Initial Environmental Examination

May 2023

IND: Construction of Imphal Ring Road

FINAL INITIAL ENVIRONMENTAL EXAMINATION AND ENVIRONMENT MANAGEMENT PLAN

Prepared by Public Works Department, Government of Manipur for the Asian Development Bank

CURRENCY EQUIVALENTS
(as on 4 May 2023)

Currency unit	=	Indian rupee (₹)
₹1.00	=	$ 0.012
$1.00	=	₹81.78

LIST OF ABBREVIATION

AADT	:	Annual Average Daily Traffic
ADB	:	Asian Development Bank
ADT	:	Average Daily Traffic
AE	:	Assistant Engineer
AEE	:	Assistant Environmental Engineer
AH	:	Asian Highway
AM	:	Arithmetic Mean
AQI	:	Air Quality Index
ARAI	:	Automotive Research Association of India
ASI	:	Archaeological Survey of India
BDL	:	Below Detection Limit
BOD	:	Biological Oxygen Demand
BUA	:	Business-As-Usual
C/L	:	Centre Line
CALINE	:	California Line Sources Dispersion Model
Ca	:	Calcium
CBR	:	California Bearing Ratio
CCF	:	Chief Conservator of Forest
CD	:	Cross Drainage
CEF	:	Composite Emission Factor
CF	:	Conservator of Forests
CGWA	:	Central Ground Water Authority
CGWB	:	Central Ground Water Board
CI	:	Chlorine
CO	:	Carbon Monoxide
CoI	:	Corridor of Impact
CPCB	:	Central Pollution Control Board
CPR	:	Common Property Resources
CRPF	:	Central Reserve Police Force
CSC	:	Construction Supervision Consultant
Cu	:	Copper
CWC	:	Central Water Commission
dB	:	Decibel
DC	:	District Collector
DFO	:	Divisional Forest Officer
DH	:	Displaced Household
DLRO	:	District Land Revenue Officer
DO	:	Dissolved Oxygen
DO	:	Duty Officer

DP	:	Displaced Person
DPR	:	Detailed Project Report
EA	:	Executive Agency
EAC	:	Expert Appraisal Committee
EC	:	Electrical Conductivity
EHS	:	Environment Health and Safety
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EMP	:	Environment Management plan
EO	:	Environmental Officer
EPA	:	Environment (Protection) Act
ES	:	Environmental Specialist
ESZ	:	Eco-Sensitive Zone
Fe	:	Iron
FLS	:	Finite Line Source
FWHA	:	Federal Highway Administration
GHGs	:	Greenhouse Gases
GIS	:	Geographical Information System
GoI	:	Government of India
GoM	:	Government of Manipur
GRC	:	Grievance Redress Cell
GRM	:	Grievance Redress Mechanism
GW	:	Ground Water
HDM-4	:	Highway Development and Management Model Four
HFL	:	High Flood Level
Hg	:	Mercury
HS	:	Homogeneous Section
ICAP	:	Indian Clean Air Program
IEE	:	Initial Environmental Examination
IMD	:	India Meteorological Department
INCCA	:	The Indian Network on Climate Change Assessment
IPCC	:	Intergovernmental Panel on Climate Change
IRC	:	Indian Road Congress
IS	:	Indian Standards
ISBT	:	Inter State Bus Terminal
IST	:	India Standard Time
IUCN	:	International Union for Conservation of Nature
IVI	:	Important Value Index
JMR	:	Joint Measurement Record
LA	:	Land Acquisition
LED	:	Light Emitting Diode

LHS	:	Left hand Side
LPG	:	Liquid Petroleum Gas
MCC	:	Manual Classified Traffic Volume Count
MCPB	:	Manipur Pollution Control Board
Mg	:	Magnesium
MI	:	Monitoring Indicators
Mn	:	Manganese
MO	:	Medical Officer
MOEF&CC	:	Ministry of Environment, Forest and Climate Change
MoM	:	Minutes of Meeting
MoRT&H	:	Ministry of Road Transport and highways
MoU	:	Memorandum of Understanding
MPN	:	Most Probable Number
MSDS	:	Material Safety Data Sheet
MSL	:	Mean Sea Level
NAAQS	:	National Ambient Air Quality Standards
NABL	:	National Accreditation Board for Testing and Calibration Laboratories
NBWL	:	National Board for Wildlife
NE	:	Not Evaluated
NGO	:	Non-Government Organization
NH	:	National Highway
NO_2	:	Nitrogen Dioxide
NOC	:	No Objection Certificate
NPV	:	Net Present Value
NQ	:	Noise Quality
NTU	:	Nephelometric Turbidity Unit
OBC	:	Other Backward Caste
OCB	:	Open Competitive Bidding
Pb	:	Lead
PCM	:	Public Consultation Meeting
PCR	:	Physical Cultural Resources
PCU	:	Passenger Car Unit
PHH	:	Physically Handicapped Persons
PIA	:	Project Influence Area
PIU	:	Project Implementation Unit
PM	:	Particulate Matter
PP	:	Project Proponent
PPE	:	Personal Protective Equipment
PPM	:	Parts Per Million
PRC	:	Public Response Centre

PS	:	Paved Shoulder
PT	:	Performance Target
PTV	:	Percent Time Violation
PUC	:	Pollution under Control
PWD	:	Public Works Department
RHS	:	Right Hand Side
ROB	:	Road Over Bridge
RoW	:	Right of Way
RP	:	Resettlement Plan
RUB	:	Road Under Bridge
SC	:	Schedlued Caste
SD	:	Standard Deviation
SEAC	:	State Level Expert Appraisal Committee
SH	:	State Highway
SO	:	Safety Officer
SO_2	:	Sulphur Dioxide
SPCB	:	State Pollution Control Board
SPL	:	Sound Pressure Level
SPS	:	Safeguard Policy Statement
SW	:	Surface Water
TCS	:	Typical Cross Section
TDP	:	Tribal Development Plan
TDS	:	Total Dissolved Solids
TEEMP	:	The Transport Emission Evaluation Model for Projects
TMC	:	Turning Movement Count
TNM	:	Traffic Noise Model
ToR	:	Terms of Reference
USEPA	:	United States Environmental Protection Agency
VDF	:	Vehicle Damage Factor
VEC	:	Valued Environment Component
WBG-EHS	:	World Bank Group – Environmental Health and Safety
WHH	:	Women Headed Household
WPA	:	Wildlife Protection Act

WEIGHTS AND MEASURES

Cum	:	Cubic Meter
dB(A)	:	A Weighted Decibel
gm/cm^3	:	Gram per Centimeter Cube
g/km	:	Gram Per Kilometer
ha	:	Hectare
ham	:	Hectare meter
km	:	Kilometer
Km/l	:	Kilometer Per Liter
Km^2	:	Square Kilometer
L_{eq}	:	Equivalent Continuous Noise Level
µg	:	Microgram
$µg/m^3$	:	Microgram Per Cubic Meter
m	:	Meter
mg/kg	:	Milligram per Kilogram
mg/l	:	Milligram per Liter
mg/m^3	:	Milligram Per Cubic Meter
$PM_{2.5}$	:	Particulate Matter of 2.5 Micron size
PM_{10}	:	Particulate Matter of 10 Micron size
Sqm.	:	Square Meter

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EXECUTIVE SUMMARY

E.1 INTRODUCTION

1. Public Works Department (PWD), Government of Manipur has decided to take up preparation of Social and Environment Safeguard documents fulfilling ADB's Safeguard Policy Statement 2009, Legal Framework of Govt. of India and Govt. of Manipur for "Construction of Imphal Ring Road". PWD, Government of Manipur has engaged M/s Intercontinental Consultants & Technocrats Pvt. Ltd., New Delhi for the Consultancy Services of preparation of Social and Environment Safeguard documents for "Construction of Imphal Ring Road". The Contract has been effective from 9th March 2021.

E.2 OBJECTIVES OF THE IEE

2. Followings are the objectives of the environmental study:

- Determine the category of the project depending on improvement proposal, environmental sensitivity and magnitude of impacts, i.e. screening as per Government of India's regulations and ADB's Safeguard Policy Statement 2009;
- Determine the appropriate extent and type of EA required (IEE or EIA), i.e scoping;
- Determine the requirement of statutory clearances;
- Baseline environmental monitoring and survey;
- Prediction of impacts on relevant environmental attributes and mitigation measures to minimize the impacts; and
- Preparation of IEE Report including EMP

E.3 DESCRIPTION OF THE PROJECT

3. Based on the traffic forecast and interaction with the client, the project road has been proposed to be improved to 4 lane with service lane, 4 lane without service lane and 2 lane standards in various sections; some stretches along the existing road and some in green field. The design speed of green field section is 80 kmph and in the existing road section, 40/50 kmph depending upon the ROW and existing geometrics.

Table-E.1 Improvement Proposal

Name of the road	Total Length (km)	Common Portion with NH-202 & AH-1 (km)	Total length proposed for improvement (km)	Total length of existing road (km)	Total length in Green field (km)
Ring road	54.155	6.390	47.765	29.995	17.770
Spur-1	1.570	-	1.570	1.570	-
Spur-2	0.815	-	0.815	0.815	-
Spur-3	1.080	-	1.080	1.080	-
Total (km)			**51.230**	**33.460**	**17.770**

Source: DPR Prepared by ICT Pvt. Ltd.

4. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is **47.765 Km.** Further, the length of SPUR to JNIMS / DDK is **1.570 km**, SPUR to RIMS is about **0.815 Km** and SPUR to FCI is about **1.080 Km.** Therefore, **total length of improvement including Imphal Ring Road and three SPURs are 51.230 km.**

5. **Corridor of Impact**, Corridor of Impact (CoI) / Proposed Right of Way (PROW) has been proposed as 14 m in general for 2 lane section and 18.5m for 4 lane section. However, due to provision of both side slip roads for proposed Flyover on NH 150, the PROW has been proposed as 35 m. Additional land will be acquired for improvement of major Junctions, bus bay, bridge approaches etc.

6. **Proposed Structures:** 3 major bridges, 6 minor bridges are proposed to be constructed. One 4-lane flyover and one 2-lane Vehicular underpass have been proposed as per project requirement keeping in view the site conditions, existing road junctions and cross roads for smooth and effective flow of traffic.

7. **Proposed Culvert:** Total 227 numbers of culverts have been proposed, out of which, 148 are box culverts and 79 are hume pipe culverts. In addition to above culverts, 43 nos. of hume pipe culvert shall be constructed on cross road of junctions.

8. Project Facilities

- Service Lane / Slip Road: Considering proper turning movement near proposed Flyover on NH-2, both side slip roads (km 47+475 to km 47+335) have been proposed on each side (0.86 km). Cycle track of 0.960 km on each side has been proposed near Porompat area.
- Footpath: At many places, the proposed ring road passes through congested market area. Since the proposed project is a ring road and connecting to market areas and habitation areas, to facilitate the pedestrian movement along the ring road and considering traffic safety 1.5m/2.0m width Drain with utility corridor cum footpath has been proposed.
- Median and Median Opening: Due to land constraint 0.5m width of New Jersy type Crash barrier has been proposed in 4 lane Sections to segregate traffic median opening of 20 m length has been considered at various location for cross passage.
- Bus Lay Bye: To address the need of people living along the project road, bus lay bay have been proposed. Due to land constraint, each Bus bay of 4.5m width and 15m long with shelter has been proposed as per IRC 86:1983. A total of 28 bus bays with bus shelters have been proposed. **E-charging points** shall be provided in the selected bus shelters under civil work.
- Road Sign and Lighting: At all intersections, shoulder mounted advanced directions signs will be provided. All curves shall be properly delineated with single chevrons signs which will be placed on outer edge of the curve, so as to view at least 2-3 chevrons from any given instance of viewing. Absolute speed limit signs and also compulsory “no parking” and “no stoppage” signs also have been proposed at regular interval. **Solar lighting** shall be provided at junctions.

9. **Project Cost:** The Civil Cost and Total project cost works out to be as under (**Table-E.2**). The total project cost includes contingencies, supervision charges, agency charges, resettlement and rehabilitation including land acquisition, environment cost and shifting of utilities.

Table-E.2 Total Civil Cost and Project Cost

Package	Civil Cost including GST (Rs. in Cr.)	Per Km Civil Cost (Rs. in Cr.)	Total Project Cost (Rs. in Cr.)	Per Km Total Project Cost (Rs. in Cr.)
I	357.79	18.6	543.99	28.3
II	440.23	22.2	665.29	33.5
III	285.32	23.5	427.63	35.2
	1083.34		**1636.91**	

Source: DPR Prepared by ICT Pvt. Ltd.

E.4 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

10. As per the ADB's Safeguard Policy Statement the proposed project has been classified as **Category 'B'** project requiring Initial Environmental Examination (IEE).

11. **Environment Clearance:** There is no provision of "Ring Road" in the "SCHEDULE" of EIA Notification. Total length of improvement including Imphal Ring Road and three SPURs are 51.230 km and proposed RoW in general is 14 m for 2 lane section and 18.5 m for 4 lane section; provision of 7(f) of the schedule cannot be applied. Therefore, as per EIA Notification 2006 and it's subsequent amendments, Environment Clearance **is not required** for the Imphal Ring Road.

12. **Forest Clearance:** The proposed project involves diversion of **12.9746 ha** forest land. Hence, Forest Clearance **is required**. The proposal was uploaded through online portal of the MoEFCC on 09/04/2022 (FC proposal No. FP/MN/ROAD/154280/2022). The status of the forest proposal is as under:

28th April 2022:	The Divisional Forest Officer (DFO), Central Forest Division recommended the proposal
08th May 2022:	The Conservator of Forests (CF), Central Forest Circle, Government of Manipur recommended the proposal
01st June 2022:	The Chief Conservator of Forests (CCF) / Nodal Officer Government of Manipur recommended the proposal
09th June 2022:	The Government of Manipur recommended the proposal
01st Dec 2022:	Stage-I Forest Clearance granted by the IRO, MoEFCC

13. **Wildlife / ESZ Clearance:** The alignment of proposed Imphal Ring Road does not pass through any protected areas and not located within 10 km radius of any protected area. Hence, Wildlife / ESZ Clearance are **not required**.

14. **ASI Clearance:** No ASI Protected Monument or World Heritage Monument is located within 300m of the proposed Imphal Ring Road. Therefore, ASI Clearance is **not required**

15. Apart from the clearances for the overall project work, the contractor, before starting the construction work, has to obtain required Clearances / NOCs listed in **Table E.3** for operating his equipment and carrying out construction work.

Table-E.3 Clearances required to be obtained by the Contractor

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
1.	Consent for Establishment of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant	▪ Manipur Pollution Control Board	▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Water (Prevention and Control of Pollution) Act, 1974 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
2.	Consent for Operation of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant		
3.	Permission for withdrawal of groundwater for construction	▪ Central Ground Water Authority ▪ State Ground Water Board	▪ Environment (Protection) Act, 1986 ▪ Ground Water Rules, 2002
4.	Location and layout of workers camp, & equipment and storage yards	▪ Manipur Pollution Control Board	▪ Environment (Protection) Act, 1986; ▪ The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016
5.	Discharges from labour camp	▪ Manipur Pollution Control Board	▪ Water (Prevention and Control of Pollution) Act, 1974
6.	Storage, handling and transport of hazardous materials	▪ Manipur Pollution Control Board	▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016
7.	Disposal of Bituminous Wastes (if any)	▪ Intimate local civic body to use local solid waste disposal site	▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016
8.	PUC Certificate for all construction vehicles and all machineries	▪ Transport Department of Govt. of Manipur	▪ The Motor Vehicles (Amendment) Act, 2019 ▪ The Motor Vehicles (Amendment) Bill, 2019
9.	Installation of DG Set (Consent to Establish)	▪ Manipur Pollution Control Board	▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
10.	Operation of DG Set (Consent to Operate)		
11.	Engagement of Labour - Labour License	▪ Labour Commissioner (Ministry of Labour and Employment)	▪ The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 ▪ Contract Labour (Regulation and Abolition) Act 1970 along with Rules, 1971
12.	Engagement of Labour - Social Security - Labour Welfare - Wages	▪ Labour Commissioner (Ministry of Labour and Employment)	▪ The Employees' Provident Fund & Miscellaneous Provisions (Amendment) Act, 1996 ▪ The Personal Injuries

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
			(Compensation Insurance) Act, 1963 ▪ The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 ▪ Equal Remuneration Act, 1976 ▪ The Payment of Wages (Amendment) Act, 2005 ▪ The Minimum Wages Act, 1948 ▪ The Minimum Wages (Central) Rules, 1950

16. In addition to the above, Contractor has to obtain:

- Insurance related to 3rd party insurance, Indemnity, Workmen Compensation etc.
- Permission / license to store explosive materials
- Permission from Municipal Council for setting up Construction Camp
- Change of Land Use Certificate from District Land Revenue Officer (DLRO)

E.5 DESCRIPTION OF THE ENVIRONMENT

17. The existing environmental conditions of the study area covering an area spread over 10 km on either side of the ring road, in general and specific environmental features of the study corridor, i.e., 50 m on either side of the centerline of the ring road, in particular, has been studied as described in the subsequent sections.

E.5.1 Seismicity

18. Imphal City lies in the northeastern (NE) region of India which is regarded as one of the most seismically active regions. The project road is situated in the **Zone V** (having severe seismic intensity) of the Seismic Map of India (as per IS: 1893, Part I, 2002) and therefore has a severe risk of potential damage due to earthquake.

E.5.2 Land Use

19. The proposed project is located in the Imphal East and Imphal West District. Agriculture is the main land use within the study area. The project site up to 10 km radius from the proposed alignment is passing through plain terrain. The predominant land use within the study area is agricultural and its related uses which covers 54.05%, followed by forest (23%), settlements / built-up areas (20.61%), water bodies (1.28%), transportation (0.57%), waste land (0.43%), industrial (0.02%) and recreation (0.04%).

E.5.3 Soil Quality

20. Three (3) sampling locations within the study area were selected for studying soil characteristics. It has been observed that the texture of soil is silty clay with 37-41% silt content and 23-28% clay content. The pH of the all samples varied between 6.84-7.26 indicates that soil is less acidic. It can be inferred that the overall fertility status of the soils within the study area is

good. It contain a good proportion of sodium, potassium & phosphorous and fair quantity of nitrogen and organic matter.

E.5.4 Climate & Meteorology

21. The climate of the study is sub-tropical to temperate climate with fairly hot summer and cold winter. April to June is summer months, while June to September is the southwest monsoon period. October and November is the post monsoon season with moderate rainfall, followed by dry winter months of December to February. Past meteorological data of nearest IMD Observatory at Imphal Airport which is deemed to be representative to the study area, has been collected for the period of 1981-2010 to establish the baseline climatic conditions of the area. The key parameters of collected meteorological data have been summarized in **Table-E.4** below:

Table E.4 Summaries of Climatological Data (Based on IMD Records of 1981-2010)

Parameter	IST	Monthly Range	Annual Mean / Total
Mean Monthly Highest Temperature (°C)		25.4 (Dec) – 33.2 (May)	33.9
Mean Monthly lowest Temperature (°C)		0.9 (Jan) – 20.1 (Jul)	1.1
Relative Humidity (%)	0830	66 (Mar) – 83 (Jul)	78
	1730	53 (Mar) – 80 (Sep)	70
Total Rainfall (mm)		11.5 (Jan) – 231.4 (Jul)	1436.7
Wind Speed (km/h)		2.3 (Dec) – 5.1 (Mar)	3.6
Cloud Cover (all cloud oktas)	0830	2.8 (Jan) – 6.9 (Jul)	5.0
	1730	2.4 (Dec) – 6.5 (Jul)	4.5

Source: Climatological Data of Imphal Airport, Indian Meteorological Department

22. An automatic weather station was established at PWD Complex, Khuyathong, Imphal for collection of meteorological data from one month (April 2021). The daily average of meteorological parameters like temperature, relative humidity, wind speed, wind direction and rain fall is summarized in **Table-E.5**

Table E.5 Summary of Meteorological Data of the Study Area

Parameters	8 April - 9 May 2021
Maximum Temperature (°C)	35.3
Minimum Temperature (°C)	12.3
Maximum Relative Humidity (%)	98.8
Minimum Relative Humidity (%)	15
Total Rainfall (mm)	161.3
Average Wind Speed (m/sec)	2.739341693
Calm condition (%)	31.1
Predominant wind direction (blowing from)	NE

Source: Field Monitoring during 08.04.2021 to 09.05.2021

E.5.5 Ambient Air Quality

23. Six sampling stations were set up for monitoring ambient air quality within the study area. Monitoring locations were selected following the CPCB guidelines for ambient air quality monitoring so as to accord an overall idea of the ambient air quality scenario in the study area. Logistic considerations such as accessibility, security and availability of reliable power supply were also considered while finalizing the monitoring locations. Details of ambient air quality monitoring locations are given in **Table-E.6**. 24-hourly monitoring results of PM2.5, PM10, SO2, NO2 and 1-hourly CO corresponding to air quality monitoring stations are presented in **Table-E.7**. The ambient air quality at the monitored locations does not exceed National Standards.

Table-E.6 Details of Ambient Air Quality Monitoring Locations

SN	Station Code	Location	Chainage	Side	Distance# (m)	Area category
1	AQ1	Canchipur, East Imphal	0+300	RHS	45	Residential
2	AQ2	Porompat, East Imphal	10+000	RHS	42	Residential & Other Area
3	AQ3	Heingang (near School building), East Imphal	21+450	LHS	35	Residential & Other Area
4	AQ4	Sankakeilbel, Lamphel West Imphal	35+550	LHS	55	Residential & Other Area
5	AQ5	Langol, West Imphal	41+400	LHS	192	Residential & Other Area
6	AQ6	Ghari, West Imphal	47+700	LHS	95	Residential

Source: On-site Field Monitoring during April 2021
Distance in meter from edge of the RoW

Table-E.7 Ambient Air Quality Monitoring Results

Station Code	Date of Sampling	Parameters				
		$PM_{2.5}$ ($\mu g/m^3$)	**PM_{10}** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2 ($\mu g/m^3$)**	**CO** (mg/m^3)
AQ1	08-04-2021	48.6	83.8	21.8	14.9	1.29
	11-04-2021	49.7	96.5	20.8	15.4	1.20
AQ2	08-04-2021	52.1	96.8	32.5	18.2	1.38
	11-04-2021	53.8	88.7	30.5	20.4	1.22
AQ3	08-04-2021	29.42	68.5	18.0	9.5	1.44
	11-04-2021	31.2	71.6	17.2	10.4	1.24
AQ4	13-04-2021	31.52	71.6	20	12	1.42
	16-04-2021	26.8	73.8	18.9	13.5	1.32
AQ5	13-04-2021	26.81	65.4	16	10	1.17
	16-04-2021	24.21	59.8	15.4	11.6	1.19
AQ6	13-04-2021	31.68	67.8	26.8	12.9	1.21
	16-04-2021	36.4	77.8	29.8	16.5	1.24
National Ambient Air Quality Standards, 2009#		60	100	80	80	04

Station Code	Date of Sampling	Parameters				
		$PM_{2.5}$ ($\mu g/m^3$)	**PM_{10}** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2 ($\mu g/m^3$)**	**CO** (mg/m^3)
World Bank EHS Guideline (Averaging Period 24 hr)		25	50	-	20	-

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.
#24-hourly or 8-hourly or 01 hourly monitored values as applicable
Note: Whenever monitoring results of two consecutive days of monitoring exceed the limits specified in NAAQS, 2009 for the respective category, it shall be considered adequate reason to further investigation.

E.5.6 Ambient Noise Level

24. To assess the background noise levels, ambient noise monitoring was conducted at Six locations (**Table-E.8**).

Table-E.8 Details of Noise Monitoring Stations

SN	Station Code	Location	Chainage	Side	Distance# (m)	Category of Area	Date of Monitoring
1	NQ1	Canchipur, East Imphal	0+300	RHS	50	Residential	08-04-2021
2	NQ2	Porompat, East Imphal	10+000	RHS	70	Residential	09-04-2021
3	NQ3	Heingang (near School building), East Imphal	21+450	LHS	50	Silence	11-04-2021
4	NQ4	Sankakeilbel, Lamphel West Imphal	35+550	LHS	70	Residential	13-04-2021
5	NQ5	Langol, West Imphal	41+400	LHS	65	Residential	14-04-2021
6	NQ6	Ghari, West Imphal	47+700	LHS	50	Residential	15-04-2021

Source: On-site Field Monitoring during April 2021
Distance in meter from existing centerline
Note: Noise Standard in Residential Zone : Day Time: 55 dB(A) Night Time: 45 dB(A)
Noise Standard in Silence Zone : Day Time: 50 dB(A) Night Time: 40 dB(A)

25. The daytime and night time noise equivalent levels in the residential & silence areas show that the ambient noise levels not exceed the stipulated of Noise standards except at NQ2 during day time. Highest noise level observed in residential area is 62.4 dB(A). L_{10} values (highest among the monitored values) are found to be 57.0 dB(A) and 51.1 dB(A) for residential and silence zone respectively, which signifies that measured noise levels exceeded these values in only 10% of the time of measurement duration. The noise levels were recorded away from the existing road to avoid influence of traffic induced noise. Therefore, it can be inferred that the slightly high noise levels at NQ2 originates from local activities including domestic.

E.5.7 Surface Water Quality

26. Seven (7) surface water (river & stream) quality monitoring stations in the study corridor were selected for the purpose of monitoring, analysis and assessment of water quality. Surface water samples were collected on 13th August 2021. The salient surface water quality parameters are analyzed and presented in **Table-E.9** depicting minimum & maximum value, arithmetic mean

and compared with CPCB Designated best use water quality criteria.

Table E.9 Salient Surface Water Quality Features

SN	Parameter	Range		Arithmetic Mean	Limit #
		Minimum	Maximum		
1	pH	6.9	7.6	7.28	6.5 -8.5
2	DO (mg/l)	4.6	5.2	4.9	4mg/l to >6 mg/l
3	BOD (3 days at 27°C) (mg/l)	5.5	7.2	6.26	<2 mg/l to <3 mg/l
4	Total coliform organisms (MPN*/100 ml	6	35	19	<50 mg/l to 5000
5	Electrical conductivity less than 2250 micro mhos/cm,	82	523	302.5	Max 2250 µmhos/cm at 25 ^{0} C
6	Boron	0.047	0.12	0.052	<2 mg/l

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.
CPCB Designated best use water quality criteria

E.5.8 Ground Water Quality

27. Three (3) ground water sampling locations comprising bore well and hand operated tube wells (hand-pumps) were identified for the monitoring and assessment of ground water quality along the proposed alignment. Ground water samples were collected on 14th August 2021. The ground water quality analysis shows that little fluctuation in pH level (6.49 – 7.47). Turbidity is found to exceed the acceptable limit in all the samples. Total hardness, total alkalinity and total dissolved solids (TDS) values for all the samples are observed to be within the acceptable limits as per the Indian Standards. The amount of dissolved ions in the ground water is represented by the parameter electrical conductivity, which varies between 362–447 µmhos/cm. Chloride varied between 41 to 54 mg/l, Sulfate content varied between 30 to 112 mg/l, Calcium content varied between 28 to 74.3 mg/l and magnesium varied between 6.27 to 9.7 mg/l for the samples. Iron levels are found to be within the acceptable limit. Heavy metals (Cr, Cu, Hg, Pb, Zn, B) are also found to be within the acceptable limit. The concentration of iron ranges from 1.82 to 2.08 mg/l in the area. Iron concentration in the ground sample of all locations is found to be greater than the acceptable limits. The physico-chemical qualities of the ground water satisfy the acceptable limit as stipulated in Drinking Water Standards of India (IS 10500 : 2012) and suitable for human consumption.

E.5.9 Biodiversity Study

28. From the ecology standpoint it very important to know the vegetation pattern, the community structure, floral assemblage, distribution pattern etc. To get a clear picture of the biodiversity and the ecology along the alignment of the ring road and its surroundings, primary survey has been carried out in the month of **March 2021**. For vegetation study standard sampling protocols [Mishra, R. (1968) “Ecology Work Book” published by Oxford and IBH Publishing Co., Calcutta] were followed. Five sampling locations were identified and total **20 quadrats were** laid out (**Table-E.10**).

Table-E.10 Description of sampling sites and number of quadrats laid

Sl. No.	Location Description	Number of Quadrats
1	Heingang, between Chainage 21+200 to 21+500	7 (Seven)
2	Koirengei near chainage 25+980	4 (Four)
3	Langol, between Chainage 32+200 to 32+600	3 (Three)
4	Langol, between Chainage 39+100 to 42+800	3 (Three)
5	Langthaballep, between Chainage 52+100 to 52+700	3 (Three)

Source: Quadrate study carried out by ICT Pvt. Ltd.

29. **Observations and conclusion on trees' composition:** Analysis of trees data shows that among five sites, *Lagestroemia speciosa* was most frequent species followed by *Zizyphus jujube, Callistemon lanceolatus etc*. Density of *Lagestroemia speciosa* was also recorded highest among the tree species followed by *Zizyphus jujube, Callistemon lanceolatus*. These tree species were also abundantly distributed within the region. Importance value index values were also comparatively high, which show that importance of these tree species was relatively high in the ecosystem in terms of biomass, productivity etc. Analysis of the tree data obtained from primary survey which exhibited that site between Chainage 21+200 to 21+500 was comparatively more diverse than other sites. If we see the concentration of the dominance values, it clearly shows that for the site between Chainage 21+200 to 21+500 concentration of dominance value was comparatively low among other sites which indicate that dominance share among tree species for resources was high, hence dominance was low at site between Chainage 21+200 to 21+500. **No rare / endangered tree species were identified** in the primary survey.

30. **Observations and conclusion on shrub' composition:** Analyzing the shrub layer data it was found that the most frequent and dominant shrub species were *Adhatoda vasica, Vitex negundo, Lantana camara* among the five sampling sites, These species were also observed to be densest species among the three forest sites. In terms of their value in the ecosystem importance value index (IVI) value was comparatively high for these species. Shrub diversity indices values exhibited that chainage between 21+200 to 21+500 site was comparatively more diverse among the five sites and due to highest dominance share among the shrub species resulted a low dominance index for the this site.

31. **Observations and conclusion on herbs' composition:** Data of herbaceous layer showed that in all the three sites most frequent and dominant herb species were *Cymbopogon fulvus, Cynodon dactylon, Apluda aristata,* and *Panicum atrosanguianeum* in all the five sampling sites, these species were also observed to be densest species among the three forest sites. The importance value index (IVI) value was comparatively high for these species. Highest herbs and grasses were found in the site between Chainage 21+200 to 21+500, reason being that this site is less disturbed which gives more opportunity to thrive the ground vegetation. Hence more dominance share for resources and habitat gives low dominance index of herbaceous vegetation of this site.

32. It has been confirmed by the Forest Department that:

- There is no rare / endangered / unique species of flora and fauna / natural, modified and critical habitats of fauna found along the alignment and close vicinity of the Imphal Ring Road

- The proposed alignment does not cross any wildlife migration corridor as well as there is no elephant corridor, wildlife migration corridor etc., within 1 Km. from boundary of the forest land proposed for diversion
- **No road kill data of the area is available** with the Forest Department through which the proposed ring road alignment is passing.

E.5.10 Protected Area

33. There is no protected area (Wildlife Sanctuary, National Parks etc.) within 10 km radius of the proposed alignment of Imphal Ring Road.

E.5.11 Physical Cultural Resources

34. Archaeological Sites: There are no archaeological sites within 300 m on either side of the proposed alignment of Imphal Ring Road.

35. Educational Institutions: Along the project road, there are 35 educational institutions out of which 2 schools are closed and 33 are operational.

36. Religious Places: Along the project road, there are 8 religious places, out of which 4 religious places are located on the right side and 4 are located on the left side of the project road.

37. Medical Facilities: There are medical facilities at 7 locations along the project road, out of which 2 are located on the right side and 5 are located on the left side.

38. Common Property Resources (CPR): There are 28 common property resources i.e. community hall, crematorium ground, hand pump, market shed, sports complex etc. along the project road, out of which 17 places are located on the right side and 11 are located on the left side of the project road.

E.5.12 Socio-economic Profile

39. The social stratification of the project area shows the dominance of General Caste population with 549 (65.36%) households, while remaining 31.79% are OBC, SC (2.50%) and others (0.35%). There are 4829 displaced persons (DPs). The average household size is 5.75. According to project census survey 149 vulnerable households will be affected by the project. The educational status of DPs reveals that 7.02% of them are still illiterate.

E.6 ANALYSIS OF ALTERNATIVES

40. During Feasibility study, three alignment options was studied for the Ring Road around Imphal town with each option consisting of segments of existing road network in Imphal City and also sections where new green field alignment is proposed to minimize impact on settlements of town. After site visits of Group of Ministers and review of various options, the alignment Option II (as given in final feasibility Report) having length of 46.635 km (Including NH202 & AH 1-4.695Km) and three Spur alignments has been approved by client due to its better connectivity in July 2014. The common portion of NH-202 & AH-1 was excluded for improvement.

41. Further upon several review meetings and presentation post DPR submission, with concerned decision maker's minor modification for alignment were discussed and incorporated in Final DPR. This revised alignment consist of aggregate length of 47.961 Km (includes NH 202 &

AH 1- 4.62 Km) and Two spur alignment with aggregate length of 1.655 Km. This was approved vide letter dated 7th February 2015.

42. Further PWD, Manipur desired revision in the alignment to ensure connectivity to some additional vital installations of city and further ensure benefits and quick access to such installations to larger population. Accordingly, the start point was shifted 287 m near Manipur University away from city to align with the under construction bridge. As per revised proposal, the stretch from Kongba Bazar to Khabam Lamkhai has been replaced by an alignment through *Ipum pat Road,* Heingang lake and connects NH-2 near CMC hospital. The previous proposed stretch inside Games village has been replaced by the alignment along Fishery office and connects near Shija hospital to the old alignment.

43. The revised Draft DPR was submitted in May 2020 incorporating the changes. In compliance to the comments and suggestion from Government of Manipur to minimize the private land acquisition, the alignment further revised and PROW width has been reduced. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is **47.765 Km.** Further, the length of SPUR to JNIMS / DDK is **1.570 km**, SPUR to RIMS is about **0.815 Km** and SPUR to FCI is about **1.080 Km.** Therefore, **total length of improvement including Imphal Ring Road and three SPURs are 51.230 km**. The Final DPR incorporating the above changes; was submitted in the month of June 2021.

E.7 ANTICIPATED IMPACTS AND MITIGATION MEASURES

E.7.1 Environmental Impacts

44. A summary of the potential environmental impacts during construction and operation phase along with recommended mitigation measures is summarized in **Table-E.11**.

Table-E.11 Summary of Anticipated Impacts and Recommended Mitigation Measures

Area	Impacts	Mitigation Measures
Construction Phase:		
Topography and geology	▪ Disfiguration & change in existing profile of the land in the proposed greenfield section of the alignment ▪ Disfiguration of topography due to indiscriminate digging of borrow pits ▪ Uncontrolled digging of borrow pits resulting in water accumulation & breeding of vector disease	▪ 6,42,799 cum earth will be generated from cutting and 5,56,890 cum earth will be required for filling. Therefore, 87% of excavated earth will be re-used to raise road levels in the construction of Imphal ring road. Remaining earth will be used in to raise embankment of other roads projects under PWD in Imphal area. Hence, there is no requirement of borrow earth for the proposed project. ▪ Road building materials shall be procured from approved and licensed quarries. ▪ All the structures have been designed for seismic force as per provisions of IRC: 6, IRC:112, IRC:78 and other applicable codes.
Soil	▪ Disruption & loss of productive top soil from agricultural fields ▪ Soil erosion and contamination	▪ Adequate measures like drainage, embankment consolidation & slope stabilization shall be taken to avoid soil erosion. ▪ Slope protection measures (stone pitching or turfing with **Coir Geotextile & Vetiver grasses**) form part of good engineering practice and therefore, it has been proposed ▪ Top soils (15 cm) of borrow pit sites shall be conserved and restored after excavation is over. ▪ Accidental spills of lubricants/oil and molten asphalt shall be avoided by adherence to good practices. ▪ Oil Interceptor shall be provided for wash down, refueling areas ▪ Vehicle parking area of the construction camp will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats.
Land use	▪ Changes in existing land use pattern of the PROW for construction of the ring road ▪ Loss of agricultural land, forest land etc. due to land acquisition	▪ 87% of excavated earth will be re-used to raise road levels in the construction of Imphal ring road. ▪ Construction debris shall be disposed of by mechanical transport in suitable pre-identified (jointly by project proponent & local administration) dumping areas in tune with the local condition to avoid land degradation & water logging due to indiscriminate dumping. ▪ Construction camp shall be provided for construction personnel to avoid indiscriminate settlement of construction workers & labourers. ▪ Regular inspection of haul roads and construction site shall be carried out to ensure regular and timely removal of construction debris to the designated dumping sites.
Drainage &	▪ The drainage network along	▪ To minimize the impact drainage & hydrological flow,

Area	Impacts	Mitigation Measures
Hydrology	the project road is subject to impacts due to proposed construction	**3 major bridges, 6 minor bridges and 227 culverts** are proposed to be constructed along the project road. It has been ensured that free flow of water is maintained wherever the project road alignment crosses river / local streams / nallah etc. ▪ All bridges have been designed for a return period of 100 years and culverts have been designed for a return period of 50 years ▪ It has been ensured that all the 1st and 2nd order streams crossing the project road alignment provided with culverts and bridges with capacity of more than 20% excess discharge. ▪ Bridges will be constructed in the lean season; hence there will be no obstruction of the water flow during construction phase. ▪ Lined, RCC and unlined drain has been proposed on both sides of the Ring Road. ▪ **Length of lined drain is 15,381 km, length of RCC drain 94,893 km and length of unlined drain is 1,435 km** ▪ There are 10 ponds within the proposed RoW, out of which 3 ponds will be fully affected and 5 ponds will be partially affected. In remaining 2 ponds, RCC box culverts are proposed based on design discharge ▪ The fully affected ponds shall be compensated by digging of new ponds in the vicinity as a part of community pool resources. Area of these new ponds shall not be less than 4,680 sq. m ▪ The depth of partially affected ponds will be increased to maintain the existing volume of water.
Water use	▪ Impact on the local water sources due to use of construction water.	▪ Minimum use of water from existing sources for construction purpose shall be ensured to minimize likely impacts on other users ▪ In compliance to the Sub-Clause 111.8.3 of MoRTH Specifications, the Contractor will identify the nearest source of water body at plant and camp site and shall source the water preferably from surface water bodies, rivers, canals and ponds in the project area. Only at locations where surface water sources are not available, the Contractor shall contemplate extraction of ground water, after intimation and consent from the CGWB. ▪ Wastage of water during the construction should be minimized
Water quality	▪ During construction phase, leakage of POL (Petroleum, Oils, and Lubricants) could lead to an increase in water	▪ Silt fencing will be provided to reduce sediment load ▪ The Contractor shall provide immediate permanent or temporary erosion, slope protection and sedimentation control measures. Such work may

Area	Impacts	Mitigation Measures
	pollution level of the receiving water body. Anticipated potential impacts are due to spillage of construction materials, such as, cement, POL, bitumen etc. falling in to the drainage channels from workshops, construction camps, quarry / borrow areas etc. of the Contractor ▪ Increase of sediment load in the run off from construction sites and increase in turbidity in receiving water bodies. ▪ Water pollution due to generation of wastewater from construction camps	involve the construction of temporary burns, dikes, sediment basin, slope drain and use of temporary mulches ▪ Oil interceptor to stop and separate the floating oils ▪ Packaged Wastewater Treatment Plant has been recommended for the construction camp ▪ As per the CGWA classification, all the Talukas, through which the proposed Imphal Ring Road is passing, fall under "safe" category. However, rain water harvesting structures with provision of oil filters and de-silting chambers has been proposed along project road as per requirement of IRC SP: 42-2014 and IRC SP: 50-2013. **A total 102 rainwater harvesting structures have been proposed for the project** (38 in Package-I, 40 in Package-II and 24 in Package-III). ▪ The fuel storage and vehicle cleaning area shall be stationed at least 500m away from the nearest water body ▪ Apart from provision of the mitigation measures, water quality shall be monitored during construction and operation phases as per environmental monitoring program to understand the effectiveness of mitigation measures suggested
Air quality	▪ Deterioration of air quality due to fugitive dusts emission from construction activities and vehicular movement along unpaved roads. ▪ Deterioration of air quality due to gaseous emissions from construction equipment & vehicular traffic. ▪ Deterioration of air quality due to emission from hot mix plants and stone crusher.	▪ Construction materials will be stored in enclosed spaces to prevent fugitive emissions. ▪ Truck carrying soil, sand and stone will be duly covered to avoid spilling. ▪ Dust suppression measures such as regular water sprinkling on haul & unpaved roads particularly near habitation ▪ Hot Mix Plant with Pollution Control Measures having Fabric Filter with multiple wet scrubber shall be installed and elevators at loading section shall be fully covered ▪ A combination of dry and wet type control system is suggested for stone crusher to minimize the impact on air quality ▪ Hot mix plants & stone crusher shall be located at least 500 m away from inhabited areas & sensitive receptors ▪ Air quality shall be monitored during construction and operation phases as per environmental monitoring program to understand the effectiveness of mitigation measures suggested
Noise level	▪ Increase in noise level due to construction activities like operation of construction	▪ Construction camp and temporary labour sheds will be located away from the immediate vicinity of the construction sites and major road traffic.

Area	Impacts	Mitigation Measures
	equipment & vehicular traffic.	▪ PPEs will be provided to construction personnel exposed to high noise levels as preventive measure. ▪ Low noise construction equipment will be used. ▪ Stationary construction equipment will be placed 113 m away from inhabited areas. ▪ Stationary construction equipment will be placed 200 m away from the silence zones ▪ Grading & clearing, excavation, foundations, erection, movement of heavy construction machinery etc. are the major noise generating activities and it is recommended to stop these activities near educational institutions during school hours ▪ Temporary barriers / enclosures (e.g. plywood with sound absorbing materials) should be built around noisy equipment. These barriers can significantly reduce noise levels and are relatively inexpensive ▪ To reduce traffic noise, **flexible pavement** has been recommended. ▪ Near educational institutions & medical amenities, maximum speed limit should be 30 kmph. The Contractor shall be responsible to install signboard displaying the speed limit (30) near the educational institutions & medical amenities after construction of the ring road and PWD Manipur shall be responsible to enforce and monitoring of the same ▪ **Noise barrier has been proposed at 24 sensitive receptors**. Solid Noise barrier in form of brick boundary wall with creepers or Acrylic walls as well as acoustic control measures in form of double-glazed windows has been proposed in various locations depending on mitigation requirement and space available for construction. ▪ Condition surveys of Sensitive Receptors within 20 meters from the road. There are **16 sensitive receptors** which are located within 20 m from the centre line of the road. Apart from the sensitive receptors, if any extremely fragile buildings or structures are found within 20 meters of the works, these buildings or structures shall be included in the survey. During piling operation, condition surveys of sensitive receptors & fragile building located within 50 m around the piling location shall be covered ▪ Vibration monitoring during operation of heavy equipment like Excavators, Motor scrapers, Vibratory rollers etc. ▪ Noise level shall be monitored during construction and operation phases as per environmental monitoring program to understand the effectiveness of mitigation measures suggested

Area	Impacts	Mitigation Measures
Floral and Forest	• There are approximately **2,704 trees** within the proposed RoW in the **non-forest land** and **2,266 trees in forest land** • Loss of habitat of fauna due to felling of trees and diversion of forest land	▪ Tree felling within proposed ROW ▪ **Trees will not be cut while birds are nesting in that trees, in such cases cutting has to be postponed until the birds have fledged the nest** ▪ To compensate the loss of trees in non-forest land, it has been decided in consultation with the Forest Department and PWD Manipur that 5,300 trees will be planted**.** ▪ Trees will be planted along the ring road at selected location (please refer Table-98 for details) in 2 rows. Cost for plantation has been included in the EMP budget ▪ As per MoEFCC Circular dated 08.11.2017, no of trees to be planted in Compensatory Afforestation land shall be at least 1,000 plants /ha of forest land diverted. Therefore, **12,974 trees shall be planted** by the Forest Department as a part of Compensatory afforestation against diversion of 12.9746 ha forest land. ▪ **Overall Compensatory Plantation is 1 : 3.7** • Apart from plantation, **two Biodiversity Parks** are proposed to be developed at Lamp Rai Chingjin and Heingang, which shall be established by the Divisional Forest Officer, Central Forest Division. Plantation of bamboo, medicinal plant, rare indigenous plants etc. as specified by Forest Department will be planted in the biodiversity park. As per the Forest Department, the proposed biodiversity park will serve as mini lung of the surrounding areas and provide them with ecological and cultural benefits. The construction of the Park is to be executed by the State Forest Department as per their design and specifications and protocols. The individual cost of the biodiversity parks are Rs. 88.50 lakh and Rs. 64.61 lakh ▪ Efforts will be made to save trees outside formation width standing on edge of the PROW. Crash barrier shall be provided at such locations ▪ Trees to be felled shall be clearly marked. ▪ Obtain tree felling permission from State Forest Department ▪ Tree felling is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances from the State Forest Department are completed and subsequently a written order is issued to the Contractor. ▪ Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees to be felled and

Area	Impacts	Mitigation Measures
		those saved will be maintained by the PIU
Fauna	▪ Diversion of forest land shall directly cause loss of habitat for wildlife.	▪ The proposed project is the construction of Imphal Ring Road and the alignment is passing through congested urban stretch of Imphal City. **No wildlife is observed / reported along the proposed alignment except domestic animal and avifauna.** However, there are several Schedule-I / vulnerable (VU) / endangered (EN) species of fauna are observed in Imphal valley (as mentioned in Chapter-IV) but none of the species are normally observed in the Imphal City. The same has been confirmed by the Forest Department as well as local residents during Public Consultation. Hence **no impact has been envisaged on Schedule-I / vulnerable (VU) / endangered (EN) species of fauna / critical habitat / natural habitat / modified habitat** ▪ **No road kill data of the area is available** with the Forest Department through which the proposed ring road alignment is passing ▪ Wildlife awareness & environmental protection training shall be provided to the work force by the Contractor / PIU. The workers shall be made aware of the location, value and sensitivity of the natural resources in the area. The program shall be conducted before starting of construction activity. All staff of PIU, engineers, support staff and construction labour will attend the awareness program. Budget of Rs.3,20,000/- (Three Lakh Twenty Thousand) has been proposed for training in the EMP budget for each implementation package. The awareness and training shall be provided before initiation of construction activity. ▪ Noise level will be kept under control as per the guidelines of CPCB and noisy activities shall be prohibited near sensitive areas during night time. ▪ Poaching shall be strictly banned and any incidence of wildlife poaching by workforce shall be reported to the Forest Department by the Contractor / PIU. There should be provision of penalty / fine for any incidence of wildlife poaching by workforce and amount of penalty / fine shall be decided by the Forest Department ▪ Noisy activity shall be prohibited during night time
Construction camp	▪ Influx of construction work-force & suppliers who are likely to construct temporary tents in the vicinity. ▪ Likely sanitation & health	▪ Temporary construction camps with adequate potable water supply, primary health facilities and fuel for cooking shall be provided ▪ Packaged Wastewater Treatment Plant has been recommended for the construction camp

Area	Impacts	Mitigation Measures
	hazards & other impacts on the surrounding environment due to inflow of construction labourers.	▪ It will be ensured that the construction workers are provided fuel for cooking to avoid cutting of trees from the adjoining areas. ▪ Contractor to provide a full-fledged dispensary. The number of beds shall be as per the requirement of the labour license
Community and Occupational Health & Safety	▪ Health & safety related problems to the community due to project-related hazards, disease (STI / HIV-AIDS etc.), and the accidental collapse or failure of project structural elements such as bridges, flyover etc. Project related activities may directly, indirectly or cumulatively change community exposure to hazards. ▪ Health & safety related problems to construction workers due to inadequate health & safety measures.	▪ Health and Safety Plan detailing adequate health & safety measures for the community as well as construction workers shall be prepared by the Contractor prior to the start of the construction activity. The same should be reviewed and approved by the Sr. Environmental Specialist of the AE / IE. ▪ A road safety, traffic management and accident management plan is to be prepared by the Contractor prior to the start of the construction activity. The same should be approved by the Sr. Environmental Specialist of the AE / IE. ▪ Periodic health check-up of construction workers will be done by the contractor. ▪ The PIU, PWD Manipur and AE / IE should assess the capacity of contractors and subcontractors w.r.t. safety issues and shall advice / arrange training for capacity enhancement so that safety performance at the project site is complying with the requirements of funding agency ▪ The Contractor, before start of the construction, has to prepare & submit a emergency response plan describing the community emergency prevention, preparedness and response arrangements in place. Emergency response plans shall be prepared in consultation with the local authorities covering a) specific emergency response procedures; b) trained emergency response teams; c) emergency contacts and communication systems / protocols; d) procedures for interaction with local and regional emergency and health authorities; e) permanently stationed emergency equipment and facilities; f) evacuation routes and meeting points and drills (annual or more frequently as necessary).
Road Safety	▪ After reviewing the accident trend of last 4 years (2016 to 2019), it is observed that road accident data in Manipur State increasing with CAGR of 5.72% and fatalities growth rate is more than 10% every year. Accident scenario of urban area in Manipur even	▪ Adequate road safety has been considered in shape of Safety measures, road signs and design criteria in the DPR. Indian Road Congress (IRC) codes have been followed in proposing and designing road safety features. All major intersections shall have shoulder mounted advanced directions signs and traffic control signaling system. The signs shall be with retro reflective micro prismatic grade conforming to Type XI sheeting of ASTM standards for short, medium and

Area	Impacts	Mitigation Measures
	more worrying as crash rate is 11% CAGR and fatalities 28%	long distance viewing to cater visibility requirement encountered by all road users. ▪ At all major junctions, there will be traffic calming system on all sides to regulate the speed of the vehicular traffic. Out of 36 major junctions, 17 nos. of rotary has been proposed which itself is a speed regulator system. All the minor roads will have ramblers and STOP signs to regulate the entry into the proposed road. ▪ Road Safety Audit will be carried out by an independent agency during construction stage and just after completion of project before open to traffic ▪ Pavement markings will be done for traffic lane line, edge lines and hatching. The marking will be with hot applied thermoplastics materials. The pavement markings will be reinforced with raised RR pavement markers and will be provided for median and shoulder edge longitudinal lines and hatch markings. Entire Highway lightings including high masts at intersections will be provided in order to improve the night time visibility
Operation Phase		
Air quality	▪ Air pollution due to vehicular emission from road traffic.	▪ Analyses of air modeling results ascertain that the predicted level of CO, PM_{10}, NOx and SO_2 concentration for peak traffic is well within the prescribed range of 4000 $\mu g/m^3$, 100 $\mu g/m^3$ and 80 $\mu g/m^3$ (NOx & SO_2) respectively. The pollutant concentrations tend to increase over the years with the increased traffic volume, but will remain within the stipulated limits. ▪ In the projected scenario, due to higher carriageway width, air turbulence and high design speed, emissions from traffic are low at receptor locations. With the use of BS-VI fuels and vehicles and gradual discontinuation of BS IV and older vehicles, the vehicular emission is expected to further reduce and may offset the increased pollutant concentration due to increased traffic volume. Hence, the pollutant concentration is not expected to increase beyond stipulated limits in operation phase of the project. ▪ The greenery and forests located along the project highway will act as a sink to the air pollutants. ▪ Road signage at regular intervals to be placed to remind motorists to keep their vehicles maintained and drives at uniform speed so as to save both in terms of fuel and pollution. ▪ As part of the routine maintenance works, good riding conditions of the road surface should be maintained to

Area	Impacts	Mitigation Measures
		reduce dust and vehicular pollution. ▪ Air quality monitoring. If monitored parameters exceeds prescribed limit, suitable control measures must be taken. ▪ Enforcement of vehicle emission rules in coordination with transport department or installing emission checking equipment
Noise level	▪ Noise due to movement of traffic.	▪ Effective traffic management and good riding conditions shall be maintained ▪ Maintenance of noise barrier ▪ Speed limitation and honking restrictions near sensitive receptors ▪ HORN PROHIBITED sign to be placed near sensitive receptors ▪ Noise monitoring. If monitored value exceeds prescribed limit, suitable control measures must be taken. ▪ Create awareness amongst the residents about likely noise levels from Highway operation at different distances, the safe noise limits and easy to implement noise reduction measures while constructing a building near road
Water quality	▪ Water logging due to blockage of drains, culverts or streams	▪ Regular visual checks and cleaning of drains shall be done along the alignment to ensure that flow of water is maintained through cross drains and other channels / streams. ▪ Monitoring of water borne diseases due to stagnant water bodies
Maintenance of Right of Way and Safety	▪ Accident Risk due to uncontrolled growth of vegetation ▪ Accident risks associated with traffic movement ▪ Accident risks due to fauna-vehicle collision.	▪ Efforts shall be made to make shoulder completely clear of vegetation ▪ Traffic control measures, including speed limits, will be forced strictly. ▪ Encroachment of squatters within the ROW will be prevented. ▪ No school or hospital will be allowed to be established beyond the stipulated planning line as per relevant local law ▪ Monitor / ensure that all safety provisions included in design and construction phase are properly maintained ▪ No parking along the Ring Road except in designated areas ▪ Tow-way facility for the breakdown vehicles ▪ Periodic inspection of the fences along the Ring Road

E.8 SOCIAL IMPACTS

45. The land required for construction of Imphal Ring Road is tentatively **94.8606 ha**, which includes 12.9746 ha forest land and 81.886 ha non-forest land. Out of 81.886 ha non-forest land, 27.1985 ha agricultural land, 19.56 ha is residential / commercial land and 35.1275 ha is government land. Based on the full census survey, 840 households with 4829 persons are identified to be affected due to the project. The summary of the social impacts are presented in the following **Table-E.12.**

Table-E12 Summary of Social Impacts

Sl. No.	Impacts			Total
1	Total Area of Land required (Govt. +Pvt.) (in ha)			94.8606
2	Area of private land to be acquired (in ha)			46.758
3	**Total number of THs**			**669**
	A	Losing Land only		550
	B	Losing Land + Structures		119
4	**Total Number of Displaced households (TH+NTH) including Tenants and Employees**			**840**
	A	Title-holders		669
	B	Total Number of Households Non-Titleholders		70
		1	Encroachers	70
	C	Tenants		85
	D	Employee		16
5	Total Number of Structures (NTH category)			**80**
6	Total number of Project Displaced Persons			**4829**
7	Total number of vulnerable households displaced			**149**
8	Total number of CPRs (structure) affected			**91**

Source: Resettlement Plan of Imphal Ring Road, June 2022

E.9 PUBLIC CONSULTATION

46. The following are the major points of concern of the participants of public consultation meeting:

- Stakeholders are concerned about the existing traffic noise and anticipate that increase of traffic flow may lead to increased noise level after project implementation.
- Majority of the stakeholders are concerned with the existing air emission by the present traffic but their opinion in post project scenario is fragmented to a considerable extent.
- Stakeholders are unanimously agreed that the road is accident prone and needs immediate improvement.
- Pedestrian crossing, proper road signage and speed control measures are the most sought after road safety measures by the stakeholders.

- Accident involving wildlife and man-animal conflicts are reported to be rare, though incidents of crop damage by wild pigs and deer are moderately reported.
- Though citizens at large are in favour of introducing speed restriction near the schools, markets and also construction of drains on both sides of the road
- Boundary wall acting as noise barriers along the school premises and settlement areas are welcomed by most of the participants.
- The citizens also expressed their concern on solid waste management facility in the villages; therefore, it is proposed to introduce composting facilities in the project affected villages on community basis for handling of household waste which is primarily biodegradable in nature.
- There is no scope for avenue plantation as per the design. Hence, as per suggestion of DCF, Central Forest Division, Imphal, Herbal garden is proposed to be developed under the forestry budget to minimize the loss of trees. The Forest Department will implement the scheme.

E.10 ENVIRONMENTAL MANAGEMENT PLAN

47. EMP has been prepared addressing the following issues:

- Stage wise (design & pre-construction stage, construction stage & operation stage) environmental management measures;
- Environmental monitoring program during construction and operation phase including performance indicator, monitoring schedule (parameters, locations, frequency of monitoring & institutional responsibility) and reporting system;
- Institutional set up identified for implementation of the EMP including institutional capacity building and
- Various guidelines such as re-development of borrow areas, quarry site, stone crushing unit; management of debris disposal site; comprehensive waste management plan; top soil conservation and reuse; storage, handling, use and emergency response for hazardous substances; wastewater treatment in construction camp; worker's safety during construction; sediment control; traffic management plan; protocol for protecting the workforce at construction site during COVID-19 etc.

48. Environmental Budget.

- The project will be implemented under 3 construction packages. A capital cost provision of about **Rs. 12.83 Crore.** has been kept towards implementation of environmental management plan for all construction packages

E.11 CONCLUSION & RECOMMENDATIONS

49. **Conclusion**: Most of the adverse impacts of road project during construction period are short term and temporary in nature. These impacts can be minimized through specific engineering solutions. Environment friendly construction methodology has been incorporated into the project design and Environment Management Plan has been prepared to minimize the overall impact on environmental attributes by the proposed project works. Therefore, the proposed project is **unlikely to cause any significant adverse environmental impacts** and no further detailed study is required.

50. **Recommendations:** The EMP, its mitigation and monitoring programs, contained herewith will be included within the bidding documents for project works for all project components. The Bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own site specific EMP (SEMP) which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the Contractors camp locations. This ensures that all potential bidders are aware of the environmental requirements of the project and its associated environmental costs.

51. The EMP and all its requirements will then be added to the Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. The Contractor will then prepare his SEMP which will be approved and monitored by the Environmental Specialist of AE / IE. Any non-conformance with the SEMP (and the EMP) the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SEMP the Contractor must employ an Environmental Officer to monitor and report Project activities throughout the Project Construction phase.

I. INTRODUCTION

A. INTRODUCTION

1. Public Works Department (PWD), Government of Manipur has decided to take up preparation of Social and Environment Safeguard documents fulfilling ADB's Safeguard Policy Statement 2009, Legal Framework of Govt. of India and Govt. of Manipur for "Imphal Ring Road Project".

2. PWD, Government of Manipur has engaged M/s Intercontinental Consultants & Technocrats Pvt. Ltd., New Delhi for the Consultancy Services of preparation of Social and Environment Safeguard documents for "Imphal Ring Road Project". The Contract has been effective from 9th March 2021.

B. PROJECT BACKGROUND

3. The project road encompasses a Ring Road around capital city of Imphal to ensure quick access to the important establishments of the city, which includes, administrative offices, Health care, academic establishments, and commercial centers. It will also reduce congestion in the city. The alignment will connect to several obligatory points.

4. During Feasibility study, three alignment options were studied for the Ring Road around Imphal town with each option consisting of segments of existing road network in Imphal City and also sections where new green field alignment is proposed to minimize impact on settlements of town. After careful consideration & site visits of Group of Ministers, the alignment Option II was finalized during final feasibility stage, with alignment length of 46.635 km (includes 4.695 Km of NH-202 & AH-1) & three SPUR alignments and approved by the PWD, Manipur in July 2014. The common portion of NH-202 & AH-1 was excluded for improvement.

5. After several review meetings and presentation post Draft DPR stage with concerned decision makers, minor modification was made and incorporated in the Final DPR. The alignment, which was approved at Final DPR stage in the month of February 2015, which consist of aggregate length of 47.961 Km (includes 4.62 Km of NH-202 & AH-1) and two SPUR alignment with aggregate length of 1.655 Km. The common portion of NH-202 & AH-1 have to be excluded for improvement.

6. **After submission of Final DPR, as desired by PWD, Manipur, the alignment has been further revised to provide connectivity to additional vital installations of the city.** The revisions envisaged by PWD, Manipur were verified on field with joint visit by DRP Consultant and representative of Authority to ensure no field constraints, good geometry, and easy land acquisition for desired revisions.

7. The revised Draft DPR was submitted in May 2020 incorporating the changes. In compliance to the comments and suggestion from Government of Manipur to minimize the private land acquisition, the alignment further revised and PROW width has been reduced. The alignment from km. 0+300 has been deviated towards Bashiklong village and joins to the old alignment at km. 1.900. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is **47.765 Km.** Further, the length of SPUR to JNIMS / DDK is **1.570 km**, SPUR to RIMS is about **0.815 Km** and SPUR to FCI is about **1.080 Km.** Therefore, **total length of improvement including Imphal Ring Road and three SPURs are 51.230 km.**

8. After submission of updated Final DPR for Imphal Ring Road, based on land acquisition status, PWD, Manipur decided to implement the project in three packages. The packaging details are given in **Table-1.**

Table-1 Packaging details of Imphal Ring Road

Package	From	To	Description	Length (km)
I	0+000	14+715	Kiyamgei to Chairenthong	14.715
	14+960	17+900	Konsam Leikai to Heinganagpat	2.940
	0+000	1+570	SPUR to DDK / JNMIS	1.570
	Package-I Total			***19.225***
II	17+900	25+980	Heinganagpat to NH-2, near Catholic Hospital	8.080
	32+125	43+100	Chingmeirong to Iroisemba	10.975
	0+000	0+815	SPUR to RIMS	0.815
	Package-II Total			**19.870**
III	43+100	54+155	Iroisemba to NH-102, Near Gambhir Singh Statue	11.055
	0+000	1+080	SPUR to FCI Godown (following the existing alignment)	1.080
	Package-III Total			**12.135**
Total length proposed for Improvement (Km)				**51.230**

Source: DPR Prepared by ICT Pvt. Ltd.

9. As discussed above, the Imphal Ring Road will be implemented into three packages.. Length of Package-I is **19.225 km**, length of Package-II is **19.870** km and length of Package-III is **12.135** km This Final IEE Report deals with the Imphal Ring Road and SPUR and **has been prepared for all packages**. An Index map of the Imphal Ring Road comprising of different roadway segments and the obligatory points is shown in **Figure-1**.

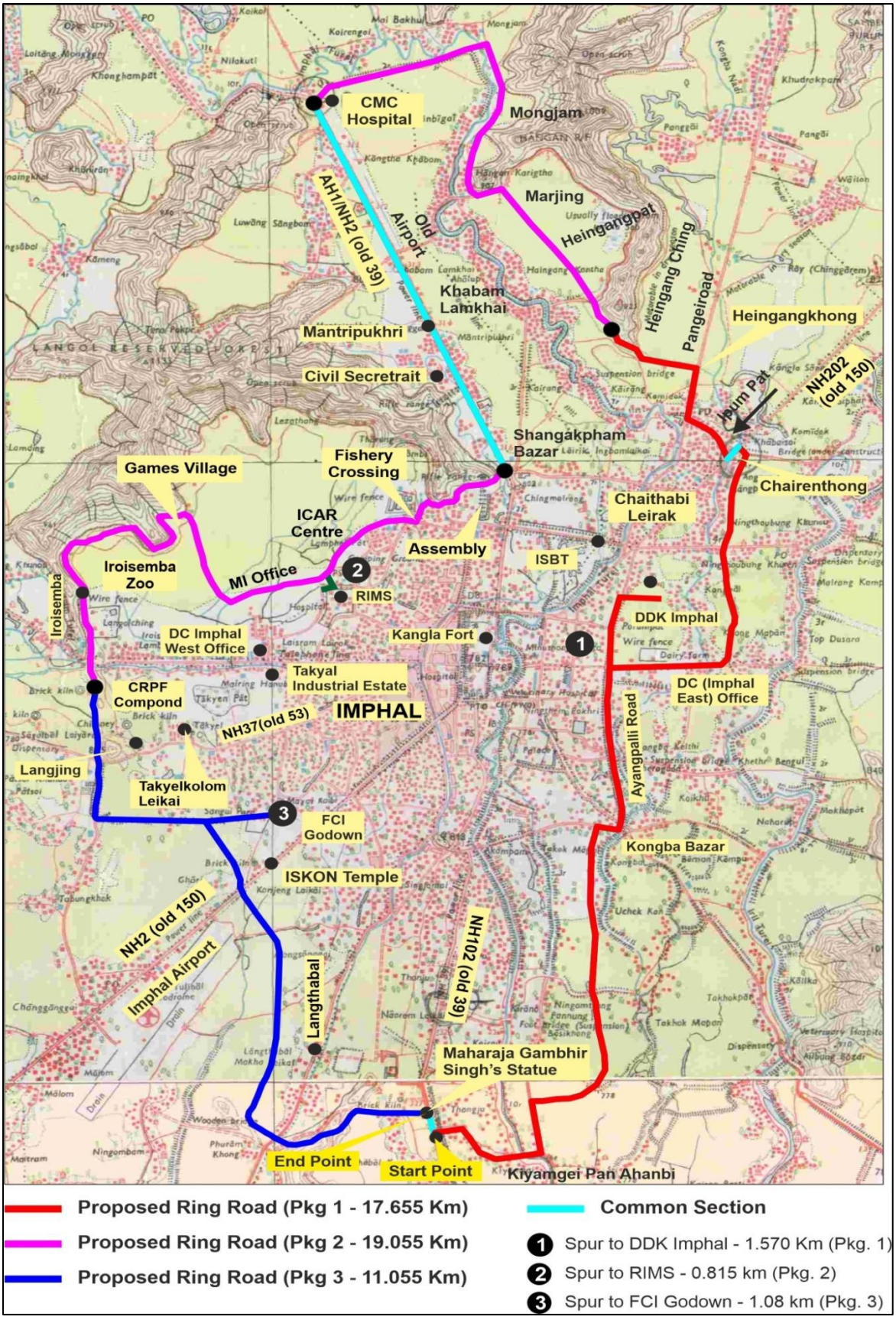


Figure-1 Index map of the Imphal Ring Road comprising of different roadway segments and the obligatory points

C. OBJECTIVES OF THE IEE

10. Followings are the objectives of the environmental study:

- Determine the category of the project depending on improvement proposal, environmental sensitivity and magnitude of impacts, i.e. screening as per Government of India's regulations and ADB's Safeguard Policy Statement 2009;
- Determine the appropriate extent and type of EA required (IEE or EIA), i.e., scoping;
- Determine the requirement of statutory clearances;
- Baseline environmental monitoring and survey;
- Prediction of impacts on relevant environmental attributes and mitigation measures to minimize the impacts; and
- Preparation of IEE Report including EMP

D. APPROACH & METHODOLOGY

11. The Initial Environmental Examination has been carried out within existing policy, legal and administrative framework considering the applicable environmental legislation, regulations & guidelines of ADB, Govt. of India and Govt. of Manipur.

- ***Reconnaissance Survey:*** A reconnaissance study has been made for identification of Valued Environment Components (VECs) on proposed project road. Location of environmentally protected areas (National Parks, Wildlife Sanctuaries, Biosphere Reserves, Reserved / Protected Forest, Important Bird Areas, World heritage Sites, Archeological Monuments etc.); surface water bodies; environmentally sensitive receptors (educational institutions, religious structures, medical facilities etc.) along the alignment has been identified during the survey. The Consultant conducted preliminary analysis of the nature, scale and magnitude of the impacts that the project is likely to cause on the environment, especially on the identified VECs.
- ***Data Collection & Review:*** Secondary data such as Survey of India Topo Sheets, Forest Working Plans, booklet of Central Ground Water Board, details of Archaeological Monuments etc. have been collected from various secondary sources. Further, secondary data, which are relevant to understand the baseline as pertaining to physical and biological environments has been collected and reviewed. Applicable environmental legislation, regulations & guidelines of ADB and MOEF&CC has also been reviewed.
- ***Environmental Screening & Scoping:*** Screening has been conducted with specific consideration such as location of the sub-projects with respect to environmentally sensitive areas and critical issues to be studied in detail as well as provide important feedback to the design / technical team. It helped to modify the designs at locations where impacts had to be avoided and incorporate mitigation measures wherever the impacts were unavoidable due to other constraints. Based on the screening, scope of the study of the assignment i.e. scoping has been done.
- ***Baseline Environmental Monitoring:*** To establish the baseline environmental status, monitoring was carried out for various environmental parameters such as meteorology, ambient air quality, ambient noise level, ground & surface water quality and soil quality along the proposed alignment.
- ***Stakeholder Consultation:*** Consultations on environmental issues have been carried out with relevant stakeholders identified through stakeholder analysis.
- ***Analysis of Alternatives:*** The environmental analysis of alternatives mainly focuses on alignment options as well as with or without project scenario.

- ***Prediction of Impacts & Mitigation Measures:*** Based on the above study potential positive and negative impacts on land environment, air environment, noise environment, water environment and biological environment has been assessed for both construction and operation phase. For each impact predicted, feasible and cost effective mitigation measures has been suggested to reduce potentially significant adverse environmental impacts to acceptable levels.
- ***Environment Management Plan:*** EMP has been prepared as per the requirements of ADB safeguard policy statement. EMP includes management and redevelopment of borrow areas, quarries, construction camp; rain water harvesting, storm water management practices; requirement of noise barrier, capacity building & training; environmental supervision, monitoring & auditing requirements; bill of quantities and monitoring formats.

E. STRUCTURE OF THE REPORT

12. Final IEE Report has been structured based on ADB's Safeguard Policy Statement 2009. The structure of the IEE Report is as follows:

Final IEE Report and EMP
Executive Summary
Chapter-1: Introduction
Chapter-2: Description of the Project
Chapter-3: Policy, Legal and Administrative Framework
Chapter-4: Description of the Environment
Chapter-5: Analysis of Alternatives
Chapter-6: Anticipated Environmental Impacts and Mitigation Measures
Chapter-7: Public Consultation
Chapter-8 Environmental Management Plan
Chapter-9: Conclusion and Recommendations

Annex to Final IEE Report and EMP
Annex-3.1: Rapid Environmental Assessment Checklist – Roads & Highways
Annex-4.1: Map showing Proposed Imphal Ring Road Alignment and Protected Area on Survey of India Toposheet
Annex-4.2: Land Use Map (10 km radius)
Annex-4.3: Environmental Standards
Annex-4.4: Biodiversity Study
Annex-6.1: Details of earthwork
Annex-6.2: Online Forest Clearance Application (Part I, II, III, IV & V)
Annex-6.3: Stage-1 Approval
Annex-6.4: Air Impact Assessment
Annex-6.5: Noise Impact Assessment
Annex-7.1: Questionnaire of Public Consultation
Annex-7.2: List of Participants attended the Public Consultation
Annex-7.3: MOM of interaction between representatives of Khurai Konsam Leikai & PIU
Annex-7.4: Extract of the Report submitted by the Expert Group
Annex-7.5: Order of Govt. of Manipur dated 07 September 2022
Annex-7.6: Order of Govt. of Manipur dated 19 September 2022
Annex-7.7: Additional Consultation at Thoran Village and MOU
Annex-8.1: Guidelines for Siting and Layout of Construction Camp
Annex-8.2: Siting, Operation and Re-development of Borrow Areas

II. DESCRIPTION OF THE PROJECT

A. DESCRIPTION OF THE EXISTING STRETCH

13. Project alignment for Imphal Ring Road is in plain & rolling terrain. Land use pattern is predominantly built up with both residential and commercial establishment on both sides except the green field alignment which is in agricultural field. The pavement of the existing sections is in good condition and in some sections it has been recently paved. Isolated potholes due to inadequate drainage are observed. Out of the total **47.765 km** stretch proposed for improvement, **29.995 km is existing road section** having carriageway width in the range of 3m – 7m and the remaining **17.770 km is a Greenfield alignment**.

Road Condition near Shija Hospital

Existing Gravel Road near Fishery Junctions

Road Condition of Sangaipour Village Road

Potholes due to lack of Drainage Facilities

14. Geometry of major portion of the stretch does not conform to IRC standards. Horizontal alignment has S Curves, or curves with small radius not conforming to IRC Standards. Due to settlements and substandard geometry, locations with deficient sight distance are observed. Since alignment is in plain and rolling terrain vertical geometry generally conforms to IRC standards. As per PWD records existing stretch of Imphal Ring Road alignment has ROW in the range of 12 m to 30 m.

15. There are 36 major intersections; 234 minor intersections, 5 bridges and 89 culverts along 29.995 km existing section of the Imphal Ring Road.

Sharp curve near Kongba Market

Alignment with S curve near Pooriam Lei Rak Junction

Sharp Curve at Games Village Junction

Sharp curve near Zoo

B. TRAFFIC STUDY

16. **Traffic Surveys:** A reconnaissance survey was taken up for the project road in third week of February 2014 and all the possible diversions were identified for the traffic in the project stretch. Traffic survey locations were identified in conjunction with the surrounding road network. The network was also verified by visiting all the associated road junctions and links so as to assess the traffic level and logistics that will be required for traffic survey. To capture traffic flow characteristics and travel pattern of users passing through the project road and requirements as per the ToR, the following primary traffic surveys were planned and conducted.

- Manual Classified Traffic Volume Count (MCC)
- Origin-Destination (O-D) and Commodity Movement Survey
- Junction Volume or Intersection Turning Movement Count (TMC)
- Axle Load Survey
- Pedestrian/Cross Movement Count
- Speed and Delay Survey
- Road Inventory Survey

17. The selected locations for traffic surveys are shown in **Figure-2**. It can be observed that the urban stretch of proposed ring road are covered extensively and appropriately in terms of

capturing the traffic flows and characteristics of the travel pattern along the project road. The traffic survey schedule is presented in **Table-2.**

Figure-2 Details of Traffic Survey Locations

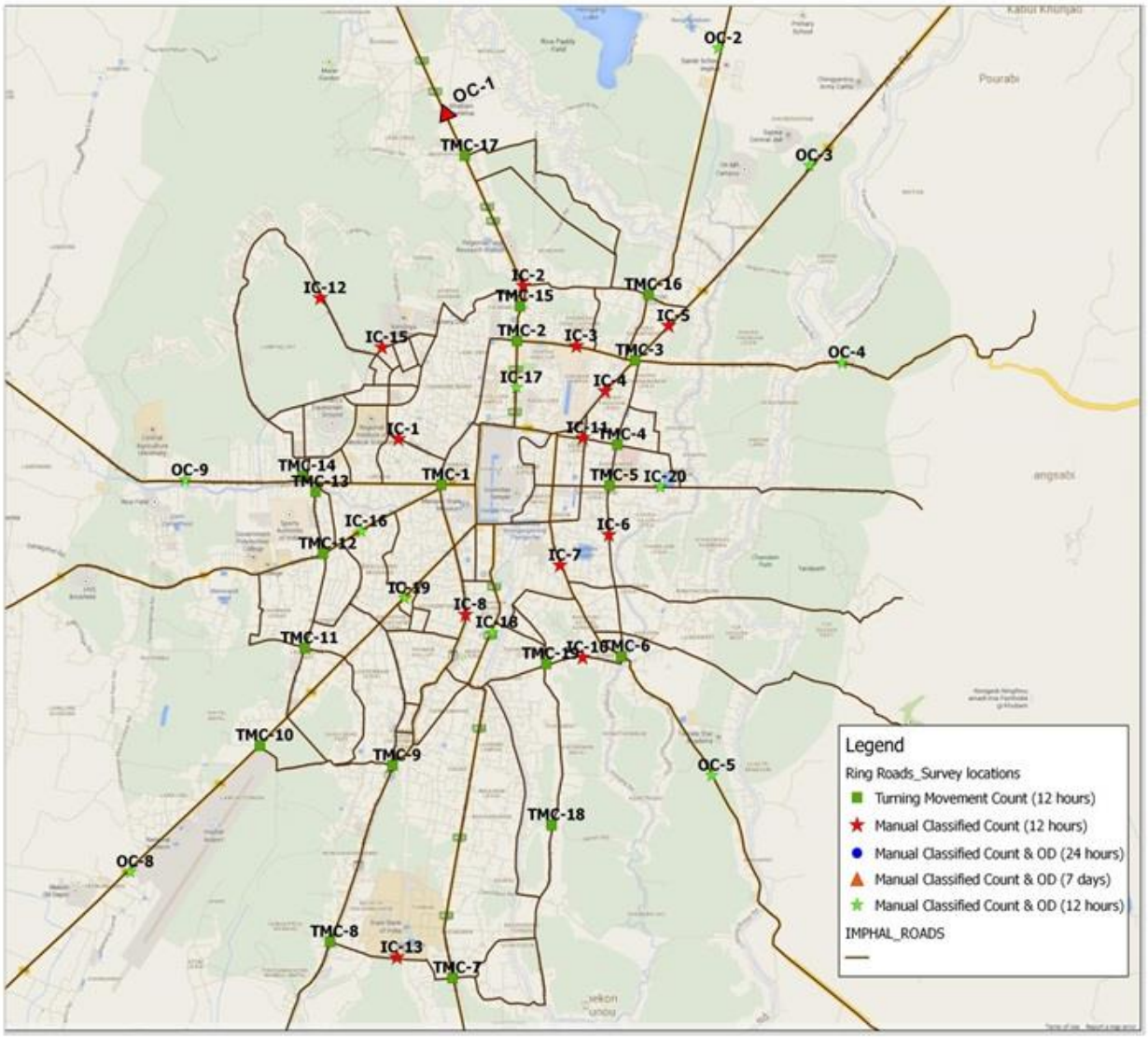


Table-2 Schedule of Traffic Survey

S. No.	Location No.	Locations	Project Road	Date
Classified Traffic Volume Counts				
1	OC-1	Near Old Airport	Imphal-Dimapur Road	6-3-2014 to 12-3-2014
2	OC 2	Near Manipur Police training school	Imphal Pangei Road	7-3-2014
3	OC-3	Near BSF camp	Imphal-Jessami Road	6-3-2014
4	OC 4	b/w Lamlong-Takhel section	Lamlong-Tinsid Road	5-3-2014
5	OC 5	b/w Imphal - Kekrupat section	Huikap Road	8-3-2014
6	OC 6	b/w Near Lilong – Imphal section	Indo-Myanmar Road	7-3-2014
7	OC-7	b/w Near Imphal – Langthabal section	Mayai Lambi Road	8-3-2014
8	OC 8	b/w Imphal - Nambol section	Airport Road	11-3-2014
9	OC 9	Near Central Agricultural University	Uripok Kangchup Road	11-3-2014
10	IC 1	b/w RIMS- Thanga Bazaar section	RIMS Road	5-3-2014
11	IC 2	Near Chingmeirong	Dimapur Imphal Road	3-3-2014
12	IC 3	Near Vishal mega mart	Lamlong-Tinsid Road	3-3-2014
13	IC 4	Near Lainingthou Awangba school	Soibam-Telipati Road	28-2-2014
14	IC 5	Near Khurai Lamlong Bazaar	Ukhrul Road-Lamlong Road	1-3-2014
15	IC 6	Near Ningthem Pukhri	Kongba-Porompat Road	28-2-2014
16	IC 7	Near Maharaj Bodhchandra College	Kongba Bazaar- Palace Compound	28-2-2014
17	IC 8	Near Sarungbam colony	Keishamthong-Mongsangei Road	5-3-2014
18	IC 10	Near Thiyabung	Singjamei- Kongba Road	27-2-2014
19	IC 11	Near Soibam Leikai	JNIMS-Hatta Road	28-2-2014
20	IC 12	On Thangmeiband - Langol Road	Langol – Supermarket Road	4-3-2014
21	IC 13	Near MU community Hall	Dinku Road- Lamlong Road	1-3-2014
22	IC 14	Near Langthabal Mantrikhong Awang Leikai	Mongshangei- Hiyangthang Road	1-3-2014
23	IC 15	Near Mayanglangjing community hall	Fishery Road	4-3-2014
24	IC 16	Silchar Road	NH-53 Imphal Silchar Road	12-3-2014
25	IC 17	Near Imphal Hotel	Imphal Dimapur Road	11-3-2014
26	IC 18	Near Sanamahi Temple	Singajamei Imphal Road	10-3-2014
27	IC 19	Near Kwakeithel Thokchom Leikai	Imphal Churachandpur Road	10-3-2014
28	IC 20	Near Modern College	Khongnang Makhong Road	4-3-2014
Turning Movement Count Survey at Intersections				
1	TMC 1	B.T Road	Paona Bazaar Junction	13-3-2014

S. No.	Location No.	Locations	Project Road	Date
2	TMC 2	New Assembly Road	Khongnangkarak Junction (Rotary)	3-3-2014
3	TMC 3	Lamlong - Keithel Road	Lamlong Junction (4 Arm)	1-3-2014
4	TMC 4	JNIMS Road	JNIMS Junction (3 Arm)	28-2-2014
5	TMC 5	Khongnang - Makhong Road	Porompat Junction (4 Arm)	28-2-2014
6	TMC 6	OLA Lampek Junction	Kongba Junction (4 Arm)	27-2-2014
7	TMC 7	Near Standard Robert English School	Langthabal Junction (3 Arm)	26-2-2014
8	TMC 8	Near Maibam Leikai	Kyamgei Junction (3 Arm)	26-2-2014
9	TMC 9	Near Haobam Marak Lourebam Leikai	Keishampat Junction (3 Arm)	6-3-2014
10	TMC 10	Near Iskcon Temple	Iskcon Junction (3 Arm)	6-3-2014
11	TMC 12	Sagolband – Lukram Leikai Junction	Chaithabi Junction (4 Arm)	11-3-2014
12	TMC 13	Near Epathoukak	Silchar Road Junction (4 Arm)	5-3-2014
13	TMC 14	Near DC office	Lamphel Junction (3 Arm)	4-3-2014
14	TMC 15	Near Nagaram village	Shangafam Junction (3 Arm)	3-3-2014
15	TMC 16	Near Konsam Leikai	Chaithabi Junction (4 Arm)	1-3-2014
16	TMC 17	Near Mantripukhri	Mantripukri Junction(3 Arm)	3-3-2014
17	TMC 18	Near Okram chutnek	Okram chuthek Junction (4 Arm)	27-2-2014
18	TMC 19	Near Singjamei	Khongman Mangil Junction (4 Arm)	27-2-2014
Origin-Destination Survey				
1	OC 1	AH-1	Dimapur-Imphal Road	10-3-2014
2	OC 2	Pangei - Imphal	Pangei Road	7-3-2014
3	OC 3	NH-150 (Jessami – Imphal)	Imphal-Jessami Road	6-3-2014
4	OC 4	Lamlong - Takhel	Lamlong-Tinsid Road	5-3-2014
5	OC 5	Imphal - Erengbung	Huikap Road	8-3-2014
6	OC 6	AH-1 (Lilong - Singjamei)	Indo-Myanmar Road	7-3-2014
7	OC 7	SH-10 (Lamthabal - Imphal)	Mayai Lambi Road	8-3-2014
8	OC 8	NH-150 (Nambol Imphal)	Airport Road	11-9-2014
9	OC 9	Near Central Agricultural University	Uripok Kangchup Road	11-9-2014
10	IC 16	Near ITI College	Silchar Road	12-9-2014
11	IC 17	Near D.M College	Imphal Dimapur Road	12-9-2014
12	IC 18	Near Yaishkul PS	Imphal Singjamei Road	10-9-2014
13	IC 19	Near Kwakeiithel Leikai	Imphal Churachandpur Road	13-3-2014
14	IC 20	Near Census Office	Chekon Wakha	4-3-2014
Axle Load Survey				
1	OC 1	Dimapur - Imphal Road	AH-1	10-3-2014

S. No.	Location No.	Locations	Project Road	Date
Pedestrian Count				
1	Km	(Arm 1,Arm 2,Arm 3 & Arm 4)	Lamlong Junction (TMC-3)	1-3-2014
Speed & Delay Survey				
Major roads in study area				

Source: DPR Prepared by ICT Pvt. Ltd.

18. The traffic estimations for various sections of proposed Ring Road have been obtained by using the calibrated and validated transport demand model developed for the study area. The traffic on the proposed Ring Road will mostly comprise of diverted traffic from the existing other roads to the Ring Road, where the improved alignment will avoid several bottlenecks and bad road condition. The Ring Road will attract long distance through traffic from regional roads (NHs and SHs) feeding to the sub-arterial and collector and also local traffic system. The Ring Road will serve (i) the long distance regional traffic (feed through the regional roads), (ii) the urban traffic diverted from local parallel roads, and (iii) the local traffic generated / destined to the areas nearby the Ring Road. Thus, it is going to serve many purposes of travel. After studying the traffic assignment of Ring Road for future years, Ring Road was divided into few homogenous sections in 2014. However, the alignment has been revised in the year 2020, for which the homogeneous sections have been re-identified and details of homogeneous section are presented in **Table-3**.

Table-3 Traffic Homogeneous Sections for the Revised Alignment

Homogenous Sections	Chainage (km)		Length (Km)
	From	To	
HS-1	0+000	2+200	2.200
HS-2	2+200	7+000	4.800
HS-3	7+000	10+815	3.815
HS-4	10+815	14+715	3.900
HS-5 (NH-150)	14+715	14+960	0.245
HS-6	14+960	25+980	11.020
HS-7 (NH-39)	25+980	32+125	6.145
HS-8	32+125	33+575	1.450
HS-9	33+575	42+875	9.300
HS-10	42+875	44+430	1.555
HS-11	44+430	48+335	3.905
HS-12	48+335	54+155	5.820
Total Length (km)			**54.155**

Source: DPR Prepared by ICT Pvt. Ltd.

19. The new alignment of the project road is mostly in plain terrain except a small section and therefore, for improvement proposals for plain terrain with urban area standard (IRC: 106-1990) has been followed. The **projected Annual Average daily traffic** (**AADT**) for all the homogenous sections of the proposed Ring Road is given in Table-4 and Table-5.

Table-4 Projected AADT (2014) for Imphal Ring Road (HS-1 to HS-6)

Year	HS-1		HS-2		HS-3		HS-4		HS-5		HS-6	
	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU
2017	34814	24233	20153	12480	40390	29797	25069	15838	9227	10573	6518	6879
2018	37144	25629	21697	13393	42703	31316	27875	17508	9891	11282	7996	7978
2019	39659	27130	23362	14375	45167	32928	31001	19362	10605	12040	9915	9342
2020	42323	28885	24955	15322	48180	35028	33108	20640	11270	12741	10562	9909
2021	45168	30755	26657	16331	51395	37263	35359	22003	11976	13483	11252	10511
2022	48205	32748	28475	17408	54825	39643	37763	23456	12728	14270	11987	11151
2023	51447	34872	30418	18557	58486	42177	40331	25007	13528	15103	12771	11830
2024	54908	37135	32494	19782	62393	44875	43075	26661	14378	15987	13607	12552
2025	58808	39680	34835	21162	66794	47908	46168	28524	15334	16975	14547	13362
2026	64530	43448	38258	23196	73262	52415	50694	31268	16759	18479	15936	14579
2027	69116	46430	41015	24816	78434	55964	54335	33454	17874	19625	17039	15521
2028	75573	50665	44885	27107	85727	61021	59449	36545	19471	21296	18601	16881
2029	80947	54147	48121	29002	91783	65160	63721	39103	20769	22620	19890	17974
2030	86648	57833	51556	31011	98204	69538	68255	41814	22141	24014	21254	19129
2031	92751	61774	55238	33161	105077	74215	73112	44715	23605	25495	22713	20359
2032	99287	65985	59183	35461	112434	79211	78315	47818	25167	27071	24273	21669
2033	106284	70487	63411	37922	120308	84547	83890	51138	26834	28745	25941	23066
2034	113777	75299	67941	40556	128736	90247	89863	54691	28613	30526	27725	24554
2035	120677	79741	72116	42991	136497	95510	95363	57969	30256	32191	29370	25941
2036	127996	84448	76547	45574	144727	101084	101201	61445	31994	33949	31114	27407
2037	135761	89434	81252	48312	153457	106986	107397	65130	33833	35804	32962	28957
2038	143999	94717	86246	51216	162714	113237	113973	69037	35779	37761	34920	30596
2039	152739	100314	91548	54296	172533	119855	120952	73181	37837	39828	36995	32328
2040	160694	105426	96377	57113	181471	125903	127306	76961	39719	41744	38888	33927
2041	169066	110800	101461	60076	190874	132258	133993	80938	41695	43753	40879	35606
2042	177874	116449	106814	63194	200766	138937	141033	85121	43769	45860	42972	37369
2043	187143	122388	112450	66475	211173	145955	148442	89521	45948	48070	45173	39220
2044	196896	128632	118383	69926	222121	153330	156242	94150	48237	50387	47487	41163
2045	207160	135196	124630	73557	233639	161081	164453	99018	50640	52818	49920	43203
2046	217959	142097	131207	77378	245756	169226	173095	104140	53164	55366	52479	45345
2047	229323	149351	138132	81398	258505	177786	182192	109527	55815	58039	55169	47595
2048	241282	156979	145423	85628	271916	186783	191769	115194	58598	60843	57997	49957
2049	253866	164998	153099	90078	286026	196238	201849	121155	61522	63783	60972	52437
2050	267108	173429	161181	94760	300871	206175	212460	127426	64593	66867	64099	55041

Source: DPR Prepared by ICT Pvt. Ltd.

*AADT: Annual Average daily traffic

Table-5 Projected AADT (2014) for Imphal Ring Road (HS-7 to HS-12)

	HS-7		HS-8		HS-9		HS-10		HS-11		HS-12	
Year	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU
2017	34170	37311	28708	27815	5070	4355	1672	1492	1761	1540	21515	20079
2018	36395	39600	30688	29574	5500	4724	1796	1592	1892	1645	22576	21040
2019	38775	42038	32819	31457	5965	5124	1929	1700	2034	1756	23705	22070
2020	41212	44521	34905	33365	6361	5453	205 6	1803	2167	1864	25221	23417
2021	43805	47154	37124	35391	6783	5803	2190	1913	2310	1978	26835	24848
2022	46564	49946	39487	37543	7234	6177	2334	2030	2462	2099	28554	26368
2023	49498	52907	42001	39828	7714	6574	2487	2155	2624	2228	30384	27982
2024	52620	56047	44678	42255	8227	6997	2650	2287	2797	2365	32332	29697
2025	56126	59562	47685	44975	8804	7473	2834	2435	2991	2519	34522	31620
2026	61354	64890	52157	49069	9653	8178	3105	2658	3278	2750	37774	34510
2027	65448	68970	55672	52234	10330	8735	3321	2830	3506	2929	40335	36749
2028	71304	74899	60686	56803	11287	9528	3626	3079	3829	3187	43984	39976
2029	76070	79619	64781	60475	12080	10177	3878	3279	4096	3395	46970	42576
2030	81107	84593	69112	64349	12920	10864	4145	3491	4379	3615	50129	45319
2031	86482	89883	73735	68477	13819	11598	4430	3717	4682	3849	53503	48242
2032	92218	95512	78670	72873	14780	12382	4736	3957	5006	4099	57105	51357
2033	98338	101500	83939	77556	15809	13220	5062	4213	5352	4365	60953	54676
2034	104870	107870	89564	82545	16910	14115	5412	4487	5723	4649	65062	58214
2035	110895	113804	94733	87142	17923	14942	5734	4741	6064	4913	68840	61474
2036	117270	120068	100204	91998	18998	15817	6076	5009	6427	5192	72839	64920
2037	124014	126682	105993	97128	20137	16744	6438	5293	6811	5487	77072	68562
2038	131150	133665	112119	102548	21344	17726	6821	5594	7218	5800	81554	72411
2039	138700	141038	118603	108275	22624	18765	7228	5912	7649	6130	86297	76478
2040	145592	147845	124496	113498	23790	19716	7599	6204	8043	6434	90611	80190
2041	152829	154983	130685	118976	25016	20714	7989	6511	8457	6753	95142	84084
2042	160429	162470	137183	124722	26305	21763	8400	6834	8893	7088	99901	88169
2043	168409	170321	144008	130748	27661	22866	8831	7172	9351	7440	104899	92455
2044	176789	178556	151174	137069	29087	24025	9285	7528	9832	7810	110150	96951
2045	185589	187194	158700	143699	30586	25243	9762	7901	10339	8198	115665	101668
2046	194830	196253	166603	150653	32163	26523	10264	8294	10872	8606	121458	106618
2047	204535	205754	174903	157948	33821	27868	10792	8705	11432	9034	127543	111811
2048	214727	215721	183619	165600	35566	29282	11347	9138	12022	9483	133936	117259
2049	225430	226174	192773	173627	37400	30767	11931	9592	12642	9956	140650	122975
2050	236670	237139	202386	182047	39329	32328	12545	10069	13294	10451	147704	128974

Source: DPR Prepared by ICT Pvt. Ltd.
*AADT: Annual Average daily traffic

20. **Traffic Validation**: As discussed above, traffic surveys on ring road and connecting road network were conducted in year 2014, and report was submitted in 2014. Further to this traffic projection were revised in year 2020 and the revised report was submitted in year 2020. Since the base year traffic study was conducted in 2014 and already 8 years has been passed, it is obvious that the traffic flow pattern has also been changed. Therefore, the PWD Manipur instructed the Consultant to validate the traffic flow in current year. Accordingly, fresh traffic survey has been conducted in March 2022 at 4 locations (OC-4, OC-6, OC-8 and TMC-5). The AADT

observed in 2022 is compared with protected AADT of corresponding sections of year 2022 based on survey done in 2014. A conversion factor has been calculated as applied to establish the revised traffic for future years for all homogeneous sections. The **Revised Annual Average daily traffic** (**AADT**) for all the homogenous sections of the proposed Ring Road is given in Table-6 and Table-7.

Table-6 Projected Revised AADT (2022) for Imphal Ring Road (HS-1 to HS-6)

	HS-1		HS-2		HS-3		HS-4		HS-5		HS-6	
Year	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU
2022	49851	32967	29986	17936	46886	32954	31840	19184	13176	14808	12264	11440
2023	53214	35116	32036	19126	50018	35084	34008	20466	14009	15681	13069	12141
2024	56805	37408	34227	20396	53360	37354	36324	21835	14895	16606	13927	12887
2025	60852	39986	36698	21827	57124	39906	38935	23377	15891	17641	14892	13723
2026	66785	43797	40309	23933	62656	43687	42755	25642	17374	19213	16317	14978
2027	71546	46819	43220	25613	67080	46675	45830	27454	18537	20413	17450	15953
2028	78244	51106	47303	27987	73318	50923	50146	30009	20199	22161	19054	17356
2029	83825	54637	50720	29955	78497	54411	53753	32131	21554	23550	20377	18487
2030	89745	58377	54348	32041	83989	58103	57581	34380	22985	25012	21780	19681
2031	96086	62376	58236	34274	89866	62048	61682	36788	24514	26568	23279	20954
2032	102875	66651	62403	36663	96157	66264	66076	39366	26145	28222	24883	22311
2033	110147	71221	66869	39221	102890	70768	70784	42125	27886	29982	26598	23757
2034	117934	76109	71655	41958	110098	75582	75828	45078	29744	31853	28432	25299
2035	125106	80619	76066	44488	116729	80016	80471	47797	31461	33605	30125	26736
2036	132714	85400	80748	47172	123762	84711	85399	50680	33279	35455	31918	28256
2037	140787	90465	85719	50019	131221	89685	90630	53738	35202	37408	33820	29864
2038	149353	95833	90996	53038	139131	94953	96181	56982	37237	39470	35835	31564
2039	158441	101522	96599	56240	147519	100532	102073	60422	39391	41648	37970	33362
2040	166715	106716	101702	59167	155151	105616	107434	63553	41360	43669	39920	35023
2041	175421	112177	107075	62248	163178	110958	113078	66848	43429	45789	41969	36766
2042	184583	117919	112732	65489	171622	116571	119018	70313	45601	48013	44125	38598
2043	194226	123956	118688	68899	180505	122471	125271	73959	47884	50346	46391	40521
2044	204373	130304	124960	72488	189850	128672	131853	77794	50281	52793	48775	42541
2045	215052	136979	131563	76264	199680	135188	138781	81829	52799	55361	51281	44662
2046	226290	143998	138516	80238	210021	142036	146074	86074	55444	58054	53917	46889
2047	238118	151378	145837	84420	220899	149234	153750	90540	58222	60879	56688	49229
2048	250565	159139	153545	88820	232343	156798	161831	95238	61141	63844	59603	51686
2049	263664	167299	161661	93451	244382	164749	170337	100181	64206	66953	62668	54266
2050	277450	175880	170206	98323	257047	173105	179291	105380	67427	70216	65891	56976

Source: DPR Prepared by ICT Pvt. Ltd.
*AADT: Annual Average daily traffic

Table-7 Projected Revised AADT (2022) for Imphal Ring Road (HS-7 to HS-12)

Year	HS-7		HS-8		HS-9		HS-10		HS-11		HS-12	
	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU	VEH	PCU
2022	45171	47081	38287	35546	7805	6459	3914	3419	4122	3522	28198	25383
2023	48034	49889	40737	37719	8326	6877	4171	3629	4394	3739	30014	26946
2024	51081	52869	43346	40029	8881	7323	4445	3852	4683	3970	31947	28607
2025	54503	56205	46277	42618	9507	7824	4754	4102	5009	4229	34122	30470
2026	59598	61254	50631	46509	10426	8566	5209	4478	5490	4617	37345	33264
2027	63597	65129	54060	49524	11161	9152	5571	4770	5873	4919	39890	35435
2028	69309	70751	58945	53869	12198	9986	6083	5190	6415	5353	43510	38558
2029	73967	75237	62942	57368	13058	10670	6506	5529	6862	5704	46478	41079
2030	78891	79966	67169	61061	13969	11395	6954	5887	7337	6075	49618	43741
2031	84147	84998	71684	64996	14945	12169	7434	6268	7844	6470	52973	46578
2032	89758	90353	76504	69188	15989	12997	7947	6675	8387	6891	56556	49602
2033	95748	96052	81652	73656	17106	13881	8495	7109	8968	7341	60384	52825
2034	102141	102118	87150	78416	18302	14826	9082	7571	9589	7820	64474	56260
2035	108037	107762	92203	82802	19402	15698	9623	8001	10162	8265	68233	59427
2036	114277	113723	97551	87436	20570	16623	10196	8456	10770	8736	72214	62774
2037	120880	120018	103213	92333	21807	17601	10804	8936	11414	9235	76429	66312
2038	127869	126666	109205	97508	23120	18638	11449	9445	12096	9762	80891	70051
2039	135265	133687	115549	102977	24511	19737	12132	9983	12820	10319	85617	74005
2040	142014	140162	121315	107963	25778	20740	12755	10478	13481	10833	89913	77611
2041	149102	146953	127372	113195	27111	21794	13410	10998	14175	11372	94427	81395
2042	156546	154077	133734	118682	28512	22903	14100	11545	14906	11938	99169	85365
2043	164365	161550	140415	124439	29986	24068	14825	12118	15674	12533	104150	89531
2044	172577	169389	147433	130478	31537	25292	15587	12721	16482	13157	109384	93903
2045	181203	177613	154804	136814	33168	26579	16389	13353	17332	13813	114882	98490
2046	190263	186239	162546	143461	34883	27932	17232	14018	18226	14502	120658	103304
2047	199778	195288	170679	150435	36688	29354	18119	14715	19166	15225	126727	108355
2048	209773	204781	179221	157751	38586	30848	19051	15448	20155	15985	133103	113656
2049	220272	214740	188194	165427	40582	32419	20032	16218	21195	16783	139802	119219
2050	231300	225188	197619	173480	42682	34070	21064	17026	22289	17622	146840	125057

Source: DPR Prepared by ICT Pvt. Ltd.
*AADT: Annual Average daily traffic

C. PAVEMENT DESIGN & COMPOSITION

21. The existing pavement is flexible. The pavement composition comprises of bituminous laid over a layer of WBM and boulder. In majority section the existing pavement is very poor condition. Based on an analysis of the various CBR values of identified borrow soils and the in-situ condition of the subgrade soil, the design sub-grade CBR has been adopted as per the **Table-8**. Based on the life cycle cost analysis, **flexible pavement has been recommended**. The pavement composition is evaluated as per design charts provided in IRC: 37-2018 and the recommended pavement composition for new flexible pavement construction and overlay is for a design life of 20 years.

Table-8 Recommended Sub-grade CBR

Homogenous Sections	Section Details (km)			Design CBR (%)	Lane Configuration
	From	To	Length		
HS-1	0+000	2+200	2.2	10	2 Lane + PS
HS-2	2+200	7+000	5.4		2 Lane + PS
HS-3	7+000	10+815	3.815		4 lane + 2 x cycle track
HS-4	10+815	14+715	3.900		2 lane + PS
HS-5 (NH-150) (Out of present Scope)	14+715	14+960	0.245		
HS-6	14+960	25+980	11.02	8	2 lane + PS
HS-7 (NH-39) (Out of present Scope)	25+980	32+125	6.145		
HS-8	32+125	33+575	1.45	8	2 lane + PS
HS-9	33+575	42+875	9.3		2 lane + PS
HS-10	42+875	44+400	1.905		4 lane
HS-11	44+400	48+335	3.555		4 Lane
HS-12	48+335	54+155	5.820		2 Lane
Spur-1	0+000	1+57	1.57	7	4 Lane
Spur-2	0+000	0+815	0.815	7	2 / 4 Lane
Spur-3	0+000	1+080	1.08	7	2 Lane

Source: DPR Prepared by ICT Pvt. Ltd.

D. IMPROVEMENT PROPOSAL

22. Based on the traffic forecast and interaction with the client, the project road has been proposed to be improved to 4 lane with service lane, 4 lane without service lane and 2 lane standards in various sections; some stretches along the existing road and some in greenfield. The widening proposal for Imphal Ring Road is given in **Table-9** and widening proposal of SPUR is given in **Table-10**.

Table-9 Widening Proposal for Imphal Ring Road

Sl. No	Section		Chainage (Km)			Lane Configuration	Remarks
	From	To	From	To	Length		
1	NH-102 (Km.327.120)	Kiyamagei Village	0+000	2+200	2.200	2 lane + PS	Existing road
2	Kiyamagei Village	Bashikhong Road	2+200	3+800	1.600	2 lane + PS	Green field
3	Bashikhong Road	Kongba Bazar	3+800	7+000	3.200	2 lane + PS	Green field
4	Kongba Bazar (Ayangpali Road)	Porompat	7+000	9+855	2.855	4 Lane	Existing road
	Porompat	WSC	9+855	10+815	0.960	4 lane+ 2 x Cycle Track	Existing road
5	Approach to DDK Imphal	DDK Imphal	10+815	11+300	0.485	2 Lane + PS	Existing road
6	DDK Imphal	NH 150 (Near Angom Leikai Road)	11+300	14+715	3.415	2 Lane + PS	Green field
7	NH 150 (Near Angom Leikai Road)	NH 150 (Jn of Ipum Pond Road)	14+715	14+960	0.245	**No Improvement (NH-202)**	
8	NH 150 (Jn of Ipum Pond Road)	Imphal Pangei Road	14+960	15+930	0.970	2 Lane + 1 x Cycle Track	Existing road
9	Imphal Pangei Road	Jn of Heingang Pangei Road	15+930	16+695	0.765	2 Lane + PS	Existing road
10	Jn of Heingang Pangei Road	Heingang Road	16+695	18+555	1.860	2 Lane + PS	Existing road
11	Heingang Road	Heingang Pond Road	18+555	20+700	2.145	2 Lane + PS	Green field
12	Heingang Pond Road	Mongjam Road (Near koirengei)	20+700	23+430	2.730	2 Lane + PS	Existing road
13	Mongjam Road (Near koirengei)	Koirengei Road (near Imphal River)	23+430	23+700	0.270	2 Lane +PS	Green field
14	Koirengei Road (near Imphal River)	Koirengei Bazar	23+700	25+980	2.280	2 Lane + PS	Existing road
15	Khabam Lamkhai	Sangakpham Bazaar	25+980	32+125	6.145	**No Improvement (NH2)**	
16	Sangakpham Bazaar	Thangmeiband Tarung	32+125	33+575	1.450	2 Lane + PS	Existing road
17	Thangmeiband Tarung	Electroral office	33+575	37+075	3.500	2 Lane + PS	Existing road
18	Electroral office	Games Village I (via Shija Hospital)	37+075	38+425	1.350	2 Lane + PS	Existing road

Sl. No	Section		Chainage (Km)			Lane Configuration	Remarks
	From	To	From	To	Length		
19	Games Village I (via Shija Hospital)	Iroisemba on UK Road.	38+425	42+875	4.450	2 Lane + PS	Existing road
20	Iroisemba on UK Road.	NH 53 (Near Langjing)	42+875	45+405	2.530	4 Lane	Existing road
21	NH 53 (Near Langjing)	Start of FCI spur	45+405	46+575	1.170	4 Lane	Existing road
22	Start of FCI spur	HRD Academy	46+575	47+475	0.900	4 Lane	Green field
23	HRD Academy	Sagolband road	47+475	48+335	0.860	4 Lane FlyOver + both side Slip Road	Green field
24	Sagolband road	Langthabal kunja	48+335	53+375	5.040	2 Lane +PS	Green field
25	Langthabal kunja	University	53+375	53+815	0.440	2 Lane +PS	Existing road
26	University	NH - 39 (Start/End of Ring Road)	53+815	54+155	0.340	2 Lane +PS	Green field
Total length for Improvement					**54.155**		
Existing Road length (Km)					29.995		
Existing NH length (Km)-No Imp-Common Section					6.390		
Green field road length (Km)					17.770		
Net Length for Improvement					**47.765**		

Source: DPR Prepared by ICT Pvt. Ltd.

Table-10 Widening Proposal for SPUR

Sl. No.	Name of Spur	Chainage			Lane Configuration
		From	To	Length (km)	
1	SPUR-1 (Spur to JNIMS)	0+000	1+570	1.570	4 lane
2	SPUR-2 (Spur to RIMS)	0+000	0+655	0.655	2 lane + PS
		0+655	0+815	0.160	4 lane
3	SPUR-3 (Spur to FCI Go-down)	0+000	1+080	1.08	2 lane + PS
Total length of SPUR				**3.465**	

Source: DPR Prepared by ICT Pvt. Ltd.

23. **Corridor of Impact:** To accommodate, the improvement proposal of Imphal Ring Road, Corridor of Impact (CoI) / Proposed Right of Way (PROW) has been proposed as 14 m in general for 2 lane section and 18.5m for 4 lane section. However, due to provision of both side slip roads for proposed Flyover on NH 150, the PROW has been proposed as 35m. In addition to above additional land for improvement of Major Junctions, Bus bay, Bridge approaches and hill sections have been proposed. The details of CoI / PROW are given in **Table-11**

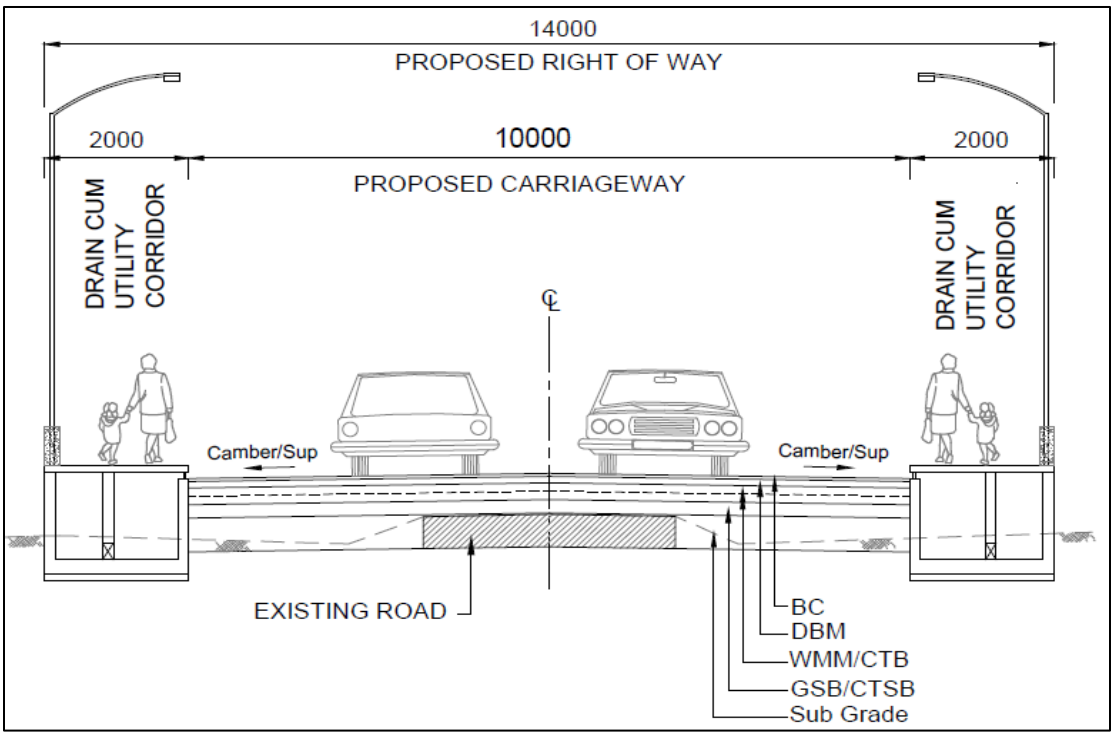
Table-11 Corridor of Impact / Proposed Right of Way

Sl. No.	Stretches (Km)		PROW Width (m)
	From	To	
1	0+000	7+000	14.00
2	7+000	9+885	18.50
3	9+885	10+815	30.00
4	10+815	14+715	14.00
5	14+960	15+145	14.00
6	15+145	15+915	13.50
7	15+915	16+815	14.00
8	16+815	17+265	15.40
9	17+265	18+500	14.00
10	18+500	20+600	16.80
11	20+600	23+643	14.00
12	23+643	24+305	16.80
13	24+305	25+980	14.00
14	32+125	33+575	13.00
15	33+575	42+875	14.00
16	42+875	47+475	18.50
17	47+475	48+335	35.00
18	48+335	50+950	14.00
19	50+950	52+155	17.00
20	52+155	54+155	14.00
SPUR1	0+000	1+570	18.50
SPUR2	0+000	0+655	14.00
SPUR2	0+655	0+815	18.50
SPUR3	0+000	1+080	14.00

Source: DPR Prepared by ICT Pvt. Ltd.

24. **Typical Cross Sections:** Based on the traffic estimates, capacity and the proposed RoW, various typical cross-sections have been worked out for the Imphal Ring Road and shown in **Figure-3 to Figure-9.**

Figure-3 TCS-1: Typical Cross Section for 2 Lane in Existing Section



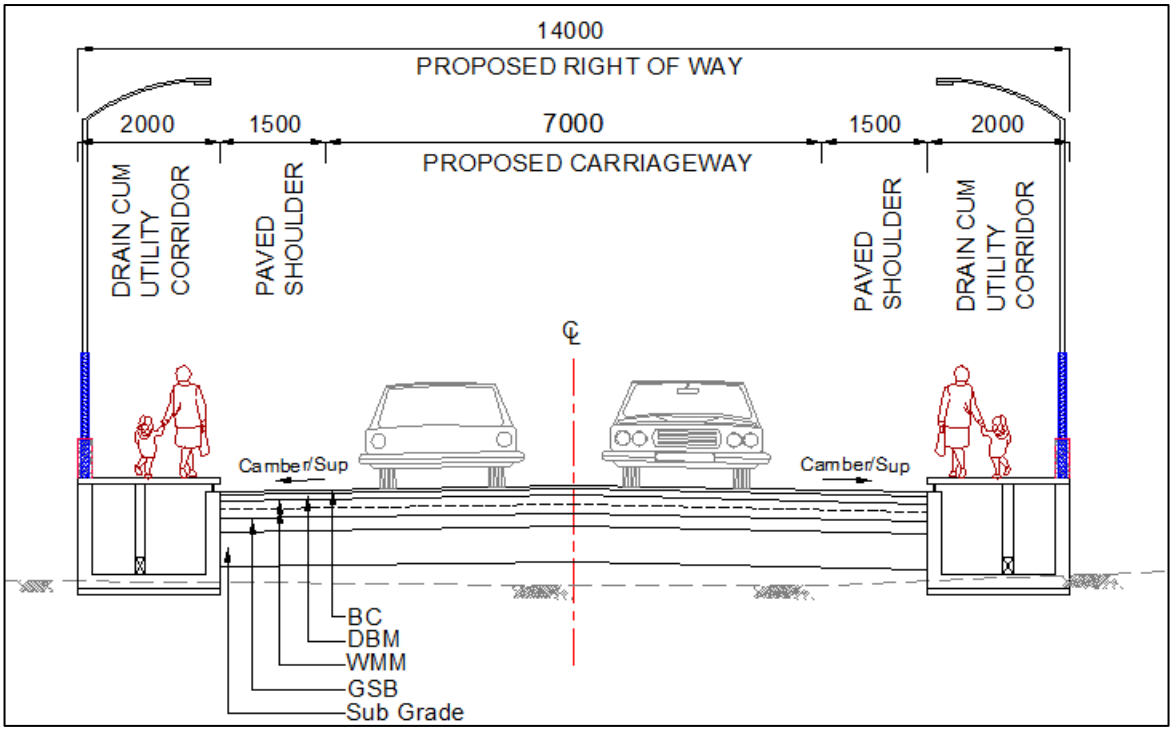


Figure-4 TCS-2: Typical Cross Section for 2 Lane in Greenfield Section

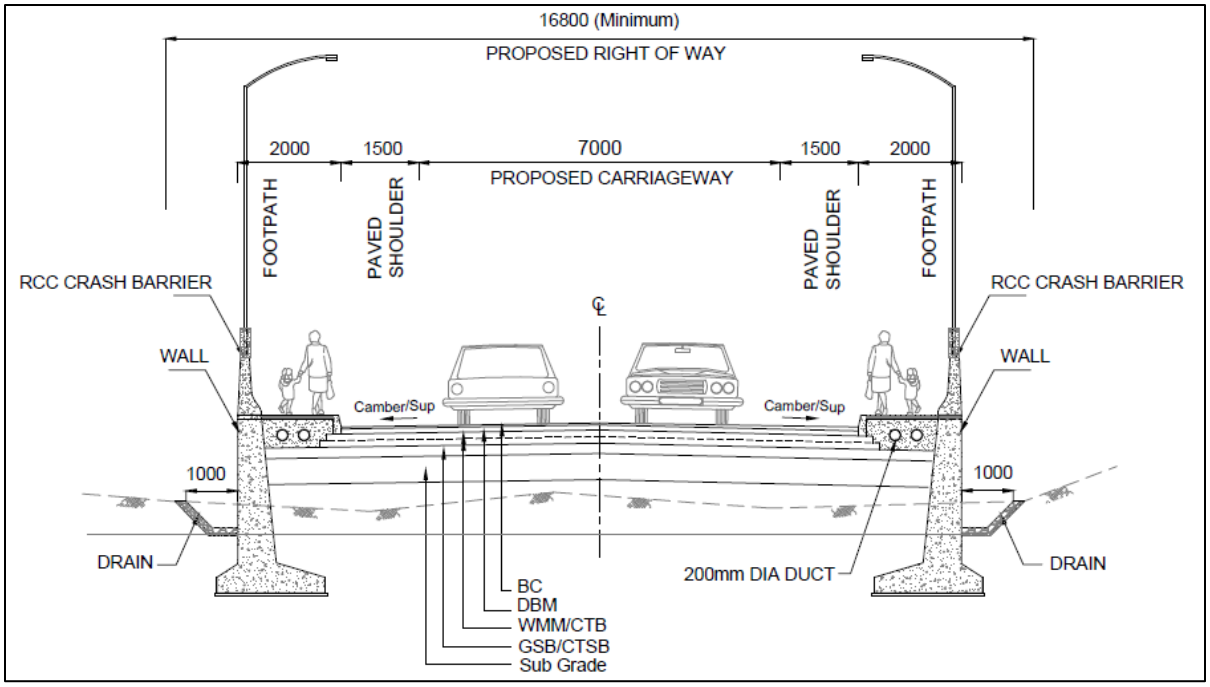


Figure-5 TCS-3: Typical Cross Section for 2 Lane in Greenfield (High Embankment)

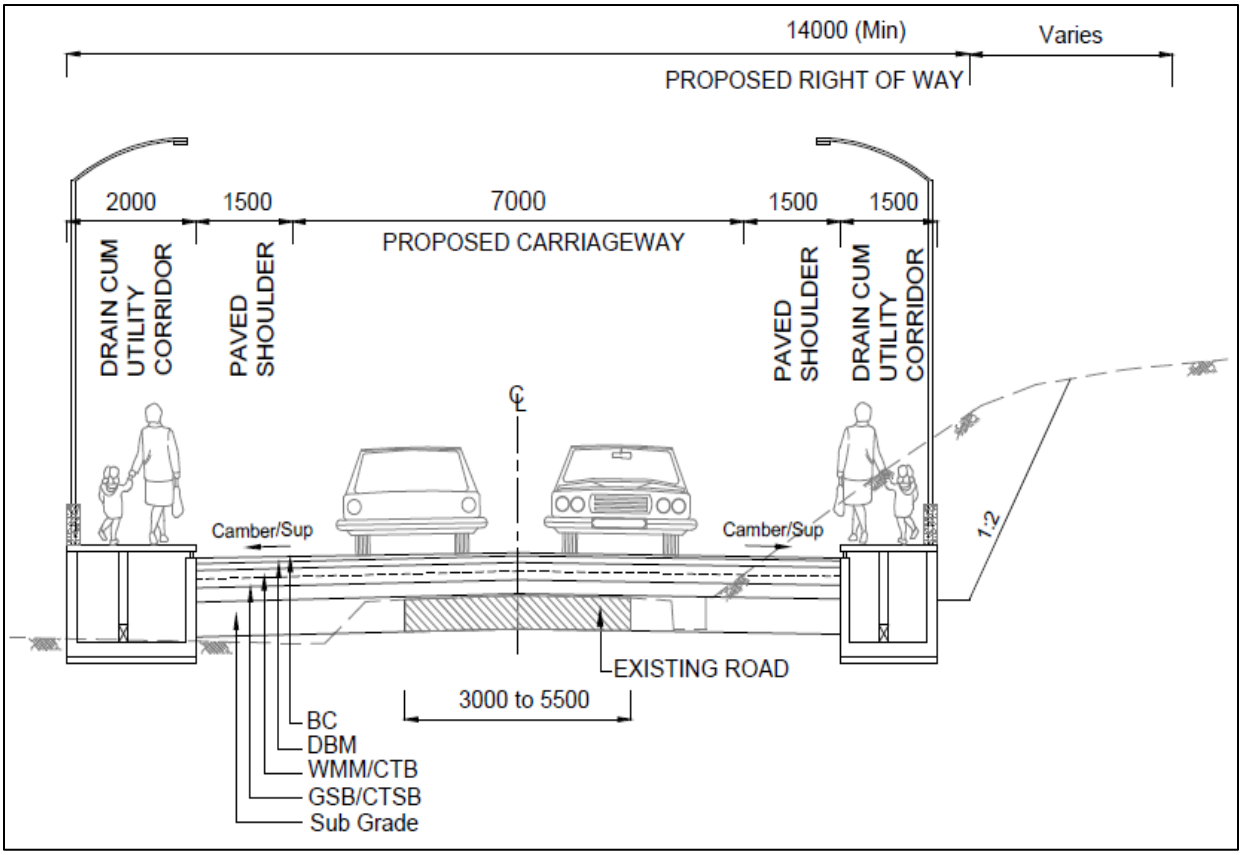


Figure-6 TCS-4: Typical Cross Section for 2 Lane with Half Cut in Existing Section (RHS)

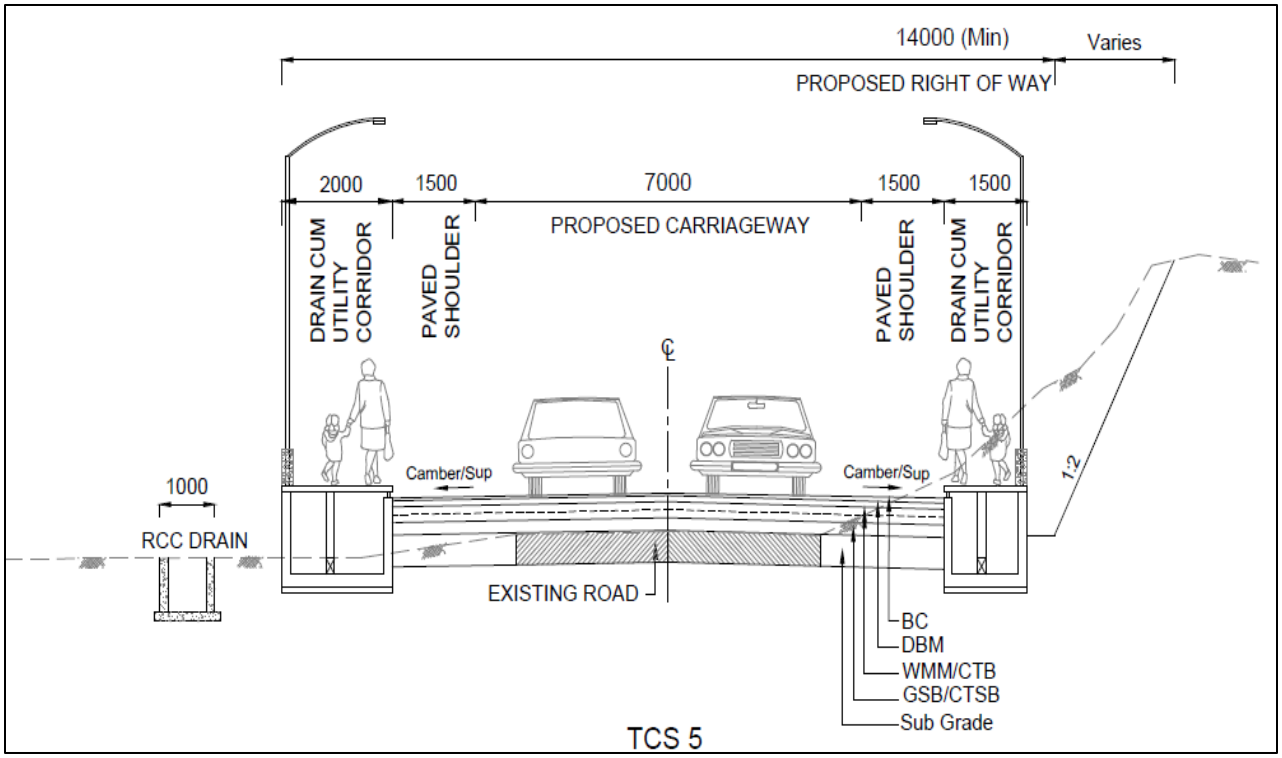


Figure-7 TCS-5: Typical Cross Section for 2 Lane with Half Cut in Existing (Urban Section)

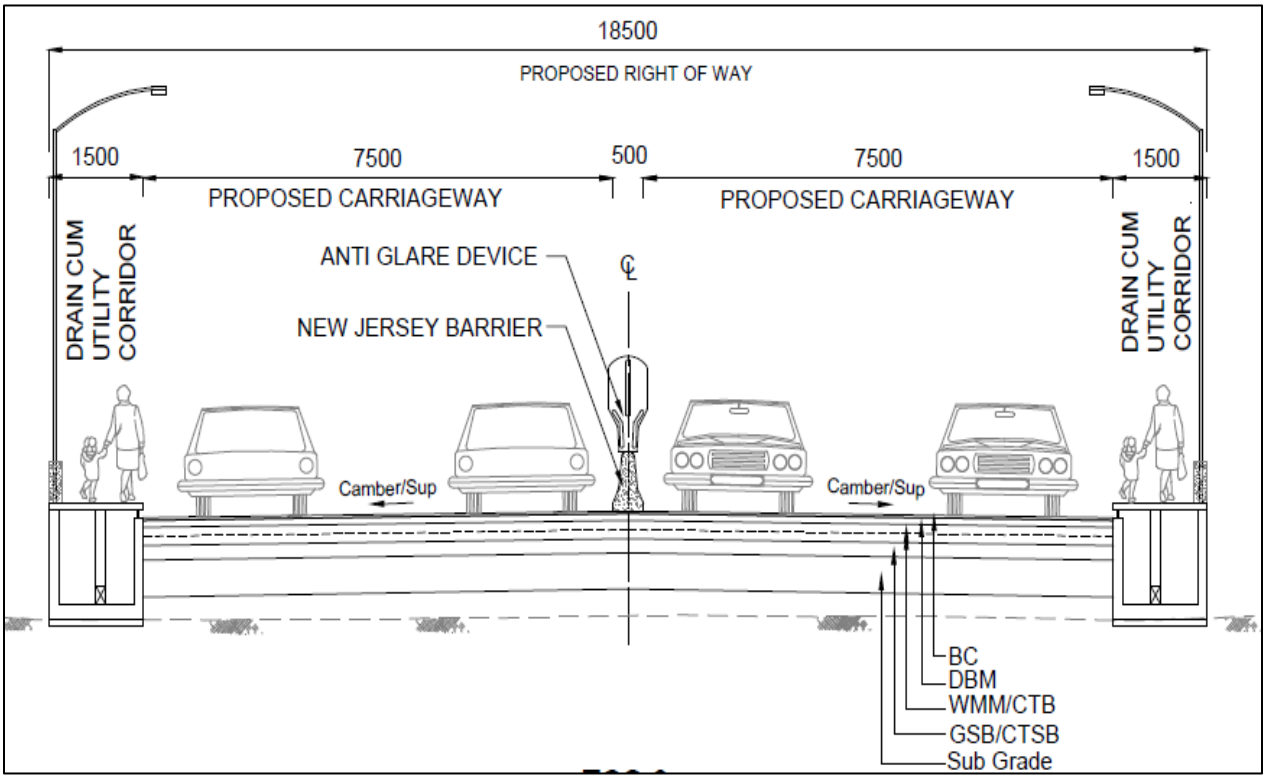


Figure-8 TCS-6: Typical Cross Section for 4 Lane Divided Carriageway without Service Road

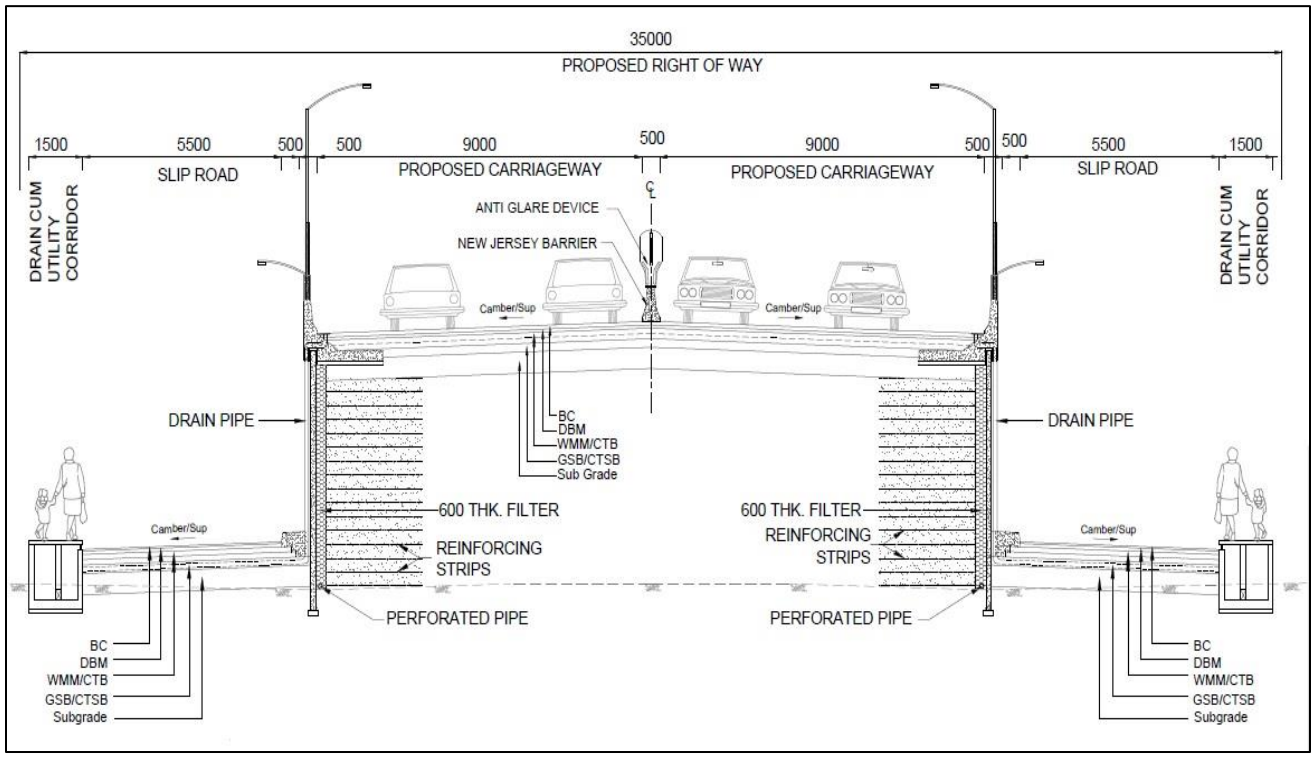


Figure-9 TCS-11: Typical Cross Section for 4 Lane Grade Separated Approach with Service Road

25. **Design Speed:** The design speed of green field section is 80 kmph and in the existing road section, 40/50 kmph depending upon the ROW and existing geometrics.

26. **Proposed Bridges:** The following new bridges have been proposed keeping in view the condition of existing bridges, hydrological requirement, proposed improvement / realignment of road, road junctions and road crossings.

Table-12 Details of Bridges on Proposed Alignment

S. No.	Design Chainage	Name of Bridge	Span Arrangement (m)	Length of Bridge (m)	Remarks
1.	0+041	Leishang Hiden - Pal-Ahanbi Bridge	2 x 22.0	44.05	New 4-lane bridge
2.	1+424	Imphal River Bridge	1 x 46.5 + 1 x 17.0	63.55	New 4-lane bridge replacing the existing bridge
3.	11+188	Bridge on Kongba River	1 x 20.00	20.05	New 2-lane bridge replacing the existing bridge
4.	17+515	Bridge on local stream at	1 x 6.00 (clear)	8.314	New 2-lane bridge replacing the existing bridge
5.	23+605	Imphal River Bridge	1 x 15.0 + 1 x 45.0 + 1 x 15.0	75.05	New 2-lane bridge
6.	42+991	Nambul River Bridge	1 x 16.50 + 1 x 31.50 + 1 x 16.50	64.569	New 2-lane bridge replacing the existing
7.	48+559	Bridge on local stream	1 x 10.00 (clear)	11.802	New 2-lane bridge in the greenfield section
8.	51+935	Nambul River Bridge	2 x 17.6	35.255	

Source: DPR Prepared by ICT Pvt. Ltd.

27. In addition to above one structure of Span 2x4m has been proposed on major junction at km 37+060. Therefore, total number of bridge is 9 which include replacement of existing bridges at 4 locations i.e. at chainage 1+424, 11+188, 17+515 and 42+991.

28. **ROB/ Flyover / Underpass:** There is no railway line crossing on the proposed alignment, therefore no ROB is required. However, one 4-lane flyover and one 2-lane vehicular underpass have been proposed as per project requirement keeping in view the site conditions, existing road junctions and cross roads for smooth and effective flow of traffic. The vertical clearances for above structures have been kept as 6.0m. The details of the flyover are given in **Table-13**.

Table-13 Details of Proposed Flyover / Underpass

S. No.	Type of Structure	Design Chainage	Span Arrangement (m)	Length (m)	Remarks
1	Flyover	47+863	1 x 43.50	43.553	New 4-lane flyover over NH-150
2	Vehicular Underpass	51+861	2 x 12.00	26.223	New 2-lane VUP over SH-10

Source: DPR Prepared by ICT Pvt. Ltd.

29. **Culvert:** Total 227 numbers of culverts have been proposed, out of which, 148 are box culverts and 79 are hume pipe culverts (**Table-14**). In addition to above culverts, 43 nos. of hume pipe culvert shall be constructed on cross road of junctions.

Table-14 Details of Proposed Culvert

Main Ring Road		SPUR	Major Junction
Box	**Hume Pipe**	**Box**	**Hume**
137	36	11	43

Source: DPR Prepared by ICT Pvt. Ltd.

E. PROJECT FACILITIES

30. **Service Lane / Slip Road:** Considering proper turning movement near proposed Flyover on NH 2, both side slip roads (km 47+475 to km 47+335) have also been proposed 0.86 km on each side. Cycle track of 0.960 km on each side has been proposed near Porompat area.

31. **Footpath:** At many places, the proposed ring road passes through congested market area. Since the proposed project is a ring road and connecting to market areas and habitation areas, to facilitate the pedestrian movement along the ring road and considering traffic safety 1.5m/2.0m width drain with utility corridor cum footpath has been proposed.

32. **Median and Median Opening:** Due to land constraint 0.5m width of New Jersy type Crash barrier has been proposed in 4 lane Sections to segregate traffic median opening of 20 m length has been considered at various location for cross passage.

33. **Bus Lay Bye:** To address the need of people living along the project road, bus lay bay have been proposed. Due to land constraint, each Bus bay of 4.5m width and 15m long with shelter has been proposed as per IRC 86:1983. A total of 28 number of bus bays with bus shelters have been proposed. **E-charging points** shall be provided in the selected bus shelters and public amenity centers under civil work.

34. **Truck Lay Bye:** As Imphal ring road is within Imphal city, provision of truck lay bye is not required.

35. **Road Sign and Lighting:** The various considerations made for different safety features included in the DPR. Indian Road Congress (IRC) codes have been followed in proposing and designing road safety features. At all intersections, shoulder mounted advanced directions signs will be provided. The signs shall be with retro reflective micro prismatic grade conforming to Type XI sheeting of ASTM standards for short, medium and long distance viewing to cater visibility requirement encountered by all road users. All curves shall be properly delineated with single chevrons signs which will be placed on outer edge of the curve, so as to view at least 2-3 chevrons from any given instance of viewing. All Mandatory, Cautionary and advance direction signs which includes Absolute speed limit signs and also compulsory “no parking” and “no stoppage” signs also have been proposed at wherever required. **Street lighting has been proposed all along the ring road with LED features fittings and shall be powered by solar system and back up facilities (power and battery both).**

36. **Pavement Marking:** Pavement markings will be done for traffic lane line, edge lines and hatching. The marking will be with hot applied thermoplastics materials. The pavement markings will be reinforced with raised RR pavement markers and will be provided for median and shoulder edge longitudinal lines and hatch markings. Highway lightings including high masts will be provided at intersections in order to improve the night time visibility.

F. PROJECT COST

37. The Civil Cost and Total project cost works out to be as under (**Table-15**). The total project cost includes contingencies, supervision charges, agency charges, resettlement and rehabilitation including land acquisition, environment cost and shifting of utilities.

Table-15 Total Civil Cost and Project Cost

Package	Civil Cost including GST (Rs. in Cr.)	Per Km Civil Cost (Rs. in Cr.)	Total Project Cost (Rs. in Cr.)	Per Km Total Project Cost (Rs. in Cr.)
I	357.79	18.6	543.99	28.3
II	440.23	22.2	665.29	33.5
III	285.32	23.5	427.63	35.2
	1083.34		**1636.91**	

Source: DPR Prepared by ICT Pvt. Ltd.

G. ECONOMIC ANALYSIS

38. The annual cost and benefit streams are used to derive the net cash flow for the project. The EIRR (Economic Internal Rate of Return) and NPV (Net Present Value for both scenarios at 12% discount rate are determined using the discounted cash flow technique for all the sections and are given in **Table-16.** The Economic Analysis has been done for the Flexible Pavement using HDM-4 for Imphal Ring Road. From the above results of analysis it is concluded that the base case EIRR is more than 12% and hence all the improvements proposals are **economically viable**. Sensitivity analysis indicates that the project is economically viable in scenario 1 & 2 and is marginally felling short in Sensitivity scenario 3. The above result indicates that the Imphal Ring Road is economically viable. Considering the social issues like better connectivity to localities and the fact that Option II is also economically viable, same is recommended for implementation.

Table-16 Result of Economic Evaluation

Description	Base case (EIRR) %	Sen-1 (EIRR) Base Costs and Base Benefits minus15%.	Sen-2 (EIRR) Base Costs plus 15 % and Base Benefits	Sen-3 (EIRR) Base Costs plus 15% and Base Benefits minus15%.
Imphal Ring Road	17.12%	16.95%	13.49%	13.85%

Source: DPR Prepared by ICT Pvt. Ltd.

H. RESOURCE REQUIREMENT

39. **Construction Material:** The project will require construction materials like aggregates, sand, stone, etc., which shall be procured from nearby approved quarries. However, environmental approval shall be sought by the Contractor for any new quarry. The estimated raw materials requirement during construction stage is given in **Table-17**.

Table-17 Raw Materials Requirement during Construction Stage

Sl. No.	Items	Unit	Quantity	Mode of Transport	Source
1.	Granular Sub Base	Cum	1,56,806	Truck	Pre-identified quarry areas and Local Traders
2.	Cement Treated Sub Base	Cum	46,763	Truck	
3.	Wet Mix Macadam & CTB	Cum	1,41,160	Truck	
4.	Dense Bituminous Macadam	Cum	41,285	Truck	
5.	Bituminous Concrete	Cum	26,461	Truck	
6.	Bitumen	MT	7,180	Tanker	Refinery
7.	Emulsion	MT	1,673	Tanker	Refinery
8.	Cement	MT	80,800	Truck	Local traders
9.	Aggregates	Cum	7,24,800	Truck	Pre-identified quarry areas
10.	Sand	Cum	90,876	Truck	Pre-identified quarry areas
11.	Steel	MT	17,481	Truck	Local traders
12.	Diesel	KL	11,587	Tanker	Local petrol pumps
13.	Fly Ash	Cum	No coal based thermal power plants within 300 km		

Source: DPR prepared by ICT Pvt. Ltd.

40. **Water Requirement:** During construction period water is required for compaction of embankment, dust suppression, concrete making and domestic use in construction camp. The estimated tentative water requirement during construction stage is given in **Table-18**.

Table-18 Breakup of Water Requirement during Construction Stage

S. N	Purpose	Unit	Quantity
1	For Road Construction:		
	a) Construction related to earthwork	KL	2,34,700
	c) Construction of GSB		
	d) Construction of WMM		
	e) Bridges, culverts, retaining walls & other structures		
2	Dust Suppression	KL	10,800
3	For drinking & other domestic purpose	KL	10,220
	Total (Kl)		**2,55,720**

Source: DPR prepared by ICT Pvt. Ltd.

Water Source: In compliance to the Sub-Clause 111.8.3 of MoRTH Specifications, the Contractor will identify the nearest source of water body at plant and camp site and shall source the water preferably from surface water bodies, rivers, streams in the project area. Only at locations where surface water sources are not available, the Contractor shall contemplate extraction of ground water, after intimation and consent from the CGWB. As per the CGWB classification, all the Talukas, through which the proposed ring road is passing, fall under **"safe"** category

41. **Power Requirement:** Power required at the construction camp would be drawn from the grid where it is available else DG sets would be used to supply the power to the Construction & Labour Camps.

42. **Land Requirement:** The land required for construction of Imphal Ring Road is tentatively **94.8606 ha** which includes 12.9746 ha forest land and 81.886 ha non-forest land. However, this may revise during the process of forest clearance and preparation of Joint Measurement Records (JMR). Existing land use of the are proposed to be acquired for the project is tabulated below:

Type of existing land use	Area (ha)
Forest Land	12.9746
Agricultural land (paddy field)	27.1985
Residential / commercial land	19.56
Government land (existing road, including shoulder & unlined drain)	35.1275
Total Area (ha)	94.8606

43. **Manpower Requirement:** The manpower requirement would vary over the construction period depending on the quantum and type of work involved. About 300 would be required during the construction stage.

44. **Construction Period:** Construction period shall be 24 months for each packages.

I. SOURCES OF CONSTRUCTION MATERIALS

45. Soil and material investigation for a road project is very essential to assess the availability of suitable construction material in the vicinity of the project road. This includes investigation of suitable borrow area for borrowing earth and quarries for stone /aggregate material and also for the other construction materials like cement, steel, bitumen etc.

46. **Earthwork:** 6,42,799 cum earth will be generated from cutting and 5,56,890 cum earth will be required for filling. Therefore, 87% of excavated earth will be re-used to raise road levels in the construction of Imphal ring road. Remaining earth will be used in to raise embankment of other roads projects under PWD in Imphal area. Hence, there is **no requirement of borrow earth for the proposed project.**

47. **Stone / Coarse Aggregate:** A total of **2 stone quarry / crusher** sources have been identified for Greater Imphal Ring Road and Spurs section as the potential source of coarse aggregates required for construction of pavement layers and structures of the highway. The lead details of these identified quarries are given in **Table-19.**

Table-19 Location of Stone / Coarse Aggregate Material

Sl. No.	Design Chainage	Side	Village Name	Crusher Name	Lead from Proposed Alignment (km)
1	0+000	RHS	Maharabi	Maharabi Stone Crusher	21 km on NH-39
2	43+480	RHS	Sagol Tongba	Biren Singh & Sons Crusher	3.8 km

Source: DPR Prepared by ICT Pvt. Ltd.

48. **Sand:** Imphal West district is rich in minor minerals such as building stone and sand. The district had 6 sand & stone quarry leases till March 2020 covering area 36.71 ha. There are no temporary permits working within the district as per information recorded in the district mining committee in the month of March 2020. As per the Manipur Minor Mineral Concession Rules, 2012 of Government of Manipur, Sand leases and permits are identified for mineable depth considering impact of sand scooping on ground water availability and stream. List of the Mineral Concession Leases for sand with location, area and period of validity is given in the **Table-20**. If adequate quantity of sand is not available in the above mentioned approved sources, the Contractor may use manufactured sand / stone dust from approved stone quarry / crusher sources or may purchase from the neighboring States

Table-20 Location of Sand

Sl. No.	Name of Lessee	Address & Contact No. of Lessee	Mining Licence grant Order No. & Date	Mining Licence Area (ha)	River Bed
1	M. Mangoljao Singh	Awang, Sekmai, Imphal West District	No. 1/77/2019/EIA/DoE/356 dt. 4/12/2019	3.5 ha	Sekmai
2	M. Mangoljao Singh	Awang, Sekmai, Imphal West District	No. 1/77/2019/EIA/DoE/356 dt. 4/12/2019	5.0 ha	Sekmai
3	M. Mangoljao Singh	Awang, Sekmai, Imphal West District	No. 1/77/2019/EIA/DoE/375 dt. 5/2/2019	15.24 ha	Sekmai
4	M. Mangoljao Singh	Awang, Sekmai, Imphal West District	No. 1/77/2019/EIA/DoE/375, dt 5/2/2019	11.5 ha	Sekmai

Source: District Survey Report for Imphal West District (Manipur State) for A) Sand Mining or River Bed Mining, B) Minerals other than Sand Mining or River Bed Mining (Pebble for Crushing / Opencast Surface Mining), 2021

49. **Water:** A total of 8 ground water samples were collected from various locations along the alignment of Imphal Ring Road in the year 2014. Due to presence of high sulphate content in some ground water samples, it is not recommended to use the ground water in the pavement courses within 500 mm of metallic items forming part of the permanent works. Also it is not suggested to use in concrete work. Therefore, surface water could be used for construction work and the same will be identified by the Contractor.

50. **Cement:** Ordinary Portland cement of Grade 43 and 53 are available from Nagaon in Assam at a lead of 350 km. Cement shall be conforming to IS: 8112 and / or IS: 12269.

51. **Bitumen:** Three (3) sources are identified as potential sources of bitumen at IOCL, Guwahati, IOCL Dibrugarh and Assam Oil at Dibrugarh in Assam.

52. **Steel:** High strength deformed bars manufactured by various steel manufacturing companies conforming to IS 1786 may be available with local dealers or may be procured from Shillong, Meghalaya at a lead of 550 km. Before incorporation into the work, steel shall be got approved by the Engineer.

53. **Fly Ash:** There is no coal based thermal power plants within 300 km from the proposed Imphal Ring Road.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. INTRODUCTION

54. The environmental management and protection policies, regulations and administrative framework governing the project are reviewed in this section. The review includes sector-specific environmental policies and regulations of the Government of India, Government of Manipur, ADB's Safeguard Policy Statement – June 2009 and the administrative framework of various agencies, such as the Ministry of Environment, Forest and Climate Change (MoEF&CC), the Pollution Control Boards and other bodies associated with the implementation of the proposed project.

B. POLICIES & LEGAL FRAMEWORK

55. **Constitutional Provisions:** The Constitution of India, in Article 48, of Directive Principles of the State, states that "the state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country". Further Article 51-A (g), of fundamental duties, emphasizes that, "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures". These two provisions of the constitution are the guiding principles for the environmental legislation in India.

56. **Applicable Environmental Legislations:** The Government of India has laid down various policy guidelines, regulations, acts and legislations pertaining to sustainability and protection of the environment and its various components. The Environmental Acts, Notifications, Rules and Amendments applicable for the proposed project include the following:

- Environment (Protection) Act and Rules, 1986
- EIA Notification, 14th September 2006 and its subsequent amendments
- The Water (Prevention and Control of Pollution) Act and Rules, 1974, 1975
- The Air (Prevention and Control of Pollution) Act, Rules and Amendment, 1981, 1982, 1983, 1987
- The Noise Pollution (Regulation and Control) Rules, 2010
- Forest (Conservation) Act, 1980 and its amendments
- Forest (Conservation) Rules, 2003 and its amendments
- Forest (Conservation) Rules, 2022
- Indian Forest (Manipur Amendment) Act,2018
- The Manipur Forest Rules, 1971
- The Schedule Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006
- The Schedule Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Amendment Rules, 2012
- Wildlife (Protection) Act, 1972 and Amended in 2003
- The Biodiversity Act, 2002
- Solid Waste Management Rules, 2016 and amendments
- Construction and Demolition Waste Management Rules, 2016
- The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016
- Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996
- Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010

- Disposal of Fly Ash Notification 2009 and its amendments on 25th January 2016
- MoEFCC Office Memorandum (File No. 22-13/2019-IA.III) dated 28th August 2019 regarding Fly Ash Notification and subsequent amendments
- The Motor Vehicles (Amendment) Act, 2019
- The Motor Vehicles (Amendment) Bill, 2019
- The Explosive Act, 1884 and The Explosive Rules, 2008
- Public Liability Insurance Act, 1991
- The Mines Act. 1952
- Mines and Minerals (Development and Regulation) Amendment Act, 2015
- The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996
- Any other applicable Acts, Policies, Notification, Circulars, Guidelines etc.

C. ADB SAFEGUARD POLICY STATEMENT 2009

57. The Asian Development Bank has defined its Safeguard requirements under its 'Safeguard Policy Statement 2009 (SPS 2009). The prime objectives of safeguard policy are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; and (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible. This policy requires assessment, mitigation and commitment towards environmental protection. The extent of assessment depends on the category of the project. ADB's SPS 2009 classify a project depending on following three categories:

- **Category A:** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment is required.
- **Category B:** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, none or very few of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An Initial Environmental Examination is required.
- **Category C:** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed

58. The proposed project cause environmental impacts which are less adverse in nature and few of them are reversible and mitigation measures can be designed more readily for the identified impacts. There is no protected area and buffer zone of protected area within 10 km radius of the proposed alignment. No cultural heritage site, wetland, mangrove etc. are adjacent to the proposed alignment. Hence, as per the ADB's Safeguard Policy Statement 2009, the proposed Imphal Ring Road has been classified as **Category 'B'** project requiring Initial Environmental Examination (IEE). Rapid Environmental Assessment Checklist is given in **Annex-3.1.**

D. ADMINISTRATIVE FRAMEWORK

59. The Government through specific legislations regulates the environmental management system in India. The Ministries / Statutory bodies responsible for ensuring environmental compliance by project promoters include following agencies.

60. **Ministry of Environment, Forest and Climate Change:** The Ministry of Environment, Forest and Climate Change is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programs. The primary concerns of the Ministry are implementation of policies and programs relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution.

61. **Central Pollution Control Board:** The Central Pollution Control Board (CPCB) basically designs the scheme, procedures and standards to control the water, air & noise pollution, land degradation and hazardous substances and waste management. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the Central level, which is a statutory body. CPCB advise the MoEF&CC on matters concerning prevention, control and abatement of water and air pollution; coordinate the activities of State Pollution Control Boards & provide technical and research assistance; prepare manual, codes, guidelines & standards etc.

62. **Manipur Pollution Control Board:** The Manipur Pollution Control Board (MPCB) is a statutory body constituted by the Government of Manipur under the provision of Section 4 of the Water (Prevention and Control of Pollution) Act, 1974 and Section 5 of the Air (Prevention and Control of Pollution) Act, 1981. The aim of MPCB is to ensure that the people of the state breathe clean air, drink safe water, and live in healthy environment. In order to meet the objectives, MPCB is responsible for addressing the environmental problems in the state that will lead to pollution.

63. **Archaeological Survey of India:** The Archaeological Survey of India (ASI), has been formed for the archaeological researches and protection of the cultural heritage of the nation. Maintenance of ancient monuments and archaeological sites and remains of national importance is the prime concern of the ASI. It regulates all archaeological activities and development works in and around archeological sites in the country as per the provisions of the Ancient Monuments and Archaeological Sites and Remains Act, 1958 as amended by the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and the rules made there under.

64. **National Board for Wildlife:** The National Board for Wildlife (NBWL) is the apex advisory body in the field of wildlife conservation in the country and is headed by the Prime Minister of India. The NBWL takes decision regarding the impact on wildlife due to road development activities and issues recommendations related to proposed road up-gradation.

E. APPLICABLE INDIAN ROAD CONGRESS (IRC) CODES

65. Over and above, the project also gives due importance to the road construction standards, norms, guidelines and management procedures prescribed by the Indian Roads Congress (IRC), which includes:

Table-21 Applicable IRC Codes

IRC:SP:84-2019	Manual of Specifications and Standards for 4 Laning of Highways
IRC:SP:73-2018	Manual of Specifications and Standards for 2 Laning of Highways with Paved Shoulder
IRC:SP:108-2015	Guidelines on Preparation and Implementation of EMP
IRC:119:2015	Guidelines for Traffic Safety Barriers
IRC:120:2015	Recommended Practice for Recycling of Bituminous Pavement
IRC:SP:98-2013	Guidelines for the use of Waste Plastic in Hot Bituminous Mixes
IRC:37-2018	Guidelines for the Design of Flexible Pavements
IRC:SP:93-2017	Guidelines on Requirements for Environmental Clearance for Road Projects
IRC:SP:21:2009	Guidelines on Landscaping and Tree Plantation
IRC:SP:58-2001	Guidelines for Use of Fly Ash in Road Embankments
IRC: SP:55-2014	Guidelines for Safety in Construction Zones
IRC: SP: 44-1996	Highway Safety Code
IRC:103-2012	Guidelines for Pedestrian Facilities
IRC: SP: 32-1988	Road Safety for Children
IRC:56-2011	Recommended Practices for Treatment of Embankment Slopes for Erosion Control
IRC:10:1961	Recommended Practices for Borrow pits for Road Embankments Constructed by Manual Operation
IRC:SP:42-2014	Guidelines on Road Drainage
IRC:SP:50-2013	Guidelines of Urban Drainage

F. CLEARANCES REQUIRED FOR THE PROJECT

66. **Environment Clearance:** List of projects requiring Prior Environmental Clearance is given in the “SCHEDULE” of EIA Notification. As per the Schedule categorization of the highway project is as follow:

Project Activity	Category 'A'	Category 'B'	Conditions if any
Highways 7(f)	)New National High ways; and)Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignments or by-passes	)All New State Highway Projects)State Highway Expansion projects in Hilly terrain (above 1,000 m MSL) and or Ecologically Sensitive Areas.	General Condition shall apply **Note:** i) Highways include expressways **MoEFCC Circular dated 14th July 2022 [S.O. 3194(E)]** ii) All Highway projects are exempted upto 100 km from line of control or border subject to compliance of Standard Operating Procedure notified in this regard from time to time iii) Width at toll plaza and junction improvement at intersection of other roads is exempted from Right of Way

67. There is no provision of 'Ring Road in the schedule as reproduced above. **Total length of improvement** including Imphal Ring Road and three SPURs are **51.230 km** and proposed RoW in general is 14 m for 2 lane section and 18.5 m for 4 lane section; provision of 7(f) of the "SCHEDULE" cannot be applied. Therefore, it can be concluded that as per EIA Notification 2006 and it's subsequent amendments, Environment Clearance **is not required** for the Imphal Ring Road.

68. **Forest Clearance:** The proposed project involves diversion of **12.9746 ha** forest land. Hence, Forest Clearance **is required**. The proposal was uploaded through online portal of the MoEFCC on 09/04/2022 (FC proposal No. FP/MN/ROAD/154280/2022). The present status of the forest proposal is as under:

28th April 2022:	The Divisional Forest Officer (DFO), Central Forest Division recommended the proposal
08th May 2022:	The Conservator of Forests (CF), Central Forest Circle, Government of Manipur recommended the proposal
01st June 2022:	The Chief Conservator of Forests (CCF) / Nodal Officer Government of Manipur recommended the proposal
09th June 2022:	The Government of Manipur recommended the proposal
01st Dec 2022:	Stage-I Forest Clearance granted by the Integrated Regional Office of the MoEFCC

69. **Wildlife / ESZ Clearance:** The alignment of proposed Imphal Ring Road does not pass through any protected areas and not located within 10 km radius of any protected area. Hence, Wildlife / ESZ Clearance are **not required**.

70. **ASI Clearance:** No ASI Protected Monument or World Heritage Monument is located within 300m of the proposed Imphal Ring Road. Therefore, ASI Clearance is **not required**.

71. Apart from the clearances for the overall project work, the contractor, before starting the construction work, has to obtain required Clearances / NOCs as listed in **Table-22** for operating his equipment and carrying out construction work.

Table-22 Clearances Required to be obtained by the Contractor

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
13.	Consent for Establishment of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant	▪ Manipur Pollution Control Board	▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Water (Prevention and Control of Pollution) Act, 1974 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
14.	Consent for Operation of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant		
15.	Permission for withdrawal of groundwater for construction	▪ Central Ground Water Authority ▪ State Ground Water Board	▪ Environment (Protection) Act, 1986 ▪ Ground Water Rules, 2002
16.	Location and layout of workers camp, & equipment and storage yards	▪ Manipur Pollution Control Board	▪ Environment (Protection) Act, 1986; ▪ The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016
17.	Discharges from labour camp	▪ Manipur Pollution Control Board	▪ Water (Prevention and Control of Pollution) Act, 1974
18.	Storage, handling and transport of hazardous materials	▪ Manipur Pollution Control Board	▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016
19.	Disposal of Bituminous Wastes (if any)	▪ Intimate local civic body to use local solid waste disposal site	▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016
20.	PUC Certificate for all construction vehicles and all machineries	▪ Transport Department of Govt. of Manipur	▪ The Motor Vehicles (Amendment) Act, 2019 ▪ The Motor Vehicles (Amendment) Bill, 2019
21.	Installation of DG Set (Consent to Establish)	▪ Manipur Pollution Control Board	▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
22.	Operation of DG Set (Consent to Operate)		
23.	Engagement of Labour - Labour License	▪ Labour Commissioner (Ministry of	▪ The Building and Other Construction workers (Regulation of

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
		Labour and Employment)	Employment and Conditions of Service) Act 1996 ▪ Contract Labour (Regulation and Abolition) Act 1970 along with Rules, 1971
24.	Engagement of Labour - Social Security - Labour Welfare - Wages	▪ Labour Commissioner (Ministry of Labour and Employment)	▪ The Employees' Provident Fund & Miscellaneous Provisions (Amendment) Act, 1996 ▪ The Personal Injuries (Compensation Insurance) Act, 1963 ▪ The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 ▪ Equal Remuneration Act, 1976 ▪ The Payment of Wages (Amendment) Act, 2005 ▪ The Minimum Wages Act, 1948 ▪ The Minimum Wages (Central) Rules, 1950

72. In addition to the above, Contractor has to obtain:

- Insurance related to 3rd party insurance, Indemnity, Workmen Compensation etc.
- Permission / license to store explosive materials
- Permission from Municipal Council for setting up Construction Camp
- Change of Land Use Certificate from District Land Revenue Officer (DLRO)

IV. DESCRIPTION OF THE ENVIRONMENT

A. INTRODUCTION

73. The existing environmental conditions of the study area covering an area spread over 10 km on either side of the ring road, in general and specific environmental features of the study corridor, i.e., 50 m on either side of the centerline of the ring road, in particular, has been studied as described in the subsequent sections.

B. PROJECT LOCATION

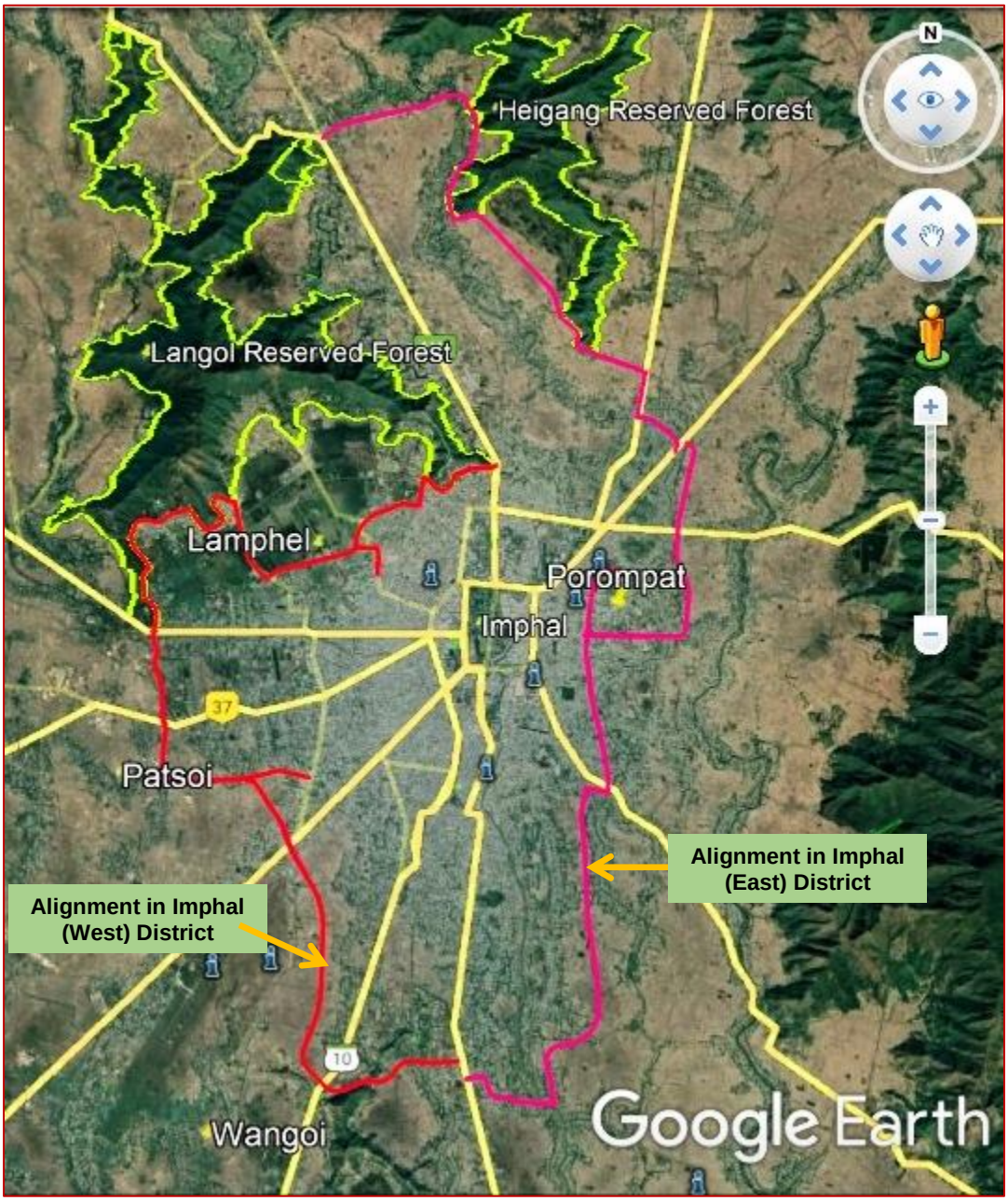
74. The alignment of the Imphal Ring Road is passing through 2 districts i.e. Imphal (East) and Imphal (West); 4 talukas and 42 villages. District and Taluka wise list of villages is presented in **Table-23**. The alignment of the Ring Road on Google Earth showing Districts and Talukas is given in **Figure-10**.

Table-23 District & Taluka wise List of Villages

District	Taluka	Village Name		
Imphal (East)	Porompat	1. Kiyamgei	10. Khuraichingangbam	19. Khurai Kosam leikai
		2. Bashikhong	11. Kongkham Leikai	20. Khomidok
		3. Wangkheiloumanbi	12. Khaidemleikai	21. Khairang
		4. Nandeibam Leikai	13. TopNaoriya	22. Heinegang
		5. Wangkhei Pachim (Brahmapur)	14. Khurai Khongnangmakhong	23. Sadr Hill East (Saikul)
		6. Wangkhei Nangpok	15. Laingam Pat	24. Mongjam
		7. Wangkheirakpam Leikai	16. Ningthoubung	25. Achambekai
		8. Poromot	17. Laisram Leikai	26. Mantripukhri
		9. Soibam Leikai	18. Angomlouwai	27. Chingmeirong
Imphal (West)	Lamphel	28. Thangmeiband		
		29. Lamphel Pat		
		30. Meiteilangol		
		31. Iroishemba		
		32. Takyelmepal		
	Patsoi	33. Langjingmakhong		
		34. Langjing		
		35. Taoboumgkhok		
		36. Lamjaotongba		
		37. Ghari		
		38. Sangaiprou Mamang		
		39. Mongshangei		
	Wangoi	40. Langthaballep		

District	Taluka	Village Name
		41. Mantrikhong
		42. Langtha Balkunga

Figure-10 Alignment of the Imphal Ring Road on Google Earth



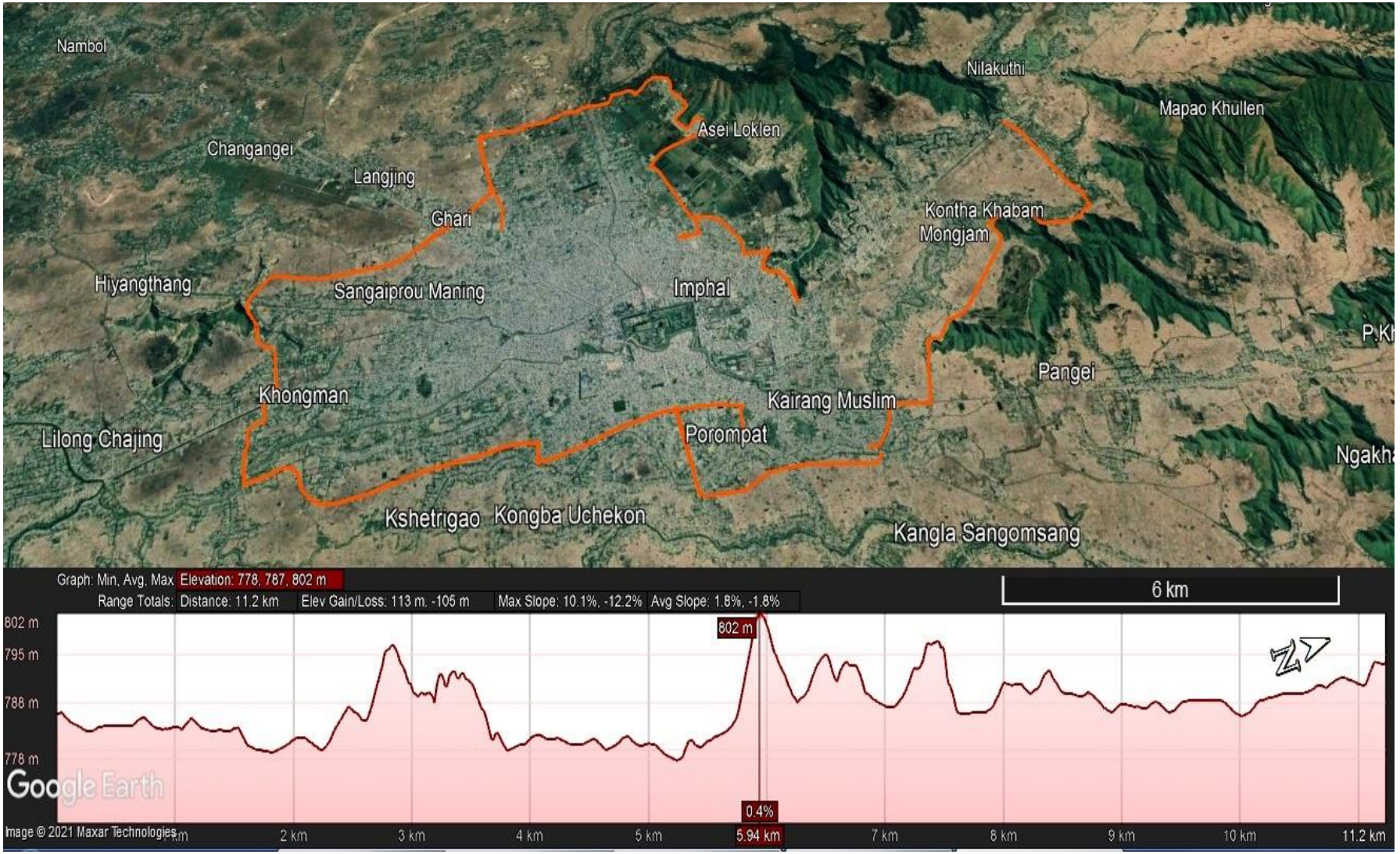
C. GEOMORPHOLOGY

75. The Imphal (East) district is flat elongated and tapering towards south with isolated hills. It is an intermountain valley surrounded by hillocks about 1,500 - 2,000 meters high with average trend of slope down from north to south from an altitude of 880 to 770 meters above MSL, which

is common to Imphal valley. The Imphal (West) district shows three prominent units i.e. a tiny plain topography, hilly areas in the extreme north & central parts and marshy land in the southern parts of the district. The general elevation is around 790 m above mean sea level.

76. Geographically the alignment lies between latitude 24°44'40.05" N to 24°52'57.20" N and between longitude 93°56'6.47" E to 93°55'9.88" E with elevation varies from about 778 m to 802 m above MSL (**Figure-11**).

Figure-11 Elevation Profile of the Project Area



D. GEOLOGY

77. Imphal valley lies within the central Manipur (Disang-Barail) Flysch Belt. The valley is almost flat, filled with fluvio-lacustrine dark grey to black clay, silt and sand alluviums. The predominant sediments are clay and a mixture of clay and sand, while silt and sand forms lensoids and bands within clay. Thoubal thrust on the east side and Churachandpur-Mao thrust (which partly forms the tectonic contact between the Disangs and Berails on the western side bound the valley. Based on the topographic features of the isolated hillocks, etc. and fracture analysis of the basement rocks, it has been inferred that the basement rock is characterized by E-W to NW-SE trending extensional faults. The stretching of the basement faults led to the development of isolated hillocks, as remnant of horsts. This forms the basis of the tectonic origin and formation of the Imphal valley (IBOTOMBI, 2000)[1]. However, this is in contrast to the erosional origin, which suggests that the valley was formed when river-borne sediments filled up a lake, the present Loktak lake at the southern part of the valley being the part of the original lake that once engulfed the entire valley (LAIBA, 1992)[2].

78. The topographical sheets, superimposed with the alignment of proposed Imphal Ring Road and it's 10 km radius is provided in **Annex-4.1**.

E. SEISMICITY

79. Imphal City lies in the northeastern (NE) region of India which is regarded as one of the most seismically active regions. The project road is situated in the **Zone V** (having severe seismic intensity) of the Seismic Map of India (as per IS: 1893, Part I, 2002) and therefore has a severe risk of potential damage due to earthquake. This region has experienced several strong magnitude earthquakes which have caused immense damage to life and property. In recent time, an earthquake with 6.7 magnitude hits Manipur on 4th January, 2016 with its epicentre located in the Tamenglong district of Manipur about 30 km west of Imphal and the city was one of the worst affected regions due to the earthquake.

F. HYDROLOGY AND DRAINAGE

80. The drainage pattern in the study area is from north to south. There are two main river basins viz, the Barak river basin and Manipur river basin in the State. The study area is located in the Manipur river basin. The Manipur river originates from north of Karong, in the Senapati district, traversing through a stretch of 50 km in the hilly tract, meanders through the Manipur valley in a North West-South East direction. Its important tributaries are the **Imphal River** meanders through the Manipur valley. There are several shallow lakes (pats) or marshes in the inter fluvial areas of these river systems, such as Lamphel lake between the rivers Nambul and Imphal; Waithou lake between the rivers Iril and Thoubal; Ikop lake, Kharung lake and Lousi lake between Thoubal and Sekmai Rivers etc. On the west, between the rivers Manipur and Khuga lies the Loktak Lake which comprises about 20 small and large lakes. The Nambul River is made up of number of small streams on its upper course and flows through the Imphal town dividing the town almost into two equal halves. The course of the rivers is short and falls in the Loktak Lake.

81. The alignment of Imphal Ring Road is crossing river and first order streams at several locations. The watersheds of the rivers at the proposed crossing points have been delineated with the help of ArcGIS 9.2 Software. The watershed area, total and centroidal stream lengths,

[1] IBOTOMBI, S. (2000), *Structural and tectonic framework of Manipur. In Manipur Science Congress, Imphal*
[2] LAIBA, M. T. (1992), The Geography of Manipur

segmental stream length and corresponding falls have been determined with the help of GIS Software. The superimposition of delineated catchment areas over the digitized Isopluvial Maps (50 Year / 100 Year-24 hr.) has also been done. For small watersheds not traceable in Digital Elevation Model, catchment areas, stream lengths and falls have been estimated through study of toposheets of the concerned area and satellite imagery. **Figure-12** reflects the catchment areas over the whole study are of the proposed ring road including drainage network, delineated with the help of ArcGIS Software and details of catchment area, design discharge and high flood level (HFL) is presented in **Table-24**.

Table-24 Catchment Area, Design Discharge & HFL of River / Stream Crossing the Alignment

Sl. No.	Chainage	Name of the River	Catchment Area (sq. km.)	Design Discharge (cumec)	Clear Waterway provided (m)	HFL (m)
1	1+424	Imphal River	361.73	700.3	60	784.054
2	11+188	Kongba Nadi	96.46	168.36	20	784.36
3	17+515	Local Stream	4.8	19	6	786.895
4	23+605	Imphal River	347	681	68	791.341
5	42+991	Nambul River	115.81	310	52	786.122
6	48+559	Local Stream	4.4	21.97	10	779.73
7	51+935	Nambul River	161.70	288.92	35	780.25

Source: DPR Prepared by ICT Pvt. Ltd.

G. AGRICULTURE AND IRRIGATION PRACTICES

82. Agriculture is the main occupation of the districts and crop production is important activity, which provides livelihood-cum employment opportunities to more than 80% of the rural population. The most important predominant crop of the district is Paddy. Rice is the staple food of Manipur and every rural household grows paddy crop as main source of income. Cultivation is almost entirely mono-crop with rice accounting about 98 percent of food-grains production and about 72 percent of the total cropped area is grown with paddy. The other important agricultural crops are Maize, Beans, Pulses, Potatoes, Mustard and Chilly etc. Farmers also started growing of Wheat crop in recent years. Agriculture profile of the study area is presented in **Table-25**.

Table-25 Agricultural Profile of the Study Area

Agro Ecological Sub Region (ICAR)	North-Eastern Hills (Purvachal), Warm Perhumid Eco-sub region (17.2)
Agro-climatic Region (Planning Commission)	Eastern Himalayan Region (II)
Major Soils Types	Clayed loam, Sandy loam, Red and Black Soil
Major Field Crops cultivated	Paddy, Maize, Pulses (Pea), Oilseed (Rapeseed & Mustard), Potato, Wheat, Sugarcane etc.
Major Horticulture Crops - Fruits	Pineapple, Banana, Lemon, Papaya, Guava, Passion fruit, Mango etc.
Major Horticultural crops - Vegetables	Cauliflower, Cabbage, Tomato, Pea, Onion

Source: Agriculture Contingency Plan for East Imphal District and West Imphal District

83. Agricultural production is sensitive to climate change and weather variability. Extreme weather events such as droughts, floods, tropical cyclones, heavy precipitation events, heat and cold waves has significant impacts on agricultural production and livelihood of the farmers. The main source of water for agriculture in the study area is rain water. The productivity is largely dependent in the rainfall because the irrigation system in Manipur is not fully developed.

Paddy Field along the Alignment of Proposed Imphal Ring Road

H. LAND USE

84. The proposed project is located in the Imphal East and Imphal West District. Agriculture is the main land use within the study area. The project site up to 10 km radius from the proposed alignment is passing through plain terrain. The predominant land use (**Table-26**) within the study area is agricultural and its related uses which covers 54.05%, followed by forest (23%), settlements / builtup ares (20.61%), waterbodies (1.28%), transportation (0.57%), waste land (0.43%), industrial (0.02%) and recreation (0.04%). The **land use / land Cover of the study area** covering 10 km on either side is provided in **Annex-4.2**.

Table-26 Land Use Pattern within 10 km Radius of the Proposed Ring Road

S.No.	Land use Category	Area (ha)	Area (%)
1	Agriculture	44,506.28	54.06
2	Forest area	18,935.34	23.00
3	Settlements/Builtup	16,966.38	20.61
4	Waterbodies (River & Ponds)	1,051.16	1.28
5	Transportation	472.34	0.57
6	Waste land	350.18	0.43
7	Industrial	12.62	0.02
8	Recreation	33.35	0.04
	Total Area (ha)	**82,327.65**	**100.00**

Source: Environmental Study carriedout by ICT Pvt. Ltd.

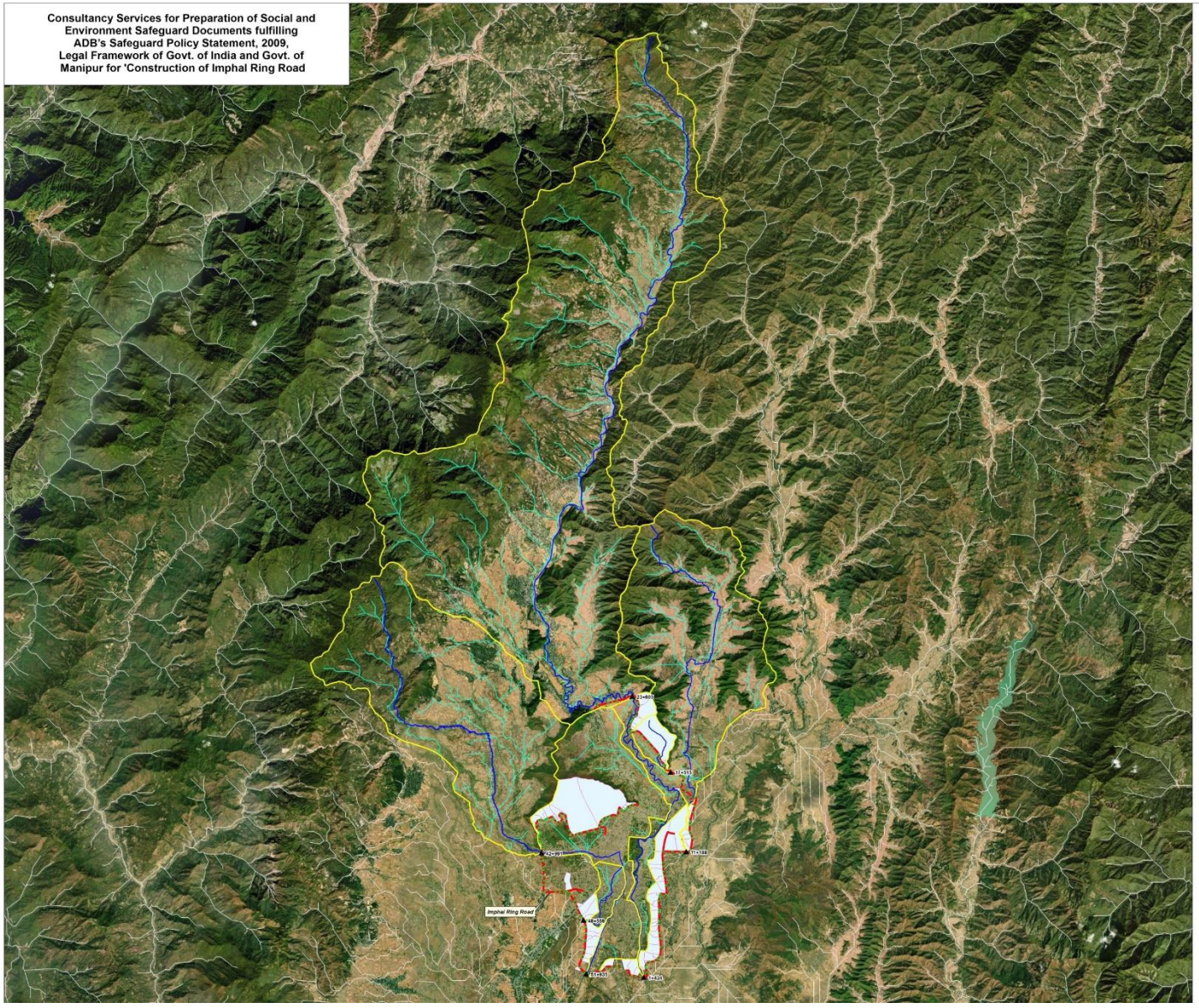


FIGURE-12

Map of Catchment Area, Drainage Network and Location of Cross Drainage Structures

I. SOIL QUALITY

85. **Soil Types of the Study Area:** Soil of the study area is found to be fertile and is mainly underlain by alluvial soil of recent origin. This valley was once full of swamps and marshy land represented by the places having lake, like Lamphelphet, Takyelpat, Sangaipat, Kakwapat and Poiroupat. The alluvial soils represent the soils of Imphal East district and Imphal West District. The soils have general clayey warm texture and grey to pale brown colour. It contain a good proportion of potash and phosphate, a fair quantity of nitrogen and organic matter and are less acidic. The organic soils cover the low lying areas of the valley. With dark grey colour and clayey loam texture, these soils have high acidity, abundance of organic matter, a good amount of nitrogen and phosphorous but are poor in potash.

86. **Soil Monitoring Stations:** The physico-chemical characteristics of soils within the study area were examined by obtaining soil samples from selected points and analyzing the same. Details of the sampling stations are provided in **Table-27.** M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection and analysis of Soil samples. Three (3) sampling locations of different land use within 50 meters on either side of the ring road alignment were collected for studying soil characteristics

Table-27 Details of Soil Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Area category	Date of sampling
1	SQ1	Wangkheiloumanbi	3+200	LHS	50	Agriculture	13-08-2021
2	SQ2	Heingang	22+100	RHS	40	Forest	13-08-2021
3	SQ3	Langthaballep	50+300	LHS	40	Agriculture	13-08-2021

Source: Field Survey in August 2021
Distance in meter from existing / proposed centerline

Photographs of Soil Sampling

87. **Soil Characteristics of the Study Area:** The physico-chemical characteristics of the soils in the study area, as obtained from the analysis of the soil samples, are presented in **Table-28**.

Table-28 Physico-Chemical Characteristics of Soil in the Study Area

Sl. No.	Parameters	Unit	Station Code		
			SQ1	SQ2	SQ3
1.	pH	-	7.26	7.19	6.84
2.	Electrical Conductivity	µmhos/cm	272	296	266
3.	Moisture	%	10.6	12.4	8.8
4.	Organic Matter	%	1.32	1.56	1.38
5.	Infiltration Rate	mm/hr.	3.18	2.96	3.25
6.	Bulk Density	gm/cc	1.21	1.18	1.19
7.	Silt	%	37	32	41
8.	Sand	%	18	26	17
9.	Clay	%	26	28	23
10.	Porosity	%	10.2	13.8	11.4
11.	Sodium as Na	mg/kg	52.6	28.6	48.13
12.	Potassium as K	mg/kg	412	266	124.8
13.	Phosphorous as P	mg/kg	8.2	9.2	9.2
14.	Magnesium as Mg	mg/kg	52.4	51.6	49.6
15.	Nitrogen	mg/kg	12.6	13.6	17
16.	Iron as Fe	mg/kg	64	36	80
17.	Lead as Pb	mg/kg	0.8	0.7	0.5
18.	Nitrate	mg/kg	21.6	23.4	17
19.	Manganese as Mn	mg/kg	6.2	5.8	7.4

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.

88. It has been observed that the texture of soil is silty clay with 37-41% silt content and 23-28% clay content. The pH of the all samples varied between 6.84-7.26 indicates that soil is less acidic. It can be inferred that the overall fertility status of the soils within the study area is good. It contain a good proportion of sodium, potassium & phosphorous and fair quantity of nitrogen and organic matter.

J. CLIMATE & METEOROLOGY

89. Climatic Conditions of the Study Area: The climate of the study is sub-tropical to temperate climate with fairly hot summer and cold winter. April to June is summer months, while June to September is the southwest monsoon period. October and November is the post monsoon season with moderate rainfall, followed by dry winter months of December to February. Past meteorological data of nearest IMD Observatory at Imphal Airport which is deemed to be representative to the study area, has been collected for the period of 1981-2010 to establish the baseline climatic conditions of the area. The key parameters of collected meteorological data have been summarized in **Table-29** below:

Table-29 Summaries of Climatological Data (Based on IMD Records of 1981-2010)

Parameter	IST	Monthly Range	Annual Mean / Total
Mean Monthly Highest Temperature (°C)		25.4 (Dec) – 33.2 (May)	33.9
Mean Monthly lowest Temperature (°C)		0.9 (Jan) – 20.1 (Jul)	1.1
Relative Humidity (%)	0830	66 (Mar) – 83 (Jul)	78
	1730	53 (Mar) – 80 (Sep)	70
Total Rainfall (mm)		11.5 (Jan) – 231.4 (Jul)	1436.7
Wind Speed (km/h)		2.3 (Dec) – 5.1 (Mar)	3.6
Cloud Cover (all cloud oktas)	0830	2.8 (Jan) – 6.9 (Jul)	5.0
	1730	2.4 (Dec) – 6.5 (Jul)	4.5

Source: Climatological Data of Imphal Airport, Indian Meteorological Department

90. ***Temperature:*** Past climatic data show that April, May & June are usually the hottest month with the mean daily maximum temperature above 29.°C. With the onset of the monsoon in end of June, there is gradual drop in day temperature but that of night temperature is remains same. January is recorded to be the coldest month with the mean daily minimum temperature of 4.6°C. The monthly ambient temperature profile in the study area between 1981 to 2010 is presented in **Table-30**.

Table-30 Monthly Ambient Temperature Profile in the Study Area (1981-2010)

Months	Daily Max (°C)	Daily Min (°C)	Highest in the month (°C)	Lowest in the Month (°C)
January	22.4	4.6	25.5	0.9
February	24.2	7.7	27.7	3.3
March	27.2	12.1	31.3	7.2
April	28.5	15.8	32.3	11.8
May	29.2	18.7	33.2	14.7
June	29.6	21.3	32.7	18.7
July	29.4	21.9	32.2	20.1
August	29.7	21.7	32.5	20
September	29.5	20.6	32.4	18.2
October	28.7	17.2	31.7	12.5
November	25.9	11.1	29.1	6.2
December	22.9	6.1	25.4	2.4
	27.3	**14.9**	**33.9**	**1.1**

Source: Climatological Data of Imphal Airport, Indian Meteorological Department

91. ***Rainfall & Relative Humidity:*** Normal annual rainfall is around 1436.7 mm. The southeast monsoon contributes around 55 percent of the annual rainfall. Maximum rainfall is observed in the month of July while minimum in the month of January. June, July & August are the wettest months with more than 12 rainy days. Mean annual humidity in the study area is 78% in the morning and 70% in the evening. The average monthly rainfall, relative humidity and wind speed data and bar projections denoting high / low values are provided in **Table-31.** The profile of rainfall, wind speed and relative humidity in the study area is presented in **Figure-13**.

Table-31 Monthly Rainfall, Wind Speed and Relative Humidity of Imphal

Months	Monthly Rainfall (mm)	No of Rainy Days	Mean Wind Speed (kmph)	Relative Humidity (%)	
				0830 Hours	1730 Hours
January	11.5	1.1	2.7	76	60
February	43.4	3.3	4.2	69	54
March	81.2	6.1	5.1	66	53
April	154.6	10.3	5.1	72	62
May	174.3	11.8	4.4	76	69
June	221.6	15.4	4.1	81	77
July	231.4	16.1	4	83	79
August	186.8	12.9	3.7	82	79
September	157.2	10.2	3.3	82	80
October	122.3	7.3	2.5	82	78
November	34.7	2.4	2.3	82	74
December	17.8	1.0	2.3	83	70
Total	**1436.7**	**97.9**	**3.6**	**78**	**70**

Source: Climatological Data of Imphal Airport, Indian Meteorological Department

92. ***Wind Speed:*** Annual average winds speed is the study area is 3.6 km/hr. Maximum wind speed is observed in the month of March and April (5.1 km/hr.)

93. ***Weather Extremes:*** High summer temperature over 35°C occurs occasionally in the month of June & July. Highest temperature has been recorded to be 36.1°C in April 1999. Moderately low temperatures had been recorded during winter months, the lowest being -2.7°C in January 1970. Thunder storms and dust storm occur in the month of March to May and fog occur in the winter months. On an average, the study area received 0.3 mm or more rainfall in 140.7 days in a year. **Table-32** shows the extreme weather data with bar projections denoting incremental frequency.

Figure-13 Monthly Rainfall, Rainy Days, Wind Speed and Relative Humidity of Mysore IMD

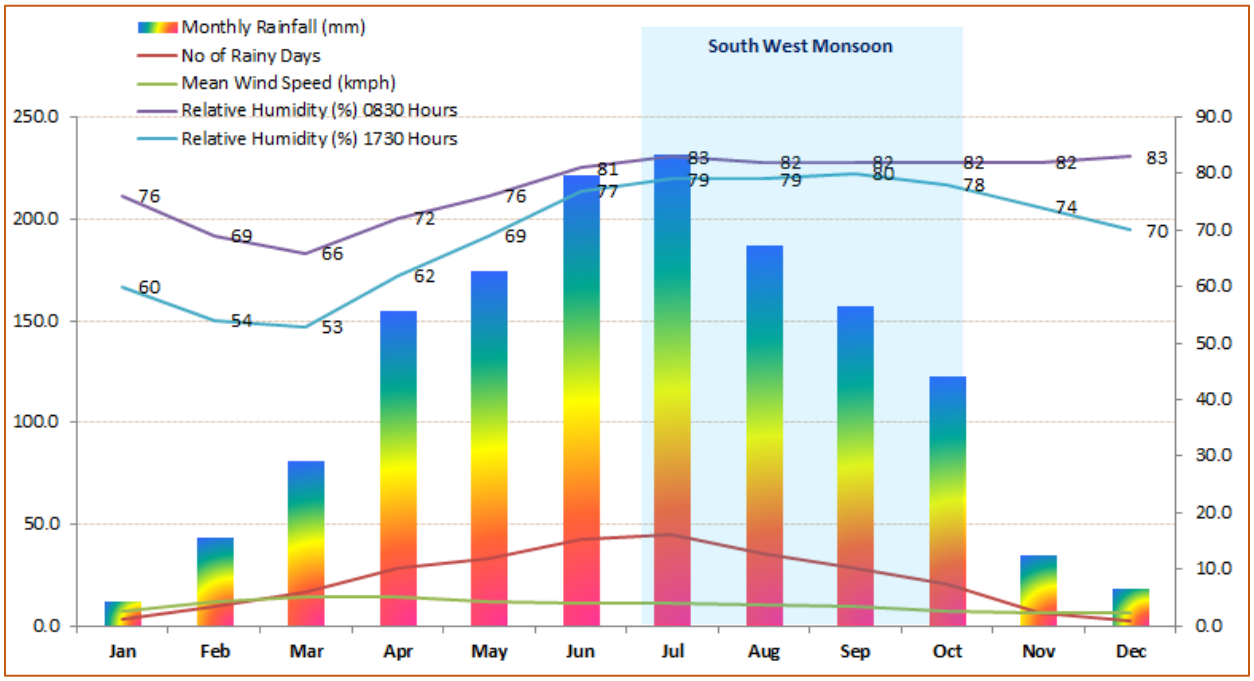


Table-32 Numbers of days with Extreme Weather Condition- Imphal IMD (1981 – 2010)

	Weather Phenomena					Visibility#				
Months	Rain more than 0.3 mm	Hail	Thunder	Fog	Dust Strom	Up to 1 km	1-4 km	4-10 km	10-20 km	Over 20 km
January	2.1	0.0	0.4	8.7	0.0	3.3-0.1	23.4-4.9	4.3-25.5	0-0.5	0-0
February	4.8	0.0	1.8	1.9	0.0	0.5-0	16.5-4.1	11-23	0-1	0-0
March	8.4	0.2	5.8	0.9	0.1	0.1-0	13.9-4.8	16.8-25.4	0.3-0.8	0-0
April	14.1	0.4	10.5	0.3	0.2	0-0	5.7-1.7	23.3-26.3	1-2	0-0
May	15.9	0.0	7.9	0.1	0.1	0-0	2.3-0.8	27.3-26.6	1.4-3.5	0-0
June	20.9	0.0	5.6	0.0	0.0	0-0.1	1.8-1	27.3-26.6	0.9-2.3	0-0
July	23	0.0	2.4	0.0	0.0	0-0	2.3-1.1	27.5-27.5	1.2-2.4	0-0
August	19.5	0.0	3.5	0.1	0.0	0-0	1.8-0.6	28.4-27.3	0.8-3.1	0-0
September	16.3	0.0	3.7	0.5	0.0	0-0.1	2.3-1.6	27.5-27	0.2-1.4	0-0
October	10.2	0.0	1.7	3.9	0.0	0.3-0	6.8-3	23.8-25.7	0.1-2.2	0-0
November	3.6	0.0	0.3	9.7	0.0	4.2-0.3	13.7-5.1	12-23.1	0.1-1.4	0-0
December	1.9	0.0	0.1	13.6	0.0	8.4-0.2	17.4-17.5	5.3-22.8	0-0.5	0-0
Annual Mea	**140.7**	**0.6**	**43.7**	**39.7**	**0.4**	**16.8-0.8**	**107.9-46.2**	**234.5-306.8**	**6-21.1**	**0-0**

Source: Climatological Data of Imphal, Indian Meteorological Department

Hyphenated values refers to the visibility at 0830 hours and 1730 hours

K. ON-SITE METEOROLOGICAL MONITORING

94. An automatic weather station was established at PWD Complex, Khuyathong, Imphal for collection of meteorological data from one month (April 2021). M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection of on-site meteorological data. The location details and meteorological monitoring parameters measured through the meteorological station are provided in **Table-33.**

Table-33 Location of Meteorological Station and Monitored Parameters

Parameters	Frequency	Location	Latitude & Longitude
Hourly Wind Speed, Wind Direction, Relative Humidity, Temperature, Rainfall and Atmospheric Pressure	Hourly data	Imphal	24°48'30.52"N 93°56'08.40"E

Source: Field Monitoring during April 2021

95. The weather station is equipped with sensors for temperature, relative humidity, wind speed, wind direction, atmospheric pressure, solar radiation and rain fall mounted on a tripod stand. The station consists of a weatherproof enclosure, which contains the data logger & power supply and having a solar panel. The data stored in a pocket-sized data shuttle from where the data downloaded in the computer. After downloading the data has been processed. The daily average of meteorological parameters like temperature, relative humidity, wind speed, wind direction and rain fall is summarized in **Table-34.** Wind Rose diagram of the study area are presented in **Figure-14.**

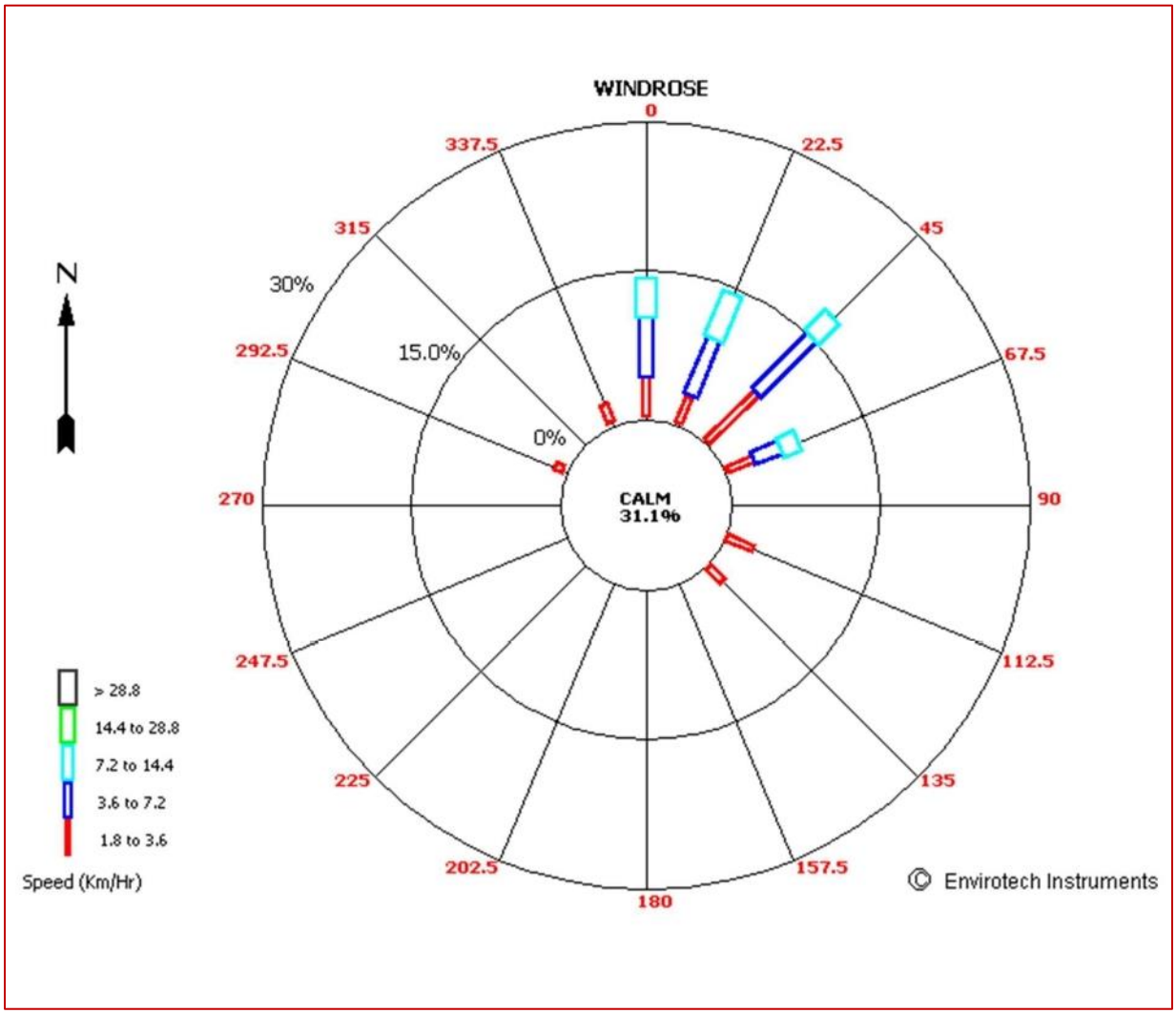
Meteorological Monitoring at Imphal

Table-34 Summary of Meteorological Data of the Study Area

Parameters	8th April - 9th June 2021
Maximum Temperature (°C)	35.3
Minimum Temperature (°C)	12.3
Maximum Relative Humidity (%)	98.8
Minimum Relative Humidity (%)	15
Total Rainfall (mm)	161.3
Average Wind Speed (m/sec)	2.739341693
Calm condition (%)	31.1
Predominant wind direction (blowing from)	NE

Source: Field Monitoring during 08.04.2021 to 09.05.2021

Figure-14 Wind Rose Diagram of the Study Area



L. AMBIENT AIR QUALITY

96. **Ambient Air Quality Monitoring Locations:** M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for ambient air quality monitoring. Six sampling stations were set up for monitoring ambient air quality within the study area. Monitoring locations were selected following the CPCB guidelines for ambient air quality monitoring so as to accord an overall idea of the ambient air quality scenario in the study area. Logistic considerations such as accessibility, security and availability of reliable power supply were also considered while finalizing the monitoring locations. Details of ambient air quality monitoring locations are given in **Table-35** and shown in **Figure-15**.

Table-35 Details of Ambient Air Quality Monitoring Locations

SN	Station Code	Location	Chainage	Side	Distance# (m)	Area category
1	AQ1	Canchipur, East Imphal	0+300	RHS	45	Residential
2	AQ2	Porompat, East Imphal	10+000	RHS	42	Residential & Other Area
3	AQ3	Heingang (near School building), East Imphal	21+450	LHS	35	Residential & Other Area
4	AQ4	Sankakeilbel, Lamphel West Imphal	35+550	LHS	55	Residential & Other Area
5	AQ5	Langol, West Imphal	41+400	LHS	192	Residential & Other Area
6	AQ6	Ghari, West Imphal	47+700	LHS	95	Residential

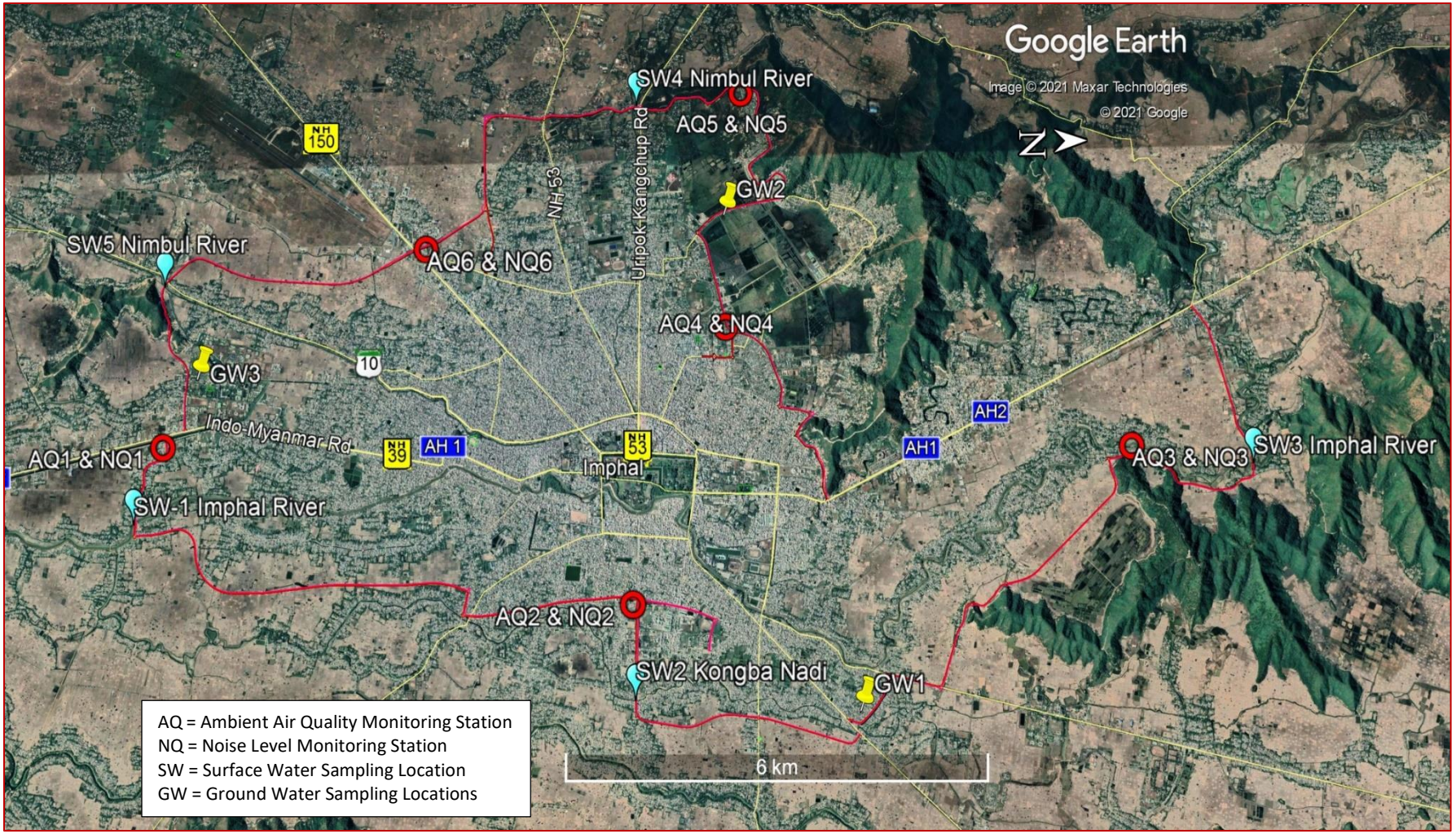
Source: On-site Field Monitoring during April 2021
Distance in meter from edge of the RoW

97. **Parameters Monitored:** Monitoring was conducted in respect of the following parameters:

- Particulate matter of size less than 2.5 micron or $PM_{2.5}$
- Particulate matter of size less than 10 micron or PM_{10}
- Sulphur Dioxide (SO_2)
- Nitrogen Dioxide (NO_2)
- Carbon monoxide (CO)

98. Ambient air quality monitoring was conducted in the month of April 2021 and twice at each station adopting a 24-hours schedule. CO has been measured 1-hourly. Ambient air quality monitoring results of the study area is presented in **Table-36**. National Ambient air quality standards and World Bank Guideline Values for Ambient Air Quality are reproduced in **Annex-4.3**.

Figure-15 Map showing Baseline Monitoring / Sampling Locations



Photographs of Ambient Air Quality Monitoring at Site

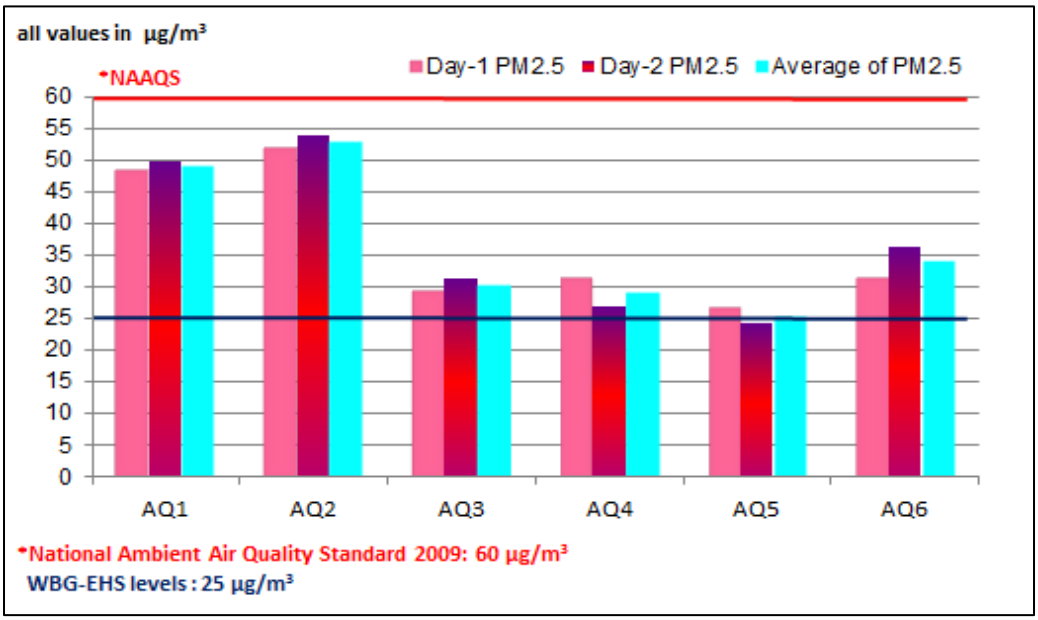
Table-36 Ambient Air Quality Monitoring Results

Station Code	Date of Sampling	Parameters				
		$PM_{2.5}$ ($\mu g/m^3$)	**PM_{10}** ($\mu g/m^3$)	**NO_2** ($\mu g/m^3$)	**SO_2 ($\mu g/m^3$)**	**CO** (mg/m^3)
AQ1	08-04-2021	48.6	83.8	21.8	14.9	1.29
	11-04-2021	49.7	96.5	20.8	15.4	1.20
AQ2	08-04-2021	52.1	96.8	32.5	18.2	1.38
	11-04-2021	53.8	88.7	30.5	20.4	1.22
AQ3	08-04-2021	29.42	68.5	18.0	9.5	1.44
	11-04-2021	31.2	71.6	17.2	10.4	1.24
AQ4	13-04-2021	31.52	71.6	20	12	1.42
	16-04-2021	26.8	73.8	18.9	13.5	1.32
AQ5	13-04-2021	26.81	65.4	16	10	1.17
	16-04-2021	24.21	59.8	15.4	11.6	1.19
AQ6	13-04-2021	31.68	67.8	26.8	12.9	1.21
	16-04-2021	36.4	77.8	29.8	16.5	1.24
National Ambient Air Quality Standards, 2009#		60	100	80	80	04
World Bank EHS Guideline (Averaging Period 24 hr)		25	50	-	20	-

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.
#24-hourly or 8-hourly or 01 hourly monitored values as applicable
Note: Whenever monitoring results of two consecutive days of monitoring exceed the limits specified in NAAQS, 2009 for the respective category, it shall be considered adequate reason to further investigation.

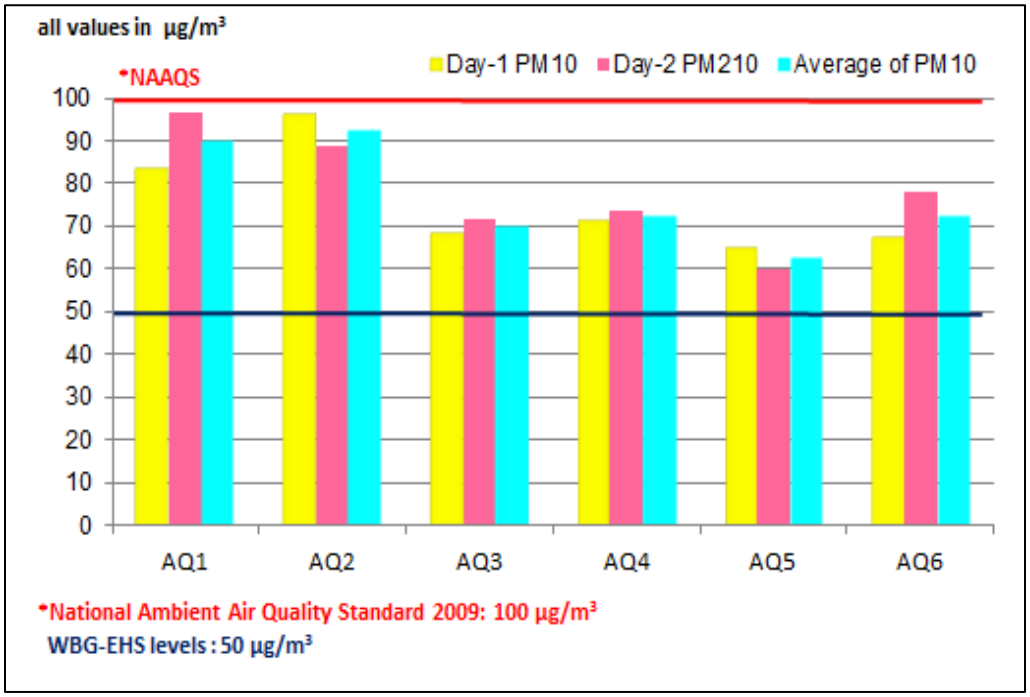
99. **Particulate Matter of Size less than 2.5 micron or $PM_{2.5}$:** There is variation in $PM_{2.5}$ levels across the monitoring locations. The lowest concentration (24.21 μg/m^3) was found at Langol (AQ5) while highest concentration (53.8 μg/m^3) was found at Porompat (AQ2). However, values of $PM_{2.5}$ across all stations was found to be within the stipulated limit of 60 μg/m^3 for Industrial, Residential, Rural & other areas as per National Ambient Air Quality Standards (NAAQS), 2009. However, value of $PM_{2.5}$ across all stations exceeds the WBG-EHS level. Variation in $PM_{2.5}$ levels across the monitoring locations is graphically presented in **Figure-16**.

Figure-16 Variation in $PM_{2.5}$ Levels across the Monitoring Locations



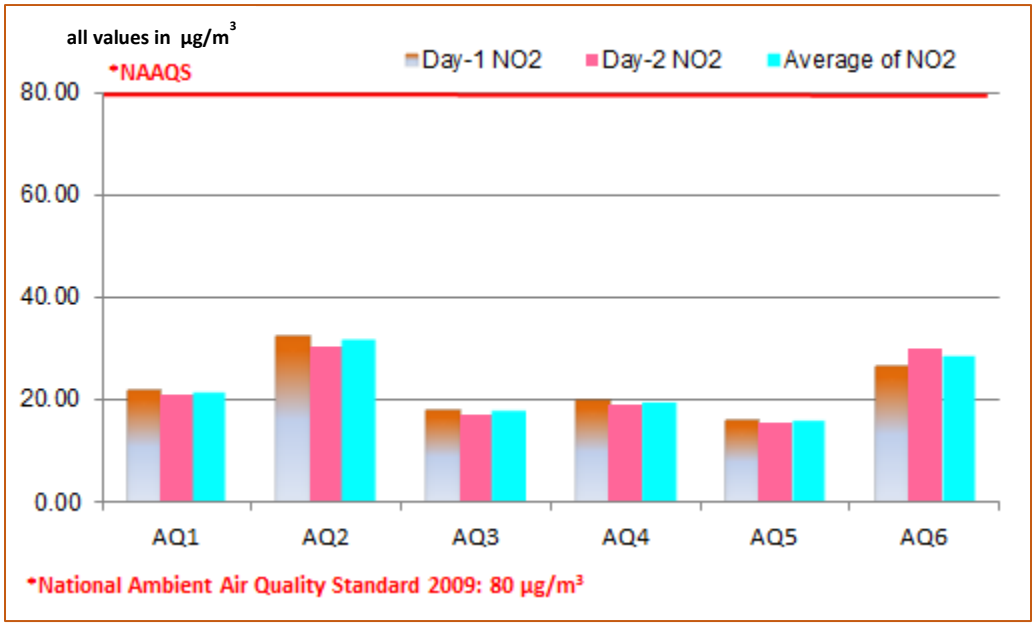
100. ***Particulate Matter of Size less than 10 micron or PM_{10}:*** There is variation in PM_{10} levels across the monitoring locations. The lowest concentration (59.8 μg/m^3) was found at Langol (AQ5) while highest concentration (96.8 μg/m^3) was found at Porompat (AQ2). However, values of PM_{10} across all stations was found to be within the stipulated limit of 100 μg/m^3 for Industrial, Residential, Rural & other areas as per NAAQS, 2009. However, value of PM_{10} across all stations exceeds the WBG-EHS level. Variation in PM_{10} levels across the monitoring locations is graphically presented in **Figure-17**.

Figure-17 Variation in PM_{10} Levels across the Monitoring Locations



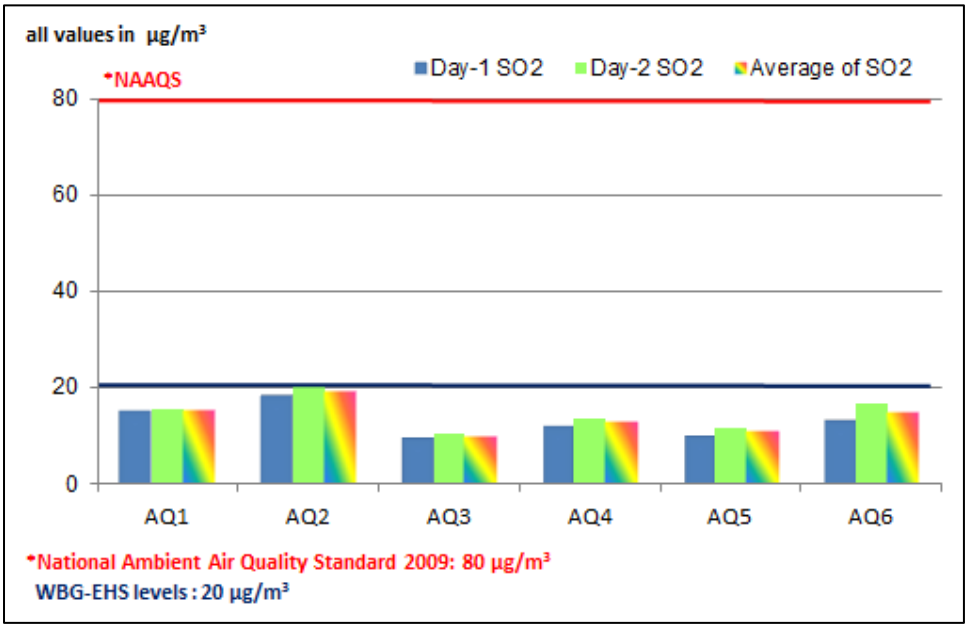
101. ***Nitrogen Dioxide (NO_2):*** There is variation in NO_2 levels across the monitoring locations. The lowest concentration (15.4 µg/m^3) was found at Langol (AQ5) while highest concentration (32.5 µg/m^3) was found at Porompat (AQ2). However, values of NO_2 across all stations was found to be within the stipulated limit of 80 µg/m^3 for Industrial, Residential, Rural & other areas as per NAAQS, 2009 and within the WBG-EHS limit of 40 µg/m^3. Variation in NO_2 levels across the monitoring locations is graphically presented in **Figure-18**.

Figure-18 Variation in NO_2 Levels across the Monitoring Locations



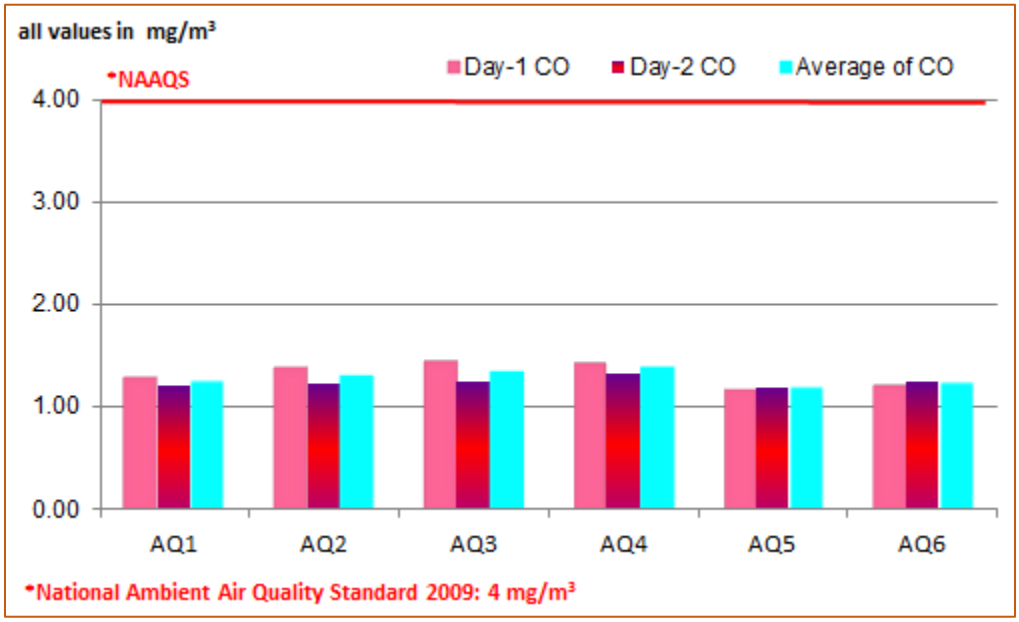
102. ***Sulphur Dioxide (SO_2):*** There is variation in SO_2 levels across the monitoring locations. The lowest concentration (9.5 µg/m^3) was found at Heinging (AQ3) while highest concentration (20.4 µg/m^3) was found at Porompat (AQ2). However, values of SO_2 across all stations was found to be within the stipulated limit of 80 µg/m^3 for Industrial, Residential, Rural & other areas as per NAAQS, 2009 and within the EHS-WBG limit of 20 µg/m^3 Variation in SO_2 levels across the monitoring locations is graphically presented in **Figure-19**.

Figure-19 Variation in SO_2 Levels across the Monitoring Locations



103. ***Carbon monoxide (CO):*** The lowest concentration (1.17 mg/m^3) was found at Langol (AQ5) while highest concentration (1.44 mg/m^3) was observed at Heinging (AQ3). However, values of CO across all stations was found to be within the stipulated limit of 4 mg/m^3 for Industrial, Residential, Rural & other areas as per NAAQS, 2009. Variation in CO levels across the monitoring locations is graphically presented in **Figure-20**.

Figure-20 Variation in CO Levels across the Monitoring Locations



104. As evident from **Table-36** and the discussion above, the ambient air quality at the monitored locations does not exceed National Standards. No industrial sources of air emission are observed along the alignment of the proposed ring road. Out of six monitoring locations, values of all the parameters are observed towards higher side in AQ1, AQ2 & AQ6 in comparison to AQ3, AQ4 & AQ5. The reason of such value is that these monitoring locations were located in the urban area. Due to traffic movement and other activities in the surrounding area, the values remain high.

105. **Indian Air Quality Index (IND - AQI):** An AQI scheme transforms weighted values of individual air pollutant concentrations into a single number or set of numbers. AQI is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. There are six AQI categories, namely Good, Satisfactory, Moderately Polluted, Poor, Very Poor, and Severe. The AQI considered various pollutants for which short-term (up to 24-hourly

Breakpoints for AQI Scale 0-500					
AQI Category (Range)	PM10 24-hr (µg/m^3)	PM2.5 24-hr (µg/m^3)	NO_2 24-hr (µg/m^3)	SO_2 24-hr (µg/m^3)	CO 8-hr (mg/m^3)
Good	0-50	0-30	0-40	0-40	0-1.0
Satisfactory	51-100	31-60	41-80	41-80	1.1-2.0
Moderately polluted	101-250	61-90	81-180	81-380	2.1-10
Poor	251-350	91-120	181-280	381-800	10-17
Very poor	351-430	121-250	281-400	801-1600	17-34
Severe	430+	250+	400+	1600+	34+

Source: National Air Quality Index, 2015 by CPCB, MoEF&CC

averaging period) National Ambient Air Quality Standards are prescribed. Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI.

106. **AQI of the Study Area:** Air quality data of the study area generated through manual monitoring network has been utilized to calculate the monitoring date wise AQI of the study area and presented in **Table-37**.

Table-37 Air Quality Index (AQI) of the Study Area

Date of Sampling	AQI					
	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6
08-04-2021	84	97	72			
11-04-2021	97	90	72			
13-04-2021				72	65	68
16-04-2021				74	60	79

107. From the above interpretation of AQI, it can be concluded that **100% time** of the monitoring period air quality of the area was **satisfactory.**

M. AMBIENT NOISE LEVEL

108. To assess the background noise levels in the study area ambient noise monitoring was conducted at six locations. M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for ambient noise monitoring. The locations of the ambient noise level monitoring stations in the study area are given in **Table-38** and shown in **Figure-15**. The stations were selected judiciously based on the following considerations:

- Obstruction free exposure of equipment
- Away from temporary noise generating sources to monitor true background levels
- Accessibility of the location during day and night
- Security and safety of the instrument

Table-38 Details of Noise Monitoring Stations

SN	Station Code	Location	Chainage	Side	Distance# (m)	Category of Area	Date of Monitoring
1	NQ1	Canchipur, East Imphal	0+300	RHS	50	Residential	08-04-2021
2	NQ2	Porompat, East Imphal	10+000	RHS	70	Residential	09-04-2021
3	NQ3	Heingang (near School building), East Imphal	21+450	LHS	50	Silence	11-04-2021
4	NQ4	Sankakeilbel, Lamphel West Imphal	35+550	LHS	70	Residential	13-04-2021
5	NQ5	Langol, West Imphal	41+400	LHS	65	Residential	14-04-2021
6	NQ6	Ghari, West Imphal	47+700	LHS	50	Residential	15-04-2021

Source: On-site Field Monitoring during April 2021

Distance in meter from edge of the RoW

Photographs of Noise Monitoring at Site

109. **Methodology of Noise Monitoring:** Ambient noise level or sound pressure levels (SPL) are measured by a continuous sound level meter having built in facilities to read noise level directly in dB(A). Since loudness of sound is important for its effects on people, the dependence of loudness upon frequency is taken into account by the A-weighting filters in-built in the noise meter which gives a direct reading of approximate loudness. A-weighted equivalent continuous sound pressure level (Leq) values were computed from the values of A-weighted SPL measured with the noise meter. Noise measurement was conducted as per IS:4954 as adopted by CPCB. Ambient noise level monitoring was carried out during **April 2021**.

110. Ambient Noise Levels in the Study Area: The ambient noise levels of the study area are presented in **Table-39**. Ambient air quality standards in respect of noise are reproduced in **Annex-4.3**.

Table-39 Ambient Noise Levels of the Study Area [dB(A)]

Station Code	Category of Area	$L_{eq(day)}$	$L_{eq(night)}$	L_{10}	L_{50}	L_{90}	L_{max}	L_{min}
NQ1	Residential	50.5	38.8	53.3	45.2	37.3	55.5	35.7
NQ2	Residential	55.3	40.1	**57.0**	50.8	37.4	**62.4**	36.4
NQ3	Silence	47.8	38.1	**51.1**	41.2	36.8	53.8	35.8
NQ4	Residential	47.1	38.4	49.0	44.1	36.3	50.1	35.8
NQ5	Residential	49.6	41.1	51.6	47.3	39.6	52.4	39.0
NQ6	Residential	50.2	38.8	52.4	46.1	37.7	53.2	37.5

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.
Note: Noise Standard in Residential Zone : Day Time: 55 dB(A) Night Time: 45 dB(A)
Noise Standard in Silence Zone : Day Time: 50 dB(A) Night Time: 40 dB(A)

111. The daytime and night time noise equivalent levels in the residential & silence areas show that the ambient noise levels not exceeds the stipulated of Noise standards except at NQ2 during day time. Highest noise level observed in residential area is 62.4 dB(A).

112. L_{10} values (highest among the monitored values) are found to be 57.0 dB(A) and 51.1 dB(A) for residential and silence zone respectively, which signifies that measured noise levels exceeded these values in only 10% of the time of measurement duration. The noise levels were recorded away from the existing road to avoid influence of traffic induced noise. Therefore, it can be inferred that the slightly high noise levels at NQ2 originates from local activities including domestic.

N. SURFACE WATER BODIES

113. The proposed alignment crosses rivers and local streams at several locations. Chainage wise details are presented in **Table-40**.

Table-40 Details of River and Stream Crossing

Sl. No.	Description	Chainage	Latitude	Longitude
1	Imphal River	1+424	24° 44' 28.129"N	93° 56' 48.489"E
2	Kongba Nadi	11+200	24° 48' 25.679"N	93° 58' 16.998"E
3	Local Stream	17+515	24°50'57.43"N	93°57'46.29"E
4	Imphal River	23+600	24° 53' 21.070"	93° 56' 28.751"
5	Nimbul River	43+000	24° 48' 26.076"	93° 53' 20.171"
6	Local Stream	48+559	24°46'17.13"N	93°54'45.73"E
7	Nimbul River	51+940	24° 44' 34.994"	93° 54' 50.240"

Source: Field survey carried out by ICT Pvt. Ltd.

114. There are **43** surface water bodies on either side of the proposed alignment. 23 surface water bodies are located on the right side of the alignment, 19 are located on the left side of the alignment and 1 is located at the centerline of the roposed alignment. Chainage wise details of pond located along ring road alignment & Spur alignment are presented in **Table-41**.

Table-41 Details of Surface Water Bodies along the Proposed Alignment

Sl. No.	Name	Design Chainage	Side	Distance# (m)	Latitude	Longitude
Along the Proposed Ring Road alignment						
1.	Pond	0+600	LHS	1.49	24° 44' 32.077"	93° 56' 20.943"
2.	Pond	0+642	LHS	2.39	24° 44' 31.262"	93° 56' 21.862"
3.	Pond	0+657	LHS	5.48	24° 44' 30.915"	93° 56' 22.315"
4.	Pond	0+694	LHS	2.61	24° 44' 30.736"	93° 56' 23.662"
5.	Pond	0+778	LHS	1.57	24° 44' 30.641"	93° 56' 26.537"
6.	Pond	0+855	LHS	6.13	24° 44' 31.065"	93° 56' 29.284"
7.	Pond	0+900	LHS	27.84	24° 44' 31.561"	93° 56' 31.129"
8.	Pond	0+970	LHS	44.25	24° 44' 30.983"	93° 56' 33.828"
9.	Pond	1+100	LHS	14.06	24° 44' 29.067"	93° 56' 37.802"
10.	Pond	4+400	LHS	197.28	24° 45' 42.333"	93° 57' 14.885"
11.	Pond	7+390	RHS	17.87	24° 47' 6.447"	93° 57' 36.381"
12.	Pond	7+744	RHS	24.25	24° 47' 18.199"	93° 57' 36.519"
13.	Pond	8+175	LHS	22.47	24° 47' 32.241"	93° 57' 33.000"
14.	Pond	8+314	LHS	20.88	24° 47' 36.449"	93° 57' 32.460"
15.	Pond	9+764	RHS	23.96	24° 48' 23.205"	93° 57' 29.741"

Sl. No.	Name	Design Chainage	Side	Distance# (m)	Latitude	Longitude
16.	Pond	9+879	RHS	33.32	24° 48' 28.510"	93° 57' 30.996"
17.	Pond	11+420	RHS	42.73	24° 48' 26.272"	93° 58' 26.040"
18.	Pond	15+000	RHS	17.71	24° 50' 5.360"	93° 58' 28.432"
19.	Ipum Pat	15+215	RHS	15.31	24° 50' 11.675"	93° 58' 28.427"
20.	Pond	15+950	LHS	17.04	24° 50' 24.765"	93° 58' 6.573"
21.	Pond	18+549	LHS	94.37	24° 51' 20.221"	93° 57' 21.939"
22.	Pond	22+364	LHS	41.87	24° 52' 45.359"	93° 56' 36.154"
23.	Pond	23+194	LHS	25.63	24° 53' 13.189"	93° 56' 37.440"
24.	Pond	23+339	RHS	15.16	24° 53' 14.649"	93° 56' 4.318"
25.	Pond	23+379	RHS	15.19	24° 53' 14.433"	93° 56' 2.862"
26.	Pond	23+424	RHS	13.55	24° 53' 14.087"	93° 56' 1.262"
27.	Pond	23+464	RHS	15.85	24° 53' 13.860"	93° 55' 59.689"
28.	Pond	24+520	RHS	13.71	24° 53' 13.410"	93° 55' 57.854"
29.	Pond	41+920	LHS	19.74	24° 48' 57.039"	93° 53' 16.289"
30.	Pond	44+700	RHS	64.94	24° 47' 31.658"	93° 53' 22.618"
31.	Pond	46+060	RHS	30.15	24° 47' 10.107"	93° 53' 52.214"
32.	Pond	47+654	RHS	38.72	24° 46' 43.432"	93° 54' 30.412"
33.	Pond	48+500	RHS	183.04	24° 46' 17.319"	93° 54' 38.117"
34.	Pond	51+884	Centre	0.69	24° 44' 36.093"	93° 54' 48.726"
35.	Pond	53+570	RHS	17.4	24° 44' 47.971"	93° 55' 42.935"
Spur alignment for JNMIS in Prompat						
36.	Pond	0+160	RHS	15.83	24° 48' 32.175"	93° 57' 31.068"
37.	Pond	0+225	LHS	31.13	24° 47' 14.212"	93° 54' 16.853"
38.	Pond	0+294	RHS	17.82	24° 48' 36.373"	93° 57' 31.894"
39.	Pond	0+384	RHS	22.49	24° 48' 39.304"	93° 57' 32.591"
40.	Pond	0+750	RHS	43.8	24° 48' 50.730"	93° 57' 36.252"
41.	Pond	1+070	RHS	20.4	24° 49' 0.431"	93° 57' 39.225"
42.	Pond	1+530	RHS	27.36	24° 48' 59.057"	93° 57' 53.028"
Spur alignment for FCI Godown						
43.	Pond	0+215	LHS	9.5	24°47'14.06"N	93°54'16.75"E

Distance in meter from propose centerline
Source: Field survey carried out by ICT Pvt. Ltd.

O. SURFACE WATER QUALITY

115. Surface water bodies are important in local context and therefore, their water quality needs to be monitored to assess the impacts of the project. M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection of surface water samples and analysis. For generating data on surface water quality parameters and drawing up the baseline scenario, **5** surface water quality monitoring stations were selected for sampling. Details of the location of Surface Water Quality Stations are provided in **Table-42** and shown in **Figure-15.** Water samples (grab samples) were collected once in the month of August 2021 from both locations and analyzed for physical, chemical and bacteriological parameters as per established standard methods and procedures.

Table-42 Details of Surface Water Quality Monitoring Stations

Station Code	Description	Chainage	Side	Distance# (m)	Date of Sampling	Usage
SW1	Imphal River	1+424	RHS	12	13-08-2021	Irrigation, livestock watering, domestic etc.
SW2	Kongba Nadi	11+200	RHS	20	13-08-2021	
SW3	Imphal River	23+600	RHS	70	13-08-2021	
SW4	Nimbul River	43+000	LHS	50	13-08-2021	
SW5	Nimbul River	51+940	LHS	100	13-08-2021	

Distance in meter from propose bridge centerline
Source: On-site Water Quality Monitoring in August 2021

Photographs of Surface Water Sampling at Site

116. The salient water quality parameters are analyzed and presented in **Table-43** depicting minimum & maximum value, arithmetic mean and compared with CPCB Designated best use water quality criteria. Details of water quality monitoring results of the surface water bodies are presented in **Table-45.** All relevant standards are provided in **Annex-4.3**.

Table-43 Salient Surface Water Quality Features

SN	Parameter	Range		Arithmetic Mean	Limit #
		Minimum	Maximum		
1	pH	6.9	7.6	7.28	6.5 -8.5
2	DO (mg/l)	4.6	5.2	4.9	4mg/l to >6 mg/l
3	BOD (3 days at 27°C) (mg/l)	5.5	7.2	6.26	<2 mg/l to <3 mg/l
4	Total coliform organisms (MPN*/100 ml	6	35	19	<50 mg/l to 5000
5	Electrical conductivity less than 2250 micro mhos/cm,	82	523	302.5	Max 2250 µmhos/cm at 25 ^{0} C
6	Boron	0.047	0.12	0.052	<2 mg/l

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.
CPCB Designated best use water quality criteria

Table-44 Surface Water Quality Analysis Results

S. N.	Parameters	Unit	SW1	SW2	SW3	SW4	SW5
1.	pH	-	7.4	7.2	6.9	7.6	7.3
2.	Temperature	^{O}C	23.5	23.7	24.2	23.4	23.2
3.	Electrical conductivity	µmhos/cm	82	523	269	203	220
4.	Turbidity	NTU	15	77	38	32	39
5.	Total Hardness as $CaCO_3$	mg/l	34.6	126	79.2	52	84.3
6.	Total Dissolved Solids	mg/l	42	260	137	126	132
7.	Total Suspended Solids	mg/l	6.5	15.9	13.8	11	14
8.	Dissolved Oxygen	mg/l	4.9	5.2	5.2	4.8	4.6
9.	Biochemical Oxygen Demand (5 days at 20^o C)	mg/l	5.5	6.4	7.2	6.4	6.2
10.	Chemical oxygen Demand	mg/l	50.4	40.7	34.6	30.2	30.8
11.	Sodium as Na	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
12.	Potassium as K	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
13.	Magnesium as Mg	mg/l	6.2	13.4	12.7	11.2	5.4
14.	Calcium as Ca	mg/l	32.4	27.9	34.9	38.4	37.4
15.	Chloride as Cl	mg/l	21.2	22.4	24.1	22.3	21.7
16.	Sulphate as SO_4	mg/l	10.9	5.1	5.4	7.8	8.2
17.	Nitrate as NO_3	mg/l	4.9	4.3	4.4	4.2	4.7
18.	Carbonate	mg/l	14.2	13.7	13.7	12.0	13.2
19.	Iron as Fe	mg/l	0.30	0.17	0.1	0.3	0.54
20.	Manganese as Mn	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05

S. N.	Parameters	Unit	SW1	SW2	SW3	SW4	SW5
21.	Arsenic	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
22.	Total Chromium as Cr	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
23.	Copper as Cu	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
24.	Mercury as Hg	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
25.	Lead as Pb	mg/l	Not detected	0.002	0.003	0.001	0.003
26.	Zinc as Zn	mg/l	0.320	0.19	0.21	0.23	0.18
27.	Boron as B	mg/l	0.120	0.047	0.052	0.058	0.052
28.	Fluoride as F	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
29.	Phosphate as PO_4	mg/l	0.5	0.4	0.6	0.4	0.7
30.	Cadmium as Cd	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
31.	Chlorine	mg/l	Not detected	Not detected	Not detected	Not detected	Not detected
32.	Total Coliforms	MPN/100ml	12	35	6	17	22
33.	Feacal Coliform	MPN/100ml	Absent	Absent	Absent	Absent	Absent

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.

117. pH values of the surface water are varies between 6.9 – 7.6 which is within the tolerance limit of 8.5. The slight alkalinity of the water may be associated with alkaline soil of the region. Dissolved Oxygen (DO) levels are found to be in the range of 3.5 to 4.8 mg/l. BOD ranges from 5.5 to 7.2 mg/l while COD ranges are found to be 30.2 to 50.4 mg/l. The values of BOD indicate that greater amount of oxidizable organic material in the water resulting increase of oxygen demand and thereby, lowering of dissolved oxygen levels. The BOD level in river water can be attributed to use of fertilizers in the agricultural fields of river catchment as well as domestic activities in the surrounding area. On the basis of the analysis results, it can be concluded that the surface water is not potable but can be used for propagation of wild life, fisheries and irrigation.

P. GROUND WATER

118. Ground water has been found to be an important source for catering to the local needs of water consumption in the rural and urban areas. Therefore, any kind of deterioration in the quality of ground water owing to the developmental activities will pose threat to the local population and attention needs to be paid towards maintaining the quality of water using all possible tools. Since the ground water is used without treatment by a large portion of population for drinking purpose and domestic use, the quality of ground water is of more concern.

119. **Depth of Ground Water[3]:** Depth to water level in the East Imphal district ranges from 1.08 to 10.32 mbgl for pre-monsoon (2004) and it varies from 0.01 magl to 6.2 mbgl during post-monsoon (2004). Annual water level fluctuation in November 2004 with respect to April 2004 ranges from 1.83 to 7.35.

[3] Ground Water Information – East Imphal District, CGWB, Ministry of Water Resources, GoI, September 2013

120. As per “Block wise Ground Water Resource Assessment-2020”, the assessment units (talukas) are divided into different categories adopting criteria such as stage of ground water development, significant long term water level decline trend during pre-monsoon and post-monsoon etc. As per the CGWA classification, **all the Talukas, through which the proposed Imphal Ring Road is passing, fall under “safe” category.**

121. **Ground Water Sampling Locations:** M/s Devansh Testing & Research Laboratory Pvt. Ltd. (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection of ground water samples and analysis. **Three (3)** ground water sampling locations comprising bore well and hand operated tube wells (hand-pumps) were identified for the monitoring and assessment of ground water quality along the proposed alignment. The details of ground water quality monitoring stations are provided in **Table-45** and shown in **Figure-15**. Ground water samples were collected once in the month of August 2021 from all locations and analyzed for physical, chemical and bacteriological parameters as per established standard methods and procedures

Table-45 Details of Ground Water Sampling Locations

S. N.	Station Code	Location	Chainage	Source	Usage	Date of Sampling
1	GW1	Ngangkham, East Imphal	Ch. 15+200	Bore well	Drinking & Domestic	14-08-2021
2	GW2	Lamlongei, West Imphal	Ch. 37+700	Bore well		
3	GW3	Sorokhaibam Leikai, West Imphal	Ch. 53+600	Hand Pump		

Source: On-site Field Monitoring during August 2021

Photographs of Ground Water Sampling at Site

122. ***Analysis Results:*** The ground water quality analysis results are provided in **Table-46.** There has been little fluctuation in pH level (6.49 – 7.47) of the analyzed samples and the overall range of pH of ground water indicates that it is weakly acidic to weakly alkaline in nature. However, pH value of all the samples are found to be within the acceptable limits of 6.5-8.5 stipulated in drinking water quality standards (IS 10500:2012). Turbidity is found to exceed the acceptable limit in all the samples. Total hardness, total alkalinity and total dissolved solids (TDS) values for all the samples are observed to be within the acceptable limits as per the Indian Standards. The amount of dissolved ions in the ground water is represented by the parameter electrical conductivity, which varies between 362–447 µmhos/cm. Chloride varied between 41 to 54 mg/l,

Sulfate content varied between 30 to 112 mg/l, Calcium content varied between 28 to 74.3 mg/l and magnesium varied between 6.27 to 9.7 mg/l for the samples. Iron levels are found to be within the acceptable limit. Heavy metals (Cr, Cu, Hg, Pb, Zn, B) are also found to be within the acceptable limit. The concentration of iron ranges from 1.82 to 2.08 mg/l in the area. Iron concentration in the ground sample of all locations is found to be greater than the acceptable limits. From the above discussion, it can be concluded that the physico-chemical qualities of the ground water satisfy the acceptable limit as stipulated in Drinking Water Standards of India (IS 10500 : 2012) and suitable for human consumption. All relevant standards are provided in **Annex-4.3**.

Table-46 Ground Water Quality Analysis Results

Sl. No.	Parameter	Units	GW-1	GW-2	GW-3	Indian Standard[1]	
						Acceptable Limit	Permissible Limit
1.	pH	-	6.49	7.47	6.88	6.5 to 8.5	No relaxation
2.	Temperature ^{O}C	^{O}C	26.8	27.2	27.7	-	-
3.	Electrical Conductivity	µmhos/cm	362	447	381	-	-
4.	Turbidity	NTU	1.6	2.3	1.1	1	5
5.	Total Hardness as $CaCO_3$	mg/l	105	130	172	200	600
6.	Total Alkalinity as $CaCO_3$	mg/l	100	120	180	200	600
7.	Total Dissolved Solids	mg/l	250	295	260	500	2000
8.	Total Suspended Solids	mg/l	4	2	2	-	-
9.	Sodium as Na	mg/l	8.2	10.9	7.24	-	-
10.	Potassium as K	mg/l	4.63	4.56	4.07	-	-
11.	Calcium as Ca	mg/l	28	74.3	64.2	75	200
12.	Magnesium as Mg	mg/l	6.2	7.9	9.7	30	100
13.	Chlorides as Cl^-	mg/l	54	49	41	250	1000
14.	Sulphate as SO_4^{2-}	mg/l	30	79	112	200	400
15.	Nitrates as NO_3-N	mg/l	3.27	3.48	3.67	45	No relaxation
16.	HCO_3^-	mg/l	84	61	29	-	-
17.	Iron as Fe	mg/l	1.82	1.96	2.08	0.3	No relaxation
18.	Manganese as Mn	mg/l	<0.03	<0.03	<0.03	0.1	0.3
19.	Copper as Cu	mg/l	<0.03	<0.03	<0.03	0.05	1.5
20.	Fluoride as F	mg/l	<0.2	<0.2	<0.2	1	1.5
21.	Boron as B	mg/l	<0.1	<0.1	<0.1	0.5	1
22.	Zinc as Zn	mg/l	<0.02	<0.02	<0.02	5	15
23.	Arsenic as As	mg/l	<0.003	<0.003	<0.003	0.01	0.05
24.	Cadmium as Cd	mg/l	<0.001	<0.001	<0.001	0.003	No relaxation
25.	Lead as Pb	mg/l	<0.01	<0.01	<0.01	0.01	No relaxation
26.	Chromium as Cr	mg/l	<0.02	<0.02	<0.02	0.05	No relaxation
27.	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	0.001	No relaxation

Sl. No.	Parameter	Units	GW-1	GW-2	GW-3	Indian Standard[1]	
						Acceptable Limit	Permissible Limit
28.	Total Coliform	MPN/ 100ml	Absent	Absent	Absent	Absent	Absent
29.	Faecal Coliform	MPN/ 100ml	Absent	Absent	Absent	Absent	Absent

Source: Analysis Results submitted by M/s Devansh Testing & Research Laboratory Pvt. Ltd.

Q. FOREST AND FLORA

123. Forest of the study area i.e. 10 km radius from the Imphal Ring Road, falls under Central Forest Division, Thoubal Forest Division and Bishnupur Forest Division. These three forest divisions are called Valley Forest Divisions. The forests of the Valley Forest Divisions have been classified into various types according to "A Revised Survey of the Forest Type of India" by H.G. Champion and S.K. Seth (1968). On the basis of this following forest types are found in the division:

Table-47 Forest Types of Valley Divisions

Tropical Moist Deciduous Forests		
Class	**Forest Type**	**Area**
3C/C3b	Moist Mixed Deciduous Forest	Lower Slopes of the Forests around valley
Sub- Tropical Wet Hills Forests		
Class	**Forest Type**	**Area**
8b/C1	Alnus, Schima, Terminalia	Higher reaches of the Forests around valley
Sub- Tropical Grasslands		
Class	**Forest Type**	**Area**
8C2/DS I	Imperata- Cymbopogon grassland	Pockets of Grasslands in the upper parts of the hills
Seasonal Swamp Forests		
Class	**Forest Type**	**Area**
4C/FS2	Biscoffia, Ipomea, Salix Type	Small pockets around Loktak

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

124. ***Tropical Moist Mixed Deciduous Forests (3C/C3b):*** According to the Botanical Survey of India (2000), the forest area of Imphal (Imphal East District, Imphal West District) is under moist mixed deciduous forests. This corresponds with Champion's 3C/3Cb East Himalayan Moist Mixed Deciduous Forests. Even though, the altitude given by Champion is slightly less, (650m). The rainfall in the valley varies from 95 cm to 120 cm spread over the year with a few months with a very dry spell of less than 5 cm rainfall in 2-3 months' time. These forests are characterized by occasional leaf shedding and profuse flowering. Floristic composition of the study area is presented in **Table-48**.

Table-48 Floristic Composition of the Study Area

Moist Valley Localities	
Top Canopy	*Acacia decurrens.* Wild., *Albizia lucidor* (Steud) Nielson, *A. procera* (Roxb) Benth., *Artocarpus chama* Buch.- Ham., *Ailanthus integrifolia* Lam. Subsp., *Bischoffia javanica* Blume., *Bombax ceiba* L., *Sterculia villosa Roxb. ex Smith*, *Kydia calycina*, *Neolamarckia cadamba, Terminalia myriocarpa, T.Chebula.*
Middle Storey	Aphanamixis polystachya (wallich), R.N. Parker, Aglaia spectabilis (Miq) S.S.Jain & Bennet, Bauhinia purpurea L., B variegate, Callicarpa arborea, Canarium strictum Roxb., Dillenia pentagyna, Dysoxylum alliarium, Macaranga deniculata Parking roxburghii, Careya arborea, Chukrasia tabularis, Stereospermum personatum, Ficus ____Mallotus phillipinesis
Lower Storey	Clerodendrum serratum, C. kaempferii, Murraya paniculata, Desmodisum oblongum, Eupatorium sp., Lantana camara, Mimosa pudica, Phlogacanthus thyrsiflora, Lantana camara, Acorus calamus, Costus specious, Cycas pectinata
Climbers	Combretum decandrum, Entada scandens, Milletia velutina, Mikania mikrantha
Foot Hills and Lower Slopes	
Top Canopy	Castanopsis tribuloides (Smith).A.D.C., Lithocarpus elegans (Blume) L. fenestrate (Roxb) Rehder, Quercus serratta, Careya arborea Roxb, Lagerstroemia speciosa, Garuga pinnata, Terminalia belerica, Terminalia myrocarpa, Adina cordifolia
Middle Storey	*Cassia fistula, Emblica officinalis, Mallotus philipensis, Bauhinia purpurea.*
Shrubs	*Nyctanthes arbortristis, Eupatorium ayapana, Clerodendrum serratum*
Climers	*Combretum decandrum, Bauhinia vahlii, Entada, Mikania*
Grass	*Cymbopogon, Cyperus, Chrysopogon*

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

R. BIODIVERSITY STUDY

125. An ecosystem can be characterized in terms of its structure (the biota and the physical environment) and processes (transfer of energy and materials between organisms and the physical environment). Although primary productivity is arguably the most prominent ecological function of plants, the specific structure of plant communities can play crucial roles in controlling ecosystem development. Plants are by far the most important means of primary production, and it is therefore very significance concern of plant community structure that indicates how productive an ecosystem is.

126. From the ecology standpoint it very important to know the vegetation pattern, the community structure, floral assemblage, distribution pattern etc. To get a clear picture of the biodiversity and the ecology along the alignment of the ring road and its surroundings, primary survey has been carried out in the month of **March 2021**. For vegetation study standard sampling protocols [Mishra, R. (1968) “Ecology Work Book” published by Oxford and IBH Publishing Co., Calcutta] were followed. Five sampling locations were identified and total **20 quadrats were** laid out (**Table-49**).

Table-49 Description of sampling sites and number of quadrats laid

Sl. No.	Location Description	Number of Quadrats
1	Heingang, between Chainage 21+200 to 21+500	7 (Seven)
2	Koirengei near chainage 25+980	4 (Four)
3	Langol, between Chainage 32+200 to 32+600	3 (Three)
4	Langol, between Chainage 39+100 to 42+800	3 (Three)
5	Langthaballep, between Chainage 52+100 to 52+700	3 (Three)

Source: Quadrate study carried out by ICT Pvt. Ltd.

127. **Observations and conclusion on trees' composition:** Analysis of trees data shows that among five sites, *Lagestroemia speciosa* was most frequent species followed by *Zizyphus jujube, Callistemon lanceolatus etc*. Density of *Lagestroemia speciosa* was also recorded highest among the tree species followed by *Zizyphus jujube, Callistemon lanceolatus*. These tree species were also abundantly distributed within the region. Importance value index values were also comparatively high, which show that importance of these tree species was relatively high in the ecosystem in terms of biomass, productivity etc. Analysis of the tree data obtained from primary survey which exhibited that site between Chainage 21+200 to 21+500 was comparatively more diverse than other sites. If we see the concentration of the dominance values, it clearly shows that for the site between Chainage 21+200 to 21+500 concentration of dominance value was comparatively low among other sites which indicate that dominance share among tree species for resources was high, hence dominance was low at site between Chainage 21+200 to 21+500. **No rare / endangered tree species were identified** in the primary survey.

128. **Observations and conclusion on shrub' composition:** Analyzing the shrub layer data it was found that the most frequent and dominant shrub species were *Adhatoda vasica, Vitex negundo, Lantana camara* among the five sampling sites, These species were also observed to be densest species among the three forest sites. In terms of their value in the ecosystem importance value index (IVI) value was comparatively high for these species. Shrub diversity indices values exhibited that chainage between 21+200 to 21+500 site was comparatively more diverse among the five sites and due to highest dominance share among the shrub species resulted a low dominance index for the this site.

129. **Observations and conclusion on herbs' composition:** Data of herbaceous layer showed that in all the three sites most frequent and dominant herb species were *Cymbopogon fulvus, Cynodon dactylon, Apluda aristata,* and *Panicum atrosanguianeum* in all the five sampling sites, these species were also observed to be densest species among the three forest sites. The importance value index (IVI) value was comparatively high for these species. Highest herbs and grasses were found in the site between Chainage 21+200 to 21+500, reason being that this site is less disturbed which gives more opportunity to thrive the ground vegetation. Hence more dominance share for resources and habitat gives low dominance index of herbaceous vegetation of this site. Details of the biodiversity study are provided in **Annex 4.4**.

Photographs of Quadrat Survey at Site

S. GIANT TREES

130. There are about **76 numbers of giant trees** i.e. girth size more than 300 cm on eitherside of the proposed alignment. 48 trees are located on the left side and 28 are located on the right side. Tree at chainage **45+930** has **special status** (meeting place). It has been decided in consultation with PIU, PWD Manipur that the **tree at chainage 45+930 will be saved** through

minor modification in the design during construction of the project road. Out of 76 giant trees, 57 trees will be coming within the RoW and there will be no impact on remaining 19 trees (highlighted). Chainage wise details of giant trees are presented in **Table-50.**

Table-50 Details of Giant Trees along the Proposed Alignment

Sl. No.	Design Chainage	Side	Distance# (m)	Latitude	Longitude
1	0+114	LHS	8.72	24° 48' 30.838"	93° 57' 29.926"
2	0+122	LHS	8.39	24° 48' 30.966"	93° 57' 29.962"
3	0+127	LHS	7.64	24° 48' 31.103"	93° 57' 30.015"
4	0+227	RHS	7.88	24° 48' 34.313"	93° 57' 31.187"
5	0+365	RHS	8.97	24° 48' 38.769"	93° 57' 31.992"
6	1+150	LHS	8.99	24° 49' 3.250"	93° 57' 39.916"
7	1+150	LHS	28.09	24° 49' 3.711"	93° 57' 39.126"
8	2+275	LHS	11.41	24° 44' 49.952"	93° 56' 51.760"
9	7+315	RHS	9.18	24° 47' 4.340"	93° 57' 35.150"
10	7+337	RHS	8.89	24° 47' 4.740"	93° 57' 35.804"
11	8+090	LHS	6.48	24° 47' 29.441"	93° 57' 33.893"
12	8+175	LHS	7.9	24° 47' 32.161"	93° 57' 33.531"
13	8+349	LHS	10.6	24° 47' 37.660"	93° 57' 32.617"
14	8+360	LHS	8.6	24° 47' 38.067"	93° 57' 32.603"
15	8+704	RHS	14.26	24° 47' 49.188"	93° 57' 30.828"
16	8+334	LHS	10.66	24° 47' 56.521"	93° 57' 29.236"
17	8+374	RHS	10.34	24° 47' 38.631"	93° 57' 33.158"
18	8+984	LHS	7.24	24° 47' 58.061"	93° 57' 29.207"
19	9+019	LHS	8.09	24° 47' 59.256"	93° 57' 29.104"
20	9+240	LHS	7.43	24° 48' 6.498"	93° 57' 28.788"
21	9+272	LHS	8.49	24° 48' 7.393"	93° 57' 28.682"
22	9+357	RHS	11.63	24° 48' 10.296"	93° 57' 29.176"
23	9+422	RHS	12.73	24° 48' 12.405"	93° 57' 29.026"
24	9+584	RHS	12.33	24° 48' 17.695"	93° 57' 28.661"
25	9+844	RHS	18.72	24° 48' 25.905"	93° 57' 30.106"
26	9+879	LHS	8.26	24° 48' 26.787"	93° 57' 30.318"
27	9+990	RHS	28.64	24° 48' 25.508"	93° 57' 33.832"
28	10+025	RHS	28.7	24° 48' 25.472"	93° 57' 35.375"
29	10+435	LHS	14.61	24° 48' 26.587"	93° 57' 49.983"
30	10+564	LHS	14.8	24° 48' 26.530"	93° 57' 54.688"
31	10+564	RHS	26.09	24° 48' 25.203"	93° 57' 54.497"
32	10+570	RHS	23.16	24° 48' 25.292"	93° 57' 55.037"
33	10+959	LHS	10.93	24° 48' 26.223"	93° 58' 8.820"
34	11+032	LHS	11.01	24° 48' 26.187"	93° 58' 11.443"
35	11+235	LHS	12.62	24° 48' 26.134"	93° 58' 18.612"
36	15+900	RHS	5.1	24° 50' 23.404"	93° 58' 8.450"
37	15+900	LHS	10.11	24° 50' 23.029"	93° 58' 7.743"
38	15+920	LHS	17.86	24° 50' 22.942"	93° 58' 7.011"

Sl. No.	Design Chainage	Side	Distance# (m)	Latitude	Longitude
39	21+189	RHS	8.98	24° 52' 15.456"	93° 56' 25.450"
40	21+225	LHS	11.3	24° 52' 16.416"	93° 56' 24.510"
41	21+229	LHS	10.2	24° 52' 16.672"	93° 56' 24.495"
42	23+111	LHS	7.53	24° 53' 11.558"	93° 56' 39.940"
43	23+144	LHS	12.79	24° 53' 12.225"	93° 56' 39.072"
44	23+153	LHS	20.65	24° 53' 12.319"	93° 56' 38.587"
45	23+400	RHS	8.19	24° 53' 19.182"	93° 56' 36.320"
46	23+425	RHS	13.98	24° 53' 20.054"	93° 56' 36.021"
47	25+384	RHS	6.62	24° 53' 6.502"	93° 55' 27.993"
48	32+777	LHS	17.19	24° 49' 52.018"	93° 56' 20.976"
49	32+796	LHS	11.71	24° 49' 52.066"	93° 56' 20.371"
50	32+900	RHS	3.89	24° 49' 50.472"	93° 56' 17.203"
51	32+930	RHS	8.51	24° 49' 49.511"	93° 56' 16.824"
52	33+025	LHS	21.27	24° 49' 46.527"	93° 56' 16.934"
53	33+215	LHS	7.33	24° 49' 42.968"	93° 56' 10.953"
54	33+344	LHS	33.73	24° 49' 44.375"	93° 56' 5.912"
55	33+350	LHS	14.47	24° 49' 44.928"	93° 56' 6.250"
56	33+364	LHS	15.24	24° 49' 45.182"	93° 56' 5.860"
57	33+400	LHS	11.29	24° 49' 46.047"	93° 56' 4.982"
58	33+650	RHS	9.13	24° 49' 48.769"	93° 55' 59.603"
59	35+525	LHS	8.9	24° 49' 12.218"	93° 55' 18.536"
60	38+644	LHS	5.92	24° 49' 39.313"	93° 54' 2.833"
61	38+729	RHS	11.94	24° 49' 40.446"	93° 54' 0.054"
62	39+239	LHS	7.13	24° 49' 26.431"	93° 54' 2.435"
63	39+870	LHS	8.37	24° 49' 30.782"	93° 53' 45.268"
64	39+990	LHS	4.66	24° 49' 33.184"	93° 53' 42.434"
65	40+025	RHS	7.22	24° 49' 33.429"	93° 53' 41.132"
66	40+084	LHS	7.23	24° 49' 32.271"	93° 53' 39.424"
67	40+490	LHS	7.72	24° 49' 26.662"	93° 53' 26.700"
68	42+685	LHS	14.28	24° 48' 35.056"	93° 53' 22.921"
69	42+927	LHS	11.3	24° 48' 27.480"	93° 53' 20.918"
70	42+937	LHS	4.34	24° 48' 27.158"	93° 53' 20.616"
71	43+121	LHS	3.25	24° 48' 21.392"	93° 53' 21.710"
72	44+129	LHS	6.62	24° 47' 49.723"	93° 53' 24.789"
73	44+179	RHS	10.28	24° 47' 48.198"	93° 53' 24.160"
74	44+229	RHS	0.02	24° 47' 46.497"	93° 53' 24.491"
75	44+354	RHS	27.4	24° 47' 42.232"	93° 53' 23.541"
76	**45+930**	**RHS**	**4.65**	**24° 47' 10.698"**	**93° 53' 47.508"**

Distance in meter from proposed centerline
Source: Field survey carried out by ICT Pvt. Ltd.

Photographs of Giant Trees along the Alignment

T. FAUNA

131. ***Mammals:*** Due to presence of a number of lakes and wetlands, there is a distinct fauna for Imphal Vally region. This area has animals of the swamps such a leopards, wild boar, swamp deer, hog deer, wild cats, etc. The Brow Antlered Deer, *Cervas eldi eldi* is found in the Keibul Lamjae are of the Lottak Lake. The distinct characteristic of these regions is the unique avifauna, comprising of endemic and migratory birds. The fish population of the region also shows a wide diversity. The fishes of Malayan region namely Pengba, Tharak, Ngaton are also found here particularly in the Loktak, Lousi, Kharung and many other wetlands. Mammalian **Fauna found in the Imphal Valley** is presented in **Table-51**.

Table-51 Mammalian Fauna of Imphal Valley

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
1	*Axis porcinus*	Hog Badger	Cervidae	Schedule III	EN
2	*Arctonyx collaris*	Hog Badger	Mustelidae	Schedule I (Part I)	-
3	*Bandicota indica*	Large Bandicot Rat	Musidae	Schedule IV	LC
4	*Callosciurus erythraeus*	Tree squirrels	Scuitdidae	Not Listed	LC
5	*Callosciurus pygerythus flythi*	Kheiroi	-do-	Schedule II	LC
6	*Canis aureus*	Jackal	Canidae	Schedule II (Part I)	LC
7	*Cannomys badius*	Bamboo rat	Rhizomidae	Not Listed	LC
8	*Capricornis sumatraensis*	Serow	Bovidae	Not Listed	VU
9	*Cervus unicolor*	Sambhar	-do-	Schedule III	VU
10	*Cuon alpinus*	Indian wild dog	Ctenomyidae	Schedule II	EN
12	*Dremomys lokriah macruillani*	Kheiroi Napu	Scuitidae	Not Listed	LC
13	*Felis chaus*	Jungle cat	Felidae	Schedule II (Part I)	
14	*Felis bengalensis*	Leopard Cat	-do	Not Listed	EN
15	*F. temmincki*	Golden cat	-do-	Not listed	LC
16	*Funambulus pennanti*	Five stripped squirrel	Scuitdidae	Schedule IV	LC
17	*Herpestis arva*	Crab eating Mongoose	Herpestidae	Not listed	-
18	*Herpextis auropunetatus*	Small Mongoose	-do	Not listed	-
19	*Helopeltis albo niger*	Flying squirrel	-do-	Schedule II (Part I)	-
20	*Hystrix brachyura*	Himalayan crestless Porcupine	-	Schedule II (Part I)	LC
21	*Panthera pardus*	Leopard	Felidae	Schedule I (Part I)	VU
22	*Lutra lutra*	Otter	Musteliadae	Schedule II (Part I)	NT
23	*Macaca assamensis*	Assamese macaque	Cercopithecidae	Schedule II (Part I)	NT
24	*Macaca mullata*	Rhesus macaque	-do	Schedule II (Part I)	LC
25	*Macaca arctiodes*	Stump Tailed Macaque	-do	Schedule II (Part I)	-
26	*Manis crassicaudata*	Pangolin	Manidae	Schedule I (Part I)	EN
27	*Martes flavigula*	Himalayan Yellow Throated martin	Mustelidae	Schedule II (Part I)	LC
28	*Melogale moschata*	Ferret Badger	-do-	Not listed	LC
29	*Megocrops nephanae*	Niphan's Fruit Rat	Pteropodiadae	Not listed	-

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
30	*Muntiacus muntjak*	Barking Deer	Cervidae	Schedule III	LC
31	*Mus cervicolor imphalensi*	Jungle Mouse	Muridae	Not Listed	-
32	*Mustela kathidh*	Ermine	Mustelidae	Not Listed	-
33	*Nycticebus coucang*	Sleder loris	Loricidae	Not listed	EN
34	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	Schedule II (Part I)	LC
35	*Paguma larvata*	Masked Civet	Viverridae	Schedule II (Part I)	LC
36	*Petourista albornfus condidulus*	Kheiroi Angangbi	Scuitdidae	Not listed	-
37	*Presbytis pileatus*	Capped Monkey	Cercopithecidae	Not listed	VU
38	*Prionodon pardicolor*	Spotted Linsang	Viverridae	Schedule I (Part I)	LC
39	*Pteropus giganteus*	Flying fox	Pteropodidae	Schedule IV	LC
40	*Rhizomys pruinosushi*	Bamboo Rat	Rhizomidae	Not listed	-
41	*Rousettus leschenaultii*	Fulvous Fruit Bat	Pteropodidae	Schedule IV	LC
42	*Rattus rattus*	Common House Rat	Muridae	Schedule IV	LC
43	*R. manipulus*	Indian Field Mouse	-do-	Not Listed	LC
44	*Rhinolophus armiger*	Great Eastern bat	Rhinolophidae	Not listed	-
45	*Rucervus eldii*	Brow-antlered Deer	Cervidae	Not listed	EN
46	*Ursus thibetanus*	Asiatic Black Bear	Ursidae	Schedule II (Part I)	VU
47	*Spakis microphtalmus*	Mole rat	Muridae	Not listed	-
48	*Sorex caudatus*	Common shrew	Soricidae	Not listed	-
49	*Suncus caeruleus*	Mask shrew	Soricidae	Not listed	-
50	*Sus scrofa*	Wild pig	Suidae	Schedule III	LC
51	*Tamiops mcclellandii*	Kheiros Arangbi	Scuitididae	Not listed	LC
52	*Viverra zibetha*	Large Indian civet	Viverridae	Schedule II (Part I)	LC
53	*Viverricula indica*	Small Indian civet cat	-do-	Schedule II (Part I)	LC
54	*Vulpes bengalensis*	Fox	Canidae	Schedule II (Part I)	LC

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

Note: WPA – Wildlife Protection Act, IUCN - International Union for Conservation of Nature, LC – Least Concern, NT – Near Threatened, EN – Endangered, VU – Vulnerable

132. ***Avifauna:*** Some of the important birds found in the areas include the Bar Backed Pheasant (the state birds of Manipur), Jungle Fowl, Bamboo Partridge, Varieties of Pigeons, Swallows, Martins, Hirundinidae etc. A detail list of birds found in the Imphal Vally is given in **Table-52**.

Table-52 Avifauna of Imphal Valley

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
1.	*Accipiter nisus*	Sparrow Hawk	Accipitridae	Schedule I (Part I)	LC
2.	*Acridotheres tristis*	Indian myna	Sturnidae	Schedule IV	LC
3.	*Acridotheres fuscus*	Jungle Myna	-do-	Schedule IV	LC
4.	*Acroeplus orientalis*	Thick Billed Warbler	Muscicapidae	Schedule IV	LC
5.	*A.nyroca*	White eye Pochard	-do-	Not Listed	LC
6.	*A.crecca crecca*	Common Teal	-do-	Schedule IV	LC
7.	*A.penelope*	Wigeon	-do-	Not Listed	LC
8.	*A.acuta*	Pintail Duck	-do-	Not Listed	LC
9.	*Aethopyga siparaja*	Yellow backed sunbird	Nectariniidae	Not Listed	LC
10.	*Aix galericulata*	Mandarian Duck	Anatidae	Not listed	LC
11.	*Alcipro poioicephala fusca*	Quaker Babbler	Muscicapidae	Not listed	-
12.	*Alauda gulgula*	Lesser sky-lark	Alaudidae	Not Listed	LC
13.	*Alcedo meninting*	Blue Eared Kingfisher	Alcedinidae	Schedule-IV	LC
14.	*Anas poecilorhyncha*	Spot bill duck	Anatidae	Schedule-IV	LC
15.	*Anas clypeata*	Shoveller	-do-	Schedule-IV	LC
16.	*Anas poecilorhyncha*	Common Teal	-do-	Not Listed	LC
17.	*Anhinga rufa*	Darter	Podicipediadae	Schedule IV	LC
18.	*Anser albifrons albifrons*	White fronted Goose	Anatidae	Not listed	LC
19.	*A.querquedula*	Blue winged Teal	-do	Not listed	LC
20.	*Aquila clanga*	Spotted Eagle	Accipitridae	Not Listed	LC
21.	*Anthracoceros malabaricus*	Indian Pied Horbill	Bucerotidae	Schedule I (Part III)	-
22.	*Arachnothera longirostris*	Little Spider Hunter	Muscicapidae	Not Listed	LC
23.	*Arachnmothera magna*	Streaked Spider hunter	-do-	Not listed	-
24.	*Ardea cinerea*	Grey Heron	Ardeidae	Not Listed	LC
25.	*Alcedo hercules*	Great Blue Kingfisher	Alcedinidae	Not Listed	NT
26.	*Aythya ferino*	Common Pochard	Anatidae	Not listed	-
27.	*A.alba modesta*	Eastern large Egret	-do-	Not listed	-
28.	*Amaurornis phoenicurus*	Indian White Breasted Water Hen	Raffidae	Not listed	LC

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
29.	*Ardea purpurea manilensis*	Purple Heron	Ardeidae	Not listed	LC
30.	*Ardeola grayii*	Indian Pond Heron	Ardeidae	Not listed	LC
31.	*Ardeola bacchus*	Chinese pond heron	-do-	Not listed	LC
32.	*Bambusicola fytchii*	Assamese bamboo Partridge	Phasinidae	Not listed	LC
33.	*Botaurus stellaris*	Bittern	Ardeidae	Not listed	LC
34.	*Bubulcus ibis*	Cattle Egret	-do-	Schedule IV	-
35.	*Buceros bicornis*	Great Indian Hornbill		Schedule I (Part III)	NT
36.	*Bubo nipalensis*	Forests Eable Owl	Striginae	Schedule IV	LC
37.	*Capella gallinago gallinago*	Fantail Snipe	Charadreidae	Not Listed	LC
38.	*Calandrella raytal*	Sand Lark	Alaudinidae	Schedule IV	-
39.	*Cairina seculata*	White Winged Wood Duck	Anatidae	Schedule I (Part III)	EN
40.	*Ceryle higuldeis*	East Himalayan pied Kingfisher	Alcedinidae	Schedule IV	-
41.	*C.leucomelanura*	Indian pied Kingfisher	-do-	Schedule IV	-
42.	*Centropus toulou*	Lesser Coucal		Not Listed	LC
43.	*Centropus sinensis intermedius*	Crow Pheasant	Cuculidae	Not Listed	LC
44.	*Cissa chinensis*	Green Magpie	Corvidae	Schedule IV	LC
45.	*Cissa flavirostris*	Blue Magpie	Corvidae	Schedule IV	-
46.	*Circus melanoleucos*	Pied harrier	Accipitridae	Not Listed	LC
47.	*Columba punicea*	Purple wood pigeon	Columbidae	Schedule IV	VU
48.	*Copsicus saularis*	Magpie Robin	Muscicapidae	Not listed	LC
49.	*Coracina novaehollandiae*	Large Cuckoo shrike	Corvidae	Not Listed	-
50.	*Coturnix coturnix japonica*	Zapanese Francolin	Phasinidae	Not listed	LC
51.	*Coturnix coturnix*	Common grey Quail	-do-	Not listed	LC
52.	*Corvus macrohynchos*	Lesser Eastern jungle Crow	Corvidae	Not listed	LC
53.	*Cucutans canobakaris*	Cukoo	Cuculidae	Schedule IV	-
54.	*Delichon urbica*	House Martin	Hirundinidae	Not listed	LC
55.	*Dendrocygna bicolor*	Large Whistling Teal	Anatidae	Schedule I (Part III)	LC

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
56.	*Diceaeum ignpectus*	Fire breasted Flowerpecker	Dicacidae	Schedule IV	-
57.	*Dicrurus adsimiles*	Northern Indian black Drongo	Dicuridae	Schedule IV	-
58.	*D.annectans*	Crow billed Drongo	-do	Schedule IV	-
59.	*D.hottentouus hottentouus*	Spangled Drongo	Dicuridae	Schedule IV	-
60.	*D.paradiseus*	Racket tailed Drongo	-do-	Schedule IV	-
61.	*Dinopium javanense*	Three Toed Woodpecker	Picidae	Schedule IV	LC
62.	*Ducula radiata*	Grey headed Imperial Pigeon	Columbidae	Not listed	LC
63.	*Dendrocygna javanica*	Lesser whistling teal	Anatidae	Not Listed	LC
64.	*Dendrocitta formosa*	Tree Pie	Coreidae	Not Listed	LC
65.	*Egreta garzetta*	Little Egret	Ardeidae	Schedule IV	LC
66.	*E.intermedia intermedia*	Median egret	-do-	Schedule IV	LC
67.	*Elanus careulens vociferous*	Black winged Kite	Accipitridae	Not Listed	-
68.	*Enicurus schistaceus*	Slatv Backed Forktail	Muscicapidae	Not Listed	LC
69.	*Enicurus ceschenaultia indicus*	Leschenauth's Forktial	Muscicapidae	Not Listed	LC
70.	*E.pupaepops longtrostirs*	Jerdon Burmese Hoopoe	Upupidae	Not listed	-
71.	*Erithecus pectoralis*	Blue Chat	Muscieapidae	Not listed	-
72.	*Falco amurensis*	Red legged Falcon	Falconidae	Not Listed	LC
73.	*Fulica atra atra*	Coot	Rallidae	Schedule IV	LC
74.	*Francolinus Francolinus*	Black Francolin	Phasinidae	Not listed	LC
75.	*F francolinus melanonous*	Assam Black Partridge	-do-	Not listed	LC
76.	*F pintadaenus phayerei*	Burmese Francolin	-do	Not Listed	LC
77.	*Falco biarmicus phayrei*	Lagger Falcon	Falconidae	Schedule IV	LC
78.	*Gallus gallus spadiceus*	Burmese Red Jungle Fowl	Phasinidae	Schedule IV	LC
79.	*Gamsorhynchus rufulus*	White Headed shirke Babbler	Muscieapidae	Not Listed	-
80.	*Glariola pratincola*	Collared Swallow Plover	Charadriinae	Not listed	-
81.	*Gallinula chloropus indica*	Indian Moorhen	Raffideae	Not listed	LC
82.	*Gallierex cinera cinera*	Kora Watercock	Rallidae	Not Listed	-

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
83.	*Garulax monleger*	Nech aced Laughing Thrush	Musciapidae	Not Listed	-
84.	*G.pectoralis*	Black Gorgeted Laughing Thrush	-do	Not Listed	-
85.	*Grus monacha*	Hooded Crane	Turnicidae	Schedule I (Part III)	VU
86.	*Grus Antigone sharpie*	Burmese Sarus	-do-	Not Listed	-
87.	*Gracula religiosa intermedia*	Northern Hill Myna	Sturnidae	Not listed	LC
88.	*Halcyon smyrnensis.*	Smyma King Fisher	Alcedinidae	Schedule IV	LC
89.	*Haliastur indus indus*	Brahminy Kite	Accipitridae	Not listed	LC
90.	*Hemipus pictsus*	Pied Flycatcher Shirke	Vangidae	Not listed	LC
91.	*Hirundo daurica*	Daunan Swallow	Hirndmidae	Not listed	LC
92.	*Ixobrychus minutus*	Little Bittern	Jacanidae	Not listed	LC
93.	*Larus brunnicephalus*	Brown headed Gull	Laridae	Schedule	LC
94.	*Lanius cristatus*	Brown Shirke	Lanidae	Not listed	LC
95.	*Liothrix lutea*	Red billed Leiothrix	Psittacidae	Not listed	LC
96.	*Loriculus vernalis*	Lorikeet	Estrildinae	Not listed	-
97.	*Lonchera Malacca*	Black Headed Munia	Timalinae	Not listed	-
98.	*Lophura leucomelanos lathami*	Blackbacked Khalij	Phasinidae	Not listed	LC
99.	*Macronous gularis*	Yellow Breasted Babbler	Muscicapidae	Schedule IV	LC
100.	*Megalaima asiatica*	Blue Throated Barbet	Capitonidae	Schedule IV	LC
101.	*Megalaima virens*	Himalayan Barbet	-do	Schedule IV	LC
102.	*Merops leschenaultii*	Chestnut Headed Bee Eater		Not listed	LC
103.	*Milvus migrans*	Large Indian Kite	Acceipitridae	Schedule I	LC
104.	*Metopidius indicus*	Bronze winged Jacana	Jacanidae	Schedule IV	LC
105.	*Motacilla alba*	White pied Wagtail	Muscicapidae	Not listed	LC
106.	*Motacilla caspica*	Grey wagtail	-do-	Not listed	LC
107.	*M.indica*	Forest Wagtail	-do-	Not listed	LC
108.	*Muscicapa poliognys*	Brook's Flycatcher	Musciepidae	Not listed	-
109.	*Myeteria leucocephala*	Painted Strok	Ardeidae	Not listed	NT

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
110.	*Netta rufina*	Red crested Pochard	Anatidae	Not listed	LC
111.	*Nyciticorax nycticorax*	Night Heron	Ardeidae	Not listed	LC
112.	*Nycticirnis athertoni*	Blue bearded bee eater		Not listed	-
113.	*Otus spilocephalus spilocephalus*	Eastern spotted scops Owl	Strigidae	Not listed	LC
114.	*Otus bakkamoena manipurensis*	Burmese collard scops Owl	-do-	Schedule IV	LC
115.	*Pellornium ruficeps*	Spotted babbler	Timaliinae	Not listed	-
116.	*Passer montanus malaccensis*	Tree Sparrow	Muscicaidae	Not listed	LC
117.	*Pericrocotus rosens*	Rosy minivet	Camphephagidae	Schedule IV	LC
118.	*Pericroctus flammens*	Long Tailed Minivet		Schedule IV	LC
119.	*Phalacrocorax carbo*	Large Cormorant	Podicipedidae	Schedule IV	LC
120.	*Phylloscopus affinis*	Leaf Wabbler	Phylloscopidae	Not listed	LC
121.	***Ploceus benghalensis***	Black Breasted Weaver Bird	Ploceidae	Not listed	LC
122.	*Ploceus manyar*	Steaked Weaver Baffler	-do-	Not listed	LC
123.	*Pomatorhenus ocheracereps*	Manipur Seimitar Baffler	Muscicapidae	Not listed	-
124.	*Porphyrio porphyrio*	Indian purple moorhen	Rallidae	Not listed	-
125.	*Prinia gracils*	Streaked Wren Warbler	Muscicapidae	Not listed	LC
126.	*Psarisomus dalhousiae*	Longtailed Broad Bill	Eurylaimidae	Not listed	LC
127.	*Pychonotus atriceps*	Black Headed Bulbul	Pycnonotidae	Schedule IV	LC
128.	*Pychnonotus melanicterus*	Black Headed Yellow Bulbul	-do-	Schedule IV	LC
129.	*Pycnonotus jucosus monticoia*	Assasm Red Chiskered Bulbul	-do-	Schedule IV	LC
130.	*P cafer cafer*	Red vented Bulbul	-do-	Schedule IV	LC
131.	*Picus canus*	Green Woodpecker	Picidae	Schedule IV	LC
132.	*Platalea leucorodia*	Spoon Bill	Ardeidae	Schedule I (part III)	LC
133.	*Pluvialis fulva*	Eastern Golden Plover	Charadridae	Schedule IV	LC
134.	*Perdicula manipurensis*	Manipur painted Bush Quail	Phasinidae	Schedule IV	EN

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
135.	*Psittacula alxander*	Red breasted Parakeet	Psittacidae	Schedule IV	NT
136.	*Rhipidura aureola*	Faintail Flycatcher	Muscicapidae	Not listed	LC
137.	*Rostratula benghalensis*	Painted Snipe	Rostratuladae	Schedule IV	LC
138.	*Saxicola jerdoni*	Jerdon's Bush Chat	Muscicapidae	Not listed	LC
139.	*Spilornis cheela burmanicens*	Crested serpent eagle	Accipitridae	Not listed	LC
140.	*Sterna albifrons*	Little Tern	Laridae	Not listed	LC
141.	*Sturnus malabaricus*	White winged Myna	Sturnidae	Schedule IV	LC
142.	*Strix leptogrammica*	Brown Wood Owl	Strigidae	Schedule IV	LC
143.	*Streptopelia chinensis*	Spotted Dove	Columbidae	Schedule IV	LC
144.	*Streptopelia sengalensis*	Laughing dove	Columbidae	Schedule IV	LC
145.	*Syrmaticus humiae*	Bar Backed Pheasant	Phasinidae	Schedule IV	NT
146.	*Turnix sylvaticus*	Little Bustard Quail	Turnicidae	Schedule IV	CR
147.	*Tragopan blythii*	Blythe's Tragopan	Phasinidae	Schedule I (Part III)	VU
148.	*Treron pompadora*	Ashey headed green pigeon	Columbidae	Schedule IV	LC
149.	*Tadorna ferruginea*	Ruddy shelduck	Anatidae	Not listed	LC
150.	*Timalia pileata*	Red Capped Babbler	Timalinae	Schedule IV	LC
151.	*Tyto alba*	Indian Owl	Strigidae	Schedule IV	-
152.	*Tyto javanica alba*	Barn owl	-do-	Schedule IV	-
153.	*Tylocpensis*	Grass owl	-do-	Schedule IV	-
154.	*Vanellus cinereus*	Greyheaded lapwing	Charadridae	Not listed	LC
155.	*Vanellus indicus*	Burmese redwatted Lapwing	Charadridae	Not listed	LC
156.	*V.spinousus duvaucelli*	Spurwinged Lapwing	Charadridae	Not listed	LC

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

Note: WPA – Wildlife Protection Act, IUCN - International Union for Conservation of Nature, LC – Least Concern, NT – Near Threatened, EN – Endangered, VU – Vulnerable, CR – Critically Endangered

133. ***Reptiles and Amphibians:*** The King Cobra, Russel's Viper, Banded Krait, Rat Snake etc. are commonly found in the region. Python is also quite numerous in the Divisions. A detail list of reptiles and amphibians are given in **Table-53** and **Table-54** respectively.

Table-53 Reptiles of the Imphal Valley

S. No.	Scientific Name	Common Name	Status as per WLP (Act) 1972	ÌUCN
1.	*Ahaetulla prasina*	Whip Snake	Not listed	LC
2.	*Bogia ochracea*	Tawny Cat Snake	Not listed	-
3.	*Bogia trigomata*	Indian Gamma Snake	Not listed	-
4.	*Bogia multimaculak*	Large Spotted Cat Snake	Not listed	-
5.	*Blythia recticulata*	Iridescent Snake	Not Listed	Data deficient
6.	*Boiga gokool*	Eastern Gamma	Not listed	-
7.	*Bungarus fasciatus*	Banded Krait	Not listed	LC
8.	*Bungarus coeruleus*	Blue Krait	Not listed	-
9.	*Calotes versicolor*	Garden Lizard	Not listed	-
10.	*Cuora amboinensis*	Box Turtle	Not listed	EN
11.	*Cyclemys dentata*	Water Turtle	Not listed	NT
12.	*Draco norvilli*	Flying Lizard	Not listed	-
13.	*Elaphe radiatus*	Trinket Snake	Not listed	LC
14.	*Kachunga tentoria*	Roofed Turtle	Not listed	VU
15.	*Lycodon jara*	Wolf Snake	Not listed	LC
16.	*Eutropis multifasciata*	Scin Lizard	Not listed	LC
17.	*Naja kaouthia*	Indian spotting Kobra	Schedule II (Part II)	LC
18.	*Herpetoreas platyceps*	Himalayan Keelback	Schedule II (Part II)	-
19.	*Ophiophagus Hannah*	Cobra	Schedule II (Part II)	VU
20.	*Psammodynastes pulverulentus*	Mock Viper	Not listed	-
21.	*Python molurus molurus*	Indian Python	Schedule I (Part II)	NT
22.	*Ptyas mucosus*	Red Snake	Schedule II (Part II)	-
23.	*Ptyas korrs*	Indo Chinese Rat Snake	Not listed	-
24.	*Rhabdophis subminiatus*	Red necked keelabck	Not listed	LC
25.	*Sibynophis collaris*	Collared Black Headed Snake	Not listed	LC
26.	*Trimeresurus gramineus*	Bamboo pit Viper	Not listed	LC
27.	*Typina diardi diardi*	Diard's Blind snake	Not listed	-
28.	*Oligodon albocinctus*	White Striped Kukri Snake	Not listed	-
29.	*Ophiodrys doriae*	Manipur Green Snake	Not listed	-
30.	*O. arnesis*	Common Kukri Snake	Not listed	-
31.	*Trimeresurus albolaris*	Green Pitviper	Not listed	-
32.	*Varanus bengalensis*	Monitor Lizard	Schedule I (Part II)	VU
33.	*Varanus Salvador*	Water Monitor Lizard	Schedule I (Part II)	LC

S. No.	Scientific Name	Common Name	Status as per WLP (Act) 1972	ÌUCN
34.	*Vipera russelli*	Russel's Viper	Schedule II (Part II)	-
35.	*Xenochrophis piscator*	Cheequered keelback	Schedule II (Part II)	-
36.	*Ptyas nigromarginata*	Green Rat Snake	Not listed	-

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

Note: WPA – Wildlife Protection Act, IUCN - International Union for Conservation of Nature, LC – Least Concern, NT – Near Threatened, EN – Endangered, VU – Vulnerable,

Table-54 Amphibians of the Imphal Valley

S. No.	Scientific Name	Common Name	Family	Status as per WLP (Act) 1972	ÌUCN
1	*Bufo melanostictus*	Common Toad	Bufonidae	Not listed	LC
2	*Bufoides species*	Toad	Bufonidae	Not listed	-
3	*Microphyla ornate*	Narrow mouthed frog	Microhylidae	Not listed	LC
4	*Hoplobatrachus tigerinus*	Indian Bullfrog	Ranidae	Not listed	-
5	*Rana tigrina*	Indian Cricket frog	Ranidae	Not listed	LC
6	*Sphaerotheca breviceps*	Indian Burrowing Frog	Ranidae	Not listed	LC
7	*Hyla annectans*	Tree Frog	Rhacophoridae	Not listed	LC
9	*Rhacophorus bipunctatus*	-	Ranidae	Not listed	LC

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

Note: WPA – Wildlife Protection Act, IUCN - International Union for Conservation of Nature, LC – Least Concern,

134. ***Fish:*** Species of *pisces* are found plenty in the rivers, lake, ponds etc. Due to the presence of a number of lakes including Lotak, Pumlen, Waithou, Poirou, Kharung, Loushi etc. which have a link with the river systems, fishes are found in wide variety and number. As the rivers flowing in the plan area drains in to Loktak and its associate wetlands, they all have connection with the lake and indirect connection with each other. Hence, all the rivers have common fish fauna. A list of the *pisces* of the valley region is presented in **Table-55.**

Table-55 Pisces of the Imphal Valley

S. No.	Scientific Name	Local Name	Family	Status as per WLP (Act) 1972	ÌUCN
1.	*Acanthophthalmus pongia*	Nganap	Cobitinae	Not listed	-
2.	*Acanthophthalmus longpinnis*	Nganap	-do-	Not listed	-
3.	*Amblypharyngodon mola*	Mukanga	Rasborinae	Not listed	-
4.	*Anabas testudineus*	Ukabi	Anabantidae	Not listed	LC
5.	*Anguilla bengalensis*	Ngaril Laina	Anguillidae	Not listed	NT
6.	*Arichthys aor*	Ngachou	Ragridae	Not listed	-
7.	***Aplocheilus panchax***	-	Cyprinodontodae	Not listed	LC
8.	*Aspidoparia morar*	-	Rasborinae	Not listed	LC

S. No.	Scientific Name	Local Name	Family	Status as per WLP (Act) 1972	ÌUCN
9.	*Aspidoparia ukhrulensis*	-	-do-	Not listed	Data deficient
10.	*Badis badis*	Ngamhai	Namdidae	Not listed	LC
11.	*Bagarius bagarius*	Ngarel	Sisoridae	Not listed	NT
12.	*Bagarius yarrelli*	Ngarel	-do-	Not listed	NT
13.	*Bangana dero*	Khabak	Cyprinidae	Not listed	-
14.	*Barilius barlia*	Ngawa	Rasborinae	Not listed	LC
15.	*Barilius barna*	Ngawa	-do-	Not listed	LC
16.	*Barilius gatensis*	Ngawa	-do-	Not listed	LC
17.	*Barilius dogarsinghi*	Ngawa	-do-	Not listed	LC
18.	*Barilius ngawa*	Ngawa	-do-	Not listed	LC
19.	*Barilius tileo*	Ngawa	-do-	Not listed	LC
20.	*Bantasio tengara*	Ngarang	Bagridae	Not listed	-
21.	*Botia berdomorei*	-	Botinae	Not listed	-
22.	*Botia dario*	Ngarang	-do-	Not listed	-
23.	*Botia histrionica*	Shareng Khobi	-do-	Not listed	-
24.	*Devario acuticephala*	Nung-nga	Cyprinidae	Not listed	LC
25.	*Calta catla*	Catla, bao	Cyprinidae	Not listed	LC
26.	*Chagunius chagunio*	Thangbol pubi		Not listed	-
27.	*Chagunius nicholsi*	Ngara		Not listed	LC
28.	*Chanda nama*	Ngamhai	Chandidae	Not listed	LC
29.	*Chanda buccalis*	Ngamgau	Chandidae	Not listed	-
30.	*Channa orientalis*	Meitei Ngamu	Chandidae	Not listed	VU
31.	*Channa striata*	Ngamu Porom	-do-	Not listed	LC
32.	*Channa punctatus*	Bogra	-do-	Not listed	LC
33.	*Chela laubuca*	-	Cutrinae	Not listed	-
34.	*Cirrhinus mrigala*	Mrigal	Cyprininae	Not listed	LC
35.	*Cirrhinus reba*	Khabak		Not listed	LC
36.	*Clarias batrachus*	Ngakra	Claridae	Not listed	LC
37.	*Colisa fasciata*	Ngamema	Belontidae	Not listed	LC
38.	*Colisa sota*	Phetin	-do-	Not listed	LC
39.	*Crossocheilus burmanicus*	Ngaroi	Garrinae	Not listed	LC
40.	*Ctenopharyngodon idella*	Napi chabi	Cyprininae	Not listed	-
41.	*Cyprinus caprio*	Puklaobi	-do-	Not listed	VU
42.	*Cyprinus carpio var mudus*	Scale carp	-do-	Not listed	VU
43.	*Cyrprinus carpio war speculris*		-do-	Not listed	VU
44.	*Danio aequipinnatus*	Nung-nga	-do-	Not listed	LC
45.	*Danio devario*	-	Rasborinae	Not listed	LC

S. No.	Scientific Name	Local Name	Family	Status as per WLP (Act) 1972	ÌUCN
46.	*Danio naganensis*		-do-	Not listed	LC
47.	*Danio yuensis*		-do-	Not listed	LC
48.	*Esomus danricus*	Ngasang	-do-	Not listed	LC
49.	*Eutropiichthys vacha*	Ngahei	Schibeidae	Not listed	-
50.	*Gagata cenia*	Ngarang, Ngayek	Sisoridae	Not listed	LC
51.	*Garra litanensis*	Nagmu sengum	Garrinae	Not listed	VU
52.	*Garra naganensis*	Nung-nga	-do-	Not listed	LC
53.	*Garra manipurensis*	Ngamu sengum	-do-	Not listed	VU
54.	*Glossogobius giuris*	Nailon-nga	Gobiidae	Not listed	LC
55.	*Glyptothorax trilineatus*	Npapang	Sisoridae	Not listed	-
56.	*Heteropneustes fossilis*	Ngachik	Heterop nenstidae	Not listed	LC
57.	*Hypopthalmychthys molitrix*	Silver carp	Hypophthalmichthynae	Not listed	NT
58.	*Labeo bata*	Ngaton, Khabak	Cyprininae	Not listed	LC
59.	*Labeo calbasu*	Ngathi	-do-	Not listed	LC
60.	*Labeo fimbriatus*	Ngathi	-do-	Not listed	LC
61.	*Labeo gonius*	Kuri	-do-	Not listed	LC
62.	*Labeo pangusia*	Ngaton	-do-	Not listed	LC
63.	*Labeo rohita*	Rou	-do-	Not listed	LC
64.	*Lepidocephalus berdmorei*	Ngakijou	Cobitinae	Not listed	-
65.	*Lepidocephalus guntea*	-do-	-do-	Not listed	-
66.	*Lepidocephalus irrorata*	Patngamu/Nganap nakuppi	-do-	Not listed	-
67.	*Mastacembelus aramatus*	Ngaril	Mastacembelidae	Not listed	LC
68.	*Monopterus albus*	Ngaprum	Synbranchidae	Not listed	LC
69.	*Mystus bleekeri*	-	Bagridae	Not listed	-
70.	*Mystus cavasius*	Ngasep	-do-	Not listed	-
71.	*Mystus micropthalmus*	Ngara	Bagridae	Not listed	-
72.	*Mystus pulcher*	-	-do-	Not listed	-
73.	*Neollissochilus hexagonolepis*	Ngara	Cyprinidae	Not listed	-
74.	*Neollissochilus stracheyi*	Ngara	Cyprinidae	Not listed	-
75.	*Neomachcheilus botia*	Ngatup	Neomacheilinae	Not listed	-
76.	*Neomachcheilus kangjukhulensis*	Leingoiphon	-do-	Not listed	-
77.	*N.Sikamealensis*	ngatup	-do-	Not listed	-
78.	*Notopterus notopterus*	Kandla	Notopteridae	Not listed	LC
79.	*Ompok bimaculatus*	Ngatin	Siluridae	Not listed	NT
80.	*Osteobrama belangeri*	Pengba, Tharak	Cyprininae	Not listed	NT
81.	*Osteobrama cunma*	Ngaseksha	-do-	Not listed	LC
82.	*Parambassis ranga*		Ambassidae	Not listed	LC

S. No.	Scientific Name	Local Name	Family	Status as per WLP (Act) 1972	ÌUCN
83.	*Poropuntius burtoni*	Nung- nga	Cyprininae	Not listed	LC
84.	*Psilorhynchus balitora*	-	-do-	Not listed	LC
85.	*Psilorhynchus homaloptera*	-	-do-	Not listed	LC
86.	*Psilorhynchus micropthalmus*	Ngamu sengum	Psilorhynchidae	Not listed	LC
87.	*Puntius chola*	Phabou nga	Cyprininae	Not listed	LC
88.	*Puntius conchonius*	Phabounga	-do-	Not listed	LC
89.	*Puntius javanicus*	Japan puthi	-do-	Not listed	LC
90.	*Puntius jayarami*	Heikak-nga	-do-	Not listed	LC
91.	*Puntius manipurensis*	Ngakha meingangbi	-do-	Not listed	LC
92.	*Puntius phutunio*		-do-	Not listed	LC
93.	*Puntius sarana orphoides*	Nganoi, Ngahou	Cyprininae	Not listed	LC
94.	*Puntius sarana sarana*	-do-	-do-	Not listed	LC
95.	*Puntius sophore*	Phabou nga	-do-	Not listed	LC
96.	*Puntius stoliczkanus*	Phabou nga	-do-	Not listed	LC
97.	*Puntius ticto ticto*	Ngakha	-do-	Not listed	LC
98.	*Raiamas bola*	Ngawa Thengeng	Rasborinae	Not listed	LC
99.	*Raiamas guttatus*	Ngawa Thengeng	-do-	Not listed	LC
100.	*Rasbora rasbora*	Nung- nga	-do-	Not listed	LC
101.	*Schizothorax richardsonii*	Sana nga	Schizothoexcinae	Not listed	VU
102.	*Semiplotus manipurensis*	Ngakoi	-do-	Not listed	Data Deficient
103.	*Tor putitora*	Ngara	Cyprininae	Not listed	EN
104.	*Tor tor*	Ngara, Ngakreng	-do-	Not listed	-
105.	*Wallago attu*	Sareng	Siluridae	Not listed	VU

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

Note: WPA – Wildlife Protection Act, IUCN - International Union for Conservation of Nature, LC – Least Concern, NT – Near Threatened, VU – Vulnerable,

Photographs of Fish available in the Local Market of Imphal

U. SCHEDULE ANIMALS

135. The animals of the Imphal Valley has been grouped in to their respective schedules as per Wildlife (Protection) Act, 1972 and presented in **Table-56**.

Table-56 List of Schedule Animals of the Imphal Valley

Schedule	Species
Schedule I Part I: Mammals	Brow Antlered Deer-Cervus eldi eldi Mcclelland, Chinese pangolin- Manis pentadactyla, Giant Squirrel-Ratufa macroura,, Hoolok- Hylobates hoolok, Hog Badger-Arectonyx collaris, Leopard- Panthera pardus, Clouded Leopard-Neofelis nebulosa, Serow-Capricornis sumatraensis, Slow Loris-Nytecebus caucang, Swamp deer- Cervus duvauceli
Schedule I Part II: Reptiles & Amphibians	Pythons- Python Molurus, Indian Tent Turtle-Kachuga tecta tecta
Schedule I Part III: Birds	Assam Bamboo Partridge- Bambusicola flythcii, Hornbills-Buceros bicornis, Pied hornill-Anthracoceros malabaricus, Bar backed Pheasant-Syrmaticus humiae humiae, Pink Headed Duck-Rhodonessa caryophyllacea, Blyth's Tragopan- Tragopan blythii, Sarus Crane-, Mountain Quails- Ophrysia supercilliosa,
Schedule II	Porcupine- Atherurus mecrourus assamensis, Rhesus Macaque- Macaca mulletta, Wild Dog-Cuon alpinus, Chameleon- Chameleon calcaratus, Civet Cat, Common Fox-Vulpes bengalensis, Himalayan Black Bear-Selenarctos thibetanus, Jungle Cat-Felis chaus, Mongoose-Herpestes sp, Martens-Martes sp, Otters- Luthra luthra, Indian Cobras- Naja sp, Russel's Viper- Vipera russeli, Rat Snake- Monitor Lizard
Schedule III	Barking Deer- Muntiacus muntjac, Sambhar-Cervus unicolor, Wild Pig-Sus scrofa.
Schedule IV	Palm Squirrel- *Funambulus pennant,* Common Indian Porcupine-*Hystrix indica,* Fresh Water Frogs, - Cobras & Kratis, Birds like Ducks, Drongos, Egrets, Flowerpeckers, junglefowls, Kingfishers, Mynas, Pigeons & Doves, Sunbirds, Teals, Thrushes, Woodpeckers, Plovers, Quails Owls etc.
Schedule V	Common Crow, Fruit Bat, Mice, Rats
Schedule VI	Beddome's Cycad- Cycas beddomei, Blue Vanda-Vanda coerulea, Ladies Slippers-Paphiopedillum spp, Red vandal- Renanthera imschootiana

Source: Forest Working Plan, Central Forest Division, 2010-11 to 2019-20

136. It has been confirmed by the Forest Department that:

- There is no rare / endangered / unique species of flora and fauna / natural, modified and critical habitats of fauna found along the alignment and close vicinity of the Imphal Ring Road
- The proposed alignment does not cross any wildlife migration corridor as well as there is no elephant corridor, wildlife migration corridor etc., within 1 Km. from boundary of the forest land proposed for diversion
- **No road kill data of the area is available** with the Forest Department through which the proposed ring road alignment is passing.

V. PROTECTED AREAS

137. There is **no protected area** (Wildlife Sanctuary, National Parks etc.) within 10 km radius of the proposed alignment of Imphal Ring Road.

W. SENSITIVE RECEPTORS

138. **Physical Cultural Resources:** PCRs[4] are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Their cultural interest may be at the local, provincial or national level, or within the international community. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

139. **Archaeological Sites**: There are no archaeological sites within 300 m on either side of the proposed proposed alignment of Imphal Ring Road

140. **Educational Institutions:** Along the project road, there are 35 educational institutions out of which 2 schools namely Sikhsha HS School Canchipur & Delhi Public Senior School Canchipur are closed. Therefore, **33 educational institutions are operational**. Design chainage wise list of educational institutions along with distance from the center line of the project road are given in **Table-57**.

Table-57 List of Educational Institutions along the Project Road

S. N.	Name	Design Ch.	Side	Distance # (m)
Along the Proposed Ring Road alignment				
1.	Kyamgei Heibong Makhong HS Govt Aided School	0+325	LHS	15
2.	The Kiyamgei Ideal School	1+200	LHS	41
3.	Kunjabati Kids Foundation	7+000	LHS	23
4.	Meitei Mayek High School	7+450	LHS	12
5.	The Eden Public School	8+130	LHS	15
6.	Sherwood School	8+294	LHS	20
7.	Little Millennium School (play school)	8+475	RHS	24
8.	Primary School, Wangkhei Nangpok	8+990	LHS	15
9.	Shemrock Kids Garden	9+310	RHS	17
10.	Modern College Imphal	10+075	LHS	71
11.	Kongal Imphal Morning High School	10+800	RHS	33
12.	Porompat Girls high School	10+884	RHS	20
13.	Konsam Tomba and Sachi School	14+560	RHS	160
14.	Paramount English School	15+760	LHS	10
15.	Jamia Azizia Girls Islamic Institute	17+250	RHS	35
16.	Heingang Awang Leikai Primary School	21+100	RHS	11
17.	Maria Montessori School (12th)	25+000	RHS	241
18.	Savio English Higher Secondary School	33+930	LHS	12
19.	ICAR research complex for North Eastern Hill region Manipur Centre Imphal	34+750	RHS	80
20.	Dental Collage, RIMS	36+000	RHS	44
21.	College of Nursing, RIMS	36+100	RHS	39
22.	Central Agricultural University	37+214	LHS	97

[4] Definition as per World Bank Operational Policy (OP) 4.11

S. N.	Name	Design Ch.	Side	Distance # (m)
23.	College of Agriculture, Central Agricultural University Imphal	42+450	LHS	95
24.	Paree Imom Sindam Sang Preschool	43+121	RHS	16
25.	South Asian institute of rural and agricultural management	44+860	LHS	130
26.	HRD Academy, Ghari	47+450	RHS	124
27.	Manipur International University	47+684	RHS	81
28.	Kids Foundation	47+964	LHS	82
29.	S I School Canchipur	53+874	RHS	26
30.	Sikhsha HS School Canchipur (**Closed**)	53+910	LHS	30
31.	Delhi Public Senior School Canchipur (**Closed**)	54+125	Centre	0
32.	Standard Roberth Higher Secondary School	54+155	RHS	120
Spur alignment for JNMIS in Porompat				
33.	Ahongei Junior High School	1+025	RHS	75
34.	Chingangbam Leikai Upper Primary School	1+568	RHS	16
SPUR to RIMS				
35.	College of Nursing medical directorate	0+785	LHS	46

Distance in meter from propose centerline
Source: Field survey carried out by ICT Pvt. Ltd.

Photographs of Educational Institutions along the Project

141. **Religious Places:** Along the project road, there are **8 religious places**, out of which 4 religious places are located on the right side and 4 are located on the left side of the project road. Design chainage wise list of religious places along with distance from the center line of the project road are given in **Table-58**.

Table-58 List of Religious Places along the Project Road

Sl. No.	Name	Design Chainage	Side	Distance # (m)
Along the Proposed Ring Road alignment				
1	Temple	1+555	LHS	18
2	Langol Temple	38+400	RHS	80
3	Temple	40+050	LHS	32
4	Ibudhou Luwang Punshiba Temple	40+400	RHS	13
5	Church	41+350	LHS	175
6	Temple	42+940	LHS	15
7	Temple	45+400	RHS	219
8	Temple	47+609	RHS	35

Distance in meter from propose centerline
Source: Field survey carried out by ICT Pvt. Ltd.

Photographs of Religious Places along the Project Road

142. **Medical Facilities:** There are medical facilities at **7 locations** along the project road, out of which 2 are located on the right side and 5 are located on the left side of the project road. Design chainage wise list of medical facilities along with distance from the center line of the project road are given in **Table-59**.

Table-59 List of Medical Facilities along the Project Road

Sl. No.	Name	Design Chainage	Side	Distance# (m)
Along the Proposed Ring Road alignment				
1	Covid Hospital	1+039	LHS	20
2	Public Health Centre, Bashikhong	2+500	LHS	237
3	Public Health Centre, Heingang	18+600	LHS	333
4	Kripa Foundation	25+254	LHS	95
5	Catholic Medical Centre	25+800	LHS	40
Spur alignment for JNMIS in Porompat				
6	Jawaharlal Nehru Institute of Medical Sciences Porompat	0+534	RHS	38
Spur alignment for RIMS				
7	Regional Institute of Medical Sciences	0+815	RHS	150

Distance in meter from propose centerline
Source: Field survey carried out by ICT Pvt. Ltd.

Photographs of Medical Facilities along the Project Road

143. **Common Property Resources (CPR):** There are 28 common property resources i.e. community hall, crematorium ground, hand pump, market shed, sports complex etc. along the project road, out of which 17 are located on the right side and 11 are located on the left side of the project road. Design chainage wise list of CPR along with distance from the center line of the project road are given in **Table-60**.

Table-60 List of Common Property Resources along the Project Road

Sl. No.	Name	Design Chainage	Side	Distance# (m)
Along the Proposed Ring Road alignment				
1	Community Hall	0+450	LHS	14
2	Community Hall	1+000	LHS	20
3	Playground	1+260	RHS	83
4	Community centre	1+300	LHS	24
5	Crematorium Ground	1+475	RHS	10
6	Market Shed	1+530	RHS	13
7	Bus shelter	1+585	RHS	11
8	Community Hall	2+000	LHS	16
9	Crematorium	7+390	RHS	45
10	Community Hall	8+669	LHS	16
11	Market Shed	11+215	RHS	10
12	Community Hall	11+235	RHS	31
13	Waiting shed	17+244	RHS	23
14	Handpump	18+530	LHS	27
15	Handpump	20+975	RHS	8
16	Community Shed	23+160	LHS	9
17	Hand Pump	23+207	RHS	13
18	Royal Turf Footbal Ground	23+432	RHS	47
19	Handpump	32+190	RHS	0.3
20	Handpump	32+700	LHS	12
21	Community toilet	33+294	RHS	3

Sl. No.	Name	Design Chainage	Side	Distance# (m)
22	Crematorium	33+380	LHS	22
23	Pony Breeding Farm	33+700	RHS	43
24	Handpump	40+970	LHS	12
25	Manipur Polo Association	41+715	LHS	35
26	Community Hall	47+824	RHS	43
27	Sports Complex Chumthang	51+500	RHS	87
28	Sports Complex Football Ground	51+425	RHS	59

Source: Field survey carried out by ICT Pvt. Ltd.

Photographs of Common Property Resources along the Project

X. SOCIO-ECONOMIC PROFILE

144. The socio-economic information of displaced persons / affected presons has been collected from the census survey of hundred percent of the Affected Persons. The census survey of Imphal Ring Road section was carried out between 9th March 2021 to 9th April 2021 and the key findings are presented in the following section.

145. **Religion Categories of Affected Households: Social** customs and traditions play a major role in determining the socio-economic development as well as occupational pattern in the influence area, keeping this in mind an initial analysis has been conducted taking into account the religious profile of the DPs within the corridor of impact. In the project road majority of the AHs

belong to Hindu religion in both the phases, i.e., (84.05%) followed by Meitei religion (10.36%), Muslim (5.24%) and remaining (0.36%) could not be enumerated at few locations due to non-availability of people. **Table-61** delineates religious cluster of the affected Households.

Table-61 Religion Categories of the Affected Households

Sl. No.	Description of the Religion	Total	Percentage
1	Hindu	705	84.05
2	Muslim	44	5.24
3	Meitei	88	10.36
4	NA/NR	3	0.36
Total		**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

146. **Social Categories of the Affected Households:** The social stratification of the project area shows that (65.36%) are from general category, (31.79%) are from other backward caste (OBC). The others (2.50%) are from scheduled caste (SC) and remaining 0.35% of households did not respond during the census survey. The details of social grouping in the project area is presented in **Table-62**

Table-62 Social Categories of the Affected Households

Sl. No.	Description of the Caste	Total	Percentage
1	General Caste	549	65.36
2	Other Backward Caste	267	31.79
3	Scheduled Caste	21	2.5
5	NA/NR	3	0.35
Total		**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

147. **Number of Project affected Persons:** 4829 DPs are being affected by the project, which includes 2347 males and 2482 females. The average household size is 5.75. The details of DPs being affected in the project are summarized in **Table-63**.

Table-63 Number of Project Affected Persons

Sl. No.	Categories of Households	Total	Percentage
1	Male	2347	48.6
2	Female	2482	51.4
Total		**4829**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

148. **Annual Income Level of the Affected Households:** The DHs falling within the corridor of impact were divided into different annual income groups. As per GOM, the income below poverty line ((BPL Level) is Rs. 27,000. According to the social survey, a majority of households (54.40%) have reported their annual income in the range Rs. above 200,001 and (31.43%) in Rs.

100,001 to 200,000 category, while 2.6% populations are below poverty line. The detail of income categories of DHs, enumerated here has been mentioned in **Table-64**.

Table-64 Annual Income Level of the Affected Households

Sl. No.	Annual Income Categories in (Rs.)	No. of Households	Percentage
1	Up to 27000 (BPL)	22	2.62
2	27001 to 50,000	1	0.12
3	50,001 to 100,000	26	3.1
4	100,001 to 200,000	264	31.43
5	Above 200,001	457	54.4
6	NA/NR	70	8.33
Total		**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

149. **Impact on Indigenous and Vulnerable Households:** The findings of the social impact assessment indicate that 149 vulnerable households are affected by the project. Moreover, there are no adverse impact on the tribal groups or indigenous people within the area of influence of the project road, and the project area does not fall within the defined Scheduled Area where specific actions like preparation of Tribal Development Plan (TDP) as per the national/ state policy and legislation are concerned. 8 scheduled caste (SC) households, 10 women headed households (WHHs) and 60 aged people of TH category have been identified as affected by the project. All the non-titleholders will be treated as vulnerable households and special assistance will be provided as per the provisions of this RP. The details of vulnerable households of different categories are delineated in **Table-65**.

Table-65 Categories of Vulnerable Households

Sl. No.	Vulnerable Categories		No. of Households	Percentage
1	THs	Schedule Cast	8	5.37
		Women Headed Household	10	6.71
		Physically Handicapped	0	0
		Aged persons (65+)	60	40.27
		BPL	1	0.67
2	NTHs		70	46.98
Total Vulnerable Households			149	**17.74**
Non-vulnerable HHs			**691**	**82.26**
Total Displaced households			**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

150. **Educational Status of the Affected Households:** A significant percentage of the displaced persons (27.98%) are graduate, (23.33%) are of 10th standard, (16.67%) are 12th standard and 10.24% are above graduate. However; 7.02% persons are illiterate. The details are as follows:

Table-66 Educational Status of Affected Households

Sl. No.	Educational status	No. of Households	Percentage

1	Illiterate	59	7.02
2	Elementary	114	13.57
3	10th Pass	196	23.33
4	12th Pass	140	16.67
6	Graduate	235	27.98
7	Above graduate	86	10.24
8	NA/NR	10	1.19
Total		**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

151. **Occupational Status of Affected Households:** The project road is dominated by families involved in agriculture activities. Out of total 840 displaced households, 554 are engaged in agriculture for their livelihood. 172 are engaged in business activities 45 DHs belongs to service class activities, 38 are engaged in labour activities, 20 are self-employed, while the occupational status of 11 households could not be ascertained due to their absenteeism. The details of occupation pattern of affected households are tabulated in **Table-67.**

Table-67 Occupational Status of Affected Households

Sl. No.	Occupational Sstatus	No. of Households	Percentage
1	Agriculture	554	65.95
2	Service	45	5.36
3	Business	172	20.48
4	Labour	38	4.52
5	Self-employed	20	2.38
6	Others	11	1.31
Total		**840**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

V. ANALYSIS OF ALTERNATIVE

A. INTRODUCTION

152. Three alignment options have been studied for the Ring Road around Imphal town with each option consisting of segments of existing road network in Imphal City and also sections where new green field alignment is proposed to minimize impact on settlements of town. These options have been formulated taking into account the various obligatory points i.e. Manipur University, D.C (Imphal East and Imphal West) office, JNIMS Hospital on Imphal Porompat road, Civil Secretariat and High Court Complex on NH-02, Inter State Bus Terminus, Assembly Secretariat, RIMS hospital, Takyel Industrial Estate, FCI Godown, Ningthemcha Karong on Imphal as given in Terms of Reference (TOR). These options are discussed below.

B. IMPROVEMENT PROPOSAL

153. **Option I:** The alignment option starts near Manipur University at National Highway 102 (Old-39) at Km 327+125 approx. 7.0 km from Imphal City Center crossing Leissang hiden canal and traverses eastward along existing local road for approx. 400m further the alignment is new greenfield section for approx. 5.4 km and connects Kongba Bazar. The alignment crosses Bashikhong Road at Km 1+400.Further alignment traverse along existing Ayangpalli road crossing junction to DC East Imphal Office and junction in front of JNMIS in Porampat upto Km 9+945.Then the alignment turns right side on the existing road to Doordarshan Kendra, Imphal (DDK). Alignment further crossing Kongpal Lekai Road is new green field alignment for approx. 2 Km. Alignment further takes left turn towards existing Chaithabi Road passing via Salanthong Bridge and further following approx. 300m from bridge along existing road deviates and is a green field alignment for approx. 5 km before it connects existing Asian Highway 1 (AH 1)/National Highway 2 (Old NH-39). Alignment further is common portion with AH 1 for approx.3.6 km, further alignment at Chaithabi Leirak Junction deviates towards hills and is new proposed alignment for approx. 0.50 km and continues along existing narrow road before reaching Fishery Crossing. After fishery crossing the alignment follows the existing new road in front of RIMS and Irrigation office. Further the alignment is proposed to traverse in front of Games Village and in front of Central Agricultural University and Iroisemba Zoo along existing narrow road and crosses existing Imphal Kangchup road and further is a new alignment for approx. 8.5 Km and cross National Highway 37 (Old NH 53) and NH 2(Old NH 150) near Imphal Airport. The alignment traverses though green field upto crossing of SH 10 near Langthabal and further continues along existing local road upon crossing Nimbul River and terminates at NH 102 at start point of the project. This option involves 4 spur alignments connecting to Assembly Secretariat & ISBT (1.400km), DC Imphal East office (1.25 km), RIMS hospital (0.81km) and FCI Godown (1.08km). The **total Ring road length of this option is about 43.00 km** whereas the total length for improvement is about 39.40 km excluding existing AH 1 of 3.6 km (**Figure-21**). New green field alignment for the above option is about 23.085 Km. Based on traffic study the project road shall be four lane divided carriageway for 11.40 km which includes a 4 lane Flyover on NH 150 and two lane with paved shoulder for 28 km.

154. **Option II:** The alignment option starts near Manipur University at National Highway 102 (Old-39) at Km 327+125 approx. 7.0 km from Imphal City Center crossing Leissang hiden canal and the alignment in general follows the alignment as discussed above in option I upto km 12+500. After crossing Lamlong-Tinsid Road and before taking left turn towards existing Chaithabi Road, the alignment further traverse about 1 km in green field upto Angom Leikai and meets NH 202 (Old-150) at about km 460+715 near Konsam leikai. Alignment further is common portion with NH 202 (Old-150) for approx.0.92 km length towords south side upto Chaithabi

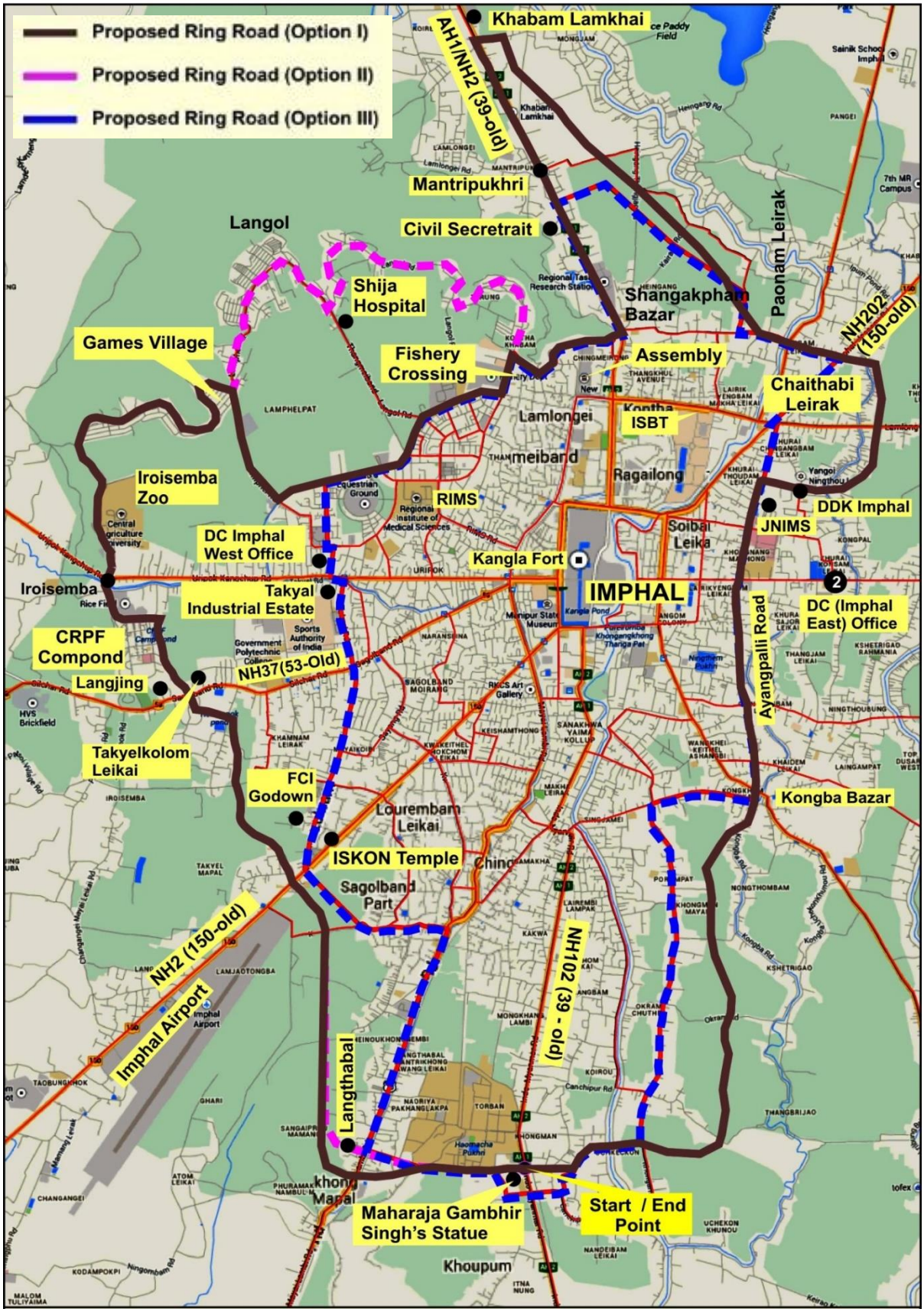
Junction with NH 202. Further the alignment follow the alignment as discussed for option I upto end of Thangameiband leikai and Fishery road Crossing. Then, the alignment follows the existing road along the the foothill through Kontha Khabam, Tarung, Shija Hospital, back side of proposed Imphal NIT campus and meets option I at junction of Games village I. Further the alignment follows the existing road upto Imphal - Kanchup – Tamenglong road and crosses Nimbul River before approaching to CRPF road. Then, the alignment follows the existing road along CRPF campus upto crossing of NH 37 (Old-53) at about Km 5+440 near Langjing and further follows the existing village road to Taobungkhok for a length of 0.9 Km. Then the alignment takes left turn along the existing Sangaipour village road to FCI Godown for a length of about 1.4 km. After taking right turn before FCI Godown, the alignment traverse through green field and crosses NH 2 (Old 150) near Imphal Airport and upto crossing of SH 10 near Langthabal. Further the alignment continues along existing local road upon crossing Nimbul River and terminates at NH 102 at start point of the project. The option involves 3 spur alignments connecting to Assembly Secretariat & ISBT (1.4km), DC Imphal East office (1.25 km) and FCI Godown (1.08km).

155. The **total length of this option for Ring road is about 46.635 km** whereas the total length for improvement is about 41.94 km excluding existing AH 1 and NH 202 of 4.695 km. New Green field alignment for this option is about 18.04 Km. Based on traffic study the project road shall be four lane divided carriageway for 12 km which includes a 4 lane Flyover on NH 150 and two lane with paved shoulder for 29.94 km (**Figure-21**).

JNIMS on Ayangapalli Road

Ring road on foothill near Games Village

Figure 21 Map Showing Option-I, Option-II & Option-III of Proposed Imphal Ring Road (Year 2014)



156. **Option III:** This option is about **33.39 km long**. The alignment in this option also starts near Manipur University at National Highway 102 (Old-39) at Km 327+400 approx. 7.0 km from Imphal city center crossing Leissang hiden canal further connecting key obligatory points identified in the Terms of Reference and terminating at the same point. Alignment ferries in and around Imphal town only and would play vital role in decongesting traffic in inside block and further allowing city traffic quick access to key installations within city. This option involves 4 spur alignments connecting to Assembly Secretariat and ISBT (1.376 km), DC Imphal East office (1.25 km), Doordarshan Kendra (0.42km) and RIMS hospital (0.81km). The total length of this option for Ring road is about 33.39 km whereas the total length for improvement is about 30.84 km excluding existing AH 1 and NH 202 of 2.55 km. New alignment for the above option is about 4.7 Km. Based on traffic study the project road shall be four lane divided carriageway for 26.74 km and two lane with paved shoulder for 4.10 km (**Figure-21**).

ISBT near Manipur Assembly

Ring road crossing location with NH 2 (Old 150)

C. EXISTING PAVEMENT CONDITION

157. Following have been observed during the reconnaissance survey with regard to road condition along the existing road sections, which potentially would fall on the various alignment options:

158. **Alignment Option-I** (Total length 43 km): Length of existing road segments – 19.915 km and length of green field stretches – 23.085 Km, both intermittently.

- The existing lane configuration is 12.6 km of single/Intermediate lane, 3.7 km of two-lane, and 3.6 km of four – lane (NH-39) flexible pavement and remaining length is Greenfield.
- Road condition is poor to fair; it is good only in 4-lane section on NH-39 (which is out of scope here).
- Minor settlement and patching distress, Rutting was observed along the project corroder, except in four lane section.
- Waterlogging sections are observed between km 8+500 to km 10+300 and km 24+300 to km 28+600.

159. **Alignment Option-II** (Total length 46.635 km): Length of existing road segments – 28.595 km and length of green field stretches – 18.04 Km, both intermittently.

- The existing lane configuration is 20.2 km of single/Intermediate lane, 4.62 km of two -lane, and 3.775 km of four – lane flexible pavement and remaining length is Greenfield.
- Road condition is poor to fair; it is good only in 4-lane section on NH-39 (which is out of scope here). Also, the 1-km stretch of NH-150 falling on alignment is not considered here.
- Minor settlement and patching distress, Rutting was observed along the project corroder, except in four lane section.
- Waterlogging sections are observed between km 8+500 to km 10+300.

160. **Alignment Option-III** (Total length 33.500 km): Length of existing road segments – 28.7 km and length of green field stretches – 4.8 Km., both intermittently.

- The existing lane configuration is 14 km of single - lane, 13 km of two-lane, and 2 km of four – lane flexible pavement.
- Road condition is poor to good in these sections.
- Minor settlement and patching noted in some sections of the existing pavement.
- Edge drop was observed.
- Rutting was observed at some sections along the project corridor.

161. Based on the observations made during pavement condition survey, its distress condition is assessed in accordance with the criteria of classification specified in Clause 4.2.1 of IRC: 81-1997. A summary of the existing pavement condition is provided in **Table-68**.

Table-68 Existing Road Condition

Sl. No.	Chainage (km)		Section Length (Km)	Pavement Condition (based on criteria for classification of pavement section as per IRC: 81-1997	Carriage way Width (m) / Lane Configuration
	From	To			
Greater Imphal Ring Road (Alignment Option-I)					
1	0+000	0+400	0.400	Poor	2.5
2	0+400	5+800	5.400	Cultivated Land / New Alignment	-
3	5+800	6+160	0.360	Very Poor	2.6
4	6+160	9+865	3.705	Poor - Fair	6.0
5	9+865	10+280	0.415	Fair - Poor	
6	10+280	12+650	2.370	Cultivated Land / New Alignment	-
7	12+650	13+000	0.350	Fair - Poor	3.7
8	13+000	13+900	0.900	Fair - Poor	
9	13+900	18+400	4.500	Bypass / Greenfield	-
10	18+400	18+650	0.250	Fair	5.5
11	18+650	22+250	3.600	Good	14
12	22+250	23+800	1.550	Poor	WBM Road
13	23+800	26+100	2.300	Poor	3.75
14	26+100	28+600	2.500	Greenfield	-
15	28+600	29+600	1.000	Poor	5.5
16	29+600	30+100	0.500	Good	4.2
17	30+100	32+600	2.500	Good	3.75
18	32+600	33+100	0.500	Very poor	3.75

Sl. No.	Chainage (km)		Section Length (Km)	Pavement Condition (based on criteria for classification of pavement section as per IRC: 81-1997	Carriage way Width (m) / Lane Configuration
	From	To			
19	33+100	34+700	1.600	Greenfield	-
20	34+700	34+900	0.200	Fair	3.75
21	34+900	41+700	6.800	Greenfield	-
22	41+700	42+600	0.900	Fair	3.75
23	42+600	43+000	0.400	Greenfield	-
Greater Imphal Ring Road (Alignment Option-II)					
1	0+000	0+400	0.400	Poor	2.5
2	0+400	5+800	5.400	Greenfield	-
3	5+800	6+160	0.360	Poor	2.6
4	6+160	9+865	3.705	Poor	6
5	9+865	10+280	0.415	Poor	Waterlogged
6	10+280	13+315	3.035	Greenfield	-
7	13+315	14+235	0.920	Poor - Fair	7
8	14+235	15+170	0.935	Poor - Fair	3
9	15+170	19+970	4.800	Greenfield	
10	19+970	23+745	3.775	Fair	14
11	23+745	25+200	1.455	Poor	WBM Road
12	25+200	28+480	3.280	Poor	3.75
13	28+480	30+000	1.520	Fair - Poor	5.5
14	30+000	30+500	0.500	Good	4.2
15	30+500	33+000	2.500	Good	3.75
16	33+000	34+000	1.000	Very poor	3.75
17	34+000	35+700	1.700	Fair	3.75
18	35+700	36+365	0.665	Good	5.5
19	36+365	40+100	3.735	Poor - Fair	3.75
20	40+100	44+500	4.400	Greenfield	--
21	44+500	46+300	1.800	Fair	3.75
22	46+300	46+635	0.335	Greenfield	--
Greater Imphal Ring Road (Alignment Option-III)					
1	0.000	0.250	0.250	Poor	3.75
2	0.250	1.540	1.290	Cultivated Land / New Alignment	--
3	1.540	3.000	1.460	Fair	5.50
4	3.000	5.500	2.500	Poor	3.60
5	5.500	7.000	1.500	Fair	6.00
6	7.000	11.000	4.000	Poor	6.00
7	11.000	13.000	2.000	Fair to Good	5.50 to 7.00
8	13.000	13.700	0.700	Poor	3.70

Sl. No.	Chainage (km)		Section Length (Km)	Pavement Condition (based on criteria for classification of pavement section as per IRC: 81-1997	Carriage way Width (m) / Lane Configuration
	From	To			
9	13.700	16.200	2.500	Cultivated Land / New Alignment	--
10	16.200	18.000	1.800	Good	Four Lane
11	18.000	25.500	7.500	Poor	3.75
12	25.500	27.000	1.500	Good	7.00
13	27.000	28.000	1.000	Cultivated Land / New Alignment	--
14	28.000	29.000	1.000	Fair	3.00
15	29.000	31.500	2.500	Good	7.00
16	31.500	33.500	2.000	Fair	3.75

Source: DPR Prepared by ICT Pvt. Ltd.

D. RECOMMENDED ALIGNMENT - 2014

162. During Feasibility study in the 2014, three alignment options have been studied for the Ring Road around Imphal town as discussed above. Each option consisting of segments of existing road network in Imphal City and also section ns where new green field alignment is proposed to minimize impact on settlements of town. These options have been formulated taking into account the obligatory points given in Terms of Reference (TOR).

163. After careful consideration & site visits of Group of Ministers, the **alignment Option II** having a length of 46.635 km (Including NH-202 & AH-1- 4.695Km) and three Spur alignments **has been approved** by the Client due to its better connectivity vide email dated 19th July 2014 and vide letter no. 14/PD/NESRIP/SASEC/2013/166 dated **01.10.2014.** The common portion of NH-202 & AH 1 was excluded from improvement. The **Draft DPR, based on Option-II was submitted in the year 2014**.

E. REVISED ALIGNMENT - 2015

164. Further upon several review meetings and presentation post Draft DPR submission, with concerned decision makers', minor modifications have been made in the alignment and incorporated in the Final DPR improvement proposal. The revised alignment, which was approved during Final DPR stage vide letter number 52/5/2014/-W(SASEC)pt. dated **7th February 2015**, consist of aggregate length of **47.961 Km** (includes NH-202 & AH 1- 4.62 Km) and two spur alignment with aggregate length of 1.655 Km. The common portion of NH-202 & AH 1 was excluded from improvement.

165. ***Revised Alignment:*** The alignment starts near Manipur University at National Highway 102 (Old-39) at Km 327+125 approx. 7.0 km from Imphal City Centre crossing Leissang hiden canal and traverses eastward along existing local road for approx. 400m further the alignment is new greenfield section for approx. 5.6 km and connects Kongba Bazar.

166. The alignment in this stretch crosses Bashikhong Road at Km 1+400 and Imphal River at Km 1+026. Further alignment traverse right towards DC East Imphal Office and crosses existing Leikai river at 10+340 and further turns left and is green field alignment for approx.3.4 km till it crosses Kongpal Lekai Road and further connects with NH 202 (Old-150) at about km 460+715 near Konsam leikai. Alignment further is common portion with NH 202 (Old-150) for approx.0.92

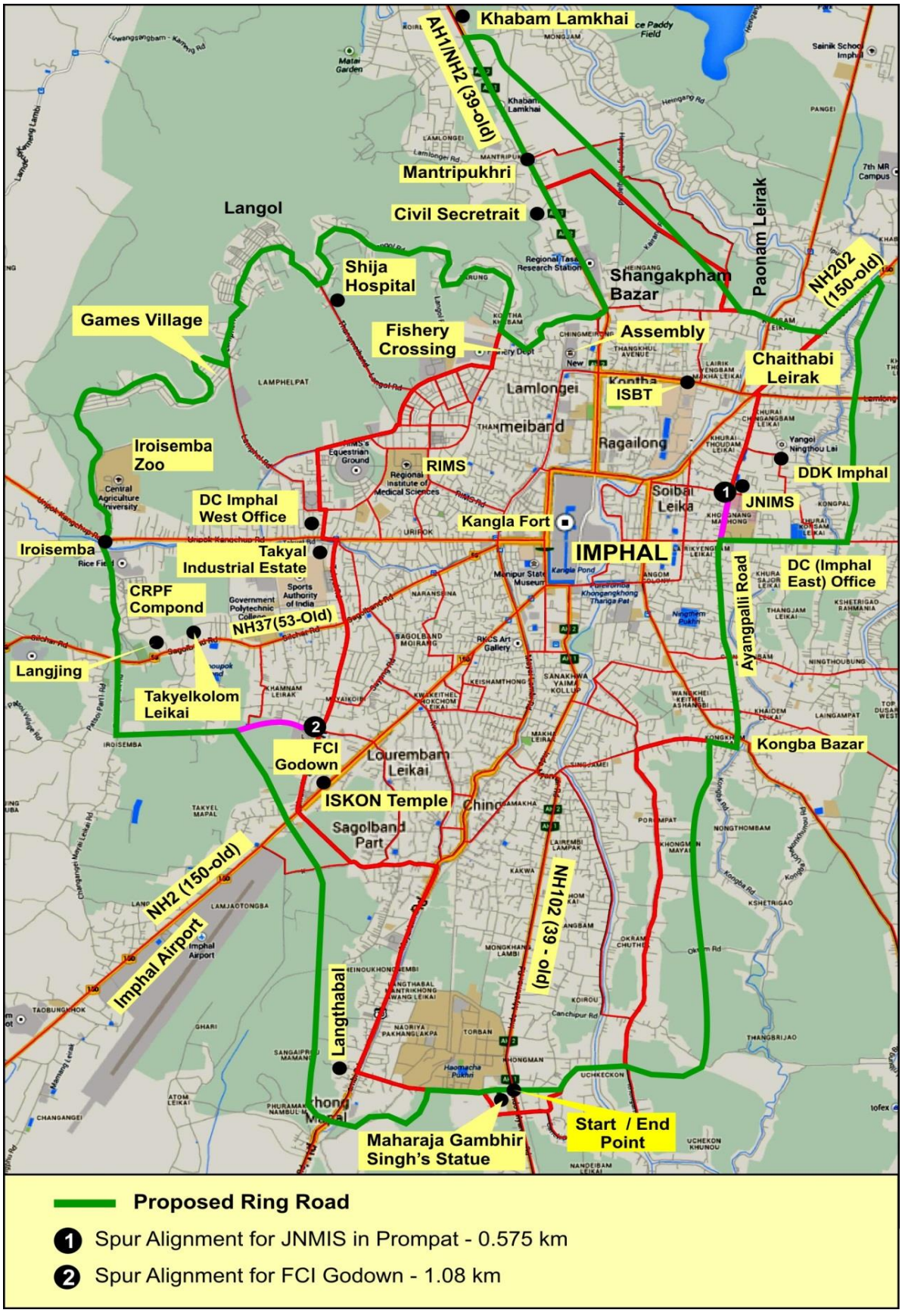
km length towords south side upto Chaithabi Junction with NH 202. Alignment further takes right turn from NH 202 towards existing Chaithabi Road passing via Salanthong Bridge over Imphal River at Km 15+433 and further follows approx. 300m from bridge along existing road and then deviates through green field alignment for approx. 5 km before it connects existing Asian Highway 1 (AH 1)/National Highway 2 (Old NH-39). Alignment further is common portion with AH 1 for approx. 3.7 km upto Shangakpham road junction. The alignment at Shangakpham road junction deviates towards hills and is new proposed alignment for approx. 0.50 km and continues along existing narrow road on the backside of Manipur Assembly before reaching Junction with Thangameiband leikai/Fishery road.

167. Then, the alignment follows the existing road along the the foothill through Kontha Khabam, Tarung, Shija Hospital, back side of proposed Imphal NIT campus and meets Games village junction at Km 32.250. Further the alignment follows the existing road along the foothill upto Imphal - Kanchup – Tamenglong road at Km 36+700 and crosses Nimbul River at Km 36+800 before approaching to CRPF road. Then, the alignment follows the existing road along CRPF campus upto crossing of NH 37 (Old-53) at Km 38+240 (Km 5+440 of NH 37) near Langjing and further follows the existing village road to Taobungkhok for a length of 0.94 Km. Then the alignment takes left turn along the existing Sangaipour village road towards FCI Godown for a length of about 1.4 km. After taking right turn before FCI godown, the alignment traverse through green field and crosses NH 2 (Old 150) at Km 41+700 (Km 458+620 of NH 2) near Imphal Airport and further continues as greenfield alignment upto crossing of SH 10 at 45+700 near Langthabal. Further the alignment continues along existing local road upon crossing Nimbul River at Km 45+770 and backside of Manipur University and terminates at NH 102 at start point of the project.

168. The revised alignment involves 2 spur alignments connecting to JNIMS in Prompat (0.575 Km) and FCI Godown (1.08km).

169. The total length of this option for Imphal Ring road is about 47.961 km whereas the total **length for improvement is about 43.341 km** excluding existing AH-1 and NH-202 of 4.62 km. New Green field alignment for this option is approx. 20.906 Km. Based on traffic study, the Client has decided that, the project road shall be four lane divided carriageway for 10.70 km which includes a 4 lane Flyover on NH 150 and two lane with paved shoulder for 32.641 km. The revised alignment option has been shown in **Figure-22.**

Figure 22 Map Showing Revised Option of Proposed Imphal Ring Road (Year 2015)



F. REVISED ALIGNMENT - 2020

170. Further PWD, Manipur in the beginning of year 2020, desired further revision in the alignment of Imphal ring road, to ensure connectivity to some additional vital installations of city and further ensure benefits and quick access to such installations to larger population. As per the revised alignment the proposed improvement **length of Imphal ring road is about 46.785 Km** whereas the aggregate length is about 53.180 Km (includes NH 202 & AH 1- 6.395 Km). The length of SPUR to JNIMS is 0.575 km and SPUR to FCI is about 1.08 Km.

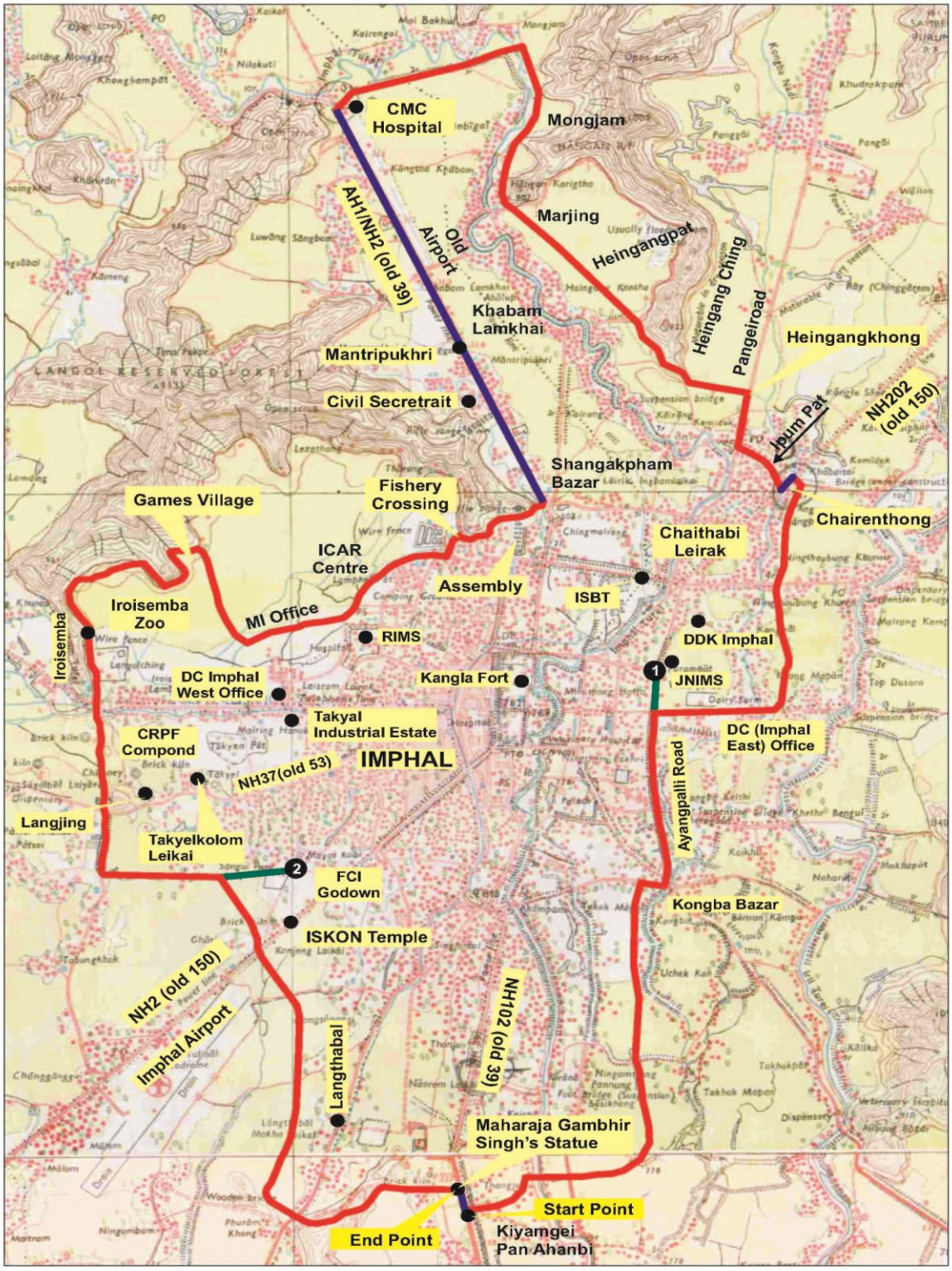
171. ***Revised Alignment:*** The alignment starts near SR Higher secondary School from NH-102 (Old-39) at Km 327+410 approx. 7.0 km from Imphal City Centre. Then it traverses eastward along existing local road for approx. 400m and then crosses Imphal River. Further the alignment traversed towards north side in Greenfield for approx. 5.0 km and connects Kongba Bazar. Then it traverse right towards DC East Imphal Office, crosses existing Leikai river at 10+375, turns left and then traversed in green field for approx.3.4 km and connects with NH 202 (Old-150) at about km 460+715 near Konsamleikai. Then there is a common section with NH 202 (Old-150) for approx.0.25 km length.

172. Thereafter, the alignment takes right turn from NH-202 along existing *Ipum pat Road* up to Khurai Heigrumakhong and takes right turn along Imphal Pongei Road for a length of about 0.8 Km. Then the alignment takes left turn towards Heingang Pengai road and follows the existing road up to Heingang (Km 17+700). Further the alignment passes through the green field area on the downstream of Heingang lake for a length of about 2.39 km and the alignment in this section is almost parallel to Imphal River. The alignment then follows the existing single lane road on the foothill and parallel to Imphal River up to the crossing of Imphal River near (Km 22 + 600). After crossing Imphal River, the alignment follows the existing single lane road up to AH-1 /NH-2 (Old NH-39). In this section also the alignment is parallel to Imphal River.

173. Alignment has common portion with AH-1 for approx.6.15 km upto Shangakpham road junction. The alignment at Shangakpham road junction deviates towards hills and traverses for approx. 1.50 km along existing narrow road on the backside of Manipur Assembly before reaching Junction with Thangameibandleikai, then turns left near Thangmeiband Polo ground (km 32+600) and connects Thangmeiband Lengai road Kontha Khabam. Further the alignment follows the existing road up to TIMS Hospital. The alignment takes right turn near Chief Electoral Office and joins the Games village road (Km 37+450).

174. Then it follows the existing road along the foothill upto Imphal - Kanchup – Tamenglong road at Km 41+900, crosses Nimbul River at Km 42+000 and follows the existing road along CRPF campus upto crossing of NH 37 (Old-53) at Km 43+432 near Langjing and follows the existing village road to Taobungkhok for a length of 0.94 Km. Then the alignment takes left turn along the existing Sangaipour village road towards FCI Go-down for a length of about 1.4 km. After taking right turn before FCI Godown, the alignment traverse through green field and crosses NH 2 (Old 150) at Km 46+885 near Imphal Airport and further continue as green field alignment upto crossing of SH 10 at 50+887. Tthe alignment crosses Nimbul River at Km 50+979, runs along the foothill, follows the existing road on the backside of Manipur University and terminates at NH-102. The Ring Road alignment involves 2 spur alignments connecting to JNIMS in Prompat (0.575 Km) and FCI Go-down (1.08km). The revised alignment option has been shown in **Figure-23.**

Figure 23 Map Showing Revised Option of Proposed Imphal Ring Road (Year 2020)



Proposed Ring Road - 47.1 km (approx.) excluding common sections.

Common Section SPUR Alignment

1 Spur Alignment for JNMIS in Prompat - 0.575 km (approx.)

2 Spur Alignment for FCI Godown - 1.08 km (approx.)

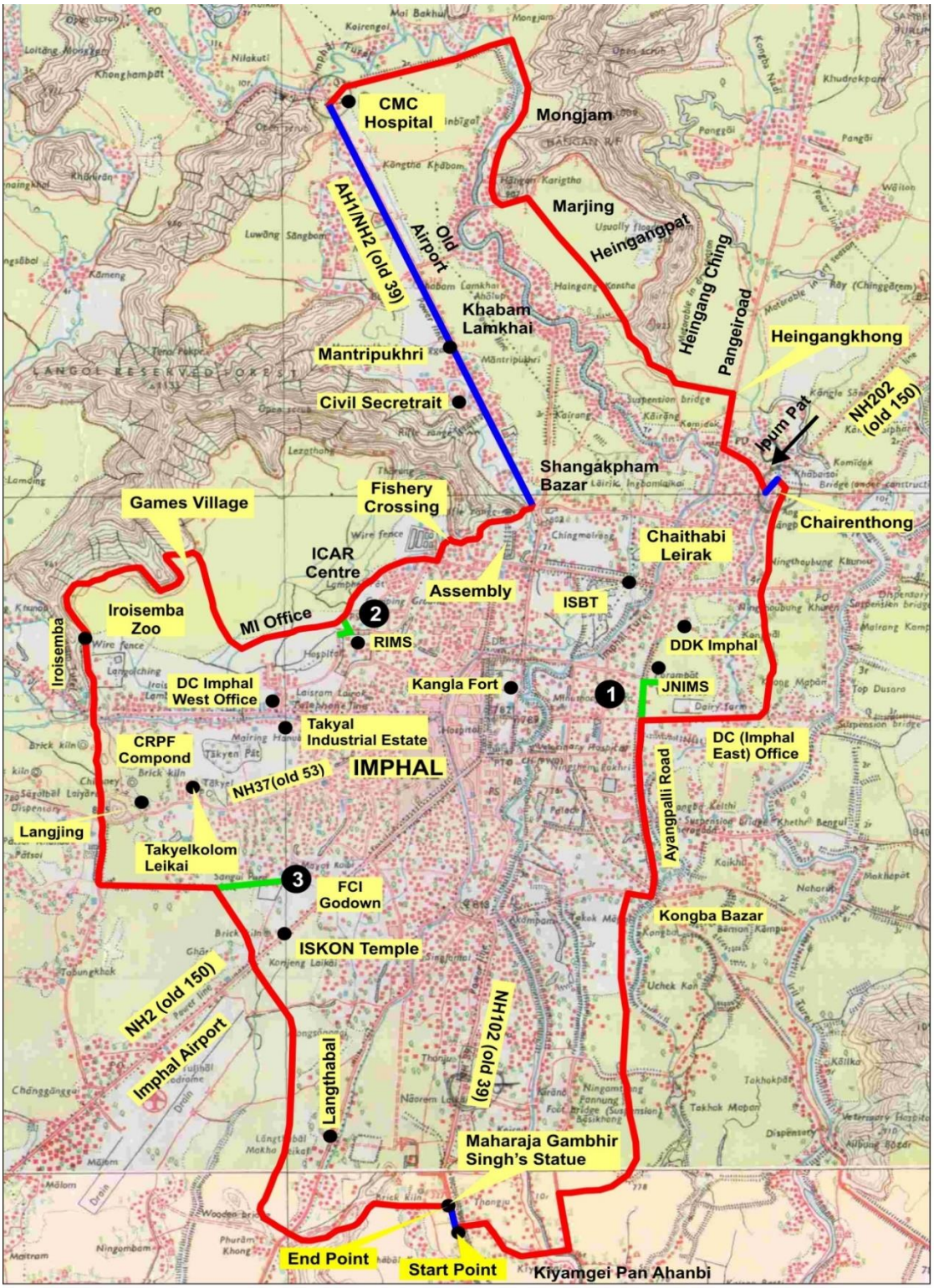
G. FINAL ALIGNMENT - 2021

175. The **revised Draft DPR was submitted in May 2020** incorporating the changes. In compliance to the comments and suggestion from Government of Manipur to minimize the private land acquisition, the **alignment further revised** and PROW width has been reduced. The alignment from km. 0+300 has been deviated towards Bashiklong village and joins to the old alignment at km 1+900. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is **47.765 Km.** Further, the length of SPUR to JNIMS / DDK is **1.570 km**, SPUR to RIMS is about **0.815 Km** and SPUR to FCI is about **1.080 Km.** Therefore, **total length of improvement including Imphal Ring Road and three SPURs are 51.230 km.**

176. The Final DPR incorporating the above changes; was submitted in the month of June 2021. The final alignment of Imphal Ring Road comprising of different roadway segments and the obligatory points is shown in **Figure-24**. This IEE report has been prepared for the final approved alignment of Imphal Ring Road.

177. After submission of updated Final DPR for Imphal Ring Road, based on land acquisition status, PWD, Manipur decided to implement the project in three packages.

Figure-24 Map Showing Final Alignment of the Imphal Ring Road (Year 2021)



Proposed Ring Road - 47.765 Km (approx.) excluding common sections.

Common Section **SPUR Alignment**

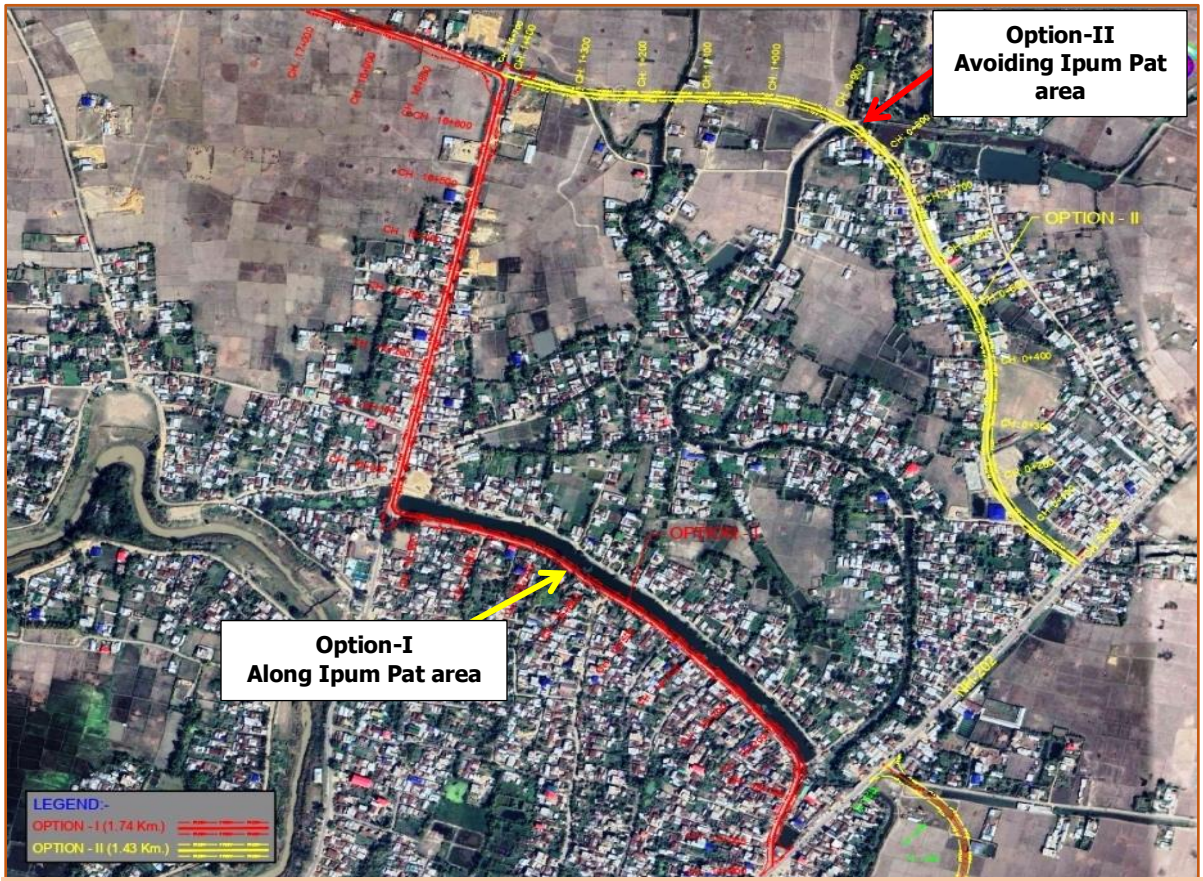
1 Spur Alignment for JNMIS in Prompat - 1.570 Km (approx.)

2 Spur Alignment for RIMS - 0.815 km (approx.) 3 Spur Alignment for FCI Godown - 1.08 km (approx.)

H. ALTERNATIVE ALIGNMENTS OF KONSAM LEIKAI (IPUM PAT AREA)

178.. Two options were studied for Konsam Leikai (Ipum Pat area). Option-I is along the Ipum Pat area and Option-II is from NH-202 to Heingangkhong, avoiding the Ipum Pat area (**Figure-25**). A comparative analysis of both the options is given in **Table-69**.

Table-69 Comparative Analysis of Alternative Alignments of Konsam Leikai



Components	Option-I (along Ipum pat)	Option-II (avoiding Ipum Pat)
Length (km)	1.74	1.43
Existing section (km)	1.74	0.875
Green field section (km)	0	**0.55**
Addl. private land acquisition (ha)	0.040	**0.77**
No. of structure to be demolished	6	**23**
Addl. Cross Drainage (CD) Structure required	0	**3**
Tentative Cost of addl.CD Structure (in Cr.)	0.00	**11.21**
Tentative Civil Cost (in Cr.)	32.09	26.28
Overall Cost (in Cr.)	32.09	**37.49**

179. After careful consideration, site visits and detailed study, **Option-I** (along the Ipum Pat) **has been recommended because it is economically viable option with minimum social impact**.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. MATRIX METHOD FOR IMPACT IDENTIFICATION

A.1 Matrix Model

180. Interaction matrix method (based on matrix developed by Leopold et. al.) has been used for evaluation of impacts. Usage of matrices for impact evaluation is highly effective[5]. In this matrix, each action and its potential for creating an impact on each environmental item has been considered. The potential for an action for creating an impact is expressed in terms of its magnitude and importance. The "magnitude" of an interaction is its extensity or scale and is described by the assignment of a numerical value from 1 to 5, with 5 representing the largest magnitude and 1 the smallest magnitude. Values near 3 represent impacts of intermediate extensity. Assignment of a numerical value for the magnitude of an interaction is based on objective evaluation of facts related to the anticipated impacts. The "importance" of an interaction is related to its significance, or an assessment of the probable consequences of the anticipated impact. The scale of importance ranges from 1 to 10, with 10 representing a very important interaction and 1 an interaction of relatively low importance. Assignment of the numerical importance value is based on the subjective judgment. Summation of the number of rows and columns multiplied with importance factor offers insight into the impact assessment.

181. The Leopold Matrix have also been utilised to identify beneficial as well as detrimental impacts through use of appropriate designators, such as plus and minus signs. In addition, it has been employed to identify impacts at various temporal phases of the project, such as construction phase and operation phase. Various socioeconomic factors have also been considered the matrix.

A.2. Scale

182. Scales have been used to describe the probability of occurrence of an impact, with the scale ranging from low to intermediate to high probability of impact. Impact scales also refers the extent of potential reversibility associated with a beneficial and detrimental impact. Higher values are associated with irreversible impacts while lower values refer the potential reversibility. Three levels of magnitude (less/medium/severe) have been considered in the matrix. Major interactions have been assigned maximum numerical scores with minor interactions being assigned minimal scores. Impact score or "magnitude" ranges from 0 to 5 with positive and negative values, depending upon the impacts arising out of the project activity. Score of each of the component has been multiplied by the "importance factor" and the total score has been obtained by summation of the products. Severity criteria of magnitude of impact are provided in **Table-69**. The score ranges of the impact evaluation based on the matrix score is provided in **Table-70**. The Impact Evaluation Matrix is presented in **Table-71**.

Table-69 Severity Criteria for Magnitude of Impacts

[5] a. Environmental Impact Assessment, Larry W. Canter, University of Oklahoma
b. A Critical Survey of Methods for Environmental Impact Assessment, Bisset R., Oxford 1983
c. Methods of Environmental Impact Analysis: Recent Trends & Future Prospects, Journal of Environment Management Vol 11, 1980

S. N.	Category	Description of Category	Impacts	
			Adverse	Beneficial
1	No appreciable impact	Short term, reversible	-1	+1
2	Significant impact	Long term, reversible	-2	+2
3	Major impact	Irreversible but of lesser extent	-3	+3
4	High Impact	Irreversible but of medium extent	-4	+4
5	Permanent Impact	Severe Irreversible impact	-5	+5

Table-70 Score Ranges for Beneficial and Adverse Impacts

SN	Total Score	Outcome
	+ve / -ve	Beneficial impact/Adverse Impact
1	0-300	No appreciable beneficial/adverse impact
2	**300-600**	**Appreciable but reversible adverse impact- mitigation measures are needed**
3	600-900	Significant adverse impacts; most of impacts are reversible. Mitigation measures are crucial
4	900-1200	Major adverse impacts; most of the impacts are irreversible. Alternative site selection is to be considered
5	>1200	Permanent irreversible adverse impact; alternatives to the project needs to be explored

Table-71 Impact Evaluation Matrix (Imphal Ring Road)

	Area	Impacts	Scale of Magnitude → / Scale of Importance ↓	1	2	3	4	5	Impact Score
				Low				High	
CONSTRUCTION PHASE	Topography, geology & Soil	▪ Change in existing land profile due to quarrying, borrow pits & construction of project road ▪ Loss of productive top soil	8				-4		-32
	Land use	▪ Changes in existing land use pattern ▪ Generation of solid waste	10					-5	-50
	Drainage & Hydrology	▪ Change in drainage pattern of the area ▪ Increased incidence of floods due to obstruction of natural drainage	10				-4		-40
	Water quality	▪ Increase of sediment load and turbidity in receiving streams/water bodies ▪ Sewage from construction camps	7			-3			-21
	Air quality	▪ Fugitive dusts emission from construction activities and vehicular movement	8				-4		-32

	Area	Impacts	Scale of Magnitude → Scale of Importance ↓	1	2	3	4	5	Impact Score
				Low				High	
		▪ Gaseous emissions from construction equipment & vehicular traffic.							
	Noise level	▪ Increase in noise level due to construction activities	8				-4		-32
	Flora, Fauna	▪ Felling of Trees along the alignment	10				-4		-40
	Forest	▪ Diversion of Forest land	10				-4		-40
	Health & Safety (Occupational & Community)	▪ Health & safety related problems to construction workers ▪ Sanitation & health hazards & other impacts on the surrounding environment ▪ Increase on incidence of road accidents	6			-3			-18
	Social Impacts	▪ Land acquisition ▪ Loss of livelihood ▪ Impact on Vulnerable population & women ▪ Impact on CPRs	10					-5	-50
	Positive impacts	▪ Employment & Trading Opportunity	8					+5	+40
OPERATION PHASE	Water quality	▪ Oil spills due to traffic movement & accidents	3			-3			-9
	Air quality	▪ Vehicular emission from road traffic	5			-3			-15
	Noise Level	▪ Traffic noise	4			-3			-12
	Positive Impacts	▪ Time & Fuel saving ▪ Reduction of air pollution ▪ Reduction of number of accidents ▪ Reduction of vehicle operating cost ▪ Economic development of the region	8				+4		+32
Total Score									**-319**

A.3 Impact Evaluation Outcome

183. Total score of evaluation matrix is **-319** which implies that the proposed project will have appreciable but **reversible adverse impact** and mitigation measures are needed.

B. IMPACTS AND MITIGATION MEASURES

184. The proposed project will have impacts on the environment in two distinct phases. During the construction phase which may be regarded as temporary or short-term; the other during the operation stage which will have long term effects. The negative impacts can be reduced or minimized only if proper safeguards are put in place during the design and construction stage itself. These can include reducing pollutant discharge from the harmful activities at source or protecting the sensitive receptor. An effective mitigation strategy will utilize a combination of both options to arrive at practically implementable measures. Conscious efforts have been worked out to minimize any adverse impacts on the various environmental and social components. Where the impacts on various environmental components have been unavoidable, mitigation measures have been worked out.

C. LAND ENVIRONMENT

C.1 Topography & Geology

185. **Construction Phase:** The impacts on existing topographical setting originate primarily from embankment preparation and opening up borrow pits to fulfill the requirement of earth material. Disfiguration of land may result from unplanned opening up of borrow pits / quarry sites. Aggregate and sand will be procured from the authorized suppliers and prevalent rules will be followed for borrowing of soil.

- Disfiguration & change in existing profile of the land in the proposed greenfield section of the alignment
- Disfiguration of topography due to indiscriminate digging of borrow pits
- Uncontrolled digging of borrow pits resulting in water accumulation & breeding of vector disease
- Disturbance on geological setting due to quarrying
- Establishment of Construction Camp

186. ***Seismological Characteristics of the Area:*** As per Seismic Map of India (as per IS: 1893, Part I, 2002); the project road is situated in the **Zone V** (having severe seismic intensity) and has a severe risk of potential damage due to earthquake. All the structures have been designed for seismic force as per provisions of IRC: 6, IRC:112, IRC:78 and other applicable codes.

187. ***Road Building Materials:*** During construction, stone aggregates & bitumen will be required for pavement, while stone aggregates, sand & cement will be required. Diesel will be required to run construction equipment. Stone aggregates and sand will be brought from the pre-identified quarry areas. The contractors usually depend on the local commercial suppliers for obtaining various construction materials. Active existing sources are most likely to be used with cost and the quality considerations. The estimated raw materials requirement during construction stage is given in **Table-72**.

Table-72 Raw Materials requirement during Construction Stage

Sl. No.	Items	Unit	Quantity	Mode of Transport	Source
14.	Granular Sub Base	Cum	1,56,806	Truck	Pre-identified quarry areas and Local Traders
15.	Cement Treated Sub Base	Cum	46,763	Truck	
16.	Wet Mix Macadam & CTB	Cum	1,41,160	Truck	
17.	Dense Bituminous Macadam	Cum	41,285	Truck	
18.	Bituminous Concrete	Cum	26,461	Truck	
19.	Bitumen	MT	7,180	Tanker	Refinery
20.	Emulsion	MT	1,673	Tanker	Refinery
21.	Cement	MT	80,800	Truck	Local traders
22.	Aggregates	Cum	7,24,800	Truck	Pre-identified quarry areas
23.	Sand	Cum	90,876	Truck	Pre-identified quarry areas
24.	Steel	MT	17,481	Truck	Local traders
25.	Diesel	KL	11,587	Tanker	Local petrol pumps
26.	Fly Ash	Cum	No coal based thermal power plants within 300 km		

Source: DPR prepared by ICT Pvt. Ltd.

188. ***Borrow Areas:*** 6,42,799 cum earth will be generated from cutting and 5,56,890 cum earth will be required for filling. Therefore, 87% of excavated earth will be re-used to raise road levels in the construction of Imphal ring road. Remaining earth will be used in to raise embankment of other roads projects under PWD in Imphal area. Hence, there is **no requirement of borrow earth for the proposed project.** The details of earthwork including location, estimated quantity of cut, fill and surplus earth is given in **Annex 6.1**. However, in the event that the Contractor opts for borrow earth or additional quantity of earth required during construction then the guideline given in the IEE report (Annex 8.2) as well as MoEFCC "Standard Operating Procedure" for borrow area dated 8th August 2022 shall be followed. Any borrowing of earth will require written consent from the PIU prior to the borrowing activities.

189. ***Establishment of Crushers:*** Contractor will be required to establish crushers along the project road. It is the responsibility of the contractor to obtain statutory clearance (such as NOC from SPCB etc.) from concerned authorities before start of stone crushing operation. The maintenance and management of access road / haul road could be a major impact. It is appropriate to consider the environmental implications in the selection of crusher areas since poor maintenance may create dust pollution, contribute to noise pollution, water pollution as well as loss of natural resources.

190. ***Mitigation Measures:*** All construction works are directly related to the land environment. Therefore, contractor needs to follow several Guidelines for various construction activities. These Guidelines are listed below and detailed out in Annexes of the IEE Report.

- Guidelines for Siting and Layout of Construction Camp (Annex-8.1)
- Guidelines for Siting, Operation and Re-Development of Borrow Areas (Annex-8.2)
    - Guidelines for Siting, Operation and Re-development of Quarrying and Stone

Crushing Operations (Annex-8.3)

- Guidelines for Siting and Management of Debris Disposal Site (Annex-8.4)
- Guidelines for Preparing Comprehensive Waste Management Plan (Annex-8.5)
    - Earthquake resistance structures with seismic restrainers are being planned to be constructed under the project as per IRC: 6, IRC:112, IRC:78 and other applicable codes. Design of all structures like bridges and cross drainage structures have taken the area's seismic characteristics into account.
    - Opening up new borrow pits will be in accordance with the IRC: 10-1961 specifications. Topsoil from the new borrow pits should be preserved and reused in restoring the pits to the satisfaction of the Authority / Independent Engineer (CSC). Opening up of new borrow pits will be restricted to 1 m depth followed by resurfacing of pits with top soil (15 cm).
    - No borrow pits will be allowed within 1.0 km of the forest area.
    - Uncontrolled digging of borrow pits will be avoided to prevent water accumulation in abandoned pits which results in breeding ground of vector disease.
    - Construction materials will be procured from existing approved and licensed quarries only where crusher is already operating. Therefore, mitigative measure for the environmental impacts due to quarrying and rehabilitation plan of the quarries is the responsibility and scope of the license holder of the quarry.
    - On owner's choice, borrow pits will be converted to water bodies (pond) with proper landscaping (i.e. rectangular in shape, proper sloping and plantation on the bank) which will add scenic beauty in those localities.

191. ***Operation Phase:*** During operation phase of the project road, no impact is anticipated on the topography and geology of the area.

C.2 Soil

192. ***Soil Erosion:*** Erosion of topsoil can be considered a moderate, direct and long term negative impact resulting from construction and maintenance of the project road. Erosion problems may occur on newly constructed slops and fills depending on the soil type, angle of slope, height of slope and climatic factors like wind (direction, speed & frequency) and rain (intensity & duration). Slope protection measures (stone pitching or turfing with **Coir Geotextile & Vetiver grasses**) form part of good engineering practice and therefore, it has been proposed.

193. ***Construction of Bridges & Culverts:*** Along the project road **9 bridges and 227 culverts** are proposed. If the residual spoil is not properly disposed of, increased sedimentation may take place during the monsoon.

194. ***Soil Contamination:*** Contamination of the soil may take place from the following activities at the construction zones, construction labour camps and other auxiliary facilities required for the construction. Details of the activities from which contamination may occur are given below:

- Scarified bitumen wastes from existing road section, excess production of bituminous product
- Debris generation due to dismantling of structures
- Maintenance of the machinery and operation of the diesel pumps, diesel generator sets, diesel storage and during transportation
- Operation of hot mix plant
- Storage and stock yards of bitumen and
- Form various activities in the labour camps

195. Following mitigation measures have been proposed:

- The top soil from all sites including widening of existing road stretches and working area; cutting area of drain, retaining wall etc.; borrow areas; construction camps; haul roads in agricultural fields (if any) and areas to be permanently covered shall be stripped to a specified depth of 15 cm and stored in stock piles for reuse. At least 10% of the temporary acquired area shall be earmarked for storing top soil. Contractor has to strictly follow the "Guidelines for Tor Soil Conservation and Reuse" as given in **Annex-8.6**.
- Accidental spills of lubricants / oil and molten asphalt will be avoided by following the "Guideline for Storage, Handling, Use and Emergency Response for Hazardous Substances" as given in **Annex-8.7**.
- Oil Interceptor shall be provided for wash down, refueling areas and accidental spill of oil and diesel.
- Vehicle parking area of the construction camp will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly slopped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor.

196. ***Slope Stabilization & Soil Conservation:*** Adequate measures like drainage, embankment consolidation & slope stabilization will be taken along the expressway to avoid soil erosion and soil conservation. The slopes have been restricted to 1 vertical : 2 horizontal for most of the sections. Soil erosion through embankments will be prevented and controlled by stone pitching or turfing with Coir Geotextile & Vetiver grasses. **Bio-engineering** is the technique of utilizing vegetation in addressing geotechnical problems. Vegetation as an aid to artificial methods in controlling surficial soil erosion is gaining larger acceptability among engineers all over the world. Growth of appropriate vegetation on exposed soil surface is facilitated by use of natural geotextiles such as **Coir Geotextiles**. Properly designed Coir Geotextiles lay on slopes or any other exposed soil surface provides a cover over exposed soil lessening the probability of soil detachment and at the same time reduces the velocity of surface runoff, the main agent of soil dissociation. Natural geotextiles degrade quicker than man-made counterpart, but facilitate growth of vegetation quicker and better due to its inherent characteristics. Road slope stabilization can range from allowing **native grass (Vetiver grass)** to re-establish on a disturbed slope to building an engineered wall.

Coir Mesh 400 gsm

197. ***Role of Coir Geotextile in Slope Stabilization:*** Coir is a biodegradable organic fiber material which is coarse, rigid and strong. The constituents of coir have been found to be mostly cellulose and lignin. Coir fiber is weather resistant and resistant to fungal and bacterial decomposition. The rate of decomposition of coir is much less than any other natural fiber. These characteristics are attributed due to the high lignin content in the fiber. Coir in the form of woven mesh mattings or non-woven stitch bonded blankets are used in engineering applications in the geotechnical field. Due to growing awareness to preserve environment, use of biodegradable natural material has gained popularity. The natural fiber, coir, which has been used in geotextiles for the past 20 years, has already proved its worth.

Coir Geo-textile laid on the Embankment

198. Coir geotextiles are made from coconut fiber extracted from the husk of coconut. Like other polymeric counterparts, coir geotextiles are developed for specific application in civil engineering like erosion control, ground improvement, filtration, drainage, river bank protection, road pavements, slope stability etc. This biodegradable and environment friendly material is virtually irreplaceable by any of the modern synthetic substitutes. Advantages of Coir Geotextile:

- ✓ The high tensile strength of coir fiber protect steep surface from heavy flows and debris movement
- ✓ It can withstand considerable pedestrian movement and vehicular traffic without deterioration
- ✓ Easy to install and huge contour of the soil surface due to its heavy weight and ability to absorb water
- ✓ Totally Biodegradable, 100% natural
- ✓ Water absorbent, thus acts as mulch on the surface and as a wick in the soil mantle
- ✓ Environment friendly and aesthetically pleasing and nonpolluting
- ✓ Provides excellent microclimate for plant establishment and healthy growth
- ✓ The thick and protruding fibers from the yarn render an extra protection against soil erosion and provide roughness to the surface floor and hold the soil particles in place.
- ✓ The coir geo textile gives the grass plenty of room to grow and at the same time provides large number of "CHECK DAMS" per square meter of soil media

- ✓ During the manufacturing process of coir yarn, chemicals are not used
- ✓ Holds the seeds and saplings in place
- ✓ Allows sunlight to pass through

199. Coir Geotextile is laid on the shoulder and slope surface helped retain the soil particles and prevent detachment of soil particles from the prepared slope. Establishment of vegetation ensured stabilization of the soil on the slope surface. It is a bio-degradable natural geotextile, can conveniently be used for controlling surface soil erosion and help growth of vegetation as a bio-engineering measure. After biodegradation coalesces with the soil and adds nutrient to the soil and fosters growth of vegetation.

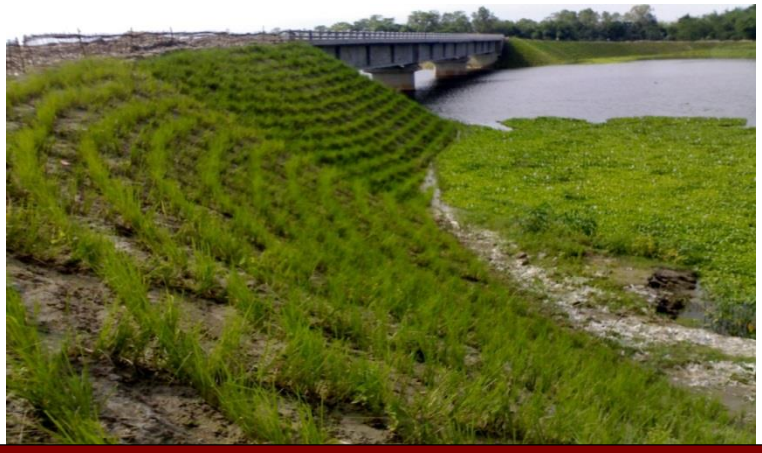
200. **Role of Vetiver Grass in Slope Stabilization:** Vetiver grass (*Chrysopogon zizanioides*) is native to India. It has been shown to be a simple and economical method to conserve soil by slowing the velocity of water and trapping sediment, filtering out nutrients, and stabilizing steep slopes. In western and northern India, it is popularly known as khus. Several aspects of Vetiver make it an excellent erosion control plant in warmer climates:

- ✓ Vetiver grass does not have stolons or rhizomes. It's massive finely structured root system that can grow very fast; in some applications rooting depth can reach 3 to 4m in the first year. This deep root system makes Vetiver plant extremely drought tolerant and difficult to dislodge by strong current.
- ✓ Stiff and erect stems, which can stand up to relatively deep water flow
- ✓ Highly resistance to pests, diseases and fire
- ✓ A dense hedge is formed when planted close together acting as a very effective sediment filter and water spreader
- ✓ New roots grow from nodes when buried by trapped sediment. Vetiver will continue to grow up with the deposited silt eventually forming terraces, if trapped sediment is not removed.
- ✓ Tolerance to extreme climatic variation such as prolonged drought, flood, submergence and extreme temperature from -14°C to +55°C
- ✓ Tolerance to wide range of soil pH from 3.3 to 12.5 without soil amendment
- ✓ High level of tolerance to herbicides and pesticides
- ✓ Highly efficient in absorbing dissolved nutrients such as N and P and heavy metals in polluted water.
- ✓ Highly tolerant to growing medium high in acidity, alkalinity, salinity and magnesium
- ✓ Highly tolerant to Al, Mn and heavy metals such as As, Cd, Cr, Ni, Pb, Hg, Se and Zn in the soils
- ✓ As typical tropical grass, Vetiver is intolerant to shading. Shading will reduce its growth and in extreme cases, may even eliminate Vetiver in the long term. Therefore Vetiver grows best in the open and weed free environment, weed control may be needed during establishment phase. On erodible or unstable ground Vetiver first reduces erosion, stabilizes the erodible ground (particularly **steep slopes**), then because of nutrient and moisture conservation, improves its microenvironment so other volunteered or sown plants can establish later. Because of these characteristics Vetiver can be considered as a nurse plant on disturbed lands.
- ✓ Vetiver is useful to treat pollution due to its capacity to quickly absorb nutrients and heavy metals, and its tolerance to elevated levels of these elements. Although the concentrations of these elements in Vetiver plants is often not as high as those of hyper-accumulators, it's very fast growth and high yield allows Vetiver to remove

a much higher volume of nutrients and heavy metals from contaminated lands than most hyper-accumulators.

- ✓ When planted closely together, Vetiver plants form dense hedges that reduce flow velocity, spread and divert runoff water and create a very effective filter that controls erosion. The hedges slow down the flow and spreads it out, allowing more time for water to soak into the ground.

✓ Acting as a very effective filter, Vetiver hedges help to reduce the turbidity of surface run-off. Since new roots develop from nodes when buried by trapped sediment, Vetiver continues to rise with the new ground level. Terraces form at the face of the hedges, this sediment should never be removed. The fertile sediment typically contains seeds of local plants, which facilitates their re-establishment



Vetiver Grass used for Slope Stabilization in Bridge ↑ & Road ↓ Embankment

C.3 Land Use

201. **Construction Phase:** The land required for construction of Imphal Ring Road is tentatively **94.8606 ha**, Preparatory activities like clearing of ROW, construction of temporary construction camps, storage of construction materials etc. will be confined within the camp & PROW. This shall not hamper the land use aspects outside ROW. However, indirectly there may be some change in the land use pattern of the proximate area due to influx of construction work-force and supplier who are likely to construct temporary tents in the vicinity. Anticipated impacts during construction stage are:

- Changes in existing land use pattern of the PROW for construction of the project road
- Loss of private agricultural land due to land acquisition (≅ 27.1985 ha)
- Diversion of 12.9746 ha forest land

202. Following **mitigation** measures have been proposed:

- 87% of excavated earth will be re-used to raise road levels in the construction of Imphal ring road.
- Construction debris shall be disposed of by mechanical transport in suitable pre-identified (jointly by project proponent & local administration) dumping areas in tune with the local condition to avoid land degradation & water logging due to indiscriminate dumping.
- Construction camp shall be provided for construction personnel to avoid indiscriminate settlement of construction workers & labourers.
- Regular inspection of haul roads and construction site shall be carried out to ensure regular and timely removal of construction debris to the designated dumping sites.
- Construction activities shall be kept confined to PROW only.

203. Anticipated **impacts** during construction stage are as follows:

- Likely change of land use due to squatter / encroachment within ROW
- Likely change of land use due to induced development outside the ROW

204. Following **mitigation** measures are proposed

- Immediately after the construction phase, it is necessary to ensure that no further deterioration or major land use changes such as ribbon development takes place in a manner that will jeopardize the interests of the State.
- Squatter development along the expressway shall be strictly avoided by proper regulation and vigilance.
- Land use control measures shall be prepared & administered to avoid occurrence of induced development as far as possible.
- Planning agencies and Collector/ Revenue Officer shall be made involved for controlled development and prohibiting squatter / encroachment within ROW.

D. WATER ENVIRONMENT

D.1 Drainage & Hydrological Flow

205. Anticipated **impacts** are as follows:

- The alignment of proposed Imphal Ring Road is crossing Imphal River, Kongba River, Na local stream at several locations.
- There are 10 ponds within the proposed RoW (**Table-73**). No other ponds than the ones listed in this table will be affected by the project.
- 3 ponds will be fully affected and affected area 4,680 Sq. m.
- 5 ponds will be partially affected. Total area of these 5 ponds is 24,428 sq. m and affected area is 3,298 Sq. m. which is **13.5% of the total area**
- In remaining 2 ponds, RCC box culverts are proposed based on design discharge, hence there will be no impact

- Roads in plain area are generally constructed on embankments as per the relevant codes and standard practices of IRC 37. The height of embankment must be 0.6 to 1 metre above the HFL. Hence embankments of 1 to 2 metre high are considered low and are very normal in practice. Generally Cross Drainage Structures (culverts) are provided to allow the flow of water from one side to the other. Moreover, construction of the portions in the in the greenfield alignment of 17.770 km, as land bridges (Elevated Road) shall not be feasible considering the cost implications which shall be more than 10 times the cost of normal road. Further the area of the green field alignments largely comprises of paddy fields which normally remains dry except during period of cultivation of around 1 to 2 months during which water (rain water/irrigation water) is retained to enable growth of the paddy. There is no active flow of water as such. Therefore, as per the hydrological calculations 62 numbers of culverts and 1 major bridge (76.37m) have been proposed in the 17.770 km of greenfield stretch for cross drainage purpose and to facilitate balancing movement of rainwater across the embankments. Minimum of 3 culverts for every km of greenfield stretch have been proposed. Further Lined drains have been provided in these stretches to drain out excess water.
- Establishments of construction camps and various plants such as hot mix plant, batching & asphalt mixing plants etc. drainage impacts at these locations may result in loss of top soil.

Table-73 List of Affected Ponds

S. N.	Design Chainage	Side	Distance# (m)	Latitude	Longitude	Total area (Sq. m)	Affected area (Sq. m)
Details of Fully Affected Ponds							
1	0+600	LHS	1.49	24°44'32.077"	93°56'20.943"	1,810	1,810
2	0+642	LHS	2.39	24°44'31.262"	93°56'21.862"	1,435	1,435
3	0+657	LHS	5.48	24°44'30.915"	93°56'22.315"	1,435	1,435
Total Area (A)						***4,680***	***4,680***
Details of Partially Affected Ponds							
4	0+778	LHS	1.57	24°44'30.641"	93°56'26.537"	1,292	833
5	0+855	LHS	6.13	24°44'31.065"	93°56'29.284"	968	539
6	1+100	LHS	14.06	24°44'29.067"	93°56'37.802"	842	149
7	15+215	RHS	15.31	24°50'11.675"	93°58'28.427"	21,017	1,729
8	24+520	RHS	13.71	24°53'13.410"	93°55'57.854"	309	48
Total Area (B)						***24,428***	***3,298***
Details of Ponds where RCC Box Culvert proposed to save the Ponds							
9	0+694	LHS	2.61	24°44'30.736"	93°56'23.662"	423	0
10	51+884	Centre	0.69	24°44'36.093"	93°54'48.726"	4,212	0
Total Area (C)						***4,635***	***0***
Total loss of Surface Water Area (A + B + C)							**7,978**

Distance in meter from propose centerline
Source: Field survey carried out by ICT Pvt. Ltd.

206. Following mitigation measures are proposed to minimize the impact due to loss of surface water area:

- The fully affected ponds shall be compensated by digging of **new ponds in the vicinity** as a part of community pool resources. Area of these new ponds shall not be less than 4,680 sq. m
- The depth of partially affected ponds will be increased to maintain the existing volume of water.
- **Enhancement measures** have been proposed for Ipum pat located at chainage 15+215 on the right side of the project road. **Deepening of Ipum pat up to 2 m** has been proposed to increase the water holding capacity. Water quality of Ipum Pat will be monitored before start of construction, during construction and operation phase. Details of enhancement plan have been discussed in the Chapter-8 (EMP) and cost of enhancement has been included in the civil budget.

207. Following mitigation measures are proposed to avoid flooding & formation of water pool

- Detailed drainage survey and hydrological investigations have been carried out and accordingly capacity of cross drainage (CD) structures have been designed to accommodate high discharges to avoid flooding & formation of water pool
- Drainage system including **surface and subsurface drains** for the project road shall be provided. The contractor shall design the drainage system based on the drainage plan given in Schedules of the Bid Document. After award of work, the contractor shall get prepared the proper drainage plan of the project on the basis of contours of the area, outlet availability and discharge requirements including discharge at the outfall from drains of local bodies. The drainage plan prepared by the contractor shall be approved by AE / IE. The drainage plan will also be vetted by one traffic experts so that these drains do not hindered free flow of traffic. Further, the drainage plan will be checked through joint inspection with the engineers of local bodies / development authority so that drainage plan is totally integrated with the local body drainage plan. The drain cover should be strong enough to withstand weight of light commercial vehicle wherever required. At crossing location of cross roads, the cover slab and wall shall be designed to withstand vehicular load. Preferably drains with well seized and well-spaced manholes shall be provided to take care of cleaning and utility maintenance. Implementation phase wise length of road side drain is given in **Table-74**.

Table-74 Details of Road Side Drain

Roadside Drains (both sides)	Length (m)
Lined built-up drain	15,381
RCC covered drain	94,893
Unlined open drain	1,435

Source: DPR prepared by ICT Pvt. Ltd.

- To minimize the impact drainage & hydrological flow, 9 bridges and 227 culverts are proposed to be constructed along the project road. It has been ensured that free flow of water is maintained wherever the project road alignment crosses river / local streams / nallah etc.
- In every km of greenfield stretch, **more than 3 culverts have been proposed** which will balance the water level on both sides
- Construction of roads in plain area of embankment 1 to 2 m high is very normal and water will be retained only during monsoon period. Moreover, the sections in the

Greenfield alignment have been designed as per the relevant codes (IRC-37) and standard practices. As per IRC 37, the height of embankment must be 0.6 to 1 m above the HFL.

- All bridges have been designed for a return period of 100 years and culverts have been designed for a return period of 50 years
- It has been ensured that all the 1st and 2nd order streams crossing the project road alignment provided with culverts and bridges **with capacity of 20% excess discharge**. Hydrological Computation of 1st order streams and 2nd order streams are presented in **Table-75** and **Table-76** respectively.
- Bridges will be constructed in the lean season; hence there will be **no obstruction of the water flow during construction phase**.
- The effective waterway of the rivers are more than the width of flow; hence, **no obstruction of the water flow is anticipated during operation phase**
- Design made to avoid physical loss to the water bodies to the extent possible.
- Silt fencing shall be provided between project road and water bodies to avoid any siltation due to runoff from construction area.
- Construction works of culverts and bridge (cross drainage structures) are taken up during the lean flow periods in summer to minimize the impacts on drainage.
- Construction work near natural drainage channels have to be carried out in such a way that flow of water is not blocked and even if it has to be blocked then the contractor must ensure that the local communities are informed about the same in advance
- Suitable drainage at construction camp will be provided to eliminate the chances of formation of stagnant water pools that leads to soil erosion & breeding of mosquitoes

Table-75 Hydrological Computation of 1st Order Streams crossing the proposed Project Road

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
1	0+076	3.41	4.09	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
2	0+700	4.79	5.75	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
3	0+949	2.52	3.02	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
4	1+210	Balancing		2.0	2.0	1						RCC Box	1x2x2
5	1+870	Balancing		2.0	2.0	1						RCC Box	1x2x2
6	2+126	0.83	0.99	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
7	2+216	3.17	3.80	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
8	2+400	0.48	0.57	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
9	2+625	0.79	0.95	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
10	2+901	4.05	4.86	4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
11	3+104	0.69	0.82	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
12	3+290	1.51	1.82	4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
13	3+840	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
14	4+359	3.04	3.65	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
15	4+680	3.29	3.95	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
16	5+190	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
17	5+346	1.80	2.16	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
18	5+379	1.76	2.12	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
19	5+911	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
20	6+039	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
21	6+539	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
22	6+761	3.41	4.09	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
23	6+840	0.42	0.51	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
24	6+957	0.58	0.70	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
25	7+324	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
26	7+838	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
27	8+411	1.65	1.99	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
28	8+676	0.62	0.74	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
29	8+971	0.63	0.76	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
30	9+204	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
31	9+845	2.23	2.67	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
32	10+393	8.24	9.88	4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
33	10+900	2.31	2.77	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
34	11+466	2.52	3.02	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
35	12+190	1.50	1.80	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
36	12+401	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
37	12+592	1.81	2.17	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
38	12+982	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
39	13+120	0.48	0.57	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
40	13+158	0.49	0.59	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
41	13+180	1.96	2.35	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
42	13+742	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
43	14+115	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
44	14+675	Balancing		2.0	2.0	1						RCC Box	1x2x2

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
45	15+140	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
46	15+623	Balancing		3.0	1.5	1						RCC Box	1x3x1.5
47	15+951	0.91	1.09	4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
48	16+333	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
49	16+575	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
50	16+703	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
51	16+825	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
52	17+062	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
53	17+830	0.54	0.64	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
54	18+035	0.94	1.13	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
55	18+172	0.91	1.09	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
56	18+486	0.75	0.90	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
57	18+730	25.70	30.84	5.0	3.0	1	15.00	2.33	34.95	Ok	Ok	RCC Box	1x5x3
58	18+893	Balancing		2.0	2.0	1						RCC Box	1x2x2
59	19+400	Balancing		2.0	2.0	1						RCC Box	1x2x2
60	19+750	Balancing		2.0	2.0	1						RCC Box	1x2x2
61	19+900	Balancing		2.0	2.0	1						RCC Box	1x2x2
62	20+320	Balancing		2.0	2.0	1						RCC Box	1x2x2
63	20+850	0.88	1.06	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
64	21+094	0.43	0.51	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
65	21+153	0.24	0.28	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
66	21+200	0.19	0.23	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
67	21+328	1.12	1.35	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
68	21+558	0.22	0.26	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
69	21+710	1.96	2.35	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
70	21+780	3.04	3.65	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
71	21+910	0.43	0.51	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
72	22+060	0.72	0.87	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
73	22+210	0.19	0.23	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
74	22+448	9.91	11.89	4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
75	22+839	0.42	0.50	3.0	2.0	1	6.00	1.73	10.38	Ok	Ok	RCC Box	1x3x2
76	23+020	2.65	3.18	3.0	2.0	1	6.00	1.73	10.38	Ok	Ok	RCC Box	1x3x2
77	23+283	4.57	5.48	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
78	24+530	Balancing		2.0	2.0	1						RCC Box	1x2x2
79	24+800	Balancing		2.0	2.0	1						RCC Box	1x2x2
80	25+067	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
81	25+696	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
82	32+140	0.31	0.38	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
83	32+560	0.82	0.98	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
84	32+740	1.02	1.22	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
85	32+940	0.89	1.07	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
86	33+010	0.37	0.45	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
87	33+122	0.25	0.30	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
88	33+288	0.69	0.83	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
89	33+408	0.35	0.42	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
90	33+768	34.31	41.17	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
91	34+060			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
92	34+529			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
93	34+733			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
94	34+755			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
95	34+975			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
96	35+025			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
97	35+295			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
98	35+489			2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
99	35+503			3.0	1.5	1	4.50	1.53	6.90	Ok	Ok	RCC Box	1x3x1.5
100	35+861	38.68	46.42	3.0	2.0	1	6.00	1.73	10.38	Ok	Ok	RCC Box	1x3x2
101	36+209			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
102	36+595			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
103	36+820			4.0	2.0	1	8.00	1.86	14.85	Ok	Ok	RCC Box	1x4x2
104	37+027			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
105	37+295			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
106	37+520			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
107	37+882			3.0	2.0	1	6.00	1.73	10.38	Ok	Ok	RCC Box	1x3x2
108	38+180			2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
109	38+496	0.50	0.60	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
110	38+786	0.98	1.18	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
111	39+031	0.63	0.75	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
112	39+375	0.56	0.68	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
113	39+590	0.62	0.74	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
114	39+800	0.71	0.85	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
115	39+894	0.61	0.73	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
116	40+244	0.58	0.70	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
117	40+327	0.62	0.75	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
118	40+411	0.60	0.72	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
119	40+527	0.47	0.56	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
120	40+689	0.32	0.38	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
121	40+850	0.58	0.70	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
122	41+181	0.56	0.67	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
123	41+426	0.61	0.73	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
124	41+588	0.48	0.57	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
125	41+694	0.59	0.71	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
126	41+806	0.45	0.55	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
127	41+929	0.33	0.39	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
128	42+026	0.42	0.51	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
129	42+200	0.62	0.75	1.0		1	0.79	0.97	0.76	Ok	Ok	Hume Pipe	1x1
130	42+330	0.38	0.46	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
131	42+443	0.55	0.65	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
132	42+605	0.38	0.45	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
133	42+747	0.32	0.38	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2
134	43+075	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
135	43+301	Balancing		1.2		1						Hume Pipe	1x1.2x
136	43+509	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
137	43+870	Balancing		1.2		1						Hume Pipe	1x1.2x
138	44+050	0.11	0.13	1.2		1	1.13	1.09	1.23	Ok	Ok	Hume Pipe	1x1.2x
139	44+394	0.52	0.62	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
140	44+671	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
141	44+914	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
142	45+340	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
143	45+967	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
144	46+210	Balancing		2.0	1.5	1						RCC Box	1x2x1.5
145	46+467	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
146	46+610	3.41	4.09	2.0	1.5	1	3.00	1.38	4.15	Ok	Ok	RCC Box	1x2x1.5
147	46+732	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
148	46+904	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
149	47+334	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
150	47+539	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
151	47+804	0.59	0.70	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
152	48+205	5.01	6.01	2.0	2.0	1	4.00	1.53	6.13	Ok	Ok	RCC Box	1x2x2
153	48+367	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
154	48+530	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
155	48+995	1.65	1.99	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
156	49+367	2.17	2.61	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
157	49+790	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
158	49+800	2.23	2.67	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
159	50+374	1.81	2.17	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
160	50+650	2.24	2.69	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
161	50+870	2.10	2.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
162	51+430	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
163	51+817	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
164	51+889	Balancing		2.0	2.0	1						RCC Box	1x2x2
165	52+090	0.93	1.12	4.0	3.0	1	12.00	2.19	26.34	Ok	Ok	RCC Box	1x4x3
166	52+319	0.44	0.52	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5

Sl. No.	Design Chainage	25 yr. Design Discharge in Cumec	Design discharge 20% more	Adopted Size & Number of Culverts (As per Approved Plan & Profile)			Check for the adopted design Culvert				Check for 20% increased discharge	Proposed Culverts	
				Width m	Height m	Number of Cell	Area (sq m)	Velocity (m/s)	Discharge Capacity (cumec)	Adequacy Check		Type	Size of Culverts
167	52+431	0.49	0.59	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
168	52+842	0.55	0.66	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
169	53+175	1.96	2.35	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
170	53+589	2.23	2.67	1.5	1.5	1	2.25	1.26	2.85	Ok	Ok	RCC Box	1x1.5x1.5
171	53+828	Balancing		1.5	1.0	1						RCC Box	1x1.5x1
172	53+904	Balancing		1.5	1.0	1						RCC Box	1x1.5x1
173	54+131	Balancing		1.5	1.0	1						RCC Box	1x1.5x1
SPUR to DDK / JNMIS													
174	0+050	Balancing		1.5	1.0	1						RCC Box	1 x 1.5 x 1.0
175	1+363	Balancing		2.0	1.5	1						RCC Box	1 x 2.0 x 1.5
SPUR to RIMS													
176	0+653	Balancing		2.0	1.5	1						RCC Box	1 x 2.0 x 1.5
SPUR to FCI Godown													
177	0+428	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
178	0+691	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
179	0+767	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5
180	0+912	Balancing		1.5	1.5	1						RCC Box	1x1.5x1.5

Source: Environmental Study carried out by ICT Pvt. Ltd.

Table-76 Hydrological Computation of 2nd Order Streams crossing the proposed Project road

Sl. No.	Description	Design Chainage	Span Arrangement (m)	Catchment Area (Sq. Km)	Discharge (m^3/sec) (Q100)	Discharge (m^3/sec) (1.2*Q100)	HFL at Q100 (m)	HFL at (1.2*Q100)	Minimum vertical Clearance	Q100 HFL +vertical Clearance	Check for 20% more discharge
A)	**Major Bridges**										
1	Imphal River	1+424	1x46.5 + 1x17.0	361.73	700	840	784.054	785.000	1.2	785.254	OK
2	Imphal River	23+605	1x15.0 + 1x45.0 + 1x15.0	347	681	817	791.341	791.803	1.2	792.541	OK
3	Nambul River	42+991	1x16.502 + 1x31.502 + 1x16.502	115.81	310	372	786.122	786.418	1.2	787.322	OK
B)	**Minor Bridges**										
4	Canal	0+041	2 x22								
5	Iril River	11+188	1 x 20	96.46	150	180	784.358	784.455	0.9	785.258	OK
6	Local River	17+515	1 x6.0	4.8	19	23	786.895	786.967	0.6	787.495	OK
7	Local River	37+060	2 x 4.0	Reconstruction due to Junction Improvement							
8	Local River	48+559	1 x 10.0	4.4	19.61	23.53	779.729	779.800	0.6	780.329	OK
9	Nambul River	51+935	2 x 17.60	161.7	257.85	309	780.249	780.352	0.9	781.149	OK

Source: Environmental Study carried out by ICT Pvt. Ltd.

D.2 Water Use during Construction Stage

208. During construction period water is required for compaction of embankment, dust suppression, concrete making and domestic use in construction camp. The estimated tentative water requirement during construction stage is given in **Table-77**.

Table-77 Breakup of Water requirement during Construction Stage

S. N	Purpose	Unit	Quantity
1	For Road Construction:		
	a) Construction related to earthwork	KL	2,34,700
	c) Construction of GSB		
	d) Construction of WMM		
	e) Bridges, culverts, retaining walls & other structures		
2	Dust Suppression	KL	10,800
3	For drinking & other domestic purpose	KL	10,220
	Total		**2,55,720**

Source: DPR prepared by the ICT Pvt. Ltd.

209. Following **mitigation measures** have been proposed:

- Minimum use of water from existing sources for construction purpose shall be ensured to minimize likely impacts on other users
- In compliance to the Sub-Clause 111.8.3 of MoRTH Specifications, the Contractor will identify the nearest source of water body at plant and camp site and shall source the water preferably from surface water bodies, rivers, canals and ponds in the project area. Only at locations where surface water sources are not available, the Contractor shall contemplate extraction of ground water, after intimation and consent from the CGWB.
- Wastage of water during the construction should be minimized

D.3 Water Quality during Construction Phase

D.3.1 *Source of Impacts*

- Construction of culverts and bridges over waterways, including associated staging, flow diversions, any dewatering, short and long term stabilization
- Increase of sediment load in the run off from construction sites and increase in turbidity in receiving water bodies
- Activities where construction water may be discharged into natural waterways
- Leakage of POL (Petroleum, Oils, and Lubricants) could lead to an increase in water pollution level of the receiving water body. Anticipated potential impacts are due to spillage of construction materials, such as, cement, POL, bitumen etc. falling in to the drainage channels from workshops, construction camps, quarry / borrow areas etc. of the Contractor.
- Accident involving hazardous materials (bitumen) may cause pollution but the occurrence of large scale spillage of bitumen is not anticipated.
- Water pollution due to generation of wastewater from construction camps

D.3.2 *Mitigation Measures*

210. **Sediment control**, whether temporary or permanent, would be project and site specific. However, some of the generic mitigation measures shall be as follows

- Silt fencing shall be provided along water bodies within the direct impact zone intercepting the project road to prevent siltation in water bodies. Sediment / silt should be collected and stockpiled for possible reuse as surfacing of slopes where they have to be re-vegetated.
- An effective traffic management plan is to be implemented to avoid any accidental spillage of hazardous materials.
- All the construction and preparatory activities including construction of culverts and bridges will be carried out preferable during dry seasons
- The CD structures should not be drained to the agricultural and horticultural farms or to the immediate vicinity of houses of the villagers.
- The fuel storage and vehicle cleaning area shall be stationed at least 500m away from the nearest water body
- Provision for oil interceptors shall be made at all the construction camps / workshop areas to separate the oil and grease waste generated from servicing of equipment and vehicles used in the construction
- The drains carrying storm water shall be connected to the nearest natural drainage channel, water bodies with silt traps.

211. **Wastewater Treatment in Construction Camp:** The construction period of the proposed project is **24 months each for package** and it is estimated that 100 persons will be engaged during the construction period in every construction package. Fresh water will be used in the construction camp for a variety of domestic uses such as washing, bathing & flushing toilets. The water that emerges after these uses contains vegetable matter, oils, detergents, dirt, soap, oils & greases. This water is called “Grey Water” or sullage. Sewage generated from the construction camp must necessarily be treated and then re-used /re-cycled for various uses that do not need potable water quality. Recycling / re-using treated sewage can reduce fresh water requirements very substantially, by almost 50-60%. Water used to flush toilets to evacuate human excreta is called “Black Water” is to be treated properly otherwise it will contaminate the surrounding surface / ground water.

212. As per the calculation; daily water requirement for drinking & domestic purposes in the construction camp is **7,000 liters** (70 liters per person for 100 persons) and generation of wastewater is **5,600 liters**. Therefore, **Packaged Wastewater Treatment Plant** has been recommended for the construction camp. Guideline for wastewater treatment in construction camp is given in **Annex-8.8**. However, any other type of packaged wastewater treatment plant may be installed.

213. **Silt Fencing:** Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. The frame will be installed at the edge of the water body along which construction is in progress. It is proposed to install silt fence at the edge of all water bodies abutting the project road including major and minor bridge locations. Silt fence will be mounted on pole fixed at a distance of 2 to 3 m apart and last 2 m of fence shall be framed up slope. The location of silt traps will depend on contractor’s proposal for site facilities and work sites and should be provided in the contractor’s

proposals. This will be checked by Sr. Environmental Specialist of the Authority / Independent Engineer and monitored by PIU. Drawing of typical silt trap is given in **Figure-25**.

214. **Oil Interceptor:** Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, vehicle parking areas of the contractor camp. Therefore, location of Oil Interceptors has been considered such that each construction camp having refueling stations, oil and lubricants storage places will have one oil interceptor to stop & separate the floating oils. The arrested products shall be disposed as per MoEF&CC and CPCB guidelines. Actual number will be decided by the Contractor with the consent of Sr. Environmental Specialist of the Authority / Independent Engineer. Drawing of typical Oil Interceptor is given in **Figure-26**.

215. **Rainwater Harvesting Structures**: The normal annual rainfall in the study area is around 1436.7mm. Depth to water level in the East Imphal district ranges from 1.08 to 10.32 mbgl for pre-monsoon (2004) and it varies from 0.01 magl to 6.2 mbgl during post-monsoon (2004). As per the CGWA classification, all the Talukas, through which the proposed Imphal Ring Road is passing, fall under **"safe" category**. However, rain water harvesting structures with provision of oil filters and de-silting chambers has been proposed along project road as per requirement of IRC SP: 42-2014 and IRC SP: 50-2013. **102 number** of the rainwater harvesting structures have been proposed (**38 in Package-I, 40 in Package-II and 24 in Package-III**). The location shall be finalized by the Contractor in consultation with IE/ AE as per requirement of IRC: SP-42. The number of rain water harvesting structures may increase / decrease as decided by the AE / IE. The cost of rainwater harvesting structures has been included in the Civil Cost of the project. Schematic drawing of rain water harvesting structure with oil & grease interceptor is given in **Figure-27**.

216. **Water Quality Monitoring:** Apart from provision of the mitigation measures, water quality shall be monitored to understand the effectiveness and further improvement in designs in reducing the concentration of pollutants. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Program (Section-J of Chapter-8). All deviated results shall be reported to Sr. Environmental Specialist of the Authority / Independent Engineer for remedial measures. It should be ensured that no construction camps or stockyards are set up near rivers and water bodies to prevent oil spills.

Figure-25 Drawing of Typical Silt Trap

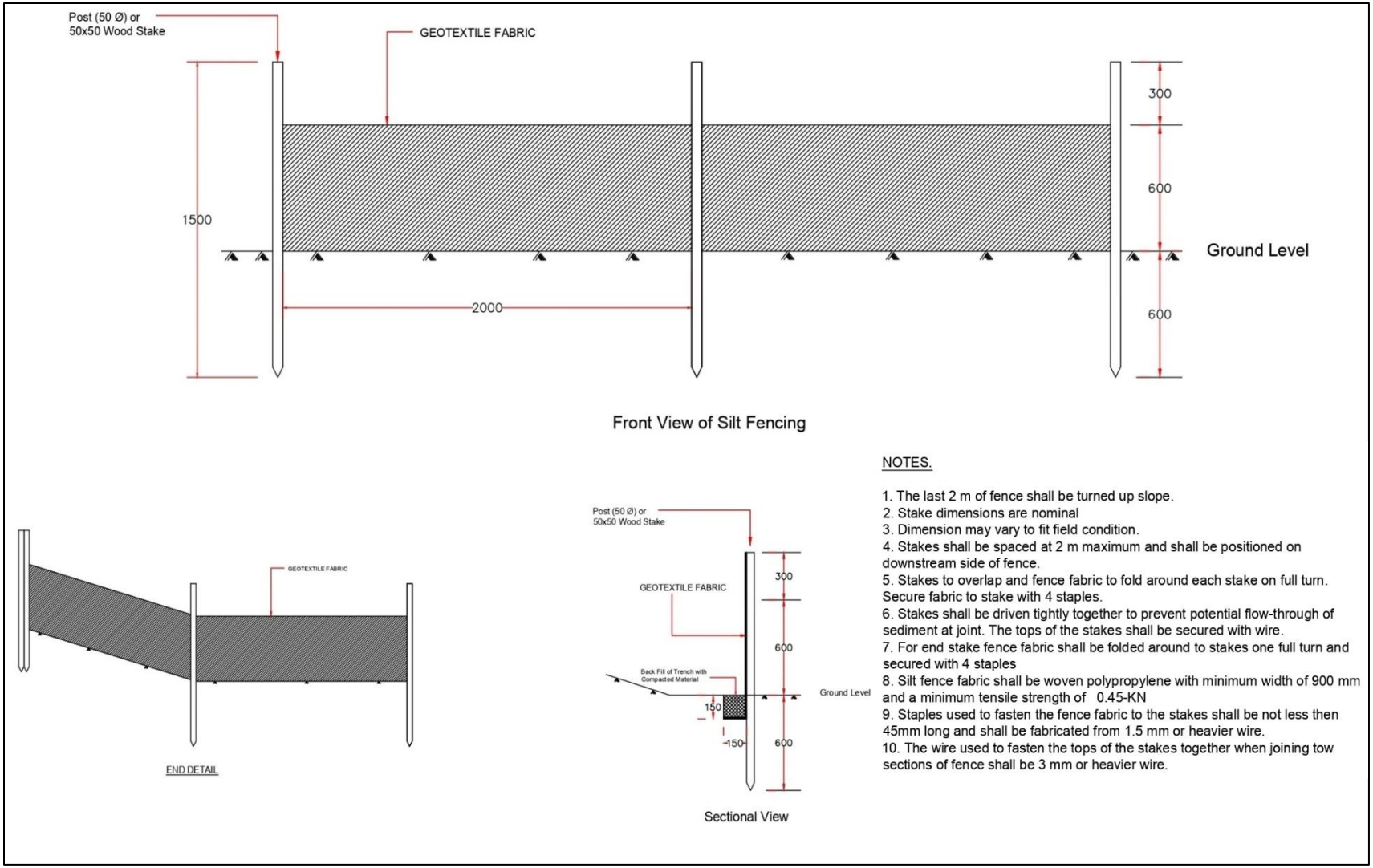


Figure-26 Drawing of Drawing of Typical Oil Interceptor

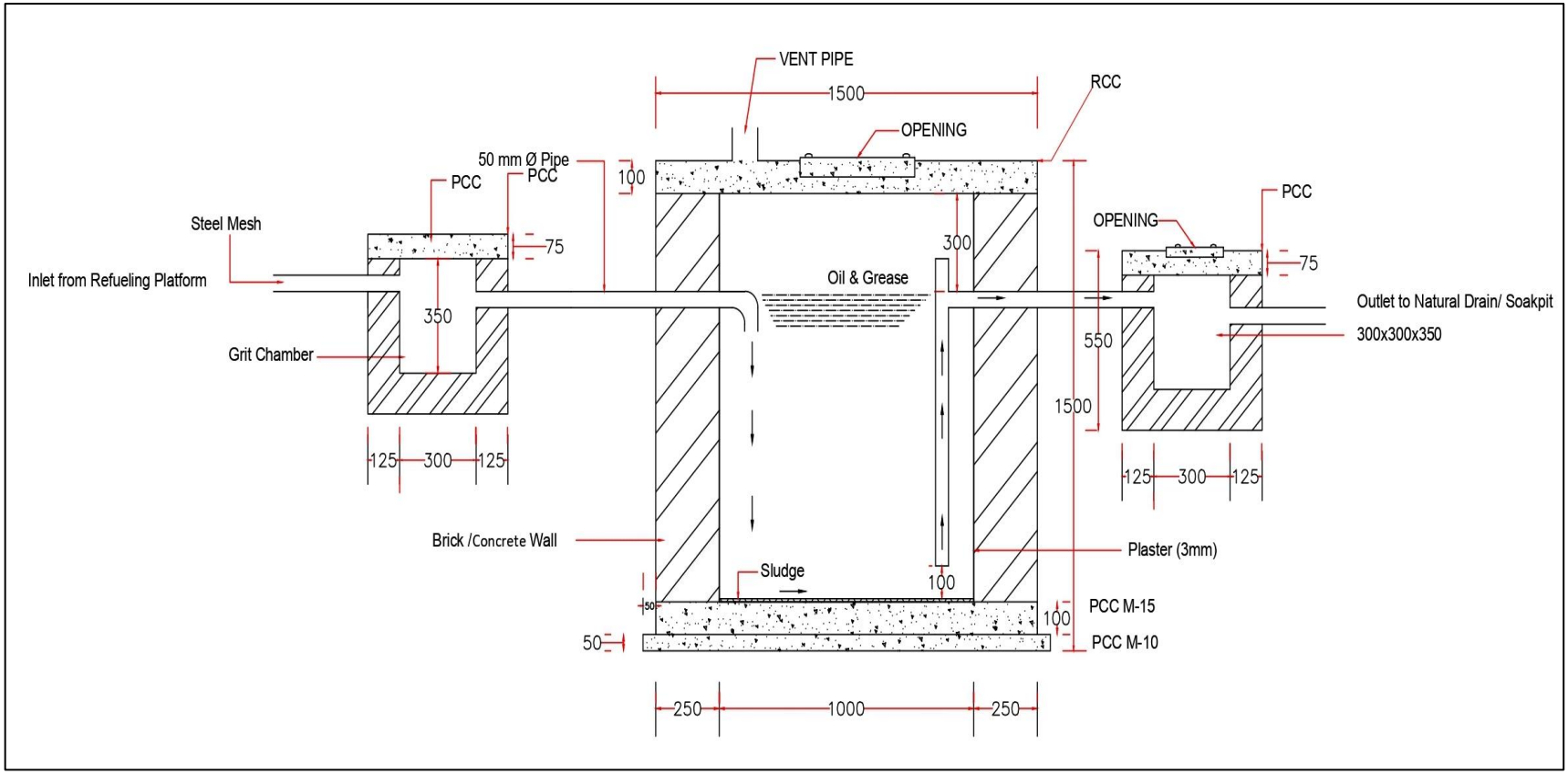
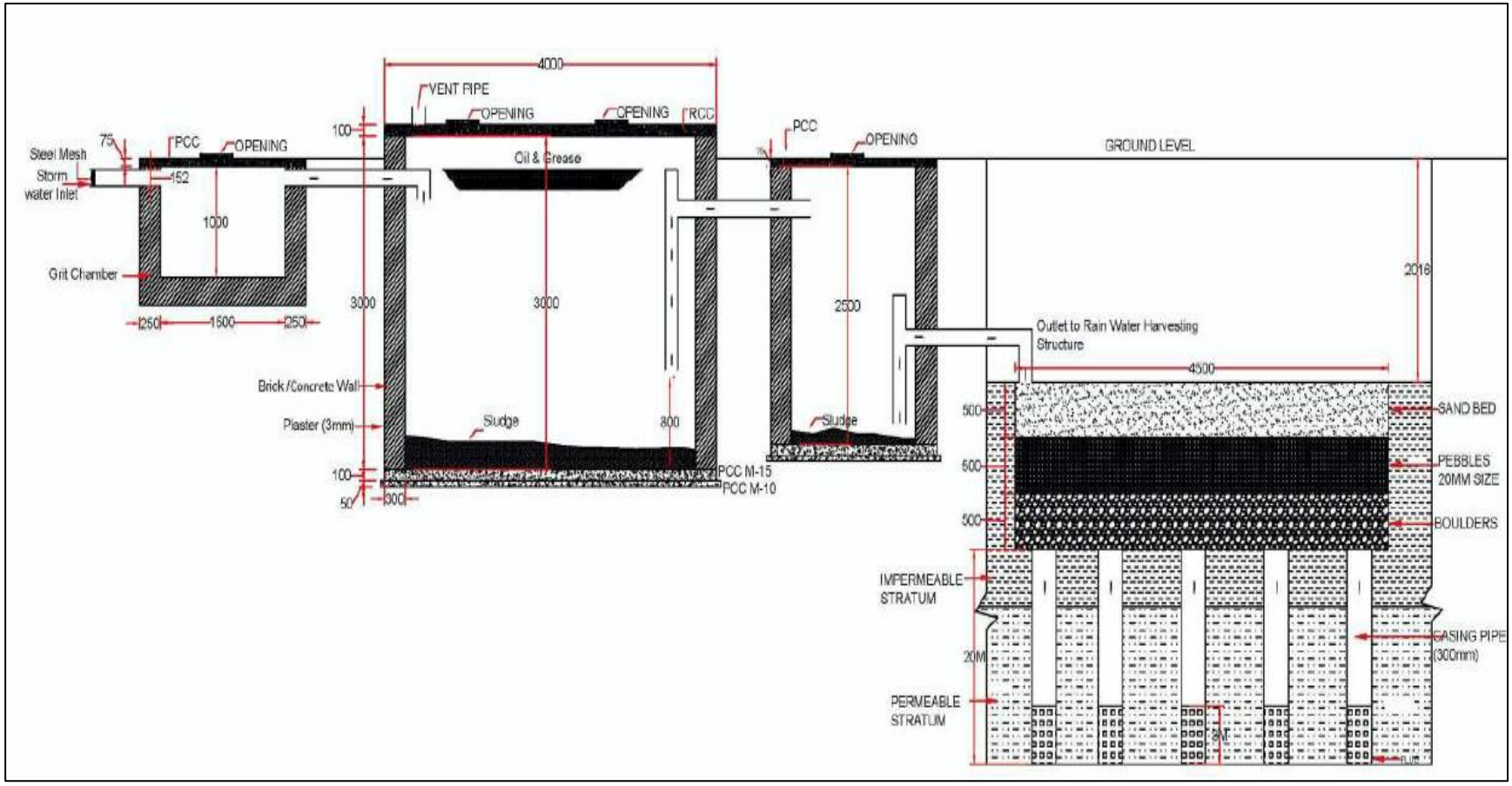


Figure-27 Schematic Drawing of Rain Water Harvesting Structure with Oil & Grease Interceptor



D.4 Water Quality during Operation Phase

D.4.1 *Source of Impacts*

- Increase of surface run-off due to more paved surface
- Filthy environment due to improper maintenance of drainage
- Chances of contamination of water bodies from surface run off containing oil spills due to traffic movement & accidents

D.4.2 *Mitigation Measures*

217. Following mitigation measures have been proposed:

- Road side drain of sufficient capacity has been provided on both sides of the project road to accommodate increased run-off. The out fall for these drains will be the nearby culverts / bridges or natural drainage channel. Silt fencing will be provided to sediment entering into the water courses.
- Contingent actions will be taken for speedy cleaning up of oil spills, fuel and toxic chemicals in the event of accidents.
- Regular maintenance of rainwater harvesting structures shall be done during the operation stage to prevent choking of these structures.
- Regular monitoring of water quality at specified representative locations will be conducted at fixed interval.

E. AIR ENVIRONMENT

E.1 Construction Phase

218. Particulate matter would be the predominant pollutant affecting the air quality during the construction phase as it is likely to generate considerable quantities of dust, especially during dry condition. Dust will be generated mainly during excavation, backfilling, hauling & transportation activities through unpaved haul roads, loading/ unloading & transportation of construction materials, spilling of material during transportation, and open storage of fine construction materials. Undesirable gaseous pollutants will be generated mostly by the automobile traffic and construction machineries. Pollutants of primary concern include $PM_{2.5}$ and PM_{10}. However, suspended dust particles may be coarse and will be settled within a short distance of construction area. Therefore, impact will be temporary and restricted within the closed vicinity along the road only. Further, this would not lead to any tangible effect, as the expected traffic volume is low. Operation of hot mix plants and Asphalt plants will cause emission of fumes and gases.

219. **Hot Mix Plant:** Asphalt is used for paving roads; which is a mixture containing thousands of different chemicals. The chemicals in asphalt vary depending on the source of the crude oil, the type of asphalt being made and the process used. In general, the fumes emitted from hot mix plant are a mixture of several different types of chemicals including carbon monoxide, nitrogen oxides, sulfur, volatile organic compounds, polycyclic aromatic hydrocarbons etc. Fumes created from heating asphalt can be inhaled into the lungs or can condense onto exposed areas of the skin. People who work in asphalt plants have the greatest exposure to asphalt fumes. Residents living near an asphalt plant also would be more likely to breathe low levels of asphalt fumes for a long period of time. Other emission sources found at hot mix plant include handline of aggregates, movement of vehicles and heating of bitumen that emit fugitive emissions.

220. **Control System:** To avoid problems of air pollution following **Guidelines[6]** is to be considered by the Contractor for setting up hot mix plant:

- The hot mix plants should be set as per the following siting criteria

Entity	Minimum distance from the entity (m)
Approved habitation, Tourist Places schools, hospitals, sports centres etc.	100 to 200 depending local condition
Sensitive areas, National monument and Bird Sanctuaries	200 to 500 Depending upon buffer zone and available green belt

- In case of case of existing hot mix plants not meeting above siting criteria, the Unit should provide minimum 6 m high compound wall of GI Sheets along plot periphery

- Stack height should provide sufficient dispersion of the emissions to keep ambient emission levels within acceptable limits. Generally, the height of a stack varies with the design of hot mix plant and supplier. In general, the effective stake height should very between **10 to 25 m** as may be prescribed by SPCBs/PCCs.

- The hot mix plant should be equipped with appropriate air pollution control devices such as **cyclone multi-clones** and **bag filter/ scrubber** and properly maintained so as to ensure optimum efficiency to achieve the standard.

- Measures such as installation of water sprinklers at point of dust emission within premises should be provided. The internal roads, working platform, loading and unloading areas should be paved or concreted and kept clean all times.

- Any process rejects or left over of hot mix should be recycled in the process.

- During construction period, contractor has to ensure that air quality monitoring results at HMP site should not exceed the following CPCB standards

S. No.	Type of hot mix plant	Particulate Matter (PM), mg/Nm^3	SO_2, mg/Nm^3	NO×
1	Batch type hot mix plant	150	250	200
2	Drum type hot mix plant	300	250	200

- **Safety measures:** Adequate measures of safety for workers working in Hot Mix plant shall be taken. Personal Protective Devices such as Goggles, mask, Helmet and safety shoes shall be provided to workers

221. **Stone Crushers:** Stone processing operations including crushing, screening, material handling and transfer operations are potential sources of particulate emissions.

- **Emission during Crushing Operation:** During crushing operation, generation of particulate emissions is inherent and the emissions are most apparent at crusher feed and

[6] Development of Environmental Standards and Guidelines for Hot Mix Plants, Central Pollution Control Board

discharge points. The greater the reduction in size during subsequent crushing stages from primary, secondary to tertiary crushing, the higher the emissions.

- **Emissions during Screening:** In the screening section, the mixture of stones is classified and separated according to size. Screening efficiency is generally considered to be in the range of 60 to 75%. Commonly used screening equipment are grizzlies, shaking screens, vibrating screens and revolving screens. Screening may be performed wet but dry screening is the most common. Dust is emitted from screening operations as a result of the agitation of dry stone. The screening of fine sizes produces higher emissions than the screening of coarse sizes.
- **Emissions during Material Handling:** Various handling devices like feeders, belt conveyors, bucket elevators and screw conveyors are used to transport crushed materials from one point to another. Particulates may be emitted from any of the material handling operations. Most of the emissions occur at transfer points. The amount of uncontrolled emissions depends on the size distribution of the material handled, the belt speed and the free fall distance.
- **Nature and Spread of Emissions:** The major source of dust generation is during size reduction in the primary, secondary & tertiary crushers. The dust is also generated during handling of stones, especially at the point where the stones fall through a height from places like one belt to another or from belt to hopper or stock piles etc. During vibratory screen large quantity of fine dust is emitted and gets air borne.
- **Impacts due to Emission:** Some percentage of the fugitive dust emissions may get settled down within the unit premises but a substantial percentage of airborne emissions are carried away to the surroundings by wind currents. Dust that settles within the plant gets air borne again due to vehicular movement or by wind and acts as a secondary emission source. Dust emissions affect the human health, vegetation, climate and damage the material. When the amount of particulates increases in the atmosphere, it absorbs incoming solar radiation, causing an increase in the atmospheric and land surface temperature. The physical properties of atmospheric particulates affect human health either by allowing penetration of the lung and causing irritation to the internal membrane, or by transporting absorbed toxic gases and vapors deeper into the lung than they would normally travel. The work place environment at stone crusher sites contain millions of suspended mineral particles of respirable size that get deposited in lungs during inhalation.
- **Emission Control System – Combination of Dry and Wet Type:** A combination of dry and wet type control system is suggested to minimize the impact on air quality. In the combination system the dust is suppressed at some point with water sprays and from some points the dust is extracted with the help of an induced draft fan and can be captured in dry type or wet spray chamber type control equipment. Such combination control systems are commonly used in stone crusher in developed countries. In the combination control system the water is to be sprayed at the primary crushing stage and in the secondary / tertiary stages the dust is to be extracted out and separately controlled. This will have benefit in terms of avoiding a coating of dust on the stone products and at the same time lesser expensive than dry type control system.
    - The **Wet Type Dust Suppression System** comprises of introducing moisture into the material flow by spraying water at key dust generating locations so as to restrain fine particulate matter from becoming air borne. The objective of wet dust suppression is to prevent emission by keeping the material moist at all process stages. Small quantities of specially formulated wetting agents or surfactants are often blended with water to reduce its surface tension and improve its wetting efficiency so that dust generation may be suppressed with a minimum of added moisture.

- The **Dry Type Dust Control System** comprises of adequate enclosure of key locations with hooding arrangement for extraction of the dust and arrangement of Cyclone or Settling Chamber to collect the coarser portion of the dust and a Bag-filter house to capture the finer portion of the emission not captured by Cyclone or Settling Chamber etc. The sufficient capacity of extraction and pressure drop across the system would be required to be provided by installing an induced draft fan of sufficient capacity. In case the pre-collector not to be installed, it would increase the dust load on the bag-filter house and would call for either more number of filter bags or more frequent cleaning of the filter bags. Therefore, the pre-collectors are recommended to reduce dust load on the bag filter.

Table-78 Typical Points where Water to be sprayed or dust to be extracted

Dry Extraction From	Wet Suppression at
Secondary /Tertiary crusher discharges	Primary crusher
Transfer points / tertiary crushing	Transfer points (before secondary crushing)
	Tertiary crusher feeds

222. To avoid problems of air pollution following guideline is to be considered by the Contractor for setting up Stone Crushers:

- Stone crushing unit shall be at-least 500 m away from nearest settlement / educational institute / religious places / water bodies and 200 m away from the centerline of National Highway / State Highway
- Stone crushing Unit shall not be allowed / permitted within 1 Km from the periphery of ancient/Historical monuments & archaeological sites
- Stone crushing units shall have to obtain necessary permission of land use from competent Authority
- Each stone crusher unit shall install adequate pollution control measures including erection of G.I. Sheets cover and the sprinklers before commencement of operations.
- Dust doom shall be provided in the unit.
- Crusher shall be covered and water sprinkling system shall be provided on crusher to suppress the dust generated due to material handling / loading / unloading activity.
- Screen classifier shall be adequately covered by G.I. Sheets to prevent the emission into the atmosphere due to screening / grading activity.
- All conveyor belts shall be adequately covered by G.I. Sheet / M.S. sheet only.
- Regular wetting of roads shall be carried out to suppress the ground level dust within the premises to control the air borne dust emission due to wind velocity.
- All approach roads and ramps shall be paved.
- Curtain or wall shall be provided surrounding the stone crusher unit.
- Display board shall be provided at the entrance of stone crusher indicating survey no, name and address of owner and the unit.
- Fine dust generated due to screening / crushing / grading shall be disposed-off into abandoned mines.

223. Other anticipated impacts during construction phase are:

- Deterioration of air quality due to fugitive dusts emission from construction activities like excavation, backfilling & concreting, and hauling & dumping of earth materials & construction spoils, and vehicular movement along unpaved roads.

- Deterioration of air quality due to gaseous emissions from vehicular traffic

224. Following **mitigation** measures have been proposed

- Proper and prior planning and appropriate sequencing and scheduling of all major construction activities shall be done, and timely availability of infrastructural supports needed for construction shall be ensured to shorten the construction period vis a vis reduce pollution.
- Construction materials shall be stored in covered godowns or enclosed spaces to prevent the windblown fugitive emissions.
- Truck carrying soil, sand and stone shall be duly covered to avoid spilling.
- Adequate dust suppression measures such as regular water sprinkling on unpaved haul roads & vulnerable areas of the construction sites from trucks or other suitable means shall be undertaken to control fugitive dust during material handling & hauling activities particularly near habitation especially in the dry seasons.
- During construction period, all activities are to adhere to the contractual obligations and all clearances and approvals such as 'Consent to Establish' and 'Consent to Operate' shall be obtained from the Manipur Pollution Control Board under Air Act. All vehicles operating for the Contractor, AE / IE and PIU shall obtain Pollution under Control (PUC) certificate.
- All required clearances are to be obtained from the Manipur Pollution Control Board and the Mining Department for establishing quarries, potential borrow areas and crushers. Contractor should submit copy of such clearances to PIU & AE / IE before start of activities.
- It will be ensured that all the construction equipment & vehicles are in good working condition, properly tuned and maintained to keep emissions within the permissible limits and engines turned off when not in use to reduce pollution.
- **Air Quality Monitoring:** Apart from provision of the mitigation measures, air quality shall be monitored. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan (Section-E of Chapter-8) and the monitored values should correspond with the National Ambient Air Quality Standards. All deviated results shall be reported to AE / IE for remedial measures.

E.2 Operation Phase

225. The major impact on the air quality during the operation stage will be due to plying of vehicles on the proposed corridor. The impact on air quality depends upon traffic volume, traffic fleet including fuel type and prevailing atmospheric conditions. An unstable atmospheric condition disperses pollutants more and results into low pollutant concentrations while stable atmospheric conditions buildup the pollution level. To assess the likely impacts on the ambient air quality due to the proposed highway project, the prediction of the carbon monoxide (CO), particulate matter (PM), Nitrogen Dioxide (NO2) and Sulphur Dioxide (SO2) concentrations have been carried out using line source dispersion modelling approach, based on Gaussian equation. CO is an indicator pollutant for vehicular pollution. So, prediction of CO concentration is representative of the impacts of air pollution due to traffic movement. The modeling for this project has been carried out using AERMOD-9, a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain, developed by the "The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC)".

226. It has been setup and run by using emission factors prevalent for Indian vehicles (ARAI, 2021) and hourly traffic volumes as predicted for the project. The study is conducted to predict hourly increment in CO, PM2.5, PM10, SO2 and NOx concentrations for the base year (i.e. 2024) and future traffic, i.e. Year 2024, 2028, 2033 and 2038. More information on the input parameters can be found in annex 6.4, “Air Quality Assessment of Imphal Ring Road”.

227. **Results*:*** During the ambient air quality monitoring (see chapter 4, section L) it was found that pollutant concentrations are within limits of NAAQS as well as WBG-EHS standards except for PM2.5 and PM10 where pollutant concentration is exceeding WBG-EHS standards while they are within limits of NAAQS. The results of the air quality modelling show a further deterioration of the air quality due to increment in vehicular traffic in future years. With the use of BS-VI fuels and vehicles and gradual discontinuation of BS IV and older vehicles, the vehicular emission is expected to further reduce and may offset the increased pollutant concentration due to increased traffic volume. The greenery and forests located along the project highway will act as a sink to the air pollutants. Since baseline values already exceed the WBG-EHS limits it is important to monitor the air quality in the surrounding of the Imphal Ring Road and take additional measures in case the air quality deteriorates to unacceptable levels.

228. Following **mitigation** measures have been proposed:

- The designed road surface shall generate lesser dust;
- Signage at regular intervals to be placed to remind motorists to keep their vehicles maintained and drive at uniform speed so as to save both in terms of fuel and pollution;
- As part of the routine maintenance works, good riding conditions of the road surface should be maintained to reduce dust and vehicular pollution;
- Regular monitoring of ambient air quality at specified representative locations will be conducted at fixed interval. If the ambient air quality worsens to unacceptable levels in certain circumstances (lack of wind, high temperatures, etc), additional measures such as a temporary reduction in speed must be considered.

F. NOISE ENVIRONMENT

F.1 Construction Phase

229. During the construction phase, noise will be generated due to movement of vehicles, and operation of light & heavy construction machineries including pneumatic tools (hot-mixer, dozer, tipper, loader, excavator, grader, scraper, roller, concrete mixer, generator, pump, vibrator, crane, compressor etc.) that are known to emit sounds with moderate to high decibel value. Noise generated from sources mentioned above will be intermittent and mostly during daytime. Moreover, villages / settlements being mostly away from the proposed project road, significant impact on local people is not apprehended, as the noise will generally die down by the time it reaches them. However, the workers are likely to be exposed to high noise levels that may affect them.

230. Operation of construction machinery will lead to rise in noise level to the range between 80-95 dB(A). The magnitude of impact from noise will depend upon types of equipment to be used, construction methods and also on work scheduling. Typical noise level of various activities during construction stage is presented below.

Table-84 Typical Noise Level during Construction Activities

Sl. No.	Construction Activity	Noise Level dB(A)
1.	Grading & Clearing	84
2.	Excavation	89
3.	Foundations	88
4.	Erection	79
5.	Finishing	84

Note: Measured at Leq assuming 70 dB(A) ambient noise level

231. Expected noise levels can be based on the types of construction work anticipated, the likely equipment required and their associated range of noise levels. Typical noise level of principal construction equipment is presented below.

Table-85 Typical Noise Level of Construction Equipment

Equipment	Typical Noise Level 50 ft from Source, dB (A)
Air Compressor	80
Backhoe	80
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concreter Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	82
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	80
Paver	85
Pile-driver (Impact)	101
Pile-driver (Sonic)	95
Pneumatic Tool	85
Pump	77
Rail Saw	90
Rock Drill	95
Roller	85
Saw	76
Shovel	82
Truck	84

Source: US Federal Transit Administration's "*Transit Noise and Vibration Impact Assessment Manual*", September 2018

232. The construction noise is generally intermittent and depends on the type of operations, location and function of the equipment and the equipment usage cycle, it attenuates quickly with increases in distance. The noise level generated from a source will decrease with distance as per the following empirical formula (inverse square law):

$SPL2 = SPL1 - 20Log_{10}(r_2/r_1)$

233. where, SPL1 and SPL2 are the sound pressure levels at distance r_1 and r_2 respectively. Considering the stationary construction equipment as a point source generating 90 dB(A) at a reference distance of 2 m, computed minimum distance required from the stationery source to meet the permissible noise limits during day time for different land use categories are given in **Table-86**.

Table-86 Minimum Distance Required from Stationary Noise Source

Category	Permissible Limits in Day Time (CPCB)	Distance Required (m)
Silence zone	50 dB(A)	200
Residential	55 dB(A)	113
Commercial	65 dB(A)	36
Industrial	75 dB(A)	11

234. From the above table it may be noted that residence within 113m from the project road will be exposed to a noise higher than the permissible limit. The impacts will be significant on construction workers, working close to the machinery.

235. There are 33 educational institutions and 7 hospitals / Public Health Centre along the project road, out of which 28 educational institutions and 4 medical facilities are located within 100 m from the proposed centerline. These locations are **sensitive to noise**. The noise levels of various construction activities and construction equipment are exceeds the permissible standards (Table 81 & 82). However, it is to be noted that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Regulations for noise exposure by Occupational Safety and Health Administration (OSHA), United States Department of Labor are given below:

Allowed to be unprotected	Allowed to be unprotected
up to 1 hour	105 decibels
up to 4 hours	95 decibels
up to 8 hours	90 decibels

236. It may not be feasible to stop all construction activities near the educational institutions during school hours. Therefore, following mitigation measures have been proposed:

- Grading & clearing, excavation, foundations, erection, movement of heavy construction machinery etc. are the major noise generating activities and it is recommended to stop these activities near educational institutions during school hours. However, it is not possible to eliminate / minimize all noise, but by letting people know what's happening, and when it is happening, they can prepare for the same. It will be the responsibility of the Contractor to inform school / hospital administration and local residents about the noisy operation as well as the steps they have taken to minimize disruption. If the work has to be carried out at a time it is going to be a nuisance, giving people notice will allow them to make alternative arrangements.
- Low noise construction equipment will be used. New equipment is generally much quieter than old equipment. Old equipment should be made quieter by adding new mufflers or sound absorbing materials. In general, electronic powered equipment is

quieter than diesel powered equipment and hydraulically powered equipment is quieter than pneumatic power.

- It will be ensured that all the construction equipment & vehicles used are in good working condition, properly lubricated & maintained to keep noise within the permissible limits and engines turned off when not in use to reduce noise.
- Temporary barriers / enclosures (e.g. plywood with sound absorbing materials) should be built around noisy equipment. These barriers can significantly reduce noise levels and are relatively inexpensive.
- Noise barriers shall be used when working near noise sensitive receptors.
- Protective gears such as ear plugs or ear muffs will be provided to construction personnel exposed to high noise levels as preventive measure (**Annex-8.9**). As a general rule, workers should be using earplugs whenever they are exposed to noise levels of 85 dB (A) or when they have to shout in order to communicate.
- Construction camp and temporary labour sheds will be located away from the immediate vicinity of the construction sites and major road traffic.
- Stationary construction equipment will be placed at least 113 m away from inhabited areas and shall be surrounded with noise barriers to the extent possible.
- Construction activities carried out near residential area will be scheduled to the daytime only so that minimum disturbances are caused to people.
- "Silence zones will be demarcated and road signs prohibiting the use of horns (No Honk Zone) will be displayed at residential areas, sensitive locations and silence zones
- **Noise Monitoring:** The effectiveness of mitigation measures and further improvement in designs to reduce the noise level due to construction and operation activity shall be monitored. The frequency, duration and monitoring plan shall be functional in construction as well as in operation stages as per the Environmental Monitoring Program (**Section-I** of Chapter-8) and the monitored values should correspond with the standard. All deviated results shall be reported to AE / IE, for remedial measures.

F.2 Operation Phase

237. **Source of Noise:** During the operational phase, movement of traffic, traffic congestion, pedestrian interferences and increase in use of horns will be the prime source of noise. There are 18 educational institutions and 7 medical facilities within 50 m of the existing stretch of the ring road.

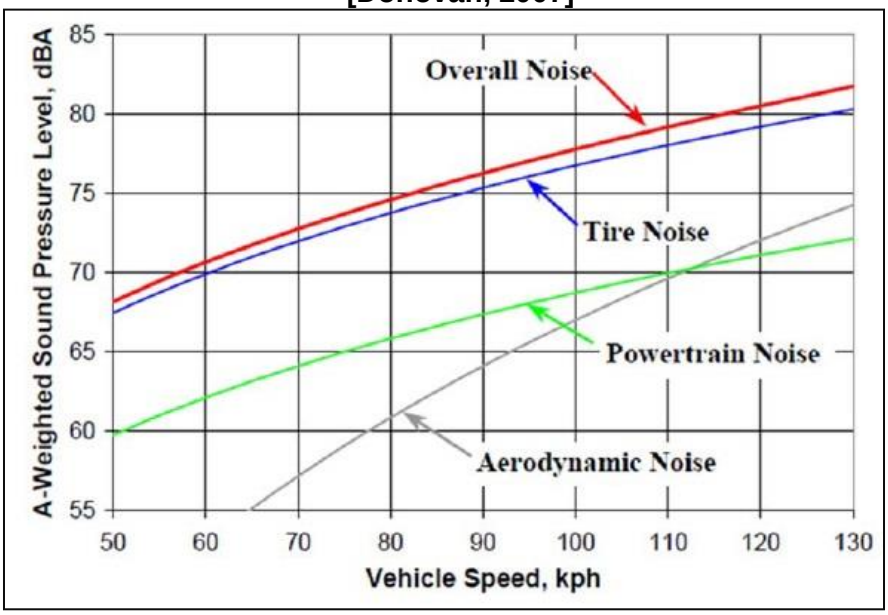
238. **Vehicle Noise and Road Surface Influence on Tire / Road Noise[7] :** There are many sources of noise when a vehicle travels down a roadway. Vehicle manufactures have made efforts to reduce tire/road noise and drive train noise. If a vehicle is in a good operating condition and has a reasonably good exhaust system, then the effect that power and drive train noise has on the overall noise level will be negligible at moderate to high speeds. There is a "cross-over speed" where tire / road noise begins to dominate the overall noise level of a vehicle. This speed lies in the range of 30-50 km/h for automobiles and 40-70 km/h for trucks [Sandberg 1992]. It has been found that the noise level increases with the increase in the speed (**Figure-69**).

239. There are several parameters, which affect the amount that the road surface contributes to the generation of tire / road noise. These parameters include the texture, age, thickness, and binder material of the pavement. The overall texture of the pavement has a significant impact on tire / road noise levels. Studies performed by the Washington State Department of Transportation

[7] U.S. Department of Transportation, Federal Highway Administration

to evaluate how tire / road noise changes with pavement age. These studies have shown that asphalt pavements start out quieter than cement concrete pavements, but the asphalt pavements exhibit an increase in noise levels over time [Chalupnik and Anderson 1992]. **Rigid Pavement** uses cement concrete to provide a stiffer foundation. It has a high flexural strength but rigid pavement doesn't absorb sound. **Flexible Pavement** is made with bituminous (asphalt) materials that absorb noise. As a result of the multiple layers of material, the road can better cope with the stress of heavy loads. This pavement is flexible because it bends or deflects the weight of vehicles that drive over it. Along with reducing sound, absorbent asphalt provides drainage and decreases the amount of standing water on any given road. These types of roads also expand and contract with temperature fluctuations, making them resilient to temperature changes. Based on the life cycle cost analysis, **flexible pavement has been recommended** for proposed Imphal Ring Road. Hence, it can be concluded that, due to flexible pavement, traffic noise will be reduced.

Figure-69 Comparison of Noise Level Separated by Component [Donovan, 2007]



240. **Speed-Noise relationships for Various Motor Vehicles:** The vehicular noise emission levels significantly vary with vehicle speed. It is therefore necessary that speed dependency of noise emissions for various categories of vehicles is taken into account while using the model for noise prediction due to the roadway. In this work the speed-noise relations presented by National Environmental Engineering Research Institute (NEERI) in their report on Environmental and Social Assessment Delhi - NOIDA Bridge Project have been adopted (**Table-87**). It can be concluded from Table-90 that, noise generated from 2/3 wheelers, car, truck & buses are minimum at 30 km speed. Proposed Imphal Ring Road alignment has been designed to a design speed of 80 kmph in green field, 30-50 kmph in urban congested areas Therefore**, near educational institutions & medical amenities, maximum speed limit should be 30 kmph**. The Contractor shall be responsible to install signboard displaying the speed limit (30) near the educational institutions & medical amenities after construction of the ring road and PWD Manipur shall be responsible to enforce and monitoring of the same.

Table-87 Speed-Noise Relationships for Various Motor Vehicles

Speed (kmph)	Noise from Car [dB(A)]	Noise from Truck & Bus [dB(A)]	Noise from 2/3 wheelers [dB(A)]
30	56.0	73.0	58.0
40	59.0	76.0	61.0
50	63.0	80.0	66.0
60	68.0	81.0	68.0
70	68.0	81.5	70.0
80	70.0	82.0	72.0
90	72.0	83.0	74.0
100	74.0	83.5	76.0

F.2.1 Prediction of Traffic Induced Noise in Homogeneous Section

241. The Federal Highway Administration's Traffic Noise Model (FHWA TNM) was used to predict future noise levels during operation of the Imphal Ring Road. The input parameters and the results of the modeling can be found in annex 6.5.

242. The model shows that the predicted increase in noise levels (Leq) at most of the noise sensitive receptors exceed the maximum permissible limit of +3dB during the day as well as night-time. Mitigation measures should be adopted for the sensitive receptors along the road corridor.

243. **Mitigation Measures**: In case the increase in noise levels at sensitive receptors is more than 3 dB(A) the project will install physical noise barriers at these locations. These physical noise barriers can be constructed from earth, concrete, masonry, wood, metal, and other materials. To effectively reduce sound transmission through the barrier, the material chosen must be rigid and sufficiently dense (at least 20 kg/sqm). To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the home or receiver to the barrier. Total noise absorption by an installed noise barrier is expected to be 20-22dB(A).

244. Details of proposed noise barrier installation at noise sensitive receptor locations and its associated cost is presented in **Table-91**. The cost for construction of noise barrier is included in the EMP Budget of respective package.

Table-91 Details of Proposed Noise Barrier at Sensitive receptor locations

S.N.	Name	Design Ch.	Side	Offset from Centre line of the alignment (m)	Landuse	Noise Barrier Proposed (Yes/ No)	Length of Noise Barrier (m)	Noise Barrier Cost (INR)
Educational institutes along the Proposed Ring Road alignment								
1	Kyamgei Heibong Makhong HS Govt Aided School	0+325	LHS	15	Educational	Yes	80	1296000
2	The Kiyamgei Ideal School	1+200	LHS	41	Educational	Yes	100	1620000
3	Kunjabati Kids Foundation	7+000	LHS	23	Educational	Yes	20	324000
4	Meitei Mayek High School	7+450	LHS	12	Educational	Yes	12	194400
5	The Eden Public School	8+130	LHS	15	Educational	Yes	17	275400
6	Sherwood School	8+294	LHS	20	Educational	Yes	21	340200
7	Little Millennium School (play school)	8+475	RHS	24	Educational	Yes	12.5	202500
8	Primary School, Wangkhei Nangpok	8+990	LHS	15	Educational	Yes	30	486000
9	Shemrock Kids Garden	9+310	RHS	17	Educational	Yes	25	405000
10	Modern College Imphal	10+075	LHS	71	Educational	Yes	250	4050000
11	Kongal Imphal Morning High School	10+800	RHS	33	Educational	Yes	40	648000
12	Porompat Girls high School	10+884	RHS	20	Educational	Yes	45	729000
13	Konsam Tomba and Sachi School	14+560	RHS	160	Educational	No	-	-
14	Paramount English School	15+760	LHS	10	Educational	Yes	12	194400
15	Jamia Azizia Girls Islamic Institute	17+250	RHS	35	Educational	Yes	80	1296000
16	Heingang Awang Leikai Primary School	21+100	RHS	11	Educational	Yes	52	842400
18	Savio English Higher Secondary School	33+930	LHS	12	Educational	Yes	28	453600
19	ICAR research complex for North Eastern Hill region Manipur Centre Imphal including Kendriya Vidhyalaya No 1	34+750	RHS	80	Educational	Yes	200	3240000
20	Dental Collage, RIMS	36+000	RHS	44	Educational	Yes	145	2349000
21	College of Nursing, RIMS	36+100	RHS	39	Educational	Yes	140	2268000
22	Central Agricultural University	37+214	LHS	97	Educational	Yes	130	2106000

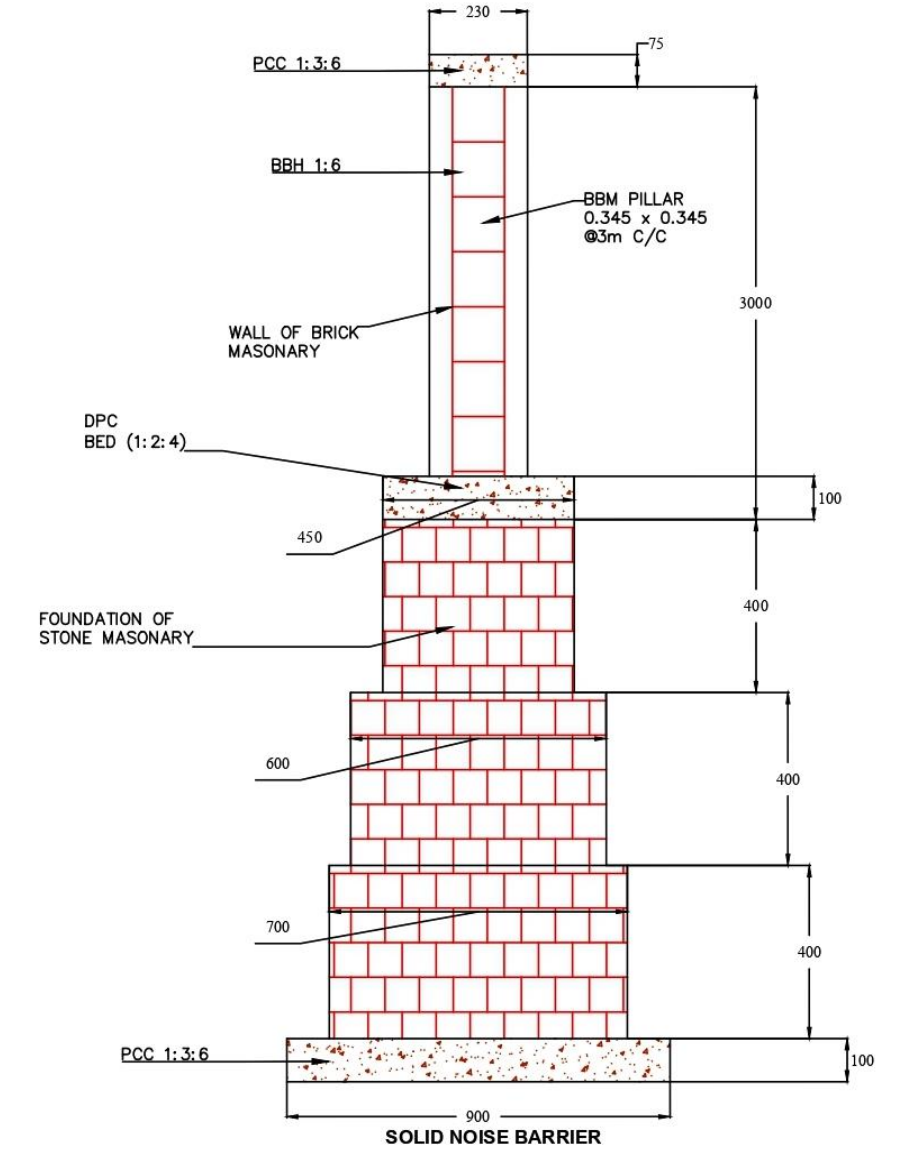
S.N.	Name	Design Ch.	Side	Offset from Centre line of the alignment (m)	Landuse	Noise Barrier Proposed (Yes/ No)	Length of Noise Barrier (m)	Noise Barrier Cost (INR)
23	College of Agriculture, Central Agricultural University Imphal	42+450	LHS	95	Educational	Yes	125	2025000
24	Paree Imom Sindam Sang Preschool	43+121	RHS	16	Educational	Yes	35	567000
25	South Asian institute of rural and agricultural management	44+860	LHS	130	Educational	No	-	-
26	HRD Academy, Ghari	47+450	RHS	124	Educational	No	-	-
27	Manipur International University	47+684	RHS	81	Educational	Yes	17	275400
28	Kids Foundation	47+964	LHS	82	Educational	Yes	45	729000
29	S I School Canchipur	53+874	RHS	26	Educational	Yes	80	1296000
30	Standard Roberth Higher Secondary School	54+155	RHS	120	Educational	No	-	-
Educational institutes along Spur alignment for JNMIS in Porompat								
1	Ahongei Junior High School	1+025	RHS	75	Educational	Yes	50	810000
2	Chingangbam Leikai Upper Primary School	1+568	RHS	16	Educational	Yes	30	486000
Educational institutes along SPUR to RIMS								
1	College of Nursing medical directorate	0+785	LHS	46	Educational	Yes	75	1215000
PCR along the Proposed Ring Road alignment								
1	Community Hall	0+450	LHS	14	Institutional	Yes	30	486000
2	Community Hall	1+000	LHS	20	Institutional	Yes	40	648000
3	Community Hall	1+300	LHS	24	Institutional	Yes	20	324000
4	Community Hall	2+000	LHS	16	Institutional	Yes	20	324000
5	Community Hall	8+669	LHS	16	Institutional	Yes	20	324000
6	Community Hall	11+235	RHS	31	Institutional	Yes	20	324000
7	Community Shed	23+160	LHS	9	Institutional	Yes	20	324000
8	Community Hall	47+824	RHS	43	Institutional	Yes	33	534600
9	Crematorium Ground	1+475	RHS	10	Institutional	No	-	-
10	Crematorium	7+390	RHS	45	Institutional	No	-	-
11	Crematorium	33+380	LHS	22	Institutional	No	-	-
Medical Facilities along the Project Road								
1	Covid Hospital	1+039	LHS	20	Medical	Yes	40	648000
2	Public Health Centre, Bashikhong	2+500	LHS	237	Medical	No	-	-

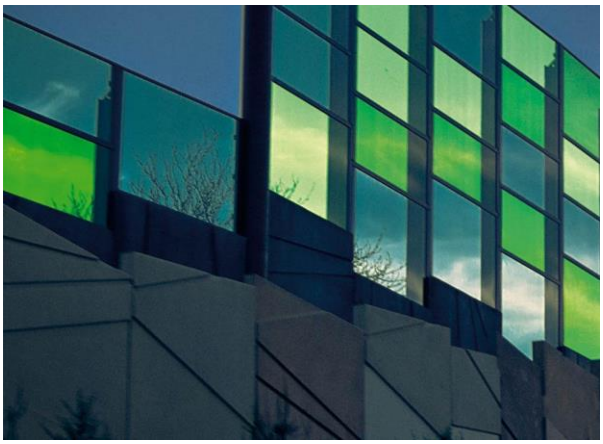
S.N.	Name	Design Ch.	Side	Offset from Centre line of the alignment (m)	Landuse	Noise Barrier Proposed (Yes/ No)	Length of Noise Barrier (m)	Noise Barrier Cost (INR)
3	Public Health Centre, Heingang	18+600	LHS	333	Medical	No	-	-
4	Kripa Foundation	25+254	LHS	95	Medical	No	-	-
5	Catholic Medical Centre	25+800	LHS	40	Medical	Yes	100	1620000
Spur alignment for JNMIS in Porompat								
6	Jawaharlal Nehru Institute of Medical Sciences Porompat	0+534	RHS	38	Medical	Yes	350	5670000
Spur alignment for RIMS								
7	Regional Institute of Medical Sciences	0+815	RHS	150	Medical	No	-	-
TOTAL							2590	41949900

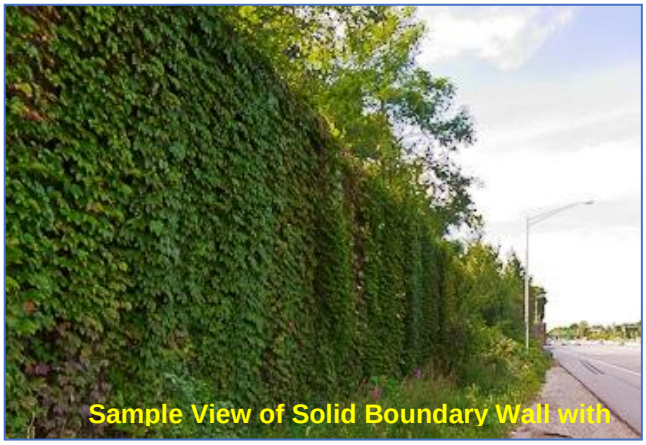
245. **Design Considerations of brick boundary wall:** The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall, plastering and painting. Creepers may be planted in consultation with the local forest officials to give an aesthetic look. Typical drawing of typical noise barrier is given in **Figure-77.**

246. **Design Considerations of Polycarbonate / Acrylic wall:** Polycarbonate wall can reduce sound up to 36 dB(A). The frames to be used for installation of noise barriers should be galvanized and are non-corrosive. The barrier should have anti combustion coating to make it fire resistant. These noise barriers have an aesthetic appeal due to their translucent appearance. It can be procured in a choice of colours, which allows it to fit in perfectly with its surroundings. A number of customized designs of these types of barriers are available and it improves the aesthetic appearance of the location. Polycarbonate has a 95% light transmission capability. Being coated with a UV protection on both sides, it withstands the continuous sun during all seasons. These sheets are very strong and impact resistant and do not shatter with stone impact. Acrylic also has similar properties to polycarbonate and acrylic barriers may also be installed based on cost consideration.

Figure-77 Typical Drawing of Solid Noise Barrier







247. Other mitigation measures proposed

- Vehicular noise & use of horns will be controlled through enforcement of laws and public awareness. It will be ensured that all the vehicles are using proper horn as per norms to keep noise within the permissible limits.
- Silence zones will be demarcated and road signs prohibiting the use of horns will be displayed at residential areas, sensitive locations and silence zones.
- Regular monitoring of noise level at specified representative locations will be conducted at fixed interval.

G. VIBRATION

G.1 Construction Phase

248. Vibration can be felt during construction due to equipment movement, pile driving, compaction, hammering, operation of batching plant and generators, etc. Vibration can cause general annoyance, sleep disturbance, architectural and structural damage to properties. In general, structural damage to the building caused by vibration phenomena are extremely rare and almost generated by the contribution of other factors.

249. Other forms of damage defined “threshold level," is the one that, without compromising the structural safety of the buildings, can cause a reduction of the value or the use. The damage threshold takes the form of cracks in the plaster, enhancements of existing cracks, damage of architectural elements.

250. It is required that the Contractor undertakes condition surveys before start of the construction of all sensitive receptors located within 20 meters from the road as well as vibration monitoring during operation of heavy machinery / equipment such as excavators, motor scrapers, vibratory rollers, pile driving equipment etc.. There are **16 sensitive receptors** identified which are located **within 20 m** from the centre line of the road (**Table-93**). Apart from these sensitive receptors, if **any extremely fragile buildings or structures** are found within 20 meters of the works, these buildings or structures shall be included in the condition survey and monitoring during construction. In case of **piling operations**, condition surveys and monitoring of sensitive receptors & fragile buildings located within **50 meters** around the piling location shall be covered. If there are any claims or reports of damage during construction period, the affected structure will be surveyed against the pre-project survey and repairs will be undertaken as appropriate by the Contractor. Vibration monitoring will be undertaken by the Contractor and the German Standard of Vibration monitoring will be done in compliance with the German Standard DIN 4150-3:1999 “Structural Vibration Part 3: Effects of Vibration on Structures”.

Table-93 Sensitive Receptors recommended for Condition Survey & Vibration Monitoring

Sl. No.	Name	Design Chainage	Side	Distance # (m)	Package
Educational Institutions					
36.	Kyamgei Heibong Makhong HS Govt Aided School	0+325	LHS	15	I
37.	Meitei Mayek High School	7+450	LHS	12	I
38.	The Eden Public School	8+130	LHS	15	I
39.	Sherwood School	8+294	LHS	20	I
40.	Primary School, Wangkhei Nangpok	8+990	LHS	15	I
41.	Shemrock Kids Garden	9+310	RHS	17	I
42.	Porompat Girls high School	10+884	RHS	20	I
43.	Paramount English School	15+760	LHS	10	I
44.	Heingang Awang Leikai Primary School	21+100	RHS	11	II
45.	Savio English Higher Secondary School	33+930	LHS	12	II
46.	Paree Imom Sindam Sang Preschool	43+121	RHS	16	II
47.	Chingangbam Leikai Upper Primary School	1+568	RHS	16	I (SPUR-1)
Religious Places					
48.	Temple	1+555	LHS	18	I
49.	Ibudhou Luwang Punshiba Temple	40+400	RHS	13	II
50.	Temple	42+940	LHS	15	II
Medical Facilities					
51.	Covid Hospital	1+039	LHS	20	I

Distance in meter from propose centerline

251. There are several technical standards, which constitute a useful reference for the evaluation of the disturbance and damages caused by vibration phenomena. For damage to the buildings the main references are: ▪ UNI 9916 "Criteria for measuring and assessing the effects of vibration on buildings", ▪ DIN 4150 and BS 7385. These standards provide a guide for the selection of appropriate methods of measurement, data processing and evaluation of the vibratory phenomena for the evaluation of the effects of vibration on buildings (risk of structural damage), with reference to their structural response and architectural integrity.

G.2 Operation Phase

252. Road traffic is not likely to have any measurable impact on the structures or on comfort. The Federal Highway Administration of the USA has determined that “all studies the highway agencies have done to assess the impact of operational traffic induced vibrations have shown that both measured and predicted vibration levels are less than any known criteria for structural damage to buildings. In fact, normal living activities (e.g., closing doors, walking across floors, operating appliances) within a building have been shown to create greater levels of vibration than highway traffic. Hence, no impact of vibration during operation period.

H. FLORA

H.1 Construction Phase

253. **Diversion of Forest Land:** The Proposed project involves diversion of **12.9746 ha** forest land under Central Forest Division, Imphal. The proposal was uploaded through online portal of the MoEFCC on 09/04/2022 (FC proposal No. FP/MN/ROAD/154280/2022). The proposal has been recommended the Divisional Forest Officer (DFO), the Conservator of Forests (CF), the Chief Conservator of Forests (CCF) and The Government of Manipur. Stage 1 approval of the Central Government has been granted. Copy of online forest clearance application (Part I to Part V) is given in **Annex 6.2**. The Stage-1 approval can be found in annex 6.3**.** The Central Forest Division, Imphal has confirmed that, **there is no natural habitat / modified habitat / critical habitat in the forest land proposed for diversion.**

254. District wise forest land proposed to be diverted is presented in **Table-94**. Geo-reference map showing the proposed diversion of forest land and forest area in the vicinity of the project road is shown in **Figure-78**.

Table-94 District wise breakup of Forest Land

District wise breakup	
District	Forest land (ha)#
Imphal East	4.9644
Imphal West	8.0102
	12.9746

Source: Forest Diversion Proposal Prepared by the ICT Pvt. Ltd.
Forest land proposed to be diverted may change during the process of Forest Clearance

255. **Trees in Non-forest Land:** Loss of flora will occur due to vegetation clearing within the proposed right of way. There are **2,704 trees** within the proposed RoW in the non-forest land (**Table-95**). Apart from trees, there are 3,220 bamboos within the proposed RoW.

Table-95 Trees within Proposed RoW in the Non-forest Area

Name of the Range	Trees in Govt. Land	Trees in Private land	Grand Total
Sadar East Range	220	296	516
Sadar West Range	1,003	660	1663
Nongmaiching Range	257	230	487
Sawombung Range	38	0	38
Total	**1,518**	**1186**	**2,704**
Total number of Bamboos to be felled = **3,220**			

Source: Joint tree enumeration by Forest Department and PWD Manipur

256. **Trees in Forest Land:** Tree enumeration has been done by the Forest Department and there are **2,266 trees** in the 12.9746 ha forest land proposed to be diverted. Girth size wise number of trees in the forest area is summarized in **Table-96** and detail list has been given in

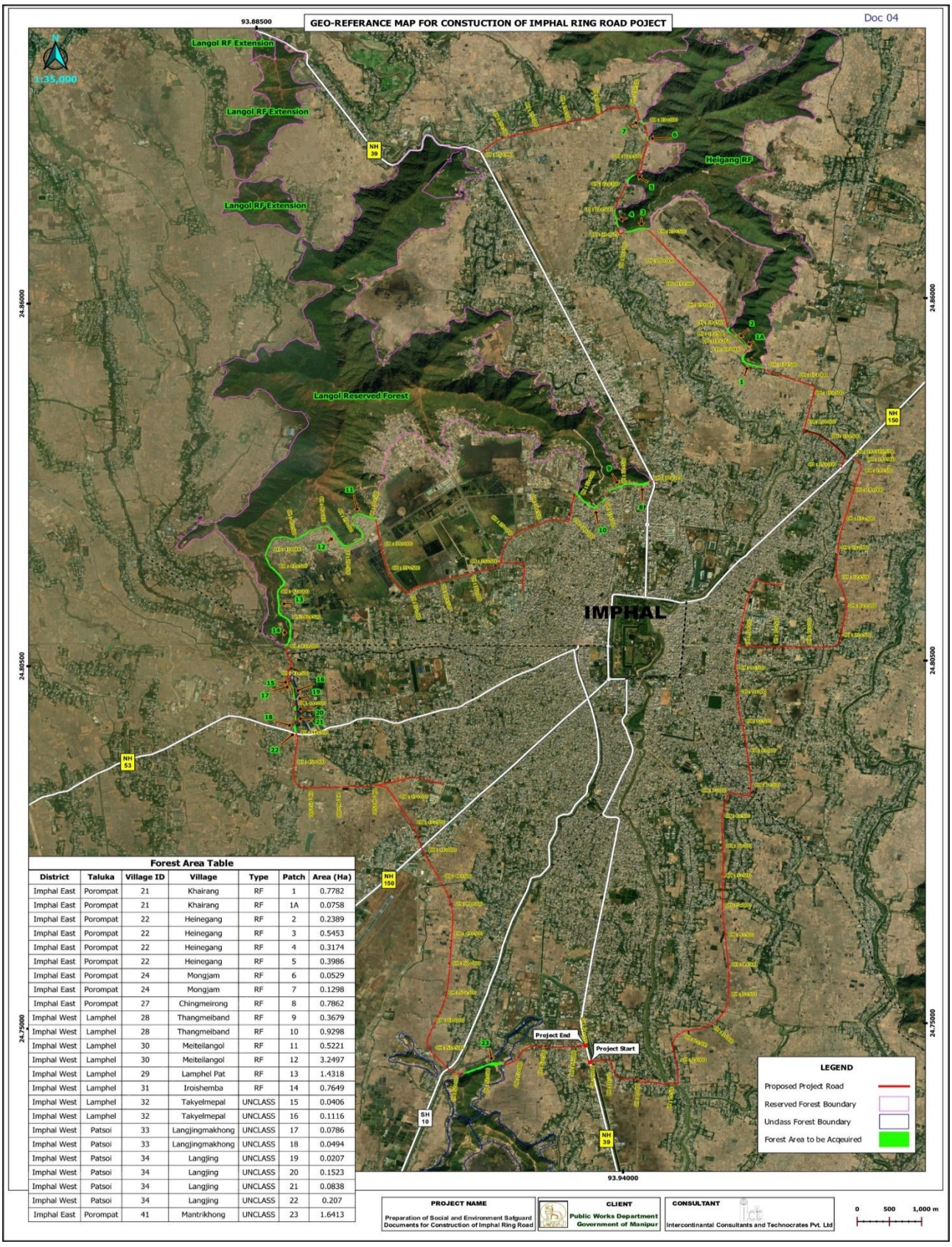
Annex 6.2. It is observed that, girth size of majority of trees (49.43%) is below 30 cm and girth size of only 16 trees (0.71%) is more than 150 cm.

Table-96 Girth Size wise Trees in the Forest Area

	Girth Size (cm)						Total
	0 – 30	31 – 60	61 – 90	91 – 120	121 – 150	>150	
No. of Trees	1120	645	291	158	36	16	**2,266**
Percentage	49.43	28.46	12.84	6.97	1.59	0.71	100.00

Source: Joint tree enumeration by Forest Department and PWD Manipur

Figure-78 Geo-reference map showing the proposed diversion of forest land and forest area in the vicinity of the project road



Forest Area Table

District	Taluka	Village ID	Village	Type	Patch	Area (Ha)
Imphal East	Porompat	21	Khairang	RF	1	0.7782
Imphal East	Porompat	21	Khairang	RF	1A	0.0758
Imphal East	Porompat	22	Heinegang	RF	2	0.2389
Imphal East	Porompat	22	Heinegang	RF	3	0.5453
Imphal East	Porompat	22	Heinegang	RF	4	0.3174
Imphal East	Porompat	22	Heinegang	RF	5	0.3986
Imphal East	Porompat	24	Mongjam	RF	6	0.0529
Imphal East	Porompat	24	Mongjam	RF	7	0.1298
Imphal East	Porompat	27	Chingmeirong	RF	8	0.7862
Imphal West	Lamphel	28	Thangmeiband	RF	9	0.3679
Imphal West	Lamphel	28	Thangmeiband	RF	10	0.9298
Imphal West	Lamphel	30	Meiteilangol	RF	11	0.5221
Imphal West	Lamphel	30	Meiteilangol	RF	12	3.2497
Imphal West	Lamphel	29	Lamphel Pat	RF	13	1.4318
Imphal West	Lamphel	31	Iroishemba	RF	14	0.7649
Imphal West	Lamphel	32	Takyelmepal	UNCLASS	15	0.0406
Imphal West	Lamphel	32	Takyelmepal	UNCLASS	16	0.1116
Imphal West	Patsoi	33	Langjingmakhong	UNCLASS	17	0.0786
Imphal West	Patsoi	33	Langjingmakhong	UNCLASS	18	0.0494
Imphal West	Patsoi	34	Langjing	UNCLASS	19	0.0207
Imphal West	Patsoi	34	Langjing	UNCLASS	20	0.1523
Imphal West	Patsoi	34	Langjing	UNCLASS	21	0.0838
Imphal West	Patsoi	34	Langjing	UNCLASS	22	0.207
Imphal East	Porompat	41	Mantrikhong	UNCLASS	23	1.6413

257. Other impacts are as follows:

- The loss of flora shall occur due to vegetation clearing within the proposed Right of Way (ROW).
- Due to clearing of agricultural land local crop production will be affected. People depended on agricultural land will be directly impacted.
- Clear felling of the tree and subsequent clearing of under growth will expose the soil to the impact of rainfall accelerating the runoff and trigger soil erosion. Productive soil may be washed away
- Deposition of fugitive dust on leaves of nearby vegetation will lead to temporary reduction of photosynthesis along the construction corridor. Such impacts will, however, be confined mostly to the initial periods of the construction phase and in the immediate vicinity of the construction area.
- Labour population during construction phase may cut trees in the area for fuel and making temporary huts.

258. Following **mitigation** measures have been proposed:

- There are 4,970 trees trees with in the proposed RoW. To minimize the impact of loss of flora, **18,274 trees** have been proposed to be planted as detailed in **Table-97**.

Table-97 Details of Compensatory Plantation

<table>
<tr><th>Description</th><th>Trees to be felled</th><th>Trees to be planted</th><th>Remarks</th></tr>
<tr><td>Non-forest Land</td><td>2,704</td><td>5,300</td><td>Trees to be planted on both sides of the road at following locations:
<table>
<tr><th>Chainage</th><th>Length (km)</th><th>Number of rows</th><th>No. of Trees</th></tr>
<tr><td>Spur – 1</td><td>1.570</td><td>2 rows</td><td>468</td></tr>
<tr><td>Spur – 2</td><td>0.815</td><td>2 rows</td><td>244</td></tr>
<tr><td>9+850 to 11+40</td><td>1.550</td><td>2 rows</td><td>462</td></tr>
<tr><td>16+000 to 17+200</td><td>1.200</td><td>2 rows</td><td>358</td></tr>
<tr><td>17+600 to 18+600</td><td>1.000</td><td>2 rows</td><td>298</td></tr>
<tr><td>22+000 to 23+400</td><td>1.400</td><td>2 rows</td><td>418</td></tr>
<tr><td>32+200 to 32+600</td><td>0.400</td><td>2 rows</td><td>120</td></tr>
<tr><td>33+050 to 42+900</td><td>9.850</td><td>2 rows</td><td>2940</td></tr>
<tr><td colspan="3">Total</td><td>5,308</td></tr>
<tr><td colspan="3">say</td><td>5,300</td></tr>
</table>
▪ Cost for plantation of 5,300 trees has been included in the EMP budget.</td></tr>
<tr><td>Forest land</td><td>2,266</td><td>12,974</td><td>▪ Forest land to be diverted = 12.9746 ha
▪ As per MoEFCC Circular dated 08.11.2017, no of plants to be planted Compensatory Afforestation land shall be at least 1,000 plants /ha of forest land diverted
▪ 12,974 trees will be planted by the Forest Department under Compensatory Afforestation (CA) Scheme and cost of CA & NPV will be paid by the PWD, Manipur</td></tr>
<tr><td>Total</td><td>4,970</td><td>18,274</td><td></td></tr>
</table>

Overall Compensatory Plantation	1 : 3.7

- No damage to the flora and fauna in the area adjoining the diverted forest area shall be caused (Condition 4, Section B of Stage-1 Approval).
- Trees will not be cut while birds are nesting in that trees, in such cases cutting has to be postponed until the birds have fledged the nest.
- Vegetation clearing shall be done within PROW; it will be ensured that trees falling outside PROW will not be felled. Efforts will be made to save trees outside formation width standing on edge of the PROW.
- There is a tree at chainage 45+930, which has special status (meeting place). It has been decided in consultation with PIU, PWD Manipur that the **tree at chainage 45+930 will be saved** through minor modification in the design during construction of the project road.
- Apart from plantation, DFO, Central Forest Division, Imphal has suggested developing two Biodiversity Parks in the vicinity of the project area, which shall be established by the Divisional Forest Officer, Central Forest Division. Scope of establishing a Biodiversity park shall be explored by PWD Manipur in consultation with the Forest Department. One of the conditions of the stage-1 approval states that the state government shall submit the details for establishment of 2 Biodiversity Parks and the costs to be borne by the User Agency. The individual cost of the biodiversity parks are **Rs. 88.50 lakh** and **Rs. 64.61 lakh**.
- The construction of the Park is to be executed by the State Forest Department as per their design, specifications and protocols
- Noise level will be kept under control as per the guidelines of CPCB and noisy activities shall be prohibited near forest areas during night time.
- Construction camps shall be located at least 1 km away from forest areas.
- Movement of labour force shall be monitored by the Contractor.
- Construction debris shall not be disposed in forest areas
- Top soil upto 15 cm depth shall be stockpiled and preserved and reused for plantation. The Contactor shall earmark the area of soil stockpiling and to be approved by Engineer in-Charge.
- LPG/ Kerosene shall be provided by the Contractor to the labours for cooking. Provision for community kitchen may be explored.
- Regular sprinkling of water should be done to suppress dust at the construction site. It is suggested that three times water spraying may be done at construction site.
- The overall impact on flora will be concentrated within the ROW of the road and cutting of trees or clearing of vegetation outside ROW shall be strictly prohibited.

H2. Operation Phase

259. Anticipated impacts during operation phase are:

- Deposition of waste along project road and impact of vehicular emission on growth of existing plants
- Vehicular emission will have impacts on vegetation along the project road. Plant along project road will be exposed to various pollutants from vehicles. Vehicular emission affects mainly photosynthetic pigments, respiratory activities, enzymatic activities, uptake of water etc. Pollutants affect the growth of photosynthetic pigments in the plants. Various gases such as nitrous oxide, volatile organic compound and suspended particulate matter deposit on the surface of leaves and affect the output of plants. The pollutants released from vehicles affect the stomatal performance hence

disrupt the gaseous exchange process. Most frequent effects reported are necrosis and chlorosis. (Wagh, N. D., Shukla, P. V.,Tambe, S. B. and Ingle, S. T. 2006) , (Joshi, P. C. and Abhishek, S. 2007)

260. Following **mitigation** measures have been proposed:

- Dumping of waste along the project road shall be strictly prohibited. Contingency plans to be followed to deal with spills or leaks on the project road.
- Regarding vehicular emission, there is a need of a proper monitoring system and strengthening of the laws on environmental protection to ensure the reduction of roadside pollution that affect the animals, plants but also the human population. Vehicular emissions are of particular concern since these are ground level sources and therefore, have the maximum impact on the population of the surroundings. Use of clean fuel (public transport and private vehicles) and encourage electric vehicle are some of the measure to deter vehicular pollution.
- No honking board shall be placed near the forest areas
- **Prohibitory sign boards** shall be placed to prevent trespassing in the forest area

I. FAUNA

I.1 Construction Phase

261. Anticipated impacts during construction phase are:

- The proposed project is the construction of Imphal Ring Road and the alignment is passing through congested urban stretch of Imphal City. It has been **confirmed by the Forest Department** that i) there is **no** rare / endangered / unique species of flora and fauna / critical habitat of fauna found along the alignment and close vicinity of the Imphal Ring Road; ii) The proposed alignment does not cross any wildlife migration corridor as well as there is **no elephant corridor, wildlife migration corridor etc., within 1 Km. from boundary of the forest land proposed for diversion.** Further, there are several Schedule-I / vulnerable (VU) / endangered (EN) species of fauna are observed in Imphal valley (as mentioned in Chapter-IV) but **none of the species are observed in the Imphal City**. The same has been confirmed by the Forest Department as well as local residents during Public Consultation. Hence, **no impact has been envisaged on Schedule-I / vulnerable (VU) / endangered (EN) species of fauna / critical habitat / natural habitat / modified habitat.**
- The clearing of land and felling of trees will directly cause loss of habitat to avifauna dwelling in the area.
- **No road kill data of the area is available** with the Forest Department through which the proposed ring road alignment is passing.

- There may be loss of habitat due to dumping of excavated earth and materials, movement of heavy vehicles and earth-movers, creation of labour camps etc. The effects of these disturbances may persist in the landscape for years.
- Disturbance from road construction activity will affect wildlife behavior. Behavioral responses of wildlife consist of avoidance of the area associated with regular or constant disturbance.
- The construction activities and noise will cause disturbance to wildlife in their movement, feeding, breeding and resting, which will be intermittent and short term reversible impact. Some of the animals may migrate to other locations increasing competition for food and habitat.
- The labors may hurt wildlife observed during construction at site. They may poach wildlife for meat.
- Domestic fauna in the area will also face problem in movement due to construction activity

262. Following **mitigation** measures have been proposed:

- Conservation and awareness measures need to be followed to avoid / minimize / compensate potential adverse impacts.
  - Construction activity shall be planned in such a manner to minimize impact on fauna. Trees outside ROW will not be felled.
  - Wildlife awareness & environmental protection training shall be provided to the work force by the Contractor / PIU. The workers shall be made aware of the location, value and sensitivity of the natural resources in the area. The program shall be conducted before starting of construction activity. All staff of PIU, engineers, support staff and construction labour will attend the awareness program. Budget of **Rs.3,20,000/- (Three Lakh Twenty Thousand)** has been proposed for **training** in the EMP budget for **each construction packages**. The awareness and training shall be provided before initiation of construction activity.
  - Noise level will be kept under control as per the guidelines of CPCB and noisy activities shall be prohibited near sensitive areas during night time.
  - Poaching shall be strictly banned and any incidence of wildlife poaching by workforce shall be reported to the Forest Department by the Contractor / PIU. There should be provision of **penalty / fine** for any incidence of wildlife poaching by workforce and amount of penalty / fine shall be decided by the Forest Department.
  - Construction camps shall be located at least 1 km away from forest areas.
  - Open fire will not be permitted at construction site. **Dos and Don'ts at the work place shall be displayed** such as no smoking, waste disposal, personal protective equipment, etc.
  - The construction and demolition waste management shall be carried out as per the provisions of the Construction and Demolition Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number G.S.R. 317(E), dated the 29th March, 2016, as amended from time to time
  - Implementing sediment and erosion controls during construction will minimize adverse Impacts of water bodies and aquatic life. Construction activity will be avoided near rivers during rainy season.
  - Drainage structures are designed to ensure continuous flow thus preventing ponding and flooding

- Overall the impact on fauna can be mitigated / minimized by strict implementation of above provided measures and monitoring during construction stage.

I.2 Operation Phase

263. Anticipated impacts during operation phase are as follows:

- Disturbance caused by traffic noise shall escalate with time and discourage wildlife movement.
- Impact on aquatic fauna shall be in case of accidental oil spill & toxic chemical release which find its way into the water bodies.

264. Following **mitigation** measures have been proposed:

- **Fencing** has been proposed on both side of the project road in the stretches passing through forest area (**1.5 km in Package-I, 15.8 km in Package-II and 2 km in Package-III**) and cost of fencing has been included in the EMP budget
- This is an urban road project and movement of wildlife in the urban area is a rare incident. Hence, **no significant impact is envisaged on wildlife during operation phase**.
- No honking board shall be placed near the forest areas.
- **Prohibitory sign boards** mentioning "Slow Down", "Animal Presence"; "Attention – You are driving through Forest Area" etc. shall be placed in the forest areas.

- Maintenance of culverts during operation phase as these culverts shall be utilized by the fauna such as snake, lizard, frog, rat, cat etc. for crossings purpose. it is to be mentioned that size of culvert proposed is sufficient for crossing of reptiles and amphibians.
- Immediate cleaning up of oil spills, fuel and toxic chemicals in the event of accidents shall be dealt as per the contingency / emergency plan.
- Contingency plan to be followed immediately in case of oil spills / chemical spill etc.

J. PROTECTED AREA

265. There is no protected area (Wildlife Sanctuary, National Parks etc.) within 10 km radius of the proposed alignment. Hence, no impact is envisaged on protected area as well as wildlife and it's habitat.

K. WASTE MANAGEMENT

K.1 Solid Waste Management

266. Approx. 50 kg/day domestic solid waste will be generated from each construction camp during the construction phase, out of which biodegradable waste is estimated to be 30 kg/day and

remaining 20 kg/day is non-biodegradable waste. There will be **2 types of containers (one for biodegradable waste and another for non-biodegradable waste)** at site for the management of domestic waste generated from construction camp and these containers **shall be emptied daily** and will be disposed of as per Solid Waste Management Rules, 2016 in consultation with the local authority. No incineration or burning of wastes shall be carried out at construction camp. Discarded plastic products, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips & scraps of metal, PVC pipes, rubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, drums and other such materials shall be either reused or shall be sold / given out for recycling.

Table-98 Generation of Domestic Waste from Construction Camp

Description	Total Occupancy	Per Capita Generation (Kg/day)	Total Solid waste generated (Kg/day)
Workers	100	0.500	50
Total solid waste generated during the construction period of 24 months			**36.5 Ton**

267. Debris shall be generated from dismantling of existing pavement (29.995 km). The existing bitumen surface can be utilized for paving of crossroads, access roads and paving works in construction sites and camps, temporary traffic diversions, haulage routes, etc. Non reusable bituminous waste (if any) to be dumped in 30 cm thick clay lined pits with the top 30 cm layer covered with good earth for supporting vegetation growth over a period only after obtaining approval of Sr. Environmental Specialist of the CSC. Pits for disposal of bituminous waste must be located **well above the maximum groundwater level** in order to prevent any groundwater contamination.

268. Other excavated materials from roadway, shoulders, verges, drains, cross drainage and the like shall be used for backfilling embankments and filling pits. Unusable debris / balance material (if any) shall be disposed of as per the Construction and Demolition Waste Management Rules, 2016 and in consultation with the Local Authority.

269. Apart from the above, following **mitigation** measures have been proposed:

- Storage of construction material in accordance with the IRC norms.
- Avoiding work during periods of heavy rainfall.
- No solid waste will be dumped near the water bodies or rivers
- Construction laborers` camps shall be located away from the habitation and from major water bodies
- The campsites will be provided with proper drainage and connected to local disposal system.
- Vehicle maintenance will be carried out in a confined area, away from water sources, and it will be ensured that used oil or lubricants are not disposed to watercourses.

270. A **comprehensive waste management plan** shall be prepared by the contractor prior to initiation of any works. The purpose of the plan is to provide standardized procedures for the clearance, removal and disposal of waste generated during the construction work as well as to establish the most efficient and cost effective methods to resolve waste disposal issues. The Guidelines for preparing comprehensive waste management plan is given in **Annex 8.5**. A capital cost provision of **Rs. 2.4 lakh** for providing solid waste management facility in construction camp

and **Rs. 1.2 lakh** for disposal of construction debris and other waste materials & it's transportation have been included in the EMP budget.

271. **Mitigation Measures other than Good engineering practices:** No solid waste management facility available in the **41** affected villages of the project area (21 villages in Package-I, 12 villages in Package-II and 8 villages in Package-III). Therefore, it is proposed to introduce composting facilities in the villages on community basis for handling of household waste which is primarily biodegradable in nature. This biodegradable waste, when converted into organic compost provides excellent manure and can be used in agriculture and horticulture. Composting not only reduces the use of chemical fertilizers that results soil and water contamination but also avoids stockpile of waste in solid waste landfill. The Swachh Bharat Mission is also committed to ensuring that all organic waste is processed into making compost. **Community composter** facilities organic composting in a hassle-free way and does not require electricity, dedicated staff to manage and hence has very low maintenance cost. Units of community composter are readily available in the market; such composter units may be provided on community basis. It is proposed to provide 2 community composter in every village (total 41 x 2 = 82 community composter) and cost of the same has been included in the EMP budget.

K.2 Liquid Waste Management

272. **Wastewater Treatment in Construction Camp:** The construction period of the proposed project is **24 months each for package** and it is estimated that 100 persons will be engaged during the construction period in every construction package. Fresh water will be used in the construction camp for a variety of domestic uses such as washing, bathing & flushing toilets. The water that emerges after these uses contains vegetable matter, oils, detergents, dirt, soap, oils & greases. This water is called "Grey Water" or sullage. Sewage generated from the construction camp must necessarily be treated and then re-used /re-cycled for various uses that do not need potable water quality. Recycling / re-using treated sewage can reduce fresh water requirements very substantially, by almost 50-60%. Water used to flush toilets to evacuate human excreta is called "Black Water" is to be treated properly otherwise it will contaminate the surrounding surface / ground water.

273. As per the calculation; daily water requirement for drinking & domestic purposes in the construction camp is **7,000 liters** (70 liters per person for 100 persons) and generation of wastewater is **5,600 liters**. Therefore, **Packaged Wastewater Treatment Plant** has been recommended for the construction camp. Guideline for wastewater treatment in construction camp is given in **Annex-8.8**. A capital cost provision of **Rs. 25.5 lakh** for liquid waste management at construction camp has been included in the EMP budget.

K.3 Hazardous Waste Management

274. Following **mitigation** measures have been proposed:

- Waste oil, oil soaked cotton / cloth etc. shall be stored in containers labeled 'Waste Oil' & 'Hazardous' and should be sold off to the Manipur Pollution Control Board authorized vendors only.
- As far as practicable the hazardous materials will be stockpiled under proper mechanical loading, unloading and stacking aided by manual labour where necessary.
- Exercise great care in the storage and use of chemicals because they may be explosive, poisonous, corrosive or combustible.

- Different types of chemicals shall be separated physically and store accordingly after proper labeling.
- Record of all hazardous materials shall be maintained along with enforcement of manufacturer's or supplier's safety standard/s and drill exercises.
- New and less known chemicals and building materials, for which toxicological studies are wanted, need to be properly evaluated prior to their inclusion in the materials list.
- All containers should be clearly labeled to indicate contents.
- Maintain the Material Safety Data Sheet of all chemicals for reference on safety precautions to be taken and the use of suitable PPE.
- Ensure use of correct personal protective equipment before allowing workers to handle chemicals.
- When opening containers, ensure holding of a rag over the cap / lid or use of safety gloves, as some volatile liquids tend to spurt up when released.
- Eye fountain, emergency shower and breathing apparatus should be available near the workplace.
- Ensure immediate medical attention in case of spill / splash of a chemical.
- Safety instructions for handling emergency situations shall be displayed prominently at both the storage and use locations.

275. Guidelines for storage, handling, use and emergency response for hazardous substances is given in **Annex-8.7**.

L. EMPLOYMENT & TRADING OPPORTUNITIES

276. It is estimated that a substantial construction personnel including skilled, semi-skilled and unskilled labourers employed by various contractors will work at site during the peak period of construction phase. Since most of sizeable labour force will be drawn from neighbourhood, no change in demographic profile is anticipated. Only for a few skilled personnel, brought to site from outside the locality, proper housing/ accommodation would be provided in the construction camps. Due to employment opportunities, some competition for workers during construction phase is therefore anticipated.

277. The construction materials like stone chips and sand will be procured locally from identified quarry sites. The other important materials like cement, steel will be procured through various local sources. Thus there is a possibility of generation of local trading opportunities, though temporary.

M. CONSTRUCTION CAMP

278. Anticipated impacts are as follows:

- Influx of construction work-force & supplier who are likely to construct temporary tents in the vicinity
- Likely sanitation & health hazards & other impacts on the surrounding environment due to inflow of construction labourers
- Generation of solid and liquid waste from construction camp

279. Following **mitigation** measures have been proposed:

- Temporary construction camps at designated & demarcated sites with adequate sanitation, drinking water supply & primary health facilities.

- Proper accommodation will be provided in the locality for the migrant construction engineers & officers.
- Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staffs, medicines and minimum medical facilities to tackle first aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.
- The health centre should have Mother & Child Welfare (MCW) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children
- At every construction site, provision of a day care shall be worked out so as to enable women to leave behind their children.
- It will be ensured that the contractor's workers are provided with adequate amenities, health & sanitation facilities in the camp by the contractor. Guidelines for Siting and Layout of Construction Camp is given in **Annex-8.1**
- It is recommended to install Packaged Wastewater Treatment Plant in the construction camp. Guideline for the same is given in **Annex-8.8**
- A comprehensive waste management plan shall be prepared by the contractor prior to initiation of any works. Guideline for preparation of Comprehensive Waste Management Plan is given in **Annex-8.5**.
- Protocol / Guideline for protecting the work force at construction sites during coronavirus COVID-19 pandemic is given in **Annex-8.12**.

N. COMMUNITY AND OCCUPATIONAL HEALTH & SAFETY

280. Anticipated impacts are as follows:

- Health & safety related problems to the community due to project-related hazards, disease (STI / HIV-AIDS etc.), and the accidental collapse or failure of project structural elements such as bridges, flyover etc. Project related activities may directly, indirectly or cumulatively change community exposure to hazards.
- Health & safety related problems to construction workers due to inadequate health & safety measures

281. Following **mitigation** measures have been proposed:

- Health and Safety Plan detailing adequate health & safety measures for the community as well as construction workers shall be prepared by the Contractor prior to the start of the construction activity. The same should be reviewed and approved by the Environmental Specialist of the CSC.
- A road safety, traffic management and accident management plan is to be prepared by the Contractor prior to the start of the construction activity. The same should be approved by the Environmental Specialist of the CSC.
- Periodic health check-up of construction workers will be done by the contractor.
- The PIU, PWD Manipur and CSC should assess the capacity of contractors and subcontractors w.r.t. safety issues and shall advice / arrange training for capacity enhancement so that safety performance at the project site is complying with the requirements of funding agency
- Guidelines for storage, handling, use and emergency response for hazardous substances is given in **Annex-8.7.**

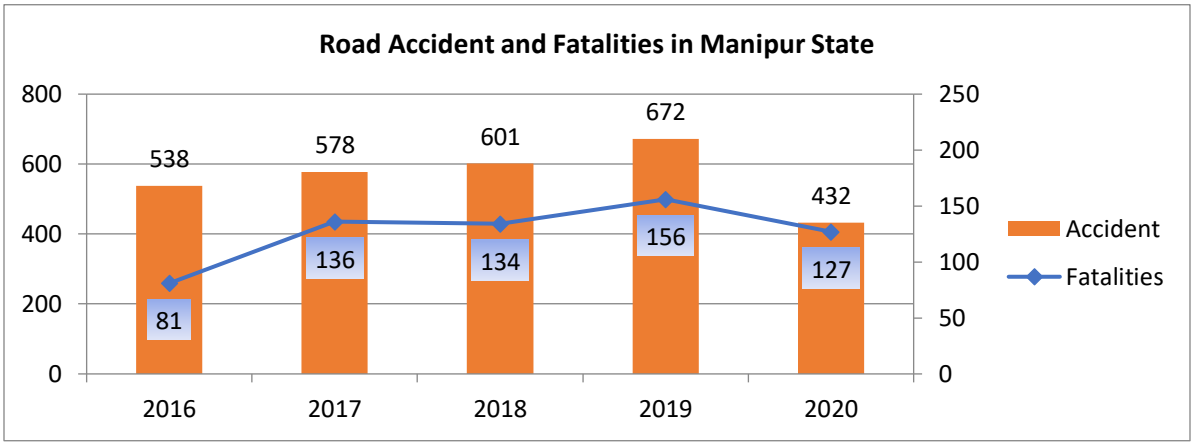
- The Contractor, before start of the construction, has to prepare & submit a emergency response plan describing the community emergency prevention, preparedness and response arrangements in place. Emergency response plans shall be prepared in consultation with the local authorities covering a) specific emergency response procedures; b) trained emergency response teams; c) emergency contacts and communication systems / protocols; d) procedures for interaction with local and regional emergency and health authorities; e) permanently stationed emergency equipment and facilities; f) evacuation routes and meeting points and drills (annual or more frequently as necessary).
- Personal protective equipment will be provided to the construction workers (**Annex-8.9**)
- Protocol / Guideline for protecting the work force at construction sites during coronavirus COVID-19 pandemic is given in **Annex-8.12**

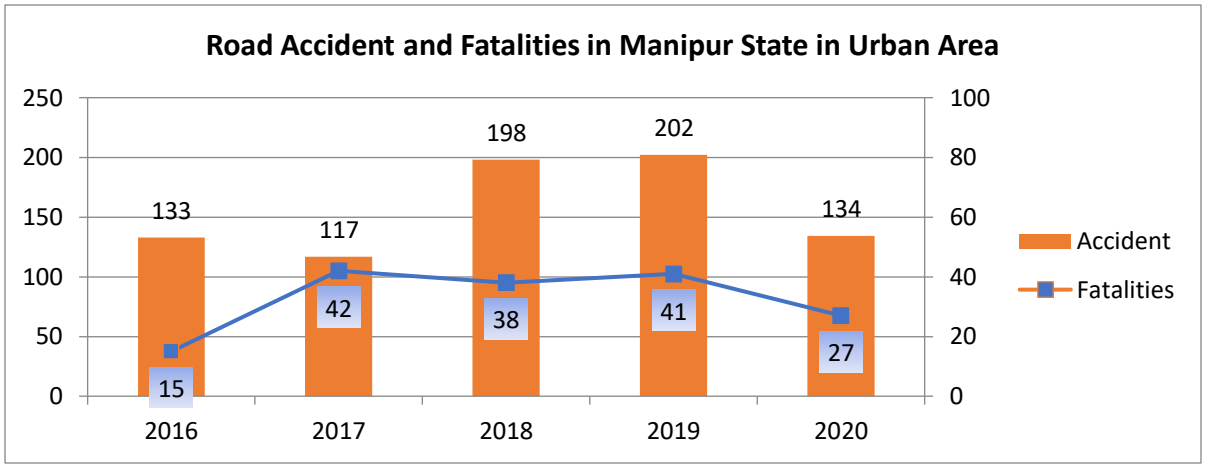
O. ROAD SAFETY

282. **Review of road crash data-Imphal / Manipur:** As per record of MoRTH, Road crash deaths in India are the highest in the world. Official data from the GoI suggest that crashes on India's roads claim the lives of about 150,000 people and injure another 450,000 people each year. To mitigate these unfortunate losses, road safety measures is a crucial first step toward its road safety vision and aspirations. As far as Manipur and its urban area concerned the following facts indicates that, due to lack of road improvement and safety concern, the accidents are very high.

283. After reviewing the accident trend of last 4 years (2016 to 2019), it is observed that road accident data in Manipur State increasing with CAGR of 5.72% and fatalities growth rate is more than 10% every year. Accident scenario of urban area in Manipur even more worrying as crash rate is 11% CAGR and fatalities 28%.

284. In 2020, number of accidents and fatalities has been reduced due to Covid pandemic as traffic on roads were restricted. Hence it is not considered in analysis. The trend of crash data of both Manipur and Imphal is presented below (Source: MoRTH, India)





285. Keeping view of above, the following safety measures for the project road has been considered.

286. **General:** Adequate road safety has been considered in shape of Safety measures, road signs and design criteria in the DPR. Indian Road Congress (IRC) codes have been followed in proposing and designing road safety features. All major intersections shall have shoulder mounted advanced directions signs and traffic control signaling system. The signs shall be with retro reflective micro prismatic grade conforming to Type XI sheeting of ASTM standards for short, medium and long distance viewing to cater visibility requirement encountered by all road users. All curves shall be properly delineated with single chevrons signs which will be placed on outer edge of the curve, so as to view at least 2-3 chevrons from any given instance of viewing. Absolute speed limit signs and also compulsory “no parking” and “no stoppage” signs also have been proposed at regular interval. Overall the entire road project will have Mandatory/Regulatory Signs, Cautionary/Warning Signs, Informatory Signs, Facility Information Signs and Route Marker Signs.

287. **Lighting:** Pavement markings will be done for traffic lane line, edge lines and hatching. The marking will be with hot applied thermoplastics materials. The pavement markings will be reinforced with raised RR pavement markers and will be provided for median and shoulder edge longitudinal lines and hatch markings. Entire Highway lightings including high masts at intersections will be provided in order to improve the night time visibility.

288. **Access to sensitive receptors:** At all major junctions, there will be traffic calming system on all sides to regulate the speed of the vehicular traffic. Out of 36 major junctions, 17 nos. of rotary has been proposed which itself is a speed regulator system. All the minor roads will have ramblers and STOP signs to regulate the entry into the proposed road.

289. **During construction:** Necessary action is to be taken to ensure provision of road signages, construction of diversion roads and other requisite provisions as per **IRC: SP:55-2014** “Guidelines on Traffic Management in work zones”. Safety of road users has to be ensured to avoid smooth and proper traffic movement and any unwanted incident within the construction zones.

290. **Road Safety Audit**: Road Safety Audit (RSA) is a formal, systematic, and detailed examination of a road project by a certified/ designated team of auditors / experts that leads to a report of potential safety concerns in the project road as per the guidelines of IRC Manual (IRC:SP:88, 2019).

291. **During DPR stage:** The main objective of road safety audit is to minimize the risk of crashes occurring on road and to find out the measures for minimizing the severity of any crashes that do occur or are likely to occur. The following section discusses about summary of stage-2 audit which is done on the detailed project report, Plan, Profile and drawings. This audit has been conducted before completion of contract documents.

292. **During Construction stage:** Before start of the project the contractor will have to be separate safety audit by independent agency/ by Authority engineer of the proposed improvement proposal. Based on the **IRC: SP: 55-2014**, the Authority Engineer has to be assigned to check the safety during construction as mentioned above. Findings of this audit will be incorporated in the Good for Construction (GFC) drawings

293. **After completion of Construction stage:** A safety audit will be conducted by an independent agency just after completion of project before open to traffic. Findings of the audit will be incorporated in the detailed design.

294. The detailed design drawings have been reviewed to ascertain, if there are any issue that may affect the safety of all road users. The specific guidelines of Indian Roads Congress have been referred and considered during the review process. The audit recommends road safety measures for each observed problem. The recommendations have been prioritized as Essential, Highly Desirable and Desirable based on their necessity as a proactive measure in order to prevent accident occurrence and incorporated in the design. Audit findings & recommendations are presented in **Table-99** and a summary of the provisions towards road safety in terms of road signs is presented in **Table-100**.

Table-99 Road Safety Audit Findings and Recommendations

Safety Concerns & Audit findings	Risk	Recommendations incorporated in the Design
Major Junctions: There are 36 major junctions along the alignment	Medium	• All major junctions shall have traffic control signaling system with table top ramblers on each side entry. However majority of the junctions has been proposed with rotary which is a traffic calming system. • Traffic moving along the road has been given adequate warning of the merging and diverging movements with the help of signing, pavement marking. This will help the traffic slow down at the point of merging and diverging and take the required direction safely. • All T type junctions have been designed as per **IRC**. • All the minor roads will have ramblers and STOP signs to regulate the entry into the proposed road. • Advance direction (Fig.16.01), Flag type direction (Fig 16.04), Give Way sign along with markings (Fig 14.03), Two way hazard marker sign at the tip of directional/splitter Island as appropriate (Fig 15.78), Warning Sign ahead of zebra crossing at appropriate point to be visible to the approaching traffic (Fig 15.33) **as per IRC -67-2012.** Also Pedestrian Informatory sign at the every location of

Safety Concerns & Audit findings	Risk	Recommendations incorporated in the Design
		Pedestrian crossing, along with the road studs as per IRC provision. • All Pedestrian facilities shall be provided for entire project as per IRC: 103-2012.
Minor Junctions: There are 134 minor junctions.	Medium	▪ Stop Sign at 1.5-6 m in advance of stop line with 'stop' word message shall be painted based on approach speeds shown in Table 6.1 IRC:35-2015 and the placement of same shall be between of 2.5m-15m from stop marking ▪ Speed breaker and warning sign. ▪ The speed of the side road traffic should be curtailed before it enters the main road with a provision of road hump of chord length given in Fig 9.8 of IRC: SP: 73-2018. The hump should be provided for all side roads, where it joins directly. Hump shall be placed around 8 m away from the edge line of the main road along with proper marking of hump. ▪ Mutual visibility between main road and side road traffic has been considered.
Sharp curves along the project road	High	• Speed Limit Sign (Fig 14.37 of IRC: 67-2012) and Curve Warning Sign (Fig. 15.01 / 15.02 of IRC:67-2012) mounted on a single post before the start of curve. Also provide No-Overtaking Sign (Fig. 14.23 of **IRC 67-2012**) before the start of the transition curve on both the approaches. The road signs on the curve shall be as per Fig.9.1 of **IRC.** • It is recommended to provide Transverse Bar Marking (TM08 **of IRC: 35-2015)** before the start of transition curve as the speed reduction device. • It is recommended to provide No-Overtaking Lane Marking (LM24 of IRC:35-2015) on carriageway along the entire length of the curve along with the transition length. Pavement marking shall be as per Fig. 4.6 of IRC: 35-2015.
Bus bay with Bus shelter	Medium	Bus bays have been proposed along the project road as per the IRC codal provision to facilitate the road user to discourage the public transport vehicles not to stop anywhere.
School Zone	High	Traffic calming measures has been proposed as per IRC: 99-2018 Section 5.1, Fig 5.5 or Fig 5.10 Schematic diagram for traffic calming measures in school zones.

Table-100 Provisions towards Road Safety in terms of Road Signs

Type of Sign board	Figure Number (IRC 67)	Quantity
Stack type advance direction sign	Fig 16.01	36
Map Type Advance direction sign	Fig 16.03	65
Object hazard marker(Left)	Fig 15.76	336
Object hazard marker(Right)	Fig 15.77	274
Two Way hazard marker	Fig 15.78	24
Compulsary Keep Left	Fig 14.48	42
Chevron Sign	Fig 15.72	698
Left Hand Curve	Fig 15.01	31
Right Hand Curve	Fig 15.02	37
Pedestrian crossing	Fig 15.33	114
Y-Intersection	Fig 15.11	1
School Ahead	Fig 15.34	20
Staggered Junction Sign	Fig 15.20	2
Speed limit	Fig 14.37	31
Speed Breaker Sign	Fig 15.49	183
Stop sign	Fig 14.01	209
Give way Sign	Fig 14.02	64
Double Chevron Sign	Fig 15.74	132
Cross Road	Fig15.14	35
Bus Stop	Fig17.35	30
Side Road right	Fig15.09	56
Side Road Left	Fig15.10	138
Compulsary Turn Left	Fig 14.45	61
Flag Type Direction Sign	Fig16.04	129
End of Dual Carriageway	Fig 15.31	1
Start of Dual Carriageway	Fig 15.30	1
Gantry sign Board	Fig 16.10	2
Reflective Median Maker (IRC:79-2019 Fig 7) @3 m spacing	IRC:79-2019 Fig 7 @3 m spacing	41

295. In addition to above provisions for road safety, additional measures to improve pedestrian safety as mentioned in IRC: 103-2012 shall be provided which will improve the safety

P. TRAFFIC MANAGEMENT

296. Detailed Traffic Control Plans will be prepared by the Contractor prior to commencement of works on any section of road. The traffic control plans will contain details of temporary diversions, details of arrangements for construction under the traffic and details of traffic arrangements after cessation of work each day.

297. Temporary diversion (including a scheme of temporary land acquisition) will be constructed with the approval of the CSC and the PIU. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers. If temporary use of private land is needed for traffic diversion, the owner has to be duly compensated. The environmental conditions of the temporary land have to be established and it will be the responsibility of the Contractor to redevelop the land to the same environmental conditions after completion of the work. In order to reduce construction impacts to a minimum a sectional approach for the works should be prescribed. In other words, the Contractor has to ensure that one section is finalized and ready to be used by the public before work is started on the next section.

298. The new bridges will be constructed either on the upstream or downstream side of the existing bridges. Normal flow of the traffic will be maintained as per **IRC SP 55.**

299. The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water, if necessary.

300. The Contractor will 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 project road under improvement. Guideline on traffic management is given in **Annex-8.11**.

Q. UTILITY SHIFTING

301. Delay and unplanned shifting of public utilities like telephone and electrical poles, water pipelines, hand pump, OFC cables etc. causes disruption of utility services to local community. Digging, shifting, and re- establishment of poles may also impair the view of community areas. All efforts shall be made to reduce the duration of utility shifting impact and restore the disturbed areas. All utilities should be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies to allow quick shifting and restoration of utility services. Visual barriers are to be provided, as necessary, on active construction zones. Consultation with affected people prior to the start of utility shifting, presenting construction timelines and guidelines should be conducted. Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services, if any.

R. MIGRATION

302. From the view point of employment of migrant skilled workers the project is small. Therefore no social tension is expected due to very small number migrant skilled workers. As the construction phase has a very short time span in comparison to the operation phase, it would not have any long term effect. Moreover the different groups of people engaged in different construction activities will leave the place after specified time span.

S. POSITIVE & BENEFICIAL IMPACTS

303. Positive & beneficial impacts are as follows:

- Employment opportunities due to recruitment of local labourers
- Trading opportunities due to procurement of some construction materials locally
- Time & saving due to faster movement of traffic
- Fuel saving due to faster movement of traffic
- Reduction of vehicle operating cost
- Better facilities to road users

T. INDUCED AND CUMULATIVE IMPACT

304. According to the ADB Environment Safeguards Sourcebook cumulative impact is described as: “The combination of multiple impacts from existing projects, the proposed project and anticipated future projects that may result in significant adverse and / or beneficial impacts that cannot be expected in the case of a stand-alone project.” The sourcebook also describes induced impacts as: “Adverse and / or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur at later or at a different location.

305. Economic activities supporting transport like fuel stations, automotive repair shops, lodging, and restaurants are expected to increase with increase of traffic and induce development in the project area. Increase in agro-industrial activities are also expected to take advantage of improved access to urban centers where there are higher demand and better prices for agricultural products. The project area has good infrastructure for industrialization. Hence the project will accelerate industrial activities and induce development significantly. Further the increased industrial activities will significantly reduce migration. The improved road will provide better connectivity and result in (i) Reduction in travel time (ii) better mode and frequency of transport (iii) access to quality health care facilities, educational and other infrastructural facilities (iv) enhanced tourism activities in the area and state which in many terms will boost the local economy (v) better investment climate for industries creating more employment opportunities to local people.

306. In terms of environment safeguard issues the improved road surface is expected to result in less dust and noise due to traffic plying on the damaged roads. However, the increased traffic due to the improved road will generate more air pollution due to vehicle exhaust and noise. The smoother road conditions will also result in increase of traffic speeds, hence creating more risks for accidents amongst traffic users as well as the local communities in the project area. Improvement in local economic conditions can also result in unorganized and illegal establishment of settlements and businesses along the roads creating new problems of waste and pollution. To address these potential problems relevant local authorities will have to monitor developments and strictly enforce rules.

307. For addressing the impacts of air pollution and noise, regular maintenance of the road surface, air and noise monitoring during construction and operation phases have been included in the EMP for implementation. For addressing safety related impacts, regular maintenance of the road furniture including safety related furniture, has been included in the EMP for implementation during operation stage. Relevant local authorities will need to monitor developments locally and strict enforce rules on location for establishment of new business and houses along the improved road.

308. Traffic modeling for the project road has considered other road development projects in the vicinity of the project road such as the upgrading of the Imphal-Moreh road. Hence cumulative environmental impacts due to increased traffic flow have been considered.

U. CLIMATE CHANGE IMPACTS AND RISKS

U.1 Estimated Carbon Emissions

309. The Transport Emissions Evaluation Model for Projects (TEEMP)[8] developed by Clean Air Asia[9] was utilized to assess the CO_2 gross emissions with and without the project improvements. The main improvement from the project that was considered for the model are better surface roughness with initially 2.0 m/km which may deteriorate over a period but not less than 2.5 m/km. The project road has been proposed to be improved to 4 lane and 2 lane standards in various sections; some stretches along the existing road and some in greenfield. There are 12 Homogeneous Sections (HS-1 to HS-12) out of which lane configuration of HS-1, HS-2, HS-3, HS-7, HS-8, HS-10 & HS-11 are 4 lane and lane configuration of HS-4, HS-5, HS-6, HS-9 & HS-12 are 2 lane. Therefore, for modeling purpose, 2 sections have been formed combing traffic of all homogeneous sections having 4 lane configuration (Stretch-1) and 2 lane configuration (Stretch -2). The model also allows for the inclusion of impacts related to traffic congestion with and without project through provisions for inserting data on the traffic numbers, lane width, number of lanes and volume/capacity saturation limit. Information that was fed into the model for projecting the CO_2 emissions were:

- Total length of Imphal Ring Road is 54.155 km; out of which 23.870 km having 4 lane configuration and 30.285 km having 2 lane configuration.
- Width of 2 lane carriageway if 7.0 m and width of 4 land carriageway is 7.5 m
- Existing road roughness varies from 4.0 m/km to 5.0 m/km and will be improved to 2.0 m/km, which may further reach up to 2.5 m/km during 5 years of road operations and hence will be resurfaced after every 5 years.
- Construction will take place over a period of 24 months in 2022-24 and road operations will begin in 2025.
- The design life of the road is 20 years (2025 to 2044)

310. Traffic forecasts were taken from the detailed project report. Emission factors were taken from the CBCP / MOEF (2007) Draft Report on Emission Factor Development for Indian Vehicles, the Automotive Research Association of India, and C. Reynolds et.al (2011) Climate and Health Relevant Emissions from in-Use Indian for three-wheelers rickshaw as follows:

Table-101 CO_2 Emission Factors

Vehicle Type	Gasoline	Diesel
2-Wheel	2.28 kg/l	
3-Wheel		2.63 kg/l
Cars/ Jeeps	2.59 kg/l	2.68 kg/l
LCV		3.21 kg/l
Bus		3.61 kg/l
HCV		3.50 g/l

311. It was assumed that the 2-wheelers and 3-wheelers have average trip distance of 1/4th of the total road length in each section, whereas all other vehicles do use the entire length as

[8] TEEMP is an excel-based, free-of-charge spreadsheet models to evaluate emissions impacts of transport projects.

[9] A network of 250 organizations in 31 countries established by the Asian Development Bank, World Bank, and USAID to promote better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors.

average trip distance. Furthermore, 2-wheelers and 3-wheelers constitute 100% and 90%, respectively of the total local traffic. It has also been assumed that over the time, the fleet composition will change and the assumptions taken for the same are as follows:

Table-102 Emission Standards of Fleet (%)

	Current Scenario				Year 2044	
Vehicle Type	**Pre-Euro**	**Euro III**	**Euro IV**	**Euro VI**	**Euro IV**	**Euro VI**
2-Wheel		50%	50%		30%	-
3-Wheel	0%	80%	20%		40%	
Cars/ Jeeps		30%	60%	10%	20%	80%
LCV/Bus/HCV		70%	30%		60%	40%

312. Emissions from road construction were estimated by using the emission factor for rural/ urban roads, by using ADB - Carbon footprint 4 (http://www.adb.org/documents/reports/estimating-carbon-footprints-road-projects/default.asp), which is equivalent to **109.6 kg CO_2/km of road construction**. ,

313. The proposed road resulting to surface roughness and road capacity improvements have implications in CO_2 emissions. Improved roughness results to higher speed and lesser emissions while increase road users increases emissions. These factors are further affected by traffic congestion once the volume/capacity saturation limit. CO_2 emissions will also result from the processing and manufacturing of raw materials needed for construction of the ring road. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is 47.765 Km. Further, the length of SPUR to JNIMS / DDK is 1.570 km, SPUR to RIMS is about 0.815 Km and SPUR to FCI is about 1.080 Km. Therefore, total length **of improvement** including Imphal Ring Road and three SPURs are **51.230 km**. **Therefore, total CO_2 emissions during construction phase will be of the order of 5,614.808 tons.**

314. Overall project's CO_2 emission intensity indicators are provided in **Table-103**. The with project scenarios will be have lower CO_2 emissions and there is no difference between "project without induced traffic" and "project with induced traffic". Furthermore, with project scenarios (both without and with induced traffic), over the time due the emissions will be controlled by maintaining the road roughness 2.0 m/km during the entire project life as well as enhanced capacity of the road. This will result in annual CO_2 emissions of the project road much below the threshold limit of 100,000 tons/year.

Table-103 Project CO_2 Emissions Intensity Indicators

	CO2		
Particular	**Business-As-Usual**	**Project (without Induced Traffic)**	**Project (with Induced Traffic)**
tons/km	3,497.77	3,283.85	3,283.85
tons/year	9,471.08	8,891.85	8,891.85
tons/km/year	174.89	164.19	164.19
g/pkm	90.38	78.84	78.84
g/tkm	208.78	183.72	183.72

U.2 Climate Risks and Adaptation needs

315. In today's world, climate change is considered the most serious global challenge. Changes in the atmosphere have been detected that could drastically alter the climate system and the

balance of ecosystems. Atmospheric changes are linked to an increase in greenhouse gases (GHGs), chiefly on account of anthropogenic releases attributed to fossil fuel consumption, land use changes, deforestation etc. Research has established that carbon dioxide (CO_2) levels in the atmosphere have risen by 35% since the pre-industrial era. Rising CO_2 concentrations increase the energy retention of Earth's atmosphere, leading to a gradual rise of average temperatures and global warming.

316. Sector specific climate risks screening has been done based on secondary sources to analyze impact on road components due to likely change in climatic variables, mainly temperature and precipitation.

317. ***Temperature*****:** Manipur state is susceptible to anthropogenic greenhouse gas (GHG) emissions. Surface temperature variation is observed during the year 1954 to 2011 and it shows an increasing trend in both the minimum and maximum temperatures. The maximum temperature has increased from 26.5°C to 27.3°C, the minimum temperature has increased from 13.8°C to 15.3°C. Even the night temperature has rapidly risen as compared to day time temperatures because the greenhouse gasses act as a glass house by trapping long wave radiation radiated by earth surface. Seasonal variability of minimum and maximum surface temperatures in Manipur was from 4°C (January) to 21.5 °C (July) and 21.5°C (January) to 28.9 °C (July) respectively. As per the spatial pattern of minimum temperature, an increasing trend was observed over Imphal (east & west).

318. As per The Climate Change study of Manipur, the state is projected to experience an increase in temperature above 1.7°C by 2030. The projected increase in annual average temperatures for the southern districts is higher than the northern districts. **The western-most district and Imphal west is projected to experience the highest increase in temperature, 1.8°C** and the northern part of the state is projected to have lower increase.

319. ***Relative Humidity:*** Average relative humidity in the state was 74.22% during 1969-2011. It is observed that the relative humidity is considerably increasing during night in Manipur. It has reached above 80% during night especially during June to September (monsoon months) due to continuous rainfall. High relative humidity during monsoon periods increases the incidents of people affected by vector borne diseases such as malaria, dengue etc. Optimum temperatures and high relative humidity during monsoon periods are favorable conditions for mosquitoes, their life cycle and the development of the parasite in their body and are highly correlated with prevailing local climatic conditions.

320. ***Water Resources:*** The impacts of climate change on water resources have been highlighted in the IPCC's Fourth assessment report on climate change indicating an intensification of the global hydrological cycle affecting both the ground water and surface water supply. Different catchment areas are likely to respond differently to climate drivers, depending largely on catchment physio-geographical and hydro-geological characteristics. The IPCC has also predicted with high confidence that the drought affected areas will increase in frequency as well as the severity of drought. The trend in precipitation in the North East Region exhibits considerable spatial variability with respect to the predictions for the year 2030. According to the INCCA (November 2010) report on "Climate Change and India: a 4x4 assessment, a sectoral & regional analysis for 2030s", some part of Manipur shows an increase in evapotranspiration during 2030. **An increase in water yield is seen in Manipur with a magnitude up to about 40%.**

- In Manipur, average mean annual rainfall is projected by INCCA to vary from a minimum of 940±149 mm to a maximum of 1330±174.5mm, with increase from 0.3% to 3% by 2030s with respect to the 1970s.
- As intensity of rainy days increases in a more warming scenario, number of rainy days is likely to decrease by 1–10 days in Manipur. The intensity of rainfall in the region is likely to increase by 1-6 mm/day.
- Entire state of Manipur is projected to receive increased precipitation.

321. **Flood:** The valley areas witnessed frequent floods in recent years even after short spell of storm due to various reasons like: manmade ecological changes in the catchment areas, the high intensity rainfall during the rainy season in the hilly areas i.e., the upper catchments of the rivers and heavy runoff and low infiltration in degraded watersheds in the upper reaches of the rivers resulting in flash floods. As a result, the available agricultural lands and habitats are damaged by such floods. Flash floods are frequent also within the urban settlement areas during rainy season. The damages due to flood comprise of breach of bunds, overflowing, landslides, erosion and depression of river banks at the vulnerable areas. Heavy siltation occurs during the monsoon season in the rivers and streams. Several perennial streams and natural springs have disappeared gradually due to siltation.

322. ***Forests & its ecosystem and Biodiversity:*** The forest types of Manipur are unlikely to be impacted by climate change under A1B scenario by 2030s, the forest could be vulnerable due to other factors such as forest fragmentation, forest degradation and forest conversion. The INCCA report (Climate Change and India A4×4 Assessment) has also concluded that the future climate may not be optimal for the current vegetation, for that grid. A Composite Forest Vulnerability Index (CFVI), developed by the INCC (Source: Report on Climate Change India : 4x4 Assessment) for the two scenarios viz.: current CFVI and future CFVI, found that the forests of some districts of Manipur namely Bishnupur, Churachandpur, Senapati, **Imphal East**, Tamenglong and Chandel have high CFVI (have high overall vulnerability).

U.3 Climate Change Mitigation for the Project

323. Key engineering measures taken to address flood risks in the design are: i) construction of lined, RCC, unlined drains, ii) construction of new culverts and widening & reconstruction of existing ones and iii) construction of major & minor bridges. As shown in **Table-104,** costs for taking these measures add up to a total of **Rs. 396.38 Crore for the project**. This is approximately **35.5%** of the total civil works costs. It must be pointed out that these measures would have been considered anyway in the conventional design as the issue of flooding is a threat to the sustainability of the road. However, these measures also contribute to adaptation of the roads for future increases in precipitation. This risk screening and risk identification exercise has helped to ensure that the project road with climate risks have adequate risk mitigation or adaptation measures. Provisions have also been made in the bidding documents for the contractor to prepare contract package specific EMP's based on the final detailed design to address a range of issues including climate related risks and vulnerabilities and accordingly incorporate required costs in the BOQ.

Table-104 Details of Climate Adaptation Measures with Cost Implications

Roads/Details		**Imphal Ring Road**
A. Cross-drainage structures		
Proposed Culverts		
Culvert Length (m)	Length of Existing culverts	203.5 m
	Length of Proposed Culverts	196 m
Cost Impact (Rs. Crore)		**49.54 Cr.**
Proposed Bridges		
Bridge Length (m)	Length of Existing Bridge	0
	Length of Proposed Bridge	377.904 m
Cost Implication (Rs. Crore)		**100.67 Cr.**
B. Roadside drains		
Lined built-up (m)		15,381 m
RCC covered drain (m)		94,893 m
Unlined open (m)		1,435 m
Cost Implication (Rs. Crore)		**246.17**
Total Cost (Rs. Crore)		**396.38 Cr.**

Source: DPR and IEE prepared by ICT Pvt. Ltd.

V. SOCIAL IMPACTS

324. **Impacts due to land acquisition:** The land acquisition for the project section has been calculated considering the proposed ROW / COI, which generally varies between 14.0 m to 18.5 m for main ring road, while at few locations, such as chainage 9+885 to 10+815 and chainage 47+475 to 48+335, the proposed ROW are 30.00 m and 35.0 m respectively. For Spur alignments the PROW varies between 14.0 m to 18.5 m. It is to mention here that the project will be implemented in two phases. As per the Land Acquisition Plan (LAP) prepared for the project, 94.861 hectares of land will be acquired out of which 49.664 hectares of land in Imphal East and 45.196 hectares of land in Imphal West. Out of 46.758 hectares of private land 23.128 hectares in Imphal East and 23.630 hectares in Imphal West

Table-105 Land Acquisition Requirements under the Project

Sl. No	**Alignments**	**Type of Ownership**	**(Area in Sq. m)**		**Total Area (in Sq. m)**	**Total Area (in ha)**
			Imphal East	**Imphal West**		
1	Main Ring Road	Private	231280	211670	4,42,950	44.295
		Government	234631	211236	4,45,867	44.5867
2	Spur Alignments	Private	0	24635	2,46,35	2.4635
		Government	30730	4424	35,154	3.5154
Total			**496641**	**451965**	**9,48,606**	**94.8606**

Source: Resettlement Plan of Imphal Ring Road, June 2022

325. **Intensity of Impact on Land Owners:** Intensity of impact on land is very important as it decides the entitlement of the affected persons as per new land acquisition act. If someone is losing their source of livelihood due to land acquisition, they will be entitled for annuity allowances. To decide the intensity of impacts on land it has been analyzed that any land holders losing more than 10 % of their productive assets are eligible for annuity allowances. The severity of impacts on land shows that 467 land holders are losing land more than 10 %. The details are given in **Table-106**.

Table-106 Severity of Impact on Land holders

Sl. No.	Scale of Impact	Impact on Land holder	%	Remarks
1	Less than 10%	83	15.09	Insignificant Impact
2	More than 10%	467	84.91	Significant Impact
Total		**550**	**100.00**	

Source: Resettlement Plan of Imphal Ring Road, June 2022

326. **Impacts due to loss of Structures:** Due to the proposed project work, 290 structures are going to be affected which are located within the available ROW. Out of these 290 affected structures, 199 are private, 43 are Government and 48 are common property resources (CPRs). The details of the affected structures are provided in **Table-107.**

Table-107 Loss of Structures

Sl. No.	Ownership of Structures	Total	Percentage
1	Private	199	68.62
2	Government	43	14.83
3	Community Property Resources (CPRs) including Religious	48	16.55
Total		**290**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

327. **Type of Affected Structures:** As per census survey, out of 199 structures, 83 are residential structures, 77 are commercial structures, 24 are residential-cum-commercial structures, 13 are boundary walls and 2 other types of structures such as cattle shed, toilet etc. The details of affected structures are given in the **Table-108**.

Table-108 Types of Affected Structures

Sl. No.	Category of Structure	Total	%age
1	Residential	83	41.71
2	Commercial	77	38.69
3	Residential-cum-commercial	24	12.06
4	Boundary Wall	13	6.53
5	Other Structures	2	1.01
Total		**199**	**100**

Source: Resettlement Plan of Imphal Ring Road, June 2022

328. **Type of Construction of Affected Structures:** The construction types of affected private structures are Permanent, Semi-Permanent and Temporary. Out of 199 structures, 44 structures are Permanent, 79 structures are semi-permanent, 61 structures are temporary and remaining 15 structures includes cattle shed, toilets and boundary wall. The details of type of constructions of the affected structures with area (sq. m) are summarized in the **Table-109**.

Table-109 Type of Construction of Affected Structure

Sl. No.	Category of Structure	Structure Details					
		Title Holders (TH)	Area (Sq.mt.)	Non-Title holders (NTH)	Area (Sq.mt.)	Total Structures	Area (Sq.mt.)
1	Permanent	33	2006.75	11	917.53	44	2924.28
2	Semi-Permanent	47	1884.062	32	1889.8	79	3773.862
3	Temporary	30	1577.79	31	1199.85	61	2777.64
4	Toilet	0	0	1	6.25	1	6.25
5	Cattle Shed	0	0	1	14	1	14
Boundary Wall							
1	Permanent	5	126.2	2	31.4	7	157.6
2	Semi-Permanent	2	18.9	2	9	4	27.9
3	Temporary	2	33.8	0	0	2	33.8
Total		**119**	**5647.5**	**80**	**4067.83**	**199**	**9715.33**

Source: Resettlement Plan of Imphal Ring Road, June 2022

329. **Magnitude of impacts on Structures:** The level of impact has been considered under two categories namely, partial impact and fully impact. Properties affected more than 50% are considered as “Fully Affected” and belongs to displacement category; while properties affected less than 50% are considered as “Partially Affected” and belongs to non-displacement category. The DPs, losing commercial /Res-cum-commercial structures, either in fully displaced category (93 DPs) or partially displaced category (12 DPs) may face economic displacement. Most of the structures are getting fully affected 173 (TH-102 & NTH-71), whereas 26 (TH-17 &NTH-9) structures are partially affected. The summary of impact is tabulated in **Table-110**

Table-110 Impact Level on Structures

Sl. No.	Impact Level	Category	Total	
			Title Holders	Non-Title holders
1	Fully Impacted	Residential	40	23
		Commercial	37	34
		Res-Com-Commercial	15	7
		Others (Boundary Wall, Cattle Shed, Bore Well)	10	7
Total A			**102**	**71**
2	Partially Impacted	Residential	8	6
		Commercial	7	2
		Res-Com-Commercial	2	1
		Others (Boundary Wall, Cattle Shed, Bore Well)	0	0

Sl. No.	Impact Level	Category	Total	
			Title Holders	Non-Title holders
Total B			**17**	**9**
Total (A+B)			**119**	**80**

Source: Resettlement Plan of Imphal Ring Road, June 2022

330. **Impacts on Displaced Households:** Due to the proposed Ring Road, 840 households will be affected out of which 669 households belongs to titleholder category and 70 households belongs to non-titleholder category as detailed in **Table-111**.

Table-111 Categories of Displaced Households

Sl. No.	Categories of Affected Households		Total	
			Number of Structures	Number of Displaced households
1	**Titleholders (THs)**			669
	A	Losing Land only		550
	B	Land + Structures	119	119
2	**Non-titleholders (NTHs)**		80	70
	A	Encroachers	80	70
3	Tenants		0	85
	A	Residential		18
	B	Commercial		67
4	Employees		0	16
Total			**199**	**840**

Source: Resettlement Plan of Imphal Ring Road, June 2022

331. **Impacts on Government and Community Property Resources (CPRs):** A total of 91 common property resources (CPRs), owned by government and other institutions, as well as village communities, are affected. The Common properties and religious structures need to be restored or relocated in consultation with concerned communities and panchayat representatives. Especially in the case of religious structures, attempts need to be made to minimize impacts at the time of implementation as far as possible. The details of affected CPRs are presented in **Table-112**

Table-112 Loss of Government and Community Property Resources (CPRs)

Type of Structure	Category of Structure	Total	
		No. of Structure	Area (Sq. m)
Government	Permanent	25	1370
	Semi-Permanent	13	414
	Temporary	2	26
	Toilet	3	11
Total A.		**43**	**1821**
Community	Permanent	8	199
	Semi-Permanent	25	1634
	Temporary	6	75
	Toilet	6	10

Type of Structure	Category of Structure	Total	
		No. of Structure	Area (Sq. m)
Total B.		**45**	**1918**
Religious	Permanent	3	18
	Semi-Permanent	0	0
Total C.		**3**	**18**
Sub-Total (A+B+C)		**91**	**3757**

Source: Resettlement Plan of Imphal Ring Road, June 2022

332. **Loss of Livelihood:** Out of 188 households, who will be losing their livelihoods, earning through commercial activities either as commercial owner or employees. 93 households are losing their livelihood permanently while 95 DPs including commercial tenants will face temporary loss of income. The phase wise details of livelihood loss are presented in the **Table-113**.

Table-113 Loss of Livelihood

Sl. No.	Category	Total	%
1	Permanent loss of Income losing commercial structures	93	49.47
2	Temporarily loss of Income/Disruption of Economic activities	95	50.53
Total		**188**	**100.00**

Source: Resettlement Plan of Imphal Ring Road, June 2022

W. ENTITLEMENT ASSISTANCE AND BENEFITS

333. **Loss of land** will be compensated at replacement cost, which will be calculated on the basis of market value, multiplied by a factor of (a) 1 (one) to 2 (two) in rural areas based on the distance of project from Urban Area as notified by the Government of Manipur; and (b) one in urban areas Solarium amount equivalent to 100% of the market value will also be calculated on the basis of factor (1 or 2). (Example: if the market value of one acre of land is Rs. 1000, the compensation rate in rural area will be (1000 x 2) + 100% = Rs. 4,000 and for urban area it will be (1000x1) + 100% = Rs. 2,000) The cost of the land will also include refund of transaction cost (including land registration cost, and stamp duties) incurred for purchase of replacement land. If the residual plot(s) is (are) not viable, i.e., the DP becomes a marginal farmer, three options are to be given to the DP, subject to his acceptance which are (i) The DP remains on the plot, and the compensation and assistance paid to the tune of required amount of land to be acquired, (ii) Compensation and assistance are to be provided for the entire plot including residual part, if the owner of such land wishes that his residual plot should also be acquired by the EA, the EA will acquire the residual plot and pay the compensation for it and (iii) If the DP is from vulnerable group, compensation for the entire land by means of land for land will be provided if DP wishes so, provided that land of equal productive value is available. The replacement of land option will be considered by the District Collector while acquiring land wherever feasible alternate land is available. All fees, stamp duties, taxes and other charges, as applicable under the relevant laws,incurred in the relocation and rehabilitation process, are to be borne by the EA. Each family losing land will be entitled for following assistances.

- One- time resettlement allowance of Rs. 50,000
- One-time assistance option from: (i) Where jobs are created through the project, employment for at least one member of the affected family with suitable training and skill development in the required field; or (ii) one-time payment of Rs. 500,000.

334. **Loss of Structures** will be compensated at replacement value with other assistance to both titleholders and non-titleholders. The details of entitlement will be as:

- Compensation for structure at the replacement cost to be calculated as per latest prevailing basic schedules of rates (BSR) without depreciation. 100% solatium on the estimated cost will be added as per provisions made under this RP. In rural area, the displaced family will be provided with the option of constructed house as per Indira Awaas Yojana (IAY) specifications in lieu of cash compensation. In urban area, the displaced family will be provided with the option of constructed house of minimum 50 sq. m. plinth area in lieu of cash compensation. Fees, taxes, and other charges related to replacement structure.
- Right to salvage materials from structure and other assets with no deductions from replacement value.
- One-time Resettlement allowance of Rs. 50,000
- One-time financial assistance of Rs. 25,000 to the families losing cattle sheds for reconstruction
- One time shifting assistance of Rs. 50,000 towards transport costs etc.

335. **Loss of livelihood** due to loss of primary source of income will be compensated through rehabilitation assistances. There are various categories of entitled persons under this category which are (i) titleholders losing income through business, (ii) titleholders losing income through agriculture, (iii) non-titleholders losing primary source of income. Details of entitlements for the above categories are described below:

- One-time financial assistance of minimum Rs. 25,000
- A training budget @ Rs 5000 will be provided for Skill up-gradation training to DPs who opted for income restoration for one member of the affected family
- Preference in employment under the project during construction and implementation.
- Monthly subsistence allowance of Rs. 3,000 for one year (total Rs. 36,000) from the date of award.
- Cash assistance @ Rs. 273/day will be paid to DPs in case of temporary disruption of livelihood for a period of 3 months.

336. **Relocation of Housing and Settlements:** The EA will provide adequate and appropriate replacement land and structures or cash compensation at full replacement cost for lost land and structures, adequate compensation for partially damaged structures, and relocation assistance, according to the Entitlement Matrix. TheEA will compensate to the non-title holders for the loss of assets other than land, such as dwellings, and also for other improvements to the land, at full replacement cost. The entitlementsto the non-titleholders will be given only if they occupied the land or structures in the project area prior to the cut-off date.

337. **Income Restoration and Rehabilitation:** The project impact reveals that due to loss of commercial structures 188 households (including households losing livelihoods indirectly such as tenants, and employees) are losing their livelihood due to the project. The entitlement proposed for theproject has adequate provisions for restoration of livelihood of the affected communities. The focus of restoration of livelihoods is to ensure that the DPs are able to at least achieve pre-project level if not improved. To restore and enhance the economic conditions of the DPs, certain income generation and income restoration programs are incorporated in the RP. To begin with providing employment to the local people during the construction phase will enable them to benefit from the project, reduce the size of intrusive work forces and keep more of the resources spent on the project in the local economy. It will also give the local communities a greater stake and sense of ownership in the project.

338. **Resettlement Budget and Financing Plan:** The resettlement cost estimate for this project includes eligible compensation, resettlement assistance and support cost for RP implementation. The support cost, which includes staffing requirement, monitoring and reporting, involvement of NGO in project implementation and other administrative expenses are part of the overall project cost. Contingency provisions have also been made to take into account variations from this estimate. The total R&R cost including the cost of GESI action plan implementation has been worked out to **Rs. 1875.15 million** (Table 114).

Table-114 Resettlement and Rehabilitation Budget

SI. No.	Components	Cost (Rs.)
1.	Land Acquisition Cost	110,94,26,472
2.	Cost of Private Structure	32,81,62,309
3.	Relocation and Enhancement cost of CPRs Structures	6,48,88,431
4.	Detailed Cost of R&R Assistance	26,58,27,150
5.	RP Implementation Consultant / NGO Cost	50,00,000
6.	For execution of Grievances Redressed Process	1,50,000
7.	Implementation of Gender Equality and Social Inclusion Action Plan	1,24,00,000
Total (1+2+3+4+5+6+7)		178,58,54,362
Contingency @ 5%		89,292,718
Grand Total (In Rs.)		187,51,47,080
Grand Total (Rs. in million)		1875.15

VII. PUBLIC CONSULTATION

A. APPROACH OF PUBLIC CONSULTATION MEETING

339. Well planned public consultation meeting can lead to reduced financial risks of time and cost over-run, legal disputes, and negative publicity, direct cost savings, increased market share through good public image, and enhanced social benefits to the affected local communities. Public Consultation Meeting (PCM) provides an opportunity for the general public, private and community bodies to know the environmental and social impacts as a result of project implementation. Thus, the meeting was held open to all general public who were concerned with the project during the initial stage.

340. Major purpose of the public consultation of environmental issues in the IEE study is to appraise the stakeholders on potential environmental impacts and collect their feedback so that adequate safeguards can be considered during the planning phases.

B. METHODOLOGY

341. ***Arrangement:*** Major settlements located close to the proposed Imphal Ring road were selected for conducting public consultation. Venue for the meeting was fixed at suitable locations like Pradhan's office, local schools, etc. in agreement with the local administration. Affected communities and potential stakeholders such as local residents, panchayat members, teachers etc. were invited to attend the meeting. Effort was made to make the gathering representative of the local population directly or indirectly affected by the potential impacts. During the meetings, no person was prevented from entering and /or leaving the PCM as he / she shall so desire.

342. ***Discussions, Questions and Answers:*** In the meeting, the participants were explained the proposed improvement proposal and potential environmental impacts due to the project. Thereafter, a session for question and answer was kept to facilitate interaction with the stakeholders, exchange of information, & direct communication and collect their opinion on the environmental issues.

343. **Collection of Feedback:** A feedback questionnaire has been prepared and distributed among the participants at the end of the meetings (**Annex-7.1**). Participants were encouraged to provide their opinion through the feedback questionnaire, however it was kept voluntary. Due to language barrier, an interpreter was also engaged for clearer understanding of the questionnaire to the local people and their views to us. Some of the participants could not fill the form as they could not read or write. The issues broadly covered in questionnaire included the following topics.

- Disturbance due to present traffic scenario with respect to environmental pollution and road safety
- Anticipation of disturbance due to the improvement proposal with respect to environmental pollution and road safety
- Expectation on road safety measures in the improvement proposal
- Accidents and conflicts involving wildlife, if any
- Preference of avenue trees, if any

344. **Record of the Meeting:** General information of the participants such as Name, gender, and name of the village the participant belongs to along with their signature was recorded during the public consultation meetings and is attached in the report as **Annex 7.2**. Registration was

kept voluntary. With exception of few isolated cases, almost all of the participants registered themselves.

C. MEETING SCHEDULES AND VENUE

345. The public consultation meeting schedule for the project road is provided in **Table-115**.

Table-115 Public Consultation Meeting Schedule

Sl. No.	Date	Time	Venue	Location Coordinates
PCM-1	March 16, 2021	11:30 AM	Bashikhong	24°44'28"N, 93°56'54"E
PCM-2	March 17, 2021	4:00 PM	Kongba	24°47'03"N 93°57'29"E
PCM-3	March 18, 2021	2:30 PM	Kongba Laishram Leikai	24°47'30"N 93°57'34"E
PCM-4	March 18, 2021	4:30 PM	Khaidem Leikai	24°48'28"N 93°58'20"E
PCM-5	March 18, 2021	5:30 PM	Kongpal	24°48'25"N 93°58'20"E
PCM-6	March 19, 2021	11:30 AM	Khurai Konsam Leikai	24°50'14"N 93°58'27"E
PCM-7	March 19, 2021	2:30 PM	Koirengei Bazaar	24°53'00"N 93°55'12"E
PCM-8	March 20, 2021	11:00 AM	Metei Langol	24°49'39"N93°54'03"E
PCM-9	March 20, 2021	3:00 PM	Central Agricultural Institute, Iroisemba	24°48'44"N93°53'24"E
PCM-10	March 21, 2021	11:30 AM	Langthabal Kunja Awang Leikai	24°44'48"N 93°55'51"E

Public Consultation at Bashikhong

Public Consultation Meeting at Kongba

Public Consultation Meeting at Kongba Leishram Leikai

Public Consultation Meeting at Kongpal

Public Consultation Meeting at Khurai Konsam Leikai

Public Consultation Meeting at Koirengi Bazaar

Public Consultation Meeting at Metei Langol

Public Consultation Meeting at Central Agricultural Institute, Iroisemba

Public Consultation Meeting at Langthabal Kunja Awang Leikai

Public Consultation Meeting at Khaidem Leikai

D. ANALYSIS OF COLLECTED FEEDBACK

346. **Stakeholders and women participants:** A total of 181 stakeholders participated in 10 public consultation meetings. Meeting at Central Agricultural Institute (CAI), Iroisemba had the highest number of participants (48). Women participants were nearly 56%; highest women participation was observed in Khaidem Leikai. Gender-wise breakup of participants is provided in **Table-116**

Table-116 Gender-wise Distribution of Participants in PCMs

Sl. No.	Location	Female	Male	Total
PCM-1	Bashikhong	08	08	16
PCM-2	Kongba	09	05	14
PCM-3	Kongba Laishram Leikai	08	10	18
PCM-4	Khaidem Leikai	11	06	17
PCM-5	Kongpal	-	09	09
PCM-6	Khurai Konsam Leikai	16	02	18
PCM-7	Koirengei Bazaar	02	07	09
PCM-8	Metei Langol	09	07	16
PCM-9	Central Agricultural Institute, Iroisemba	28	20	48
PCM-10	Langthabal Kunja Awang Leikai	11	05	16
Total		**102**	**79**	**181**

347. Providing written opinion on environmental issues was kept voluntary in the public consultation meetings. Responses of the participants, who volunteered to provide written feedback, have been analyzed in subsequent sections and distributions of respondents in various PCMS are summarized in **Table-117**. Overall, about 50% of women and 49% of men responded with written response.

Table-117 Gender wise Distribution of Respondents given written feedback

Sl. No.	Location	No of responses			% of response w.r.t. total participants		
		Female	Male	Total	Female	Male	Total
PCM-1	Bashikhong	3	4	7	37.50%	50.00%	43.75%
PCM-2	Kongba	4	2	6	44.44%	40.00%	42.86%
PCM-3	Kongba Laishram Leikai	3	5	8	37.50%	50.00%	44.44%
PCM-4	Khaidem Leikai	6	2	8	54.55%	33.33%	47.06%
PCM-5	Kongpal	0	3	3	0.00%	33.33%	33.33%
PCM-6	Khurai Konsam Leikai	9	1	10	56.25%	50.00%	55.56%
PCM-7	Koirengei Bazaar	1	3	4	50.00%	42.86%	44.44%
PCM-8	Metei Langol	3	4	7	33.33%	57.14%	43.75%
PCM-9	Central Agricultural Institute, Iroisemba	17	12	29	60.71%	60.00%	60.42%
PCM-10	Langthabal Kunja Awang Leikai	5	3	8	45.45%	60.00%	50.00%
Total		**51**	**39**	**90**	50.00%	49.37%	49.72%

348. **Perception of Participants on Noise Pollution Issues:** About 95% respondents felt that traffic induced noise pollution could be disturbing. 27% respondents scaled present traffic noise as highly disturbing while another 47% viewed it as moderately disturbing. About 40% of the respondents expected the traffic volume to increase after project implementation. About 62% of the respondents anticipated increased noise level to be high or moderate after project implementation. It may also be noted that the anticipation on noise menace due to honking remains lesser among the respondents in future traffic scenarios than in existing traffic conditions. The perception of the respondents with respect to noise pollution is detailed in **Table-118**

Table-118 Perception of Respondents on Noise Pollution due to Traffic

1 Do you feel disturbed due to traffic noise	**Yes**	**95.56%**			**No**	**4.44%**
If yes, then Degree of Impact	*High*	*Moderate*	*Low*	*Insignificant*	*Can't Say*	*Not Applicable*
Disturbance from Noise of present traffic	26.67%	46.67%	17.78%	2.22%	2.22%	4.44%
Disturbance from Honking of present traffic	20.00%	53.33%	20.00%	2.22%	-	4.44%
2 Increase in traffic volume after project implementation	40.00%	33.33%	15.56%	2.22%	4.44%	4.44%
3 Do you anticipate change in noise level due to the project?	Increase	84.44%	Decrease	11.11%	No Change	4.44%
If anticipated increase, then Degree of Impact	*High*	*Moderate*	*Low*	*Insignificant*	*Can't Say*	*Not Applicable*
Increase in noise after project implementation	40.00%	22.22%	8.89%	4.44%	8.89%	15.56%
Increase in honking after project implementation	33.33%	26.67%	8.89%	2.22%	11.11%	15.56%
Disturbance due to construction machinery & vehicles	40.00%	33.33%	6.67%	2.22%	2.22%	15.56%

349. **Perception of Participants on Air Pollution Issues:** About 82% of the respondents felt that traffic induced air pollution could be disturbing. However, only 36% and 42% respondents scaled present air pollution and dust levels due to traffic as highly disturbing respectively while another 29% and 24% respondents viewed the same as moderately disturbing respectively. About 82% of the respondents could not identify any other sources of air pollution in vicinity other than traffic.

350. It is noteworthy that about 42% respondents anticipated improved air quality after project implementation due to better road conditions while 4% of them could not anticipate any change in air quality in future with respect to the present condition. However, 53% respondents anticipated air quality to deteriorate due to increased traffic flow after the project implementation. The perception about dust pollution due to traffic movement remains high among the respondents in present traffic conditions but 46.67% respondents feel no concern of dust pollution after project implementation. The perception of the respondents with respect to air pollution is detailed in **Table-119.**

Table-119 Perception of Respondents on Air Pollution due to Traffic

4 Do you feel disturbed due to air pollution	**Yes**	**82.22%**			**No**	**17.78%**
If yes, then Degree of Impact	*High*	*Moderate*	*Low*	*Insignificant*	*Can't Say*	*Not Applicable*
Disturbance due to air emissions from present traffic	35.56%	28.89%	6.67%	6.67%	4.44%	*17.78%*
Disturbance due to dust due to present traffic	42.22%	24.44%	2.22%	8.89%	4.44%	*17.78%*
5 Any other sources of Air Pollution other than traffic	4.44%	2.22%	-	11.11%	82.22%	-
6 Change in air quality due to the project?	Deteriorate	53.33%	Improve	42.22%	No Change	4.44%
If anticipated increase, then Degree of Impact Ø	*High*	*Moderate*	*Low*	*Insignificant*	*Can't Say*	*Not Applicable*
Increase in air pollution due to increased traffic	8.89%	26.67%	13.33%	4.44%	-	*46.67%*
Increase in dust due to increased traffic	11.11%	26.67%	15.56%	-	-	*46.67%*
Increase in dust due to construction activity	24.44%	22.22%	4.44%	2.22%	-	*46.67%*

351. **Perception of Respondents on Road Safety Issues:** 89% of the respondents almost felt that the road at the present condition is accident prone and requested to take immediate steps for its improvement, whereas 33% of the respondents feared that construction period may lead to further increase of accidents and suggested for adequate safety measures must be enforced. 69% of the respondents wanted pedestrian crossings at important junctions and popular movement locations like schools, hospitals and markets etc. while 64% of them equally felt that the speed breakers and road signage are required at these locations to avoid accidents. The respondents shared their concern that the present road signage is insufficient and the proposed improvement proposal should provide proper road signage. 33% respondents viewed regular police petrol can also curb the accident rate while another 42% were of the opinion that speed cameras should be installed at important junctions and considered it as the most effective tool to nab the offenders responsible for over speeding causing fatal accidents. About 56% and 49% respondents opined that regular road safety education camps and Driver Awareness Programs can also bring down accident rates respectively. The perception of the respondents regarding safety issues is detailed in **Table-120.**

Table-120 Perception of Respondents on Road Safety Issues

Perception on Road Accidents	%
Is the road accident prone?	88.89
Anticipation of increased road accidents in construction phase?	33.33
Choice of People on Road Safety Measures	
Speed Breaker	64.44
Pedestrian crossing	68.89
Road signage	64.44
Improved emergency services	37.78
Police Petrol	33.33
Speed Cameras	42.22
Road safety education camps	55.56
Driver Awareness Programs	48.89

352. **Perception of Respondents on Ecology and Biodiversity Issues:** Only 33% respondents reported sighting of wild animals in the project area. Out of them only 15.6% said prevalence of sighting is moderate, while 8.9% respondents ranked the sighting prevalence as low. 18% of the respondents reported that they experienced crop damage sometime or the other by wild animals. Accidents involving wildlife is reported by 7% respondents while injury to human life by wild animals are reported to be a very rare event. No wildlife accident spots were identified by the respondents.

353. Respondents reported that major wildlife observed in the project area involves deer, monkeys and wild pigs. They opined that flowering and fruit being trees like bottlebrush, mango etc. should be selected for roadside plantations. The perception of the respondents regarding ecology and biodiversity issues is detailed in **Table-121.**

Table-121 Perception of Respondents on Ecology & Biodiversity Issues

Indicators	**%**
Are wild animals sighted in your area?	33.3%
Frequency of Sighting wild animals	*Moderate – 15.6%* *Low – 8.9%* *Insignificant – 4.4%*
Crop damage by wild animals	17.8%
Accident involving wildlife	6.7%
Incident on man wildlife conflict	4.4%
Poaching / wildlife trafficking incident in nearby locality	No
Frequently sighted wild animals	Deer, Monkey & Wild pig
Frequent Wildlife accident spots, if any	Nil
Preferred tree species in agricultural land boundaries	Mango, Neem, Banyan, and Jackfruit
Preferred species for roadside plantation	Mango, Bottlebrush, Eucalyptus, Pine, Neem & Gulmohar

E. MEETING WITH GOVERNMENT OFFICIALS

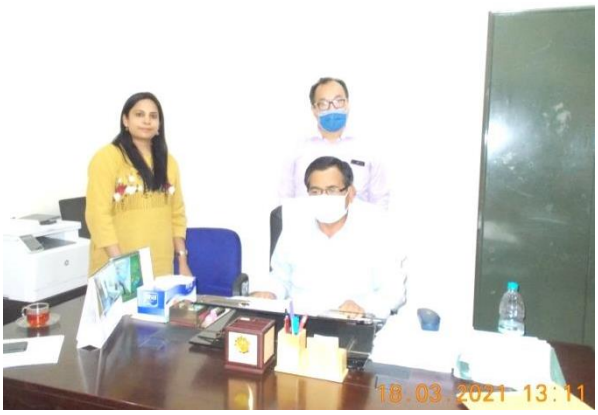
354. Consultation was also carried out with officials of the government bodies of State Forest department, Wildlife Department and Manipur Pollution Control Board to get their views on the environmental aspects of the project area. The basic aim of consultation was to collect the secondary data viz; the presence of Wildlife Sanctuaries (WLS), forest areas and other environmental sensitive features along the project road and to ascertain the location of alignment within these areas. The following secondary data were collected during the visit for carrying out the study.

- Forest map delineating the Forest Division boundaries
- Working Plan of the concerned Forest Divisions
- Boundary map of the Wildlife Sanctuaries to scale
- Notification on declaration of Eco-sensitive Zone
- Flora-fauna details
- Details of Protected Areas
- Wildlife Management Plan

355. The list of government officials consulted on environmental aspects is given in**Table-122**

Table-122 List of Government Officials Consulted

Sl. No.	Name	Designation and Department	Contact Number
1.	Mr. R. K. Amarjit Singh	DFO, Central Forest Division	8132827909 8794386483
2.	Ms. Vahneichong Singson	DFO Incharge, Wildlife	9612194286 9411514960 9774787334
3.	Mr. L. Radhakishore Singh	Chairman, Manipur Pollution Control Board	-
4.	T. Mangi Singh	Member Secretary, Manipur pollution Control Board	9436020873 9366072838



Photographs of Consultation with Government Officials

F. OUTCOME OF THE PUBLIC CONSULTATION MEETING

356. The following are the major points of concern of the participants of PCM:

- Stakeholders are concerned about the existing traffic noise and anticipate that increase of traffic flow may lead to increased noise level after project implementation.
- Majority of the stakeholders are concerned with the existing air emission by the present traffic but their opinion in post project scenario is fragmented to a considerable extent.

- Stakeholders are unanimously agreed that the road is accident prone and needs immediate improvement.
- Pedestrian crossing, proper road signage and speed control measures are the most sought after road safety measures by the stakeholders.
- Accident involving wildlife and man-animal conflicts are reported to be rare, though incidents of crop damage by wild pigs and deer are moderately reported.
- Though citizens at large are in favour of introducing speed restriction near the schools, markets and also construction of drains on both sides of the road
- Boundary wall acting as noise barriers along the school premises and settlement areas are welcomed by most of the participants.
- The citizens also expressed their concern on solid waste management facility in the villages; therefore, it is proposed to introduce composting facilities in the project affected villages on community basis for handling of household waste which is primarily biodegradable in nature.
- There is no scope for avenue plantation as per the design. Hence, as per suggestion of DCF, Central Forest Division, Imphal, a Herbal garden is proposed to be developed under the forestry budget to minimize the loss of trees. The Forest Department will implement the scheme.

G. CONSULTATION WITH COMMUNITY REPRESENTATIVES ON PROJECT SPECIFIC ISSUES IN A SPECIFIED AREA

G.1 Consultation with the Representatives of Khurai Konsam Leikai

357. An interaction session was carried out on **2nd May 2022** at PIU Office, PWD, Manipur between the officials of Project Implementation Unit (PIU) led by Project Director, EAP, PWD, Manipur and 5 (five) representatives of Khurai Konsam Leikai regarding construction of the Imphal Ring Road at Ipum pat area. Following **representatives of Khurai Konsam Leikai** were present:

- K. Sanjit S/o K. Budha
- Ng. Loken S/o (L) Ng. Angouba
- Ng. Naobi Singh S/o Ng. Mangi Singh
- K. Shanta S/o K. Biramangol
- Ng. Tondonba S/o Ng. Ibochouba

358. The issues raised by the representatives of village Khurai Konsam Leikai and commitment made by PIU, EAP, PWD, Manipur is given in **Annex-7.3** and summarized below:

S. N.	Issues Raised by villagers of Khurai Konsam Leikai	Clarification / Commitment of PIU
1	The proposed Ring Road portion within the locality will cause major traffic problems with plying heavy trucks.	It has been clarified by the PD/EAP that the specified Ring Road is to be constructed to cater to this traffic and not highway traffic as it is wrongly assumed. The Ring Road has not been designed for the highway traffic. If the villagers wish to provide gates to prevent the heavy multi axle trucks from entering the area, the same may be provided as it is done in other cities. Further, the Govt. may issue necessary notification restricting the entry of the heavy vehicles during daytime or any specific time period as is the practice in all major cities.
2	The Ipum pat (water body) is the only perennial water source from where the daily requirement of water consumption is met, and it is used by the villagers inhabiting both sides of the water body. They are afraid that the project will damage the water body and collection of water across the road will be difficult and dangerous once the Ring Road is constructed.	The PD/EAP expressed that the impact on water body will be very minimal and the project proposes to rejuvenate the water body by constructing R.C.C / C.C Retaining Wall to protect the banks from further erosion and incorporating water purifying measures like fountains / cascades to circulate and oxygenate and improve the quality of water and prevent it from decaying. 5 (five) water pumps with water storage tanks to draw water from across the Pat will be provided for easy collection of water at identified locations. Lighting will also be provided for value addition of the lake in consultation with the inhabitants of the locality.
3	There is an apprehension that the local Community Hall, Club Building, Crematorium Ground and Community structure within the Crematorium ground will be disappeared.	The PD/EAP has clarified that the actual crematorium will not be affected by the proposed project alignment. However, the Community Hall near the Crematorium and Community structure within the Crematorium ground which are likely to be partially affected will be restored at par or better conditions under restoration of Common Property Resources (CPR). A new Double Storied Club Building can also be reconstructed under restoration of CPR. The Crematorium Ground which is to be affected partially can be provided with concrete floor and a ramp to the ground can also be provided in consultation with the community.
4	Few inhabitants will become homeless and other inhabitants may suffer frequent fatal road accidents as the inhabitants are used to staying at the side of the road as a part of their life.	The PD clarified that, as per the revised section only 6 (six) houses / structures will be partially (less than 15% of the size of the structures) affected and there is no possibility of rendering any household or inhabitant homeless by the project. The PD/EAP stated that considering the safety of the locality, a service road of 3m width, segregated from the main carriageway by crash barriers, will be constructed for dedicated use of the locality.
5	In view of the above apprehensions and fear, an alternate route which is completely in the mid of Agricultural Land with minimal impact on any habitation was suggested. Further it was also submitted that the proposed alignment of Imphal Ring Road has zig – zag pattern with 6 sharp corners within a short length.	The PD/EAP has assured that the proposed alternative alignment will be taken up simultaneously as a part of the pipeline projects of Externally Aided Projects which is under process.

359. The resolutions taken among all stakeholders including the representatives of Khurai Konsam Leikai village regarding Ipum Pat on 2nd May 2022 was apprised by the Project Director, EAP, PWD, Manipur to the independent multi-disciplinary Expert Group constituted under Section 7(1) of LARR Act, 2013. The members of the Expert Group visited the site on 6th August 2022 and submitted their recommendations during its third sitting as recorded in the Expert Group's Report. Extract from the report containing the relevant section is enclosed as **Annex-7.4**

360. The recommendation of the Expert Group approved by the Government of Manipur vide order dated 7th September 2022 (**Annex-7.5**) and notification for Land Acquisition under Section 12 of LARR Act, 2013 was published / issued by the competent authority of the State Government vide order dated 19th September 2022 (**Annex-7.6**). This order may be considered as the concurrence by the State Authority with the proposed plan.

G.2 Consultation with Tharon Village Authority and Tharon PEI

361. A 'Memorandum of Understanding (MOU)' was signed between Project Implementation Unit (PIU), Externally Aided Projects (EAP), PWD, Manipur and **Tharon Village Authority and Tharon PEI** (Thoubei / Customary court), on **6th July, 2022** and several decisions have been taken as per the MoU. The details of decision taken in the meeting has been given **Annex-7.7** and summarized below

S. N.	Issues Discussed	Decision taken as per MOU signed
1	The portion of the ring road in the village boundary of the Tharon village (Chainage Km 32+630 to Km 33+020)	The particular portion will be double lane standard road of 7.50 meter width carriageway. Footpath cum lined drain of 1.50 meter will be provided on the both side of the road with metal beam crash barrier on the valley side thus the total road width will be 10.50 meters. However additional provisions of the land for construction of breast wall and retaining wall will be provided.
2	Payment of Non-Titleholders	Minimize the impact on the standing structures on both hill side and valley side by adjusting the alignment and the compensation of non-titleholders will be compensated as per the ADB's Safeguard Policy Statement 2009
3	The Tharon Village Anganwadi Centre Meira House of the women folk, waiting shed cum market shed	Similar or better configurations will also be constructed at suitable locations.
4	Road Facilities	Will also provide the street lighting system, safety measures and all applicable road furniture, community hall and the adjustable gate to limit entry of multi-axle heavy vehicles will also provide at both end of the village boundary
5	Augment on water supply at Tharon locality	Two water tank of 25KL will be constructed at suitable locations before the existing water pipeline is removed

H. INFORMATION DISCLOSURE

362. Disclosure of the information shall be undertaken by PIU, PWD Manipur at a macro level and by the Contractor in the project site at micro level. The wide dissemination of information to the public shall be undertaken by PIU, PWD Manipur through the disclosure of IEE / EMP Report on the website of PWD Manipur (http://pwdmanipur.nic.in/en/reports) as well as in the **ADB website** as per SPS 2009 requirements. At the project site, i.e. the direct impact zone, information boards shall be displayed at critical and pre-identified locations to disseminate the project details. Such information boards shall display project name, contractor's name, concerned official's name in Contractor's office with his designation and contact no., name and contact details of an authorized official in the local PIU / PWD office. These information boards shall be approximately of size 5' x 5' and shall be designed and put up in such a way that the public can easily read it from a distance. Such boards shall be setup, not only along active project stretches, but also at the sites of construction camps and labour camps and other project facilities like borrow area, quarry and stone crusher site and debris disposal site. These information boards shall also mention the availability of a complaint register with the nearest site office of the contractor. Under the Right to Information Act, 2005 and it's amendment thereafter, the contractor is bound to share any information demanded by the public, pertaining to any aspect of the project, as and when it is demanded.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. INTRODUCTION

363. Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. The desired results from the environmental mitigation measures proposed in the project may not be obtained without a management plan to assure its proper implementation & function. The EMP envisages the plans for the proper implementation of management measures to reduce the adverse impacts arising out of the project activities.

B. COMPLIANCE WITH THE EMP

364. A copy of the EMP must be kept at the construction site office during the construction period at all times. The EMP will be made binding on contractor operating on the site and must be included as Contractual Clauses in any contractual agreement for the Contractor.

- All persons employed by the contractor or his sub-contractors will abide by the requirements of the EMP.
- The Contractor will not direct a person to undertake any activity, which would place them in breach of the specifications contained within the EMP.
- Should the Contractor be in breach of any of the specifications contained in the EMP, the Construction Supervision Consultant (CSC) will in writing, instruct the Contractor responsible for the incidence of non-compliance regarding corrective and /or remedial action required, specify a timeframe for implementation of these actions, implement a penalty and / or indicate that work could be suspended if non-compliance continue.
- Should non-compliance continues, further written notification will be forwarded to the contractor responsible for the incident of non-compliance outlining the required corrective and / or remedial action, the timeframe for implementation, penalties and / or work could be suspended as specified previously.
- Contracts with contractor to include clauses to hold the contractor responsible for the cost of any delays, corrective or remedial actions required because of non-compliance with the specifications and clauses of the EMP.
- The Contractor have to submit daily, monthly and quarterly environmental compliance reports to the CSC as per the reporting protocol given in the EMP.
- The CSC must notify the PIU, PWD Manipur in writing, within a timeframe thereof, if there is any delay in submission of daily, monthly and quarterly environmental compliance reports by the Contractor
- All stakeholders will be given access to the EMP for the purpose of assessing and / or monitoring compliance with the conditions contained in the EMP.

C. NON-CONFORMANCE AND CORRECTIVE ACTION

365. The Contractor is deemed not to have complied with the EMP if:

- Within the boundaries of the site, site extensions and haul / access roads there is evidence of a contravention of clauses.
- If environmental damage ensues due to negligence
- The contractor fails to comply with corrective or other instructions issued by the PIU, PWD Manipur / CSC within a specified time.
- The Contractor fails to respond adequately to complaints from the public

D. PENALTY CLAUSE FOR NONCONFORMITY TO EMP

366. The Contractor shall implement all mitigation measures for which responsibility is assigned to him as stipulated in the EMP. Application of a penalty clause to the contractor will be applied only in the incidents of non-compliance. The penalty imposed will be per incident and will be deducted from the contractor's payment. Unless stated otherwise in the project specification, the penalties imposed per incident or violation will be determined by the CSC in consultation with the PIU, PWD Manipur and depending on the severity and / or regularity of the incidence occurring. Any lapse in implementing the EMP will attract the penalty clause as detailed below:

- All lapse in obtaining clearances / permissions under statutory regulations and violations of any regulations shall be treated as a major lapse.
- Any complaints of public, within the scope of the Contractor, formally registered with the CSC or with the PIU, PWD Manipur Grievance Redressal Cell and communicated to the contractor, which is not properly addressed within the time period intimated by the CSC / PIU PWD Manipur shall be treated as a major lapse.
- Nonconformity to any of the mitigation measures stipulated in the EMP (other than stated above) shall be considered as a minor lapse.
- On observing any lapses, CSC shall issue a notice to the Contractor to rectify the same.
- Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after one month from the original notification date and first reminder date respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.
- If a major lapse is not rectified upon receiving the notice, CSC shall invoke the penalty clause, in the subsequent interim payment certificate.
- Penalty for major lapses shall be with-holding of 10% of the interim payment certificate, subject to a maximum limit of Rs. 30 Lakhs.
- If the lapse is not rectified within one month after withholding the payment, the amount withheld shall be forfeited.
- The Senior Environmental Specialist of the CSC will issue each notice of noncompliance to the contractor in triplicate with a copy to the PIU PWD Manipur and Team Leader of CSC. The notice for invoking a penalty clause will also be issued in triplicate.

E. INTERNATIONAL PRACTICES DURING EMP IMPLEMENTATION

367. The contractor while implementing the EMP will follow 'General Environmental, Health and Safety Guidelines' of International Finance Corporation (IFC) and develop procedures to achieve the following:

- Minimum air emissions from construction activities to maintain good levels of ambient air quality in the surroundings of construction sites and construction camps
- Minimize energy consumption in construction activities
- Minimize wastewater generation and proper disposal at camp and construction sites
- Use of optimum natural resources
- Effective reutilization of waste and proper disposal of waste, which cannot be reused / recycled
- Minimum disturbance to the population on account of noise generation
- Minimize / avoid pollution of water sources

- Safe working environment to the construction crew through safe operating procedures and encouraging the use of personal protective equipment (PPE) by the work force; for which contractor will procure adequate personal protective equipment
- Effective traffic management on the project road to achieve better safety of the construction crew and road users
- Prevention of communicable diseases through awareness campaign for STD and Hepatitis
- The contractor will prepare an 'On Site Emergency Plan' to deal with any mishap such as fire, explosion, spillage of hazardous materials etc. at camp and construction sites

F. STAGE WISE ENVIRONMENTAL MANAGEMENT MEASURES

368. The EMP includes a list of all project-related activities at different stages of project (design & pre-construction stage, construction stage and operation & maintenance stage), remedial measures, reference to laws/ guidelines, monitoring indicators & performance target and a clear reporting schedule. The EMP sets a time frame to all proposed mitigation and monitoring actions with specific responsibility assigned to the proponents, the contractors and the regulatory agencies to implement the project and follow-up actions defined. The contractor should follow this broad guidelines outlined in the environmental management measures while developing their EMP and should include approach to mitigation measures specific to impact identified on ground based on final design or change in design or scope. **Any variation approved by** CSC **or PIU, PWD Manipur, should take cognizant of environmental management measures for change in design or scope**. Stage wise management measures are presented in **Table-123.**

Table-123 Stage Wise Environmental Management Plan

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
A. DESIGN AND PRE-CONSTRUCTION STAGE							
1. Alignment							
1.1 Pavement damage and drainage provisions	▪ Flexible pavement has been recommended ▪ Design CBR value of sub grade is recommended to be 7% to 10%. ▪ RCC Drain with Utility corridor cum Footpath shall be provided. At merging location of cross road, the drain cum footpath shall be design to withstand vehicular load. ▪ The RCC covered drain with utility cum footpath shall be constructed ▪ To ensure internal drainage of the pavement structure, the granular sub-base/stabilized granular sub base layer shall extend to full width across the shoulders in the embankment. Pavement layers of the paved shoulder shall be same as that of the adjacent carriageway ▪ **3 nos. of major bridges, 6 no. of minor bridges and 227 nos. of culverts have been proposed** ▪ Lined, RCC and unlined drain has been proposed	Design requirement IRC:37-2012 IRC: 58-2015	Entire stretch of proposed road; IRC: SP: 73 Clause 6.2.4). For list of bridges and culverts, Please refer **Schedule B** of the Bid Document	MI: Design and number of bridges, culverts and length of drain, PT: Design and numbers are in accordance with site needs	Review of detail design documents & drawings and comparison with site conditions	Design Consultant	PWD Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	on **both sides** of the Ring Road. ▪ Length of lined drain is **15,381 km,** length of RCC drain **94,893 km** and length of unlined drain is **1,435 km**						
2. Natural Hazards and Climate Change Risks							
2.1 Flooding / Water-Logging	▪ Provision of adequate number of CD structures has been proposed. ▪ It has been ensured that all the 1st and 2nd order streams crossing the project road alignment provided with culverts and bridges with capacity of 20% excess discharge. ▪ All CD structures designed for 50year HFL return period and bridges designed for 100 year HFL return period ▪ Adequate water ways for bridges and culverts have been proposed.	Design requirement	Entire stretch of proposed road	MI: Design and numbers of cross drainage structures, No. of bridges, location of roadside drain, embankment height PT: Design and numbers are in accordance with site needs	Review of design documents and drawings and comparison with site conditions	Design Consultant	PWD Manipur
2.2 Damage to pavement integrity like Rutting, softening and migration of liquid asphalt. Thermal expansion in bridge expansion	▪ Asphalt binder specifications based on viscosity-grade specifications as per IS 73-2013 guidelines and IS 15462-2004 for rubber modified binder and polymer modified binders.	IRC 37 2012 for flexible pavement design, IRC 81 1997 for strengthening of flexible pavement	Entire stretch of proposed road	MI: Pavement Surface and bridge expansion joints during extreme heat PI: No softening, rutting, asphalt migration /thermal expansion of joint	Review of design documents and drawings and comparison with site conditions	Design Consultant during preliminary design and Contractor during detailed design	PWD Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
joints and paved surfaces							
2.3 Earthquake	▪ Relevant IS codes shall be adopted in designing the structures to sustain the magnitude of earthquake corresponding to Seismic zone of the project area ▪ Project area is located in Zone V (having severe seismic intensity)	Dislodgement of superstructure shall be taken as per Clause 222 of IRC:6.	Entire stretch of proposed road	MI: Bridge and Culverts PT: Design conforms BIS and IRC guidelines	Review of design documents and drawings and comparison with site conditions	Design Consultant during preliminary design and Contractor during detailed design	PWD Manipur
2.4 Drought	▪ The design of foundations and sub-structures shall conform to IRC guidelines and MORTH clause ▪ Ensure water availability for compaction work and consolidation of sub-structure	IRC:78-2000 Standard Specifications and Code of Practice for Road Bridges	Entire stretch of proposed road	MI: Substructure of bridges PI: Substructures are consolidated and compacted	Review of design documents and drawings and comparison with site conditions	Design Consultant during preliminary design and Contractor during detailed design	PWD Manipur
3. Loss of Land and Assets							
3.1 livelihood loss to affected persons	▪ Social Impact Assessment and Resettlement Plan to be undertaken as per National Policy and ADB' guidelines. ▪ Complete all necessary land and property acquisition procedures prior to the commencement of civil work. ▪ Adhere to the Land Acquisition procedures in accordance to Entitlement Framework. ▪ Compensation and assistance as per project	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. and ADB's Involuntary Resettlement	Throughout the corridor	MI: Payment of compensation and assistance to PAFs as per RAP Number of complaints / grievances related to compensation and resettlement PT: Minimal number of complaints / grievances. All cases of	Check LA records; design drawings vs land plans; Interview with affected persons Check status of employment given to local people during construction	PWD, Manipur & implementing NGO	PWD, Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	Resettlement Action Plan (RAP) ▪ Income restoration as per RAP ▪ Preference in employment and petty contracts during construction to affected persons ▪ Constitute Grievance Redressal Cell (GRC) as per RAP	Policy. Contract Clause for preference to local people during employment.		resettlement and rehabilitation if any are resolved at GRC level. No case referred to arbitrator or court.			
4. Felling of Trees and Diversion of Forest Land							
4.1 There are approximately **2,704 trees** within the proposed RoW in the **non-forest land** and **2,266 trees in forest land** 4.2 Loss of habitat of fauna due to felling of trees and diversion of forest land	▪ Tree felling within proposed ROW ▪ **Trees will not be cut while birds are nesting in that trees, in such cases cutting has to be postponed until the birds have fledged the nest** ▪ To compensate the loss of trees in non-forest land, it has been decided in consultation with the Forest Department and PWD Manipur that 5,300 trees will be planted**.** ▪ Trees will be planted along the ring road at selected location (please refer Table-98 for details) in 2 rows. Cost for plantation has been included in the EMP budget ▪ As per MoEFCC Circular dated 08.11.2017, no of trees to be planted in	▪ Forest (Conservation) Act, 1980 ▪ Forest (Conservation) Second Amendment Rules,2014	Entire stretch of proposed road	MI: Number and location where trees can be further saved within PROW, budget allocated for greenbelt development PT: Unnecessary tree felling within PRoW avoided; Budget allocation is adequate	Review final design. Check budget provision for plantation.	- Design Consultant, PWD, Manipur & Forest Department	PWD, Manipur & Forest Department

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	Compensatory Afforestation land shall be at least 1,000 plants /ha of forest land diverted. Therefore, **12,974 trees shall be planted** by the Forest Department as a part of Compensatory afforestation against diversion of 12.9746 ha forest land. ▪ **Overall Compensatory Plantation is 1 : 3.7** ▪ Apart from plantation, **two Biodiversity Parks are proposed to be developed in the vicinity of the project area**, which shall be established by the Divisional Forest Officer, Central Forest Division. As per the Forest Department, the proposed biodiversity park will serve as mini lung of the surrounding areas and provide them with ecological and cultural benefits. The parks shall also provide conservation of flora and fauna. The construction of the Park is to be executed by the State Forest Department as per their design and specifications and protocols. The individual cost of the biodiversity parks are Rs. 88.50 lakh						

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	and Rs. 64.61 lakh ▪ Efforts will be made to save trees outside formation width standing on edge of the PROW. Crash barrier shall be provided at such locations ▪ Trees to be felled shall be clearly marked. ▪ Obtain tree felling permission from State Forest Department ▪ Tree felling is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances from the State Forest Department are completed and subsequently a written order is issued to the Contractor. ▪ Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees to be felled and those saved will be maintained by the PIU						
4.3 Diversion of Forest Land	▪ Forest area proposed to be diverted is to be marked on ground through a joint inspection with Forest Officials. ▪ FRA Certificate under the Scheduled Tribes and other Traditional Forest	▪ Forest (Conservation) Act, 1980 ▪ Forest (Conservation) Second Amendment Rules,2014	The Proposed project involves diversion of ≅ **12.9746 ha forest** land under Central Forest Division, Imphal	MI: Geometric adjustments made to avoid forestland, budget amount for diversion of forest land	Review final design. Check budget provision for compensatory afforestation.	- Design Consultant (incorporated in DPR, Preparation of Application for Forest Clearance),	PWD Manipur & Forest Department

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	Dwellers (Recognition of Forest Rights) Act, 2006. **Working Permission:** To facilitate speedy execution of projects involving linear diversion of forest land, in-principle (Stage-I) approval issued by the Central Government may be deemed as the working permission for tree cutting and commencement of work, if the required funds for CA, NPV, Wildlife Conservation Plan, Plantation of dwarf species of medicinal plants and all such other compensatory levies specified in the in-principle approval are realized from the User Agency, and where necessary, for CA, transfer and mutation of non-forest / revenue forest land in favour of the State Forest Department is complete. Thereafter, a senior officer of the State Government (not below the rank of DFO) having jurisdiction over the forest land proposed to be diverted; shall **pass an order for tree cutting and commencement of work of a linear project in forest land**		0.7782 ha in Package-I 10.5551 ha in Package-II 1.6413 ha in Package-III	PT: Unnecessary tree felling on forest land avoided. Budget allocation is adequate,		- Contractor (follow up for Forest clearance) - PWD & - Forest Department	
5. Shifting of Utilities							

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
5.1 Disruption of utility services to local community	▪ All telephone and electrical poles / wires and underground cables (if any) should be shifted before start of construction ▪ Bore wells, water supply pipelines and hand pumps located within the proposed RoW should be shifted before start of construction ▪ Necessary permission and payments should be made to relevant utility service agencies to allow quick shifting and restoration of utility services ▪ Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services if any ▪ Contractor has to prepare several sub- plans prior to construction. Please refer the reporting and review matrix given in Table-125	Project requirement	Entire stretch of proposed road	MI: Number of complaints from local people, number, timing and type of notifications issued to local people, time taken to shift utilities PT: No. of complaints should be 0. Effective and timely notification. Minimal time for utility shifting	Interaction with concerned utility authorities and local public	Contractor/ PWD / Utility Company	PWD Manipur & CSC
B. CONSTRUCTION STAGE							
1. Air Quality Management Plan							
1.1 Dust Generation due to construction activities and transport, storage and handling of	▪ Transport, loading and unloading of loose and fine materials through covered vehicles. ▪ Paved approach roads. ▪ Storage areas to be	- MORT&H Specifications for Road and Bridge works - The Air (Prevention	Entire stretch of proposed road	MI: PM_{10} level measurements Complaints from locals due to dust PT: PM_{10} level	Standards CPCB methods; Observations; Public consultation;	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
construction materials	located downwind of the habitation area. ▪ Water spraying on the unpaved haulage roads and other dust prone areas. ▪ Provision of PPEs to workers. ▪ Idling of vehicles should be minimized to the extent possible ▪ Levels of PM_{10} and $PM_{2.5}$ should meet WBG-EHS limits for ambient air quality	and Control of Pollution) Act, 1981(Amended 1987) and Rules 1982 and - Central Motor and Vehicle Act 1988 - Annex-4.3 (Relevant Standards)		<100 µg/m^3; Number of complaints should be zero.	Review of monitoring data maintained by the Contractor		
1.2 Emission of air pollutants (HC, SO_2, NO_2, CO etc.) from vehicles and use of equipment and machinery	▪ Regular maintenance of machinery and equipment. ▪ Contractor to submit PUC certificates for all vehicles / equipment / machinery used for the project and maintain a record of the same during the contract period. ▪ Batching, WMM, HMP and crushers at downwind (1km) direction from the nearest settlement. ▪ These plants shall be used after obtaining consent to establish & consent to operate from Manipur Pollution Control Board ▪ Only Crushers licensed by the Manipur Pollution Control Board shall be	The Air (Prevention and Control of Pollution) Act, 1981(Amended 1987) and Rules 1982 World Bank Guideline Values for Ambient Air Quality	Batching & Asphalt Mixing Plants, Hot Mix Plant, Crushers, DG sets locations	MI: Levels of HC, SO_2, NO_2, and CO. Status of PUC certificates PT: To keep SO_2 and NO_2 levels less than 80 µg/m^3. PUC certificate of equipment and machinery is up to date	Standards CPCB methods Review of monitoring data maintained by the Contractor	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	used ▪ Hot mix plant should be fitted with dust extraction unit ▪ SPM value at a distance of 40 m from a unit located in a cluster should be less than 500 g/m^3. The monitoring is to be conducted as per the monitoring plan. ▪ DG sets with stacks of adequate height and use of low sulphur diesel as fuel. ▪ LPG should be used as fuel source in construction camps instead of wood ▪ Air quality monitoring as per Environmental Monitoring Program ▪ Contractor to prepare traffic management and dust suppression plan duly approved by AE / IE & PIU						
2. Noise & Vibration Management Plan							
2.1 Disturbance to local residents and sensitive receptors due to excessive noise from construction activities and operation of equipment and machinery	▪ All equipment to be timely serviced and properly maintained. ▪ Construction equipment and machinery to be fitted with silencers and maintained properly. ▪ Only IS approved equipment shall be used for construction activities. ▪ Near school, noisy	Legal requirement Noise Pollution (Regulation & Control) Rules, 2003 and amended in 2010; Clause No 501.8.6.	Refer to Environmental Monitoring Program of Chapter-VIII of IEE Report Refer to Table No. 88, 89 and 90 of Chapter-VI of IEE Report	MI: day and night Noise levels. Number of complaints from local people; Cracks and displacement in building due to vibration	Consultation with local people; Review of noise level monitoring data maintained by the Contractor; Observation of	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	construction activities shall be carried out after closing of school and in the weekends / holidays only ▪ Carry out noisy operations intermittently to reduce the total noise generated ▪ Restrict construction near residential and built up areas to daylight hours. ▪ Honking restrictions near sensitive areas ▪ Noise limits for construction equipment such as compactors, rollers, front loaders, concrete mixers, cranes (moveable) etc. shall not exceed 75 dB(A) at a distance of 11 m from its source ▪ PPEs to workers ▪ Noise monitoring as per Environmental Monitoring Program ▪ **Noise barrier has been proposed at 24 sensitive receptors**. Solid Noise barrier in form of brick boundary wall with creepers or Acrylic walls as well as acoustic control measures in form of double-glazed windows has been proposed in various locations depending on mitigation requirement and space	MORT&H Specifications for Road and Bridge works; DIN 4150 and BS 7385 Section-F of Chapter-VI of IEE Report		PT: Zero complaints or no repeated complaints by local people. Average day and night time noise levels are within permissible limits for work zone areas No damage to buildings due to vibration	construction site Visual checks and photo documentation for vibration impact		

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	available for construction. **Package wise** location of proposed noise barrier are provided in **Table-92 & Table-93 in Chapter-VI of IEE Report** ▪ Condition surveys of Sensitive Receptors within 20 meters from the road. There are **16 sensitive receptors** which are located within 20 m from the centre line of the road ▪ Vibration monitoring during operation of heavy equipment like Excavators, Motor scrapers, Vibratory rollers etc.						
3. Land & Soil							
3.1 Land use Change and Loss of productive / topsoil	▪ In case of borrow area, Non-agricultural areas to be used to the extent possible. ▪ If using agricultural land, top soil to be preserved and laid over either on the embankment slope for growing vegetation to protect soil erosion. ▪ Guideline on Top Soil Conservation and Reuse is given in **Annex-8.6** ▪ Hot-mix plants, batching plants, construction camps shall be located at least	Project requirement Annex-8.1 Guidelines for Siting and Layout of Construction Camp Annex-8.6 Guidelines on Top Soil Conservation and Reuse	Entire stretch of proposed road; Land identified for construction camp, storage areas, hot-mix plant, batching plant etc.	MI: Location of Construction Camp, Storage Areas, Hot-mix Plant, Batching Plant Top soil storage area PT: Zero complaints or disputes registered against contractor by land owner	Visit of construction camp, plant sites; review of the reports submitted by the Contractor	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	500m away from habitation and 1000 m away from forest area ▪ Land for temporary facilities like construction camp, storage areas etc. shall be brought back to its original land use ▪ Details of sites identified for Construction Camp should be reported to the Sr. Environmental Specialist of CSC for approval in the format as given in **Annex-8.13**						
3.2 Slope failure and Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	▪ Bio-turfing of embankments to protect slopes. ▪ Slope protection by providing frames, dry stone pitching, masonry retaining walls, planting of grass and trees. ▪ Side slopes of all cut and fill areas will be graded and covered with stone pitching / Coir Geo-Textile, grass (Vetiver grass). Care should be taken that the slope gradient shall not be greater than 2:1. ▪ The earth stock piles to be provided with gentle slopes to soil erosion	IRC: 56 recommended practice for treatment of embankment slopes for erosion control Clause No. 306 and 305.2.2 MORT&H	Entire stretch of proposed road	MI: Occurrence of slope failure or erosion issues PT: No slope failures. Minimal erosion issues	Review of design documents and site observation	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
3.3 Borrow Area Management	▪ In principle no borrow area is required for the project however in case of any eventualities a borrow area might be needed. ▪ Non-productive, barren lands, upland shall be used for borrowing earth with the necessary permissions /consents. ▪ Follow IRC recommended practice for borrow area (IRC:SP:108:2015) for identification of location, its operation and rehabilitation ▪ Borrow areas not to be dug continuously. ▪ To the extent borrow areas shall be sited away from habitate areas. ▪ Depths of borrow pits to be regulated and sides not steeper than 25%. ▪ Topsoil to be stockpiled and protected for use at the rehabilitation stage. ▪ At least 10% of the acquired area shall be kept for stockpiling of fertile topsoil. The piles shall be covered with gunny bags / tarpaulin. ▪ Slope of stockpile shall not exceed 1:2 (V:H) and edge of pile shall be protected by silt fencing	IRC Guidelines on Borrow Areas; Environmental Protection Act and Rules,1986; Water Act 1974; Air Act 1981 Annex-8.2 Guidelines on Siting, Operation and Re-development of Borrow Area Standard Operating Procedure for Borrow Area, MoEFCC, 8th August 2022	Borrow sites location	MI: Existence of borrow areas in inappropriate unauthorized locations. Poor borrow area management practices. Number of accidents. Complaints from local people. PT: Zero accidents. Zero complaints.	Review of design documents and site observations	Design Consultant and Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	▪ Transportation of earth materials through covered vehicles. ▪ Borrow areas shall be leveled with salvaged material or other filling materials which do not pose contamination of soil. Else, it shall be converted into fish pond. ▪ Detailed site selection criteria, operation of borrow area and redevelopment plan given in **Annex-8.2**. ▪ Details of identified sites should be reported to the Sr. Environmental Specialist of CSC for approval in the **Format** given in **Annex-8.13**						
3.4 Quarry Operations	▪ Aggregates will be sourced from existing licensed quarries. ▪ Copies of consent / approval / rehabilitation plan for a new quarry or use of existing source will be submitted to AE/ IE & PIU. ▪ The contractor will develop a Quarry Redevelopment plan, as per the Mining Rules of the State and submit a copy of the approval to EA. ▪ Obtain environmental clearance from SEIAA in	IRC Guidelines on Quarry Areas; Environmental Protection Act and Rules,1986; Water Act 1974; Air Act 1981 Annex-8.3 Guidelines on Siting, Operation and Re-development of Quarry Area	Quarry area locations	MI: Existence of licenses for all quarry areas from which materials are being sourced Existence of a Quarry Redevelopment Plan PT: Quarry license is valid; No case of non-compliance to consent /permit	Review of design documents, contractor documents and site observation; Compliance to EC conditions in case of opening new quarries	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	case of opening new quarry ▪ Quarrying shall be done only after obtaining proper permit or license from the Department of Mining and quarrying operation shall comply with the requirements of the Manipur Pollution Control Board. ▪ Detailed site selection criteria, operation of quarry area and redevelopment plan given in **Annex-8.3**. ▪ Details of identified sites should be reported to the Sr. Environmental Specialist of CSC for approval in the **Format** given in **Annex-8.13**			conditions and \ Air quality meets the prescribed limit			
3.5 Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	▪ Construction vehicles, machinery, and equipment to be stationed in the designated ROW to avoid compaction. ▪ Approach roads / haulage roads shall be designed along the barren and hard soil area to reduce the compaction. ▪ Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear	Design requirement	Parking areas, Haulage roads and construction yards.	MI: Location of approach and haulage roads; Presence of destroyed / compacted agricultural land or land which has not be restored to its original Condition PT: Zero occurrence of destroyed / compacted land and undestroyed	Site observation	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	and tear to the village /minor roads. ▪ Land taken for construction camp and other temporary facility shall be restored to its original conditions			land			
3.6 Contamination of soil due to leakage / spillage of oil, bituminous and non-bituminous debris generated from demolition and road construction	▪ Construction vehicles and equipment will be maintained and refueled in such a fashion that oil / diesel spillage does not contaminate the soil. ▪ Fuel storage and refueling sites to be kept away from drainage channels. ▪ To avoid soil contamination **Oil-Interceptors** shall be provided at wash down and refueling areas. ▪ Waste oil and oil soaked cotton / cloth shall be stored in containers labeled 'Waste Oil' & 'Hazardous' and should be sold off to the Manipur Pollution Control Board authorized vendors only ▪ Non-bituminous wastes to be dumped in low lying areas or borrow pits (if any) with the written concurrence of landowner and covered with a layer of at least 30 cm fertile topsoil.	Design requirement; Annex-8.4 Annex-8.5 Annex-8.7	Fuelling station, construction sites, and construction camps and disposal location.	MI: Quality of soil near storage area Presence of spilled oil or bitumen in project area PT: Soil test conforming to no – contamination; No sighting of spilled oil or bitumen in construction site or camp site	Site observation	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	▪ Bituminous waste to be dumped in 30 cm thick clay lined pits with the top 30 cm layer covered with good earth for supporting vegetation growth over a period only after obtaining approval of Sr. Environmental Specialist of the AE / IE. ▪ Pits for disposal of bituminous waste must be located well above the maximum groundwater level in order to prevent any groundwater contamination						
3.7 Temporary use of land for traffic diversion	▪ The environmental conditions of the temporary land have to be established ▪ It will be the responsibility of the Contractor to redevelop the land to the satisfaction of the owner after completion of the work ▪ Redevelopment of the temporary land should be approved by the Sr. Environmental Specialist of the AE / IE	Project requirement	Where ever traffic diversion is required as per design	MI: Location of diverted area PT: Zero complaints or disputes registered against contractor by land owner	Site observation	Contractor	PWD Manipur & CSC
4. Water Quality Management Plan							
4.1 Sourcing of water during construction	▪ Requisite permission shall be obtained for abstraction of groundwater from	CGWA Guidelines	Entire stretch of proposed road	MI: Approval from competent authority;	Checking of documentation; Talk to local	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	Central Ground Water Authority and State Ground Water Board ▪ Where surface water sources are to be tapped, arrangements shall be made by contractor that the water availability and supply to nearby communities remain unaffected. ▪ The possible sources could be abandoned quarry filled with rainwater, river, tanks or wells, specially created tanks nearby perennial rivers subject to approval of village & local administration. ▪ Water intensive activities not to be undertaken during summer season.			Complaints from local people on water availability PT: Valid approval from Competent Authority. Zero complaints from local people.	people		
4.2 Disposal of water during construction	▪ Provisions shall be made to connect drains with existing nearby natural drains.	Design requirement	Entire stretch of proposed road	MI: Condition of drainage system in construction site; Presence / absence of water logging in project area. PT: Existence of proper drainage system. No water logging in project area	Standards methods; Site observation and review of documents	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
4.3 Alteration in Surface Water Hydrology	▪ Provision of adequate no. of cross drainage structures. ▪ 3 nos. of major bridges, 6 nos. of minor bridges and 227 nos. of culverts have been proposed ▪ All CD structures designed for 50year HFL return period and bridges designed for 100 year HFL return period ▪ It has been ensured that all the 1st and 2nd order streams crossing the proposed road alignment provided with necessary culverts, mirror bridges and major bridges with capacity of 20% excess discharge ▪ Construction of cross drainage structures shall be undertaken during lean flow period.	Design requirement,	Near all drainage channels, River / Nallah crossings etc.	MI: Proper flow of water in Rivers, Streams and Nallah PT: No complain of water shortage by downstream communities. No record of overtopping / water logging	Review of design documents Site observation	Contractor	PWD Manipur & CSC
4.4 Siltation in Water Bodies due to construction activities / earthwork	▪ Embankment slopes to be modified suitably to restrict the soil, debris entering water bodies. ▪ Silt fencing shall be provided along water bodies within the direct impact zone intercepting the project road to prevent siltation in water bodies. ▪ Sediment / silt should be collected and stockpiled	Design requirement; Worldwide Best Practices; Annex-8.10 Guideline for Sediment Control	Near all water bodies/ waterway	MI: Presence/absence of siltation in rivers, streams, nallah, ponds and other water bodies in project area; water quality monitoring PT: No records of siltation due to	Field observation	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	for possible reuse as surfacing of slopes where they have to be re-vegetated. ▪ Earthworks and stone works to be prevented from impeding natural flow of rivers, streams and water canals or existing drainage system. ▪ **Guideline for Sediment Control** is given in **Annex-8.10**			project activities. Surface water quality tests confirm to turbidity and TSS limit			
4.5 Deterioration in Surface water quality due to leakage from vehicles and equipment and waste from construction camps.	▪ No vehicles or equipment should be parked or refueled near water-bodies, so as to avoid contamination from fuel and lubricants. ▪ Oil and grease traps and fuelling platforms to be provided at re-fuelling locations. ▪ All chemicals and oil shall be stored away from water and concreted platform with catchment pit for spills collection. ▪ All equipment operators, drivers, and warehouse personnel will be trained in immediate response for spill containment and eventual clean-up. Readily available, simple to understand and preferably written in the local	The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof; Annex-8.8 Guideline for Wastewater Treatment in Construction Camp	Water bodies**;** refueling stations; construction camps.	MI: Water quality of river, stream, ponds and other water bodies in project area; Presence of oil floating in water bodies in project area PT: Surface water quality meets water quality standards (IS:2296)	Water quality tests as per the Environmental Monitoring Plan Field observation	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	language emergency response procedure, including reporting, will be provided by the contractors ▪ Construction camp to be sited away from water bodies. ▪ Solid wastes must be collected, stored and taken to identified disposal site only. ▪ Packaged Wastewater Treatment Plant is to be installed in the Construction Camp. **Guideline for Wastewater Treatment in Construction Camp** is given in **Annex-8.8** ▪ Water quality shall be monitored during construction stage						
5. Flora and Fauna Management Plan							
5.1 Vegetation loss due to site preparation and construction activities	▪ Vegetation clearing shall be done within PROW; it will be ensured that trees falling outside PROW will not be felled. Efforts will be made to save trees outside formation width standing on edge of the PROW. ▪ Top soil upto 15 cm depth shall be stockpiled and preserved and reused for plantation. The Contactor	IRCSP:21-2009	Entire stretch of proposed road except major and minor bridge locations; flyover, interchange locations	MI: ROW width; Number of trees for felling; PT: Additional compensatory afforestation done by contractor; Number of trees planted;	Review of relevant documents; Tree cutting permission; Meeting with villagers & Forest Officials; Field Observations	Contractor & Forest Department	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	shall earmark the area of soil stockpiling and to be approved by Engineer in-Charge. ▪ LPG/ Kerosene shall be provided by the Contractor to the labours for cooking. Provision for community kitchen may be explored. ▪ Poaching shall be strictly banned and any incidence of wildlife poaching by workforce shall be reported to the Forest Department by the Contractor / PIU. There should be provision of **penalty / fine** for any incidence of wildlife poaching by workforce and amount of penalty / fine shall be decided by the Forest Department.						
6. Construction Camp Management Plan							
6.1 Impact associated with location	▪ All camps should be established with prior permission from MPPCB. Camps to maintain minimum distance from following: # 500 m from habitation, # 1000 m from forest areas, # 500 m from water bodies,	Design Requirement The Water (Prevention and Control of Pollution) Act,1974and its amendments thereof Annex-8.1 Guidelines for Siting and Layout of Construction	All construction camps	MI: Location of camp sites and distance from habitation, forest areas and water bodies PT: Distance of camp site is less than 500m from listed locations	On site observation Interaction with workers and local community	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
		Camp					
6.2 Worker's Health in construction camp	▪ The location, layout and basic facility provision of each camp will be submitted to AE / IE and approved by the Sr. Env. Specialist of AE / IE. ▪ The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner. ▪ Adequate water supply and Packaged Wastewater Treatment Plant shall be provided. ▪ Contractor to provide a full-fledged dispensary. The number of beds shall be as per the requirement of the labour license ▪ Contractor to conduct workshop on HIV / AIDS for all his laborers at all his camps at least once in a quarter ▪ The Contractor shall ensure that all officers / employees / labors follow all the prescribed mitigation measures to protect their workforce and minimize the risk of spread of **COVID-19** infection as per the guideline given in **Annex-8.12**	The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and The Contract Labour (Regulation & Abolition) Act, 1970 The Water (Prevention and Control of Pollution) Act,1974 and amendments thereof Provision of ISO:14001:2015 Annex-8.12	All construction camps	MI: Camp health records. Existence of proper first aid kit in camp site. Complaints from workers. PT: No record of illness due to unhygienic conditions or vectors. Zero cases of STD. Clean and tidy camp site conditions.	Camp records Site observation Consultation with contractor workers and local people living nearby	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	▪ Contractor shall conduct monthly health check-ups of all his laborers in his camps through registered medical practitioner ▪ Waste disposal facilities such as dust bins must be provided in the camps and regular disposal of waste must be carried out. ▪ The Contractor will take all precautions to protect the workers from insect and pest to reduce the risk to health. This includes the use of insecticides which should comply with local regulations.						
7. Management of Construction Waste / Debris							
7.1 Selection of Debris Disposal Sites	▪ Unproductive / wastelands shall be selected for dumping sites away from residential areas and water bodies ▪ Dumping sites must be having adequate capacity equal to the amount of debris generated. ▪ Public perception and consent from the village Panchayats has to be obtained before finalizing the location. ▪ Guideline for Siting and Management of Debris Disposal Site is given in **Annex-8.4**	Design Requirement; Annex-8.4: Guideline for Siting and Management of Debris Disposal Site,	At all Dumping Sites	MI: Location of dumping sites Number of public complaints. PT: No public complaints. Consent letters for all dumping sites available with contractor	Field survey and interaction with local people. Review of consent letter	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
7.2 Reuse and disposal of construction and dismantled waste	▪ All excavated materials will be used for backfilling of embankments ▪ Unusable materials should be suitably disposed-off with approval of the concerned authority. ▪ Guideline for Preparing Comprehensive Waste Management Plan is given in **Annex-8.5**	Design Requirement; "Guidelines on Environmental Management of Construction & Demolition (C&D) Wastes" of Central Pollution Control Board, March 2017 Annex-8.5: Guideline for Preparing Comprehensive Waste Management Plan	Entire stretch of proposed road	MI: Percentage of reuse of existing surface material; Method and location of disposal site of construction debris PT: No public complaint and consent letters for all dumping sites available with contractor or AE / IE	Contractor records Field observation Interaction with local people	Contractor	PWD Manipur & CSC
8. Safety and Traffic Management Plan							
8.1 Management of existing traffic and safety	▪ Temporary traffic diversion shall be planned by the contractor and approved by the 'Engineer'. ▪ The traffic control plans shall contain details of diversions; traffic safety arrangements during construction; safety measures for night time traffic and precautions for transportation of hazardous materials. Traffic control plans shall be prepared in line with requirements of	Design requirement and IRC: SP: 27 IRC:SP: 44 Highway Safety Code IRC: SP: 55 Guidelines for Safety in Construction Zones;	Entire stretch of proposed road specially at location of Interchanges, Flyovers, Vehicular Underpasses, Vehicular Overpasses	MI: Traffic Management Plan. Presence/ absence of safety signs, clear traffic demarcations, flag men etc. on site. Complaints from road users. Number of traffic accidents PT: No complaints. No accidents due to poor traffic	Review Traffic Management Plan; Field observation of traffic management and safety system Interaction with people in vehicles using the road	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	IRC's SP 55 document'. ▪ The Contractor will ensure that the diversion / detour are always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. ▪ On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. ▪ Restriction of construction activity to only one side of the existing road. ▪ The contractor shall inform local community of changes to traffic routes, and pedestrian access arrangements with assistance from "Engineer". ▪ Use of adequate signage to ensure traffic management and safety. Conduct of regular safety audit on safety measures. ▪ Adequate lighting for traffic diversions and detours ▪ Guideline for Preparing of Traffic Management Plan is given in **Annex-8.11**	IRC:53 Road Accident recording The Building and other Construction workers Act 1996 and Factories Act 1948 Annex-8.11 Guideline for Preparing of Traffic Management Plan		management. Traffic signs, demarcation lines etc. present in appropriate locations on site			
8.2 Safety of Workers and accident risk from construction	▪ Contractors to adopt and maintain safe working practices. ▪ Usage of fluorescent and	Same as Point No. 8.1 Annex-8.9	Construction sites	MI: Availability of Safety gears to workers	Site observation Review records on safety	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
activities	retro refectory signage, in local language at the construction sites ▪ Training to workers on safety procedures and precautions. ▪ Mandatory appointment of Safety Officer. ▪ All regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress shall be complied with. ▪ Provision of PPEs to workers. ▪ Provision of a readily available first aid unit including an adequate supply of dressing materials. ▪ The contractor will not employ any person below the age of 18 years ▪ Use of hazardous material should be minimized and/or restricted. ▪ Emergency plan (to be approved by engineer) shall be prepared to respond to any accidents or ▪ Accident Prevention Officer must be appointed by the contractor. ▪ The Contractor shall ensure	Guideline to Ensure Worker's Safety during Construction Annex-8.7 Guidelines for Storage, Handling, Use and Emergency Response for Hazardous Substances Provision of ISO:14001:2015		Safety signage Training records on safety Number of safety related accidents PT: Zero fatal accidents. Zero or minor non-fatal accidents.	training and accidents Interact with construction workers		

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	that all officers / employees / labors follow all the prescribed mitigation measures to protect their workforce and minimize the risk of spread of **COVID-19** infection as per the guideline given in **Annex-8.12** ▪ Other provisions to ensure Worker's Safety during Construction should be followed as per **Annex-8.9.** ▪ A guideline for Storage, Handling, Use and Emergency Response for Hazardous Substances is given in **Annex-8.7.** ▪ On occurrence of any accident or injury, the safety officer should submit an accident report to the AE / IE as per the format given in IRC:53-2012 "Road Accident Reporting"						
8.3 Accident risk to local community	▪ Restrict access to construction sites only to authorized personnel. ▪ Physical separation must be provided for movement of vehicular and human traffic. ▪ Adequate signage must be provided for safe traffic movement ▪ Provision of temporary diversions and awareness to locals before opening	Same as Point No. 8.1	Construction sites	MI: Safety signs and their location; Incidents of accidents; Complaints from local people PT: Zero incident of accidents. Zero complaints.	Site inspection Consultation with local people	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	new construction fronts.						
9. Site Restoration and Rehabilitation Plan							
9.1 Clean-up Operations, Restoration and Rehabilitation	• Contractor will prepare site restoration plans, which will be approved by the 'Engineer'. • The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. • All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used / affected by the project will be left clean and tidy to the satisfaction of the Sr. Environmental Specialist of AE / IE • All the opened borrow areas and its approach roads will be rehabilitated • Prior to setting up the sites baseline sampling of soil and groundwater has to be carried out. After restoration and rehabilitation soil and groundwater must be sampled again as verification. Contractor will be liable for any environmental damage to the sites that are not	Project requirement Annex-8.2 Annex-8.3 Annex-8.4 Annex-8.5 Provision of ISO:14001:2015	Entire stretch of proposed road, construction camp sites and borrow areas if any	MI: Condition of camp sites, construction sites and borrow areas. Presence / absence of construction material / debris after completion of construction works on construction site. PT: Clean and tidy sites. No trash or debris left on site. Site restored and leveled.	Site observation Interaction with locals; Issue completion certificate after restoration of all sites are found satisfactory	Contractor	PWD Manipur & CSC

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	restored to the satisfaction of the Environmental Expert						
C. OPERATION AND MAINTENANCE STAGE							
1. Air Quality Management Plan							
1.1 Air pollution due to due to vehicular movement	▪ Avenue plantations shall be maintained. ▪ Regular maintenance of the Highway will be done to ensure good surface condition ▪ Air quality monitoring. If monitored parameters exceeds prescribed limit, suitable control measures must be taken. ▪ Signages shall be provided reminding them to properly maintain their vehicles to economize on fuel consumption. ▪ Enforcement of vehicle emission rules in coordination with transport department or installing emission checking equipment	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Entire stretch of proposed road	MI: Air quality monitoring as per post project Environmental Monitoring Program PT: Levels are equal to or below baseline levels given in the EIA report	As per CPCB requirements Site inspection	PIU / NABL approved Environmental Monitoring Agency	PWD, Manipur
2. Noise Management Plan							
2.1 Noise due to movement of traffic	• Effective traffic management and good riding conditions shall be maintained • Speed limitation and honking restrictions near sensitive receptors • HORN PROHIBITED sign to	Noise Pollution (Regulation & Control) Rules, 2003 and amended in 2010	Sensitive receptors as identified in the EIA Report	MI: Noise monitoring as per post project Environmental Monitoring Program PT: Levels are	Noise monitoring as per noise rules , 2000 Discussion with people at sensitive	PIU / NABL approved Environmental Monitoring Agency	PWD, Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	be placed near sensitive receptors • Noise monitoring. If monitored value exceeds prescribed limit, suitable control measures must be taken. • Create awareness amongst the residents about likely noise levels from Highway operation at different distances, the safe noise limits and easy to implement noise reduction measures while constructing a building near road			equal to or below baseline levels given in the EIA report	receptor sites		
3. Land & Soil							
3.1 Soil erosion at embankment during heavy rainfall.	▪ Periodic checking to be carried to assess the effectiveness of the stabilization measures ▪ Soil quality monitoring. If monitored parameters exceeds prescribed limit, suitable control measures must be taken. ▪ Necessary measures to be followed wherever there are failures	Project requirement	At bridge locations and embankment slopes and other probable soil erosion areas. Soil quality monitoring from different land use area along the Highway such as agricultural area, residential area and forest areas	MI: Existence of soil erosion sites; Number of soil erosion sites soil quality monitoring as per post project Environmental Monitoring Program PT: Zero or minimal occurrences of soil erosion	On site observation As per CPCB requirements	PIU / NABL approved Environmental Monitoring Agency	PWD, Manipur
4. Water Quality Management Plan							
4.1 Siltation	▪ Regular checks shall be made for soil erosion and	Project requirement	Near surface Water bodies	MI: Water quality monitoring as per	Site observation	PIU / NABL approved	PWD, Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	turfing conditions for its effective maintenance.			post project Environmental Monitoring Program PT: No turbidity of surface water bodies due to the road		Environmental Monitoring Agency	
4.2 Water logging due to blockage of drains, culverts or streams	▪ Regular visual checks and cleaning of drains shall be done along the alignment to ensure that flow of water is maintained through cross drains and other channels / streams. ▪ Monitoring of water borne diseases due to stagnant water bodies	Project requirement	Near surface Water bodies	MI: Presence/ absence of water logging along the road PT: No record of overtopping/ Water logging	Site observation	PIU	PWD, Manipur
5. Maintenance of Right of Way and Safety							
5.1 Accident Risk due to uncontrolled growth of vegetation	▪ Efforts shall be made to make shoulder completely clear of vegetation.	Project requirement	Throughout the Highway	MI: Presence and extent of vegetation growth on either side of Highway. Number of accidents. PT: No accidents due to vegetation growth	Visual inspection Check accident records	PIU	PWD, Manipur
5.2 Accident risks associated with traffic movement.	▪ Traffic control measures, including speed limits, will be forced strictly. ▪ Encroachment of squatters within the ROW will be prevented.	IRC:SP:55	Throughout the Highway	MI: Number of accidents Conditions and existence of safety signs, rumble strips etc. on the road	Review accident records; Site observations	PIU	PWD, Manipur

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	▪ No school or hospital will be allowed to be established beyond the stipulated planning line as per relevant local law ▪ Monitor / ensure that all safety provisions included in design and construction phase are properly maintained ▪ No parking along the Ring Road except in designated areas ▪ Tow-way facility for the breakdown vehicles			Presence/absence of sensitive receptor structures inside the stipulated planning line as per relevant local law PT: Fatal and non-fatal accident rate is reduced after improvement			
5.3 Accident risks due to fauna-vehicle collision.	▪ Periodic inspection of the fences along the Ring Road ▪ Periodic inspection of culverts in order to make sure that reptiles & amphibians can pass	Project requirement	Alignment passing through forest area	MI: Number of accidents PT: No damage to fences and no obstructed culverts	Review accident records; Site observations	PIU	PWD, Manipur

IRC: Indian Road Congress, AE: Authority Engineer, PWD: Public Works Department

G. ENHANCEMENT OF WATER BODY

369. **Enhancement of Water Body:** An interaction was held between the officials of Project Implementation Unit (PIU), PWD, Manipur and representatives of Khurai Konsam Leikai regarding construction of the Imphal Ring Road at Ipum pat area on 2nd May 2022 at PWD Office. During the interaction, the representatives of Khurai Konsam Leikai informed that Ipum pat (water body) is the only perennial water source from where the daily requirement of water is met, and it is used by the villagers inhabiting both sides of the water body. The PD / EAP expressed that the impact on the water body will be minimal and that it is proposing to enhance the water body (Ipum pat) as a part of best engineering practice.

370. Ipum Pat is located at Khurai Konsam Leikai at chainage 15+215 on the right side of the project road (**Table 124**). Rain water is stored in Ipum pat and there is a culvert on the western part of Ipum pat which is connecting it with a canal. No government record is available to establish this water body as a heritage / historical water body. The length of the water body along the project road is 814 m.

Table-124 Water Body proposed for Enhancement

Sl. No.	Name	Design Chainage	Side	Distance# (m)	Latitude	Longitude	Package
44.	Ipum Pat	15+215	RHS	15.31	24° 50' 11.675"	93° 58' 28.427"	I

371. Following enhancement measures have been proposed for **Ipum Pat** and shown in Drawing No: PWD/IRR/Ipump pat/01/R0. A capital cost provision has been covered **under civil budget (Package-I)** for implementation of the enhancement plan.

- Deepening of the water body up to 2 m (earth excavation)
- Phycoremediation (a bioremediation technique using algae) of water using NUALGI
- Provide retaining wall on the left bank and **Rip-rap structure** on the right bank of the water body
- Sitting arrangement with RCC Precast Benches with back support
- Pathway / Jogging track with Interlocking paver blocks & sand filling
- Entry & exit point; lighting facility; open gym & play area, fencing & railing
- Water fountain at **2** locations
- Water pipeline and storage tank at 5 locations so that local people can use this water after rejuvenation of Ipum pat
- Oil interceptor
- Water quality monitoring before start of the construction, during construction and operation phase of project

372. **Phycoremediation using NUALGI:** Phycoremediation using NUALGI is proposed to improve the water quality of the pond. Phycoremediation is the use of algae to remediate polluted waters. Among all the algae, diatoms are the most prolific photosynthesizes because of their silica shells, which are translucent. This helps the diatoms to photosynthesize even in low light conditions.

373. The “NUALGI Technology” is based on providing micro nutrients required for diatom algae growth to speed up the nutrient removal in stagnant water and converting these nutrients to fish biomass. NUALGI contains micronutrients along with silica which is required for diatom growth. During photosynthesis, diatoms consume Nitrates and Phosphorous, as also uses up CO_2 from

the atmosphere. In the process, they release oxygen (pure oxygen in water) to almost saturation levels, which will help the water body regain its original levels of Dissolved Oxygen. The absorption of CO_2 will also mitigate the water acidification and pH levels would move towards more basic levels. The high levels of DO would set up a chain of benefits, primarily it promotes aerobic bacteria which would digest the excess nutrients in water and convert them into the base constituents. Such high levels of DO would also oxidize the heavy metals which would precipitate out of water, where other bacterial strains would consume them. NUALGI will also trigger growth of Zooplanktons, which consume diatom algae. The zooplanktons are consumed by fish, thus ensuring that the diatom algae exits the water as fish biomass and does not decay in water like other cellulose algae. This will lead to e**nvironmentally friendly way of converting the excess nutrients to fish biomass.** Guideline on Phycoremediation of water using NUALGI is given in **Annex-8.14** and a typical enhancement plan for Ipum Pat is shown in Drawing No. PWD/IRR/ Ipum Pat/01/R0.

H. EMERGENCY RESPONSE PLAN

374. Project Proponents shall prepare site specific Emergency Response Plans to face and address any emergency situation with respect to vehicular accidents, heavy floods and spillage of oil or other hazardous materials. Copy of emergency plan may be circulated in local language to affected villages. A consultation may also be formed regarding discussion on Emergency Response Plan with local populace. A communication flow chart may also be drafted for easy understanding of information flow during emergency situation. It requires establishing and developing a communication and response system to minimize the impacts of these situations and also minimize the time required to respond to these situations in order to safeguard people, property and environmental resources. Contractor shall submit approved Accident Safety and Hazardous Chemical Spill Management Plan. The plan should also have details of detours in case of emergency. The Emergency Contact Information of concerned local authorities should be displayed at suitable locations along the road particularly in accident prone zones and sensitive locations.

I. GRIEVANCE REDRESSAL MECHANISM

375. A project-specific grievance redress mechanism (GRM) shall be established to receive, evaluate, and facilitate the resolution of affected person's (AP's) concerns, complaints, and grievances about the social and environmental performance at the level of the project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve environmental concerns linked to the project. The GRM will provide an accessible and trusted platform for receiving and facilitating the resolution of APs' grievances related to the project. The multi-tier GRM for the project is outlined below, each tier having time-bound schedules and with responsible persons identified to address grievances and seek appropriate persons' advice at each stage as required.

376. Project area-wise public awareness campaigns will ensure that knowledge of the grievance redress procedures is generated. The PIU, with the assistance of RP Implementation NGO will conduct awareness campaigns to ensure that general public, including poor and vulnerable households are made aware of the grievance redress procedures.

377. **Grievance Redress Process:** Presently there is no Grievance Redressal Cell (GRC) in PWD, Manipur. Therefore, it is proposed to form a GRC at PIU, PWD Manipur for the Imphal Ring Road project. The GRC shall be headed by the Project Director. The Environmental Specialist (ES) of PIU, PWD Manipur will be a member of this cell to redress complaints pertaining to

environmental issues. The contact details of the members (email and phone numbers) of this cell shall be available at the PWD Manipur official web site and the details shall also be available at the construction camp of contractors, PIU office at PWD Complex, Khuyathong etc. This GRC shall discuss the issue / complaint in its monthly meeting and resolve the issues within two weeks' time after receiving the grievance. If the matter is not resolved by GRC at PIU level within stipulated time, it shall be referred to the Chief Engineer who will resolve the complaint within a period of two months.

378. In case of **minor complaints**, the Contractor shall be responsible to redress the same immediately. The Contractor may engage a person for the same or may give additional responsibility to the Environmental Officer / Safety Officer. The contact details of the person responsible for resolving minor issues are to be displayed at project site. The minor complaints will be reported in the daily reports of the contractor and that in case the complainant is not satisfied with the proposed solution, the complaint will be forwarded to the GRC.

379. **Registering complaints:** Complainants shall have the flexibility of conveying grievances / suggestions by registering in the compliant registers placed at PWD Office, PIU Office, project site offices or by e-mail or by post or by registering online of PWD Manipur website. PIU shall establish a public response centre (PRC) helpline specifically addresses the issues arising out of project implementation.

380. The Environmental Specialist (ES) of PIU shall have the overall responsibility for timely grievance redressal on environmental issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

381. In the event that the GRM is not in a position to resolve the issue, the affected persons can also use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters or the ADB India Resident Mission. This is to be adopted only as a last resort in case all efforts to resolve the issue by the contractor or the GRC have been explored and the project level GRM is unable to resolve the issue. The complaint can be submitted in any of the official languages of ADB's Developing Member Countries. The ADB Accountability Mechanism information shall also be included in the Project Information Document to be distributed to the affected communities, as part of the project GRM.

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

383. **Periodic Review and Documentation of Lessons Learned:** The Project Director shall periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the project's ability to prevent and address grievances.

384. **Costs:** All costs involved in establishment of the GRC, resolving the complaints (meetings, consultations, communication and reporting / information dissemination) shall be borne by the PWD, Manipur

385. **Complaints register with the Contractor:** The contractor shall keep and maintain a complaint register report at his site office along the project road as well as project facilities like construction camp, labour camp etc., for public to register their complaints. The Contractor, after

taking necessary action based on the complaint, shall also incorporate the same, in the complaint register. This report shall also be part of the monthly report for CSC to monitor and take necessary action, if needed. It has to be noted that, inaction upon the complaint of the public shall be considered as a major lapse from the side of the Contractor, leading to invoking of penalty clause, which is given in Section-E of this Chapter as well as the Contract document.

J. ENVIRONMENTAL MONITORING PROGRAM

386. The purpose of the environmental monitoring program is to ensure that the envisaged purpose of the project is achieved and results in desired benefits to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring program be designed and carried out. The broad objectives are:

- To evaluate the performance of mitigation measures proposed in the EMP
- To evaluate the adequacy of Environmental Impact Assessment
- To suggest improvements in management plan, if required
- To enhance environmental quality
- To satisfy the legal and community obligations

387. The environmental monitoring plan contains:

- Performance Indicators
- Environmental Monitoring Program
- Reporting Formats
- Necessary Budgetary Provisions

388. **Performance Indicators:** The physical, biological and social components identified to be particularly significant in affecting the environment at critical locations have been suggested as Performance Indicators. The Performance Indicators shall be evaluated under three heads as:

a) Environmental condition indicators to determine efficiency of environmental management measures in control of air, noise, water and soil pollution.
b) Environmental management indicators to determine compliance with the suggested environmental management measures
c) Operational performance indicators that have been devised to determine efficiency and utility of the proposed mitigation measures

389. The Performance Indicators and monitoring plans prepared are presented in **Table-125**.

Table-125 Performance Indicators

S.N.	Details	Indicators	Stage	Responsibility
A.	**Pre-Construction Stage: Environmental Management Indicators and Monitoring Plan**			
1.	Location of construction camps have to be identified and parameters indicative of environment in the area has to be reported. Reporting format is given in Annex-8.13	Construction camp	Pre-construction	Contractor
2.	Location of borrow areas have to be finalized and parameters indicative of environment in the area has to be reported. Reporting format is given in Annex-8.13	Borrow areas	Pre-construction	Contractor
3.	Location of Quarry and Stone Crusher sites have to be finalized and parameters indicative of environment in the area has to be reported. Reporting format is given in Annex-8.13	Quarry and Stone Crusher sites	Pre-construction	Contractor
4.	Locations for Debris Disposal Site have to be identified and parameters indicative of environment in the area has to be reported. Reporting format is given in Annex-8.13	Debris Disposal Site	Pre-construction	Contractor
5.	Progress of tree removal marked for cutting is to be reported	Site clearing	Pre-construction	Contractor
B.	**Construction Stage: Environmental Condition Indicators and Monitoring Plan**			
1.	The parameters to be monitored as per frequency, duration & locations of monitoring specified in the Environmental Monitoring Program prepared (Refer **Table-124**)	Air quality	Construction	Contractor through NABL approved monitoring agency
		Noise Level	Construction	Contractor through NABL approved monitoring agency
		Vibration Monitoring and Condition survey of Sensitive Receptors	Construction	Contractor through specialized Agency
		Ground Water quality	Construction	Contractor through NABL approved monitoring agency
		Surface Water quality	Construction	Contractor through NABL approved monitoring agency
		Soil quality	Construction	Contractor through NABL approved monitoring agency
2.	Contractor shall report implementation of the measures suggested for topsoil	Top Soil Conservation	Construction	Contractor

S.N.	Details	Indicators	Stage	Responsibility
	conservation to Sr. Environmental Specialist of AE/ IE			
3.	Contractor shall report implementation of the measures suggested for slope stabilization and sediment control to Sr. Environmental Specialist of AE/ IE	Slope Stabilization and Sediment Control	Construction	Contractor
4.	Contractor shall report implementation of the measures suggested for waste management to Sr. Environmental Specialist of AE/ IE	Waste Management Plan	Construction	Contractor
5.	Contractor shall report implementation of the guideline to ensure worker's safety during construction to Sr. Environmental Specialist of AE/ IE	Worker's Safety during Construction	Construction	Contractor
6.	The Contractor will be responsibility for redevelopment of the land to the satisfaction of the owner after completion of the work. Redevelopment of the temporary land should be approved by the Sr. Environmental Specialist of the AE / IE	Temporary use of land for traffic diversion	Construction	Contractor
C.	**Operation Stage: Management & Operational Performance Indicators**			
1.	Sr. Environmental Specialist of AE/ IE and PIU will undertake joint site visit with the Contractor to determine whether the Borrow areas, Quarry areas, Debris disposal site have been rehabilitated in line with Guidelines	Rehabilitation of Borrow areas, Quarry area, Debris Disposal site	Operation	Sr. Environmental Specialist of AE/ IE and Safeguard Officer of PIU / PWD Manipur

390. **Monitoring Schedule:** The detail monitoring schedule during construction and operation stages are presented in **Table-126**. For each of the environmental condition indicator, the monitoring program specifies:

- Parameters to be monitored
- Location of the monitoring sites
- Frequency and duration of monitoring
- Institutional responsibilities for implementation and supervision

Table-126 Environmental Monitoring Program

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
Air Quality	Construction[10]	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, HC	Wherever the contractor decides to locate the Batching & Asphalt Mixing Plants, Hot Mix Plant, Crushers, DG sets – 2 locations for Package-I 2 locations for Package-II 2 locations for Package-III	Twice in a season at one day interval for 3 seasons (except monsoon) Construction work should be in full swing during monitoring Duration: 24 hours	Contractor through NABL approved monitoring agency	CSC & PIU, PWD Manipur
		PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO,	At 2 locations for Pkg.-I - Canchipur (Ch. 0+300) - Porompat (Ch. 11+800) At 2 locations for Pkg.-II - Heinging (Ch. 21+450) - Langol (41+400) At 1 locations for Pkg.-III - Ghari (47+700)	Twice in a season at one day interval for 3 seasons (except monsoon) Construction work should be in full swing during monitoring Duration: 24 hours	Contractor through NABL approved monitoring agency	CSC & PIU, PWD Manipur

[10] Construction period is 24 months

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
	Operation[11]	PM_{10}, $PM_{2.5}$, SO_2, NOx, CO,	<u>At 2 locations for Pkg.-I</u> - Canchipur (Ch. 0+300) - Porompat (Ch. 11+800) <u>At 2 locations for Pkg.-II</u> - Heinging (Ch. 21+450) - Langol (41+400) <u>At 1 locations for Pkg.-III</u> - Ghari (47+700)	Twice in a year (except monsoon) <u>Duration:</u> 24 hours	PIU through NABL approved monitoring agency	PIU, PWD Manipur
Noise level	Construction	Noise level in dB(A)	<u>At 5 locations for Pkg.-I</u> Equipment yard; Stone Crusher Unit and 3 sensitive receptors finalized by the Sr. Environmental Specialist of AE/ IE <u>At 5 locations for Pkg.-II</u> Equipment yard; Stone Crusher Unit and 3 sensitive receptors finalized by the Sr. Environmental Specialist of AE/ IE <u>At 5 locations for Pkg.-III</u> Equipment yard; Stone Crusher Unit and 3 sensitive receptors finalized by the Sr. Environmental Specialist of AE/ IE	4 times a year (in each season) <u>Duration:</u> 24 hours	Contractor through NABL approved monitoring agency	CSC & PIU, PWD Manipur

[11] Monitoring in Operation Phase will be conducted in every 2.5 years for 5 years

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	**Location**	**Frequency**	**Implementation**	**Supervision**
Noise level	Operation	Noise level in dB(A)	3 locations for Pkg-I - Kiyamgei Ideal School, - Shemrock Kids Garden, - Jawaharlal Nehru Institute of Medical Sciences Porompat 3 locations for Pkg-II - Savio English Higher Secondary School, - Heingang Awang Leikai Primary School, - Catholic Medical Centre 1 location for Pkg-III - S I School Canchipur	Twice in a year Duration: 24 hours	PIU through NABL approved monitoring agency	PIU, PWD Manipur
Vibration level Peak Particle Velocity [mm/s]	Construction	Continuous during operation of vibration sources / heavy equipment like Excavators, Motor scrapers, Vibratory rollers etc. as prescribed in German Standard DIN 4150-3:1999 “Structural Vibration – Part 3: Effects of vibration on structures			Contractor through a specialized agency	CSC & PIU, PWD Manipur

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	**Location**	**Frequency**	**Implementation**	**Supervision**
Condition survey of Sensitive Receptors	Construction	Package-I: 11 Sensitive Receptors Package-II: 5 Sensitive Receptors (refer Section-G, Chapter VI of IEE Report) Apart from the sensitive receptors, if any **extremely fragile buildings** or structures are found **within 20 m** of the works, these buildings or structures shall be included in the survey. During piling operation, condition surveys of sensitive receptors & fragile building located **within 50 m** around the piling location shall be covered. **Method:** visual observation, photo documentation, videography **Parameters:** Age, No. of storey, height, No. of Basement level, type and depth of foundation, construction type, roof and wall structure, flooring and ceilings, internal wall and external wall plastering and paintings, electrical cabling, pumbing and mechanical systems including lifts within the building. The record must include about (i) cracks or signs of vibration/ displacement (ii) signs of dampness and (iii) All existing repair works related to cracks, vibration/ displacement and dampnes			Contractor through a specialized agency	CSC & PIU, PWD Manipur
Ground Water Quality	Construction	Physical, Chemical & Biological parameters as per IS 10500:2012 Additional parameters: Oil & grease, HC & VOC Any additional parameters as decided by the AE / IE	<u>At 4 locations for Pkg.-I</u> Construction plants, Construction camp, Bashikhong Village and Porompat <u>At 4 locations for Pkg.-II</u> Construction plants, Construction camp, Heingang and Meiteilangol <u>At 3 locations for Pkg.-III</u> Construction plants, Construction camp and Lamjaotongba	4 times a year	Contractor through NABL approved monitoring agency	CSC & PIU, PWD Manipur

<table>
<tr><th rowspan="2">Environment Component</th><th rowspan="2">Project Stage</th><th colspan="3">Environmental Monitoring Program</th><th colspan="2">Institutional Responsibility</th></tr>
<tr><th>Parameters</th><th>Location</th><th>Frequency</th><th>Implementation</th><th>Supervision</th></tr>
<tr><td></td><td>Operation</td><td>Physical, Chemical & Biological parameters as per IS 10500:2012</td><td><u>At 2 locations for Pkg.-I</u>
Bashikhong Village and Porompat

<u>At 2 locations for Pkg.-II</u>
Heingang and Meiteilangol

<u>At 1 location for Pkg.-III</u>
Lamjaotongba</td><td>Twice in a year (Pre-monsoon & post-monsoon)</td><td>PIU through NABL approved monitoring agency</td><td>PIU, PWD Manipur</td></tr>
<tr><td>Surface Water Quality</td><td>Construction</td><td>Please refer Table-45 of Chapter-IV of the IEE Report</td><td>At 3 locations for Pkg.-I:<table><tr><th>Design Ch.</th><th>Village</th></tr><tr><td>1+424</td><td>Imphal River</td></tr><tr><td>11+188</td><td>Iril River</td></tr><tr><td>15+215</td><td>Ipum Pat</td></tr></table>At 2 locations for Pkg.-II:<table><tr><th>Design Ch.</th><th>Village</th></tr><tr><td>23+605</td><td>Local stream</td></tr><tr><td>42+911</td><td>Nimbul River</td></tr></table>At 2 locations for Pkg.-III:<table><tr><th>Design Ch.</th><th>Village</th></tr><tr><td>48+559</td><td>Local stream</td></tr><tr><td>51+935</td><td>Nimbul River</td></tr></table></td><td>4 times a year</td><td>Contractor through NABL approved monitoring agency</td><td>CSC & PIU, PWD Manipur</td></tr>
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<table>
<tr><th rowspan="2">Environment Component</th><th rowspan="2">Project Stage</th><th colspan="3">Environmental Monitoring Program</th><th colspan="2">Institutional Responsibility</th></tr>
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<table><tr><th>Design Ch.</th><th>Village</th></tr><tr><td>48+559</td><td>Local stream</td></tr><tr><td>51+935</td><td>Nimbul River</td></tr></table></td><td>Twice in a year (Pre-monsoon & post-monsoon)</td><td>PIU through NABL approved monitoring agency</td><td>PIU, PWD Manipur</td></tr>
<tr><td>Soil</td><td>Construction</td><td>pH, Conductivity, Organic matter, N, P, Na, K, Pb, Oil & grease, Heavy metals, PAH</td><td>At 4 locations for Pkg.-I
At 4 locations for Pkg.-II
At 4 locations for Pkg.-III

Wherever the contractor decides to locate the
1) Hot Mix Plant;
2) Construction plants/ camp and remaining 2 will be from different land use area along the project road such as agricultural area / forest area / residential area</td><td>Once in a year</td><td>Contractor through NABL approved monitoring agency</td><td>CSC & PIU, PWD Manipur</td></tr>
</table>

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
	Operation	pH, Conductivity, Organic matter, N, P, Na, K, Pb	At 2 locations for Pkg.-I At 2 locations for Pkg.-II At 2 locations for Pkg.-III From different land use area along the project road such as agricultural area / forest area / residential area	Once in a year	PIU through NABL approved monitoring agency	PIU, PWD Manipur
Soil Erosion	Construction	Visual observation & turbidity test	Visual observation at high embankments sites such as bridge location, culvert locations, embankment area etc.	Pre-monsoon and post-monsoon season	Environmental Specialist, Hydrologist, and Material Specialist of Construction Supervision Consultants & Contractor	CSC & PIU, PWD Manipur
Haul Road	Construction	Maintenance of haul roads, generation of dust.	Haul roads & hauling mode	At least twice a day i.e. midday and evening	Contractor	CSC & PIU, PWD Manipur

Note:

1) Construction period is 2 years

2) Operation period is 5 years; monitoring in Operation Phase will be conducted twice in a year for 5 years

Note: Manipur has the following four seasons in the year:

- Winter Season : December to February
- Summer Season : March to May
- Monsoon Season : May to September
- Post-monsoon : October to November

K. INSTITUTIONAL ARRANGEMENTS

391. Project Implementation Unit (PIU) of PWD Manipur is overall responsible for successful implementation of the project with assistance from the Contractor and Construction Supervision Consultant (CSC).

392. Project Director will be heading the overall functioning of the PIU. The PIU will ensure that the statutory requirements are not violated during the pre-construction, construction and operation stages of the project. The Authority / Independent Engineer serves as “Engineer of the Authority” for supervision of the project. Sr. Environmental Specialist of the CSC will supervise all forestry and environmental related issues during construction phase of the project. The “Contractors” herein mean the agency hired for execution of the construction works for the project. The contractor will be responsible for actual implementation of the EMP in the field and will also be responsible for health and safety issues including COVID-19 protocol.

L. REPORTING PROTOCOL

393. The reporting system will start with the Contractor who is the main executor of the implementation activities. The contractor will report to the Sr. Environmental Specialist of CSC who in turn shall report to the PIU. The Contractor will submit daily, monthly and quarterly environmental compliance reports to the CSC. The CSC will submit separate monthly and quarterly environmental monitoring reports to PIU in addition to submission of the report in respect of its duties and functions as per the agreement with PWD. The PIU will be responsible for preparation of the targets for identified non-compliances. PIU will submit the **Environmental Monitoring Report** to ADB on six monthly basis (January to June and July to December). The reporting formats are provided in **Annex-8.13.**

394. The reporting and reviewing matrix is included in the EMF which is as under:

	Reporting Responsibility	**Reviewing Responsibility**
Daily Report	**Contractor** ▪ Summary of environmental issues and activities as per format provided in Annex-8.13	**Construction Supervision Consultant** ▪ Review the report and suggest Corrective Action
Monthly Report	**Contractor** ▪ Summary of environmental issues and activities as per format provided in Annex-8.13	**Construction Supervision Consultant** Review the report and suggest Corrective Action
Monthly Monitoring	**Construction Supervision Consultant** ▪ Carry out independent Monitoring of Env Safeguards ▪ Compilation of issue reported, action taken and status	**PIU, PWD Manipur** ▪ Review the actions taken and issue directions to the Contractor
Quarterly Reporting	**Construction Supervision Consultant** ▪ Summary of environmental compliance and activities as per format provided in Annex-8.13	**PIU, PWD Manipur** ▪ Review the action taken report and develop new strategies
Six Monthly Reporting	**PIU, PWD Manipur** ▪ Environmental Monitoring Report (EMR) as per format provided in Annex-8.13	**ADB** Review the Semiannual report, provide comments / observations (if any) and set timeline for compliance of the same

395. The Reporting and Reviewing Matrix presented in the **Table-127** below shall be followed for overall review and monitoring and to ensure proper flow of information and timeliness of reporting.

Table-127 Reporting and Reviewing Matrix

Stage	Description of Reporting Format	Format No	Frequency	Reporting responsibility	To be reviewed
Pre-construction	Identification of Disposal Site	P1	One time	Contractor	CSC
Pre-construction	Setting up of Workers Camp and Storage Area	P2	One time	Contractor	CSC
Pre-construction	Establishment of Borrow Area	P3	One time	Contractor	CSC
Pre-construction	Establishment of Quarry Area	P4	One time	Contractor	CSC
Pre-construction	Establishment of Plants	P5	One time	Contractor	CSC
Pre-construction	Road Safety Reporting Formats	P6	Monthly	Contractor	CSC
Pre-construction	Arrangement of Temporary Land	P7	Quarterly	Contractor	CSC
Pre-construction	Tree Cutting / Stump Removal	P8	Monthly	Contractor	CSC
Pre-construction	Identification of Construction Water Source	P9	Quarterly	Contractor	CSC
Construction	Details of Earthworks undertaken	C1	Monthly	Contractor	CSC
Construction	Details of Plant Operations	C2	Monthly	Contractor	CSC
Construction	Details of Quarry Operations	C3	Monthly	Contractor	CSC
Construction	Progress of Land Fill Operations	C4	Monthly	Contractor	CSC
Construction	Details of Machinery in Operation	C5	Monthly	Contractor	CSC
Construction	Env. Monitoring in during Construction Stage	C6	Quarterly	Contractor	CSC
Construction	Safety Checklist	C7	Monthly	Contractor	CSC
Construction	Accident Reporting	C8	Monthly	Contractor	CSC
Construction	Construction Camp Management	C9	Monthly	Contractor	CSC
Construction	Redevelopment of Borrow Areas	C10	Quarterly	Contractor	CSC
Construction	Restoration of Construction Site	C11	Quarterly	Contractor	CSC
Construction	Complaints Registering & Monitoring	C12	Daily	Contractor	CSC
Construction	Summary of Statutory Clearances obtained	CSC 1	Quarterly	AE / IE	PIU
Construction	Checklist for Environmental Inspection	CSC 2	Quarterly	AE / IE	PIU
Construction	Project Summary Sheet	CSC 3	Quarterly	AE / IE	PIU
Construction	Environmental Compliance Report	EMR	Semi-annual	PIU	ADB
Operation	Cleaning of culverts and longitudinal drains	O1	Monthly	Maintenance Consultant	PIU
Operation	Env. Monitoring in Operation Stage	C6	Quarters		PIU

M. IMPLEMENTATION ARRANGEMENTS

396. The PWD Manipur is responsible for the implementation of the provisions made within the EMP through CSC with the help of project offices. The services of CSC will be procured to assist the site offices for monitoring the environmental aspects of the project during implementation. The CSC will have a multi-disciplinary team and will also have an environmental management team having intermittent input of a senior level Environmental Specialist supported by middle level full time Environmental Specialists (one for each phase). This team will ensure compliances of mitigation measures and all statutory requirements during implementation and operation of project.

397. **Construction Supervision Consultant (CSC):** The CSC to be procured through open competitive bidding (OCB) shall assist the PWD with the implementation of project, once the project documents are ready. The Environmental Specialist of the AE / IE shall be the key personnel to ensure the successful implementation of EMP provisions. Since OCB procurement is envisaged, the selected CSC are expected to have the necessary professional(s) to tackle the issues that the project is likely to bring up. The Environmental Specialist of the CSC will be a key position, which can be leveraged to ensure that the Contractor complies with the various EMP requirements.

398. The EMP prepared for the Project road, needs to be followed during the implementation of the civil works. The EMP is integrated in the technical specification and contract documents.

399. Qualification and Responsibilities of Senior Environmental Specialist of CSC:

Qualifications & Experience

- Postgraduate in Environmental Management / Environmental Science / Ecology / Environmental Planning / degree in Civil Engineering with PG / specialisation in environment.
- 15 years of total experience with a minimum of 10 years in the preparation and implementation of EMP of highway projects and an understanding of environmental, health and safety issues.
- Prior practical experience in Highways projects funded by Multilateral Agencies

Roles & Responsibilities

- The key responsibility of the Environmental Specialist will be the successful implementation of the EMP
- In addition, he / she will update PWD on the progress of environmental protection and / or enhancement works as envisaged in the EMP
- Supervise and monitor the implementation of EMP by the Contractor
- Review and approve site-specific environmental mitigation / enhancement designs worked out by the Contractor based on the EMP prepared during project preparation
- Review and recommend the Contractors' Implementation Plans for approval (with any changes that may be necessary) to ensure compliance with the environmental provisions of the Contract
- Monitor tree plantation programs and the periodic Environmental Monitoring (air, noise, water, soil and biodiversity) programs to ensure compliance with the statutory requirements and the EMP
- Hold regular meetings with Contractor and provide update to PWD Manipur regarding the progress of environmental works
- Prepare and submit Quarterly and Semi-annual Environmental Monitoring Report (EMR)

to PIU, PWD Manipur

- Develop and organise environmental training programmes to upgrade the skills within the staff of the environmental cell and the Contractors
- Document and develop good practices during project implementation for wider dissemination

400. The project will require continuous environmental supervision from the CSC's side. Since the **Sr. Environmental Specialist for AE / IE are to be deployed on intermittent basis**, it is required to have **fulltime Jr. Environmental Specialist** to assist the key professional. Field Engineers supervising the construction works also needs to be trained on environmental aspects, who then shall apprise the Team Leader and the Sr. Environmental Specialist of any significant development on environment

401. Qualification and Responsibilities of Junior Environmental Specialist (Sub Professional):

Qualifications & Experience

- Postgraduate in Environmental Management / Environmental Science / Ecology / Environmental Planning / Environmental Engineering
- 7 years of experience with a minimum of 3 years in the preparation and or implementation of EMP of highway projects and an understanding of environmental, health and safety issues
- Prior practical experience in multilateral funded projects in highways sector would be an advantage

Roles & Responsibilities

- The key responsibility of the Environmental Specialist will be the successful implementation of the EMP
- In addition, he / she will update the Key Environmental Specialist & the TL of CSC on the progress of environmental protection and / or enhancement works as envisaged in the EMP
- Regularly supervise and monitor the implementation of EMP by the Contractor
- Verify the extent of environmental compliance of the Contractor regularly
- Monitor tree plantation programs and the periodic Environmental Monitoring (air, water, noise, soil & biodiversity) Programs to ensure compliance with the statutory requirements and the EMP
- Interact & hold regular meetings with Contractor Environmental Officers in implementation of the EMP
- Assist the Key Environmental Specialist in preparation of Quarterly and Semi-annual Environmental Monitoring Report
- Assist the Key Environmental Specialist in documenting good practices during project implementation for wider dissemination
- Regularly monitor the approved site-specific environmental mitigation / enhancement designs based on the EMP prepared

402. **Contractor:** Execution of works will be the responsibility of the Contractor. The Contractor may himself be the executioner of the project or might decide to sublet some part to petty contractor. The contractor shall be responsible for both the jobs done by the petty contactor (if Sublet) as well by him. In both the cases the Contractor will implement the environmental measures. This has been done with a view to ensure that road construction and environmental

management go together. The Contractors shall employ a **full time Environmental Officer** whose qualification and responsibilities shall be as stated below:

403. Qualification and Responsibilities of Environmental Officer (EO) of Contractor:

Qualifications & Experience

- Postgraduate in Environmental Management / Environmental Science / Zoology / Botany / Ecology / Environmental Planning / Environmental Engineering
- 5 years of experience with a minimum of 2 years in the implementation of EMP of highway projects and an understanding of environmental, health and safety issues
- Prior practical experience in multilateral funded projects in highways sector would be an advantage

Roles & Responsibilities

- The Environmental Officer shall report directly to the Resident Construction Manager / Project Manager of the Contractor so that the pertinent environmental issues that he raises are promptly dealt with.
- He shall also have a direct interaction with the Environmental Specialist of the CSC.
- Monitor / implement measures laid out in the EMP and or as directed by the IE for the work executed both by petty contractors and the contractor.
- Implement tree plantation programs (if under Contractor's scope) and conduct periodic Environmental Monitoring (air, water, noise, soil & biodiversity) Programs to ensure compliance with the statutory requirements and the EMP
- Provide key inputs in the development of the Contractors' implementation plan for all construction activities, including haulage of material to site, adhering to the requirements of the EMP and getting approval of the CSC on the same before start of works.
- Ensure that the regulatory permissions required for the construction equipment, vehicles and machinery (given in the EMP) have been obtained and are valid at all times during the execution of the project.
- Prepare / fill up the environmental and safety related compliances as per daily, weekly, fortnightly, monthly, quarterly, semi-annual checklists in the EMP
- Prepare Safety Plans, Debris & Waste disposal Plan, Emergency Response Plans, Quarry Management Plan, other environment related plans and health, safety issues including COVID-19 protocol for approval of the CSC.
- Identify locations for siting construction camps and other plants, machinery, vehicles and equipment, as well as locations for storage and disposal of wastes, both from the construction camps and from the site and obtain approval for the same from the CSC.
- Detail out site-specific environmental mitigation and enhancement measures and obtain approval of the CSC for the same
- Carry out the measurements of environmental mitigation and / or enhancement works and prepares bills for the same for approval and payment through the CSC.
- Ensure that the safety of the workers and other site users is not compromised during construction
- Ensure that adequate monitoring facilities are available for collecting samples of all discharges from the Contractor's plants, equipment and camps
- Verify the extent of environmental compliance at sites from where the Contractor is procuring the material – Borrow Area, Quarries, Crushers or even sand and suggest appropriate mitigation measures, if required

404. The environmental officer shall have an environmental, health and safety team to help him in implementing the EMP. These team members may / may not report to him / her directly but shall apprise him of all the incidents and mark a formal report of any incident having an impact on the Health, Environment and Safety issues.

405. **Safety Officer (SO):** The safety officer shall on day to day basis interact and assist the EO in implementation of the safety features mentioned in the EMP. He shall also assist the EO in the preparation & submission of safety plans.

406. **First Aider / Medical Officer (MO):** The first aider / medical officer shall interact and assist the EO in implementation of the health features mentioned in the EMP

407. **Duty Officers (DO) /Supervisors:** The Duty Officers shall on day to day basis, take the necessary mitigation measures as per the directions of the EO, SO & MO and monitor the project facilities and report to the EO on activities that adversely affect the environment in the vicinity.

408. **Plant Engineer:** The Plant Engineer has the responsibility of managing and controlling the hot mix plant, crusher unit and fleet of vehicles. He shall ensure that the environment is not degraded at his plant site. Even though the EO shall routinely monitor to detect any negative issues due to operations and bring it to the knowledge of Plant manager for taking rectification works. In case of emergency the Plant Engineer shall immediately notify the EO for necessary actions.

N. INSTITUTIONAL CAPACITY BUILDING

409. Construction industry of India is an important indicator of the development as it creates investment opportunities across various related sectors. The industry is fragmented, with a handful of major companies involved in the construction activities across all segments; medium sized companies specializing in niche activities; and small and medium contractors who work on the subcontractor basis and carry out the work in the field. In the absence of any institutional mechanism for skill formation, construction workers continue to be trained by the traditional master craftsmen. Apart from its inadequacy in quantitative terms, the traditional system neither utilizes new technologies and work methods, nor does it absorb the benefits of research and development.

410. Therefore, for successful implementation of EMP it is important to orient contractor's supervisory staff as well as key field staff towards environmental issues of highway project, implementation of mitigation measures, green construction technology and sustainable environment to safeguard natural resources and environment. The Environmental Specialist at PIU and Construction Supervision Consultant are also responsible for the implementation of the EMP, need to be trained. To ensure the success of the proposed implementation set up, there is need for training and skill up-gradation. Hence, considering the requirement, the following training program is suggested.

411. **Training Components:** The environmental training should encompass the following:

- Understanding of the relevant environmental regulations and their application to the project;
- Environmental & Social Issues in Road Project
- Road Safety and Road Safety Audit for Highway

- Mainstreaming Biodiversity in Road Transportation Projects for Promoting Smart Green Infrastructure
- Mitigation measures of noise generated from construction equipment
- Environmental Monitoring during Construction stage and Operation stage
- ISO 14001:2015 Environmental Management System

412. **Training Program:** A training program needs to be worked out incorporating the project needs as well as the intermediate-term capacity building needs of the PIU, CSC and Contractor. The program should consist of a number of training modules specific to target groups. The training would cover the basic principles and postulates of environmental assessment, mitigation plans and program implementation techniques, monitoring and management methods and tools. Looking into the potential requirements of each of the target groups, several training component has been suggested.

413. Given below is a list of Training Institutes (**Table-128**) which can be contacted for providing training in various issues related to environmental management

Table-128 List of Training Institutes

Sl. No.	Name of Training Institute
1.	Indian Academy of Highway Engineers (IAHE) (Ministry of Road Transport & Highways, Govt. of India) A-5, Institutional Area, Sector-62, NH-24 Bypass, NOIDA-201301 (UP) Telephone: 0120-2400085 - 86, 2405006 - 09, Course Coordinator: Shri. M. Riten Kumar Singh(JointDirector) Email: iahe.training@gmail.com
2.	Wildlife Institute of India Post Box # 18, Chandrabani, Dehadun 248 001 Uttarakhand Email: dwii@wii.gov.in Phone: 0135-2640910, 0135-2640114, 0135 2646102 Fax: 0135-2640117
3.	Central Road Research Institute (CRRI) P.O. CRRI, Delhi-Mathura Institute, New Delhi – 110 025 Shri. T. K. Amla, Chief Scientist, Head & Course Organizer Phone: 011 26921939 Email: tkamla.crri@nic.in
4.	**Centre for Innovations in Public Systems (CIPS)** Administrative Staff College of India, College Park Campus Road No. 3, Banjara Hills, Hyderabad – 500 034 Phone: 040 667 20720 Fax: 040 667 20721 E-mail: chakrapani@cips.org.in
5.	National Environmental Engineering Research Institute (NEERI) Nehru Marg, Nagpur – 440020, Maharashtra Phone: 0712 2249885-88; 2249970-72 URL: http://www.neeri.res.in
6.	**A.** Envirotech Instruments Pvt. Ltd. Manufacturers of Air Pollution Monitoring Instruments A-271,Okhla Industrial Area, Phase-1, New Delhi-110020 **Phones:** 011 26813887, 26814139 **Fax: 0**11 26811833

Sl. No.	Name of Training Institute
	Email: envirotech@vsnl.com
7.	Centre for Science and Environment 41, Tughlakabad Institutional Area, New Delhi-110062 Phone: 011 29955124, 29956110, 29956394, 29956399 Fax: 011 29955879 Email: cse@cseindia.org

O. ENVIRONMENTAL BUDGET

414. The budgetary provision for the implementation of the environmental management plan of the project road can be categorized in to two types and is presented below:

- Environmental Management Plan Works to be **implemented by the Contractor** under civil works contracts
- Environmental Management Plan Works to be **implemented by the PIU, PWD Manipur**

415. The project will be implemented under 3 construction packages. A capital cost provision of about **Rs. 12.83 Crore** has been kept towards implementation of environmental management plan for all construction packages. Summary of environmental budget is presented in **Table-129.**

Environmental Management Plan
Works to be implemented by the Contractor under Civil Works Contracts (Bill of Quantities)

Mitigation / Enhancement Budget

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Topography & Geology	Construction	Establishment of Construction Camp	Covered under Civil Budget			
Soil	Construction	Slope stabilization	Covered under Civil Budget			
Air	Construction	Dust suppression with sprinkling of water;	Trip	9 trips per day x 300 days in a year for 2 years = 5,400 trips	400	21,60,000
Water	Construction	Provision of water supply facilities for **3** construction camps	Month	24	30,000	7,20,000
Water	Construction	Provision for Oil Interception Chambers in construction yard near to 1) vehicle parking, fueling and washing area and 2) Hot Mix Plant	No.	2 units in a construction yard x 3 construction yards = 6	20,000	1,20,000
Water	Construction	Construction of Sedimentation Tanks in construction yard near to 1) Concrete mix plant and 2) Hot mix plant	No.	2 units in a construction yard x 3 construction yards = 6	45,000	2,70,000

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Water	Construction	Silt fencing near water bodies and areas identified by the AE/ IE	Meter	2,600	800	20,80,000
Water	Construction	Rainwater Harvesting Structure	No.	**102**		Covered under Civil Budget
Noise	Construction	Construction of **solid noise barrier** at sensitive receptors	M	1,100	9,000	99,00,000
Noise	Construction	Construction of **Acrylic noise barrier** at sensitive receptors	Sq. m	265	15,000	39,75,000
Vegetation loss	Construction	Provision of fuel in the construction camp	No.	4 commercial LPG Cylinder per month x 24 months = 96 cylinders	4,000	3,84,000
Solid Waste Management	Construction	Providing solid waste management facility in **3** construction camps	Month	24	15,000	3,60,000
Management of Construction Debris	Construction	Disposal of construction debris and other waste materials & transportation in **3** construction camps	Month	24	15,000	3,60,000
Liquid Waste Management	Construction	Installation of Packaged Wastewater Treatment Plant in **3** Construction Camps and it's maintenance for 2 years	Lump sum	03	25,50,000	76,50,000
Safety of Workers	Construction	Providing PPE to the labours during the construction	Cost/ person	300	1,000	3,00,000
Health Checkup	Construction	Provision for biannual health checkups	No.	300 persons x 4 checkups = 1,200	1,200	14,40,000
Resettlement & Rehabilitation	Construction	Compensation for structure including affected religious structures, livelihood loss, resettlement assistances & RP implementation	Covered under Project Cost			
					Total	**2,97,19,000**

Note: 1) Construction period is 24 months/ 2 years
2) Number of Construction camp = 3
basis of unit cost is the Consultant's past experience in similar projects

Environmental Monitoring Budget

Parameters	Stage	Frequency	No. of Locations	No. of Samples	Unit Cost/ Sample# (Rs.)	Total Cost (Rs.)
Ambient Air Quality	Construction	Twice in a season for 3 seasons (except monsoon)	11	132	7,000	9,24,000
	Operation	Twice in a year for 5 years (except monsoon)	5	50	7,000	3,50,000
Noise Level	Construction	4 times a year	15	120	2,000	2,40,000

Parameters	Stage	Frequency	No. of Locations	No. of Samples	Unit Cost/ Sample# (Rs.)	Total Cost (Rs.)
		(in each season)				
	Operation	Twice in a year for 5 years	7	70	2,000	1,40,000
Vibration	Construction	Twice in a year	14	56	30,000	16,80,000
	Operation	Once in in a year for 5 years	8	40	30,000	12,00,000
Ground Water Quality	Construction	4 times a year (in each season)	11	88	10,000	8,80,000
	Operation	Twice in a year for 5 years (Pre-monsoon & post-monsoon	5	50	10,000	5,00,000
Surface Water Quality	Construction	4 times a year (in each season)	7	56	10,000	5,60,000
	Operation	Twice in a year for 5 years (Pre-monsoon & post-monsoon	7	70	10,000	7,00,000
Soil Quality	Construction	Once in a year	12	24	6,000	1,44,000
	Operation	once in every year for 5 years	6	30	6,000	1,80,000
Transportation of samples to the laboratory	Construction	Immediately after sampling	-	-	Lump sum	6,00,000
	Operation	Immediately after sampling	-	-	Lump sum	10,00,000
					Grand Total	**90,98,000**

Note: 1) Construction period is 24 months/ 2 years
2) Operation period is 5 years
basis of unit cost is the Consultant's past experience in similar projects

Training & Mobilization Budget

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Training and Mobilization	Construction & Operation	Training of Environmental staff of PWD Manipur involved in the project, staff of AE / IE, Contractor, and collaborating Government agencies	Training cost per person	4 persons @ 2 trainings per year for 2 years	20,000 per person	3,20,000
Facilities and Equipment	Construction & Operation	Infrastructure facility (such as computer, printer, scanner, internet etc.) for the team at PIU who will be responsible for monitoring of the implementation of EMP	Set	2	200,000	4,00,000
					Total	**7,20,000**

basis of unit cost is the Consultant's past experience in similar projects

Environmental Management Plan
Works to be implemented by the PIU, PWD Manipur

Budget for acquisition of Forest Land & Plantation

Component	Stage	Description	Unit	Quantity	Unit Cost# (Rs.)	Total Cost (Rs.)
NPV	Pre-construction	Net Present Value of the forest land being diverted	ha	12.9746	14,36,670	1,86,40,219
CA		Raising and maintenance of Compensatory Afforestation	ha	25.9492	2,63,900	68,48,000
Tree Felling		Tree felling before start of the construction by the Forest Department	-	-	-	22,64,746
Avenue Plantation	Construction	Plantation against felling of trees in the non-forest area by the Forest Department	-	-	-	1,49,45,614
Additional mitigation measures other than legal requirement	Construction	Establishment of Biodiversity Park -1 by the DFO / Central Forest Division, Govt. of Manipur	-	-	-	88,50,000
	Construction	Establishment of Biodiversity Park -2 by the DFO / Central Forest Division, Govt. of Manipur	-	-	-	64,60,500
Fencing with wooden poles / ballies and Bamboo	Construction	Fencing on both side of the road passing through forest area - Supply and fixing wooden poles / ballies of 15 cm dia, 1.8 m high above the ground level & 1.2 m inside the ground with good quality of wood (Safeda or equivalent) at an interval of 1.5 m with 30 cm cross bracing and fixing the good quality bamboo diagonally between the ballies as directed by the engineer including painting with green color etc. complete in all respects	Rm	19,300	1,400	2,70,20,000
					Total	**8,50,29,079**

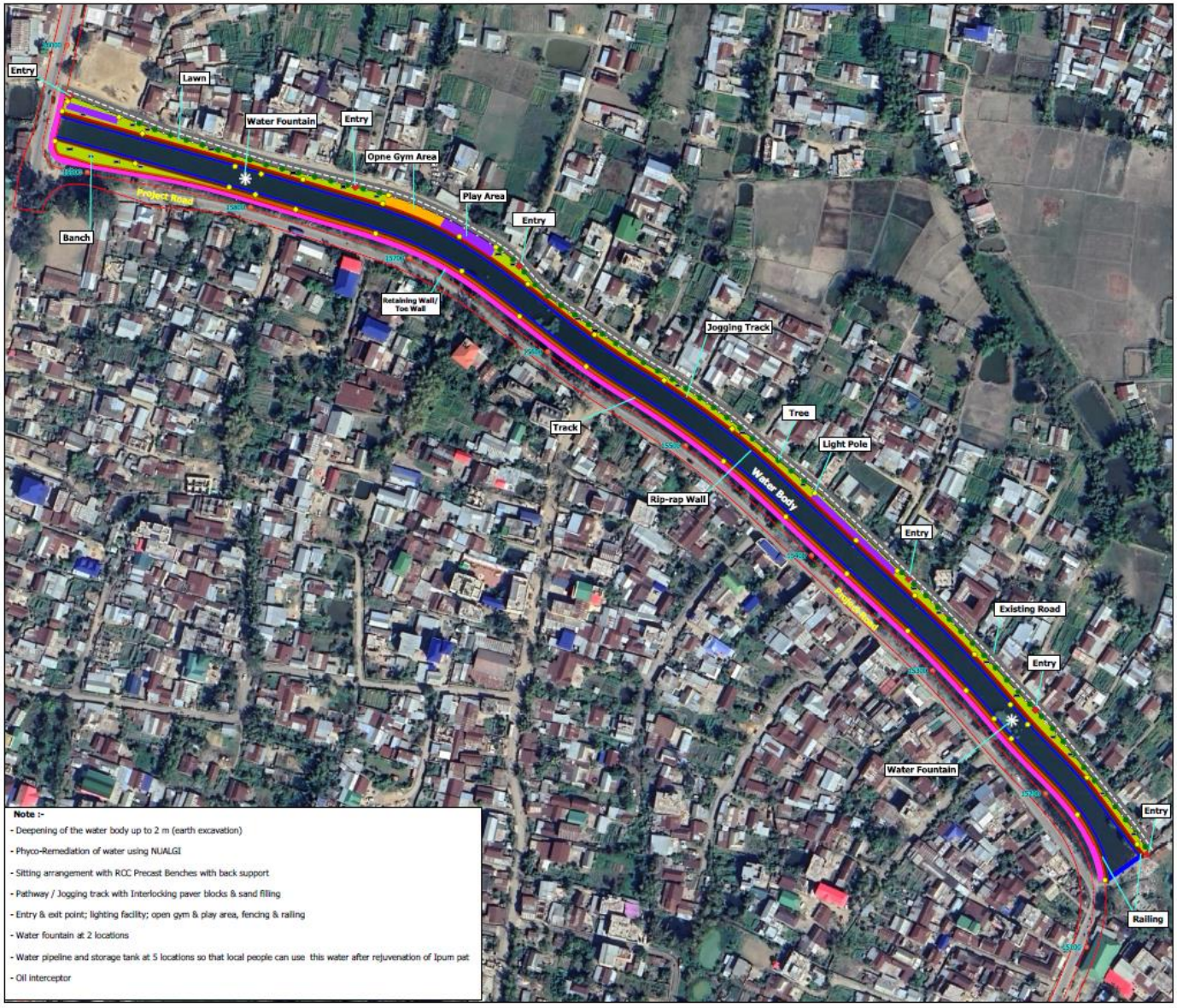
Mitigation Measures other than Good Engineering Practices

Sl. No.	Description	No. Of Village	Unit / Village	Total Unit	Unit Cost# (Rs.)	Total Cost (Rs.)
1	Community Composter in the 21 project affected villages of Package-I	41	2	82	45,000	36,90,000
2	Enhancement of water body (Ipum Pat)				Covered under	Civil Budget
					Total	**36,90,000**

#basis of unit cost is the Consultant's past experience in similar projects

Table-129 Summary of Environmental Budget

Component	Description	To be implemented by	Amount (Rs.)
1.	Mitigation / Enhancement	Contractor	2,97,19,000
2.	Environmental Monitoring		90,98,000
3.	Training & Mobilization		7,20,000
		Subtotal	***3,95,37,000***
4.	Budget for acquisition of Forest Land & Plantation	PIU, PWD Manipur	8,50,29,079
5.	Mitigation Measures other than Good engineering practices		36,90,000
		Subtotal	***8,87,19,079***
		Grand Total	**12,82,56,079**
			Rs. 12.83 Cr.



Note :-

- Deepening of the water body up to 2 m (earth excavation)
- Phyco-Remediation of water using NUALGI
- Sitting arrangement with RCC Precast Benches with back support
- Pathway / Jogging track with Interlocking paver blocks & sand filling
- Entry & exit point; lighting facility; open gym & play area, fencing & railing
- Water fountain at 2 locations
- Water pipeline and storage tank at 5 locations so that local people can use this water after rejuvenation of Ipum pat
- Oil interceptor

Waterbody Enhancement Plan

LEGEND

- Entry Exit Point
- Light Pole
- Seating Arrangement
- Fencing
- Railing
- Existing Road
- Jogging Track
- Lawn
- Opne Gym Area
- Play Area
- Reprep Wall
- Retaining Wall
- Treck
- Water Fountain
- Proposed Centerline
- Proposed RoW

S. No	Items	Area
1.	Lawn (m²)	2835
2.	Open Gym Area (m²)	200
3.	Play Area (m²)	624
4.	Entry Exit Gate (No)	16
5.	Lighting	Both Side
6.	Seating Arrangement (No)	@ 10m interval
7.	Tree Plantation (No)	63
8.	Fencing/ Railing	Both Side
9.	Jogging Track (m²)	808m x 2m
10.	Rip-rap wall	Right bank
11.	Track (m²)	800m x 3m
12.	Water Fountain (No)	2

0 50 100 m

PROJECT NAME
Preparation of Social and Environment Safguard Documents for Construction of Imphal Ring Road

CLIENT
Public Works Department
Government of Manipur

CONSULTANT
Intercontinental Consultants and Technocrates Pvt. Ltd

Drawing No: PWD/IRR/Ipump pat/01/R0

IX. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION:

416. Public Works Department (PWD), Government of Manipur has decided to take up preparation of Social and Environment Safeguard documents fulfilling ADB's Safeguard Policy Statement 2009, Legal Framework of Govt. of India and Govt. of Manipur for "Construction of Imphal Ring Road".

417. The project road encompasses a Ring Road around the capital city of Imphal to ensure quick access to the important establishments of the city, which includes administrative offices, health care, academic establishments and commercial centers. It will also reduce congestion in the city. The alignment will connect to several obligatory points. As per the revised alignment total length of Imphal Ring Road is 54.155 Km out of which proposed improvement length is 47.765 Km. Further, the length of SPUR to JNIMS / DDK is 1.570 km, SPUR to RIMS is about 0.815 Km and SPUR to FCI is about 1.080 Km. Therefore, total length of improvement including Imphal Ring Road and three SPURs is 51.230 km. Proposed RoW in general is 14 m for 2 lane section and 18.5 m for 4 lane section

418. As per ADB Safeguard Policy Statement 2009, proposed project is **"Category B"** project. The Initial Environmental Examination (IEE) Report attempts to identify potential environmental impacts associated with the construction and operational phases of the proposed road project. Apart from positive impacts road projects could also generate some adverse direct and indirect environmental impacts. Direct environmental impacts are usually due to construction activities, while indirect environmental impacts are usually related to the operation of improved roads.

419. As per EIA Notification 2006 and it's subsequent amendments, **Environment Clearance is not required** for the Imphal Ring Road.

420. The proposed project involves diversion of **12.9746 ha** forest land. Hence, Forest Clearance **is required**.

421. The alignment of proposed Imphal Ring Road does not pass through any protected areas and is not located within 10 km radius of any protected area. Hence, **Wildlife Clearance** is **not required.**

422. Interaction matrix method (based on matrix developed by Leopold et. al.) has been used for evaluation of impacts. Total score of evaluation matrix is **-319** which implies that the proposed project will have **appreciable but reversible adverse impact** and mitigation measures are needed.

423. The identified **Residual Impacts during the Construction Phase** include:

- Drainage & Hydrological Flow: To minimize the impact 3 major bridges, 6 minor bridges and 221 culverts are proposed to be constructed along the project road. All bridges have been designed for a return period of 100 years and culverts have been designed for a return period of 50 years. It has been ensured that all the 1st and 2nd order streams crossing the project road alignment provided with culverts and bridges with capacity of 20% excess discharge. Further, the fully affected ponds shall be compensated by digging of new ponds in the vicinity as a part of community pool

resources and depth of partially affected ponds will be increased to maintain the existing volume of water. Residual impacts will be **LOW.**

- Flora: There are 4,970 trees within the proposed RoW (2,704 trees in the non-forest land and 2,266 trees in the forest land). To compensate the loss of trees in non-forest land, **18,274 trees will be planted**. Overall Compensatory Plantation is **1:3.7**. Apart from that Biodiversity Park has been proposed at two locations. Residual impacts will be **MODERATE.**

- Diversion of Forest Land: The Proposed project involves diversion of 12.9746 ha forest land, which is 14.4% of the total land acquisition. To minimize impact, **compensatory afforestation will be carried out in 25.949 ha area** by the Forest Department. Residual impacts will be **MODERATE**.

- Habitat: The clearing of land and felling of trees will cause loss of habitat to avifauna dwelling in the area. The Central Forest Division, Imphal has confirmed that, **there is no natural habitat / modified habitat / critical habitat in the forest land proposed for diversion.** There is no Protected Area within 10 km radius of the project road. The proposed alignment does not cross any wildlife migration corridor as well as there is **no elephant corridor, wildlife migration corridor etc. within 1 Km. from boundary of the forest land proposed for diversion.** The restoration and re-planting programs should go a long way to mitigating these impacts, however in the short term residual impacts will be **MODERATE**.

- Protected Areas: There is no Protected Areas within 10 km radius of the project road. **NO** Residual Impacts
- Land Acquisition: No residual impacts are anticipated if the LARP is implemented correctly. However, there will still be disruption to the local community during the LARP implementation process. A GRM has been prepared to manage complaints received during this process. Residual impacts will be **LOW / MODERATE**.
- Land Use: There will be permanent change in the land use pattern within the proposed right of way. Residual impacts will be **MAJOR.**
- Air Quality: There will be short term reversible impact. Comprehensive mitigation measures have been set to manage deterioration of air quality. Residual impacts will be **LOW.**
- Noise: Comprehensive mitigation measures have been set to manage construction noise. However, there may still be instances where construction works may result in unanticipated elevated levels of noise. However, these will only be temporary and localized. Good oversight from the Contractors EHS team and supervision by the Environmental Specialist of AE / IE should limit the impact. Residual impacts will be **LOW.**
- Waste Management: In general, if the mitigation measures suggested are implemented residual impacts will be **LOW**.

424. The identified **residual impacts during the Operation Phase** include:

- Drainage & Hydrological Flow: The effective waterway of the rivers is more than the width of flow; hence, no obstruction of the water flow is anticipated during operation phase. **NO** Residual Impacts.

- Air Quality: Air quality in the surrounding of the Imphal Ring Road will be monitored and additional measures will be taken in case the air quality deteriorates to unacceptable levels. Residual impacts will be **LOW.**
- Noise: Effective traffic management, maintenance of good riding conditions, speed limitation, honking restrictions near sensitive receptors and noise monitoring will minimize the impact. In case modelling has shown that the increase in noise levels at sensitive receptors during the operation stage is expected to be more than 3 dB(A), the project will install physical noise barriers. Residual impacts will be **MODERATE.**
- Greenhouse Gases: Residual impacts from the generation of GHGs will remain throughout the lifecycle of the Project. This is an unavoidable consequence of the project, but the growth of the electric car market and more fuel efficient cars may in the future lead to a decrease in the emissions generated on the Project road. Residual impacts will be **MODERATE**.
- Road Safety: Advanced directions signs & traffic control signaling system as per ASTM standards; pavement markings; highway lightings including high masts at intersections; traffic calming system on all sides to regulate the speed of the vehicular traffic etc. have been adopted in the road design as per IRC Guidelines. A Road Safety Audit will be carried out by an independent agency during construction stage and just after completion of project before open to traffic to verify that all designed safety measures are in place. Due to these safety aspects included in the road design a **POSITIVE** residual impact can be expected.

425. Environmental Management Plan

- The project will be implemented under 3 construction packages. A capital cost provision of about **Rs. 12.83 Crore** has been kept towards implementation of environmental management plan for all construction packages

B. RECOMMENDATIONS

426. Most of the adverse impacts of road project during construction period are temporary in nature. These impacts can be minimized through specific engineering solutions. Environment friendly construction methodology has been incorporated into the project design and Environment Management Plan has been prepared to minimize the overall impact on environmental attributes by the proposed project works. Therefore, it is unlikely to cause any significant adverse environmental impacts and no further detailed study is required.

427. The EMP, its mitigation and monitoring programs, contained herewith will be included within the bidding documents for project works for all project components. The bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own site specific EMP (SEMP) which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the Contractors camp locations. This ensures that all potential bidders are aware of the environmental requirements of the project and its associated environmental costs.

428. The EMP and all its requirements will then be added to the Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. The Contractor will then prepare his SEMP which will be approved and monitored by the Environmental Specialist of AE / IE. Any non-conformance with the SEMP (and the EMP) the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SEMP the

Contractor must employ an Environmental Officer to monitor and report Project activities throughout the Project Construction phase.