were raised by the participants. Width of road was another item discussed in the meeting and suggestions made on the necessity of widening it by 12 m unifomally across the length of the road.
Lawngtalai	*General: About Project, alignment, components and its significance* • Participants in general shared positive opinion during the discussion. They nonetheless had some concerns about compensation and environmental and health hazard (mentioned below). *Project Concerns and Issues: Environment and Ecology* • Putting caution, participants narrated that during MMTP project, the sand/soil debris were dumped in just downside the road. Such practices are hazardous for the environment, vegetation, flora & fauna. It was requested that these aspects should be kept in mind during implementation of this project. • Participants also requested for more attention to be given towards afforestation & ensuring minimal project related disturbance for the ecological balance in the area. • The project found support among most of the participants, however, few of them had concerns on the issue environmental hazards that the project may bring in. Improper sanitation of workers in camp or local inhabitants may also pollute water, particularly drinking water sources. Participants suggested that the construction camp, if needed, should be provided with appropriate waste disposal and sanitation facilities in order to avoid such pollution. • Another village representative shared that households displaced will be forced to relocate on a newly developed site and such locations will invariably be more prone to landslide. Such changes and growth in settlement areas will add to the events of landslides. • Another worry expressed was related to creation of burrow pits, shallow pits and quarries because of road construction activities. These will become breeding sites for vector borne diseases. Similarly, there will be threat of HIV/AIDS from migrant construction workers from outside. Participants broadly have positive view about the project and its significance. They however have bad experiences regarding compensation award process from similar projects in the past. This was the major discussion point during the meeting.
Saiha	*General: About Project, alignment, components and its significance* • Meeting proceedings began with some of the public representatives exhorting all present to extend support to the project. Almost all participants expressed their opinion in support of the project, particularly in view of the poor condition of the existing road.

	Project Concerns and Issues: Environment and Ecology • Some of the participants had concerns about the land slide and soil erosion that might occur in the area because of construction activities. Overall, the participants had very positive opinion about the project, particularly in view of the bad condition of the existing road.

Source: JICA Study Team

	
Stakeholder Meeting in Aizwal	**Stakeholder Meeting in Serchip**
	
Stakeholder Meeting in Lunglei	**Stakeholder Meeting in Lawngtlai**

Photo 9.1 Selected Picture of 1st Round Consultation

9.2 2nd Round Consultations with Communities

The second round of district level meetings was held in all the 5 districts. Reflecting the number of villages in Lunglei district, two meetings were held in Lunglei this time. The type and number of participants to each meeting is shown below.

Table 9.3 Participation Details of 2nd Round of Consultation

District	Date	Total No. of Participants			Representation (No.) from					
		Total	M	F	Govt. Dept.	Village Council	NGO	MCHP*	District Taxi Union	Affected HHs
Aizawl	26-Aug-15	37	34	3	2	13	9	6	2	15
Serchhip	24-Aug-15	85	60	25	3	26	22	14	1	32
Lunglei	13-Aug-15	78	55	23	4	28	19	10	2	34
	17-Aug-15	90	64	26	1	31	28	22	1	38
Lawngtlai	16-Aug-15	56	40	16	2	18	18	8	2	18
Saiha	20-Aug-15	52	39	13	3	19	14	6	1	16

Note: * Mizo Hmeichhe Inswikhawm Pawl (MHIP) is the women groups present across Mizoram.
Source: JICA Study Team

GOVERNMENT OF INDIA

MINISTRY OF ROAD TRANSPORTATION AND HIGHWAYS
NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION

GOVERNMENT OF INDIA

PREPARATORY STUDY FOR NORTH EAST CONNECTIVITY IMPROVEMENT PROJECT IN INDIA

WIDENING AND IMPROVEMENT OF NH51 (TURA-DALU)

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

NOVEMBER 2015
JAPAN INTERNATIONAL
COOPERATION AGENCY (JICA)

NIPPON KOEI CO.,LTD.
NIPPON KOEI INDIA PVD. LTD.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendix

ABBREVIATIONS

BRDB	Border Roads Development Board
BRO	Border Roads Organization
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DOEF	Departments of Environment and Forests
DOF	Department of Forest
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GHG	Green House Gas
GOI	Government of India
IRC	Indian Road Congress
MLCU	Martin Luther Christian University
MOEF	Ministry of Environment & Forest
MORTH	Ministry of Road Transport & Highways
MSPCB	Mizoram State Pollution Control Board
NHAI	National Highway Authority of India
NHIDCL	National Highways and Infrastructure Development Corporation
NOC	No-objection Certificates
PAPs	Project Affected Persons
PIU	Project Implementation Unit
PUC	Pollution under Control Certificate

PWD	Public Works Department
RAP	Resettlement Action Plan
RO	Regional Offices
ROB	Road over Bridge
ROW	Right of Way
SC	Supervision consultants
SPCBs	State Pollution Control Boards

EXECUTIVE SUMMARY

The Government of India has requested the Government of Japan to provide financing for about 1,200 km of roads that enhance connectivity in North-East States. Out of 10 candidate roads and bridges, Tura-Dalu section of NH51 in West Garo Hills District in Meghalaya has been selected as one of the two priority projects (the other is Aizawl-Tuipang section of NH54 in Mizoram).

The project objective is to improve intra-state connectivity for North East States and regional road connectivity for Meghalaya and North East India to Bangladesh. The residents of the North East Region, Bangladesh and Myanmar and countries beyond should benefit from the increased regional connectivity which is expected to result in increased trade and economic development over the longer term.

The existing road is about 54 km in length, and consists of two separate sections between KP85-95 and KP101-145 of NH51. This is to avoid large scale disturbance to Tura town for which a separate bypass is being considered. The project road lies within the administrative boundary of West Garo Hills District of Meghalaya. From Tura, the road provides connectivity to international boarder with Bangladesh. The current condition of road, however, is poor and the road is prone to road subsidence and slope failures. The riding quality is poor, making travelling arduous and difficult, particularly in monsoon season.

The significant environmental impacts attributable to the widening and improvement of the road pertains to clearance of roadside trees for widening and forest clearance for spoil bank sites, temporary deterioration of ambient air quality and nose/vibration levels during construction phase from land clearing, ground shaping, and quarry and camp operations; and community and occupational health and safety. These impacts will be mitigated through compensatory afforestation; timing of construction activities to minimize fauna disturbance; control of noise, dust, wastewater, fuel combustion emissions, and construction debris generation through good construction practices; and implementation of road safety measures to separate road users from active construction fronts.

The assessment of the potential impact revealed that the project will not affect critical habitats or sensitive ecosystem as a road already exists and no new road construction is taking place inside pristine or government reserved forests. The project area is largely made up of agricultural fields and settlements.

During operation stage, the main impacts are increase in mobile emissions, road safety to motorist and pedestrian. Road safety measures will be implemented as per IRC guidelines. Road safety apputenances like information, regulatory and warning signs coupled with crash barriers will reduce

serious injuries to road users. Adequate slope protection and retaining wall as well as cross drains and side drains will be installed and maintenance will be implemented to avoid soil erosion and reduce the risk of landslide.

Several consultations were organized during the project preparation to engage major stakeholder representatives to incorporate their concerns in the overall design. These involved officials of PWD, District Officials, Forest department officials, likely affected persons and village heads (Nokma) in the project area. Most of the people interviewed strongly support the project.

The NHIDCL, through its Project Implementing Unit (PIU), is the Executive Agency of the Project. It will ensure the effective implementation of the environmental management plan. There is a need for the PIU to organize its environmental unit to provide close support to the Project Director to ensure the contractors maintain environmental compliance. This EIA report is based on the preliminary design of NH51 widening and improvement, and as such, its contents will need to be updated once the final ROW drawing is established.

CHAPTER 10 INTRODUCTION

10.1 Background

India has achieved remarkable economic growth in the past decades. Rapid development of in transport infrastructures strengthened the linkage between major cities and thus contributed to the economic growth. In particular, road is one of most important modes of transportation given that road transportation constitutes 85% of passenger and 60% of freight transport in India. However, development of transport infrastructure is lagging in mountainous regions of India due to financial and technical reasons, leading to greater economic disparity between mountainous regions and plain areas of the country which have been fully benefited from improved transport network.

Only 28.5% (63.4% is average in whole country) of the road in North-East states is paved and only 53% of national highway has more than 2-lane road. This is because the North-East states are located far from mainland of India and access road to neighboring countries are underdeveloped due to security concern. Severe natural conditions such as steep mountainous geography (most of the state is located in hilly area) and heavy rainfall (Mawsynram in East Khasi Hills district of Meghalaya is known to be the wettest place on Earth with an average annual rainfall of 11,872 mm) also complicates the challenge. To accelerate economic growth in this part of the country, therefore, improvement in the road network is of great importance. To this end, Government of India (GOI) launched "Special Accelerated Road Development Program for North-East" committed in "Twelfth Five Years Plan (from April, 2012 to March, 2017)" to cope with above mentioned problems by improvement of national highways that connect major cities within the North-East states, and requested Government of Japan to provide loan assistance in carrying out the improvement. Tura-Dalu section of NH51 located in West Garo Hills District of Meghalaya States has been selected among a total of 10 candidate roads and bridges during the screening process as part of the preparatory study.

10.2 Project Location

The study road of NH51 starts from Tura to Dalu in Meghalaya state with the total length of approximately 54km. The study road passes mostly on rolling terrain, and alignment of the study road consists of combination of medium horizontal and vertical curves as shown in Figure 1.1 and 1.2 below. The number of existing lane is one for the entire section. Pavement condition is rather deteriorated in the whole section due to inadequate road maintenance. The project aims to improve the road network by widening and improvement of the targeted section of NH51 and thereby contributing to the accelerated economic growth and poverty reduction in the region.

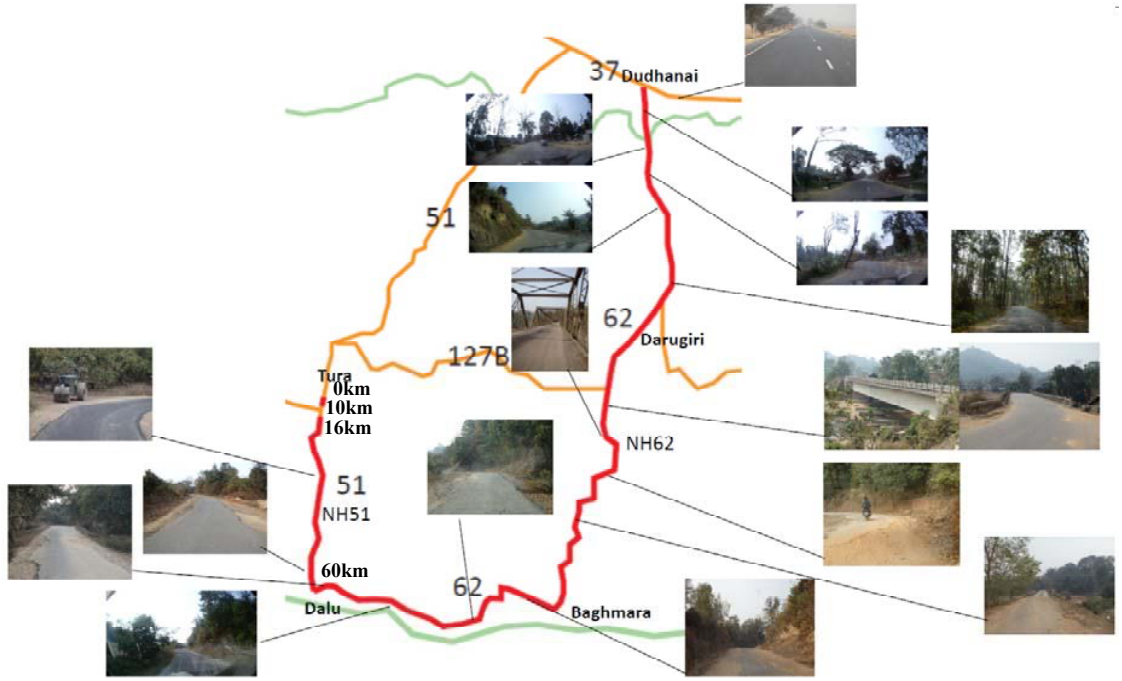


Figure 10.1 Road Alignment and Present Condition of NH51

Figure 10.2 NH51 Existing Road Profile

10.3 Requirement and Objective of EIA Report

As per MOEF EIA Notification dated 14.09.2006 (as amended in August 2013), any highway project falls under Category A if the project entails *i) New National Highways; and ii) Expansion of National*

Highways greater than 100km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignments and bypasses. The proposed expansion & widening of NH51 does not involve additional land acquisition beyond 40m and thus does not fall under Category A, as defined in EIA Notification. While preliminary environmental assessment was undertaken by DPR consultant during the preparation of the NH51 DPR, the project does not require environmental clearance from MOEF[4].

On the other hand, the project has been classified as Category A as per JICA's Environmental and Social Guidelines, for which a full EIA study is required. Based on this backdrop, a new EIA study has been carried out which builds on previous studies while taking into account additional requirements as per JICA's guidelines. The Environmental Checklist for road projects is attached in Annex X. The EIA aims to:

- Review environmental assessment undertaken as part of DPR study and identify gaps to satisfy requirements under JICA Guidelines for Environmental and Social Considerations
- Study baseline conditions (physical, social and environmental) along the targeted section and influence area of NH51
- Carry out environmental analysis with respect to proposed project vis-à-vis existing condition; identify environmental impacts that may be expected to occur during design, construction and operation; and identify environmental issue/challenges that require further studies
- Carry out alternative analysis including comparison with "no project' scenario
- Assess environmental impacts of the proposed project components on natural, physical and socio-economic environments
- Develop cost effective and implementable measures for mitigating adverse environmental and social impacts and enhancing positive aspects
- Develop a practical and implementable Environmental Management Plan (EMP) for mitigation of impacts and monitoring of implementation of mitigation measures during design, construction and operation stages
- Consult and inform the project affected people (PAP) and other stakeholders, and ensure their active participation

10.4 Structure of EIA Report

The report is organized as follows:

[4] The project requires NOC (Consent-for-Establishment and Consent-for-Operation) from the respective State Pollution Control Board, which will be discussed in more detail Chapter 3.

- Chapter 2 gives key features of the project such as standards and proposed design features
- Chapter 3 discusses the Environmental legislation and policy within which the project is to be implemented. The chapter presents the clearance requirements at various levels.
- Chapter 4 describes the Environmental and Social baseline along the project area.
- Chapter 5 discusses the Alternatives considered during the project design.
- Chapter 6 gives an overview of environmental and social components that are likely to be affected during different stages of the project (Scoping)
- Chapter 7 identifies and assesses potential environmental impacts and proposes mitigation measures
- Chapter 8 discusses Environmental Management Plan and its implementation arrangement
- Chapter 9 gives an overview of the community consultation carried out during the project preparation stage

CHAPTER 11 DESCRIPTION OF PROJECT

11.1 Preparatory Study For North East Connectivity Improvement Project in India

Only 28.5% (63.4% is average in whole country) of the road in North-East states is paved and only 53% of national highway has more than 2-lane road. Poor infrastructure has been the bottleneck of the economic development of North East States. To address this challenge, the Government of India requested Government of Japan to provide loan assistance in carrying out the improvement of existing roads in eight sections, repairing of two existing bridges and construction of one new bridge within six states of North East state in India. The Preparatory Study has been carried out in response to this request with two key objectives, which are: i) to screen project and identify priority project(s) and ii) to review existing feasibility study (Detailed Project Report) prepared by Indian consultant and propose preliminary design of priority projects. Tura-Dalu section, stretching for about 54km, has been selected as one of the priority section and thus the preliminary design is proposed for its widening and improvement.

11.2 Widening and Improvement of NH51 (Tura-Dalu)

Existing condition of the targeted section of NH51 is shown in Table 2.1. The project involves the widening of existing one-lane road to two-lane roads with installment of proper slope protection and land slide prevention measures, drainage and traffic safety facilities. The total width of the road including carriageway and road shoulder will be 12m.

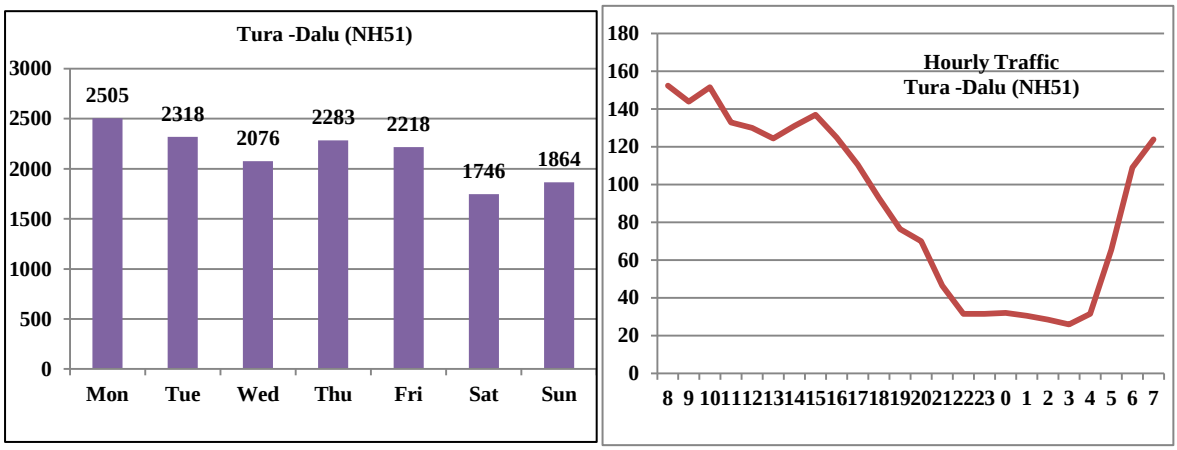
Table 11.1 Present Conditions and Provisional Improvement Cost of NH51

No.	Data Items	Type / Unit	Road	
			NH51 (Upper: KM distance from Tura, Lower: KP)	
			0-10	16-60
			85-95	101-145
1	Number of Lanes	Four (4): Carriageway Width (7m+7m), Double (2): Carriageway Width (7m/10m), Intermediate (1.5): Carriageway Width (5m/5.5m), Single (1): Carriageway Width (3.5m/3.75m) New (0)	1	1
2	Carriageway Width	m	3.75	3.75
3	Shoulder Width	Average in section / m	1	1
4	Shoulder Type	Paved or Unpaved	Unpaved	Unpaved
5	Average Altitude	m	258	110
6	Average Roughness	IRI	5.2	6.5
7	Total Area of Crack	%	25	32
8	Ravelled Area	%	1.5	2
9	No. of Pot Holes	per km	30	24
10	Edge Break Area	m2/km	162	162

No.	Data Items	Type / Unit		Road	
				NH51 (Upper: KM distance from Tura, Lower: KP)	
				0-10	16-60
				85-95	101-145
11	Road Side Friction	%		40	27
12	Average Travel Speed	km/h		21	36
13	Road Capacity	PCU – IRC73-1980		1,000	1,000
14	Improvement Project Cost (W=12m: Carriageway 3.5mx2+ Shoulder 2.5mx2)	Mountainous (INR crore/km)	9	0	0
		Rolling (INR crore/km)	5.5	55	242
		Level (INR crore/km)	4	0	0
		Long Bridge (INR crore/km)	120	0	0
		Total (INR crore)		55	242

Source: JICA Study Team

The current traffic volume of NH51 is shown below.



Source: JICA Study Team

Figure 11.1 Daily (L) and Hourly (R) Variation of Traffic Volume of NH51

Traffic projections for the project road has been made based on the estimated growth rates derived from the trend of the number of vehicle registration and economic indicators in the area. As shown in Table 2.2 below, 2-laning of NH51 is necessary to cater for future increase in the traffic volume.

Table 11.2 Projected Traffic Volume in NH51 till 2035

Road ID	Road/Section & Terrain	Unit	2020	2025	2030	2035
RD-3.1	Km 0 -Km 10, Rolling	Veh.	2524	4435	7653	11123
		PCU	2498	3999	6328	8996
		No. of Lanes	2	2	2	2
RD-3.2	Km16 -Km 60 , Rolling	Veh.	5001	8420	14135	20251
		PCU	5482	8489	12997	18176

Road ID	Road/Section & Terrain	Unit	2020	2025	2030	2035
		No. of Lanes	2	2	2	2

Source: JICA Study Team

Key components of widening and improvement are summarized below.

11.2.1 Earth work, slope protection and land slide prevention

Locations of land slide and road deformation as identified during the inventory survey is shown below.

Table 11.3 Recommendation of NH51 Widening Side

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
NH-51	01	221	93	+	400	~	93	+	420	SF	x				L	V	Soil retaining wall
	02	014	4	+	480	~	4	+	540	SF	x				R	V	Soil retaining wall
	03	015	4	+	540	~	4	+	580	SF					R	V	Soil retaining wall
	04	030	10	+	181	~	10	+	219	SF	x		x	x	L	H	Earth removal
	05	046	15	+	440	~	15	+	480	SF	x	x			-	-	Subsurface drainage
	06	055	18	+	520	~	18	+	560	SB		x			-	-	Subsurface drainage
	07	057	19	+	430	~	19	+	470	SB		x			-	-	Subsurface drainage
	08	058	19	+	700	~	19	+	720	SB		x			-	-	Subsurface drainage
	09	059	20	+	000	~	20	+	020	SB		x			-	-	Subsurface drainage
	10	060	20	+	240	~	20	+	280	SB		x			-	-	Subsurface drainage
	11	060	20	+	480	~	20	+	520	SB		x			-	-	Subsurface drainage
	12	061	20	+	640	~	20	+	660	SB		x			-	-	Subsurface drainage
	13	061	20	+	850	~	20	+	870	MM		x	x		R	V	Road realignment
	14	062	21	+	020	~	21	+	060	SB		x			-	-	Subsurface drainage
	15	062	21	+	200	~	21	+	250	SB		x			-	-	Subsurface drainage
	16	063	21	+	360	~	21	+	600	SB		x			-	-	Subsurface drainage
	17	064	21	+	660	~	21	+	720	SB		x			-	-	Subsurface drainage
	18	069	23	+	700	~	23	+	780	SB		x			-	-	Subsurface drainage
	19	070	23	+	940	~	24	+	010	MM-p		x			R	H	- No need
	20	070	24	+	120	~	24	+	220	SB		x			-	-	Subsurface drainage
	21	071	24	+	420	~	24	+	480	SB		x			-	-	Subsurface drainage
	22	074	25	+	680	~	25	+	700	MM		x			L	V	Soil retaining wall
	23	091	32	+	020	~	32	+	040	MM		x			L	V	Retaining wall

Source: JICA Study Team
MM: Mass Movement, MM-p: Inactive mass movement, SF: Slope Failure, SB: Subsidence
R: Right side, L: Left side, H: Hill side, V: Valley side

Slope along NH51 is covered by very loose quaternary alluvium. As such, slope failure and erosion have frequently occurred on cut slope along NH51. In order to reduce the cult soil volume it is proposed that the widening should be done on both hill and valley sides in case by case basis and apply land slide prevention measures at sites prone to disaster and road subsidence.

To reduce the risk of slope failure, such loose soil slope shall be cut with 1:1.2 gentler than IRC standard for landslide prevention as shown below. The cut slope shall be greened by seeding and

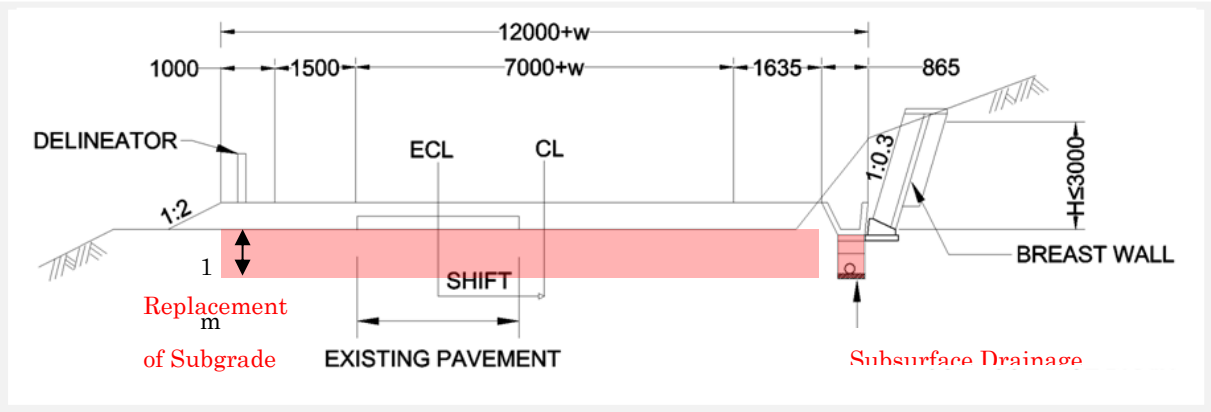
mulching consisting of jute netting including seeds which cover all over the slope and prevent erosion by rain water.

Table 11.4 Design Criteria of Cut Slope and Slope Protection Work

IRC Standard*		JICA Study Team Rock/Soil Classification		Cut Grade	Slope Protection Work
Classification	Cut Grade				
Ordinary Soil/ Heavy Soil	**1:1.0 ~ 1:0.5**	Soil	Dense Soil	**1:1.0**	Seeding and Mulching
			Loose Soil	**1:1.2**	Seeding and Mulching

*IRC: SP:48:1948 Clause 7.4
Source: JICA Study Team

A number of road subsidence sites have been identified in the slope inventory survey, which occur due to consolidation of loosen subsurface soil and high groundwater level except for embankment sliding. Therefore, replacement of subgrade with 1.0m thick and subsurface drainage are proposed as countermeasures of sinking as shown below.



Source: JICA Study Team

Figure 11.2 Typical Cross Section of Countermeasure for Sinking

11.2.2 Drainage design

It is necessary to that culvert or side ditch on road have adequate capacity of draining water surrounding or upstream of road to downstream properly. Specially, hill road is always suffered from large volume of water from mountain slope towards the road. It is quite important to protect the road by arranging cross drainage appropriately to satisfy the discharge from crossing water. According to the inventory survey conducted as part of the preparatory study, hume pipe culvert consists of approximately 70% of existing culverts in the targeted section of NH-51. However, diameter of some pipes are not enough to handle expected volume of water flows and aging and soil accumulation also undermine the function of existing culverts. It is therefore proposed that all existing culvers to be replaced with new one based on the IRC standard.

Photo 11.1Existing Pipe Culvert (L) and Slab Culvert (R) Along NH51

11.2.3 Bridge

It is necessary for bridges to provide function adapted to current National Highway standard. If the existing bridge is adequate for requirement of current National Highway, it can be retained with or without some repairing works. If the existing bridge is deemed to be inadequate, it should be replaced to new bridge. The design is based on the IRC standard in principal. A review during the preparatory study found that out of fourteen existing bridges in project area of NH51, one 6m-long bridge requires re-construction and seven others require replacement of super-structure. Six bridges are found to be in good condition and can be used as they are.

11.2.4 Traffic safety

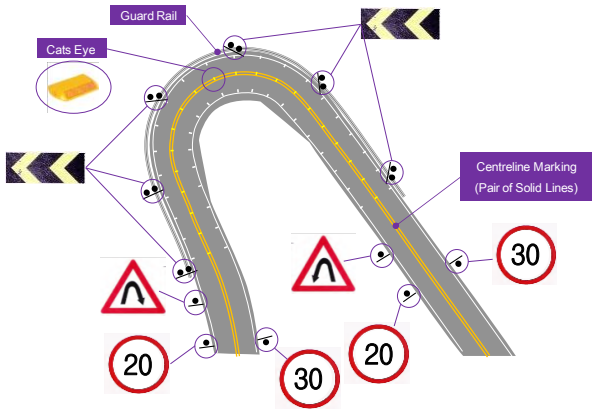
Traffic safety facilities will provided on roads or roadside to secure safety of all road users as well as nearby residents. Considering the function of existing road as rural community roads as well as usage trend, three types of safety-related facilities has been proposed in the preliminary design.

Table 11.5 Traffic Safety Facilities Proposed for NH51

No.	Item	Remarks / Related Code
1	Traffic Sign	IRC67-2001, IRC7-1971, IRC-SP-31-1992
2	Road Marking	IRC35-1997, IRC-SP-31-1992, IRC2-1968
3	Road Delineator	IRC79-1981
4	Guard Rail	
5	Street Furniture (Blinker, Road Stud/Cats Eye)	MoRTH's Research Project R-63

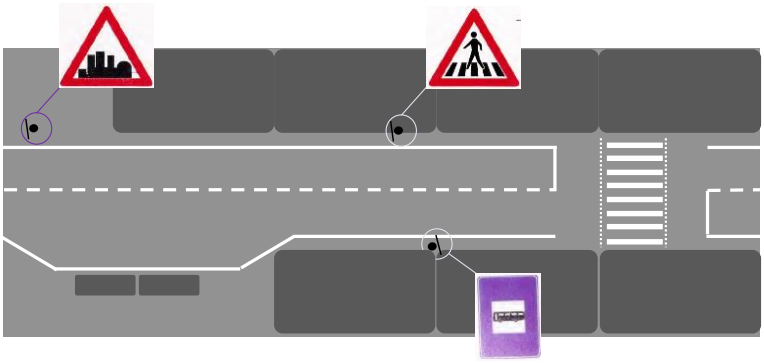
Source: JICA Study Team

Example of proposed traffic safety facilities at hair-pin curves and in built-up area is shown in Figures below.



Source: JICA Study Team

Figure 11.3 Traffic Safety Facilities to be installed at Hair-Pin Bends



Source: JICA Study Team

Figure 11.4 Traffic Safety Facilities to be installed at Built-up Area

11.2.5 Road Appurtenances

Road appurtenances are miscellaneous facilities for road users to take a rest and obtain road-related information. For road administrators, they are useful facilities for maintaining their roads efficiently. During the preparatory study, facilities listed in Table below are proposed for consideration during the detail design stage.

Table 11.6 Road Appurtenances to be Applied for NH51

No.	Item	Remarks / Related Code
1	Kilometer Stone	IRC8-1980, IRC26-1967
2	Boundary Stone	IRC25
3	Bus Bay	w/Bus Shed, IRC80-1981
4	Road Amenity	Public Toilet, Bazar Shed

Source: JICA Study Team

11.2.6 Surplus Soil Management

Based on the result of preliminary design of NH51 widening and improvement, the necessary volume

of spoil bank for disposal of surplus soil has been estimated as shown below. Overall, the project will need spoil bank with the total capacity to handle about 268 thousand m^3 of surplus soil.

Table 11.7 Spoil Bank Volume Requirement

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH51	1	Cut Soil	cu.m	41,840	0.9	37,656	37,656
		Fill Soil	cu.m			0	
	2	Cut Soil	cu.m	77,562	0.9	69,806	29,177
		Fill Soil	cu.m			40,629	
	3	Removed Soil for Replacement	cu.m			201,600	201,600
	Total						268,433

Source: JICA Study Team

The preparatory study has identified 9 candidate locations which altogether will have sufficient capacity and satisfy conditions described below.

- To find out suitable place at every 5km length along NH-51 with following condition;
  - Ground shape with concavity topography
  - Less ground gradient than 22 degree which is assumed as average angle of spoil bank slope with necessary steps
  - No built-up area
  - Not close to National Park, Wildlife Sanctuary or other ecologically sensitive areas
- To be able to construct the spoil bank in less than 30m height

The locations of 9 candidate sites in 51 km are shown below. The final location of the spoil bank will need to be agreed upon in consultation with local community during the detailed design.

Table 11.8 List of Spoil Bank Candidate Sites

No.	Section	Sta.	Capacity of Spoil Bank
			Cu.m
1	Sta. 85-94	88+000	47,120
2	STA.101-143	105+805	4,620
3		110+000	86,190
4		110+550	58,260
5		119+340	16,856
6		124+800	77,440
7		130+800	15,526
8		135+420	22,806
9		139+100	12,883
Total in NH-51			341,701

Source: JICA Study Team

CHAPTER 12 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

As per the Environmental Protection Act in 1986 and its enforcement rights given to Ministry of Environment & Forest (MOEF), MOEF has overall authority for the administration and implementation of government policies, laws and regulations, sustainable development and pollution control in India. MOEF identifies the need to enact new laws and amend existing environmental legislation when required, in order to continue to conserve and protect the environment. At the state level, the Department of the Environment and the Department of Forest perform a similar role to MOEF. The acts are implemented by Central Pollution Control Board (CPCB) and respective State Pollution Control Boards (SPCBs). Policy Guidelines, Acts and Regulations pertaining to the protection and improvement of environment that are relevant to this project has been identified and discussed below.

12.1 National Level Laws and Regulations

12.1.1 The Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 is the umbrella legislation providing for the protection of environment in the country. Subject to the provisions of this Act, the Central Government, shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution. For the implementation of act Environment (Protection) Rules, had been formulated in 1986. The Rules provided for various standards for emission and discharge of environmental pollutants (Schedule I to IV). The Central Government has delegated the powers vested on it (under section 5 of the Act) to the State Govt. of Mizoram. This law is applicable to this project for environment protection in general.

12.1.2 The Forest (Conservation) Act, 1980 (amended in 1988)

The Forest (Conservation) Act, 1980 amended in 1988 pertains to the cases of diversion of forest area and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are applied for at the following levels of government:

- If the area of forests to be cleared or diverted exceeds 20ha (or, 10ha in hilly area) then prior permission of Central Government is required;
- If the area of forest to be cleared or diverted is between 5 to 20ha, the Regional Office of Chief Conservator of Forests is empowered to approve;
- If the area of forest to be cleared or diverted is below or equal to 5ha, the State Government

can give permission; and,

- If the area to be clear-felled has a forest density of more than 40%, permission to undertake any work is needed from the Central Government, irrespective of the area to be cleared.

12.1.3 The Water (Prevention and Control of Pollution) Act, 1974

The Water (prevention and Control of Pollution) Act, 1974 resulted in the establishment of the Central and State level Pollution Control Boards (CPCB and SPCBs) whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of certain facilities.

12.1.4 The Air (Prevention and Control of Pollution) Act, 1981

The CPCB and the SPCBs are empowered to set air quality standards, monitor and prosecute offenders under this Act. Powers have also been conferred to give instructions for ensuring standards for emission from automobiles to concerned authority in charge of registration of motor vehicles under the Motor Vehicles Act, 1939 (Act 4 of 1939).

12.1.5 The Motor Vehicles Act, 1988

In 1988, the Indian Motor Vehicles Act empowered the State Transport Authority to enforce standards for vehicular pollution and prevention control. The authority also checks emission standards of registered vehicles, collects road taxes, and issues licenses. In August 1997, the Pollution under Control Certificate (PUC) program was launched in an attempt to crackdown on the vehicular emissions in the states.

12.1.6 The Land Acquisition Act, 1894 (Replaced by Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013)

The Land Acquisition Act 1894 has so far served as the base policy document on which the State Government passes resolution to acquire land for different projects. This act is superseded by new act (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013), which took effect on January 1st, 2014. However, the State Government of Meghalaya opposes the new Act on the ground that being under the Sixth Schedule of the Constitution, land in the State belongs to the individuals and not the Government.

12.2 State Level Legislation and Other Acts

No specific state-level legislation relevant to the environmental clearance requirements, other than

those mentioned above are in force in the State of Meghalaya.

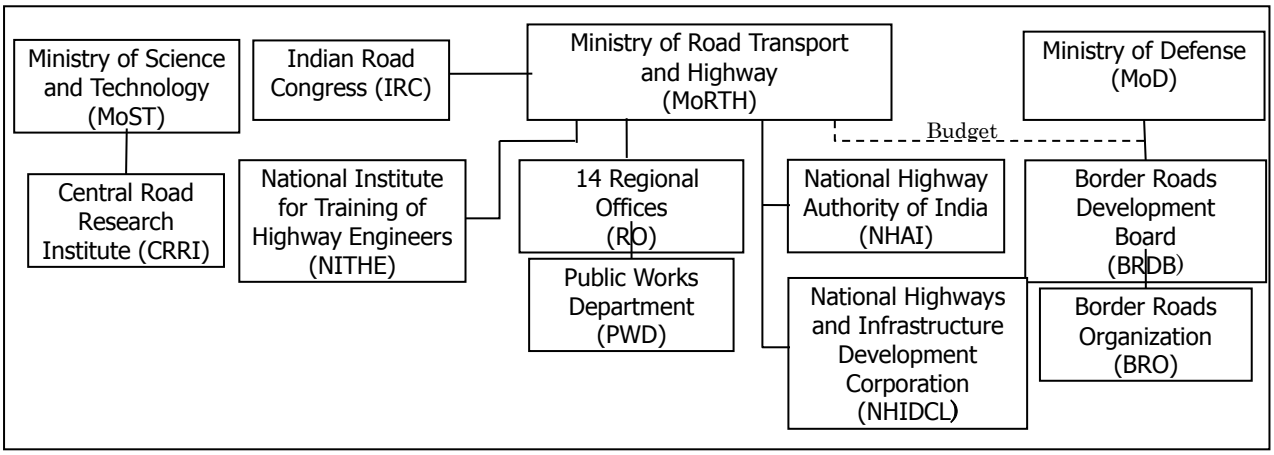
12.3 Institutional Set-up

Strengthening & widening of NH51 has been initiated and is being carried out by the NHIDCL, under the auspice of Ministry of Road Transport & Highways (MORTH). Though the primary responsibility of the project rests with the NHIDCL, a brief discussion on the various institutions involved and their level of responsibilities in the project implementation is presented in the following sections.

12.3.1 Road Sector Institutions

(1) National Level Institutions

National Highways development has been promoted by National Highway Authority of India (NHAI) and Regional Offices (RO) under Ministry of Road Transport and Highway (MORTH), and Border Roads Organization (BRO) under Border Roads Development Board (BRDB). National Highways and Infrastructure Development Corporation (NHIDCL) was established for promoting development of National Highways in North East and border area of India, and started operation from 1st January 2015. Figure 3.1 shows overall structure of organizations related to national highways development.



Source: Ministry of Road Transport and Highway (JICA Study Team modified)

Figure 12.1 Organizational Structures for National Highway Development

NHAI was set up by the National Highways Authority of India Act of 1988. It is the main nodal agency for developing, managing and maintaining India's network of National Highways. It became an autonomous body in 1995. The NHAI maintains 70,934 Km of National Highways and Expressways across India. NHIDCL started operation from 1st January 2015 and development of the target roads of this study is being promoted under NHIDCL.

NHIDCL is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes, surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner. An approximate aggregate length of 10,000 kms has been identified to begin with for development through this company. The company envisages creating customized and specialized skills in terms of addressing issues like complexities of geographical terrains and addressing extensive coordination requirements with security agencies. The company would also endeavor to undertake infrastructure projects including but not restricted to urban infrastructure and urban or city transport and to act as an agency for development of all types of Infrastructure. The company envisages working towards cross sharing of technical know-how and enhancing opportunities for business development with other nations and their agencies including the multilateral organizations and institutions.

The company also proposes to improve road connectivity and efficiency of the international trade corridor, by expanding about 500 km of roads in the North Bengal and Northeastern region of India to enable efficient and safe transport regionally with other South Asia Sub-regional economic Cooperation (SASEC) member countries. These projects are being funded by Asian Development Bank.

(2) State-level Institutions

Public Works Department (PWD) Meghalaya is the premier agency of the government of Meghalaya engaged in planning, designing, construction and maintenance of Government assets in the field of built environment and infrastructure development. Assets in infrastructure development include Roads, Bridges, City Centers, Footpaths, New Capital Complex, and Airport, and assets in built environment include Hospitals, Schools, Colleges, Technical Institutes, Police Buildings, Prisons, Courts among others. PWD Meghalaya also sustains and preserves these assets through a system of maintenance which includes amongst others specialized services like rehabilitation works, roads signage and aesthetic treatments like interiors, landscaping etc.

12.3.2 Environmental Institutions

The environmental regulations, legislation, policy guidelines and control that may impact this project, are the responsibility of a variety of government agencies. In all, as discussed in the subsequent sections, the following agencies would play important roles in this project.

(1) Ministry of Environment and Forests (MOEF)

The primary responsibility for administration and implementation of the Government of India's (GOI) policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment and Forests (MOEF). Established in 1985, the MOEF is the agency primarily responsible for the review and approval of EIAs pursuant to GOI legislation.

(2) MOEF Regional Offices

The Ministry of Environment and Forests (MOEF) has set up regional offices, with each region having an office. The office for the present project is located at Shillong, Meghalaya. This office is responsible for collecting and furnishing information relating to EIA of projects, pollution control measures, methodology and status, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, mangroves and biological reserves.

(3) Central Pollution Control Board (CPCB)

Statutory authority attached to the MOEF and located in New Delhi, the main responsibilities include inter alia the following:

- Planning and implementing water and air pollution programs;
- Advising the Central Government on water and air pollution programs;
- Setting air and water standards; and
- Coordinating the various State Pollution Control Boards.

The role of the CPCB, (for this project) will only be in an advisory capacity while the project shall adhere to the norms and standards set up by the Mizoram State Pollution Control Board (MSPCB).

(4) Departments of Environment and Forests (DOEF)

They perform the functions similar to the MOEF at the state level.

(5) Meghalaya State Pollution Control Board (M-SPCB)

The M-SPCB has the mandate for environmental management at the state level, with emphasis on air and water quality. The board is responsible for:

- Planning and executing state-level air and water initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum Standards;
- Enforcing and monitoring of all activities within the State under the Air Act, the Water act and the Cess Act, etc.;
- Conducting and organizing public hearings for projects as defined by the various Acts and as stipulated by the Amendment (April 1997) to the EIA Act; and,
- Issuing No-objection Certificates (NOC) for industrial development defined in such a way as to include road projects as the Third National Highway Project.

(6) Meghalaya State Forest Department

The Meghalaya State Forest Department is responsible for the protection and managing the forest designated areas within the state. The Forest Department works out Forest Working Plans for the various forest divisions to manage and protect the forest resources. These plans form the basis for managing the forest resources and for chalking out specific plans and policies with respect to the conservation, protection and development of the forest areas. The Forest department will be responsible for granting clearances for forest areas that need to be cleared for the project, according to the provisions of the Forest (Conservation) Act, 1980.

12.4 Requirements of Various Clearance in Different Stages of Project

As discussed earlier, Environmental Clearance is not required for this project as the scale of widening and land acquisition for this project is not significant enough not trigger the requirement. However, the forest clearance permit will have to be obtained prior to the commencement of construction activity, as per the requirement of the Forest Act. According to the discussions held with Department of Environment and Forests, the application will be processed at various Forest Department offices at Division, State and Central Government level depending on forest land requirement for non-forest purposes. Part 1 of the application format has to be filled in by NHIDCL, the project proponent while Part 2 of the application will be cleared by the Forest Division. Part 3 will be cleared at State Environment and Forest Department while Part 4 (at Nodal Officer under Forest Conservation Act) and Part 5 (Secretary of Department of Environment and Forest at Government of Meghalaya) will clear them before forwarding it to Ministry of Environment and Forest in Delhi for appraising and

issuing Forest Clearance.

Also, various clearance will be required for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts. Clearance from the State Department of Mining is required for establishing quarries. Clearance from the Sate Ground Water Boards/Authorities is required for establishment of new tube-wells/bore-holes in case they are required during construction work. Also, the provisions as laid down in the Factories Act, 1948, Labor Act, 1988 and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 with respect to hygiene and health during the construction stage would apply for this project. With limited possibility, the provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 may also apply during the construction and the operation periods. The applicability of environmental and other relevant rules and acts is shown in Table 3.1 below.

Table 3.1 Clearance Requirements

No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Pre-Construction Stage (Responsibility: MORTH)						
2	Road-side tree cutting and clearing forest	Forest Conservation Act1980 & MOEF Letter Dt.18.02.1998	Permission for Road-side tree cutting	State and Central Government	MORTH	2-3 months
3	Filling of Roadside water bodies (ponds and borrow pits)	State Fisheries Policy Draft Wetlands (Conservation & Management) Rules, 2008	Permission for filling of water bodies	State Irrigation Department State Fisheries Department State Wetlands Conservation Committee	MORT&H	2-3 months
Construction Stage (Responsibility: Contractor)						
1	Establishing stone crusher, hot mix plant,	Water Act of 1974, Air Act of 1981, Noise Rules of	Consent-forest abolishment	States Pollution Control Boards for respective	The Contractor	4-6 months

	wet mix plant and Diesel Generator Sets	2000 and Environmental Protection Action of 1986 and as Amended		section		
2	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-for operation	States Pollution Control Boards for respective section	The Contractor	4-6 months
3	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
4	Storage of fueloil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	States Pollution Control Boards for respective section and or Local Authority (DC)	The Contractor	4-6 months
5	Quarry Operation	State Minor Mineral Concession Rules, The Mines Act of1952, Indian Explosive Act of1984, Air Act of1981 and WaterAct of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	4-6 months
6	Extraction of	Ground Water	Permission for	State Ground	The	4-6 months

	ground water	Rules of 2002	extraction of ground water foruse in road construction activities	Water Board	Contractor	
7	Engagement of labor	Labor Act	Labor license	Labor Commissioner	The Contractor	2-3 months

Source: JICA Study Team

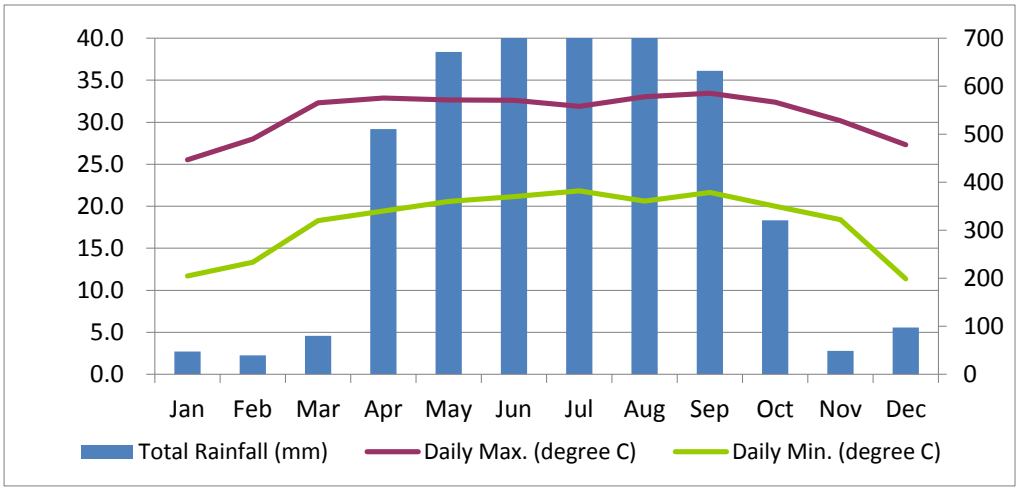
CHAPTER 13 ENVIRONMENT AND SOCIO-ECONOMIC BASELINE

This chapter assesses existing environment and socio-economic conditions against which likely environmental and social impact of the project is analyzed. The baseline data presented below have been collected by monitoring surveys as well as literature reviews and interactions with local people and government officials at various levels. A more detailed socio-economic profile can be found in the RAP report prepared for this project. The Scoping Matrix that summarizes likely scale of impacts for various components is included in Chapter 6, and Environmental Checklist as per JICA Guideline is included in Appendix A.

13.1 Natural Environment

13.1.1 Climate

Meghalaya experiences tropical monsoon climate, which varies from western to eastern parts of the plateau. The Garo Hills District, which lies in the western part of the state has tropical climate characterized by high rainfall and humidity, generally warm summer and moderately cold winter. For the entire state, the mean summer temperature is 26° C and the mean winter temperature is 9° C. The mean annual rainfall varies from 2,000-4,000 mm with most rainfall occur during May to September. Maximum rainfall of 12,000 mm has been recorded in the southern slope of Khasi Hills along the Cherrapunjee-Mawsynram belt. The monthly total rainfall and maximum/minimum temperature of Tura is presented below.



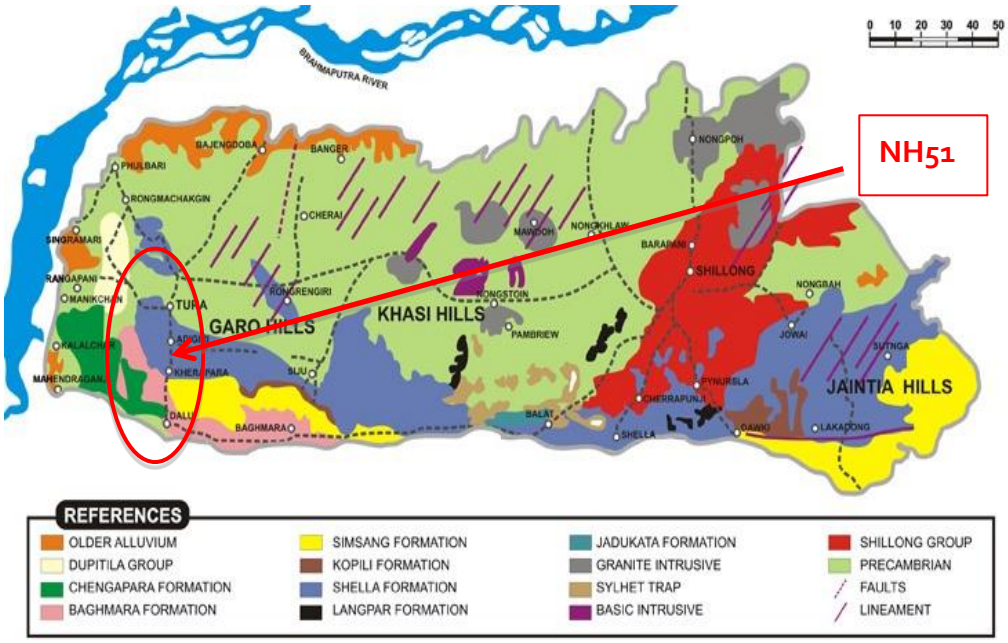
Source: West Garo Hills District Statistical Handbook 2015

Figure 13.1 Monthly rainfall and daily maximum and minimum temperature in Tura (2011-2013)

13.1.2 Topography, Geology, and Soil

The geology of Meghalaya consists of older and stable rock types, which are resistant to weathering, mostly belonging to Periods of Archean Gnessic complex, Shillong Groups of rocks, Lower Gondwana rocks, Sylhet Traps and Cretaceous-Tertiary sediments. The layers of land surface in the project area mainly comprises of Schist, Gneisses, Quartzite, sand stone, Shale, Lime Stone, Granite, Granodiorite and Pegmatite.

West Garo Hills District shows different types of soil as the provenance differs. Red Gravelly Soil and Red Sandy Loam in the hilly slopes and Clayey Loam in the plans are the common soil types in the project area. The soils are acidic in nature and comparatively rich in organic matter and nitrogen but poor in phosphorous. Tura, the district capital, is a valley located at the foothills of the Tura Hills and right below the Tura Peak. The elevation of Tura is approximately 350m. It is filled with small rivulets and green valleys all around. Meanwhile, Dalu, located 33 km North-east of Tura at the end of NH51 and NH62, has the elevation of about 20m. The geological map of Meghalaya is shown below.



Source: Department of Mining and Geology, Government of Meghalaya

Figure 13.2 Geological Map of Meghalaya

13.1.3 Flora and Fauna

Meghalaya State is known as one of the wettest places in the world and supposed to be the storehouse of various exotic and endangered species. 139 species of Mammals, 540 species of Aves, 94 species of Reptilians, 33 species of Amphibians and 152 species of Pisces have been reported in Meghalaya.

Community/village forest along the targeted section of NH51 is home to various flora and fauna. The Meghalaya Government records show the following flora and fauna. Floral/vegetation assessment carried out through quadrate methods: for trees 10mx10m, for shrubs 5mx5m and for Herbs 1m x1m square shaped quadrates were used. Quadrates were laid randomly in the corridors upside and downside of the road. All species in the quadrates were recorded & ecological parameters including density, frequency were calculated. Faunal species were recorded with the visual observation during site visits, secondary data from the Environment and Forest department and local information from local community.

FAUNA

1) Mammalian Fauna

Common Name	Zoological Name	IUCN Category
Western Hoolock gibbon	*Hoolock hoolock*	EN (ver. 3.1)
Stump-tailed macaque	*Macaca arctoides*	VU (ver. 3.1)
Rhesus macaque	*Macaca mulatta*	LC (ver. 3.1)
Assamese macaque	*Macaca assamensis*	NT (ver. 3.1)
Northern Pig-tailed Macaque	*Macaca leonina*	VU (ver. 3.1)
Bengal Slow loris	*Nycticebus bengalensis*	VU (ver. 3.1)
Golden langur	*Trachypithecus geei*	EN (ver. 3.1)
Capped langur	*Trachypithecus pileatus*	VU (ver. 3.1)
Golden cat	*Catopuma temminckii*	NT (ver. 3.1)
Leopard cat	*Prionailurus bengalensis*	LC (ver. 3.1)
Jungle cat	*Felis chaus*	LC (ver. 3.1)
Large Indian civet	*Viverra zibetha*	NT (ver. 3.1)
Masked Palm civet	*Paguma larvata*	LC (ver. 3.1)
Indian Grey mongoose	*Herpestes edwardsii*	LC (ver. 3.1)
Indian fox	*Vulpes bengalensis*	LC (ver. 3.1)
Himalayan Black bear	*Ursus thibetanus*	VU (ver. 3.1)
Yellow Throated marten	*Martes flavigula*	LC (ver. 3.1)
Yellow-Bellied weasel	*Mustela kathiah*	LC (ver. 3.1)

Common Name	Zoological Name	IUCN Category
Indian flying squirrel	*Petaurista philippensis*	NE
Malayan Giant squirrel	*Ratufa bicolor*	NT (ver. 3.1)
Lsser Bandicoot Rat		LC (ver. 3.1)
Greater Bandicoot Rat	*Bandicota indica*	LC (ver. 3.1)
Short-tailed Bandicoot Rat	*Nesokia indica*	LC (ver. 3.1)
Indian Crested porcupine	*Hystrix indica*	LC (ver. 3.1)
Lesser Bamboo rat	*Cannomys badius*	LC (ver. 3.1)

Source JICA Expert Team

2) Avian Fauna

Common Name	Zoological Name	IUCN Category
Indian black baza	*Aviceda leuphotes*	LC (ver. 3.1)
Barred jungle owlet	*Glaucidium radiatum*	LC (ver. 3.1)
Peafowl	*Pavo cristatus*	LC (ver. 3.1)
Green Peafwol	*Pavo muticus*	EN (ver. 3.1)
Red jungle-fowl	*Gallus gallus*	LC (ver. 3.1)
Thick-billed green pigeon	*Treron curvirostra*	LC (ver. 3.1)
Blue throated barbet	*Psilopogon asiaticus*	LC (ver. 3.1)
Long-tailed broadbill	*Psarisomus dalhousiae*	LC (ver. 3.1)
Grey-headed myna	*Sturnus malabaricus*	LC (ver. 3.1)
Jungle myna	*Acridotheres fuscus*	LC (ver. 3.1)
Green magpie	*Cissa chinensis*	LC (ver. 3.1)
Indian house crow	*Corvus splendens*	LC (ver. 3.1)
Red winged crested cuckoo	*Clamator coromandus*	LC (ver. 3.1)
Large green-billed malkoh	*Phaenicophaeus tristis*	LC (ver. 3.1)
Crow pheasant	*Centropus sinensis*	LC (ver. 3.1)
Red headed trogon	*Harpactes erythrocephalus*	LC (ver. 3.1)
Red wattled lapwing	*Vanellus indicus*	LC (ver. 3.1)
Burmese roller	*Coracias affinis*	LC (ver. 3.1)

Source JICA Expert Team

3) Reptile Fauna

Different varieties of lizards, snakes, turtle/tortoises, geckos are recorded. Different species of snakes include Blind snakes, Indian Gamma, Checkered Keelback, Red necked Keelback and others. Important poisonous species include Indian Cobra and Vipers.

Common Name	Zoological Name	IUCN Category
Blind snakes(Few-scaled Worm Snake)	*Gerrhopilus oligolepis*	DD (ver. 3.1)
Indian Gamma	*Boiga trigonata*	LC (ver. 3.1)
Checkered Keelback	*Xenochrophis piscator*	NE
Red necked Keelback	*Rhabdophis subminiatus*	LC (ver. 3.1)
Indian Cobra	*Naja naja*	NE

Source JICA Expert Team

FLORA

1) Tall trees

Botanical Name	Family	IUCN Category
Schima wallichii	Theaceae	NE
Terminalia bellirica	Combretaceae	NE
Engelhardtia spicata	Juglandaceae	LC (ver. 2.3)
Aesculus assamica	Sapindaceae	NE
Aporosa wallichii	Phyllanthaceae	NE
Bridelia retusa	Phyllanthaceae	NE
Cryptocarya andersonii	Lauraceae	NE
Talauma hodgsonii	Magnoliaceae	LC (ver. 3.1)
Lagerstroemia parviflora	Lythraceae	NE
Gmelina arborea	Lamiaceae	NE
Shorea robusta	Dipterocarpaceae	LC (ver. 2.3)

Source JICA Expert Team

2) Lower canopy

Botanical Name	Family	IUCN Category
Miliusa velutina	Annonaceae	NE
Ziziphus rugosa	Rhamnaceae	NE
Helicia robusta	Proteaceae	NE

Botanical Name	Family	IUCN Category
Engelhardtia spicata	Juglandaceae	LC (ver. 2.3)
Ficus prostrata	Moraceae	NE

Source JICA Expert Team

3) Shrubby species

Botanical Name	Family	IUCN Category
Capparis zeylanica	Annonaceae	NE
Bauhinia acuminata	Leguminosae	LC (ver. 3.1)
Mimosa himalayana	Fabaceae	NE
Mussaenda roxburghii	Rubiaceae	NE
Eupatorium morifolium	Asteraceae	NE
Solanum kurzii	Solanaceae	NE
Phlogacanthus tubiflorus	Acanthaceae	NE

Source JICA Expert Team

4) Intertwining trees

Botanical Name	Family	IUCN Category
Dysolobium grande	Annonaceae	NE
Mucuna bracteata	Leguminosae	LC (ver. 3.1)
Fissistigma wallichii	Annonaceae	NE
Paederia scandens	Rubiaceae	NE
Solena heterophylla	Cucurbitaceae	NE
Aristolochia saccata	Aristolochiaceae	NE

Source JICA Expert Team

5) Epiphytic climbers

Rhaphidophora spp., members of Loranthaceae, Cuscuta reflexa and few species of epiphytic orchids like Rhynchostylis retusa, Cleisostoma simondii are also present.

Botanical Name	Family	IUCN Category
Rhaphidophora spp.	Araceae	
Loranthaceae	Leguminosae	LC (ver. 3.1)

Botanical Name	Family	IUCN Category
Cuscuta reflexa	Convolvulaceae	NE
Rhynchostylis retusa	Orchidaceae	NE
Cleisostoma simondii	Orchidaceae	NE

Source JICA Expert Team

6) Herbaceous plants

Acanthaceae, Aneilema scaberrimum, Anemone spp Burmania Sp., Coiictyospermum, Dictyospermum, Coix sp. Cyprus spp., Ericcaulon, Fabaceae, Oxalis corniculate, Poaceae etc are noticed. Ferns and fern-allies, liverworts and mosses etc. are also seen on old tree trunks and stones etc. near water sources, in shady places.

Botanical Name	Family	IUCN Category
Acanthaceae	Acanthaceae	
Aneilema scaberrimum	Commelinaceae	NE
Anemone spp.	Actiniidae	
Burmania Sp.		
Coiictyospermum		
Dictyospermum spp.	Commelinaceae	NE
Coix sp.	Gramineae	LC (ver. 3.1)
Cyprus spp.		
Eriocaulon sp.	Eriocaulaceae	NE
Fabaceae	Fabaceae	NE
Oxalis corniculata	Oxalidaceae	NE
Poaceae	Poaceae	NE

Source JICA Expert Team

A detailed field observation of the study area was done in June and August 2015. Extensive study was done in four locations/spots. They are chosen as a site that feature different ecological characteristics of the project area. The observations are enumerated below.

1) Paddy Field (KM post 144-145)

In the paddy field land preparation was going on and seeding was done for transplantation of rice seedlings. Small fishes like Channa spp., Colisa spp., Puntius spp., Noemacheilus spp. Rasbora spp., Crane and Indian common crow were seen in the rice field.

2) Amongpara Village Forest (KM post 125-126)

It is a vast area with diverse floral vegetation. The commonly seen species are Albizza spp., Ammora spp., Artocarpus heterophyllus, Bambuseae, Bauhinia spp., Bombax ceiba, Colocasia spp., Dalbergia, Ficus spp., Gmelina spp., Lagerstroemia spp., Mimosa pudica, Musa spp., Paederia scandens, Phoebe spp, Phlogacanthus tubiflorus, Shorea robusta, Tectona grandis, Terminalia spp.. Cuscuta reflexa and few species of epiphytic orchids like Rhynchostylis retusa, Cleisostoma simondii were also found. Bryophytes and liverworts were also seen in the trunk of old trees. In certain areas of the community forest the natural vegetation was cleared and teak, areca plantation was done.

3) Jhum Cultivation (KM post 119)

Terrestial observation was carried out in the area. Floral species of Dactyloctenium aegyptium, Manihot esculenta, Matricaria discoidea, Mimosa pudica, Musa spp., Oryza sativa, Taraxacum officinale, Urochloa mutica, Zea may. Faunal species of Hirudinea and Rhopalocera were observed. Mixed cropping of maize, banana, rice and tapioca was carried out.

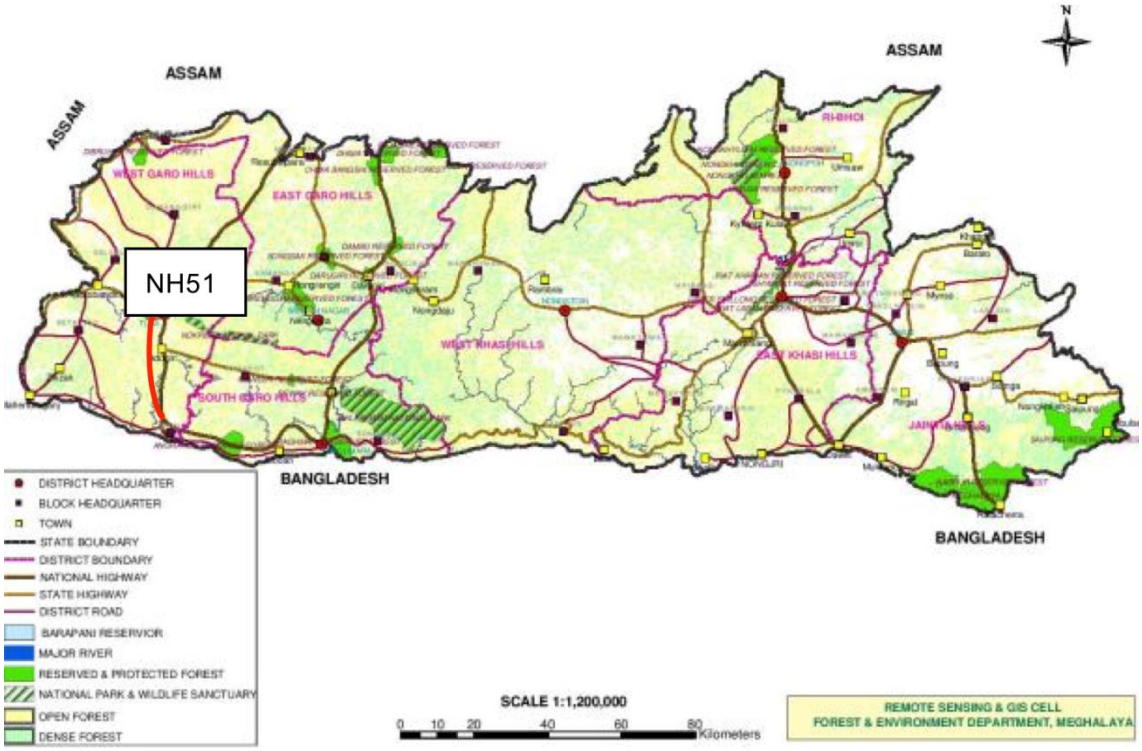
4) Rubber, Areca Plantation (KM post 107-109)

In many areas of the community forest the natural vegetation were cleared and commercial plantation of rubber and areca nut was carried out on the slopes. The lower canopy was covered with grasses. Cashewnut were also commercially cultivated in many pockets throughout the road. Sparrow, butterfly, lizards, owl, common monkey, golden langur, red jungle-fowl, Indian black baza, thick-billed green pigeon, cobra were encountered during the field survey. Sound of Gryllidae was heard in abundance. There is a citrus garden of the Department of Agriculture and Ganol Ecopark. During the field survey it was noticed that shifting cultivation/ 'Jhum' practice is very common and in many areas the forest/natural vegetation are cleared and secondary monoculture of cashewnut (Sal (Shorea robusta), Teak (Tectona grandis) are established. Rice, maize, banana, pineapple cultivation are done in pockets. Several species of bamboo (Bambuseae spp.), stretch for long distances forming thickets of secondary vegetation.

13.1.4 Protected Area and Forest

Forest of Western Garo Hills can be broadly classified into tropical, subtropical and temperate forests. The Indian Institute of Remote Sensing has classified vegetation of Meghalaya into following categories: tropical evergreen, tropical semi-evergreen, tropical mosit deciduous, subtropical broad leaved, subtropical pine and temperate forest types, grasslands and savanna.

As shown in Figure 4.3 below, the target section of NH51 does not pass through or border with existing National Park, Wildlife Sanctuary and Protected/Reserved Forest. Being a sixth schedule state, the forest area is under the village Council and is known as community forest/village forest. The targeted section of NH51 passes through forest and plantation (teak, rubber and cashews) for which appropriate measures to mitigate negative impacts due to road widening will be required.



Source: Forest and Environment Department, Meghalaya

Figure 13.3 Map of Protected/Reserved Forest and National Park & Wildlife Sanctuary

13.1.5 River System and Hydrology

In the project area of NH51 between Tura to Dalu, the project route passes several rivers and its tributaries, including following Rivers.

Ganol River	Mason River
Rongkhon River	Rongnabak River
Jintal River	Debok River

The hydrological study is conducted based on IRC: SP:13 “Guidelines for the design of small bridges

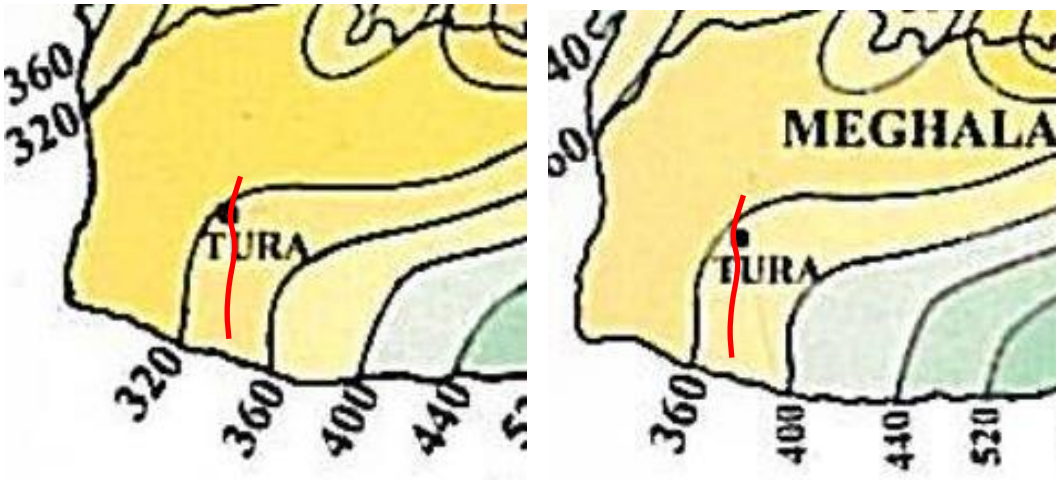
and culverts" which is well used technical standard for hydrological study in Indian highway design. The analysis is conducted based on Rational Formulae for peak-off from catchment. The size of floods is determined by factors such as rainfall intensity, distribution in time and space, duration, catchment area, shape, slope and permeability of the soil and vegetable cover.

The rainfall intensity is determined based on the ATLAS of State-wise Generalized ISOPLUVIAL MAPs of Eastern India (Part-II), published by India Meteorological Department, Government of India. The long-term rainfall intensity is modeled as shown below, which have informed the design of drainage and culverts.

Table 13.1 Rainfall intensity for each section in NH-51

From	To	25Years- 24hours Rainfall intensity (mm)	50Years- 24hours Rainfall intensity (mm)
KP90 of NH51, Tura	KP148, Dalu	360mm	400mm

Source: JICA Study Team



Source: ATLAS of Statewise Generalised ISOPLUVIAL (Return Period) Maps of Eastern India (Part – II)

Figure 13.4 Detailed isopluvial map with project location for NH51 for 25 Years (L) and 50 Years (R)

13.1.6 Mineral Resources

West Garo Hills District is endowed with rich mineral resources including coal, limestone, lithomargic clay, fireclay, phosphorite, gypsum and glass sand. The total estimated coal reserve in Garo Hills Districts is of the order of 35,900 million tones and is mainly located at three fields in the districts. Meanwhile, Garo Hills Districts are estimated to hold 510 million tones of limestone, majority of which is located in South Garo Hills District. NH51 is one of the corridors along which

coal and other mineral resources are exported to Bangladesh.

13.2 Living Environment

13.2.1 Air Quality

During the preparation of Detailed Project Report (DPR) by Indian Consultants, ambient air sampling was carried out in eight locations along the project road in February 2011. The monitoring data for dry season shows that all parameters are under the threshold by CPCB/MOEF. Additional monitoring for pre-monsoon season has been carried out between May to June 2015 in three locations. The locations for each monitoring station are shown below.

Table 13.2 Locations Ambient Air Quality Monitoring

Station Code	Location	GPS
AAQ1	G K Sangma Petrol Pump, Tura	N25 26.451, E90 12.598
AAQ2	Forest Gate, Tura Dalu Road,	N25 30.174, E90 12.905
AAQ3	Near Woodland School, Barengapara, Dalu	N25 30.174, E90 12.598

Source: JICA Study Team

Being a rural area without a major industrial activity, there are not major sources of air pollution along the project road except for vehicular traffic[5]. As shown in the table below, it is evident that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards.

Table 13.3 Results of Ambient Air Quality Monitoring

Station Code	Date	Parameters				
		Respirable Suspended Particulate Matter (as PM10 (µg/m3)	Suspended Particulate Matter (µg/m3)	Sulphur Dioxide (as SO_2) (µg/m3)	Oxides of Nitrogen (as NO_2) (µg/m3)	Lead (as Pb) (µg/m3)
AAQ1	5/30-5/31	75	190	22	24	0.05
	6/1-6/2	70	165	22	24	0.06
	6/2-6/3	72	185	22	24	0.07
	6/11-6/12	68	179	22	23	0.08
	6/12-6/13	77	168	22	23	0.05
	6/18-6/19	71	155	18	21	0.03
	6/20-6/21	52	164	19	23	0.03
	6/25-6/26	68	165	17	23	0.06

[5] The level of air pollution is expected to be higher in central Tura, which is outside the scope of this project. The proposal for Tura bypass currently under consideration will contribute to mitigate the pollution level by reducing congestion within Tura town.

	6/27-6/28	72	188	20	23	0.04
	6/29-6/30	69	176	22	25	0.04
AAQ2	5/30-5/31	75	190	22	24	0.05
	6/1-6/2	65	155	23	25	BDL
	6/2-6/3	52	130	21	23	BDL
	6/11-6/12	59	148	22	25	BDL
	6/12-6/13	50	134	17	21	BDL
	6/18-6/19	47	150	12	17	BDL
	6/20-6/21	39	140	15	23	BDL
	6/25-6/26	48	130	19	22	BDL
	6/27-6/28	44	136	14	18	BDL
	6/29-6/30	75	190	22	24	0.05
AAQ3	5/30-5/31	78	170	24	26	0.03
	6/1-6/2	75	185	24	26	0.05
	6/2-6/3	68	160	21	23	0.06
	6/11-6/12	70	185	22	24	0.04
	6/12-6/13	70	155	20	28	0.06
	6/18-6/19	70	170	19	21	BDL
	6/20-6/21	70	170	19	21	0.05
	6/25-6/26	70	170	19	21	0.05
	6/27-6/28	69	166	20	24	0.06
	6/29-6/30	78	170	24	26	0.03
CPCB Limit		**100**	**200**	**80**	**80**	**1.0**

Source: JICA Study Team

13.2.2 Ground and Surface Water Quality

There are no major pollution sources in the area and water quality along the road is good as per the report by Public Heath Engineering Department, Shillong. In order to find out existing condition, monitoring of ground and surface water quality was carried out in February 2011 (dry season) during the DPR preparation. The data from seven sites for ground water testing (KM post 93+950, 115+200 and 142+450) and four surface water monitoring show that water quality is fair within the desirable limits.

Water quality for pre-monsoon and monsoon period the project area has been analyzed by collecting surface water sample along the road in June and July 2015. Analysis of the samples shows that the water is alkaline in nature (pH <8), is soft in the area and the Hardness is below the permissible limit. Chloride concentration is well below the desirable limit in all locations. Sulphate and Nitrate concentrations are low and within the permissible limit and thus indicate low degree of organic pollution. Iron levei is higher than the desirable standard, reflecting local soil condition in the area.

Table 13.4 Ground and Surface Water Quality

Parameters	Duragre locality (south of Tura)	River at around halfway between Tura and Dalualu	Tibapara locality (noth of Dalu)	Dalu	Limits IS: 10500
	GW1	SW1	GW2	SW2	
Temperature	32.1	32.1	32.3	32.1	
pH	7.49	7.46	7.03	7.64	6.6 to 8.5
Color (Hazen unit)	<5	<5	<5	<5	-
Odor and smell	Agreeable	Agreeable	Agreeable	Agreeable	
Suspended Solid (mg/l)	24	17	33	2.0	-
BOD (mg/l)	Nil	Nil	Nil	Nil	-
COD (mg/l)	Nil	Nil	Nil	Nil	-
Total Hardness (mg/l)	68	24	80	20	300
Calcium (mg/l)	25.65	6.41	11.22	4.81	75
Magnesium (mg/l)	0.97	1.94	5.83	1.94	30
Electric Conductivity	174.6	85.7	126.9	73	-
Chloride (mg/l)	8.11	2.02	6.08	2.02	250
Sulphate (mg/l)	4	5.71	33.52	3.24	200
Nitrate (mg/l)	1.2	1.51	0.37	0.37	45
Fluoride (mg/l)	0.17	0.12	0.04	0.19	1
Total Dissolved solid (mg/l)	110	54	80	46	500
Iron (mg/l)	33.52	4.07	2.0	0.1	0.3
Coliform Organism / 100 ml	Absent	Absent	Absent	Absent	

Note: GW stands for groundwater, SW stands for surface water
Source: JICA Study Team

13.2.3 Noise Level

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. During DPR preparation, noise level monitoring was carried out in six locations in February 2011 (dry season). Apart from the areas near Tura and Dalu town, the project road mostly passes through open forest and plantation and thus noise is not a major issue and the monitoring result were within the limit prescribed by PCPB. The monitoring for pre-monsoon and monsoon seasons has been carried out as part of the preparatory study in three locations. The nose level near school in Dalu town is within the limit of residential area (55dB for daytime and 45dB for nighttime, but slightly above the limit for silence zone (50dB for daytime and 40dB for nighttime), indicating the need of proper noise level mitigation measures around sensitive facilities. The figures in other locations are within the limit.

Table 13.5 Ambient Noise Level

Sr. No.	Location	Ambient Noise Level Leq.dB(A)					
		Day Time (07.00 AM to 11.00 PM)			Night Time (10.00 AM to 12.00 PM)		
		L_{min}	L_{max}	L_{eq}	L_{min}	L_{max}	L_{eq}
Monitoring 1. Date: May 30, 2015 to May 31, 2015							
1	GK Sangma Petrol Pump	70	52	60	58	46	47
2	Near Woodland school, Barengapara, Dalu	71	53	58	55	44	46
3	Forest Gate, Chokpot, Tura	68	51	57	53	47.2	38.5
Monitoring 2. Date June 29, 2015 to June 30, 2015							
1	GK Sangma Petrol Pump	70	46	52	54	41	43
2	Near Woodland school, Barengapara, Dalu	70	46	51	54	40	42
3	Forest Gate, Chokpot, Tura	69	50	52	53	40	40
Standard for commercial area for residential area for silence zone		-	-	65 55 50	-	-	55 45 40

Source: JICA Study Team

13.2.4 Hazards

With the inherently weak geology of fractured rock, the steep, unstable slops are further weakened by water flows during monsoons and result in landslides. Deforestation due to felling of trees for timber, animal fodder and removal of vegetation for jhum cultivation are also contributing to soil erosions and destabilization of slopes. Occurrence of landslide is more frequent in monsoon, often causing severe disruption in the lifeline, which deprive the local population along NH51 from supply of essential commodities. The locations of the landslide prone areas along the targeted section of NH51 has been identified during the road/slope inventor survey, which was carried out as part of the Preparatory Study, and the various slope protection measures have been included in the scope of this project. The sites of landslide and road deformation as identified by the inventory survey are shown below.

Table 13.6 Landslide Lications identified on NH51

Sec	LS No.	Landslide Location								Disaster Type	Road Deformation				Recommended Widening Side		
		Slope No.	Start			~	End				Collapse	Sinking	Crack	Bulge	R/L	H/V	Landslide Countermeasure
NH-51	01	221	93	+	400	~	93	+	420	SF	x				L	V	Soil retaining wall
	02	014	4	+	480	~	4	+	540	SF	x				R	V	Soil retaining wall
	03	015	4	+	540	~	4	+	580	SF					R	V	Soil retaining wall
	04	030	10	+	181	~	10	+	219	SF	x		x	x	L	H	Earth removal
	05	046	15	+	440	~	15	+	480	SF	x	x			-	-	Subsurface drainage
	06	055	18	+	520	~	18	+	560	SB		x			-	-	Subsurface drainage
	07	057	19	+	430	~	19	+	470	SB		x			-	-	Subsurface drainage
	08	058	19	+	700	~	19	+	720	SB		x			-	-	Subsurface drainage
	09	059	20	+	000	~	20	+	020	SB		x			-	-	Subsurface drainage
	10	060	20	+	240	~	20	+	280	SB		x			-	-	Subsurface drainage
	11	060	20	+	480	~	20	+	520	SB		x			-	-	Subsurface drainage
	12	061	20	+	640	~	20	+	660	SB		x			-	-	Subsurface drainage
	13	061	20	+	850	~	20	+	870	MM		x	x		R	V	Road realignment
	14	062	21	+	020	~	21	+	060	SB		x			-	-	Subsurface drainage
	15	062	21	+	200	~	21	+	250	SB		x			-	-	Subsurface drainage
	16	063	21	+	360	~	21	+	600	SB		x			-	-	Subsurface drainage
	17	064	21	+	660	~	21	+	720	SB		x			-	-	Subsurface drainage
	18	069	23	+	700	~	23	+	780	SB		x			-	-	Subsurface drainage
	19	070	23	+	940	~	24	+	010	MM-p		x			R	H	- No need
	20	070	24	+	120	~	24	+	220	SB		x			-	-	Subsurface drainage
	21	071	24	+	420	~	24	+	480	SB		x			-	-	Subsurface drainage
	22	074	25	+	680	~	25	+	700	MM		x			L	V	Soil retaining wall
	23	091	32	+	020	~	32	+	040	MM		x			L	V	Retaining wall

Source: JICA Study Team
MM: Mass Movement, MM-p: Inactive mass movement, SF: Slope Failure, SB: Subsidence
R: Right side, L: Left side, H: Hill side, V: Valley side

13.3 Socio-Economic Conditions

13.3.1 Ethnic and Demographic Profile

According to the 2011 Census, the population of Meghalaya is 2,967,000. Out of those, 86% belong to scheduled tribe. A total of 17 notified STs are recognised in the state with the Khasi, Garo and Jaintia[6] being the three major tribes. The Khasi constitutes more than half of the total ST population of the state (56.4%), and Garo accounts for 34.6%. Altogether, they constitute more than 90% of the total ST population. The Khasi, Garo and Jaintia had their own kingdoms until they came under British administration in the 19th century. Other tribes include the Koch, the Biate of Saipung Constituency and Jowai, the related Rajbongshi, Boro, Hajong, Dimasa, Hmar, Paite, Kuki, Lakhar, Karbi, Rabha and Nepali. All of them were generally known as "hill tribes" by the British. English is the official and widely spoken language of the state. Other principal languages are Khasi, Pnar and Garo. Hindi and Bengali are also widely spoken in the state.

The total population of West Garo Hills is 470,796 according to 2011 Census. The share of ST, SC and other categories and changes between 2001 and 2011 are shown in Table 5.1 below.

[6] Jaintia (Synteng or Pnar) is listed both as a sub-tribe under Khasi and as a separate ST.

Table 13.7 Demographic Profile of West Garo Hills District

No		Census Year					% variation		
			WGH-2001		2011		1991-2001	2001-2011	2001-2011 excl. SWGH
		1991	Incl. SWGH	Excl. SWGH.	Incl. SWGH	Excl. SWGH.			
1	**Scheduled Tribe**								
	Male	158066	194457	135460	236772	167379	23	22	24
	Female	155374	191741	133508	***237237***	168462	23	24	26
	Total	313440	386198	268968	474009	335841	23	23	25
2	**Scheduled Caste**								
	Male	2787	3743	2630	*4535*	3458	34	21	31
	Female	2503	3546	2453	*4275*	3257	42	21	33
	Total	5290	7289	5083	8810	6715	38	21	32
3	**Others**								
	Male	44850	60987	48428	82852	66187	36	36	37
	Female	39447	55769	45093	77620	62053	41	39	38
	Total	84297	116756	93521	160472	128240	39	37	37
	West Garo Hills	403027	510243	367572	643291	470796	27	26	28

Source: District Statistical Handbook 2015

13.3.2 Literacy Rate

Trend of literacy rate between 2001 and 2011 in West Garo Hills District and its development blocks are shown below. Significant progress has been achieved in terms of literacy rate, particularly among women.

Table 13.8 Literacy in West Garo Hills in 2001 and 2011

Group	Literacy Rate	
	2011	2011
Male	57%	72 %
Female	43%	63 %
Total	51%	67 %
Urban	80%	91 %
Rural	46%	62 %

Source: 2015 District Statistical Handbook

Table 13.9 Block-wise Literacy Rate in 2011

Group	Male		Female		Total	
	Persons	%	Persons	%	Persons	%
Rongram (urban)	30,418	93	29,836	90	60,254	91
Rongram (rural)	19,614	80	16,607	70	36,220	75
Dadenggre	11,087	65	8,486	50	19,573	58
Selsella	37,188	58	30,825	49	68,013	53
Tikrikilla	17,424	72	14,176	59	31,600	65
Dalu	16,207	76	13,613	65	29,820	71
Gambegre	8,359	76	7,072	66	15,431	71
Total	**140,297**	**72**	**120,615**	**63**	**260,912**	**67**

Source: 2015 District Statistical Handbook

13.3.3 Economic Activities

Meghalaya is primarily a rural-agrarian economy with 80% of the population residing in rural areas and around 65.8% of the working population engaging in agricultural and allied activities. Although efforts have been made by the Government to discourage jhum practice (shifting cultivation), it continues in certain parts, restricting overall productivity of land. Cultivators both of shifting and settled cultivation substantially depend on monsoon, as area under irrigation is virtually negligible. Though the production of principal crops like rice, maize and wheat reveals increasing trends during the last few years, yet the production of rice which is a staple food of the state is not sufficient to meet the requirement of the state.

Meghalaya is an example of an industrially poor region in an industrially backward economy. It is undeveloped in terms of almost all criteria applied for identifying industrially backward states such as per capita income from industry and mining, workers engaged in registered units, per capita consumption of electricity, length of surfaced road, railway mileage and so forth. The number of registered manufacturing units in the state stood merely at 31 in 2001, which in fact was less than half of the number that existed in 1998. Out of 31 units, 27 are located in the East Khasi Hills and Ri-Bhoi districts alone, two each in Jaintia Hills and East Garo Hills and none in the districts of West Khasi Hills, South Garo Hills and West Garo Hills where the project road is located.

13.3.4 Cultural Resources

Tura is a place of historical importance and a tourist destination with traces of Christian missionaries whose records are found as early as in mid 19th century. Omed Momin and his nephew, Ramke Momin are reportedly first Garos to have been baptized in the area in 1863. Catholic missionaries began organized evangelization work among Garo people in 1933.

The region is famous for the Wangala Dance, a Garo post-harvest festival that marks the end of the agricultural year. It is an act of thanksgiving to the sun god of fertility, known as Misi-A-Gilpa-Saljong-Galapa. This is the most popular festival of the Garo Hills, and is held in November (the precise date being fixed by the village headman). According to the District Statistical Handbook, there were 319,058 visitors to West Garo Hills District during 2011-2012 period. In terms of tourist attractions, the district has 6 waterfalls, 2 caves, 11 viewpoints and 3 trekking paths.

CHAPTER 14 ANALYSIS OF ALTERNATIVE

The scope for alternative is limited due to hilly nature of the terrain and the nature of the project, which essentially aims to improve and widen existing road. The chapter reviews two alternative options (without project scenario (zero option) and another widening/improvement option based on a different concept) and compares them with the proposed option. The chapter also reviews the option for bypass/flyover to alleviate traffic congestion in Tura town.

14.1 Alternatives

14.1.1 Without project scenario (zero option)

The existing road has many roadside settlements, particularly in and around two major built-up areas – Tura and Dalu. The traffic flow is impacted by conflicts between the local and through traffic, which is further compounded by various land use conflicts including uncontrolled development along the highway and encroachment. Given the current level of population growth and economic development, traffic volume is likely to expand further, adding more pressure to already constrained road capacity.

The without project scenario entails that existing road and slope conditions will persist. Poor pavement condition will lead to more vehicular emissions with detrimental impacts on health and ecosystem. Also, continuation of uncontrolled encroachment will increase the risk of traffic accident in built-up areas, particularly in Dalu where street vendors market daily goods on the road today. In addition, landslide will be more frequent in this scenario, depriving the local population along NH51 from supply of essential commodities and undermine the potential of economic growth. In particular, NH51 serves as one of the major trade routes connecting Meghalaya and Bangladesh and as such, blockage of NH51 will negatively affect the potential of mineral and horticultural product exports to Bangladesh.

14.1.2 Widening and improvement Option 1 (as proposed in DPR)

A design proposal for widening and improvement for NH51 is proposed in DPR prepared by Indian Consultants. While the project is expected to bring positive benefits, the design proposed in DPR is likely to cause significant environmental impacts which can be avoided or mitigated. Some of the issues include:

- Widening is proposed only toward hill side, resulting in higher volume of cut soil;
- Proposal of re-installing all existing culverts is made without hydrological analysis. Drainage without proper runoff estimate can cause soil erosion and damage the road; and

- Re-construction was proposed for one minor bridge and rehabilitation was proposed for ten minor bridges without information about damage condition and specific details of rehabilitation.

14.2 Options for Mitigating Traffic Congestion in Tura

The proposed project has two sections (85km – 95km and 101km to 148km) and avoids intervention with densely built-up section of Tura town. Preliminary design and concept of Tura bypass have been proposed in DPR report with additional proposal for ROB/flyover to smoothen traffic flow in a major intersection in the town. However, the proposed ROB/flyover passes through areas known as Christian Compound, which accommodate sensitive and important facilities such as church, school and hospital and there is already anti-ROB/flyover sentiment among local population. As such, it is found that the potential benefits of ROB/flyover cannot justify negative impacts associated with it, particularly in places where Christianity is deeply rooted in the life of local people. Measures to mitigate congestions in Tura is required in the long-term, but it is recommended that a more detailed study be carried out to identify optimal route for bypass and ROB/flyover with respect to environmental and social impacts. Hence, the bypass and ROB/flyover have been dropped from the scope of the preparatory study and EIA.

14.3 Comparison of Alternatives with the Proposed Design

Comparison of with and without project scenario is provided below.

Table 14.1 **Comparison of With and Without Project Scenarios**

Component	Without Project	DPR	Proposed Design
Social Impact	**No change in the short-term, but congestion and poor road quality will undermine the road utility over the long-term**	**30m ROW is proposed and thus more than double the land is required compared with the proposed design. Three churches and one policy station, one fire station will be affected.**	**12m ROW is adopted in general. Required acquisition of 67 ha of land for ROW and 11.6 ha for spoil bank. 367 households will be affected.**
Widening	**N/A**	**Hill side only**	**Both sides as appropriate**

Cut Grade	**N/A**	**Same across the entire strech**	**Decide based on classification of rock and soil.**
Surplus soil	**N/A**	**Significant**	**Minimized**
Landslide	**High risk**	**High risk (no slope protection measures proposed)**	**Landslide sites identified and slope protection measures proposed**
Congestion in built-up area	**Continue to deteriorate**		
Impact on forest	**N/A**	**Larger due to the need of disposing greater volume of surplus soil**	**Minimized by balancing cut and fill. Candidate sites for spoil bank proposed.**
Safety	**Existing risks remain unresolved**	**No information**	**Proper traffic signs and safety facilities to be installed**
Road-side amenities	**N/A**	**KM stone, bus bay etc.**	**KM stone, bus bay, public toilet etc.**
Environmental quality	**Continue to deteriorate due to higher emissions caused by poor road condition**	**Greater traffic volume may cause higher emissions**	**Greater traffic volume may cause higher emissions**

Source: JICA Study Team

CHAPTER 15 SCOPING OF ENVIRONMENTAL IMPACT

The positive and negative impacts associated with the proposed project vary both spatially and temporally depending on the baseline environmental quality along the targeted section as well as the scale and nature of project intervention during the various stages of the project. The Scoping Matrix below summarizes various environmental and social components that are likely to be affected by the project.

Table 15.1 Generic Scoping Matrix for Hilly/Mountainous Road

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Natural Environment				
Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected as the project in this stage does not affect climate.
				C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
Topography	D	B-	D	P: No impact is expected as no change to topography will be made in this stage.
				C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
				O: Topographic condition will b stable after the completion of construction work which include slope protection and slope stabilization.
Geology	D	D	D	P, C, O: No impact is expected as the project does not change geological feature of the project area.
Soil Erosion	D	B-	B+/ B-	P: No impact is expected.
				C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
				O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
Hydrology	D	C-	C-	P: No impact is expected.
				C: Construction work may cause minor, temporary impacts on hydrology.
				O: Cutting and/or filling may result in changes in local hydrology. The impact should be managed through adequate drainage measures.
Groundwater	D	D	D/ B-	P: No impact is expected since no engineering work will be carried out at this stage.
				C: The project does not envision the use of groundwater and thus no impact is expected. If the tunnel is constructed for bypass sections, however, appropriate measures should be undertaken to avoid/minimize the impact.
				O: No impact is expected during the operation stage, but measures should be undertaken if the project involves construction of tunnel.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected as no engineering work will be carried out at this stage.
				C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work could affect mountain ecosystem and local flora and fauna including jhum and plantation.
				O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
Protected Areas/Forest	D	B-	B-	P: The highways proposed for expansion/improvement does not traverse or border with national parks. However, one of the proposed road (NH62 in Meghalaya) traverses reserve forest.
				C: By the construction work, some of the forest area will be opened up.
				O: The level of sunshine may increase due to the expansion of the open area, potentially influencing the vegetation in the edge of the forest. Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem.
Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.
Landscape	D	D	B+	P: No impact is expected as no engineering work will be carried out at this stage.
				C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
				O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region.
Natural Disaster	D	B-	B+	P: No impact is expected since the project at this stage does not alter existing condition.
				C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
				O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment				
Air Pollution	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
				O: Air pollution is expected to increase due to increase traffic volume on the road.
Offensive Odor	D	D	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
Water Pollution	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
Bottom Sediment Contamination	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
				C: Some construction materials such as cement and sand are expected to be washed out mainly by the rain, but the impacts on bottom sediment are expected to be negligible.
				O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
Soil Contamination	D	C-	D	P: No impact is expected as no engineering work is carried out at this stage.
				C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
				O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
Ground Subsidence	D	D	D	P/C/O: No impact is expected. The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.
Noise/ Vibration	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
				O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
Sunshine Obstruction	D	D	D	P/C/O: No impact is expected since the project does not involve construction of tall building that may block sunshine.
Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
				C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
				O: Waste will be generated from road users and workers of maintenance works.
Social Environment				
Involuntary Resettlement	A-	A-	A-	P: The project will result in large-scale involuntary resettlement, particularly in built-up areas where structures exist in both sides of the road. Minimizing the resettlement should be the priority for road design.
				C: Temporary relocation might be required for accommodation of construction yards and workers' camps. Resettlement may cause cultural and social conflict between resettling people and host community.
				O: Resettlement may cause cultural and social conflict between resettling people and host community.
Land Use	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
				O: Greater traffic volume may affect the use of road and surrounding area by local residents. Uncontrolled jhum (shifting cultivation) along the road may undermine the effectiveness of slope protection/ stabilization measures and increase the risk of land slide and soil erosion.
Utilization of Local Resources	D	A-	A-	P: No impact is expected.
				C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.
				O: Improvement in road infrastructure may change the flow of commodity distribution, potentially impacting the use of local resources.
General, Regional /City Plans	D	D	C+/ C-	P: No impact is expected.
				C: No impact is expected.
				O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
Social Institutions and Local Decision-making Institutions	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to affect social institutions such existing as social capital and local decision-making institutions.
				C: Existing as social capital and local decision-making institutions will be affected by the influx of resettling population and construction workers.
				O: Existing as social capital and local decision-making institutions will be affected by the influx of resettling population.
Social Infrastructure and Services	A-	A-	A-	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.
				C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
				O: The resettlement can result in prolonged disturbance in social infrastructure and services. In the long term, however, the project is expected to improve access to social infrastructure and services by providing better road network.
Local Economy and Livelihood	A-	A-	A-	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
				C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
				O: The project may trigger unintended side effect with detrimental impact on local community, e.g. influx of non-local people and more competition in business and pressure on local natural resources. Over the long term, the project is expected to have positive impact on local economy as improved road network ensures more stable supply of essential goods. However, the end of construction work may create short-term unemployment of construction workers.
Unequal Distribution of Benefit	A-	A-	A-	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
and Damage				C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage
				O: People residing along the road may accrue greater benefits compared with others, potentially increasing rich-poor gap within the community.
Local Conflicts of Interest	A-	A-	A-	P/C/O: Unequal distribution of benefit and damage may trigger and/or intensify local conflicts of interests in the community.
Water Usage, Water Rights and Communal Rights	C-	C-	D	P: Water usage and water rights of the affected households may be curtailed due to resettlement. However, irrigation is not common in the region and thus, the impact will be minor, if any.
				C: Disturbance to water usage, water rights and communal rights during construction work is expected to be minor and short-term in nature. However, communal rights and distribution should be carefully examined to avoid negative impacts.
				O: No impact is expected.
Cultural and Historical Heritage	C-	C-	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage. There are, however, several observation decks and memorial stones along the road which may be affected depending on the widening width.
				C: Several observation decks and memorial stones along the road which may be affected depending on the widening width.
				O: No impact is expected.
Religious Facilities	A-	A-	A-	P: Several memorial stones and graves are located along the road and may be affected depending on the widening width. Small religious facilities in built-up areas may also be affected.
				C/O: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	A-	A-	P: Community facilities (public halls etc.) will have to be relocated incase road widening is implemented within the built-up area.
				C: Noise and vibration during construction work may affect school and hospitals.
				O: These facilities can be affected due to noise and vibration resulting from increase in traffic volume. Also, congestion may undermine the utility of such facilities.
Poor People	A-	A-	A-	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures.
				C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
				P: In the long-term, economic development in the region is likely to benefit the poor, however, the poor may fail to benefit from the project due to the lack of skills and coping capacity
Ethnic Minorities/ Indigenous People	A-	A-	A-	P/C/O: North East States are home of diverse tribal groups (Scheduled Tribe) with distinct language and cultures. Preparation of RAP and livelihood restoration plan, therefore, must take into account this diversity.
Gender	D	C-	B+	P: No impact is expected.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
				C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
				O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
Children's Rights	D	D	D	P: No impact is expected at this stage.
				C/O：Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected at this stage.
				C: Influx of construction workers is likely to increase the health risk, particularly that of STD/STI and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
				O: An increase in traffic volume and road users may have negative impact on public health.
Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected at this stage.
				C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
				O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Other				
Accidents	D	B-	C+/ C-	P: No impact is expected as the project at this stage does not alter existing condition.
				C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
				O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
Climate Change	D	B-	B+/ B-	P: No impact is expected.
				C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
				O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
Source: JICA Study Team

Table 6.2 below shows the Scoping Matrix specific for NH51. This has been prepared based on the environmental assessment, taking into account specific project features as well as of as environmental and social conditions. The item is highlighted if likely impact after the assessment is found to be larger than estimated in generic scoping matrix.

Table 15.2 Scoping Matrix for NH54 Widening and Improvement

Sl.	Item	Scoping Result			Rational of Assessment
		P	C	O	
Natural Environment					
1.1	Climate/ Meteorological Phenomena	**D**	**D**	**D**	P: No impact is expected as no engineering work is carried out at this stage.
					C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
1.2	Topography	**D**	**B-**	**D**	P: No impact is expected as no engineering work is carried out at this stage.
					C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
					O: Topographic condition will be stable after the completion of construction work which include slope protection and slope stabilization.
1.3	Geology	**D**	**D**	**D**	P/C/O: No impact is expected as the project does not alter geological condition of the area.
1.4	Soil Erosion	**D**	**B-**	**B+/B-**	P: No impact is expected as no engineering work is carried out at this stage.
					C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
					O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
1.5	Hydrology	**D**	**B-**	**B-**	P: No impact is expected as no engineering work is carried out at this stage.
					C: Construction work may cause minor, temporary impacts on hydrology.
					O: Cutting and/or filling may result in changes in local hydrology. New drainage and culvert will be installed, taking into account the likely water flow in the area.
1.6	Groundwater	**D**	**D**	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: The project does not envision the use of groundwater and thus no impact is expected. However, appropriate measures should be undertaken to properly manage effluent during construction.
					O: No impact is expected during the operation stage.
1.7	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected. No unique/endangered species have been identified during assessment.
					C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work will affect mountain ecosystem and local flora and fauna including jhum and plantation.
					O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
1.8	Protected Areas/Forest	**D**	B-	B-	P: The targeted section of NH54 does not traverse or border with national parks or protected forest.

					C: By the construction work, some of the forest (including plantation and village forest) area will be affected.
					O: Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem. Monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary.
1.9	Coastal Zone	**D**	**D**	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.
1.10	Landscape	**D**	**D**	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
					O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region. Bus bay and other road amenities also help improve aesthetic conditions of the road.
1.11	Natural Disaster	**D**	**B-**	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
					O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment (Pollution Control)					
2.1	Air Pollution	**D**	**B-**	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
					O: Air pollution is expected to increase due to increase traffic volume on the road. Relevant data (e.g. actual/projected traffic volume) shall be shared with relevant State authority so that mitigation measures can be developed.
2.2	Offensive Odor	**D**	**D**	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
2.3	Water Pollution	**D**	**B-**	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
					O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
2.4	Bottom Sediment Contamination	**D**	**B-**	D	P: No impact is expected.
					C: The project involves construction of new small bridges. Silt-trap will be used to avoid construction materials such as cement and sand being washed out during construction work.

					O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
2.5	Soil Contamination	**D**	**D**	D	P: No impact is expected as no engineering activity will be carried out at this stage
					C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
					O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
2.6	Ground Subsidence	**D**	**D**	B+	P/C: No impact is expected as existing conditions will not be altered.
					O: The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.
2.7	Noise/ Vibration	**D**	**B-**	B-	P: No impact is expected.
					C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
					O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
2.8	Sunshine Obstruction	**D**	**D**	D	P/C/O: No impact is expected.
2.9	Wastes/Hazardous Materials	**D**	**B-**	B-	P: No impact is expected.
					C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
					O: Waste will be generated from road users and workers of maintenance works.
Social Environment					
3.1	Involuntary Resettlement	**A-**	**D**	D	P: The project will result in large-scale involuntary resettlement, particularly in built-up areas near Tura and Dalu where structures exist in both sides of the road. Minimizing the resettlement should be the priority for road design.
					C: Resettlement will be completed before construction begins and thus no resettlement is expected during operation
					O: No impact is expected, as relocation will be completed before construction begins.
3.2	Land Use	**A-**	**A-**	D	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.
					C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
					No impact is expected as sufficient slope protection/stabilization measures to protect land use.
3.3	Utilization of Local Resources	**D**	**A-**	D	P: No impact is expected.
					C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.

					O: No impact is expected as use of local resources is not expected during operation.
3.4	General, Regional /City Plans	**D**	**D**	D	P: No impact is expected.
					C: No impact is expected.
					O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
3.5	Social Institutions and Local Decision-making Institutions	**D**	**D**	D	P/C/O: No impact is expected as there will be no change in social institutions and local decision-making institutions such as village councils and women groups
3.6	Social Infrastructure and Services	**A-**	**A-**	B+	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.
					C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
					O: The project is expected to improve access to social infrastructure and services by providing better road network.
3.7	Local Economy and Livelihood	**A-**	**A-**	B+	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
					C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
					O: The project will have positive impact on local economy as improved road network ensures more stable supply of essential goods. In the long-term, this will lead to regional economic development with more job and business opportunities.
3.8	Unequal Distribution of Benefit and Damage	**A-**	**A-**	D	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.
					C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage.
					O: No impact is expected as the project is an improvement of an existing road and the road will continue as before to accrue benefits to those along the road.
3.9	Local Conflicts of Interest	**D**	**D**	D	P/C/O: No impact is expected as the project is an improvement of an existing road and structures/services will be equally restored
3.10	Water Usage, Water Rights and Communal Rights	**D**	**D**	D	P/C/O: No impact is expected as rain water is used for both household and agricultural use
3.11	Cultural and Historical Heritage	**C-**	**D**	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage.
					C/O: No impact is expected as the project will not affect cultural and historical heritages
3.12	Religious Facilities	**A-**	**A-**	D	P: Several memorial stones located along the road may be affected. Small religious facilities in built-up areas may also be affected.

					C: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
					O: No impact is expected as sufficient noise control measures will be implemented.
3.13	Sensitive Facilities (ex. hospital, school, precision machine factory)	**B-**	**B-**	D	P: Small community facilities (public halls etc.) may have to be relocated incase road widening is implemented within the built-up area.
					C: Noise and vibration during construction work may affect school and hospitals but the impacts are expected to be minor.
					O: Greater traffic volume is expected to increase noise and vibration level, but adequate mitigation measures will be implemented.
3.14	Poor People	**A-**	**A-**	D	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures to be included in rehabilitation plan.
					C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
					P: No impact is expected. In the long-term, economic development in the region is likely to benefit the poor.
3.15	Ethnic Minorities/ Indigenous People	**A-**	**A-**	D	P/C/O: Tura-Dalu section of NH51 is mainly inhabited by Garo people, registered Scheduled Tribe in India, with distinct culture and language. Preparation of RAP and livelihood restoration plan, therefore, must take into account this factor.
3.16	Gender	**D**	**C-**	B+	P: No impact is expected.
					C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
					O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
3.17	Children's Rights	**D**	**D**	D	P: No impact is expected.
					C/O：Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
3.18	Public Health (sanitation and infectious diseases)	**D**	**B-**	B-	P: No impact is expected.
					C: Influx of construction workers is likely to increase the health risk, particularly that of STD and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
					O: An increase in traffic volume and road users may have negative impact on public health.
3.19	Occupational Health and Safety (OHS)	**D**	**B-**	B-	P: No impact is expected.
					C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
					O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Others					
4.1	Accidents	**D**	**B-**	B+/B-	P: No impact is expected as the project at this stage does not alter existing condition.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.

					O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
4.2	GHG emissions	**D**	**B-**	B+/B-	P: No impact is expected.
					C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
					O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,

Source: JICA Study Team

CHAPTER 16 ASSESSMENT OF IMPACT AND MITIGATION MEASURES

Widening and improvement of the targeted section of NH51 involves major upgrading works including relaying of pavement and widening road width to 12 m. The proposed project will have both positive and negative impacts on the surrounding environment during different stages of the project planning and implementation. This chapter assesses the nature, type and magnitude of the potential negative impacts on the various relevant environmental and social components along the project area as identified during the Scoping stage (see Chapter 6). For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

16.1 Natural Environment

16.1.1 Climate (1.1[7])

Pre-Construction and Construction Phase

Since the proposed project is only widening and strengthening to 2 lane road, no change in the macroclimate i.e. precipitation, temperature and wind is envisaged. However, there will be localized, temporary impact due to vegetation removal and the creation of paved surface for road. There may be an increase in daytime temperature around alignment due to loss of vegetation. The impact will be more prominent at locations where the cutting of trees is in clusters.

Operation Phase

During operation phase, increased traffic plying will lead to increase in temperature levels locally along the carriageway though it will be insignificant and temporary.

16.1.2 Topography and geology (1.2, 1.3)

Pre-Construction and Construction Phase

The change in topography (that of existing) is envisaged to some extent at various places along the entire length of the road while developing 2 lane standard. The change in topography will also happen due to operation of borrow areas. The construction of material handling yards and labor camps will also alter the existing topography temporarily.

Operation Phase

During the operation phase, there will be probable induced developments in the form of tourism and

[7] The number in bracket corresponds to the serial number in Scoping Matrix (Table 6.1)

commercial establishments along the highway. During monsoon, the change in topography will also be visible due to landslide and damage to side slope and breast wall. The benefits in the form of land leveling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

Mitigation Measures

During construction phase, the existing vegetation including shrubs and grasses along the route (except within the strip directly under embankment or cutting) will be properly maintained. The borrow areas shall be operated and closed as per the specifications for road and bridge construction manual of MORTH. The borrow areas shall be filled with the rejected waste/material, spoil and then finally a layer of topsoil shall be spread over it before carrying out plantation and turfing.

During operation phase, maintenance of embankment will be carried out to avoid soil erosion. The slope protection/ retaining wall if damaged due to land slide will be repaired promptly. The slope protection will also be established/strengthened regularly through plantation of shrubs and vegetation.

16.1.3 Soil Erosion (1.4)

Pre-Construction and Construction Phase

Site preparation will involve demolition of building, clearing of brushwood, tree removal and temporary re-routing of utilities. This brings risks of erosion to the exposed ground and topsoil. The soil erosion in construction stage may take place at the slope of the embankments, construction sites of cross drainage structures, at borrow areas and at construction sites which will be cleared.

Operation Phase

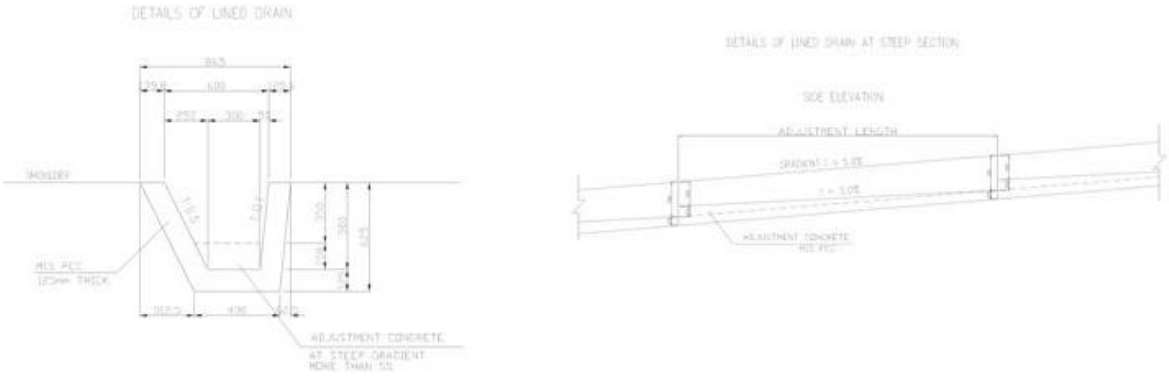
The soil erosion in operation stage may take place during operation at side slopes of road and near the approaches to bridges and interchanges. The risk is higher during monsoon.

Mitigation Measures

To control roadside soil erosion, turfing with grasses and shrubs will be carried out in accordance with the recommended practice in IRC guidelines. At the locations of steep slopes near crossings of highway with major rivers suitable protection measures such as stone pitching will be adopted. The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent erosion control measures to prevent soil erosion that will adversely affect construction operations, damage adjacent properties or cause contamination of nearby streams or other

watercourses, village ponds or water bodies etc. The green belt will be developed simultaneously along with construction activities to control the erosion process. In addition, gabion and apron concrete will be installed at the outlet of culverts to avoid soil erosion due to water runoff.

During the operation phase, the slope protection measures like sodding, turfing shall be done and monitored regularly. The green belt will be monitored and replantation for the loss of plants species will be done immediately. The side ditch on road is designed as concrete lined ditch for all section of cut side to prevent damage from water runoff. General arrangement plan for side ditch is shown in figure below.



Source: JICA Study Team

Figure 16.1 General arrangement plan for side ditch

16.1.4 Hydrology (1.5)

Pre-Construction and Construction Phase

Potential impact on hydrology will be minor, as the project does not involve diversion or re-routing of existing water resources. However, the existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

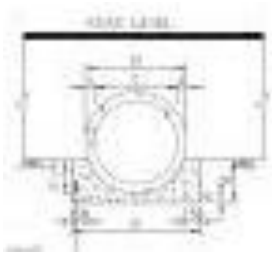
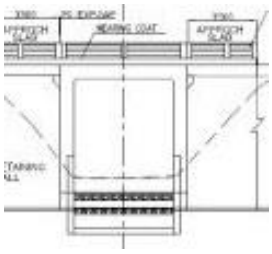
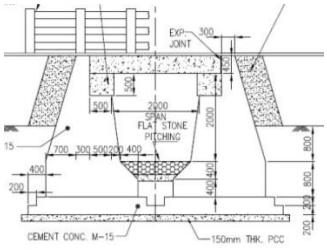
Operation Phase

The projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies.

Mitigation Measures

The new drainage system is designed by based on hydrological calculation result. Based on obtained location of water crossing and water discharge, dimension and locations for drainage system are determined. For cross drainage structure, appropriate culvert type is selected by taking account of economy, construction workability, and maintenance ability. Comparison of different culvert types is shown below. In principle, pipe culvert is used where the water discharge is comparably small. BOX culvert is proposed where the water discharge is comparable large. The size is determined to satisfy the water discharge obtained by hydrological calculation.

Table 16.1 Comparison for culver type

	Pipe culvert	BOX culvert	Slab culvert
Layout			
Economy	◎	○	△
East of Construction	◎	○	△
Durability	○	○	△
Capacity	○	◎	◎
Comment	To be applied for small discharge point	To be applied for large discharge point	Not applied

Source: JICA Study Team

16.1.5 Groundwater (1.6)

No tunnel is proposed in this project and as such, the project will not affect groundwater level or quality in the area. If contractor propose to use water from under surface water source, however, permission from the Water Resource Department and Local Administration is mandatory. The contractor is expected to properly manage effluents and waste water during the construction stage to avoid potential influence to the groundwater.

16.1.6 Ecosystem, Flora, Fauna and Biodiversity (1.7)

The main impact on flora involves the removal of trees and grubbing of vegetative cover for construction and a clear zone within the Right of Way (ROW) and for spoil bank. Widening of the 1-lane to 2 lanes would have negative impact on plant species by way of cutting the trees and shrubs

for construction activities. The types of impacts on flora can be as follows:

- Loss of trees;
- Loss of canopies;
- Compaction of vegetation, and
- Pollution and dust accumulation on vegetation.

Meghalaya is one of the wettest regions in the world and home of rich biodiversity. Meghalaya biodiversity board has listed 139 mammals, 540 birds, 94 reptiles, 33 amphibians and 152 fish species in the State. While no unique faunal community has been found in the proximity of the project area, signboards will be used to make sure that workers will be aware of the important species during the construction state to promote conservation. Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with State Environment and Forest Department with which the project authority will discuss potential measures to promote conservation and monitoring of ecosystem shall be carried out as was undertaken during the EIA study. In addition to the efforts to minimize the scale of forest clearing and impacts associated with construction activity, following measure will be taken care during construction phase to avoid collision of some wild as well domestic animals:

- It is suggested that regular monitoring by the forest department should be done;
- Anti-poaching measures during construction phase should be strengthened to check violation of existing regulations;
- Side barriers will be provided to avoid collision of animals in forest area; and
- Animal under passes will be provided at various suitable locations to avoid accident.

<u>Mitigation Measures</u>

The tree plantation felled will be replaced and compensated according to the Compensatory Afforestation Policy under the Forest Conservation Act, 1980. Apart from trees earmarked for feeling, no additional tree clearing within the ROW will be allowed. All construction workers should adhere to this rule.

Plantation of shrubs and under trees in the median shall be undertaken to prevent the glare of the vehicles coming in the opposite direction. Construction vehicles, machinery and equipment will move or be stationed in the (ROW) to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil will be avoided.

Construction of road will involve removal of topsoil and cutting resulting in clearing of vegetation cover and felling of trees. However such impacts will primarily occur at the project site during initial period of the construction phase and will be minimized through adoption of mitigation measures. It is recommended that the lost trees will be compensated at 1:3 ratio. The site of compensatory afforestation will be specified by the Forest Department during the process of obtaining forest clearance. As per its guidance, the project proponent will plant saplings (types and number to be specified) at designated location (either degraded forest or vacant/abandoned jhum area).

Following measure will be taken during construction phase.

- It is suggested that regular monitoring by the forest department should be done. In keeping view of likely increase in vehicular emissions in the future, the monitoring should include the assessment of impact due to greater air pollution;
- A suitable landscaping plan for the project road has been prepared to enhance the ecological status of the area;
- It was noticed, that the project road did not have tree cover at few locations (Jhum lands) tree plantation at these location will enhance the aesthetics as well as reduce the pollution level of the area; and
- Initiative should be taken to remove the impacted small girth size trees with the help of Forest Department and replanted them at designed place. Though cost involvement against this type of work can be high, it will save the life of growing plants.

Improved road network may trigger poaching. At the moment, educational activities and removal of traps by rangers are undertaken to reduce poaching. While NHIDCL is not responsible for the control of poaching, a proposal shall be made to relevant authority regarding the potential increase in poaching and the necessity of adequate management system, such as restriction of precious wildlife trade.

16.1.7 Protected Areas/Forest (1.8)

Pre-Construction and Construction Phase

The project road does not traverse or border with national park, wildlife sanctuary or reserved forest. As discussed above, however, the project will cause deforestation due to removal of trees and grubbing of vegetative cover for construction and a clear zone within ROW. Based on the field survey

and satellite data, forest area accounts about 53.2% of the area to be acquired (or 41.8 ha out of 78.6 ha).

Operation Phase

Increases in traffic volume are likely to have negative impact on forest ecosystem.

Mitigation Measures

At the planning stage, efforts to avoid or minimize the number of trees to be cut have been done as part of the design for widening of the road. There will also be measures including replanting the trees at suitable location during the construction stage. Further the plantation at the Jhum lands can also be taken up as a part of plantation program for the loss of tress. See also section 7.1.6 for measures for deforestation.

16.1.8 Landscape (1.10)

No site of significant scenic value has been identified along the targeted section of NH51. However, road and traffic markings to be installed in accordance with IRC:35-1997 will ensure smooth and orderly flow of traffic and contributes to better aesthetic condition of the road by reducing congestion.

Buses standing indiscriminately on the carriageway to drop or pick-up passengers can seriously affect capacity of the roadway, besides being a source of accidents. It is, therefore, desirable that on all busy non-urban highways, consideration should be given to the construction of bus lay-byes of suitable design at required locations to ensure orderly movement of the through traffic. For convenience of tourists, it is also proposed that bus bay will be equipped with amenities including public toilets and bazar shed.

Table 16.2 Proposed Bus Bay Locations for NH51

No.	Location	Distance from Babadam (km)	Section Length (km)
1	Babadam	-	
2	Champarea	0.2	0.2
3	Ganol	1	0.6
4	Rongan Hiran	4	3
5	Dap. of Agriculture Rongkhon	6	3
6	Tura	8	2
7	Dadaungiri	19	10
8	Rubber	19	0.2
9	Purakashya	26	7
10	Chokpot	30	4
11	Moropgre	41	12
12	Rengsipara	47	6
13	Rendapara	48	0.8
14	Megupara	55	7
15	Purakhasia	56	0.9
16	Dalu	57	1

Source: JICA Study Team

In most cases, effluents from existing public toilet along NH51 are discharged without any treatment. For new public toiles to be constructed in bus bays or replacement of existing toilets that will be affected by the road widening, septic tack or toilet with an opening for collecting night soil will be installed to reduce negative impacts.

16.1.9 Natural Disaster (1.11)

Slope along NH51 is covered by very loose quaternary alluvium. It is concerned that slope failure and erosion have frequently occurred on cut slope along NH51. Therefore, such loose soil slope shall be cut with 1:1.2 gentler than IRC standard for landslide prevention as shown below. The cut slope shall be greened by seeding and mulching consisting of jute netting including seeds which cover all over the slope and prevent erosion by rain water. See also section 7.1.3 and 7.1.4 for measures to improve road resilience against disaster.

Table 16.3 Design Criteria of Cut Slope and Slope Protection Work

IRC Standard*		JICA Study Team		Cut	Slope Protection Work
Classification	Cut Grade	Rock/Soil Classification		Grade	
Ordinary Soil/ Heavy Soil	**1:1.0 ~ 1:0.5**	Soil	Dense Soil	**1:1.0**	Seeding and Mulching
			Loose Soil	**1:1.2**	Seeding and Mulching

*IRC: SP:48:1948 Clause 7.4
Source: JICA Study Team

Inproper maintenance of road facilities such as sediment deposition in culverts can cause natural disasters or exacerbate their impacts. NHIDCI will be responsbible for regular maintenance of road facilities to reduce the risk of natural disaster during the operation period.

Frequency and intensity of heavy rain is likely to increase due to climate change. In the project area, an increase of annual rainfall is predicted to be 5-10% for the period from 2021 to 2050. The design of various components of the road (slope protection, drainage etc.) takes into account likely effect of climate change. With increase of the rainfall frequency and intensity, river water and groundwater level are expected to be high, which could cause inundation and damage to the road facilities. Therefore, spring water points have been carefully studied and subsurface drainage is proposed where necessary. Flood marker was checked in site reconnaissance and interview survey for the disaster countermeasure design to inform the road design. The table below shows adaptation measures for climate change taken into consideration in this road design.

Table 16.4 Adaption Measures for Climate Change in NH51

Factor	Design Policy considering Adaptation
Side Slope	· Retaining wall is built all along the road. · Slope protection work is constructed on some weathered and loosen slopes. · Cut slope is covered with vegetation works to prevent erosion and collapse. · Replacement of subgrade and subsurface drainage are planned as countermeasure against sinking.
Embankment	· Drain filter is sandwiched in embankment. · Flood level is confirmed in site reconnaissance and interview survey near river bank in south of NH51.
Bridge & Drainage System	· Rainfall intensity is carefully determined based on the authorized data : ATLAS of Statewise Generalised ISOPLUVIAL MAPs of Eastern India published by Indian Meteorological Department. The isopluvial value from higher edge of counter range is applied. · The capacity of all structures is determined to be capable for the discharge of 50 years return period.
Pavement	· Super elevation is installed properly. · Pavement material is examined not to rise over 60 °C on the surface.
Road Sign	· Wind load and visibility is taken into consideration.

Source: JICA Study Team

16.3 Living Environment

16.3.1 Air Pollution (2.1)

Pre-Construction and Construction Phase

The short-term and localized degradation of air quality will occur from dust generation due to procurement and transport of raw materials from quarries and borrow pits, site clearance, use of heavy vehicles, machinery/ equipment, stone crushing handling and storage of aggregates and generation of fine particulate matter (smoke) in asphalt processing. Dust would be generated from haulage of materials and detouring of traffic on non-permanent, temporary pavement etc.

Hot mix plants contribute substantially to the deterioration of air quality due to emissions of oxides of Sulphur, Hydrocarbons and particulate matter. During the construction period, temporary impacts include generation of Odor from construction activities as well as from construction camps. During construction of road, the movement of different types of construction machinery and vehicle will be increased. This in other way increases the fuel consumption.

From the results of the ambient air quality monitoring conducted along the road, it is noticed that the monitoring parameters are within the standards as prescribed by the Central Pollution Control Board The concentration of the air pollutants will further increase during construction period but for limited period only. The impacts on air quality during construction will be mostly localized and concentrated within the ROW. The impacts due to dust generation may felt downwind of the site rather than the site itself due to local wind pattern.

Operation Phase

The project road is mostly passing through the rural areas with alluvial soil. Dust generation due to movement of vehicles is envisaged along the project road, but not in significant amount. Due to increase in speed and volumes of vehicular traffic on the project corridor, marginal increase in the air pollutant levels is expected but not significant. Widening of road will attract larger community to use this corridor which in-turn increase the fuel consumption and has direct impact on national economy and local ecosystem.

Mitigation Measures

The hot mix plants, crushers and the batching plants will be sited at least 500 m in the downwind direction from the nearest settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants will be taken up. The hot mix plant will be fitted with

dust extraction system. Asphalt and concrete plants will be operated in conformity with government pollution control legislation, and located away from the settlements as far as possible. All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. Regular monitoring of particulate Matter at crusher sites, during the construction, will be conducted. Regular water sprinkling will be done on the cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork, water will be sprayed to prevent dust emission. The vehicles delivering construction material will be covered to avoid spilling. Planting of trees/vegetation on the periphery of the construction site will be taken up.

During the operation stage of the project, vehicular emissions of critical pollutants (RSPM, CO, HC, SO_2, and NO_x) will be monitored and roadside tree plantation will be maintained. Over the long-term, projected increase in traffic volume, particularly ones of heavy trucks, may pose health threat in roadside community. The peak hourly estimated traffic volumes for the years 2020 and 2035 have been considered to project future air quality scenarios to provide an indication of long-term variations in air quality. The future level of air pollution, modeled based on the projected increase in traffic volume indicates that the level of pollution (CO and NOx levels) will remain below the standard during the projected period (2035). Nevertheless, mitigation measures such as introducing speed limit and other measures to control congestion in built-up area may be necessary in the longer term. Also, local communities should be well informed of the risk of air pollution. Awareness raising campaign may include distribution of facemask to mitigate risk of air pollution and other information kit.

16.3.2 Water Pollution (2.3)

Pre-Construction and Construction Phase

The Tura-Dau section of NH51 traverses one small stream, and passes through paddy area near Dalu. Road projects may marginally lead to increased run-off during construction stages, which will increase sediment accumulation in nearby water bodies. Though most of the natural watercourses are perennial in nature, the impacts due to the increased run-off would be negligible due to the project road. During construction, the disposal of solid and liquid waste from labor camps, fuel and lubricant spills or leaks from construction vehicles, pollution from fuel storage and distribution sites and that from hot-mix plants is likely to affect water quality unless adequate mitigation measures are designed. The existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

Use of water for construction activities such as compaction, suppression, concrete work may pose pressure on local water supplies; the demand would be met from surface water bodies like ponds, canal and rivers. Municipal water supply will be used only for drinking purposes (for construction camps), if available and if permitted by the local municipal authority. No local/municipal water supply would be used for construction purpose.

Operation Stage Impacts

Road projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies. Though most of the natural watercourses are non-perennial in nature, the impacts due to the increased run-off would be negligible due to the project road and will be restricted only during monsoon and early part of post-monsoon seasons.

In the operation stage, pollutants from vehicles, and accidental fuel spills may make their way into the receiving environment. The major pollutants of concern are suspended solids, oil and grease, lead etc. All the rivers present at this road section are non-perennial surface water bodies. No adverse direct impact on the water quality (both underground and surface water bodies) is expected during the operation period. The change in natural drainage pattern is very insignificant from the present state of the project.

Mitigation Measures

To avoid contamination of the various water bodies and drainage channels, construction work close to the canals or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per the State Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to approve disposal sites.

To avoid contamination of the water body and drainage channels from fuel and lubricants, the vehicles and equipment will be properly maintained and re-fuelled only at designated places. The slopes of embankment leading to water bodies will be modified and re-canalized so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water.

Discharge of oil and grease is most likely from construction vehicle parking area, vehicle repair area and workshops. An oil interceptor shall be provided to ensure that all wastewater flows into the interceptor prior to its discharge. The device has a chamber for separation of oil and water and can handle 200 L/hour of wastewater. The oil float appearing on the surface is removed by periodic cleaning once a week by skimming off the oil film from the surface.

The sewage system (including septic tanks and soak pits) for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse. The workplace will have proper medical approval by local medical, health or municipal authorities. The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Due to the non-availability of water required for construction, if a new tube-well is to be bored, prior sanction and approval by the Central Ground Water Board (CGWB) will be obtained. Wastage of water during the construction will be minimized.

16.3.3 Bottom Sediment Contamination (2.4)

It is proposed that one 6m long bridge will be replaced with the new one and the super-structure of seven small bridges will be replaced. During engineering work of the bridges over the rivers, sediment pollution may occur. As one of the mitigation measures, silt fencing will be provided to restrict runoff into the water during construction phase.

16.3.4 Soil Contamination (2.5)

Pre-Construction and Construction Phase

The contamination of soil during construction stage is primarily due to construction and allied activities. The soil contamination may take place due to solid waste from the labor camps set- up during construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. The contamination of soils can also occur at the site of hot-mix plants from leakage or spillage of asphalt or bitumen. At the site of batching plants, because of spillage of cement, leakage of curing agents the soil contamination can occur. The contamination of soil may take place due to dumping of solid waste in unscientific manner, leaching of fuel/oil & grease from workshops, petrol stations and DG sets.

Operation Stage Impacts

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can belong term and irreversible depending upon the extent of spill.

Mitigation Measures

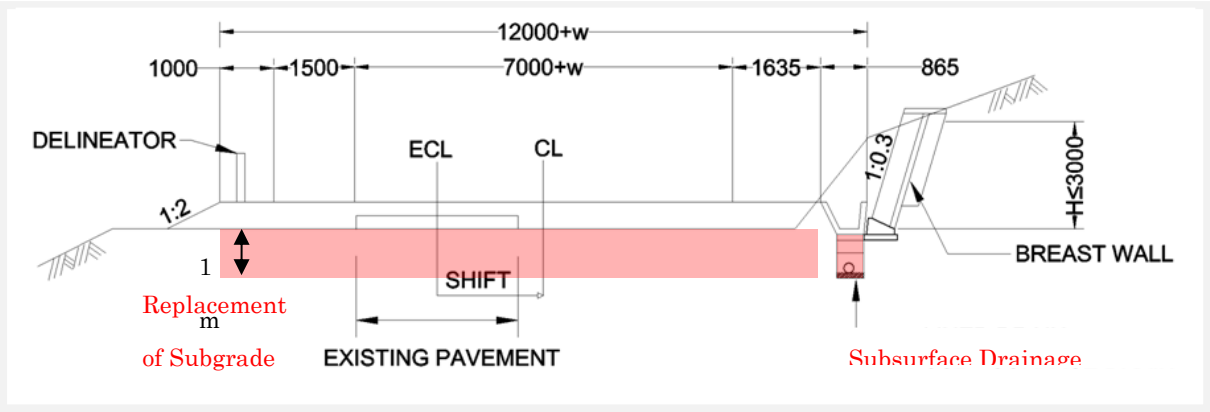
At construction yards, the vehicles/equipment will be maintained and re-fuelled in such a fashion that oil/diesel spillage does not occur and contaminate the surrounding soil. It will be ensured that the fuel storage and re-fuelling sites are kept away from drainage channels and important water bodies. At the washdown and re-fuelling areas, "Oil Water Separators" shall be provided. All spills and discarded petroleum products shall be disposed off in accordance to the Hazardous Waste Management and Handling Rules. Fuel storage and re-fuelling areas will be located at least 500 m from all water bodies near the road alignment. The fuel storage and re-fuelling areas shall not be located on agricultural lands or productive lands to avoid topsoil contamination. The earthwork will be carried out strictly in accordance with the design so that no excess earth is borrowed. The construction waste generated will be reused in the construction of highway.

Bituminous waste will be used after milling and in case bituminous waste is required to be disposed off it shall be disposed in secured way by providing 50 mm tick clay layer. The solid waste generated during construction phase which includes municipal waste both organic & inorganic in nature which shall be stored/treated/disposed off in accordance with Municipal Solid Waste (Management & Handling) Rules. The hazardous waste may include oil waste, biomedical waste, E-waste etc. This shall be disposed off in accordance with the Hazardous Waste (Management, Handling & Transboundary Movement) Rules, Biomedical Waste (Management and Handling) Rules and E-Waste (Management and Handling) Rules respectively.

In the operation stage, the petrol pumps & vehicle washing area located along the ROW will be monitored regularly for any spillages and corrective remedial measures like spread of sand, provision of oil & greases separators for passing wash water of petrol pumps & vehicle washing area before diverting it to water bodies shall be done regularly. The solid waste generated from the way side amenities will include Municipal Waste both organic and inorganic, hazardous waste (like used batteries), will be treated in accordance with Municipal Solid Waste (Management & Handling) Rule and Hazardous Waste (Management, Handling & Transboundary Movement) Rules.

16.3.5 Ground subsidence (2.6)

Many road subsidence sites have been identified in the slope inventory survey, which was assumed to occur due to consolidation of loosen subsurface soil and high groundwater level except for embankment sliding. Replacement of subgrade with 1.0m thick and subsurface drainage is planned as countermeasures of sinking as shown in below Figure, which will significantly improve the existing condition.



Source: JICA Study Team

Figure 16.2 Typical Cross Section of Countermeasure for Sinking

16.3.6 Noise and vibration (2.7)

Pre-Construction and Construction Phase

During the construction, the major sources of noise pollution are movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A). The major work will be carried out during the daytime. The noise levels in the project area during the construction stage will be intermittent and temporary in nature. Typical noise levels associated with the various construction activities and construction equipment are presented below.

Table 16.5 Typical Noise Levels of Construction Equipment

Construction Equipment	Noise Level dB(A)
Bulldozer	80
Front end loader	72-84
Jack hammer	81-98
Crane with ball	75-87
Crane	75-77
Bulldozer	80

Backhoe	72-93
Front end loader	72-84
Cement & Dump trucks	83-94
Jack hammer	81-98
Scraper	80-93
Welding generator	71-82
Grader	80-93
Roller	73-75
Concrete mixer	74-88
Concrete pump	81-84
Concrete vibrator	76
Paver	86-88
Truck	83-94
Tamper	74-77
Air compressor	74-87
Pneumatic tools	81-98

Source: U.S. Environmental Protection Agency, noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. 300.1. December 31, 1971

At the moment, noise level is within the desired level. The noise level will be increased during construction period, which have significant impact for a limited period on the surrounding environment. The noise levels in the working environment are compared with the standards prescribed by Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by Government of India through Model rules framed under the Factories Act. The acceptable limits for each shift being of 8 hour duration, the equivalent noise level exposure during the shift is 90 dB(A). Hence noise generated due to various activities in the construction camps may affect workers, if equivalent 8 hour exposure is more than the safety limit. ACGIH (American Conference of Government Industrial Hygienists) proposed an 8 hour Leq limit of 85 dB(A). Exposure to impulses or impact noise should not exceed 140 dB(A). The workers in general are likely to be exposed to an equivalent noise level of 80-90 dB(A) in an 8 hour shift for which all statutory precautions as per laws should be taken into consideration.

Operation Stage Impacts

During the operation stage of the project, reduction of vehicular engine noise (as a result of reduced congestion from earlier, smoother flow of traffic due to 2 separate lanes), vehicular body noise (as a result of reduced development roughness) and reduction of blowing of horns will bring the noise levels down, but as volume of traffic, mainly heavy duty traffic will be increase in future due to rapid development and industrialization along the road corridor this may increase noise. The noise prediction at different scenarios indicate that the noise levels can be exceeding the Noise standards of 55 dB(A) for daytime and 45 dB(A) for night time at several receptor locations without barrier scenario.

Mitigation Measures

The high noise levels will cause discomfort to local residents and workers. Following mitigation measures shall be adopted to keep the noise and vibration levels under control.

- The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum;
- Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than90dB(A);
- In construction sites within 150 m of human settlements, noisy construction will be stopped between 10 PM and 6 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement;
- Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use as schools and hospitals;
- Near to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used;
- Phase demolition, earthmoving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately
- Construction machinery will be located away from the settlements;
- Careful planning of machinery operation and scheduling of operations can reduce the noise levels. Use of equipment, emitting noise not greater than 90 dB(A) for the eight-hour operations shift and locating of construction yards at a distance of at least 500 m from any residential areas can be adhered to;
- Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures, which should be followed by the contractors during the civil works;
- The noise control measures include limitations on allowable grades. Open-graded asphalt and avoidance of surface dressings to reduce tire noise in sensitive areas. Maintenance of proper road surface repairs also helps in reducing noise levels;
- Use of air horns should be minimized on the highway during nighttime. During daytime use of horns should be restricted at few sensitive locations. This can be achieved through the use of sign boards along the roadside;

- Future development along the road should follow correct land use norms so that sensitive receptors are not located along the road, specifically along the bypasses; and
- Development of greenbelt along the main road can also bring about considerable reduction in noise levels. The area available on both sides of the road should be used to develop green belt comprising selected species of trees with high canopy to provide added attenuation of noise

16.3.7 Wastes/Hazardous Materials (2.9)

Types of construction waste which are expected to be generated include asphalt chunks, chunks of concrete, surplus soil, construction scrap materials and organic waste generated by construction workers. The amount and percentage composition of construction waste will depend on the final design and the schedule of the construction, and thus generic mitigation measures proposed in EMP should be updated once the final ROW drawing is completed. All other construction wastes are also planned to comply with relevant Center or State laws pertaining to waste management.

Table 16.6 Required Volume for Spoil Bank

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH51	1	Cut Soil	cu.m	41,840	0.9	37,656	37,656
		Fill Soil	cu.m			0	
	2	Cut Soil	cu.m	77,562	0.9	69,806	29,177
		Fill Soil	cu.m			40,629	
	3	Removed Soil for Replacement	cu.m			201,600	201,600
	Total						268,433

Source: JICA Study Team

The volume of surplus soil is estimated as below. Candidate locations with sufficient and necessary conditions for spoil bank construction have been screened with following criteria:

❖ To minimize transport of surplus soil, spoil bank should be located at every 5km distance along NH-51 with following condition;
- Ground shape with concavity topography
- Less ground gradient than 22 degree which is assumed as average angle of spoil bank slope with necessary steps
- No built-up area
- No national sanctuary area

- ❖ To be able to construct the spoil bank in less than 30m height

Based on the above criteria, 9 locations along the stretch of NH-51 have been identified for spoil spoil bank construction with the total capacity of about 342 cu.m. The list of each candidate site is shown below.

Table 16.7 List of Spoil Banks

No.	Section	Sta.	Capacity of Spoil Bank
			Cu.m
1	Sta. 85-94	88+000	47,120
2	STA.101-143	105+805	4,620
3		110+000	86,190
4		110+550	58,260
5		119+340	16,856
6		124+800	77,440
7		130+800	15,526
8		135+420	22,806
9		139+100	12,883
Total in NH-51			341,701

Source: JICA Study Team

16.4 Socio-Economic Environment

16.4.1 Involuntary Resettlement (3.1)

As per the preliminary ROW design, 367 households (173 households whose houses will be affected and 194 households whose businesses will be affected) will be affected by the project. The total number of people is 1,820. Out of these, 319 households (161 households whose houses will be affected and 158 households whose businesses will be affected) will have to be relocated. The remaining 48 will be partially affected but relocation will not be necessary. More details about resettlement impact, resettlement policy and proposed compensation package can be found in the RAP report.

16.4.2 Land Use (3.2)

The project does not lead to large-scale change in land use as the engineering work will be constrained mostly along the existing road. On the other hand, construction of spoil bank is likely to cause changes in land use pattern, potentially affecting existing agricultural and plantation activities. In particular, several plantation is located by the road and installment of retaining walls, embankment and slope protection measures not only affect the land but potentially alter long-term productivity by changing micro-level hydrology. This issue should be taken into account when the compensation for

agricultural land/plantation next to existing road is finalized by District Collector.

For sections where NH51 passes through community forest, jhum area and plantation, engineering work should be scheduled in a way that minimize disruption of access by local people. At the same time, proper management of effluent and soil erosion shall be carried out to avoid negative impact on such resources.

16.4.3 Utilization of Local Resources (3.3) and Local Economy and Livelihood (3.7)

Significant volume of local resources such as sand may be used for construction work. This could cloud out the use of such resources for other purposes in the short-term. In the long-term, the better road network may attract new business, possibly from outside the state with detrimental impact on local business/traders. While the project overall will have significant positive impacts on the local and regional economy, the better transport network may put some groups at risk at least in the short and medium-term. This is of particular concern because Dalu is at the border with Bangladesh. For example, if the travel time is reduced thanks to the improved road condition, truck drivers may stop taking rest in Dalu or other places, negatively affecting local businesses in the project area. These potential high-risk groups should be identified in the preparation of R&R plan to ensure that they will not be in a disadvantaged position due to the project.

16.4.4 General, Regional /City Plans (3.4)

The project will create new opportunities for village and block-level development planning. In particular, the construction of spoil bank will create large area of flat land where such surface is a scarce commodity. The development of spoil bank, therefore, should be coordinated with the village/block development plan so that the land will benefit the community.

16.4.5 Social Institutions and Local Decision-making Institutions (3.5)

Being a tribal state, block and village council and traditional community leaders called Nokma have significant influence on decision-making process in the area. As such, their support and cooperation is critical in smooth implementation of the project, particularly activities related to resettlement. The implementation of EMP as well as RAP/R&R should be built on existing social institutions and will be best guided by local people, rather than outside experts.

16.4.6 Social Infrastructure and Services (3.6)

For most people residing along NH51, the highway is the only route of access to social infrastructures

such as schools and hospitals. Construction activity is likely to cause temporary disturbance to their access to such infrastructure and service and therefore, schedule and timing of the engineering activity should be developed in consultation with the local community. When road blockage is necessary, e.g. for blasting, the local community should be informed in advance so that they can make alternate plan accordingly.

16.4.7 Unequal Distribution of Benefit and Damage (3.8) and Local Conflicts of Interest (3.9)

Roadside location offers critical advantages for local business (tea stalls, restaurant, petty shops). Resettlement from roadside to inner part o the village may significantly undermine the viability of these businesses, and therefore, business owners to be affected may be worse off compared with farmers to be relocated. Likewise, allocation of plot in resettlement site may become a source of conflicts among affected households who wish to be relocated to more advantageous plots. Sound arbitration and conflict resolution mechanism by local leaders should be in place for smooth implementation of RAP and R&R activity.

16.4.8 Water Usage, Water Rights and Communal Rights (3.10)

Irrigation is not practiced along the project area and thus water is not likely to become a source of conflicts in the course of project implementation.

16.4.9 Cultural and Historical Heritage (3.11)

No sites of cultural or historical significance have been identified along the project road.

16.4.10 Religious Facilities (3.12) and Sensitive Facilities (3.13)

The project will not affect religious facility, but the access to churches may be impaired during the construction stage. Given the significance of religious belief in the area, access to these facilities, particularly Sunday mass, should not be disturbed by construction activities. Similarly, more stringent standard for noise and vibration and air quality should be adopted where sensitive facilities such as school and hospitals are located.

16.4.11 Poor People (3.14)

The baseline survey has identified gap between official poverty level and poverty level as reported by the people. R&R activity should take into account the limited coping capacity of the local community and develop measures that leads to sustainable income generation of the affected people, rather than one-off payment of compensation and assistance.

16.4.12 Ethnic Minorities/ Indigenous People (3.15)

In the state of Meghalaya, the tribal (Scheduled Tribe: ST) population constitutes about 85% of the total population. Most of affected people belong to Garo tribe except for Dalu town with sizable Bengali community. Majority of the affected people also belong to ST, and hence they are not minority. While tribal groups in project area holds traditional culture, including shifting cultivation in forest called jhum, they freely interact and share their sources of water, folklore, food, infrastructure and other belongings with the non-ST and other tribal population within and outside community. This is clear from the fact that Bengali and Garo community along NH51 co-exist peacefully without ethnicity-related tensions. Moreover, ST population in project area is not isolated from outside and they are open to new ideas such as family planning and formal education.

16.4.13 Gender (3.16)

Tribal and non-tribal women in North East States enjoy a relatively higher position in the society than what their non-tribal counterparts do, which is reflected in their high literacy rate. Garo women are largely involved in household work, collection of forest produce, firewood collection, cultivation and other agricultural activities and thus they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in this RAP in which options to facilitate women's participation in project implementation and various opportunities to be created by the project is discussed. In particular, women shall have preferential access to specific types of project-related job opportunities, including light-duty work and part-time jobs that do not interfere with women's responsibility at home.

16.4.14 Public Health (sanitation and infectious diseases) (3.18) and Occupational Health and Safety (OHS) (3.19)

The health and safety measures at design, construction and operation phase are given below.

Table 16.8 Health and Safety Measures

Design Stage	
Geometric Correction at Critical Curves	Critical curves have been rectified to maintain project design speed and visibility. (IRC-86-1983 " Geometric Design for Road in Plains")
Construction Stage	
Health hazard to workers due to bad water and sanitation	At every workplace, good and sufficient potable water (as per IS) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. Adequate drainage, sanitation and waste disposal shall be provided at workplaces. Preventive Medical care shall be provided to workers.

Health/ social hazard, sexual harassment to female workers	Segregation of male and female areas in labor camp shall be executed.
Hygiene at Construction Camps	The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer. There shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act. Except in workplaces provided with water-flushed latrines connected with a well designed septic tank, all latrines shall be provided with low cost 'Twin Pit Latrine' system. The pit can be closed after the construction is over. There shall be adequate supply of water, close to latrines and urinals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.
Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees. If the quarry site is porous, it shall be used by groundwater recharging.
Risk from Operations	The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this project. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.
Risk from Electrical Equipment	Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.
Risk at Hazardous Activity	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day notice of the proposed use of any herbicide

	or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the siteshall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.
Risk of Lead Pollution	No man below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
Risk caused by Force' Majure	All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.
Risk from Explosives	Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.
Malaria risk	The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him
Loss of Access	At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.
Traffic Jams and Congestion	Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. **The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution.** The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.

Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. All signs, barricades, pavement markings shall be as per the MORT&H specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer. Excavated pits shall be filled to avoid falling of animals/ human beings.
Operation Phase	
Dwellers in settlements may rush to high way and meet accident	Specially design urban section and footpath sections shall be applied to the necessary locations.
Vehicles parked in settlements may lead to narrow carriageway	Specially designed parking areas shall be executed at the required locations.
Fast moving vehicles may threat safety in settlements.	Specially designed pedestrian crossings shall be constructed at required locations.
Accidents involving hazardous materials.	The rules s defined Hazardous waste handling Act shall be compiled. Vehicles delivering hazardous substances shall be printed with appropriate signs. In case of spillage, the report to relevant departments will be made and instructions followed in taking up the contingency measures.
Other Safety Measures	Traffic Management plan shall be developed especially along congested locations. Traffic control measures including speed limits will be enforced strictly. Further growth of encroachment and squatting within row shall be discoursed.

Source: JICA Study Team

16.5 Other Issues

16.5.1 Accidents (4.1)

Construction Phase Impacts

The project will improve the road safety through design measures identified during the various road surveys. Road safety will be enhanced in the project through engineering (design), enforcement (safety measures, signage, etc.) and education. The issue of road safety is one of the key issues that may surface in construction stage. During the construction stage, dismantling of structure, cutting of trees, haulage material obstructing vision, spillage of lubricants on road making it slippery is generally the cause of road accidents. Similarly, in operation stage, increase in traffic and increase in speed would tend to increase in accidents. In spite of these, the social benefits from the project are quite significant.

It is likely that there will be some concern of safety for highway users during construction period, as haulage of material and other equipment would restrict movement of vehicles. Highway patrolling system with ambulance facility and crane will render assistance to users in distress and disabled

vehicles which in-turn will improve the safety level.

Operation Phase Impacts

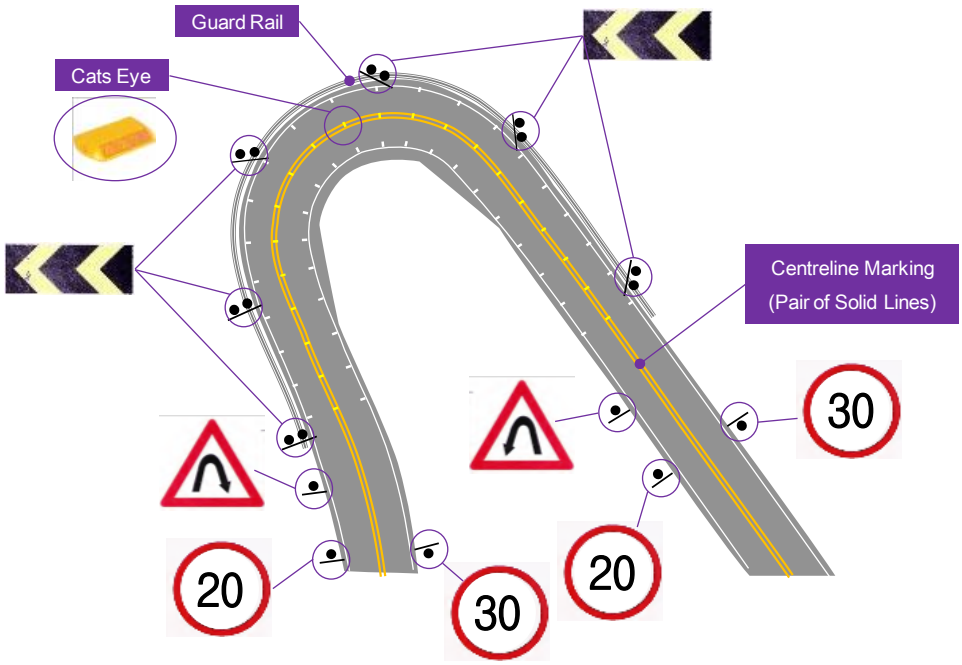
The proposed project implementation would improve the road safety for the highway users as well as locals living by the side of the road. In operation stage, increase in traffic and increase in speed would tend to increase in accidents. In-spite of these, the social benefits from the project are quite significant. In operation phase, increase in vehicle speed may cause thereof to the safety of pedestrians and for cattle for crossing road.

Mitigation Measures

Street furniture known as road studs, blinker or cat's eye include equipment installed on road or roadside to assist visibility of road alignment/structures. They are retro-reflective safety devices used in road marking. Generally, it consists of two pairs of reflective glass spheres set into a white rubber dome, mounted in a cast-iron housing. This is the kind that marks the centre of the road, with one pair of devices showing in each direction. A single-ended form has become widely used in other colors at road margins and as lane dividers.

Since the NH51 is located in mountainous region, hair-pin bends are unavoidable from the viewpoint of cost and environmental impact. Design speed of 20km/h is applied for hair-pin bends, while design speed of 30km/h is adopted in general. Small horizontal curves such as R20m-R25m are used in steep terrain to avoid large-scale earthwork and/or demolition of houses. At those sub-standard sections, securing traffic safety by applying combination of facilities shall be considered.

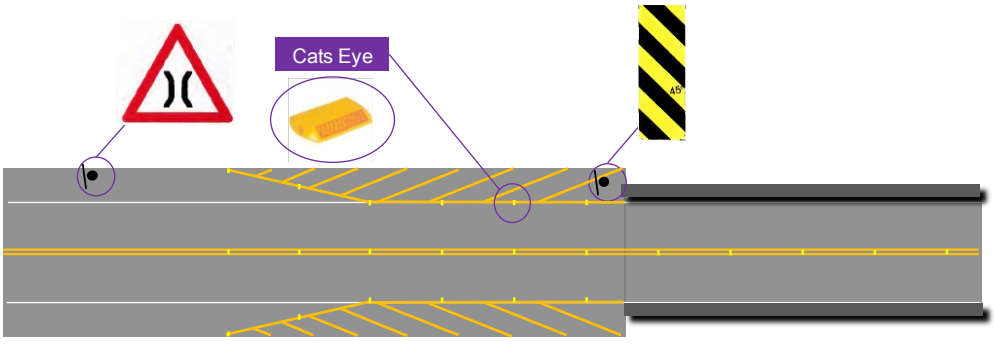
In hair-pin bends, it is difficult to secure overtaking sight distance and thus, the section shall be designated as no-overtaking section. In order to inform that to drivers, the double centre line with marking of pair of solid lines is applied. Cats eyes to delineate road alignment are to be installed on the centre line and lane edges so that drivers will be able to identify the direction he should go before entering into the curve. Furthermore, traffic signs and guard rails shall be properly equipped to avoid hazardous accidents. Figure 7.3 shows an example of combined traffic safety facilities to be installed at hair-pin bends.



Source: JICA Study Team

Figure 16.3 Traffic Safety Facilities to be installed at Hair-Pin Bends

In the locations where the existing bridges are to be utilized with rehabilitation works, carriageway width becomes narrower than that of earthwork sections due to the difference in shoulder width. It is, therefore, proposed to install facilities that notify drivers the decrease in carriageway width and existence of concrete curb. Figure 7.4 shows an example of combined traffic safety facilities to be installed at narrow bridges.

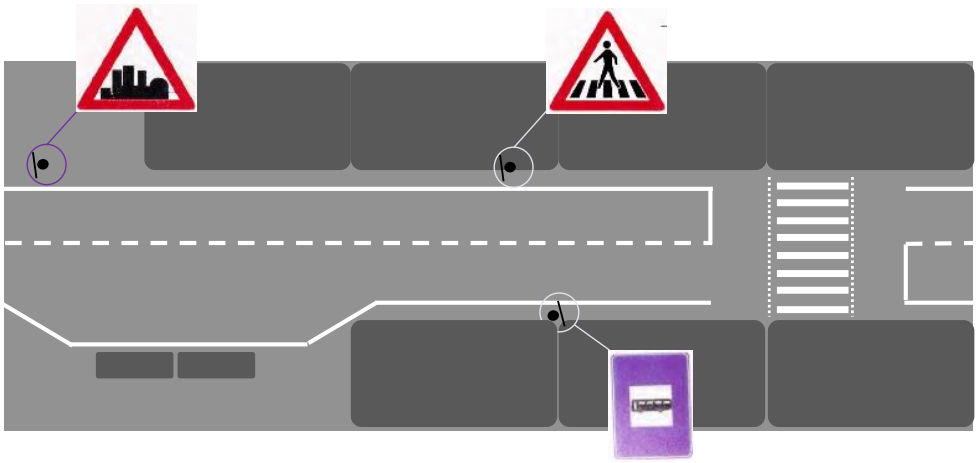


Source: JICA Study Team

Figure 16.4 Traffic Safety Facilities to be installed at Narrow Bridges

In built-up areas near Tura and Dalu, there are a lot of buildings, shops or houses at roadside as well as pedestrians going along the sidewalk and crossing the road. Furthermore, more road facilities such

as bus stops are necessary than rural sections. Therefore, drivers have to handle much information on roads/traffic and decide their maneuvers in a short time at built-up areas. In order to assist road users in obtaining information, appropriate traffic signs and road markings shall be provided properly. Figure 7.5 shows an example of combined traffic safety facilities to be installed at built-up sections.



Source: JICA Study Team

Figure 16.5 Traffic Safety Facilities to be installed at Built-up Sections

16.5.2 GHG emissions (4.2)

There is a possibility of increased GHG emission due to the operation of heavy vehicles as well as traffic jams incidental to the construction works, this impact will be temporary. On the other hand, it is expected that the GHG emission will be increase due to increase traffic volume. The increase will be mitigated by keeping good road conditions which will reduce consumption of extra fuel and congestion, thereby mitigating GHG emissions over time.

Monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary.

CHAPTER 17 ENVIRONMENTAL MANAGEMENT PLAN

17.1 Overview

Descriptions of environment management measures during different stages of the project are provided in this chapter.

17.1.1 Pre-construction Stage

Required management measures during the pre-construction stage include the clearance of the ROW, plantation of trees, the measures for protecting/replacing community resources such as electric poles, public urinals and water points that are likely to be impacted. Their enhancement shall also be completed before construction work starts so that the community can start using these when the construction activity begins.

17.1.2 Construction Stage

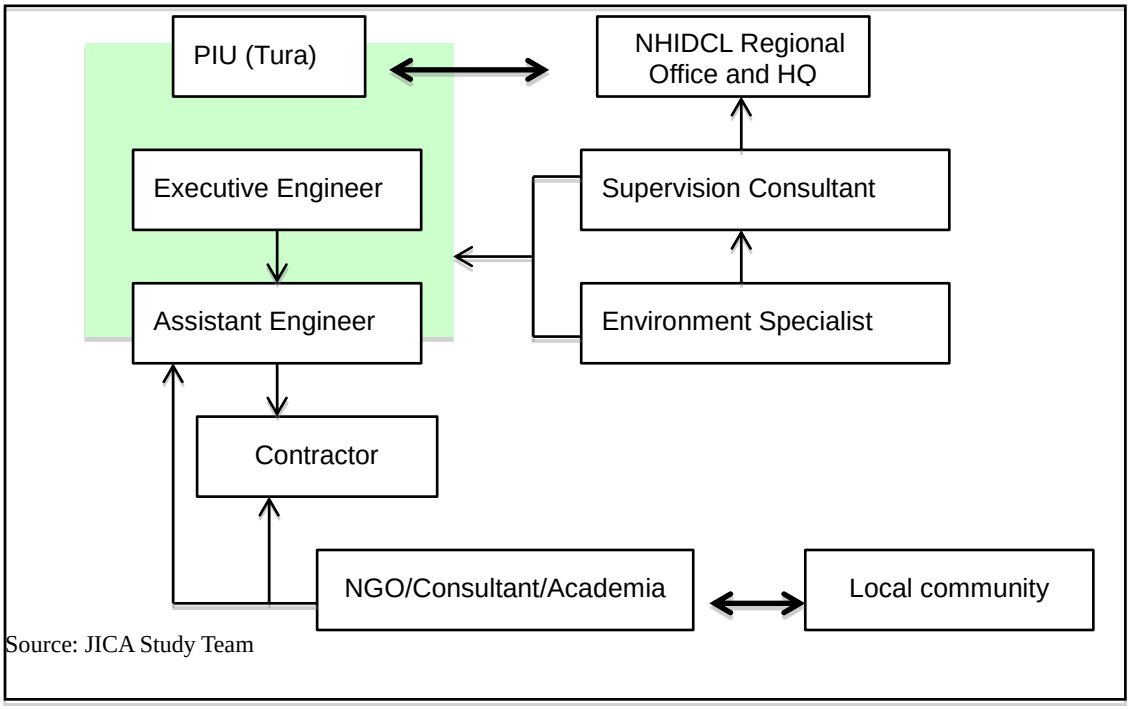
This will be most crucial and active stage for the Environmental Management Plan (EMP). In addition to the monitoring of the construction activity itself to ensure that the environment is not damaged beyond permissible limits, the enhancement of cultural and community properties, mitigation and enhancement measures for water bodies through proper treatment of spoil soils will be undertaken as the construction progresses. To facilitate implementation of the enhancement and mitigation measures suggested, working drawings of the same have been provided in the Appendices. In addition, the provision of proper risk management with respect to construction activities such as accidental spillage is critical at this stage to avoid damage to flora and fauna, agricultural land and other sensitive resources. Typical locations of concerns include the locations of hot-mix plants (spillage of fuel, bitumen etc.) and labor camp sites.

17.1.3 Operation Stage

The operation stage will essentially entail monitoring activity along the project area. In addition to checking the efficacy of the protection/ mitigation/ enhancement measures implemented, this will help verify or refuse the predictions made as a part of the impact assessment. Thus, it will complete a very important feedback loop for the project.

17.2 Environment Management Plan for Mitigation of Negative Impacts

The detailed measures adopted and/or to be adopted during different stages of the project to mitigate negative impacts and enhance positive aspects are shown in Table 8.1 to 8.3. The responsibility for implementation and supervision of EMPs are vested with three agencies, namely Contractors, PIU, and Supervision consultants (SC). The Contractors herein mean the agency hired for execution of the construction works for the respective contract packages. PIU would be implementation agency with the support of PWD. The Figure below indicates implementation structure of the EMP.



Source: JICA Study Team

Figure 17.1 Institutional Arrangement for EMP Implementation

It has been proposed that Executive Engineer (environment) based in Tura will be in charge for the implementation of EIA and EMP for this project. Such an engineer will be assisted by Assistant Engineer (Environment), who will be assisted by a Junior Engineer as well as Supervision consultant (and Environment Specialist) and contractor.

The construction supervision consultant are expected to have in-house capacity to advise on and supervise the implementation of the EMP including suggesting enhancement design options and modifications, as necessary. For this purpose, the supervision consultant will employ a full-time environmental specialist.

Compensatory plantation and maintenance and protection of vegetation will be required as part of environmental mitigation and enhancement works. Likewise, spoil soils shall be used, where possible, to create community assets such as playground as per request of the community. In these types of works, the project may engage NGO, Consultant or experts from local universities to liaise with local community for effective implementation of the project.

Table 17.1 Environmental Management Plan for Pre-Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P1	Relocation of Project Affected Persons (PAP)	● All requirements of the RAP as applicable shall be complete before start of construction stage. The activities broadly include acquisition of land and structures, relocation of utilities, payment of compensation and provision assistance	All areas	Before construction begins	Government of Meghalaya, District Revenue authorities, Nokma and NGO/Consultant/Academica	PIU, SC
P2	Removal of vegetation	● Minimize the scale of vegetation clearing by factoring vegetation/forest cover in the final design of the road alignment process ● Removal of trees to be carried out after forest clearance is obtained ● Reforestation/replantation of trees at a term as instructed by the Forest Dept. or by the Forest Dept. ● Activity shall be supervised to avoid poaching of animals	All areas	Before construction begins (Reforestration/replantation may extend to during/after construction)	PIU, Contractor, Forest Dept.	PIU, SC, Forest Dept.

P3	Setting up construction camps	● Camps shall be located at least 500m away from the nearest built-up area. ● Sewage system for a construction laborer's camp shall be designed, built and operated so that no pollution to ground or adjacent water bodies/ watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. ● In relation to underground water resources, the contractor shall take all necessary precaution to prevent interference with such water resources. ● All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	All construction campsite identified by the contractor and approved by SC	During Establishment, Operation and Dismantling of Such Camps.	Contractor	PIU, SC
P4	Setting up hot mix plants	● Hot mix plants and batching plants shall be located sufficiently away from habitation and agricultural operations. ● Where possible such plants will be located at least 1000m away from the nearest habitation.	All hot-mix and batching plants	During Erection, Testing, Operation and Dismantling of Such Plants.	Contractor	PIU, SC
P5	Finalizing sites for surplus soil dumping	● Location of dumping sites shall be finalized. The sites shall meet following conditions: i) dumping does not impact natural drainage courses; ii) no endangered/rare flora is impacted by such dumping	All areas identified as potential dumping sites	During mobilization	Contractor	PIU, SC
P6	Identification of hazard-prone locations	● The contractor shall identify locations sensitive to landslides (in addition to the ones that area already identified) and shall duly report these to the Supervision Consultant (SC) and to PIU.	All area	During mobilization	Contractor	PIU, SC

P7	Identify and prepare relocation sites	● Location of relocation sites shall be identified in consultation with district/village authorities and PAPs. ● Sites to be developed including provision of necessary utilities such as water and electricity.	Near villages with large-scale resettlement		PIU	PIU

Source: JICA Study Team

Table 17.2 Environmental Management Plan for Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Soil						
C1	Soil Erosion in Borrow Pits	● The depth of borrow pits shall be restricted so that sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank.	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C2	Loss of top soil in Borrow pits	● Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable topsoil shall be preserved and used for tree plantation.	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C3	Compaction of Soil	● Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil.	Throughout corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C4	Soil erosion in embankments	● Pitching shall be done for slope stabilization as per the IRC guidelines	At the places of embankments	Construction Stage	Contractor and Supervision Consultant	PIU

C5	Contamination of soil from fuel and lubricants	● Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be minimum. ● Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near Labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C6	Contamination of land from construction waste and quarry materials	● Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments. ● Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. ● Construction waste including non-bituminous and bituminous waste shall be dumped in approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.	Solid waste dump Site identified and approved by SPCB or competent authority. Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
C7	Loss of top soil in land acquisition	● Topsoil shall be stripped, stored and shall be laid on ground for landscaping purpose.	Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
Water						

C8	Contamination of water by fuel/ oil spillage of vehicle	● Construction vehicles / equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage. ● Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C9	Contamination of stagnant water body by fecal matters from labor camp.	● Labor camp shall not be allowed near any of the water bodies. ● The proper sanitation facilities shall be provided.	Preapproved locations away from the water bodies.	Construction Stage	Contractor and Supervision Consultant	PIU
C10	Deposition of dust in open wells near construction site	● The mouth/opening of the well shall be covered with suitable material during any of the construction activity so as to prevent dust entering in the well.	All the wells along the project corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C11	Using drinking water for construction purpose	● The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. ● Wastage of water shall be kept minimum during construction.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C12	Hand pump close to road may get affected in widening	● All the Hand pumps shall be relocated to suitable alternate place.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C13	Wells or water storage system may get affected in widening	● Alternate arrangements will be made for all the Wells or water storage system	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C14	Altering flow of natural drains	● Drain shall be channelized with Slope protection - Gabion Structure.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C15	Sanitation of waste disposal in construction camps	● The construction of camps will be done with sufficient buffer from habitation. ● At construction sites and labor camps sufficient no of latrines will be provided. ● The sewage generated from the camps will be properly disposed off so that it does not affect water bodies	Wherever labor camp is located	Construction Stage	Contractor and Supervision Consultant	PIU

Air						
C16	Emission from construction vehicles and machinery.	● All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. ● Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles, equipment and machinery.	Wherever the hot mix plant and batching plant is setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C17	Air pollution from various plants affecting settlements	● The asphalt plants, crushers and batching plants shall not be sited at least 500 m in leeward direction from nearest human settlement	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
C18	Air pollution may exceed the limits prescribed by Central Pollution Control Board.	● Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan.	Locations given in Environmental Monitoring Plan.	Construction Stage	Contractor and Supervision Consultant	PIU
C19	Vehicles will generate dust and suspended particles.	● The dust generated by vehicles on site shall be arrested using a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.	Wherever the plants are setup and sensitive locations as suggested in monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
Noise						
C20	Noise levels from vehicles. Asphalt plants and equipment	● The plants and equipment used for construction shall confirm to CPCB norms. ● Vehicles and equipment used shall be fitted with silencer. ● Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. ● All equipment and plants shall strictly be placed away from educational institutes and hospitals. ● Regular monitoring of noise parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan.	Wherever the plants are setup.	Construction Stage	Contractor and Supervision Consultant	PIU

C21	Noise from blasting operations	● Blasting as per Indian Explosives act will be carried out. ● People living near such blasting operation sites shall be informed before the operational hours. ● Workers at blasting sites shall be provided with earplugs.	At the sites where the blasting is required and in quarry sites	Construction Stage	Contractor and Supervision Consultant	PIU
C22	Noise barriers	● Construction of noise barriers in the form of walls at Sensitive locations upon consultation with stakeholders.	All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located.	Construction Stage	Contractor and Supervision Consultant	PIU
Flora and Fauna						
C23	Tree cutting for widening	● Three trees shall replace each tree cut for the purpose. ● The Engineer shall approve such felling only when the NHIDCL receives a "clearance" for such felling from the MOEF, as applicable. ● Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
C24	Damage or Loss of Important Flora	● During construction, at any point of time, if a rare/ threatened/endangered flora species is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineer shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.	Throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU
Health and Hygiene						

C25	Health hazard to workers due to bad water and sanitation	● At every workplace, good and sufficient potable water (as per IS 10500) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. ● Adequate drainage, sanitation and waste disposal shall be provided at workplaces. ● Preventive Medical care shall be provided to workers.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C26	Health hazard to workers by various construction activity	● Personal protective equipment shall be provided to worker as per the Factories Act.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU
C27	Health/ social hazard, sexual harassment to female workers	● Segregation of male and female areas in labor camp shall be executed.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU

C28	Hygiene at Construction Camps	● The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the resident engineer. ● These shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. There shall be adequate supply of water, close to latrines and urinals. ● All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU

C28	Hygiene at Construction Camps	● On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.				
C29	Abandoned Quarry will accumulate water and act as a breading ground for disease vectors.	● Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.	All quarry locations.	Construction Stage	Contractor and Supervision Consultant	PIU
Safety						
C30	Safety of vehicles plying on road while the construction activity is going on.	● Prior arrangement/traffic diversion for safe passage of vehicles shall be made with proper direction and signage at the construction site. ● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.	Throughout the project area	Construction stage	Contractor and Supervision Consultant	PIU

C31	Risk from Operations	● The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. ● The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C32	Risk from Electrical Equipment	● Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. ● All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

C33	Risk at Hazardous Activity	● All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. ● The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day's notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product. This should comply with Hazardous Material Act.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C34	Risk of Lead Pollution	● Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. ● Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

C35	Risk caused by Force' Majure	● All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU
C36	Risk from Explosives	● Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable. ● The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. ● The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.	Place of use of Explosives	Construction stage	Contractor and Supervision Consultant	PIU
C37	Malarial risk	● The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU

C38	First Aid	● At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided.	At the construction site /labor camp	Construction stage	Contractor	PIU
Disruption to Users						
C39	Loss of Access	● At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. ● The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.	Throughout the project area, particularly in built-up areas	During Construction.	Contractor	Engineer

C40	Traffic Jams and Congestion	● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. ● Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. While approving temporary diversion construction, the Engineer will seek endorsement from the PIU. ● Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. ● The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. ● The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.	Throughout Corridor	During Construction.	Contractor	Engineer

C41	Traffic Control and Safety	● The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. ● All signs, barricades, pavement markings shall be as per the MORTH specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer as per EMP. Excavated pits shall be filled to avoid falling of animals/ human beings.	Throughout the project area	During Construction.	Contractor	Engineer
Environment Enhancement						
C42	Hand pumps enhancement/relocation for ground water recharging	● Hand pumps within Right of Way shall be enhanced/relocated.	At the respective locations along the corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C43	Roadside landscape development	● Avenue plantation of foliage trees mixed with flowering trees, shrubs and aromatic plants shall be carried out where ever land is available between ditches and Right of Way.	Throughout the corridor	Construction Stage	Contractor and Supervision Consultant	PIU
C44	Providing better bus bays	● Bus shelters shall be provided at given locations	As per traffic plan	Construction Stage	Contractor and Supervision Consultant	PIU
C45	Better sitting arrangements where small space is available	● Designed sitting arrangements shall be provided.	As per the design	Construction Stage	Contractor and Supervision Consultant	PIU
C46	Landscaping of junctions	● All rotary junctions shall be landscaped suitably	As per landscape design at the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C47	Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	● The abandoned quarry locations shall be planted suitably as the plan	Wherever quarries are located and abandoned	Construction Stage	Contractor and Supervision Consultant	PIU

C48	Erosion of embankments, shoulders, side slopes, and pavement leading to deterioration and affecting stability and integrity of road	● Earth works specifications will include provision for stable slope construction, compacting and laying out turf including watering until ground cover is fully established ● Proper construction of Breast wall and retaining wall at the locations identified by the design team to avoid soil erosion ● The measures proposed for slope stabilization are: Discharge zones of drainage structures (culverts and minor bridges) provided with riprap ● Construction in erosion and flood prone areas will not be in monsoon /season. ● Side slopes will be kept flatter wherever possible, and in case of steeper slopes it will be supported by the retaining wall.	At the respective locations throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU

Source: JICA Study Team

Table 17.3 Environmental Management Plan for Operation Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
O1	Water quality degradation due to road-run-off	● Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off ● Monitoring shall be carried out as specified in the monitoring plan	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU

O2	Soil and water contamination from accidental spills	● Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals ● Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level by early operation stage	PIU, SPCB, Local Government Bodies	PIU
O3	Air quality degradation due to increases in traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
Q4	Increases in noise and vibration due to greater traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Install noise barrier (wall etc.) in sensitive areas, if necessary	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O5	Traffic safety	● Traffic control measures including speed limits to be enforced strictly. ● Local government bodies and development authorities will be encouraged to control building development along the highway.	All area	Throughout operation stage	PIU, Local Government Bodies	PIU
O6	Accidents involving hazardous materials	● Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including: ✓ For delivery of hazardous substances, permit license, driving license and guidance license will be required. ✓ These vehicles will only be harbored at designated parking lots. ✓ In case of spill of hazardous materials, the relevant departments will be notified at once to deal with it with the spill contingency plan.	All area	Manual/guideline to be prepared during early operation stage	PIU	PIU

O7	Roadside tree plantation, flora and fauna	● Trees planted along the corridor shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence every year for 3 years and all necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU

Source: JICA Study Team

Based on the above, the cost for implementation of EMP is estimated as below.

Table 17.4 Budget for EMP Implementation

Item	Detail	Unit	Unit	Quantity	Total (Rs)
I. Monitoring					
Air	Monitoring near hot mix plant locations approved by the Engineer as per NAAQS ,2009 CPCB	No.	5,000	30	150,000
Water	At locations specified in the monitoring plan as per IS 10,500 & IS 2296	No.	5,000	20	100,000
Noise	At equipment yards as directed by Engineer as per CPCB guideline 1989	No.	2,000	30	60,000
Flora and Fauna	Monitoring of impact on biodiversity	No.	50,000	12	600,000
Sub-Total (I)					910,000
II. Afforestation	Compensatory afforestation, in accordance with Forest Conservation Act (1980) as per guideline provided in EMP	No.	200	10,000	2,000,000
Sub-Total (II)					2,000,000
III. Institutional Cost					
Expert fees	Lump sum				4,000,000
Staff training	Lump sum				500,000
Ext. monitoring	Lump sum				1,000,000
Information disclosure	Lump sum				300,000
Sub-Total (III)					5,800,000
Sub-Total (I+II+III)					8,710,000
Contingency (10%)					871,000
Total					**9,581,000**

17.3 Environment Monitoring Plan

To ensure effective implementation of the EMP, it is essential that an effective monitoring plan be designed and carried out. The environmental monitoring plan provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect. The monitoring includes: i) Visual observations; ii) Selection of environmental parameters at specific locations; and iii) Sampling and regular testing of these parameters.

Monitoring methodology covers the following key aspects: Components to be monitored; parameters for monitoring of the above components; monitoring frequency; monitoring standards; responsibilities for monitoring; direct responsibility, overall responsibility; and monitoring costs. Environmental monitoring of the parameters involved and the threshold limits specified are discussed below.

Ambient air quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM 2.5, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulphur Dioxide (SO_2) and Lead (Pb). These will be monitored at designated locations starting from the commencement of construction activity. Data should be generated at all identified locations in accordance to the National Ambient Air Quality Standards, 2009. The location, duration and the pollution parameters will be monitored and the responsible institutional arrangements are detailed out in the Monitoring Plan.

Water quality

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc and cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at all identified locations in accordance to the Indian Standard Drinking Water Specification – IS 10500: 1991.

Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized in the Table 8.4. Draft Monitoring Form for each parameter to be monitored in different stages of the project is included in Appendix B.

Table 17.5 Environmental Monitoring Plan

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M1	Air	Construction	SPM, RSMP, SO_2, NOx, CO, HC	● Dust sampler to be located 50m from the plan in the downwind direction. ● Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M2		Construction	SPM, RSPM	● Dust sampler to be located 50m from the earthworks site downwind direction. Follow CPCD method for analysis	Air (P&CP) Rules, CPCB, 1994	Stretch of road where construction is underway	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M3		Operation	SPM, RSMP, SO_2, NOx, CO, HC	● Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling location specified in EIA report	Twice a year for one year	Continuous 24 hours	PIU	PIU
M4	Water	Construction	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	● Sample collected from source and analyze as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for three years		Contractor through approved monitoring agency	PIU
M5		Operation	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	● Grab sample collected ● from source and analyze as per Standard Methods for Examination of Water ● and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for one year		PIU	PIU
M6		Operation	Cleaning of drains and water bodies	● Choked drains, water bodies undergoing siltation and subject to debris disposal should be monitored under cleaning operations	To the satisfaction of the engineer (PWD)	All area	Post-monsoon		PIU	PIU

M7	Noise and vibration	Construction	Noise levels on dB (A) scale	● Free field at 1m from the equipment whose noise levels are being determined	Noise standards by CPCB	At equipment yard	Once every 3 Month (max) for three years, as required by the engineer	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	PIU
M8		Operation	Noise levels on dB (A) scale	● Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement	Noise standards by CPCB	At maximum 5 sites inc. those listed in EIA report for noise monitoring locations	Twice a year for 1 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	PIU	PIU
M9	Soil erosion	Construction	Turbidity in Storm water; Silt load in ponds, water courses	● Visual observations during site visits	As specified by the engineer / Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall	Pre-monsoon and post-monsoon for three years		Contractor	PIU
M10		Operation	Turbidity in Storm water; Silt load in ponds, water courses	● Visual observations during site visits	As specified by the engineer / Water quality standards	As directed by the engineer	Pre-monsoon and post-monsoon for one year		PIU	PIU
M11	Construction camp	Construction	Monitoring of: 1.Storage Area; 2. Drainage Arrangement 3. Sanitation in Camps	● Visual Observations and as directed by the engineer	To the satisfaction of the engineer and Water quality standards	At storage area and construction workers' camp	Quarterly during construction stage		PIU	PIU
M12	Afforestation	Construction and operation	Plant survival	● The success of tree planting. Monitor the rate of survival after six months, one year and 18 months in relation to total numbers of trees planted		All area	Minimum three years after planting		NGO, PIU	PIU

M13	Flora and Fauna	Construction and operation	Condition of ecosystem	• Comparison to pre-project flora and fauna	As specified in TOR	As specified in TOR	Twice a year for three years		PIU	PIU

Source: JICA Study Team

CHAPTER 18 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

Stakeholder consultation is an important method of involving various stakeholders particularly, local community with reference to the proposed development initiatives. Consultations provide a platform to participants to express their views, concerns and apprehensions that might affect them positively or negatively. This process is of particular importance for this project given the high ST share among the affected population. The World Bank OP 4.10 on Indigenous Peoples emphasizes "a process of free, prior, and informed consultation with the affected Indigenous People's communities at each stage of the project, and particularly during project preparation, to fully identify their views and ascertain their broad community support for the project. Stakeholder Through participation and consultation stakeholders influence development initiatives, and decision-making process. The effectiveness of participation and consultation is directly related to the degree of involvement by the likely project affected persons and the local community and integration of outcome of consultations wherever feasible in the proposed development initiatives.

The purpose of consultations was to inform people about the project, take note of their issues, concerns and preferences, and allow them to make meaningful choices. It ensured participation of potential project affected persons (PAPs), local community and other stakeholders. People in general were informed in advance, and allowed to participate in free and fair manner. Consultations provided meaningful contributions with regard to reducing adverse impacts, address safety issues, etc. Concerns, views and suggestions expressed by the participants during these consultations were integrated into the design aspects wherever feasible. The following sections present details of the consultations.

18.1 1st Round Consultations with Communities

The initial briefing was made to every village representatives (Nokma) prior to the commencement of the baseline survey. MLCU team as well as Environmental and Social Expert of the Study Team visited villages along the targeted section of NH51 to inform them of the project, seek their support to the survey, and to verify the validity of the survey questionnaire. The first round of consultations was held in conjunction with the baseline survey. Initially, it was planned that one consultation meeting to be held in each development block at this stage. However, after such meeting in Rongram Block, there were requests from the PAPs to hold follow-up meetings for community members so that more members can be engaged in the process. Responding to this request, two additional meetings were held in Rongram block, providing opportunities for more stakeholders to voice their opinions about the project. The details of the meeting are summarized below, and the list of attendees in each meeting

is included in Appendix C.

Table 18.1 Summary of 1st Round of Consultation Meetings

Block	Date	Venue	
Dalu	**May 21st, 2015**	**Multi-facility Building, Dalu**	**17**
Gambegre	**May 22nd, 2015**	**Bharat Nirman Rashtriya Gram Seva Kendra, Darakgre Bazar**	**36**
Rongram	**June 26th, 2015**	**Circuit House, Tura**	**11**
Follow-up meeting 1	**June 29th, 2015**	**Chibgral Community Hall**	**67**
Follow-up meeting 2	**July 4th, 2015**	**Rongkohn School**	**74**

Source: JICA Study Team

Table 18.2 Participation Details of 1st Round of Consultation

District	Date	Total No. of Participants	Representation (No.) from		
			Govt. Dept.	Nokma/ Vilalge Rep	Affected Persons
Dalu	May 21st, 2015	17	2	11	4
Gambegre	May 22nd, 2015	36	2	11	23
Rongram	June 26th, 2015	11	3	8	0
Follow-up meeting 1	June 29th, 2015	67	2	4	61
Follow-up meeting 2	July 4th, 2015	74	2	0	72

Source: JICA Study Team

Photo 6.1 Consultation at Gambegre Block (L) and Rongram Block (follow-up meeting 2) (R)

The consultation meetings were attended mainly by village representatives (Nokma and Village Council members), who then shared the meeting contents with other members in the village. At the outset, PWD and village representative introduced the consultant's team with the participants and stated the broad objective of such consultations. The MLCU team and Environment and Social Expert of the Study Team provided brief description about the project, highlighting importance of consultations with likely project affected persons, local community and other stakeholders. Design concepts (e.g. minimize surplus soil, install proper slope protection) with preliminary alignments were also informed and explained. Expected benefits and likely anticipated adverse impacts as well as resettlement policy framework as per JICA Guidelines for Environmental and Social Considerations were conveyed as well. The consultations were held in local language (Garo) with assistance from a local person who helped in interpretation as well as preparation of transcripts. The proceedings of the consultations were audio recorded as part of documentation process. A summary of consultations on various issues is presented below:

- The community people mentioned about their grievances and experiences of not getting any compensation from the Government during previous road improvement projects and land acquisitions. Villagers without any land documents also raised their concerns about compensation payments.

18.2 2nd Round Consultations with Communities

The second round of consultation meetings with communities was planned to be held in October to share the result of the EIA survey with the community and discuss Environment Management Plan and other matters related to environmental and social considerations. Due to prolonged heavy rain in the project area since mid-August, however, such meetings could not be held as of August 28th.

While the formal consultation meetings was postponed, the phone interview with village representatives was proposed as a means to seek stakeholders' feedback before formal consultation at this stage. However, the proposal was dropped on the ground that i) all stakeholders should be informed of the opportunity of any kind of consultation in advance and ii) in keeping with the FPIC principle, stakeholders should be allowed to express their views and concerns in an open forum. While the phone meeting does not replace the formal consultation, it might give wrong impression to affected community and backfire to the project. While the consultant team makes an effort to share the results of the EIA study to affected communities, feedback on the same will be sought in formal

consultation meetings with proper venue and prior notice to all affected communities.

18.3 Meeting with Government Officials and Other Key Persons

In addition to the block-wise public meetings, several meetings were held with various state and district level department officials at different stages during the course of the EIA study. Discussions were focused on developing an understanding of existing state policies and practices with respect to management of environmental and social issues associated with the proposed project, likely challenges, perceived impact and suggestions and recommendations, among others.

During interaction and discussion with Govt. officials and Council Members, it generally emerged that people in the area are eager to see the commencement of the actual widening and strengthening of NH51. They pointed out that several attempts have been made in the past to improve the condition of the highway, but every time it turned out to be a false start. They further averred that this preparatory survey would lead to action on the ground. The highway has been in a state of neglect since the last three decades and a similar situation prevails on NH62, which together with NH51, forms the lifeline of West Garo Hills and South Garo Hills, connecting towns like Tura, Baghmara, William Nagar, to the major cities in the area, like Dhubri, Guwahati, Shillong, Agartala and Siliguri.

They strongly opined that improvement and strengthening of NH51 and NH62 should be prioritized. This they averred, would open up the market and other opportunities for people in the area. They pointed out that development of the area could be taken up based on the bio resources of the region on a sustainable basis. Tourism would be incentivized, thus generating employment opportunities for the thousands of locals passing out of educational institutions in the area. Locally available fruits, like Pineapple, Jackfruit, Litchis and Bananas could be quickly dispatched to other parts of the country and the surplus crop processed locally. Floriculture would also receive an impetus, considering the floral diversity of the area, thus becoming a revenue source for the locals and the govt. too.

The officials pointed out that the machinery to organize and implement various schemes are in place. However, due to the lack of a proper road network, all schemes are operating below par. They further averred, that the Project would receive their full cooperation and the locals would also participate in it eagerly. Considering the high expectations that the locals have for the Project, there would be very few hurdles, according to them. The Forest Officials, both State and District Government pointed out that there are no forest reserves on NH51, nor any protected area or elephant corridor in NH51. Hence, improvement of this highway could be prioritized without tedious process of de-reservation, which, in

some cases, takes more than a decade.

18.4 Information Disclosure

The EIA report will be posted on the website of JICA as well as NHIDCL. Also, the Garo version of the executive summary will be distributed to Nokma in each village along the targeted section of NH51 and will be shared with other members of the village.