

Initial Environmental Examination

January 2017

IND: Karnataka State Highways Improvement Project III

Chintamani to Andhra Pradesh Border

CURRENCY EQUIVALENTS

(as on 17 January 2017)

Currency Unit	=	Indian Rupee (INR)
INR 1.00	=	\$ 0.0147
\$ 1.00	=	INR 67.869

ABBREVIATIONS

AADT	:	Annual Average Daily Traffic
ADB	:	Asian Development Bank
ADT	:	Average Daily Traffic
AE	:	Assistant Engineer
AEE	:	Assistant Environmental Engineer
AIDS	:	Acquired Immune Deficiency Syndrome
AM	:	Arithmetic Mean
AP	:	Affected Person
AQ	:	Air Quality
ARAI	:	The Automotive Research Association of India
ASI	:	Archeological Survey of India
BAU	:	Business-As-Usual
BCCI-K	:	Bangalore Climate Change Initiative – Karnataka
BDL	:	Below Detection Limit
BOD	:	Biological Oxygen Demand
BPL	:	Below Poverty Line
C/L	:	Centre line
Ca	:	Calcium
CALINE 4	:	California Line Source Dispersion Model Version 4
CBR	:	California Bearing Ratio
CD	:	Cross Drainage
CEF	:	Composite Emission Factor
CEW	:	Corridor East-West
CGWA	:	Central Ground Water Authority
CGWB	:	Central Ground Water Board
Cl	:	Chlorine
CO	:	Carbon Monoxide
CoI	:	Corridor of Impact
CPCB	:	Central Pollution Control Board
CPO	:	Chief project Officer
CPR	:	Common Property Resources
CRN	:	Core Road Network
CRTN	:	Calculation of Road Traffic Noise
CSC	:	Construction Supervision Consultant
Cu	:	Copper
CWC	:	Central Water Commission
dB	:	Decibel
DC	:	District Collector
DFO	:	Divisional Forest Officer
DGRC	:	District Grievance Redress Committee
DLRO	:	District Land Revenue Officer
DO	:	Dissolved Oxygen

DO	:	Duty Officer
DPR	:	Detailed Project Report
EA	:	Executing Agency
EAC	:	Expert Appraisal Committee
EC	:	Electrical Conductivity
EHS	:	Environment Health and Safety
EIA	:	Environmental Impact Assessment
EMP	:	Environment Management Plan
EO	:	Environmental Officer
EPA	:	Engineering Procurement Annuity
EPA	:	Environment (Protection) Act
EPC	:	Engineering Procurement Construction
ES	:	Environmental Specialist
Fe	:	Iron
GHGs	:	Greenhouse Gases
GIS	:	Geographical Information System
GoI	:	Government of India
GoK	:	Government of Karnataka
GRC	:	Grievance Redressal Cell
GRM	:	Grievance Redress Mechanism
GW	:	Ground Water
HDPE	:	High Density Polyethylene
HFL	:	High Flood Level
Hg	:	Mercury
HIV	:	Human Immunodeficiency Virus
HS	:	Homogeneous Section
ICAP	:	Indian Clean Air Program
ICB	:	International Competitive Bidding
IE	:	Independent Engineer
IEE	:	Initial Environmental Examination
IMD	:	India Meteorological Department
IRC	:	Indian Road Congress
IS	:	Indian standards
IUCN	:	International Union for Conservation of Nature
IVI	:	Important Value Index
KPWD	:	Karnataka Public Works Department
KRDCL	:	Karnataka Road Development Corporation Limited
KSAPCC	:	Karnataka State Action Plan on Climate Change
KSHIP	:	Karnataka State Highways Improvement Project
LA	:	Land Acquisition
LAP	:	Land Acquisition Plan
LAQ	:	Land Acquisition Officer
LHS	:	Left Hand Side
LPG	:	Liquid Petroleum Gas
Mg	:	Magnesium
MI	:	Monitoring Indicators
Mn	:	Manganese
MO	:	Medical Officer
MOEF&CC	:	Ministry of Environment, Forest and Climate Change
MoRT&H	:	Ministry of Road Transport and Highways
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
NO ₂	:	Nitrogen Dioxide
NOC	:	No Objection Certificate
NPV	:	Net Present Value
NQ	:	Noise Quality
NTU	:	Nephelometric Turbidity Unit
OBC	:	Other Backward Caste
ODR	:	Other District Road
PAF	:	Project Affected Family
PAH	:	Project Affected Households
PAP	:	Project Affected Persons
Pb	:	Lead
PBDPS	:	Performance based Deferred Payment System
PCC	:	Plain Cement Concrete
PCM	:	Public Consultation Meeting
PCU	:	Passenger Car Unit
PD	:	Project District
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
PPTA	:	Project Preparatory Technical Assistance
PRC	:	Public Response Centre
PT	:	Performance Target
PTV	:	Percent Time Violations
PUC	:	Pollution under Control
RAP	:	Reclaimed Asphalt Pavement
RCC	:	Roller-compacted concrete
REA	:	Rapid Environmental Assessment
Rev	:	Revision
RHS	:	Right Hand Side
ROB	:	Rail Over Bridge
RoW	:	Right of Way
RUB	:	Road Under Bridge
SAR	:	Sodium Absorption Ratio
SC	:	Schedule Caste
SD	:	Standard deviation
SDO	:	Social Development Officer
SEAC	:	State Level Expert Appraisal Committee
SH	:	State Highway
SIA	:	Social Impact Assessment
SO	:	Safety Officer

SO ₂	:	Sulphur Dioxide
SPCB	:	State Pollution Control Board
SPL	:	Sound Pressure Level
ST	:	Schedule Tribes
SW	:	Surface Water
TCS	:	Typical Cross Section
TDS	:	Total Dissolved Solids
TEEMP	:	The Transport Emissions Evaluation Model for Projects
USEPA	:	United States Environmental Protection Agency
VDF	:	Vehicle Damage Factor
VEC	:	Valued Environment Component
WHH	:	Women-headed Households
WLPA	:	Wild Life Protection Act
WMM	:	Wet-Mix Macadam

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 meters
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
MW	-	Megawatt
PM2.5/ 10	-	Particulate Matter of 2.5 Micron or 10 Micron Size
Sqm.	-	Square Meter

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EXECUTIVE SUMMARY

A. Introduction

1. The Government of Karnataka through the Government of India has received in principal approval for a loan from the Asian Development Bank (ADB) towards Karnataka State Highways Improvement Project –III (KSHIP-III) for developing State Road network adopting innovative financial models under Public Private Partnership (PPP). A pre financial feasibility has been conducted by PIU KSHIP on a Core Road Network of 4,403 km out of which 1,350 km has been selected for Detailed Project Preparation and Implementation under KSHIP-III.

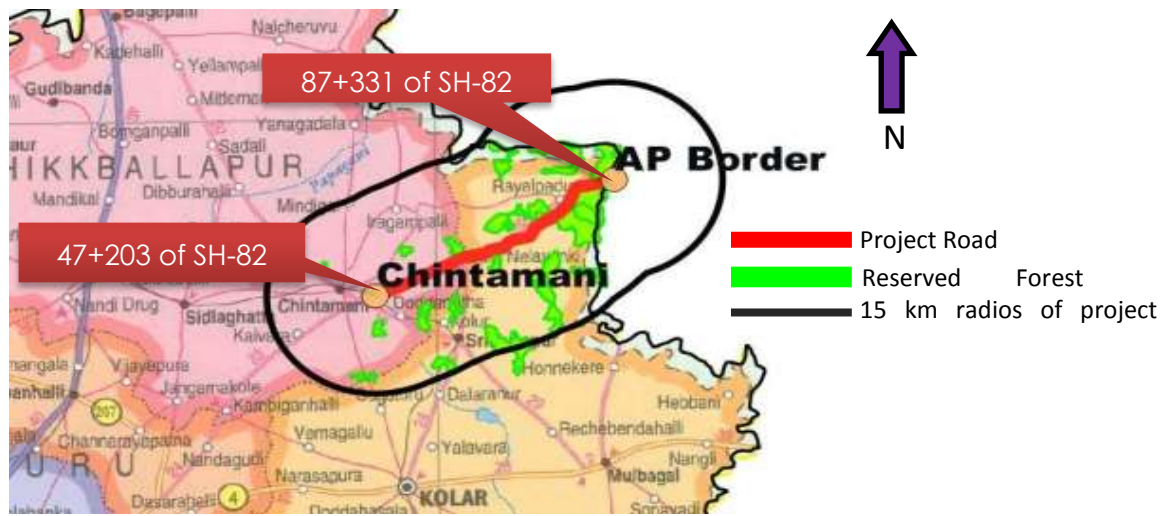
2. In pursuance of the above, Intercontinental Consultants and Technocrats Pvt. Ltd. have been appointed as Consultants by KSHIP to carry out the Preparation of Detailed Project Report and provide Transaction Advisory Services for Karnataka State Highway Improvement Project-III Group II roads in the State of Karnataka to two/four lane with Paved Shoulder Configuration”.

1. Objectives of the IEE

3. Following 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.

B. Description of the Project



Source: Political Map

4. The Project road starts from the junction of NH-234 near Chintamani (Km 47+203 of SH-82) in Chikkabalapura district and ends at Border of Andhra Pradesh at Km 87+331 of SH-82 in Kolar District of Karnataka. The length of the project road is **39.774 Km**.

2. Project Highlights

Table 1: Salient Existing Features of the Project Road

Road stretch	Chintamani to Andhra Pradesh Border (SH-82)
Road length	39.774 km
Start point	Junction of NH 234 near Chintamani at Ch. Km 47+203 of SH-82
End point	Andhra Pradesh Border at Ch. Km 87+331 of SH-82
Districts en-route	Chikkabalapura & Kolar
Important settlements / villages	Chintamani, Seegalpalya, Thadigol Cross, Nelavanki, Manchineelkote, Royalpad
Existing carriageway	Majority has two-lane carriageway with width 7.0 m. A small section of 215 m is 4 lane
Terrain	Predominately plain except small section of project road traverse through rolling terrain.
Existing ROW	In urban / built up area - 17.5 m to 25 m In rural / open country area - 21 m to 50 m
Land Use	Mainly agricultural followed by forest, orchard plantation and built-up area
Minor Bridges	5 (all existing)
Major Bridges	Nil
Culverts	71 existing culverts (56 Hume Pipe and 15 Slab culverts)
RUB	01 (A Railway line of Southern Railways crosses the project road at Km 48+769)
Flyover	Nil
Road Intersections:	4 major and 39 minor road crossing

3. Classified Traffic Volume Counts

5. Based on the traffic surveys conducted by iDeCK during the pre-feasibility study, the project road has been divided into two homogeneous (HS) traffic sections. Homogeneous section wise Annual Average Daily Traffic is presented in **Table 2**.

Table 2: Homogeneous Sections of Traffic on Project Highway

Sl. No.	Homogeneous Section (HS)	Existing Chainage (km)		Design Chainage (Km)		Length (km)	Traffic Volume AADT (PCU)
		From	To	From	To		2015
1	HS- I	47+203	63+626	47+203	63+600	16.367	8,633
2	HS- II	63+626	87+331	63+600	86+977	23.377	6,281

Source: Survey conducted by iDeCK & ICT

6. It is observed from the above table that AADT at homogeneous section I (HS-I) is 8,633 PCUs which is estimated from traffic volume count conducted by iDeCK, projected till 2015. The traffic for the homogeneous section II (HS-II) of the project road is 6,281 PCUs which has been counted at km. 69+077 by ICT in 2015.

4. Traffic Forecast

7. Homogenous Section-I would be required to be improved to two-lane with paved shoulder from 2015 itself, and would require further improvement to four lane, when the traffic will cross the threshold value of 18,000 PCUs/day in the year 2026.

8. Homogenous Section-II would be required to be improved to two-Lane with paved shoulder from the beginning i.e. opening year 2020. The homogenous section II would require to be widened to 4 lane configurations from the year 2032 onwards, when the traffic would cross the threshold value of 18,000 PCUs/day.

5. Improvement Proposal

Table 3: Summary of Improvement Proposal

Proposed RoW	<ul style="list-style-type: none"> ▪ In urban / built up area: varies from 16 m to 20 m ▪ In rural / open country area: varies from 26 m to 36 m depending on the height of embankment 																							
Widening Scheme	<p>2-lane with paved shoulder configuration except in the built up sections en-route, 600 m length of 4-lane divided carriageway with raised median has been proposed at two locations due to safety issue.</p> <ul style="list-style-type: none"> ▪ Concentric Widening : 36.159 km ▪ Curve Improvement : 2.640 km ▪ Realignment : 0.975 km 																							
Bypass	No bypass proposed																							
Realignment	<p>At two locations:</p> <table border="1"> <thead> <tr> <th rowspan="2">Name of Village</th> <th colspan="2">Existing Ch. Km</th> <th colspan="3">Design Chainage</th> </tr> <tr> <th>Start</th> <th>End</th> <th>Start</th> <th>End</th> <th>Length</th> </tr> </thead> <tbody> <tr> <td>Tadgol Crossing</td> <td>63+500</td> <td>64+200</td> <td>63+470</td> <td>64+045</td> <td>0.575 km</td> </tr> <tr> <td>Thopalli</td> <td>75+130</td> <td>75+600</td> <td>74+900</td> <td>75+300</td> <td>0.400 km</td> </tr> </tbody> </table>	Name of Village	Existing Ch. Km		Design Chainage			Start	End	Start	End	Length	Tadgol Crossing	63+500	64+200	63+470	64+045	0.575 km	Thopalli	75+130	75+600	74+900	75+300	0.400 km
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Tadgol Crossing	63+500	64+200	63+470	64+045	0.575 km																			
Thopalli	75+130	75+600	74+900	75+300	0.400 km																			
Bridge	There are a total of 5 bridges on the project road. Out of these 1 bridge has been replaced due to realignment or hydrological consideration, 1 bridge has been retained and 3 bridges have been proposed to be widened																							
RUB	Existing RUB will be retained after minor repair																							
Culverts	44 Hume Pipe, 27 RCC Box and 2 Slab culverts will remain across the project highway. In addition to these 46 Hume Pipe culverts are proposed for cross drainage at road junctions																							
Pedestrian Subway	2 nos. pedestrian subways have been proposed near school																							
Road Side Drains	<ul style="list-style-type: none"> ▪ Roadside drains shall be provided on both sides of the embankment 																							

	<ul style="list-style-type: none"> ▪ In plain section trapezoidal drain sections have been proposed on both sides. ▪ In urban sections, lined drains with footpath have been proposed
Bus Bays	40 bus bays at 20 locations
Truck Lay Bys	Truck lay bye on both sides of the project road have been proposed at km 65+760 (Left) and Km 65+930 (right) near the proposed toll plaza area
Toll Plaza	One toll plaza has been proposed at Km 60+100. However as decided during consultation with the client, construction of toll plaza will not be taken up immediately & only provision of land for the toll plaza has been made
Design Speed	100 Km per hour in open areas as ruling design speed and 80 km per hour as minimum design speed. In built-up areas, the design speed achieved is 50 km per hour.
Road Safety Devices	<ul style="list-style-type: none"> ▪ Road Markings ▪ Road Signs ▪ Roadside Safety Barriers ▪ Pavement Marking and Lighting
Project Cost	Civil Cost : Rs. 166.89 Crore EMP Cost : Rs. 4.1 Crore

C. Policy, Legal and Administrative Framework

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

10. **Environment Clearance:** The proposed project is the strengthening & widening of existing State Highway. Project road is passing through plain & rolling terrain (below 1,000 m MSL) and is not passing through any ecologically sensitive area. Therefore, **Environmental Clearance is not required from Government of India for improvement of SH-82 from Chintamani to Andhra Pradesh Border (39.774 Km) in the State of Karnataka.**

11. A summary of various statutory clearances required for the project road is presented in **Table.4.**

Table 4: Statutory Clearances required for the Project Road

Type of Clearance	Name of the Authority	When Required
Forest Clearance	Department of Forest, GoK	Before Construction
Tree Felling Permission	Department of Forest, GoK	Before Construction

12. 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 5** for operating his equipment and carrying out construction work.

Table 5: 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	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ Central Ground Water Authority ▪ State Ground Water Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Ground Water Rules, 2002
4.	Permission for extraction of sand from river bed	<ul style="list-style-type: none"> ▪ Department of Mines & Geology, Government of Karnataka 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986
5.	Permission for extraction of sand from river bed	<ul style="list-style-type: none"> ▪ District Level Environment Impact Assessment Authority (DEIAA) 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986
6.	New Quarry and its operation	<ul style="list-style-type: none"> ▪ Department of Mines & Geology, Government of Karnataka ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Karnataka Minor Mineral Concession Rules, 1994 ▪ The Mines Act, 1952 ▪ Mines and Minerals (Development and Regulation) Amendment Act, 2015 ▪ The Explosive Act, 1984 ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Water (Prevention and Control of Pollution) Act, 1974
7.	Opening of New Borrow Areas / Quarry	<ul style="list-style-type: none"> ▪ MoEF&CC / SEIAA / DEIAA ▪ Karnataka State Pollution Control Board ▪ District Collector 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Minor Mineral and Concession Rules, 2015
8.	Location and layout of workers camp, & equipment and storage yards	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986; ▪ Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989
9.	Discharges from labour camp	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Water (Prevention and Control of Pollution) Act, 1974
10.	Storage, handling and transport of hazardous materials	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016 ▪ Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989
11.	Disposal of Bituminous Wastes	<ul style="list-style-type: none"> ▪ Intimate local civic body to use local solid waste disposal site 	<ul style="list-style-type: none"> ▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
12.	PUC Certificate for all construction vehicles and all machineries	Transport Department of Govt. of Karnataka	<ul style="list-style-type: none"> ▪ The Motor Vehicle Act 1988 ▪ The Motor Vehicles (Amendment) Bill, 2015 ▪ The Central Motor Vehicles Rules, 1989
13.	Installation of DG Set (Consent to Establish)	Karnataka State Pollution Control Board	<ul style="list-style-type: none"> ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
14.	Operation of DG Set (Consent to Operate)		
15.	Engagement of Labour - Labour License	Labour Commissioner (Ministry of Labour and Employment)	<ul style="list-style-type: none"> ▪ 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
16.	Engagement of Labour - Social Security - Labour Welfare - Wages	Labour Commissioner (Ministry of Labour and Employment)	<ul style="list-style-type: none"> ▪ 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

13. 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 local Panchayat / Municipal body for setting up Construction Camp
 - Change of Land Use Certificate from District Land Revenue Officer (DLRO)

D. Description of the Environment

14. The existing environmental conditions of the study area covering an area spread over 15 km on either side of the road, in general and specific environmental features of the study corridor, i.e., 50 m on either side of the existing centerline of the road, in particular, has been studied as described in the subsequent sections.

1. Seismicity

15. The project area is located in the southern India which is moderately active seismic region. The project road is situated in the Zone II (having low seismic intensity) of the Seismic Map of India (as per IS: 1893, Part I, 2002) and therefore has a low risk of potential damage due to earthquake.

2. Land Use

16. The land use pattern in most of the stretch along the project road is agricultural land (67%) followed by forest area (25%) and built-up (8%).

3. Soil Quality

17. Two (2) sampling locations within the study area were selected for studying soil characteristics. It has been observed that the texture of soil is silt loam with 34-38% sand content and 52-55% clay content. The pH of the soils ranged between 7.54 to 7.62 indicating slightly alkaline soil. The organic matter was observed to sufficient and varying in the range of 1.44% to 3.59%. The sodium absorption ratio is low (0.39 to 0.49%), while the nitrogen content of the soil is sufficient. Thus, it can be inferred that the overall fertility status of the soils within the study area is good.

4. Climate & Meteorology

18. In the study area has a tropical climate with hot summer, high rainfall and mild winter. The months of November and December are generally dry and cool. The month of April is the hottest with mean daily maximum temperature being above 35°C. However, extreme temperatures have been recorded up to 39°C. With the onset of monsoon there is a slight drop in the temperature. Lowest night temperatures in the cold seasons has been recorded to be dropped up to 8.5°C, while the mean minimum temperature remains around 15°C in winter. Humidity is high (82%) during monsoon season. Visibility in winter months remains clear and mist rarely leads to foggy conditions.

19. Past meteorological data of nearest IMD Observatory at Arogyavaram, located at 12 km areal distance near the end of the project road, is presented below for the period of 1951-1980 to establish the baseline climatic conditions of the area.

Table 6: Summary of Climatological Data (Based on IMD Records of 1951-80)

Parameter	IST	Monthly Range	Annual Mean/Total
Mean Daily Maximum Temperature (°C)		25.7 (Dec) – 35.2 (April)	30.4
Mean Daily Minimum Temperature (°C)		14.9 (Dec) – 23.4 (May)	19.7
Relative Humidity (%)	0830	60 (Mar) - 82 (Dec)	71
	1730	29 (Mar) – 67 (Nov)	50
Total Rainfall (mm)		5.4 (Jan) – 148.6 (Oct)	755.4
Wind Speed (km/h)		6.9 (Nov) – 18.8 (Jul)	8.7
Cloud Cover (all cloud oktas)	0830	1.8 (Mar) – 6.5 (Jul)	4.4
	1730	2.5 (Mar) – 7.0 (Jul)	5.1

Source: Climatological Data of Arogyavaram (Station 43271), Indian Meteorological Department

20. An automatic weather station was established at Thadigal Cross for collection of meteorological data from 8th December 2015 to 6th January 2016. Meteorological data of the study area is summarized below:

Table 7: Summary of Meteorological Data of the Study Area

Parameters	Dec 2015 to January 2016
Maximum Temperature (°C)	34.2

Parameters	Dec 2015 to January 2016
Minimum Temperature (°C)	11.6
Maximum Relative Humidity (%)	97.3
Total Rainfall (mm)	3.6
Average Wind Speed (m/sec)	1.96
Calm condition	19.8%
Predominant wind direction (blowing from)	North West
Dry hours (%)	99.5%

5. Ambient Air Quality

21. For drawing up the baseline status of ambient air quality in the study corridor, ambient air quality monitoring has been conducted at 2 representative locations along the project road (**Table 8**) at a frequency of twice a week at each station for one month. 24-hourly monitoring results of PM_{2.5}, PM₁₀, SO₂, NO₂ and 1-hourly CO corresponding to air quality stations AQ1 and AQ2 are presented in **Table 9**. The 24-hourly average 98-percentile values of all parameters at both the locations were observed to be within the prescribed limit for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards, 2009.

Table 8: Details of Ambient Air Quality Monitoring Stations

SN	Station	Place	Existing Chainage	Side	Distance# (m)	Land use
1	AQ1	Thadigal Cross	62+300	RHS	55	Residential area
2	AQ2	Manchineela Kotte	73+300	RHS	70	Residential & agriculture

Distance in meter from existing centerline

Table 9: Statistical Analysis of Ambient Air Quality along the Project Road

Pollutant	AAQMS	Location	Mes	Min	Max	SD	p98	PTV ^{IND}	PTV ^{WB}	Indian Standard
PM _{2.5} (µg/m ³)	AQ1	Thadigal Cross	8	10.00	15.00	1.41	14.86	0	0	60
	AQ2	Manchineela Kotte	8	28.00	40.00	3.93	39.72	0	0	
	Overall 2 Locations		16	10.00	40.00	10.97	39.40	0	0	
PM ₁₀ (µg/m ³)	AQ1	Thadigal Cross	8	40.00	60.00	5.99	59.44	0	0	100
	AQ2	Manchineela Kotte	8	56.00	68.00	3.71	67.72	0	0	
	Overall 2 Locations		16	40.00	68.00	7.19	67.40	0	0	
SO ₂ (µg/m ³)	AQ1	Thadigal Cross	8	8.20	12.60	1.47	12.42	0	0	80
	AQ2	Manchineela Kotte	8	10.20	16.20	1.88	16.06	0	0	
	Overall 2 Locations		16	8.20	16.20	2.27	15.90	0	0	
NO ₂ (µg/m ³)	AQ1	Thadigal Cross	8	22.00	32.00	3.03	31.72	0	0	80
	AQ2	Manchineela Kotte	8	20.00	32.00	3.87	31.72	0	0	
	Overall 2 Locations		16	20.00	32.00	3.59	32.00	0	0	
CO (mg/m ³)	AQ1	Thadigal Cross	8	0.30	0.43	0.04	0.43	0	0	4
	AQ2	Manchineela Kotte	8	0.24	0.33	0.03	0.33	0	0	
	Overall 2 Locations		16	0.24	0.43	0.05	0.42	0	0	

Source: On-site Field Monitoring during Dec15 – Jan 15

AAQMS: Ambient Air Quality Monitoring Station Code, Mes: Number of Measurements, AM: Arithmetic Mean, SD: Standard Deviation, p98: 98-Percentile Value, PTV: Percent time violation with respect to the standard

6. Ambient Noise Level

22. To assess the background noise levels, ambient noise monitoring was conducted at four locations, two in residential areas and other two at silence zone (**Table 10**).

Table 10: Details of Noise Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Area category
1	NQ1	Thadigal Cross	62+350	RHS	55	Residential
2	NQ2	Manchineela Kotte	73+300	LHS	70	Residential
3	NQ3	Bhagwan Buddha High School, Kamlavarpalli	63+430	LHS	27	Silence
4	NQ4	Govt Higher Primary School, Thopalli	74+500	LHS	16	Silence

Source: On-site Noise Monitoring during December 2015 & March 2016

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)

23. The day (L_{deq}) and night (L_{neq}) noise equivalent levels in the monitored residential locations, i.e., NQ1-Thadigal Cross and NQ2- Manchineela Kotte show that the ambient noise levels are within but very close to the stipulated Noise standards.

24. Maximum noise level observed in residential areas in day time is 68.2 dB(A) and 57.6 dB(A) for monitoring stations of NQ1 and NQ2 respectively.

25. Day time measurement was carried out at sensitive receptors and L_{d10} values are found to be 52.6 dB(A) and 58.9 dB(A) respectively, which signifies that measured noise levels exceeded these values in only 10% of the time of measurement duration.

7. Surface and Ground Water Quality

26. 2 surface water (ponds) and 2 ground water quality monitoring stations (hand-pumps) in the study corridor were selected for the purpose of monitoring, analysis and assessment of water quality (**Table 11**)

Table 11: Details of Surface and Ground Water Quality Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Usage
Surface Water						
1	SW1	Pond, K. Shettihalli	65+100	RHS	55.5	Irrigation & Domestic
2	SW2	Pond, Mandyala	78+600	LHS	137	Irrigation
Ground Water						
1	GW1	Thadigal Cross	65+100	RHS	65	Drinking & Domestic
2	GW2	Manchineela Kotte	73+250	LHS	95	Drinking & Domestic

Distance in meter from existing centerline

Source: On-site Water Quality Monitoring in December 2015

27. Surface water quality results shows the surface waters in the study area are devoid of any extraneous chemical contamination; there is no toxic or organic constituents are not detected in samples. However, have high coliform count, high BOD levels and low dissolved oxygen indicates discharge of fecal matters and agricultural runoff in the water.

28. Ground water, in general, is hard in nature and the physico-chemical quality satisfies the permissible limit as stipulated in Drinking Water Standards (IS 10500:2012).

8. Ecology and Biodiversity

29. Biodiversity survey was conducted in the month of December, 2015 to study the flora and fauna of the project area. Before conducting the assessment work reconnaissance survey of the entire road stretch was made and sampling was done in each vegetation type. In all five sample plots of 100 m x 10 m were laid for the purpose of biodiversity assessment. The first sample plot was laid near the starting point, second plot in the mid-section of the road and remaining three plots were laid in the forest area. The plots were laid on either side of the road. The GPS co-ordinates and altitude were recorded for each of the sample plots and presented in **Table E.12**.

Table 12: GPS Co-ordinates and Altitude of the Sample Plots

Sample Plots	Latitude	Longitude	Altitude (m)	Vegetation Type & Location
1	13° 23' 22.4"	78° 06' 19"	839	Shrubby vegetation – near start point of the Project Road
2	13° 28' 31.7"	78° 17' 36.9"	824	Part of the plot is low land – mid section of the Project Road
3	13° 30' 14.7"	78° 20' 0.5"	841	Plantation (Part of the plot is low land) – Forest Area
4	13° 32' 4.0"	78° 22' 14.2"	844	Plantation (Shrubby vegetation) – Forest Area
5	13° 31' 38"	78° 20' 38.9"	821	Plantation (Shrubby vegetation) – Forest Area

Source: Biodiversity Study conducted by ICT Pvt. Ltd. in December 2015

30. **80 floral species** were identified, out of which, 30 were tree species, 29 shrubs and 21 herb species. In the present assessment, the Shannon's diversity index for tree species was 3.02, for shrubs 2.97 and for herbs 2.89 for the overall project road irrespective of sample plots. Shannon's diversity index values obtained for different sites was found to be moderate to low when compared to reported values of 3.6 to 5.4 for tropical forests (*Knight, 1975*) and is nearer to the range (2.557 to 3.375) reported for Permanent Preservation Plots at Western Ghats of Karnataka (*Karthik, 2009*) and 2.31 to 3.30 for the Western Ghats of Southern Karnataka (*Sarkar et al., 2011*).

31. **58 faunal species** were identified in the project area during field survey out of which 26 are avian species, 26 insects, 3 (three) mammals, 2 (two) reptiles and 1(one) amphibian species. None of the species found in the project area fall under the threatened category as per IUCN. All the evaluated species are in Least Concern Category.

32. **Protected Areas:** The project road does not traverse through any National Park, Wildlife Sanctuary or Biosphere Reserve. Rayalpadu Reserve Forest, Addagallunelavanki Reserve Forest and Attikunte Mallampalli Reserve Forest are located within 10 Km radius of the road.

33. As per the ADB's SPS 2009, Natural Habitats are the land and water areas where the biological communities are formed largely by native plant and animal species and where human activity has not essentially modified the area's primary ecological functions. The forest areas along the project road have large number of indigenous species, which justifies it to be classified as natural habitats.

34. **Royalpadu Reserve Forest:** The road is passing through Royalpadu Reserve Forest in both sides for **3.977 km** and in one side (RHS) for a length of **7.5 km**. Total length of the forest along the project road is 11.477 km. The Forests of the area fall under dry-deciduous and tropical thorn and scrub type.

9. Educational, Medical and Religious Properties

35. The number of roadside educational, medical and religious properties is summarized in **Table 13**. The project road has no site of archaeological, historical and national importance in its vicinity.

Table 13: Roadside Educational, Medical and Religious properties

Items	Total Number
Educational Institutions	10
Medical Amenities	None
Religious Places	33
Hand Pump & Bore Wells	77 Bore-wells, 5 Hand Pumps

E. Analysis of Alternatives

36. Due to availability of existing ROW and with no congested major settlement along the project road no bypasses was proposed. However, realignments have been proposed at two locations. The analysis of alternatives was carried out 'with the project' and 'without the project' scenarios in terms of potential environmental impacts.

F. Anticipated Impacts and Mitigation Measures

1. Environmental Impacts

37. A summary of the potential environmental impacts during construction and operation phase along with recommended mitigation measures is summarized in **Table 14**:

Table 14: Summary of Anticipated Impacts and Recommended Mitigation Measures

Area	Impacts	Mitigation Measures
Construction Phase		
Topography and geology	<ul style="list-style-type: none"> ▪ Disfiguration & change in existing profile of the land due to borrow pits & construction of realignments. ▪ Disturbance on geological setting due to quarrying. ▪ Uncontrolled digging of borrow pits resulting in water accumulation & breeding of vector disease. 	<ul style="list-style-type: none"> ▪ Borrow pits will be allowed at only pre-identified locations. ▪ Borrow pits will be restricted to 1 m depth followed by resurfacing of pits. ▪ Road building materials will be procured from approved and licensed quarries. ▪ Suitable seismic design of the road structures will be adopted to mitigate the earthquake impacts.
Soil	<ul style="list-style-type: none"> ▪ Disruption & loss of productive top soil from agricultural fields due to borrow pits ▪ Loosening of top soil & loss of vegetative cover along the road due to excavation & back filling which will lead to enhanced soil 	<ul style="list-style-type: none"> ▪ Adequate measures like drainage, embankment consolidation & slope stabilization will be taken along the road to avoid soil erosion. ▪ Top soils (15 cm) of borrow pit sites will be conserved and restored after excavation is over. ▪ Accidental spills of lubricants/oil and molten asphalt will be avoided by adherence to good practices.

Area	Impacts	Mitigation Measures
Land use	<p>erosion.</p> <ul style="list-style-type: none"> ▪ Generation of solid waste in the form of construction spoils from construction sites. ▪ Changes in existing land use pattern of the proposed ROW for construction of the road. ▪ Proposed ROW in built up area varies from 16 m to 20 m and in rural area it varies from 26 m to 36 m depending on the height of embankment 	<ul style="list-style-type: none"> ▪ Earth material generated from excavation of roadways & drainage will be reused during site development. ▪ Construction debris will be disposed of in suitable pre-identified dumping areas. ▪ Dumping areas will be biologically reclaimed. ▪ Construction camp will be provided to avoid indiscriminate settlement of construction workers.
Drainage	<ul style="list-style-type: none"> ▪ Change in drainage pattern of the land. ▪ Increased incidence and duration of floods due to obstruction of natural drainage courses by the road embankment. ▪ Chances of filling of existing drainage courses during earth filling. 	<ul style="list-style-type: none"> ▪ Adequate drainage facilities will be provided along the road to facilitate its long life, and to avoid soil erosion & land degradation. ▪ Adequate cross drainage works & structures will be provided for smooth passage of runoff to avoid flooding. ▪ Filling of existing drainage courses will be strictly avoided. ▪ Suitable drainage at construction site & camp will be provided to avoid water stagnation, soil erosion & mosquito breeding.
Water use	<ul style="list-style-type: none"> ▪ Impact on the local water sources due to use of construction water. 	<ul style="list-style-type: none"> ▪ Maximum rainwater harvesting and minimum use of existing water sources for construction will be ensured to minimize likely impacts on other users.
Water quality	<ul style="list-style-type: none"> ▪ Increase of sediment load in the run off from construction sites and increase in turbidity in receiving streams/water bodies. ▪ Water pollution due to sewage from construction camps. 	<ul style="list-style-type: none"> ▪ Silt fencing will be provided to reduce sediment load ▪ Oil interceptor to stop and separate the floating oils ▪ Proper sanitation facilities will be provided in construction camp to prevent health related problems. ▪ All the construction activities will be carried out during dry seasons only. ▪ Rainwater Harvesting Structures and silt fences has been proposed at 16 locations near natural drainage channel / causeways and near stream crossing ▪ 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
Water body	<ul style="list-style-type: none"> ▪ 1 pond and 4 road side ditches are located within the Col 	<ul style="list-style-type: none"> ▪ All water bodies have been saved and there will be no impact on surface water bodies. ▪ Enhancement measures have been proposed for roadside pond located at Hebbari village at chainage km 52+800 on the left side of the project road

Area	Impacts	Mitigation Measures
Air quality	<ul style="list-style-type: none"> ▪ 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 asphalt and hot mix plants. 	<ul style="list-style-type: none"> ▪ 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 ▪ Asphalt and hot mix plants will be located at least 500 m away from inhabited areas & sensitive receptors and 300 m from the road. ▪ Use of Recycled Asphalt Cold Mix Technology to reduce air pollution ▪ 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	<ul style="list-style-type: none"> ▪ Increase in noise level due to construction activities like operation of construction equipment & vehicular traffic. 	<ul style="list-style-type: none"> ▪ Construction camp and temporary labour sheds will be located away from the immediate vicinity of the construction sites and major road 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 ▪ Construction activities carried out near residential area will be scheduled to the daytime only so that minimum disturbances are caused to people. ▪ Construction of solid Noise barrier and plantation ▪ Noise level shall be monitored during construction and operation phases as per environmental monitoring program to understand the effectiveness of mitigation measures suggested
Flora & fauna	<ul style="list-style-type: none"> ▪ Total 4,802 trees are required to be felled ▪ No threatened species of flora is falling in the ROW of the project road 	<ul style="list-style-type: none"> ▪ Approx. 9,623 trees shall be planted along the road ▪ Plantation in oxbow land will be carried out as per standard tree plantation program approved by the Forest Department, GoK. ▪ Plantation shall be maintained for 5 years ▪ Compensatory afforestation shall be carried out in the ratio of 1:3. Compensatory Afforestation shall be provided as per the Forest Conservation Act, 1980 and amendment. The amount required for tree cutting and Net Present Value (NPV) for Forest land shall be provided by KSHIP to Forest Department ▪ Total compensatory will be 1:5 ▪ Cooking fuel (LPG/ Kerosene) will be provided to construction workers to avoid cutting / felling of trees for fuel wood. ▪ Soil erosion shall be checked by adopting bio-

Area	Impacts	Mitigation Measures
		<p>engineering measures</p> <ul style="list-style-type: none"> ▪ The IE shall ensure that no open fire is done in construction camp as it may lead to fire to surrounding forest causing injury to wildlife ▪ Noise will be kept under control by regular maintenance of equipment and vehicles. No honking board shall be placed near Forest. Noisy activity shall be prohibited during night time
Forest	<ul style="list-style-type: none"> ▪ 3.3526 hectares of reserved forest land is to be diverted 	<ul style="list-style-type: none"> ▪ Net Present Value will be provided to Forest Department of Karnataka towards the cost of forest land to be diverted and cost of compensatory afforestation ▪ To avoid risk of collision of wildlife with vehicles and construction equipment, temporary fencing may be done along the boundary of the diverted forest area (4.295 \cong 4.5 km length) during construction period. ▪ Construction camps shall be located away from Forest areas. ▪ No construction camp shall be allowed within the designate limits of the forest areas and within 1km from their boundaries. ▪ No earthworks or surfacing will be permitted along stretches of road passing through the reserved forest area after 6:30 p.m. ▪ No disposal of debris shall be allowed within these areas except at locations identified during project preparation.
Amenities, Religious and Cultural Properties	<ul style="list-style-type: none"> ▪ 2 educational institutions will be partially affected i.e. only boundary wall will be affected ▪ 7 religious structures will be affected ▪ There are no medical amenities along the project road 	<ul style="list-style-type: none"> ▪ Affected structures will be suitably relocated ▪ Affected utilities like electrical transmission lines, telephone lines, water pipelines, petrol pumps etc. will be suitably shifted by the concerned departments
Construction camp	<ul style="list-style-type: none"> ▪ Influx of construction work-force & suppliers 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. 	<ul style="list-style-type: none"> ▪ Temporary construction camps with adequate potable water supply, sanitation & primary health facilities and fuel for cooking will be provided to accommodate construction workers. ▪ It will be ensured that the construction workers are provided fuel for cooking to avoid cutting of trees from the adjoining areas. ▪ Domestic as well as the sanitary wastes from construction camps will be cleared regularly.
Occupational health & safety	<ul style="list-style-type: none"> ▪ Health & safety related problems to construction workers due to inadequate health & safety measures. 	<ul style="list-style-type: none"> ▪ Adequate safety measures complying to the occupational safety manuals will be adopted to prevent accidents/hazards to the construction workers ▪ Periodic health check-up of construction workers will be done.

Area	Impacts	Mitigation Measures
Road safety	<ul style="list-style-type: none"> ▪ Increase on incidence of road accidents due to disruptions caused in existing traffic movements. 	<ul style="list-style-type: none"> ▪ Proper traffic diversion and management will be ensured during construction at the interactions and construction areas. ▪ Reduction of speed through construction zones.
Operation Phase		
Land use and Encroachment	<ul style="list-style-type: none"> • Change of land use by squatter/ encroachment within ROW and induced development outside the ROW. 	<ul style="list-style-type: none"> • Planning agencies and Collector/ Revenue Officer will be made involved for controlled development and prohibiting squatter/ encroachment within ROW.
Drainage	<ul style="list-style-type: none"> • Filthy environment due to improper maintenance of drainage. 	<ul style="list-style-type: none"> • Drainage system will be properly maintained.
Water quality	<ul style="list-style-type: none"> • Chances of contamination of water bodies from road surface run off containing oil spills due to traffic movement & accidents. 	<ul style="list-style-type: none"> ▪ Longitudinal roadside drains of sufficient capacity will be provided on both sides of the 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 ▪ Monitoring of water quality at specified locations will be conducted at fixed interval
Air quality	<ul style="list-style-type: none"> ▪ Air pollution due to vehicular emission from road traffic. 	<ul style="list-style-type: none"> ▪ Truck parking lay-byes and bus bays will be provided at required locations to facilitate smooth traffic flow. ▪ Monitoring of air quality at specified locations will be conducted at fixed interval
Noise level	<ul style="list-style-type: none"> ▪ Noise pollution due to Traffic noise. 	<ul style="list-style-type: none"> ▪ To reduce traffic induced noise, noise barrier in the form of solid boundary wall is proposed for sensitive receptors. The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall, plastering and painting. It is also proposed to plant shade and flowering trees within the boundary of the sensitive receptors, between the building line and the compound wall. Creepers may be planted in consultation with the local forest officials to give an aesthetic look ▪ Monitoring of noise level at specified representative locations will be conducted at fixed interval. ▪ Roadside plantation with suitable species near sensitive receptors and inhabited areas will result in partial noise attenuation. ▪ Maintenance of noise barrier

Area	Impacts	Mitigation Measures
Flora & fauna	<ul style="list-style-type: none"> ▪ Illegal felling of road side plantation. ▪ Effect on aquatic fauna in case of accidental spill of oil, fuel & toxic chemicals into water bodies 	<ul style="list-style-type: none"> ▪ Plantation along the ROW will be maintained properly and protected from illegal felling. Contingent actions will be taken in the event accidental spill of oil, fuel & toxic chemicals.
Road safety	<ul style="list-style-type: none"> • Impacts on human health due to accidents. • Damage of road due to wear & tear. 	<ul style="list-style-type: none"> ▪ 40 nos. of Bus Shelters shall be provided along the project road conforming to design standards. ▪ Semi-rigid type / rigid type / flexible type safety barriers shall be provided on the high Embankment Section (where the height of embankment is more than 3.0 m) and along the horizontal curve having radius up to 450m for complete length including transition and 20m further before and after. ▪ Rigid Type such as Concrete Crash Barriers shall be provided on the bridges, isolated structures and its approaches.

2. Social Impacts

38. The scope of land acquisition is quite limited in the project because of availability of sufficient RoW. According to the Land Acquisition Plan (LAP) **22.13 Ha** of land will be acquired for the project. Out of total 22.13 Ha of land, which is going to be affected, 9.78 ha (44.19%) land is privately owned, while 8.99 ha (40.62%) and 3.35 ha (15.14%) land belongs to Government / Waste & Forest Land respectively.

39. A summary of the impacts based on the Census survey of likely to be impacted structures and Land owners is provided in **Table 15**.

Table 15: Summary of Impact on Structures and Displaced Persons

Type of Impact	Number
Total number Project Affected Persons (PAPs)	1662
Total Households Affected including (Structures, Land, Tenants and Employees)	398
Total Vulnerable Households Affected	306
Significantly Affected Households (Title-Holders & Non-titleholders)	115
Marginally Affected Households (Title-Holder & Non-Title Holders)	30
Significantly Affected Households (Title-Holders)	65
Significantly Affected Households (Non-titleholders)	50
Significantly Affected Families (Title-Holders)	151
Significantly Affected Families (Non-titleholders)	175
Marginally Affected Households (Title-Holders)	23
Marginally Affected Households (Non-Titleholders)	7
Marginally Affected Families (Title-Holders)	78
Marginally Affected Families (Non-Titleholders)	21
Households Affected by loss of income (Shop owner, Artisans Tenants & Employees)	144
Households Affected by Land Acquisition	216

Type of Impact	Number
Households Affected by Impact on Private Structures (Structures, Tenants & Employees)	183
CPR affected	5
Religious structures affected	7
Government structures affected	30

40. The resettlement cost estimate for the RP includes compensation for structure at replacement cost without depreciation, compensation for livelihood loss, resettlement assistances and cost of RP implementation. The total resettlement cost for the project is **INR 24.17 Crores**. The EA will provide the necessary funds for compensation for land and structures and R&R assistance. The EA will ensure timely availability of funds for smooth implementation of the RP.

G. Public Consultation

41. 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 stakeholder 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 boars and deer are moderately reported.
- Though school authorities and citizens at large are in favour of introducing speed restriction near the schools.
- Boundary wall acting as noise barriers along the school premises are welcomed by most of the participants, while a few felt high boundary walls should may result obstructed vision and reduced illumination.

42. **Consultation in Religious Places:** To assess the requirement of noise barrier in the religious places along the project road, consultations with stakeholders were carried out at 4 religious places. The response of the participants varied widely regarding installation of noise barrier. Some participants showed reservation against construction of boundary wall due to temple aesthetics and accessibility (58.3%), while other supported the concept (41.7%).

H. Environmental Management Plan

43. 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 Top Soil Conservation and Reuse, Siting and Layout of Construction Camp, Slope Stabilization, Management of Borrow and Quarry Area, Sediment Control, Comprehensive Waste Management Plan, Traffic Management Plan, Worker's Safety during Construction, Tree Plantation Strategy, Storage, Handling, Use and Emergency Response for Hazardous Substances, Phyco-Remediation of Polluted Water using NUALGI, Reporting Formats etc.

1. Environmental Policy of KSHIP

- Comply with all applicable environmental legislation and other requirements
- Protecting & conserving natural resources and enhancing the environmental values while preventing pollution and minimizing the impact on the natural environment
- Implement, maintain and continually improve an effective environmental management system
- Apply an approach of "avoid, minimize and mitigate", to the management of environmental impacts associated with road improvement for its Stakeholders
- Develop awareness of environmental management processes, standards and responsibilities among KSHIP employees, consultants, contractor partners etc.
- Be responsive to community and stakeholder views on environmental issues
- Set specific environmental objectives and targets relating to the key environmental aspects of KSHIP activities; measure and report progress in achieving these targets

2. Environmental Budget

44. 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 KHSIP

45. A capital cost provision of about **Rs. 4.1 Crore** has been kept towards implementation of environmental management plan. Summary of environmental budget is presented in **Table 16**.

Table 16: Summary of Environmental Budget

Component	Description	To be implemented by	Amount (Rs.)
A.	Mitigation / Enhancement	Contractor	16,986,375
B.	Environmental Monitoring		1,918,000
Subtotal			18,904,375
C.	Forestry	KSHIP	21,085,091
D.	Training & Mobilization		1,040,000
Subtotal			22,125,091
Grand Total			41,029,466

I. Conclusion and Recommendations

46. 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.

47. Recommendations: Environmental Management Plan has been prepared incorporating various modern technologies and guidelines to reduce the environmental impacts of highway constructions to make it a Green Highway. Therefore, it is recommended to follow the EMP and associated Guidelines during construction and operation phases of the project.

I. INTRODUCTION

A. Project Background

1. The Government of Karnataka (GoK) through the Government of India (GoI) has received in principal approval for a loan from the Asian Development Bank (ADB) towards Karnataka State Highways Improvement Project–III (KSHIP- III) for developing State Road network adopting innovative financial models under Public Private Partnership (PPP). The Executing Agency (EA), the Public Works Department, represented by the Project Director, Project Implementation Unit, Karnataka State Highway Improvement Project (PIU-KSHIP) has already completed a Pre-Financial Feasibility Study for about 4,403 km of select corridors of the Core Road Network (CRN) of the state and based on the outcome of this study, it intends to improve about 1,350 km of state highways under this ADB finance. With a view to this, the EA has engaged a consultant to prepare the Detailed Project Report and carry out Transaction Advisory Services for Karnataka State Highway Improvement Project-III (**KSHIP III**), for project roads drawn under **Group II**.

2. In pursuance of the above, Intercontinental Consultants and Technocrats Pvt. Ltd. have been appointed as Consultants by KSHIP to carry out the Preparation of Detailed Project Report and provide Transaction Advisory Services for Karnataka State Highway Improvement Project-III Group II roads in the State of Karnataka to two/four lane with Paved Shoulder Configuration”.

3. The project roads have been divided into packages based on the time lines required for the fulfilment of environmental safeguards as per the MOEF&CC & ADB’s Safeguard Policy Statement 2009; project cost and to attract bidders of both large and small scale. Accordingly, the project roads under Group II have been divided into 5 packages as presented in **Table 1**. The Project Roads are shown in the Index Map (**Figure 1**).

Table 17: Package-wise Summary of Project Roads under Group II

Package No.	Project Roads	Length (km)
1	1A Kollegal to Hannur	23.8
	1B Chintamani to Andhra Pradesh Border	39.8
	1C Bengaluru to Magadi and	35.7
	1C Magadi to Kunigal	15.3
2	Magadi to near Somwarpet	165.5
3	Gadag to Honnali	138.2
	Total Length (km)	418.3

4. In this report, Package-1B “Chintamani to AP Border Road” has been discussed.



Figure 1: Index Map showing Location of Project Roads

B. Objectives of the Study

5. The main objectives of the Initial Environmental Examination (IEE) study are as follows:
- To determine the category of the project depending on the length, extent of land acquisition, location, environmental sensitivity and the nature and magnitude of its potential environmental impacts, i.e. screening as per Government of India's regulations and ADB's Safeguard Policy Statement 2009;
 - To determine the appropriate extent and type of Environmental Assessment (EA) required, i.e scoping;
 - To determine whether the project requires environment clearance, forest clearance, wildlife clearance, consents to establish etc. depending on its type of development;
 - To establish present environmental conditions of the study area through available data / information supported by field studies, wherever necessary;
 - To predict the potential impacts on relevant environmental attributes due to the proposed project and to recommend adequate mitigation measures to minimize / reduce adverse impacts;
 - To prepare an Initial Environmental Examination (IEE) report including Environmental Management Plan (EMP).

C. Approach and Methodology

6. The Initial Environmental Examination has been carried out within existing policy, legal and administrative framework considering the applicable environmental legislation, regulations & guidelines of ADB and MOEF&CC.

- **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, District Planning Maps, Forest Working Plans, booklet of Central Ground Water Board, details of Archeological 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 bypasses, if any, cross-sections, sources of materials from an environmental management perspective.
- **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; enhancement plan for water bodies; requirement of noise barrier, capacity building & training; environmental supervision, monitoring & auditing requirements; bill of quantities etc.

D. Structure of the Report

7. This Initial Environmental Examination Report (IEE) and Environment Management Plan (Volume-VIII) is a part of the Detailed Project Report of the **Chintamani to Andhra Pradesh Border** Project Road under the corridor CEW 28.

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

Volume: VIII (A)	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

Volume: VIII (B) Annex

II. DESCRIPTION OF THE PROJECT

A. Project Location

9. The Project road starts in Chikkabalapura district from the junction of NH 234 near Chintamani (Km 47+203 of SH-82) and ends at the Border of Andhra Pradesh at Km 87+331 of SH-82 in Kolar District of Karnataka (**Figure 2**). The Latitude & Longitude of start and end points are 13° 22'59.155" N & 78°05'17.292" E and 13°32'25.439" N & 78°23'39.081" E respectively. **The length of the project road is 39.774 Km.** Project road predominately traverse through plain terrain except small section of project road which traverse through rolling terrain.

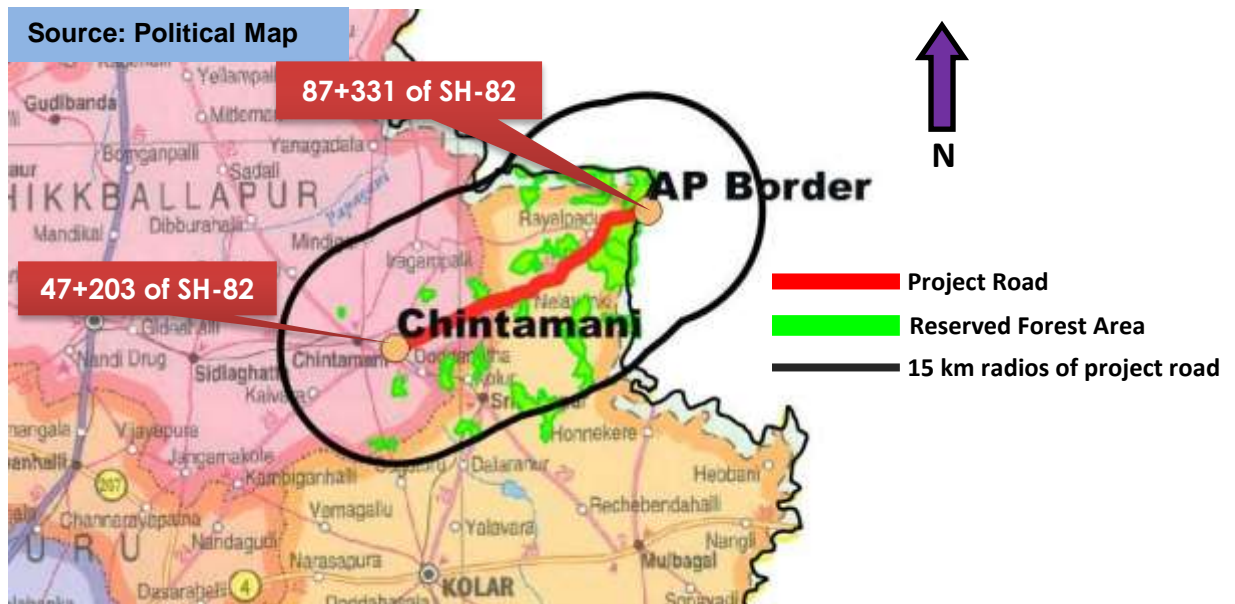


Figure 2: Map Showing location of the Project Road

10. Project road has connectivity to a National Highway and State highway as such improvement of project road would benefit and improve network mobility in the region. The Start of Project road is at a junction with NH 234, further beyond project road end point at Andhra Pradesh border leads to Madanapalle and also forms connectivity to two major National Highways NH-215 & NH 219. The project road also serves an alternative key connectivity to famous Tirupathi temple from Bengaluru.

B. Description of the Project Road

11. The project road starts from NH-234 with a four legged skew junction and traverses eastward. It crosses the existing railway line of Southern Railway at Km 48+770, through a Railway under Bridge (RUB). The project road meets SH-99 at Thadigol cross at Km 62+450 with a T-junction and thereafter has an overlapping section up to Km 63+600 with SH-99. After that, the project road moves eastward up to AP Border in Kolar District, traversing through both plain and rolling terrain. There are many substandard horizontal as well as vertical curves. About 33 horizontal curves are found substandard having radius beyond 240m. The initial stretch up to Km 75+000 passes mostly through agricultural land and then mostly through the reserved forest. There is only one major road and some minor village road crossings. The project road ends at the border with Andhra Pradesh at Km 87+331.

12. **Carriageway:** The majority of the Carriageway of the Project Highway has two-lane carriageway with width 7.0 m. A small section of 215m is 4 lane undivided section at RUB location from km 48+551 to 48+866. The type of the existing pavement is flexible.

13. **Terrain:** Predominately plain except small section of project road traverse through rolling terrain.

14. **Road Intersections:** There are 4 major roads including the one at start point (NH 234) and 39 minor road/village roads connecting the project road. All the junctions have been proposed for improvement.

15. **Pavement Condition:** The existing pavement is flexible and the composition of layer predominantly consists of bituminous layers laid over granular base/WMM and granular sub base/river material with boulders/moorum present at some locations. The bituminous surfacing varies in the range of 40 mm to 100 mm and the Granular Base/sub base layer varies from 110 to 430mm.

16. **Existing Bridges & Culverts:** The project road has 5 minor bridges and 71 culverts (56 Hume pipe and 15 slab culverts).

17. **Railway Crossing:** A railway line of Southern Railways crosses the project road at Ch. Km 48+769, through a Railway under Bridge (RUB) of span 2 x 7.5 m.

C. Traffic Study

18. During the pre-feasibility study, traffic surveys were conducted by iDeCK in 2009. As per the terms of reference of this study the Consultants were required to validate these surveys.

1. Composition of Traffic

19. The composition of traffic was worked out from the traffic volume count data. Along the project stretch the share of passenger traffic varies from 76 % to 80%, whereas goods traffic varies from 20 % to 24 %. Share of trucks (including LCV, 2 Axle, 3 Axle and MAVs) is varying from 16 % to 23% of total traffic. The share of car and taxi varies from 23% to 37% of total traffic and of non-motorized traffic varies from 1% to 3% along the project stretch.

2. Classified Traffic Volume Counts

20. Based on the traffic surveys conducted by iDeCK during the pre-feasibility study and reconnaissance of the surrounding network, the project road has been divided into two homogeneous traffic sections. The homogeneous section wise Annual Average Daily Traffic (AADT) is presented in **Table 18**.

21. It is observed from the above table that AADT at homogeneous section I (HS-I) is 8,633 PCUs which is estimated from traffic volume count conducted by iDeCK, projected till 2015. The traffic for the homogeneous section II (HS-II) of the project road is 6,281 PCUs which has been counted at km. 69+077 by ICT in 2015.

Table 18: Homogeneous Sections of Traffic in Project Road

Sl. No.	Homogeneous Section (HS)	Existing Chainage (km)		Design Chainage (Km)		Length (km)	Traffic Volume AADT (PCU)
		From	To	From	To		2015
1	HS- I	47+203	63+626	47+203	63+600	16.367	8,633
2	HS- II	63+626	87+331	63+600	86+977	23.377	6,281

Source: Survey conducted by iDeCK & ICT

3. Turning Movement Survey

22. Turning Movement surveys were carried out at junction with SH 99. It is observed that along SH-82, the total approach volumes during peak hour, is 350 PCUs (263 vehicles) at SH-99 Junction (Km 62+197). The peak hour proportion at this intersection is 9.5%.

4. Axle Load Survey

23. The axle load survey has been carried out to calculate the Vehicle Damage Factor (VDF) and the axle load spectrum for design of pavement. Based on the survey the VDF for 2-axle trucks has been computed in the range 0.59-9.43 while the VDF for 3-axle truck lies in the range 0.63-7.5. The VDF for multi- axle vehicle has been calculated to be in the range 1.43-9.79. The results indicate low VDF values in UP direction (i.e. towards AP border) and higher values in DN direction.

5. Traffic Forecast

24. For traffic forecast, the techniques of 'Elasticity of Transport Demand', based on historical growth in vehicle registration and trend of the economy in the area, has been adopted for estimating the growth rates for different modes of traffic that are likely to use the project road in future. The likely induced and generated traffic has been added to arrive at the future traffic for each of the homogeneous sections. The projected traffic for each of the homogeneous sections is presented in **Table 19** and **Table 20**. Based on the traffic projection, the improvement warrants for both the project roads are explained below.

25. The base year traffic count analysis and its projection to future years shows that, Homogenous Section-I would be required to be improved to two-lane with paved shoulder from 2015 itself, and would require further improvement to four lane, when the traffic will cross the threshold value of 18,000 PCUs/day in the year 2026.

26. Homogenous Section-II would be required to be improved to two-lane with granular shoulder until the year 2022, after which it may be improved to two-lane with paved shoulder configuration which is just about 3 years after opening to traffic. Hence to avoid widening within a short period and to enhanced safety and reduced maintenance requirement, it is logical to improve homogenous section II (HS-II) to two-Lane with paved shoulder from the beginning (i.e. opening year 2020). The homogenous section II would require to be widened to 4 lane configurations from the year 2032 onwards, when the traffic would cross the threshold value of 18,000 PCUs/day.

Table 19: Projected Annual Average Daily Traffic on Homogenous Sections - I

Homogenous Section I- Chintamani to Khadgal Cross (km 47+203 to km 63+600)									
Vehicle Type	Year								
	2015	2019	2020	2022	2025	2030	2035	2040	2050
Car	1190	1559	1705	1982	2428	3373	4621	6140	10000
Total Jeep/ Van	405	511	554	637	770	1030	1316	1641	2429
Mini Bus	87	103	110	124	144	179	217	252	340
Bus	471	561	599	670	776	967	1177	1364	1832
Tempo LGV - Freight (3,4 Axle)	363	468	509	590	719	974	1286	1652	2444
Tempo LGV - Freight (6 Axle)	0	0	0	0	0	0	0	0	0
2 Axle Truck	326	421	454	522	637	863	1138	1460	2268
3Axle Truck	315	407	439	505	615	834	1100	1412	2191
MAV	158	198	211	239	284	379	501	643	999
Three Wheeler	305	371	399	451	530	660	803	931	1135
Two Wheeler	3499	4586	5017	5883	7309	10324	14145	18795	32107
Tractor	103	115	118	126	135	150	160	170	190
Tractor With Trailer	6	6	6	6	6	6	6	6	6
Cycle	136	140	141	143	145	150	160	170	190
Cycle Ricks	0	0	0	0	0	0	0	0	0
Hand Cart	0	0	0	0	0	0	0	0	0
Animal Drawn	2	2	2	2	2	2	2	2	2
Non Tollable	0	0	0	0	0	0	0	0	0
Non Tollable PCUs	0	0	0	0	0	0	0	0	0
Total PCUs	8633	10930	11812	13547	16353	21991	28926	36946	57581
Total Vehicles	7366	9448	10266	11880	14500	19891	26632	34638	56133

Table 20: Projected Annual Average Daily Traffic on Homogenous Sections - II

Homogenous Section II-Khadgal Cross to AP Border (km 63+600 to km 86+977)									
Vehicle Type	Year								
	2015	2019	2020	2022	2025	2030	2035	2040	2050
Car	1452	1904	2083	2420	2964	4119	5643	7497	12212
Total Jeep/ Van	85	107	116	133	161	216	276	344	509
Mini Bus	15	18	19	21	24	29	34	39	49
Bus	280	334	357	400	463	578	703	815	1095
Tempo LGV - Freight (3,4 Axle)	292	376	409	474	578	782	1033	1328	1966
Tempo LGV - Freight (6 Axle)	97	126	137	158	193	262	347	447	694
2 Axle Truck	48	62	67	77	94	128	169	218	339
3Axle Truck	180	233	251	288	352	476	628	806	1251
MAV	362	453	484	549	654	872	1152	1479	2299
Three Wheeler	83	102	109	123	145	181	220	255	311
Two Wheeler	1223	1604	1754	2057	2555	3610	4946	6571	11223
Tractor	6	6	6	6	6	6	6	6	6
Tractor With Trailer	27	31	32	34	36	41	41	41	41
Cycle	0	0	0	0	0	0	0	0	0
Cycle Ricks	0	0	0	0	0	0	0	0	0
Hand Cart	0	0	0	0	0	0	0	0	0
Animal Drawn	1	1	1	1	1	1	1	1	1
Non Tollable	10	10	10	10	10	10	10	10	10
Non Tollable PCUs	10	10	10	10	10	10	10	10	10
Total PCUs	6280	7974	8611	9865	11887	16003	21147	27155	42358

Homogenous Section II-Khadgal Cross to AP Border (km 63+600 to km 86+977)									
Vehicle Type	Year								
	2015	2019	2020	2022	2025	2030	2035	2040	2050
Total Vehicles	4162	5367	5836	6751	8236	11311	15209	19857	32006

D. Improvement Proposal

1. Corridor of Impact

27. The land width required for construction of the road is found to be varying between 26-36m depending on the height of embankment. The available RoW is not consistent and varies significantly along the project road. The IRC (73:1980) recommended minimum RoW for State Highways to be 45 in open country and 30 m in built-up areas, which is not available throughout the length of the project road. Wherever this required width is not available, KSHIP is acquiring only the required width of land for construction to limit the associated social impacts and compensation cost, in turn the project cost.

28. Therefore, the Corridor of Impact (COI) is the proposed construction width, which is varying from 16 to 20 m in built-up areas and 26 to 36 m in rural / open country area.

2. Widening Scheme

29. The existing road is to be widened to standard 2-lane with paved shoulder configuration based on the traffic projection. However to address the safety issue in the built up sections en-route, 600m length of 4-lane divided carriageway with raised median has been proposed at two location. The proposed improvements as far as possible are kept within the existing right of way to avoid/ minimize land acquisition. The land acquisition is proposed at locations having inadequate width, realignments, geometric improvements for provision of highway facilities like Toll plaza, Bus Lay byes, Truck lay byes etc. The proposed lane configuration is given in **Table 21**. Considering the need to minimize land acquisition concentric widening of existing carriageway is adopted for majority of the section. The summary of widening is given in **Table 22**.

Table 21: Recommended Lane configuration

Sl. No.	Design Ch. Km		Length (km)	Lane configuration
	From	To		
1	47+203	70+830	23.627	2 Lane with Paved shoulder
2	70+830	71+130	0.300	4 Lane built up
3	71+130	73+150	2.020	2 Lane with Paved shoulder
4	73+150	73+450	0.300	4 Lane built up
5	73+450	86+977	13.527	2 Lane with Paved shoulder
Total Length (Km)			39.774	

Table 22: Summary of Widening

Widening length in Km		Curve Improvement (Km)	Realignment (Km)	Total Length (km)
Concentric	Eccentric			
36.159	0	2.640	0.975	39.774

3. Typical Cross Sections

30. Based on the traffic projection, capacity and the design standards, the typical cross-sections applicable for various sections of the project road have been prepared. The typical cross sections are given in **Annex-1**. Cross-sections proposed in urban locations have been customized to suit field conditions and minimize R&R impact and land acquisition. The cross-sections in urban locations were developed within 16 m and 20 m formation width, without compromising on safety and capacity augmentation requirement of the project road. These typical sections have been prepared separately for various alternatives like reconstruction, rehabilitation, built-up areas etc. as follows:

TCS-1	Typical Cross Section for 2 Lane with Paved Shoulder (Open Country) – Concentric Widening
TCS-2	Typical Cross Section for 2 Lane with Paved Shoulder (Open Country) – Realignment / New Construction / Bypass
TCS-3	Typical Cross Section for 4 Lane Divided Highway Without Service Road (Urban Section) – Concentric Widening Built-Up Section within 20m COI
TCS-4	Typical Cross Section for 2 Lane with Paved Shoulder (Urban Section) – Concentric Widening Built Up Section with 16m COI
TCS-5	Typical Cross Section for RUB Approach
TCS-6	Typical Cross Section for 2 Lane with Paved Shoulder (Cutting Section – Rigid Pavement)
TCS-7	Typical Cross Section for 2 Lane with Paved Shoulder (Cutting Section)
TCS-8	Typical Cross Section for 2 Lane with Paved Shoulder (Half Cutting / Half Fill Section)

4. Bypasses and Realignments

31. The project road SH-82 does not pass through any congested settlement, therefore no need of bypasses envisaged. However, the project road is having substandard horizontal geometry in some sections. There are 27 nos. horizontal curve having radius less than 200m with a design speed of less than the minimum 80 kmph stipulated in code along the project road. Hence to improve safety of road users, realignment has been considered as part of geometric improvement. The details of the proposed realignment are as given in **Table 23**.

Table 23: Details of Proposed Realignment

Sl. No.	Name of Town/Village	Existing Chainage Km		Realignment Chainage		
		Start	End	Start	End	Length (Km)
1	Tadgol Crossing	63+500	64+200	63+470	64+045	0.575
2	Thopalli	75+130	75+600	74+900	75+300	0.400

32. **Realignment (Tadgol crossing):** The project road turns right ward at km 63+500 before Tadgol crossing with horizontal curve radius of 117m. The SH 99 takes off with Y junction from SH 82 where some small residential and commercial buildings exist along the road. Then the alignment turns leftward with curve radius of about 55m. Further the project road moves rightward at Km 64+200 with radius of 75m. Thus the section from Ch. 63+500 to Ch. 64+200 has very poor horizontal geometry and is a black spot where number of total accidents had happened in the past. Hence, to improve safety of the road users, geometric improvement in form of realignment has been proposed between Ch. 63+500 to 64+200 (**Figure 3**). Further due to the realignment, the road length has also been reduced by 125m



Figure 3: Proposed Tadgol Realignment

33. **Realignment near Thopalli Settlement:** There are four continuous substandard horizontal curves within a length of about 470m from km. 75+130 to km. 75+600. The horizontal curve radii are of 40m to 90m. Further the embankment height in this stretch is also about 2.5m. Due to these existing features this stretch is an accident prone area. Hence considering the safety and to reduce the series of curves, realignment has been proposed from Km 75+130 to Km 75+600 (Figure 4).



Figure 4: Proposed Realignment near Thopalli Settlement

5. Improvement of the Existing Road Geometrics

34. In the following sections, where improvement of the existing road geometrics to the prescribed standards is not possible, the existing road geometrics shall be improved to the extent possible within the given right of way and proper road signs and safety measures shall be provided:

Table 24: Improvement of Existing Road Geometrics

Sr. No.	Design Chainage		Type of Deficiency	Remarks
	From (Km)	To (Km)		
1	61+350	61+600	Deficient Geometry	Geometric Improvement
2	61+970	62+230	Deficient Geometry	Geometric Improvement
3	63+300	63+470	Deficient Geometry	Geometric Improvement
4	64+830	65+140	Deficient Geometry	Geometric Improvement
5	66+600	66+820	Deficient Geometry	Geometric Improvement
6	67+870	68+200	Deficient Geometry	Geometric Improvement
7	72+750	73+100	Deficient Geometry	Geometric Improvement
8	78+290	78+460	Deficient Geometry	Geometric Improvement
9	79+290	79+460	Deficient Geometry	Geometric Improvement
10	82+270	82+680	Deficient Geometry	Geometric Improvement

6. Pavement Design

35. Pavement for new construction in widening, bypass and reconstruction portion is designed based on subgrade strength, material characteristics and Design traffic. Flexible pavement is designed for design life of 15 years as per IRC:37-2012 as well as 20 years as desired by client for project road section.

36. Two pavement composition options are considered for the road section. These are:

- Option-1: using conventional pavement materials
- Option-2: Recycled Asphalt Pavement (RAP) material

37. A comparative study of both the options is also made. For RAP Layer, maximum 30% recycled asphalt materials is considered to be generated from existing pavement. VG-30 grade bitumen is suggested for design traffic less than 30 MSA and VG-40 grade bitumen for design traffic more than 30 MSA.

38. Provision of RAP has been decided based on intensity of traffic. In the proposed project road, estimated design traffic is more than 30 MSA. Therefore, RAP is not proposed in Chintamani to AP Border Road.

39. Based on the study of pavement for the project road, following pavement composition for new construction as well as rehabilitation for 15 years and 20 years design life is shown in **Table 25**, **Table 26** and **Table 27** below:

Table 25: Recommended Pavement Composition for 15 Years Design Life (New / Rehabilitation)

Homogenous Section	From Km	To Km	Subgrade CBR (%)	Design Traffic (Msa)	Design Period	Characteristics Deflection (mm)	Pavement Composition (mm) (New/Rehabilitation/Overlay)							
							New			Rehabilitation			Overlay	
							BC	RAP	CTSB	BC	RAP	CTSB	BC	DBM
Stage 1 Design														
HS I (2 L) I Phase	47.2	63.6	12	26	2019-26	0.70	40	100	200	40	100	200	-	-
HS II	63.6	78.0	12	30	2019-33	1.13	40	105	200	40	105	200	-	-
	78.0	86.9	10	30	2019-33	0.90	40	110	200	40	110	200	-	-

HS	Chainage km		Design Period	Design Subgrade CBR (%)	Design Traffic (MSA)	Pavement Composition (mm)			
	From	To				BC	DBM	WMM	GSB
Stage 2 Design									
HS-I (add. 2 L)	47.2	63.6	2027-33	12	20	40	70	250	200
HS-I (old 2 L)	47.2	63.6	2027-33	Overlay of 40 mm BC					

Table 26: Recommended Pavement Composition for 20 Years Design Life (New / Rehabilitation)
(Case 1: Stage Construction)

HS	Chainage		Design Subgrade CBR (%)	Design Traffic (MSA)	Design Period	Characteristics Deflection (mm)	Pavement Composition (mm) (New/Rehabilitation/Overlay)								
	From Km	To Km					New				Rehabilitation				
							BC	DBM	RAP	WMM	GSB	BC	DBM	RAP	WMM
Stage 1 Design															
HS I (2L)	47.2	63.6	12	26	2019-26	0.70	40	75	-	250	200	40	75	-	250
HS II	63.6	78.0	12	50	2019-38	1.13	40	80	-	250	200	40	80	-	250
	78.0	86.9	10	50	2019-38	0.90	40	95	-	250	200	40	95	-	250

Stage 2 Design									
HS	Chainage		Design Period	Design Subgrade CBR (%)	Design Traffic (MSA)	Pavement Composition (mm)			
	From Km	To Km				BC	DBM	WMM	GSB
HS-I (add. 2 L)	47.2	63.6	2027-38	12	40	40	80	250	200
HS-I (old 2 L)	47.2	63.6	2027-38	Overlay of 40 mm BC + 50 mm DBM					

Table 27 Pavement Composition (New / Rehabilitation)
(Case 2: Single Stage Construction)

HS	Chainage		Design Subgrade CBR (%)	Design Traffic (MSA)	Design Period	Characteristics Deflection (mm)	Pavement Composition (mm) (New/Rehabilitation/Overlay)								
	From Km	To Km					New					Rehabilitation			
							BC	DBM	RAP	WMM	GSB	BC	DBM	RAP	WMM
Single Stage Design															
HS I (2L)	47.2	63.6	12	70	2019-38	0.70	40	95	-	250	200	40	95	-	250
HS II	60.0	78.0	12	50	2019-38	1.13	40	80	-	250	200	40	80	-	250
	78.0	86.9	10	50	2019-38	0.90	40	95	-	250	200	40	95	-	250

40. In line with the discussion with the client it is recommended to adopt single stage construction for a design life of 20 years.

7. Bridges

41. There are a total of 5 bridges on the project road. Out of these 1 bridge has been replaced due to realignment or hydrological consideration, 1 bridge has been retained and 3 bridges have been proposed to be widened (**Table 28**).

Table 28 Improvement Proposal of Bridges

Sl. No.	Design Chainage	Span Arrangement (m)	Total Length (m)	Remarks
1	49+979	3 x 7.7	23.12	Widen with repairs
2	63+535	1 x 19.90	19.945	New 4-lane bridge proposed
3	67+763	1 x 9.00	9.02	Replaced being hydraulically deficient
4	70+302	1 x 6.7	6.72	Widen with repairs
5	77+579	1 x 8.35	8.37	Widen with repairs

8. Railway under Bridge

42. The project road crosses the Southern Railways Track at Km 48+769, through an existing Railway under Bridge (RUB) of span 1x7.016m (along Highway). Since the existing structure is in good condition, the same has been proposed to be retained after minor repair. It has been observed that due to drainage problem, the flexible pavement on the approaches has been seriously damaged. Hence to maintain smooth flow of traffic, rigid pavement from Km 48+250 to Km 49+100 has been proposed along with some geometric improvement of vertical profile.

9. Pedestrian Subway

43. To facilitate the pedestrians near school, 2 nos. pedestrian subways have been proposed as presented in **Table 29**.

Table 29 Details of Proposed Pedestrian Subways

S. No.	Design Chainage (Km.)	Size (m)	Total Length (m)	Carriageway width (m)	Overall deck width (m)	Remarks
1	63+490	5 x 3	6	7.5 and 10	13.5 and 10.5	4-lane
2	73+200	5 x 3	6	11.00	16.00	2-lane

10. Culverts

44. Considering the adequacy and hydrological requirements, some additional culverts and replacement of some culverts have been proposed. There are 44 hume Pipe, 27 RCC box and 2 slab culverts have been proposed. In addition to these, 46 hume pipe culverts are proposed for cross drainage at road junctions.

11. At-Grade Intersection / Grade Separated Intersection

45. Apart from the start point of the project road, some major and minor roads connect the project road. SH-99 at two locations and one Major District Road at Km 81+520 connects the project road.

46. For smooth merging & diverging of cross road traffic, at grade intersections have been proposed at various locations. 4 major Junctions and 39 minor junctions have been identified and improvement has been proposed.

12. Service Roads

47. There is no major built up section along the project road and due to very low local traffic in settlement area, provision of service roads have not been made.

13. Road Side Drain

48. Roadside drains shall be provided on both sides of the embankment to safely carry the discharge from the embankment without jeopardizing the safety of the toe resulting safe guard to the pavement from water.

49. In rural section trapezoidal drain sections has been proposed on both side. In urban sections lined drains with footpath has been proposed for safety reasons. The Length of lined drain on both side of the project road is 2,870 m and length of unlined drain on both side of the project road is 76,678m.

50. The shape and size of the roadside drains has been decided on the basis catchment area and its characteristics to the nearest outfall point. For rural areas, the drains have been proposed as open and trapezoidal with 2(H):1(V) side slope as per IRC: SP: 73-2015 (Clause 6.2.4). The minimum bed width and depth of flow at starting section shall be 500 mm and 300 mm respectively.

14. Footpath

51. Considering the safety of pedestrian traffic, drain cum footpath has been proposed on both side of the project road in the following location locations:

Table 30: Location of Footpaths

Sl. No	Stretch (Km)		Side
	From	To	
1	68+326	68+726	Both sides
2	70+830	71+130	Both sides
3	73+150	73+450	Both sides

15. Bus Bays

52. 20 Locations for construction of 40 bus bays (on RHS & LHS) on the project road are identified as probable locations to address the need of people living along the stretch. Most of the bus bays have been proposed on existing bus stop.

16. Truck Lay Bys

53. To facilitate the truck traffic, truck lay bye on both sides of the project road have been proposed at km 65+760 (Left) and Km 65+930 (right) near the proposed toll plaza area.

17. Toll Plaza

54. Considering traffic flow and Homogeneous section, one toll plaza has been proposed at Km 60+100. However as decided during consultation with the client, construction of toll plaza **will not be taken up immediately** & only provision of land for the toll plaza has been made.

18. Design Speed

55. The design speed shall be the minimum design speed of 100 Km per hour for plain / rolling terrain except in the stretches as given below:

Table 31: Design Speed

Sr. No.	Design Chainage		Design Speed (Km/hr)
	From (Km)	To (Km)	
1	66+500	66+900	80
2	68+300	69+800	80
3	70+800	71+300	80
4	73+000	73+500	65
5	78+300	78+500	80
6	82+100	82+900	80

19. Additional Land Acquisition

56. According to the Land Acquisition Plan (LAP) 22.13 Ha of land will be acquired for the project. Out of total 22.13 Ha of land, which is going to be acquired, 9.78 Ha land is privately owned, while 8.99 Ha is Government / Waste land and 3.35 Ha is forest land. The details of land acquisition requirement are summarized in the **Table 32**.

Table 32: Details of Land being acquired for the Project

Sl. No.	Land Details	Acquisition of Land Area (Ha.)	Percentage
1	Private Land	9.78	44.19
2	Forest land	3.35	15.14
3	Govt. Land / Waste Land	8.99	40.62
Total		22.13	100.00

Source: Land acquisition Plan, ICT Pvt. Ltd 2015

E. Road Safety Devices

57. Road safety aspects have been well studied and several safety features like road marking, signage, safety barriers, boundary stones, kilometer stones and hectometer stones, pavement marking and lighting has been proposed as discussed below. The engineering design of the road has also considered IRC codal provisions related to road safety such as:

- IRC: SP: 32-1988 Road Safety for Children
- IRC: SP: 44-1994 Highway Safety Code
- IRC: SP: 55-2001 Guidelines for Safety in Construction Zones
- IRC:119:2015 Guidelines for Traffic Safety Barriers

1. Road Markings

- Road Markings shall comprise of carriageway markings such as longitudinal markings and object markings such as raised pavement markers (Cat's Eyes or Road Studs).
- All markings shall conform to IRC:35-2015

2. Road Signs

- Three types of Road signs shall generally be provided (such as Mandatory / Regulatory, Cautionary / Warnings, and informative signs).
- Locations of Signs shall conform to IRC:67-2012 and Section 800 of MoRT&H Specifications.

3. Roadside Safety Barriers

58. The following types of Road Safety Barriers shall be provided on the Project Road Sections:

- Semi-rigid type / rigid type / flexible type safety barriers shall be provided on the high Embankment Section (where the height of embankment is more than 3.0 m) and along the horizontal curve having radius up to 450m for complete length including transition and 20m further before and after.
- Rigid Type such as Concrete Crash Barriers shall be provided on the bridges, isolated structures and its approaches.

4. Boundary stone, Km stone and Hectometer Stone

59. Road boundary stones have been proposed all along the project highway to discourage future encroachment into the right of way. Km stone and hectometer stones have been proposed all along the project road as per IRC codal provisions

5. Pavement Marking and Lighting

60. 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.

61. Highway lightings including high masts will be provided at intersections in order to improve the night time visibility. All the built up locations as well Underpasses has been proposed lighting arrangements.

F. Sources of Construction Materials

62. 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.

63. **Borrow Areas:** Potential sources of earth for the construction of embankment and subgrade were identified on either side of project road. The details of proposed borrow areas investigated with their respective locations; corresponding chainages and lead from nearest point to project road are tabulated in **Table 33**.

Table 33: Location of Proposed Borrow Areas

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)	Present Land Use
1	50+500	LHS	Imareddyhalli	1.30	Barren land
2	55+600	LHS	Nandigenahalli	1.20	Barren land
3	59+600	RHS	Kamatampalli	0.60	Barren land
4	64+800	LHS	Thadigol Cross	0.20	Barren land
5	70+300	RHS	Chakappli	0.20	Barren land
6	75+800	LHS	Thoopalli	0.10	Barren land
7	80+500	LHS	Madarangpalli	0.10	Barren land
8	85+300	RHS	Hakki Pikki Colony	0.50	Barren land



View of Borrow Area at Ch. Km 59+600



View of Borrow Area at Ch. Km 80+500

64. **Stone/ Coarse Aggregate Material:** Two stone quarries are identified along the project road section and samples are collected and tested. The materials have been tested to ascertain their suitability for road construction and compliance with the specifications requirements. The sampling locations, name of quarry /village and approximate lead distances from project site are given in **Table 34**.

Table 34: Location of Stone / Coarse Aggregate Material

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)	Approx. Quantity
1	47+000	LHS	SNR stone crusher, Raguttahalli	18.0	70,00,000 cum
2	60+500	LHS	JNS stone crusher Gandhi Nagar	5.50	80,00,000 cum

65. **Fine Aggregate Material:** Two sources of natural sand are identified along the project road as presented in **Table 35**.

Table 35: Location of Fine Aggregate Material

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)	Approx. Quantity
1	47+000	LHS	Raguttahalli	30.0	Huge
2	55+600	LHS	Pallikunte	7.70	Huge

66. However, local enquiry suggests that extraction / mining of natural sand is banned in Karnataka state. It is therefore suggested to use manufactured sand which can be obtained by crushing the stone at crusher plant itself, in the pavement construction as well as concreting of the structures

67. **Cement:** Ordinary Portland cement of Grade 43 and 53 are available in and around Chintamani. Cement shall be conforming to IS: 8112 and / or IS: 12269.

68. **Bitumen:** Bitumen can be procured from oil refinery from Chennai, Tamil Nadu, with a lead of about 280 Km from Chintamani or Mangalore Oil Refinery with a lead of about 426 Km. The Specification of Bitumen must comply with relevant IS/IRC codes.

69. **Steel:** High strength deformed bars manufactured by various steel manufacturing companies conforming to IS 1786 may be available with local stockists in and around Chintamani. Before incorporation into the work, steel shall be got approved by the Engineer.

70. **Waste Plastic:** Waste plastic creates problem to the environment. The waste plastic is definitely a great worry for our country as well as the whole world. If the plastic is not utilized properly, we need to dump it as a waste. There is a generation of more than 10,000 tons of waste plastic in India every day. The waste plastic is recycled in India in an unorganized way. This un-utilized plastic does not degenerate or bio-degrades but will remain as it is for lakhs of years. Therefore, the best way of disposal of waste plastic is its recycling to the maximum extent and waste plastic has great potential for use in bituminous construction as its addition in small dose helps in substantially improving Marshall Properties, fatigue life and other properties.

71. The reason behind extra durability and strength of “plastics roads” is due to the higher melting point of which is created from the plastic additives. Not only does it increase the melting point but also the elasticity of the road. In the turbulent climate of India, roads are severely treated and cause an extensively large drain on the natural resources to maintain. The higher elasticity of the “plastic roads” will be able to survive harsher treatment which will reduce the maintenance costs.

72. Consultant suggests using waste plastic in the bitumen intended for bituminous wearing course. During the course of investigation Consultant have identified one source of Waste plastic within the vicinity project influence area, the address of which is as follows:

K. K. Plastic Waste Management Pvt. Ltd,
No. 50, 1st Floor, Opp. Post Office,
Yelachenahalli, Kanakapura Road
Bengaluru - 78
Phone- 91 80 2666 1056/ 2666 1513
Mobile- 98450 78600/ 9880045811
E- mail- kkplasticroads@hotmail.com

G. Project Cost

73. The Civil Cost and total project cost works out to be as under:

Table 36 Project Cost

Length (In Km)	Civil Cost (In INR Cr.)	Per Km Civil Cost (In INR Cr.)	Total Project Cost (In INR Cr.)	Per Km Total Project Cost (In INR Cr.)
39.774	166.89	4.20	266.14	5.69

74. The total cost includes Contingencies, Supervision charges, Administrative charges, Quality Control charges, Road Safety cell audit charges and cost of Resettlement and Rehabilitation, Land acquisition cost, Environmental cost and shifting of utilities.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Introduction

75. 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, State Govt. of Karnataka, 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 and Legal Framework

1. Constitutional Provisions

76. 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.

2. Applicable Environmental Legislations

77. 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
- Forest (Conservation) Act, 1980 and its amendments
- Forest (Conservation) Rules, 2003 and its amendments
- Wildlife (Protection) Act, 1972 and Amended in 2003
- The Biodiversity Act, 2002
- The Karnataka Preservation of Trees Act, 1976
- Construction and Demolition Waste Management Rules, 2016
- Municipal solid Waste (Management and Handling) Rules, 2000
- The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016
- Noise Pollution (Regulation & Control) Rules, 2003 and amended in 2010
- 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
- ADB Safeguard Policy Statement 2009
- The Motor Vehicles Act, 1988

- The Motor Vehicles (Amendment) Bill, 2015
- Public Liability Insurance Act, 1991

C. Description of Key Environmental Legislations

1. The Environment (Protection) Act, 1986

78. This Act is umbrella legislation designed to provide a framework for the coordination of central and state authorities, established under the Water (Prevention and Control) Act, 1974 and Air (Prevention and Control) Act, 1981. Under this Act, the central government is empowered to take measures necessary to protect and improve the quality of the environment by setting standards for emissions and discharges; regulating the location of industries; management of hazardous wastes, and protection of public health and welfare. Empowered by the EP Act, the MoEF&CC, GoI has issued various notifications regulating the siting of industry and operations, procuring clearance to establish industries and development of projects with appropriate EIA studies, coastal zone regulations and many other aspects of environment through notifications.

2. EIA Notification and its Subsequent Amendments

- As per the Environmental Impact Assessment (EIA) Notification, 14th September 2006 and its amendment up to 17th April 2015, new national /state highway projects as well as expansion of national /state highway require Prior Environmental Clearance.
- Projects have been grouped under Category 'A' requiring clearance from Expert Appraisal Committee (EAC) of MoEF&CC, GoI and Category 'B' requiring clearance from the State / Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC).
- The concerned Committee (EAC or SEAC) will finalize the TOR on the basis of Form-1, proposed draft TOR & Pre-Feasibility / Feasibility Report.
- Environmental Impact Assessment study is to be carried out strictly as per the TOR provided by the Committee. Public Hearing is required for Category 'A' project.
- Public Hearing is required for road & highway projects **except** expansion of Roads and Highways (item 7 (f) of the Schedule) which do not involve any further acquisition of land

79. 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)	i) New National High ways; and ii) 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	i) All New State Highway Projects ii) State Highway Expansion projects in Hilly terrain (above 1,000 m MSL) and or Ecologically Sensitive Areas.	General Condition shall apply Note: Highways include expressways

80. General Condition of the EIA Notification: Any project or activity specified in Category 'B' will be appraised at the Central level as Category 'A', if located in whole or in part within 5 km from the boundary of:

- (i) Protected Areas notified under the Wild Life (Protection) Act, 1972 (53 of 1972),
- (ii) Critically Polluted areas as identified by the Central Pollution Control Board constituted under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) from time to time,
- (iii) Eco-sensitive areas as notified under sub-section (2) section 3 of the Environment (Protection) Act, 1986, and
- (iv) Inter-State boundaries and international boundaries;

81. **Conclusions:** The proposed project is the strengthening & widening of existing State Highway. Project road is passing through plain & rolling terrain (below 1,000 m MSL) and is not passing through any ecologically sensitive area. **Therefore, Environmental Clearance is not required from Government of India for improvement of SH-82 from Chintamani to Andhra Pradesh Border (39.774 Km) in the State of Karnataka.**

3. The Water (Prevention and Control of Pollution) Act and Rules, 1974, 1975

82. This Act represented India's first attempts to comprehensively deal with environmental issues. It was enacted for the prevention and control of water pollution, and the maintaining and restoring of the wholesomeness of water. The Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. The Act was amended in 1988 to conform closely to the provisions of the EPA, 1986. It set up the CPCB (Central pollution Control Board), which lays down standards for the prevention and control of water pollution. At the state level, the SPCBs (State Pollution Control Board) function under the direction of the CPCB and the state government.

83. As per the "Modified Directions under Section 18(1)(b) of The Water ((Prevention and Control of Pollution) Act and Rules, 1974 and The Air (Prevention and Control of Pollution) Act, 1981 regarding Harmonization of Classification of Industrial Sectors under Red / Orange / Green / White Categories" of **Central Pollution Control Board, dated March 07, 2016**, NOC from SPCB is required only for "New Highway Construction Project". Improvement / expansion of existing highway do not fall under any other four categories (Red, Orange, Green and White). Therefore, **NOC (under Water Act) from SPCB will not be required for improvement of existing state highway 82 (Chintamani to AP Border)**. It has also been verified from the Karnataka State Pollution Control Board.

4. The Air (Prevention and Control of Pollution) Act, Rules and Amendment, 1981, 1982, 1983, 1987

84. To counter the problems associated with air pollution, ambient air quality standards were established, under the 1981 Act. The Act provides means for the control and abatement of air pollution. The Act seeks to combat air pollution by prohibiting the use of polluting fuels and substance, as well as by regulating appliances that given rise to air pollution. Under the Act establishing or operating of any industrial plant in the pollution control area requires consent from state boards. The boards are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes.

85. The Air (Prevention and Control of Pollution) Rules formulated in 1982, defined the procedures for conducting meeting of the boards, the powers of the presiding officers, decision-making, the quorum, manner in which the records of the meeting were to be set etc. They also prescribed the manner and the purpose of seeking assistance from specialists and the fee to be paid to them.

86. National Ambient Air Quality Standard (NAAQS) for major pollutants were notified by the CPCB in April 1994 and amended in 16th November 2009 (**Annex-3.1**). To empower the central and state pollution boards to meet grave emergencies, the Air (Prevention and Control of Pollution) Amendment Act, 1987 was enacted.

87. As per the “Modified Directions under Section 18(1)(b) of The Water ((Prevention and Control of Pollution) Act and Rules, 1974 and The Air (Prevention and Control of Pollution) Act, 1981 regarding Harmonization of Classification of Industrial Sectors under Red / Orange / Green / White Categories” of **Central Pollution Control Board, dated March 07, 2016**, NOC from SPCB is required only for “New Highway Construction Project”. Improvement / expansion of existing highway do not fall under any other four categories (Red, Orange, Green and White). Therefore, **NOC (under Air Act) from SPCB will not be required for improvement of existing state highway 82 (Chintamani to AP Border)**. It has also been verified from the Karnataka State Pollution Control Board.

5. Forest (Conservation) Act, 1980 and its amendments

88. The Act came into force with effect from October 25, 1980. This Act provides for the conservation of forests and regulating diversion of forestlands for non-forestry purposes. The basic objective of the Act is, to regulate the indiscriminate diversion of forestlands for non-forestry uses and to maintain a logical balance between the development needs of the country and the conservation of natural resources/ heritage.

89. When projects fall within forestlands, prior clearance is required from relevant authorities under the Forest (Conservation) Act, 1980. For diversion of forestland, the project proponent needs to apply to the State Government. Depending on the area required to be diverted, the proposals are cleared by MoEF Regional or Central Offices provided that the cost of compensatory afforestation, cost of rehabilitation of endangered/rare species of flora/fauna, and the net present value of the forest resources are deposited upfront with the state Forest Department.

6. Forest (Conservation) Rules, 2003 and its amendments

90. These are rules by the Central Government for working and conduct of business outlined under the Forest (Conservation) Act, 1980. As per the Forest (Conservation) Rules, 2003 & its amendment, proposal involving diversion of forest land up to 5 hectares other than the proposal relating to mining and encroachments are decided by the Regional Offices of the MOEF. The Regional Office of MOEF is competent to process, scrutinize and forward decision on proposal involving diversion of more than 5 ha to 40 ha of forest land along with the recommendation (if any), to MOEF, New Delhi. For proposal involving diversion of more than 40 ha forest land the state Government/ Union Territory would forward the proposal with recommendation to MOEF as per para 2.5(ii) of guidelines issued under Forest (Conservation) Act.

7. Wildlife (Protection) Act, 1972 and Amended in 2003

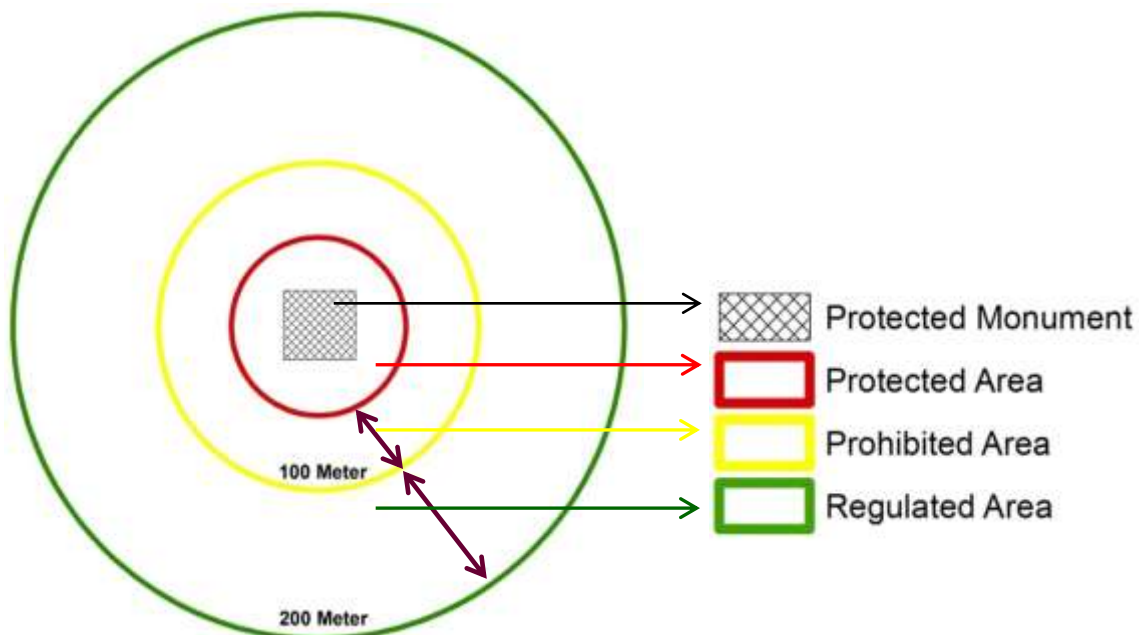
91. This Act empowers the Central and State Governments to establish National Parks and Sanctuaries; to formulate rules and designate authorities for the maintenance of National Parks, Sanctuaries and Zoos; to protect and conserve the flora and fauna. Vide Circular No. 11-9/98-FC dated 4-12-1998 issued by the Asst. Inspector General of Forests states that the Ministry of Environment and Forest has taken a decision not to permit development activities inside National Park/Sanctuaries and Tiger reserves areas that are not in consonance of Section 29 of the Wildlife (Protection) Act, 1972.

8. The Karnataka Preservation of Trees Act, 1976

92. This Act has put restriction on felling of trees in the State unless and until permitted by the Tree Officer. Any person desiring to fell a tree shall apply in writing to the tree officer for permission in that behalf. It further defines clauses for planting adequate number of trees, planting in place of fallen / destroyed trees, preservation of trees and adoption of trees.

9. Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010

93. This Act provides for the preservation of ancient and historical monuments and archaeological sites and remains of national importance and for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects. According to this Act, areas within the radii of 100m and 300m from the “Protected Monument” are designated as “Prohibited Areas” and “Controlled / Regulated Areas” respectively.



94. No development activity (including building, mining, excavating, blasting) is permitted in the “prohibited areas”. Development activities likely to damage the protected monument are not permitted in the “controlled / regulated areas” without prior permission from the Archaeological Survey of India (ASI) if the site/remains/ monuments are protected by ASI or the State Directorate of Archaeology.

95. None of the notified archaeological monuments recognized by the ASI, UNESCO or World Heritage Monuments intercept with the road improvements.

10. Disposal of Fly Ash Notification 2009 and its amendment on 25th January 2016

96. The main objective of the Fly Ash Notification is to conserve the topsoil, protect the environment and prevent the dumping and disposal of fly ash discharged from coal based power plants. The fly ash notification makes essential the use of fly ash in road construction activities.

97. As per the amendment of the Notification dated 25th January 2016 “No agency, person or organization shall, within a radius of **300 kilometres** of a thermal power plant undertake construction or approve design for construction of roads or flyover embankments with top soils; the guidelines or specifications issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP: 58 of 2001 as amended from time to time regarding use of fly ash shall be followed and any deviation from this direction can only be agreed to on technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-Chief of the concerned agency or organization or on production of a certificate of "fly ash not available" from the Thermal Power Plant(s).

98. The amendment further states that “The cost of transportation of ash for road construction projects within a radius of 100 km from a coal or lignite based thermal power plant shall be borne by the thermal power plant and the cost of transportation beyond the radius of 100 km and up to 300 km shall be shared equally between the user and the thermal power plant”. The time period to comply with the provisions of the amendment by all concerned authorities is 31st December, 2017.

99. **Bellary** Thermal Power Plant is located **within 300 km** from the proposed project road. Fly ash will be utilized for construction of road embankment.

11. ADB Safeguard Policy Statement, 2009

100. 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.

101. 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. As per the ADB's Safeguard Policy Statement the proposed **Chintamani to Andhra Pradesh Border Project** corridor having length of 39.774 km has been classified as **Category 'B'** project requiring Initial Environmental Examination (IEE).

12. Construction and Demolition Waste Management Rules, 29 March, 2016

102. The rules shall apply to everyone who generates construction and demolition waste such as building materials, debris, rubble waste resulting from construction, re-modeling, repair and demolition of any civil structure of individual or organization or authority. This will address the indiscriminate disposal of C&D Waste and enable channelization of the waste for reuse and recycling in gainful manner. Under the Rule, permission for building construction or any other infrastructure activity will not be given unless the waste generators submit specific plans to local authorities on how to dispose the waste.

a. *Responsibility of Waste Generators*

- Every waste generator shall be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated separately; deposit at collection centre so made by the local body or handover it to the authorized processing facilities, ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains.
- Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work, segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar; keep the concerned authorities informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis.
- Waste generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities;

b. *Responsibility of Local Authority (LA)*

- LA shall be responsible for proper management of construction and demolition waste within its jurisdiction including placing appropriate containers for collection of waste, removal at regular intervals, transportation to appropriate sites for processing and disposal.
- LA shall seek detailed plan or undertaking as applicable, from generator of construction and demolition waste and sanction the waste management plan; seek assistance from concerned authorities for safe disposal of construction and

demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any;

- LA shall give appropriate incentives to generator for salvaging, processing and or recycling preferably in-situ;
- LA shall establish a data base and update once in a year, device appropriate measures in consultation with expert institutions for management of construction and demolition waste generated including processing facility and for using the recycled products in the best possible manner

c. Duties of State Government or Union Territory Administration

- The Secretary in-charge of development in the State Government or Union territory administration shall prepare their policy with respect to management of construction and demolition of waste within one year from date of final notification of these rules.
- The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition waste.
- The Town and Country planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long term basis.
- Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10-20%) in municipal and Government contracts subject to strict quality control.

Table 37 Timeframe for Planning & Implementation

Sl. No.	Compliance Criteria	Cities with population of ≥ 01 million	Cities with population of 0.5-01 million	Cities with population of <0.5 million
1.	Formulation of policy by State Government	12 months	12 months	12 months
2.	Identification of sites for collection and processing facility	18 months	18 months	18 months
3.	Commissioning and implementation of the facility	18 months	24 months	36 months
4.	Monitoring by SPCBs	3 times a year	2 times a year	2 times a year

D. Applicable Indian Road Congress Codes

103. 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 38: Applicable IRC Codes

IRC:SP:108-2015	Guidelines on Preparation and Implementation of EMP
IRC:SP:98-2013	Guidelines for the use of Waste Plastic in Hot Bituminous Mixes
IRC:SP:93-2011	Guidelines on Requirements for Environmental Clearance for Road Projects
IRC:104 1988	Guidelines for EIA of Highway Projects
IRC:SP:21:2009	Guidelines on Landscaping and Tree Plantation
IRC:103 1988	Guidelines for Pedestrian Facilities
IRC: SP: 32-1988	Road Safety for Children
IRC: SP: 44-1994	Highway Safety Code

IRC: SP: 55-2001	Guidelines for Safety in Construction Zones
IRC:10:1961	Recommended Practices for Borrowpits for Road Embankments Constructed by Manual Operation
IRC:56-1974	Recommended Practices for Treatment of Embankment Slopes for Erosion Control
IRC:119:2015	Guidelines for Traffic Safety Barriers
IRC:120:2015	Recommended Practice for Recycling of Bituminous Pavement

E. Clearances Required for the Project

104. A summary of various statutory clearances required for the project road is presented in **Table 39**.

Table 39: Statutory Clearances required for the Project Road

Type of Clearance	Name of the Authority	When Required
Forest Clearance	Department of Forest, GoK	Before Construction
Tree Felling Permission	Department of Forest, GoK	Before Construction

105. 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 40** for operating his equipment and carrying out construction work.

Table 40: Clearances Required to be obtained by the Contractor

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
17.	Consent for Establishment of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Water (Prevention and Control of Pollution) Act, 1974 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
18.	Consent for Operation of Hot Mix Plant, WMM Plant, Stone Crushers and Batching Plant		
19.	Permission for withdrawal of groundwater for construction	<ul style="list-style-type: none"> ▪ Central Ground Water Authority ▪ State Ground Water Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Ground Water Rules, 2002
20.	Permission for extraction of sand from river bed	<ul style="list-style-type: none"> ▪ Department of Mines & Geology, Government of Karnataka 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986
21.	Permission for extraction of sand from river bed	<ul style="list-style-type: none"> ▪ District Level Environment Impact Assessment Authority (DEIAA) 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986
22.	New Quarry and its operation	<ul style="list-style-type: none"> ▪ Department of Mines & Geology, Government of Karnataka ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Karnataka Minor Mineral Concession Rules, 1994 ▪ The Mines Act. 1952 ▪ Mines and Minerals (Development and Regulation) Amendment Act, 2015 ▪ The Explosive Act, 1984 ▪ Air (Prevention and Control of

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
			<ul style="list-style-type: none"> ▪ Pollution) Act, 1981 ▪ Water (Prevention and Control of Pollution) Act, 1974
23.	Opening of New Borrow Areas / Quarry	<ul style="list-style-type: none"> ▪ MoEF&CC / SEIAA / DEIAA ▪ Karnataka State Pollution Control Board ▪ District Collector 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986 ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ Minor Mineral and Concession Rules, 2015
24.	Location and layout of workers camp, & equipment and storage yards	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Environment (Protection) Act, 1986; Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989
25.	Discharges from labour camp	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Water (Prevention and Control of Pollution) Act, 1974
26.	Storage, handling and transport of hazardous materials	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016 ▪ Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989
27.	Disposal of Bituminous Wastes	<ul style="list-style-type: none"> ▪ Intimate local civic body to use local solid waste disposal site 	<ul style="list-style-type: none"> ▪ Hazardous and Other Waste (Management and Trans-boundary Movement) Rules, 2016
28.	PUC Certificate for all construction vehicles and all machineries	<ul style="list-style-type: none"> ▪ Transport Department of Govt. of Karnataka 	<ul style="list-style-type: none"> ▪ The Motor Vehicle Act 1988 ▪ The Motor Vehicles (Amendment) Bill, 2015 ▪ The Central Motor Vehicles Rules, 1989
29.	Installation of DG Set (Consent to Establish)	<ul style="list-style-type: none"> ▪ Karnataka State Pollution Control Board 	<ul style="list-style-type: none"> ▪ Air (Prevention and Control of Pollution) Act, 1981 ▪ The Noise Pollution (Regulation and Control) Rules, 2000
30.	Operation of DG Set (Consent to Operate)		
31.	Engagement of Labour - Labour License	<ul style="list-style-type: none"> ▪ Labour Commissioner (Ministry of Labour and Employment) 	<ul style="list-style-type: none"> ▪ 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
32.	Engagement of Labour - Social Security - Labour Welfare - Wages	<ul style="list-style-type: none"> ▪ Labour Commissioner (Ministry of Labour and Employment) 	<ul style="list-style-type: none"> ▪ 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

Sl. No.	Construction Activity & Type of Clearance Required	Statutory Authority	Statute Under which Clearance is Required
			<ul style="list-style-type: none"> ▪ The Payment of Wages (Amendment) Act, 2005 ▪ The Minimum Wages Act, 1948 ▪ The Minimum Wages (Central) Rules, 1950

106. 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 local Panchayat / Municipal body for setting up Construction Camp
- Change of Land Use Certificate from District Land Revenue Officer (DLRO)

F. Administrative Framework

107. 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.

1. Ministry of Environment, Forest and Climate Change

108. 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.

2. Central Pollution Control Board

109. 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.

3. Karnataka State Pollution Control Board

110. The KSPCB is the government agency responsible for ensuring the compliance to relevant standards related to discharges to the environment. Activities of KSPCB include, planning and execution of State wide program for prevention, control and abatement of water and air pollution; advise the State Government on prevention, control and abatement of water and air pollution and siting of industries; ensure compliance with the provisions of relevant

environmental legislation; establish and review local effluent and emission standards; ensure legal action against defaulters; and develop cost effective methods for treatment, disposal and utilization of effluent.

4. Archaeological Survey of India

111. 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.

5. National Board for Wildlife

112. 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.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

113. The existing environmental conditions of the study area covering an area spread over 15 km on either side of the road, in general and specific environmental features of the study corridor, i.e., 50 m on either side of the existing centerline of the road, in particular, has been studied as described in the subsequent sections.

B. Location – Districts En-Route

114. The project road, having a length of about **39.774 km**, passes through the Chikballapur and Kolar districts of Karnataka. The length of the road in Chikballapur district is 10.852 km while in Kolar district, the length of the project road is 28.922 km. The location of the project road is shown on Index Map at **Figure 5**.

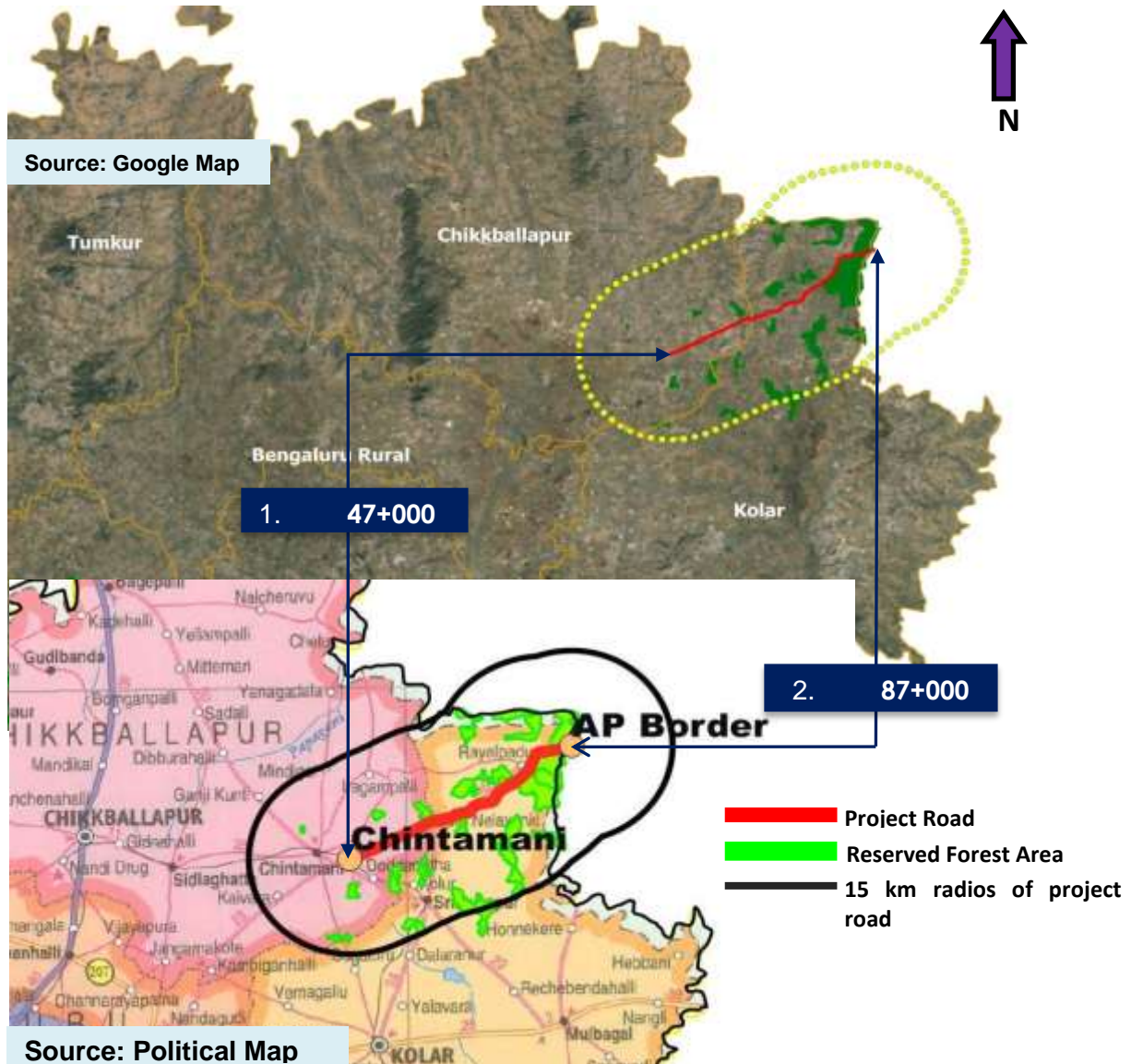


Figure 5: Map showing location of the Chintamani AP Border Road

C. Geology, Topography and Soil

115. The prevailing rock in the study area is light to dark grey or whitish biotic granite gneiss, which varies considerably from place to place varies in texture, structure and appearance, according to the fineness or coarseness of its constituent grains and the relative abundance or scarcity, and mode of deposition of the darker ferro-minerals. The study area does not contain minerals of sufficient commercial value. The geological map of the area superimposed with the project road alignment is presented in **Figure 6**.

116. The topography of the study area is undulating. The project area located in the valley of Palar river Basin, which is an important basin located between Pennar and Cauvery Basin and is well cultivated. The northern part of the area district forms a depression forming the valley of the North Pinakini River towards Gauribidanur. The general elevation of the study area varies from 249 to 911 m above mean sea level, while the general elevation of project corridor varies between 790-871 m.

117. The soils around project road occur on different landforms such as hills, ridges, pediments, plains and valleys. The types of soils distributed range from red loamy soil to red sandy soil and lateritic soil.

118. The district Chikkaballpur in which project lies underlines Granites, gneisses, schists, laterites and alluvium. Basic dykes intrude the above formations at places. Granites and gneisses occupy major portion of the district. Schists are mostly confined to the northwestern part of Gauribidanur taluk. Laterites occupy small portions in Chikkaballapur, and Sidlaghatta taluks. Alluvium is confined to river courses. Fractures or lineaments occupy well defined structural valleys and majority of them trend NE-SW direction.

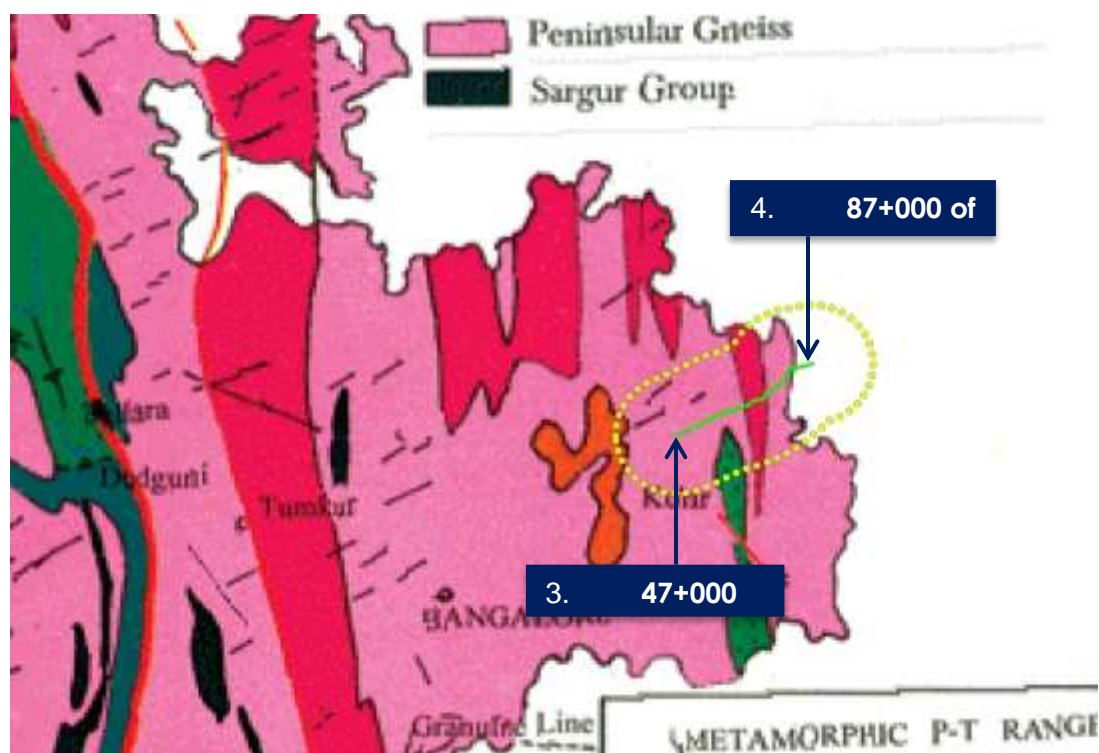


Figure 6: Geological Map of the Study Area

D. Seismicity

119. The project area is located in the southern India which is moderately active seismic region. The project road is situated in the Zone II (having low seismic intensity) of the Seismic Map of India (as per IS: 1893, Part I, 2002) and therefore has a low risk of potential damage due to earthquake.

E. Drainage and River System

120. Drainage is controlled by topography. The drainage pater of the area is highly dendritic in nature. The undulating terrain is traversed by interconnected grid of numerous causeways and drainage channels that connects Palar and Pinakani rivers, both originating from the hillocks of Chikkaballur district and carries the runoff during the rainy season only. There is no perennial river in the study area.

F. Agriculture and Irrigation Practices

121. The predominant crops grown are finger millet, groundnut and pulses. Finger millet occupies about 45% of the total cultivated area. The important irrigated crops are paddy, mulberry, sugarcane, potato and other vegetables. The important commercial fruit crops grown are mango and grapes. The area irrigated by wells constitutes 99% of the total irrigated area. Dug well irrigation practice is largely replaced by bore-well irrigation. Irrigation is being practiced both in the valley as well as in upland areas.



Agricultural activity along the Project Road

G. Land Use

1. Method of Data Preparation

122. The land use/land cover has been presented in the form of a map prepared by using Survey of India Topographical sheet no. 57K/3, 57K/7 and 57K/6B/9 (1:50000 scale) and satellite images. The map data has been processed using geo-processing software ArcGIS and Erdas Imagine software supported with ground truth verification. Area and distance calculations have been carried out using the software after geo-referencing the interpreted data with the help of the topographical maps. The land use map of the study area covering 15 km on either side is provided in **Annex 4.1** and **Figure 8** below (Compressed Version). The topographical sheets, as mentioned above, superimposed with the project road alignment and its 15 km radius are provided in **Annex 4.2**.

2. Land use within Corridor of Impact

123. Agriculture activity has been noted on both sides of the project road for majority section with plantation of fruits bearing trees. The project road passes through very few small settlements. Commercial activities were only found when alignment passing through settlements however no major industries are located along the project road.

124. The land use pattern within 50 m on either side of the project road is agricultural land (67%) followed by forest area (25%) and built-up (8%). Within ROW the land use is mainly open land with series of trees by the side of the earthen shoulder



Project Road inside the Reserved Forest



Agricultural Activities along the Project Road

3. Land Use within the Study Area

125. The land use classification within approximately **15 km** area of the project site is summarized in **Table 41** and major land use types are graphically presented in **Figure 7**.

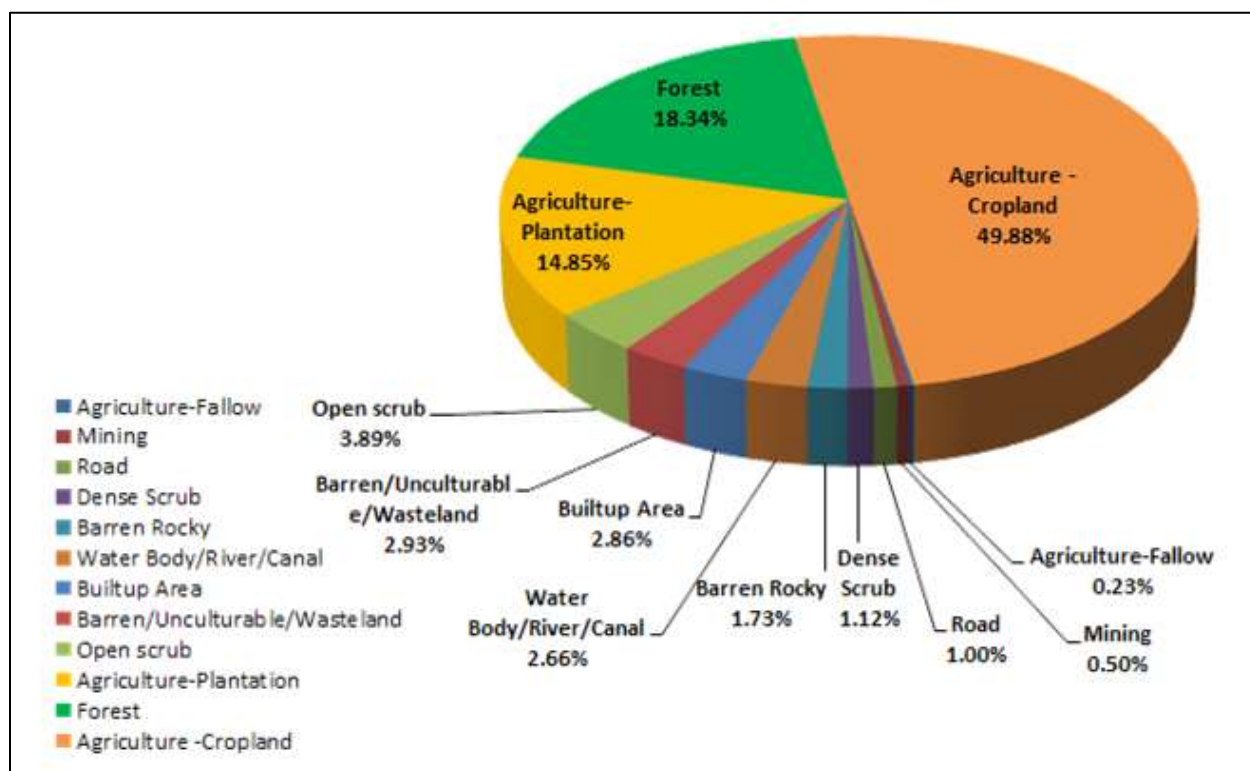


Figure 7: Land use types in the study area

126. Majority of the land is under agrarian use (50%), followed by forest (18%) and orchard plantations (15%).

Table 41: Area Statistics of Land Use/Land Cover Map

Land use Classes	Sq. km	Percentage
Agriculture, Fallow	4.244167	0.2
Mining	9.359128	0.5
Road	18.677258	1.0
Dense Scrub	21.062843	1.1
Barren Rocky	32.419228	1.7
Water Body/River/Canal	49.849085	2.7
Builtup Area	53.542458	2.9
Barren/Unculturable/Wasteland	54.779456	2.9
Open scrub	72.889627	3.9
Agriculture – Orchard Plantation	278.127954	14.9
Forest	343.457158	18.3
Agriculture - Cropland	934.045946	49.9
Total	1872.454308	100.0

Source: Field Survey and interpretation of Satellite Imagery by ICT, December 2015

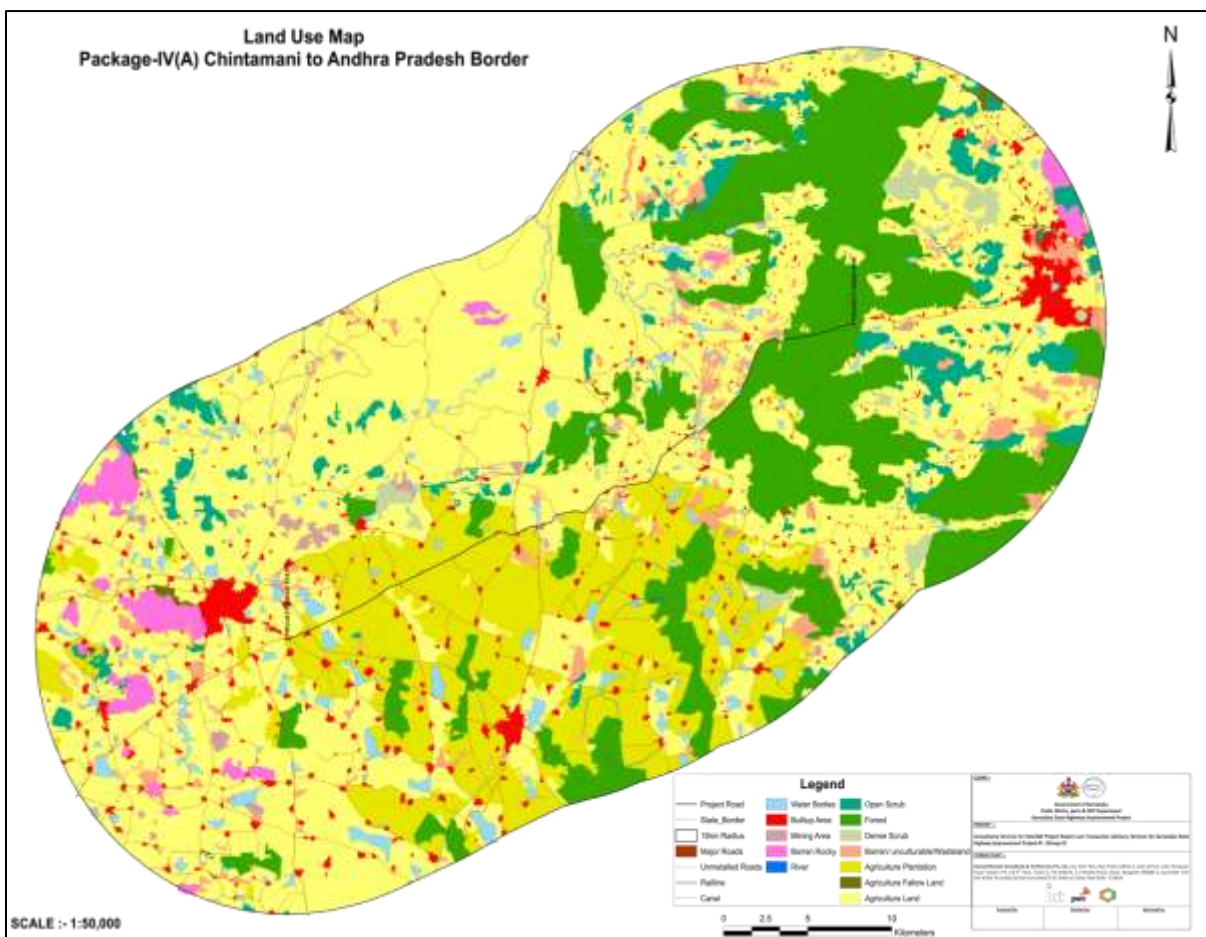


Figure 8: Land Use map of 15 km radius of the project area

H. Soil Quality

127. Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal growth.

1. Soil Monitoring Stations

128. 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 26**.

Table 42: Details of Soil Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Area category
1	SQ1	Thadigal Cross	62+550	LHS	40	Agriculture
2	SQ2	Gontapalli Village	83+500	RHS	60	Forests

Source: Field Survey in December 2015

Distance in meter from existing centerline

129. M/s Mantec Environmental Laboratory (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection and analysis of Soil samples. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm. Two (2) sampling locations within the study area were selected for studying soil characteristics.

2. Soil Characteristics of the Study Area

130. While characterizing soil samples, analytical methods for various parameters have been adopted from M. L. Jackson and SSA series (USA) Volume I and II and applicable IS Codes.

131. The physico-chemical characteristics of the soils in the study area, as obtained from the analysis of the soil samples, are presented in **Table 43** & **Table 44**. The results are compared with standard soil classification.

Table 43: Sand, Silt, Clay & Soil Porosity

Sl. No.	Location Code	Sand (%)	Silt (%)	Clay (%)	Porosity (%)	Soil Texture
1	SQ1	34	11	55	39	Silt Loam (Brown)
2	SQ2	38	10	52	41	Silt Loam (Brown)

Source: Field Survey in December 2015

Table 44: Physico-Chemical Characteristics of Soil in the Study Area

SN	Parameters	Unit	Location Code	
			SQ1	SQ2
1.	pH	-	7.62	7.54
2.	Colour		Brown	Brown
3.	Bulk Density	g/cm ³	1.48	1.51
4.	Electrical Conductivity	µs/cm	415	422
5.	Moisture	%	18	16
6.	Potassium as K	mg/100g	0.63	0.71
7.	Nitrogen as NO ₃ -N	mg/100gm	11	12.2
8.	Phosphorous as P	mg/100gm	41.8	51.8

SN	Parameters	Unit	Location Code	
			SQ1	SQ2
9.	Chloride (Cl ⁻)	mg/kg	16	12.4
10.	Sodium	mg/kg	1.7	1.3
11.	SAR	-	0.49	0.39
12.	Lead	mg/Kg	BDL	BDL
13.	Sodium Sulphate	%	0.11	0.1
14.	Calcium Sulphate	%	0.005	0.005
15.	Organic Matter	%	3.59	1.44
16.	Iron as Fe	ppm	3.1	3.6
17.	Infiltration Rate	mm/hr.	0.8	1.01

Source: Field Survey in December 2015

132. It has been observed that the texture of soil is silt loam with 34-38% sand content and 52-55% clay content. The pH of the soils ranged between 7.54 to 7.62 indicating slightly alkaline which can hold excess calcium and molybdenum salts and are generally low in iron and boron nutrients. This kind of soil is suitable for growing cereals such as wheat, oat and barley, while most of the other crops including corn and soybeans require slight pH correction towards the lower ranges. The studied pH range also indicates the suitability of the soils for optimum growth of blue green bacteria, which fixes atmospheric nitrogen and also supports growth of other bacteria, Actinomycetes (range 6.5-9.5), which boost the fertility status of the soil.

133. The Electrical conductivity was low, varies between 415 to 422 $\mu\text{s}/\text{cm}$, which indicates low salinity status of the soil. This low conductivity values also favors growth of soil microorganisms. Exchangeable potassium, sodium, calcium and magnesium were found to be low.

134. The organic matter was observed to sufficient and varying in the range of 1.44% to 3.59%. The sodium absorption ratio is low (0.39 to 0.49%), while the nitrogen content of the soil is sufficient. Thus, it can be inferred that the overall fertility status of the soils within the study area is good.

I. Climate and Meteorology

1. Climatic Conditions of the Study Area

135. In the study area has a tropical climate with hot summer, high rainfall and mild winter. The months of November and December are generally dry and cool. The month of April is the hottest with mean daily maximum temperature being above 35°C. However, extreme temperatures have been recorded up to 39°C. With the onset of monsoon there is a slight drop in the temperature. Lowest night temperatures in the cold seasons has been recorded to be dropped up to 8.5°C, while the mean minimum temperature remains around 15°C in winter. Humidity is high (82%) during monsoon season. Visibility in winter months remains clear and mist rarely leads to foggy conditions.

136. Past meteorological data of nearest IMD Observatory at Arogyavaram, located at 12 km areal distance near the end of the project road, is presented below for the period of 1951-1980 to establish the baseline climatic conditions of the area. The key parameters of collected meteorological data have been summarized in **Table 45** below.

Table 45: Summaries of Climatological Data (Based on IMD Records of 1951-80)

Parameter	IST	Monthly Range	Annual Mean/Total
Mean Daily Maximum Temperature (°C)		25.7 (Dec) – 35.2 (April)	30.4
Mean Daily Minimum Temperature (°C)		14.9 (Dec) – 23.4 (May)	19.7
Relative Humidity (%)	0830	60 (Mar) - 82 (Dec)	71
	1730	29 (Mar) – 67 (Nov)	50
Total Rainfall (mm)		5.4 (Jan) – 148.6 (Oct)	755.4
Wind Speed (km/h)		6.9 (Nov) – 18.8 (Jul)	8.7
Cloud Cover (all cloud oktas)	0830	1.8 (Mar) – 6.5 (Jul)	4.4
	1730	2.5 (Mar) – 7.0 (Jul)	5.1

Source: Climatological Data of Arogyavaram (Station 43271), Indian Meteorological Department

a. Temperature

137. A semi-arid climate, characterized by typical monsoon, tropical weather with hot summers and mild winters is observed in the study area. April & May are usually the hottest month when mean daily maximum temperature remains about 35°C and the mean daily minimum about 23°C. However, extreme temperatures have been recorded up to 39.8°C.

138. With the onset of the monsoon in mid-June, there is appreciable drop in day temperature but that of night temperature is less. In October the temperature decreases. December is generally the coldest month with the mean daily maximum temperature at 25°C and the mean daily minimum at 15°C. Night during January are, however, slightly cooler than December. Lowest night temperatures in the cold seasons have been recorded to be dropped up to 8.5°C. The monthly ambient temperature profile in the study area is presented in **Figure 9**.

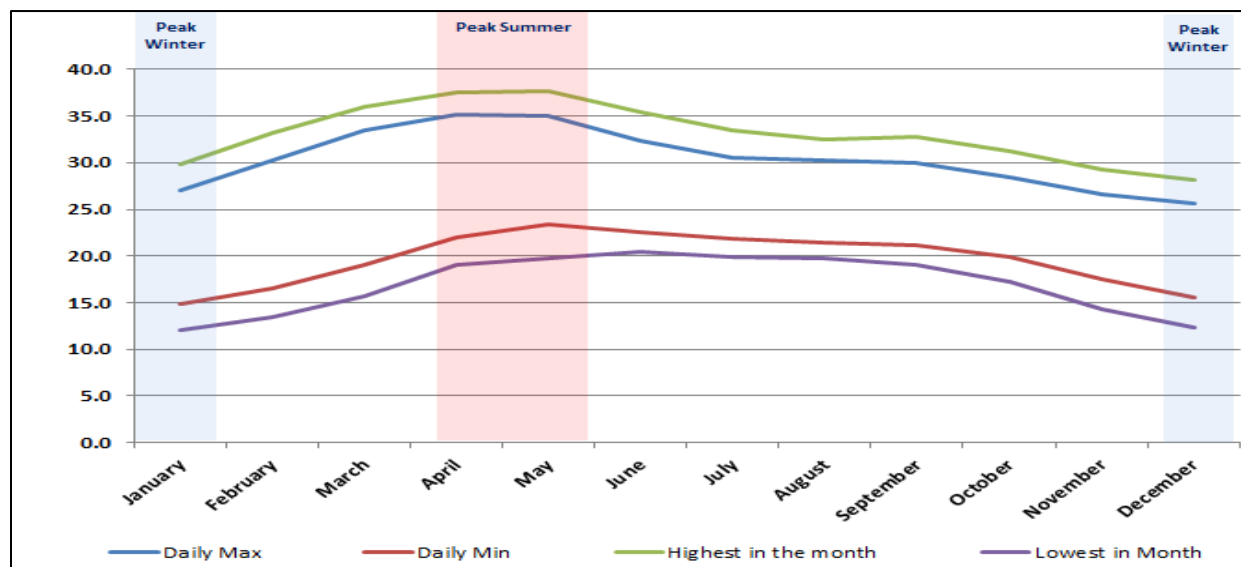


Figure 9: Monthly Ambient Temperature Profile

b. Rainfall & Relative Humidity

139. Normal annual rainfall is around 755 mm in the region. Historical data shows that moderate rains occur in the month of November due to NE monsoon. The southwest monsoon

contributes around 47 percent of the annual rainfall. The other monsoon (NE) yields around 37 percent and the balance of around 16 percent results from the pre-monsoon and winter.

140. The average monthly rainfall, relative humidity and wind speed data and bar projections denoting incremental frequency and high/low values is provided in **Table 46**. September and October are the wettest months with over 118 mm monthly rainfall and 7 days rainy days on average. Thunderstorms are common during the month of May. The post monsoon season often gets copious rains due to passing depressions. On annual basis the variability coefficient are less than 30 percent indicating consistent rainfall. On seasonal basis dry season rainfall is most inconsistent whereas the monsoon rainfall is least inconsistent. The lowest annual rainfall recorded in the district is around 300 mm while the highest is over 1300 mm¹. The rainfall profile in the study area is presented in **Figure 10**.

Table 46: Rainfall, Relative Humidity and Mean Wind Speed in the Study Area

Months	Monthly Rainfall (mm)	No of Rainy Days	Mean Wind Speed (kmph)	Relative Humidity (%)	
				0830 Hours	1730 Hours
January	5.4	0.5	5.7	78	47
February	7.0	0.3	7.3	67	35
March	10.0	0.5	8.5	60	29
April	30.3	1.9	8.1	65	35
May	69.7	4.4	9.7	61	38
June	56.8	4.0	13.2	66	49
July	88.3	6.5	13.5	72	56
August	89.1	6.3	12.7	72	56
September	118.6	7.0	9.3	74	57
October	148.6	8.1	5.8	79	66
November	95.1	5.8	5.2	80	67
December	36.5	2.9	5	82	60
Total	755.4	48.2	8.7	71	50

c. Wind Speed

141. Average winds speed is high in monsoon north east monsoon and winter months, while in summer months witness relatively less wind flow. The wind speed profile in the study area is presented in **Figure 10**.

¹ Source: Ground Water Information Booklet, Kolar District – CGWB, Ministry of Water Resources, Gol

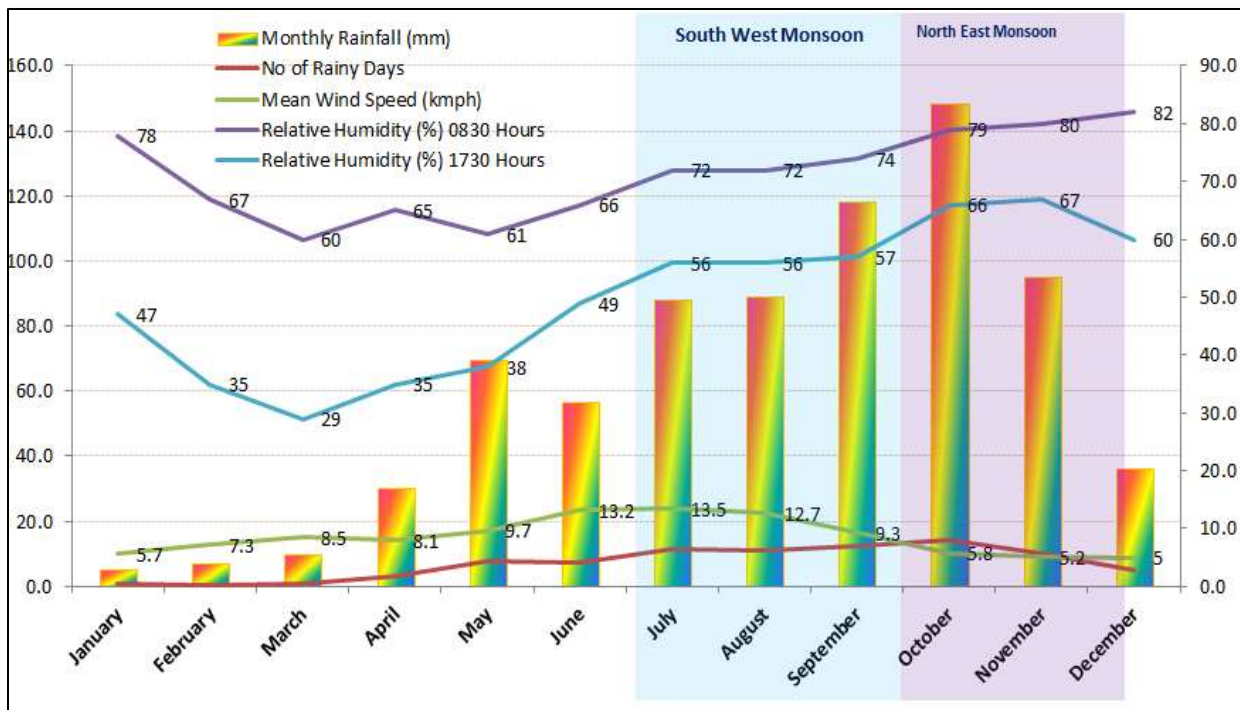


Figure 10: Monthly Rainfall, Rainy Days, Wind Speed and Relative Humidity

d. Weather Extremes

142. High summer temperature over 35°C occurs occasionally in the month of May. Highest temperature has been recorded to be 39.8°C in May 1980. Moderately low temperatures had been recorded during winter months, the lowest being 8.5°C in December 1970.

143. Dust Storms are extreme rare and its occurrence storms have not been recorded in 60 years. However, thunders are frequent in April-May and September-October but it has been recorded in other non-winter months rarely. Heaviest shower of 383.8 mm in 24 hours was received in the Oct 1953, while 311.9 mm rain was received in July 1954.

144. On an average, the study area receives 0.3 mm or more rainfall in 70 days in a year. Winter is not associated with poor visibility. **Table 47** shows the extreme weather data with bar projections denoting incremental frequency and up & down arrows showing maximum and minimum values respectively.

Table 47: Numbers of days with Extreme Weather Condition in the Study Area

Months	Weather Phenomena					Visibility#				
	Rain more than 0.3	Hail	Thunder	Fog	Dust Storm	Up to 1 km	1-4 km	4-10 km	10-20 km	Over 20 km
January	0.8	0.0	0.0	0.8	0.0	0.4-0	1.8-0.3	5.1-1.7	9.9-4.3	13.8-24.7
February	0.5	0.0	0.1	0.0	0.0	0.1-0	0.6-0	4-0.6	6.9-4.3	16.4-23.1
March	0.6	0.0	0.3	0.2	0.0	0.1-0	0.5-0.2	3-1	7.6-7.4	19.8-22.4
April	2.7	0.0	1.7	0.0	0.0	0-0	0.1-0.3	2-2	9.2-6.6	18.7-21.1
May	6.6	0.0	2.8	0.0	0.0	0-0	0.4-0.7	2.4-2.7	7.4-7.1	20.8-20.5
June	6.4	0.0	1.3	0.0	0.0	0-0	0.4-1	3-3.4	8.9-8.1	17.7-17.5
July	10.6	0.0	1.0	0.0	0.0	0-0.1	0.6-1.2	4-4.2	10.8-8.9	15.6-16.6
August	9.8	0.0	0.9	0.0	0.0	0-0.1	0.6-1.8	3.3-3.8	11-9.5	16.1-15.8
September	9.3	0.0	1.4	0.0	0.0	0-0	0.7-1	3.2-3.9	9.9-8.3	16.2-16.8
October	11.2	0.0	2.5	0.0	0.0	0.1-0	1.5-2.6	4.7-4.3	10.9-8.6	13.8-15.5
November	7.5	0.0	0.1	0.3	0.0	0.5-0.3	2.6-1.9	5.5-4.5	9.8-8.3	11.6-15
December	4.0	0.0	0.0	0.2	0.0	0.3-0.1	3.1-2.1	7-3.1	11.2-11.2	9.4-14.5
Annual Mean	70.0	0.0	12.1	1.5	0.0	1.5-0.6	12.9-13.1	47.2-35.2	113.5-92.6	189.9-223.5

Source: Climatological Data of Gadag, Indian Meteorological Department
Hyphenated values refers to the visibility at 0830 hours and 1730 hours

2. On-site Meteorological Monitoring

145. An automatic weather station was established at Thadigal Cross for collection of meteorological data from 8th December 2015 to 6th January 2016. M/s Mantec Environmental Laboratory (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 48**.

146. 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.

147. 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 presented in **Annex-4.2** and summarized in **Table 48**.

Table 48: Location of Meteorological Station and Monitored Parameters

Parameters	Frequency	Location	Latitude & Longitude
Hourly Wind Speed, Wind Direction, Relative Humidity, Temperature & Rainfall	Hourly data	Thadigal Cross	13°26'6.91"N 78°12'47.46"E

Source: Field Survey during Dec 2015 to Jan 16

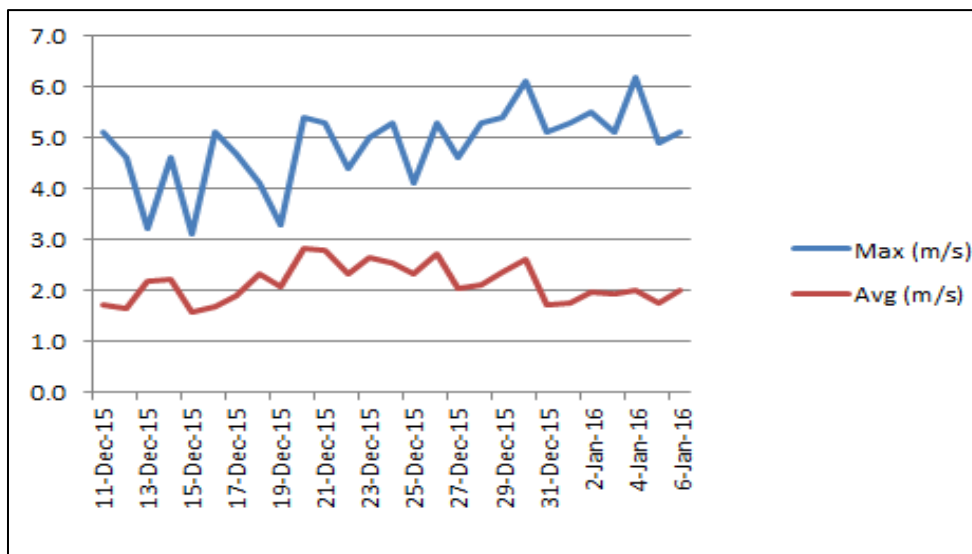


Figure 11: Daily Fluctuation of Temperatures in Study area

148. A maximum temperature of 34.2°C and minimum temperature of 11.6°C was observed during the monitoring period. Daily fluctuations in maximum and minimum temperature are presented graphically in **Figure 11**.

149. The minimum temperature during study period shows a consistent declining trend from December to January, which is considered as month having lowest night time temperature.

150. Daily fluctuation of wind speed during the monitoring period is shown in **Figure 12**. Average wind speed during the monitoring period was 1.96 m/sec and predominant wind direction (blowing from) was North West.

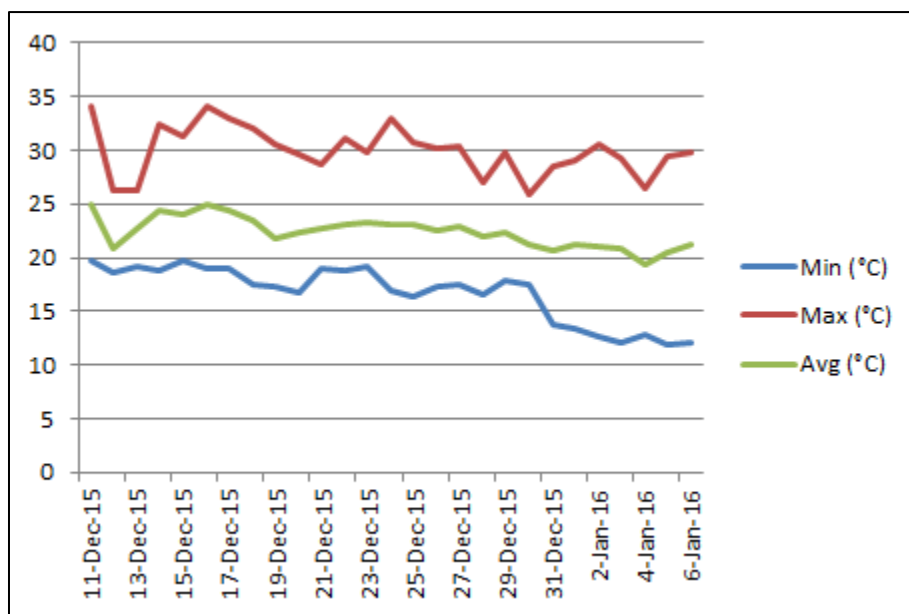


Figure 12: Daily Fluctuation of Wind Speed in Study area

151. The wind rose diagram of the study area is presented in **Figure 13**. The maximum wind speed in the monitoring period shows an inclining trend towards January, having minimum nighttime temperature.

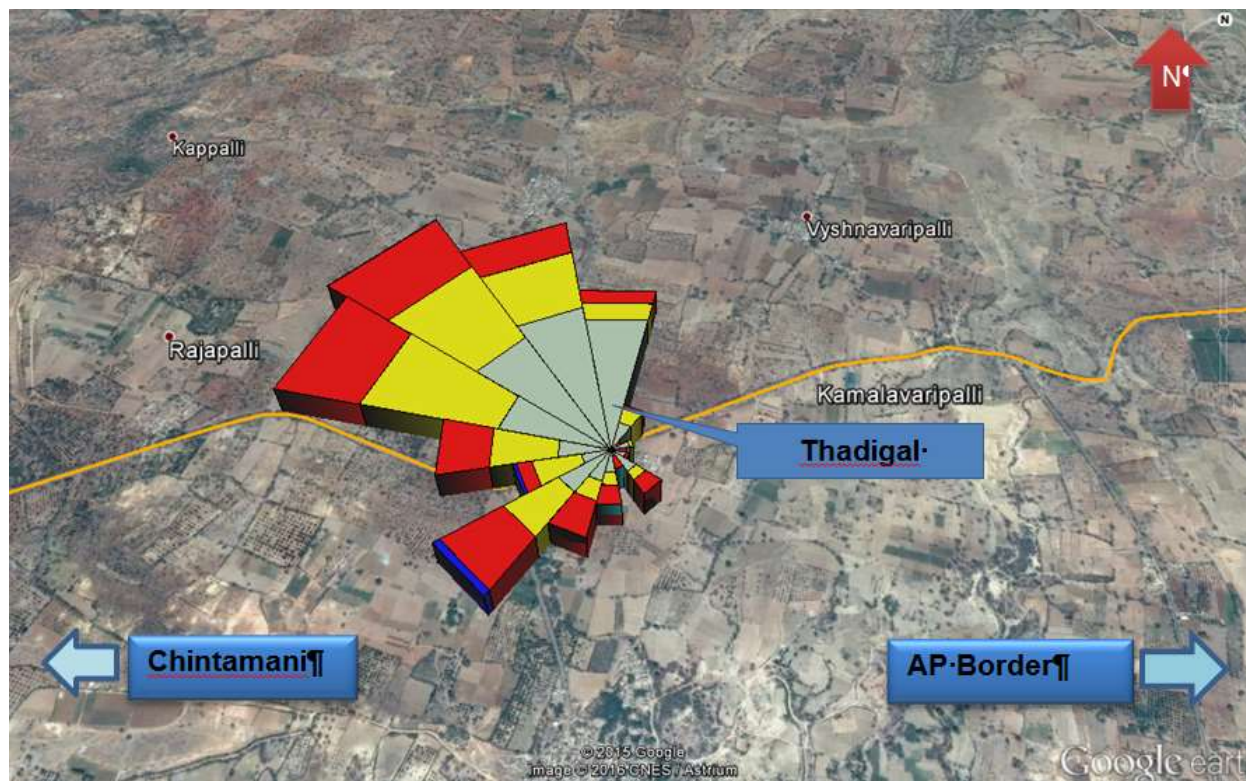


Figure 13: Wind Rose Diagram of the Study Area

152. Maximum Relative humidity during the monitoring period is found to be 97.3% while the average relative humidity was about 70.3%. The period was mostly dry; Rainfall has been limited to 4 hours spanning 4 days during the entire study period.

Table 49: Summary of On-site Meteorological Data

Parameters	Dec 2015 – Jan 2016
Maximum Temperature ($^{\circ}$ C)	34.2
Minimum Temperature ($^{\circ}$ C)	11.6
Maximum Relative Humidity (%)	97.3
Total Rainfall (mm)	3.6
Average Wind Speed (m/sec)	1.96
Calm condition	19.8%
Predominant wind direction (blowing from)	North West
Dry hours (%)	99.5%

Source: On-site Monitoring during Dec15-Jan16

J. Ambient Air Quality

1. Ambient Air Quality Monitoring Stations

153. M/s Mantec Environmental Laboratory (A NABL Accredited & MoEF Recognized laboratory) was engaged for ambient air quality monitoring. Two sampling stations were set up for monitoring ambient air quality within the study area. The locations of the monitoring stations were selected 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 etc. were considered while finalizing the locations of such stations.

154. The locations of the ambient air quality monitoring stations in the study area are given in **Table 50**.

Table 50: Details of Ambient Air Quality Monitoring Stations

SN	Station	Place	Existing Chainage	Side	Distance# (m)	Land use
1	AQ1	Thadigal Cross	62+300	RHS	55	Residential area
2	AQ2	Manchineela Kotte	73+300	RHS	70	Residential & agriculture

Source: On-site Field Monitoring during Dec 15 – Jan 16
Distance in meter from existing centerline

2. Parameters Monitored & Monitoring Period

155. 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 PM₁₀
- Sulphur Dioxide (SO₂)
- Nitrogen Dioxide (NO₂)
- Carbon monoxide (CO)

156. Ambient air quality monitoring was conducted over one month period (Dec 15-Jan 16) at a frequency of twice a week at each station adopting a 24-hours schedule. CO has been measured 1-hourly. Ambient air quality monitoring methodology has summarized in **Table 51**.

Table 51: Methodology for Ambient Air Quality Monitoring

Parameter	Sampling Frequency	Sampler Name, Model & Make	Measurement Methods
PM _{2.5}	24-hourly twice a week	Fine Particulate Sampler Ecotech (AAS127)	Gravimetric
PM ₁₀		Respirable Dust Sampler Ecotech (AAS127)	Gravimetric
SO ₂			Colorimetric (EPA modified West & Gaeke Method)
NO ₂			Colorimetric (Arsenite modified Jacobs & Hochheiser Method)
CO	1-hourly twice a week	-	Non Dispersive Infra Red (NDIR) Spectroscopy Technique

Source: NABL & CPCB Guidelines on Air Quality Analysis

3. Monitoring Results

157. Monitoring station-wise as well as overall statistical analysis comprising of minimum, maximum, arithmetic mean, standard deviation and 98-percentile of the ambient air quality are shown in **Table 51**. Pollutant-wise summary of monitoring results are provided in **Table 52 to 57**.

158. National ambient air quality standards are reproduced in **Annex-3.1**. The detailed on-site twice a week 24-hourly monitoring results of PM_{2.5} PM₁₀ SO₂ NO₂ and 1-hourly CO corresponding to air quality stations AQ1 and AQ2 are presented in **Annex-4.3**.

a. **Particulate Matter of Size less than 2.5 micron or PM_{2.5}**

Table 52: Summary of PM_{2.5} levels in Study Area

Station Code	Station Location	Area Category	PM _{2.5} (µg/m ³)			
			Range	Mean	98%tile	NAAQ Standard
AQ1	Thadigal Cross	Residential & Rural	10-15	12.63	14.86	60
AQ2	Manchineela Kotte		28-40	33.75	39.72	
Overall of 2 locations			10-40	23.19	39.40	

Source: On-site Field Monitoring during Dec15 – Jan 16

159. Arithmetic mean of the 24-hourly average values of PM_{2.5} varied station-wise between 10-40 µg/m³ with overall mean of the 2 stations being 23.19 µg/m³.

160. The 24-hourly average 98-percentile values of PM_{2.5} (max 39.72 µg/m³ at AQ2) at both the locations were observed to be within the limit of 60 µg/m³ for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards, 2009.

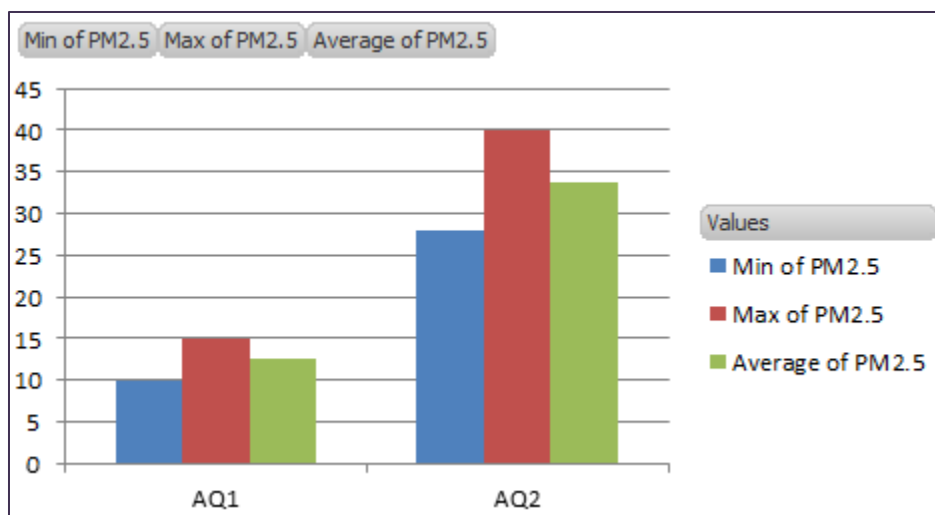


Figure 14: Variation in PM_{2.5} Levels

b. **Particulate Matter of Size less than 10 micron or PM₁₀**

Table 53: Summary of PM₁₀ levels in Study Area

Station Code	Station Location	Area Category	PM ₁₀ (µg/m ³)			NAAQ Standard
			Range	Mean	98%tile	
AQ1	Thadigal Cross	Residential & Rural	40-60	51.13	59.44	100
AQ2	Manchineela Kotte		56-68	61.50	67.72	
Overall of 2 locations			40-68	56.31	67.40	

Source: On-site Field Monitoring during Dec15 – Jan 16

161. Arithmetic mean of the 24-hourly average values of PM₁₀ varied station-wise between 40-68 µg/m³. The overall mean for both stations was 56.31 µg/m³.

162. The 24-hourly average 98-percentile values of PM₁₀ (max 67.72 µg/m³ at AQ2) at both locations were observed to be within the limit of 100 µg/m³ for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards.

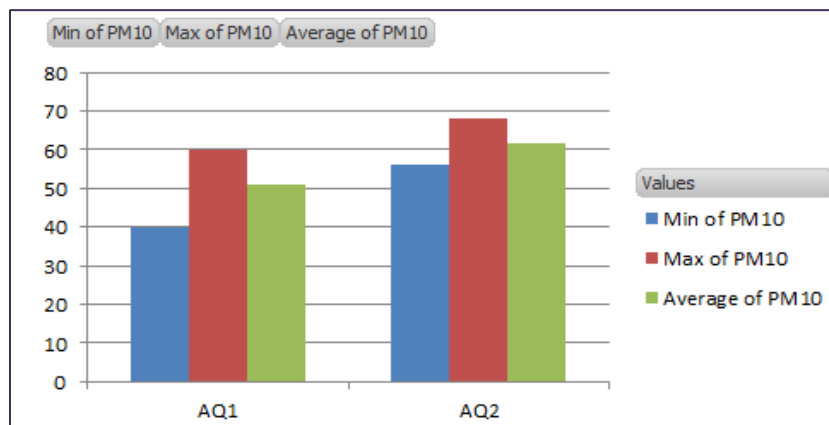


Figure 15: Variation in PM₁₀ Levels

c. Sulphur Dioxide (SO₂)

Table 54: Summary of SO₂ levels in Study Area

Station Code	Station Location	Area Category	SO ₂ (µg/m ³)			
			Range	Mean	98%tile	NAAQ Standard
AQ1	Thadigal Cross	Residential & Rural	8.2-12.6	10.09	12.42	80
AQ2	Manchineela Kotte		10.2-16.2	13.14	16.06	
Overall of 2 locations			8.2-16.2	11.61	15.90	

Source: On-site Field Monitoring during Dec15 – Jan 16

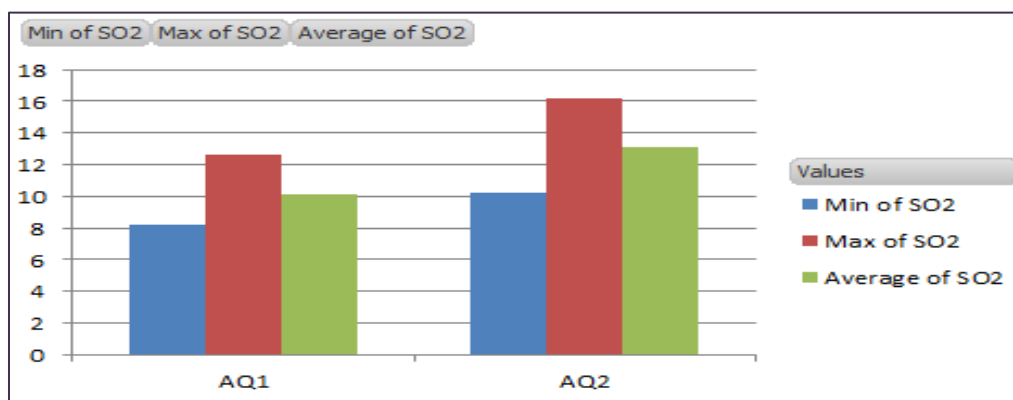


Figure 16: Variation in SO₂ Levels

163. Arithmetic mean of the 24-hourly average values of SO₂ varied station-wise between 8.2-16.2 µg/m³ with overall mean of the 2 stations being 11.61 µg/m³.

164. The 24-hourly average 98-percentile values of SO₂ (max 16.06 µg/m³ at AQ2) at both the locations were observed to be within the limit of 80 µg/m³ for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards, 2009.

d. Nitrogen Dioxide (NO₂)

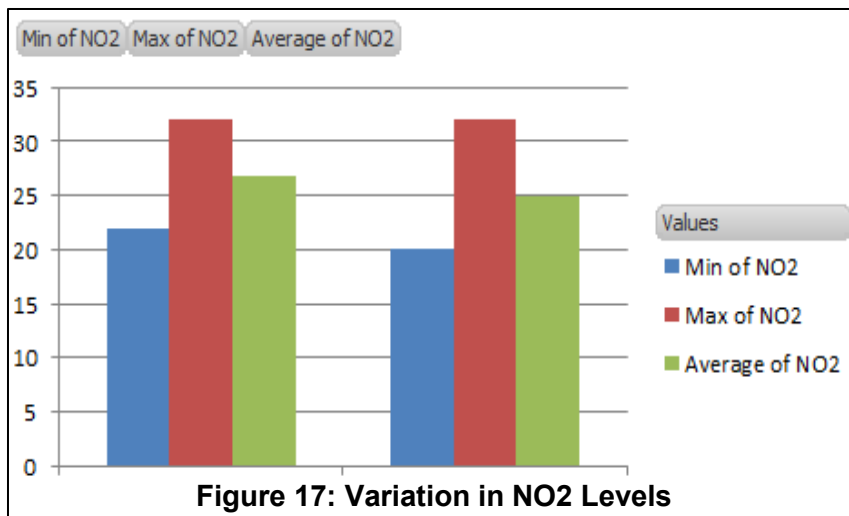
Table 55: Summary of NO₂ levels in Study Area

Station Code	Station Location	Area Category	NO ₂ (µg/m ³)			
			Range	Mean	98%tile	NAAQ Standard
AQ1	Thadigal Cross	Residential & Rural	22-32	26.75	31.72	80
AQ2	Manchineela Kotte		20-32	25.00	31.72	
Overall of 2 locations			20-32	25.88	32.00	

Source: On-site Field Monitoring during Dec15 – Jan 16

165. Arithmetic mean of the 24-hourly average values of NO₂ varied station-wise between 20-32 µg/m³ with overall mean of the 2 stations being 25.88 µg/m³.

166. The 24-hourly average 98-percentile values of NO₂ (31.729.05 µg/m³ for both stations) at both the locations were observed to be within the limit of 80 µg/m³ for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards, 2009.

**Figure 17: Variation in NO₂ Levels**

e. Carbon monoxide (CO)

167. Arithmetic mean of the 24-hourly average values of CO varied station-wise between 0.24-0.43 mg/m³ with overall mean of the 2 stations being 0.33 mg/m³.

**Figure 18: Variation in CO Levels**

Table 56: Summary of CO levels in Study Area

Station Code	Station Location	Area Category	CO (mg/m ³)			
			Range	Mean	98%tile	NAAQ Standard
AQ1	Thadigal Cross	Residential & Rural	0.30-0.43	0.37	0.43	4
AQ2	Manchineela Kotte		0.24-0.33	0.30	0.33	
Overall of 2 locations			0.24-0.43	0.33	0.42	

Source: On-site Field Monitoring during Dec15 – Jan 16

168. The 24-hourly average 98-percentile values of CO (max 0.43 mg /m³ at AQ1) at both the locations were observed to be within the limit of 4 mg/m³ for Industrial, Residential, Rural & other areas as stipulated in the National Ambient Air Quality Standards, 2009.

Table 57: Statistical Analysis of Ambient Air Quality along the Project Road

Pollutant	AAQMS	Location	Mes	Min	Max	SD	p98	PTV ^{IND}	PTV ^{WB}
PM _{2.5} (µg/m ³)	AQ1	Thadigal Cross	8	10.00	15.00	1.41	14.86	0	0
	AQ2	Manchineela Kotte	8	28.00	40.00	3.93	39.72	0	0
	Overall 2 Locations		16	10.00	40.00	10.97	39.40	0	0
PM ₁₀ (µg/m ³)	AQ1	Thadigal Cross	8	40.00	60.00	5.99	59.44	0	0
	AQ2	Manchineela Kotte	8	56.00	68.00	3.71	67.72	0	0
	Overall 2 Locations		16	40.00	68.00	7.19	67.40	0	0
SO ₂ (µg/m ³)	AQ1	Thadigal Cross	8	8.20	12.60	1.47	12.42	0	0
	AQ2	Manchineela Kotte	8	10.20	16.20	1.88	16.06	0	0
	Overall 2 Locations		16	8.20	16.20	2.27	15.90	0	0
NO ₂ (µg/m ³)	AQ1	Thadigal Cross	8	22.00	32.00	3.03	31.72	0	0
	AQ2	Manchineela Kotte	8	20.00	32.00	3.87	31.72	0	0
	Overall 2 Locations		16	20.00	32.00	3.59	32.00	0	0
CO (mg/m ³)	AQ1	Thadigal Cross	8	0.30	0.43	0.04	0.43	0	0
	AQ2	Manchineela Kotte	8	0.24	0.33	0.03	0.33	0	0
	Overall 2 Locations		16	0.24	0.43	0.05	0.42	0	0

Source: On-site Field Monitoring during Dec15 – Jan 16

AAQMS: Ambient Air Quality Monitoring Station Code, Mes: Number of Measurements, SD: Standard Deviation, p98: 98-Percentile Value, PTV^{IND}: Percent time violation with respect to the Indian standards; PTV^{WB}: Percent time violation with respect to the World Bank Standards

169. As evident from **Table 57** and the discussion above, the air quality at the monitored locations are well within the National Standard. No industrial sources of air emission are observed along the project road. The emission sources at the monitored locations appear to be primarily from domestic and local activities.

K. Ambient Noise Level

1. Noise Monitoring Stations

170. To assess the background noise levels in the study area ambient noise monitoring was conducted at four locations. 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

171. M/s Mantec Environmental Laboratory (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 58**.

Table 58: Details of Noise Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Area category
1	NQ1	Thadigal Cross	62+350	RHS	35	Residential
2	NQ2	Manchineela Kotte	73+300	LHS	40	Residential
3	NQ3	Bhagwan Buddha High School, Kamlavarpalli	63+430	LHS	27	Silence
4	NQ4	Govt Higher Primary School, Thopalli	74+500	LHS	16	Silence

Source: On-site Noise Monitoring during December 2015 & March 2016

Distance in meter from existing centerline

2. Methodology of Noise Monitoring

172. 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.

173. A-weighted equivalent continuous sound pressure level (L_{eq}) 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 December 2015.

3. Ambient Noise Levels in the Study Area

174. The ambient noise levels of the study area are presented in **Table 43**. Ambient air quality standards in respect of noise are reproduced in **Annex-3.1**.

175. The day (L_{deq}) and night (L_{neq}) noise equivalent levels in the monitored residential locations, i.e., NQ1-Thadigal Cross and NQ2- Manchineela Kotte show that the ambient noise levels are within but very close to the stipulated Noise standards.

176. However, L_{10} values in day and night time are found to be slightly above the standards which signify that the noise levels exceeds these levels only 10% time of measurement.

177. Maximum noise level observed in residential areas in day time is 68.2 dB(A) and 57.6 dB(A) for monitoring stations of NQ1 and NQ2 respectively.

Table 59: Ambient Noise Levels of the Study Area in dB(A)

Station	Zone	L _{d10}	L _{d90}	L _{deq}	L _{n10}	L _{n90}	L _{neq}	L _{dn}	L _{eq(24)}	L _{Min}	L _{Max}
NQ1	Residential	56.1	46.5	54.1	56.9	40.4	45.1	54.4	56.2	41.9	68.2
NQ2	Residential	53.9	40.2	51.6	48.6	38.1	43.6	51.0	53.4	37.6	57.6
NQ3	Silence	52.6	39.9	46.9	-	-	-	-	-	38.4	53.1
NQ4	Silence	58.9	42.9	51.5	-	-	-	-	-	41.8	60.0

Source: On-site Noise Monitoring during December 2015 & March 2016

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)

178. Day time measurement was carried out at sensitive receptors and L_{d10} values are found to be 52.6 dB(A) and 58.9 dB(A) respectively, which signifies that measured noise levels exceeded these values in only 10% of the time of measurement duration.

L. Surface Water Bodies and Water Quality

179. The project area has a number of water bodies and low lying areas which gets filled up during the rainy seasons and act as a natural rainwater store. List of water bodies and low lying areas located along the project road and their distances from the existing centerline are provided in **Table 60**.

Table 60 List of Water Bodies & Low Lying Areas along the Project Road

SL	Particular	Ch. km	Distance# (m)	Side	Village	Use of Water	Length of Water Body along Road (m)
1.	Doddo Ganjur Kere (Pond)	49+700	786.0	RHS	Cheemanahalli	Crop Irrigation	*
2.	Pond	52+800	86.3	LHS	Hebbari	Post-harvest washing	*
3.	Low Land	56+200	75.8	LHS	Kodivaripally	No use	*
4.	Pond	65+100	68.2	RHS	K. Shettihalli	Crop Irrigation, Livestock watering, Domestic	135
5.	Road Side Ditch	65+250	21.2	LHS	K. Shettihalli	No use	8
6.	Road Side Ditch	65+275	28.2	LHS	K. Shettihalli	No use	5
7.	Low Land	66+360	20.3	RHS	Doddabandarala palli	Crop Irrigation	13
8.	Pond	67+300	25.4	LHS	Jodi Kothapalli	No use	6
9.	Ditch	68+900	16.6	RHS	Chakapalli	Livestock watering	4
10.	Low Land	71+600	186.0	LHS	Nelavanki	Crop Irrigation, Livestock watering	*
11.	Low Land	72+900	34.8	RHS	Manchineelkote	Crop Irrigation, Livestock watering	86
12.	Low Land	75+000	24.5	RHS	Thopalli	Crop Irrigation, Livestock watering	60
13.	Pond	78+600	136.8	LHS	Mandyala	Crop Irrigation, Livestock watering	*
14.	Pond	78+850	130.2	LHS	Mandyala	Livestock watering	*
15.	Pond	80+200	159.9	LHS	Yendaguttapalli	Livestock watering	*
16.	Low Land	81+000	326.5	LHS	Royalpad	Crop Irrigation, Livestock watering	*

SL	Particular	Ch. km	Distance# (m)	Side	Village	Use of Water	Length of Water Body along Road (m)
17.	Low Land	82+360	78.4	LHS	Gontapalli	Crop Irrigation, Livestock watering	*
18.	Pond	85+750	14.9	LHS	Gontapalli	No use	13
19.	Ditch	85+800	12.5	RHS	Gontapalli	No use	2.5
20.	Ditch	86+600	12.0	LHS	Gontapalli	No use	100
21.	Ditch	86+900	16.8	LHS	Gontapalli	No use	13

Source: Field Survey in December 2015

Distance in meter from existing centerline; * Not located adjacent to the project road

1. Water Quality Monitoring Stations

180. 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 Mantec Environmental Laboratory (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, 2 surface water quality monitoring stations (designated as SW1 & SW2) were selected. Details of the location of Surface Water Quality Stations are provided in **Table 61**.

Table 61 Details of Surface Water Quality Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Usage
1	SW1	Pond, K. Shettihalli	65+100	RHS	55.5	Irrigation & Domestic except drinking
2	SW2	Pond, Mandyala	78+600	LHS	137	Irrigation

Source: On-site Water Quality Monitoring in December 2015

Distance in meter from existing centerline

181. Water samples (grab samples) were collected once in the month of December 2015 from these stations and analyzed for physical, chemical and bacteriological parameters as per established standard methods and procedures.

182. All the basic precautions and care were taken during the sampling to avoid contamination. Analysis of the samples was carried out as per established standard methods and procedures prescribed by the CPCB, e.g. relevant IS Codes (IS:2488 (Part-1 to 5) "Methods for Sampling and Testing of Industrial Effluents"), and "Standard Methods for Examination of Water and Wastewater" published by APHA.

2. Surface Water Quality in the Study Area

183. The salient water quality parameters are statistically analyzed and presented **Table 62** depicting minimum, maximum, arithmetic mean, standard deviation and percent time violations (PTV) with respect to Indian Surface Water Quality Standards i.e. the percentages of time the water quality parameters violate the permissible standards. Detailed Surface Water Quality Analysis results are provided in **Table 63**.

184. Temperature varied between 23.0-23.1°C. pH values were generally above the neutral mark (7.55-7.91) which were within the tolerance limit of 6.5-8.5. Conductivity varied between

358-484 $\mu\text{mhos/cm}$ with TDS ranging between 233-325 mg/l. Such low values of conductivity and TDS indicate that the water is marginally mineralized and devoid of any industrial discharges.

185. Dissolved oxygen levels are found to be in the range of 5.2-5.4mg/l, which is lower than the Class A(6.0 mg/l) but higher than Class D (4.0 mg/l) Surface water quality standards. BOD ranges from 24-26 mg/l while COD ranges are found be 52-64 mg/l. High values of BOD and COD signifies presence of decomposable and oxidizable organic matter in the water resulting lowering of dissolved oxygen levels.

186. Total hardness values were observed to vary in the range of 112-151 mg/l, well below the prescribed limit of 300 mg/l for surface water. Oil & grease and nitrates remain undetected in all samples.

Table 62: Salient Surface Water Quality Features

SN	Parameter	Range	AM	SD	PTV
1.	pH	7.55-7.91	7.73	0.18	0
2.	DO (mg/l)	5.2-5.4	5.3	0.1	100
3.	BOD (3 days at 27°C) (mg/l)	24-26	25	1	100
4.	TDS (mg/l)	233-315	274	41	0
5.	Total hardness (mg/l as CaCO ₃)	112-151	131.5	19.5	0
6.	Nitrate nitrogen (mg/l as NO ₃)	4.7-4.9	4.8	0.1	0
7.	Iron (mg/l as Fe)	0.12-0.17	0.145	0.025	0
8.	Fluoride (mg/l as F)	0.32-0.42	0.37	0.05	0

Source: On-site Water Quality Monitoring in December 2015

AM- Arithmetic mean, SD- Standard deviation, BDL- Below detection limit

PTV- Percent time violations over permissible limits* (maximum) stipulated for Inland Surface Waters (Class D) i.e. fish culture and wildlife propagation (IS:2296).

Table 63: Surface Water Quality Analysis Results

Sl. No.	Parameters	Units of Measurements	SW1	SW2	Tolerance Limits as per IS:2296 (Class-A)
1.	pH	-	7.55	7.91	6.5-8.5
2.	Temperature	°C	23	23.1	---
3.	Conductivity	$\mu\text{mhos/cm}$	358	484	---
4.	Colour	Hazen Units	<5	<5	10
5.	Turbidity	NTU	6	5	---
6.	Total Hardness as CaCO ₃	mg/l	151	112	300
7.	Total Dissolved Solids	mg/l	233	315	500
8.	Total Suspended Solids	mg/l	9	7	---
9.	Sodium as Na	mg/l	9	46	---
10.	Potassium as K	mg/l	1	4	---
11.	Calcium as CaCO ₃	mg/l	35	52	200
12.	Magnesium as CaCO ₃	mg/l	116	60	100
13.	Dissolved Oxygen	mg/l	5.4	5.2	6.0
14.	COD	mg/l	64	52	---
15.	BOD 3 days at 27°C	mg/l	26	24	2.0
16.	Chloride as Cl	mg/l	31	51	250
17.	Sulphate as SO ₄	mg/l	29	23.2	400
18.	TKN as N	mg/l	5.5	5.9	---
19.	Nitrate as NO ₃	mg/l	4.7	4.9	20
20.	Iron as Fe	mg/l	0.12	0.17	0.3

Sl. No.	Parameters	Units of Measurements	SW1	SW2	Tolerance Limits as per IS:2296 (Class-A)
21.	Manganese as Mn	mg/l	<0.02	<0.02	0.5
22.	Cadmium as Cd	mg/l	<0.001	<0.001	0.01
23.	Total Arsenic as As	mg/l	<0.01	<0.01	0.05
24.	Total Chromium as Cr	mg/l	<0.05	<0.05	0.05
25.	Copper as Cu	mg/l	<0.01	<0.01	1.5
26.	Mercury as Hg	mg/l	<0.001	<0.001	0.001
27.	Lead as Pb	mg/l	<0.01	<0.01	0.1
28.	Zinc as Zn	mg/l	0.09	0.13	15
29.	Boron as B	mg/l	ND	ND	---
30.	Fluoride as F	mg/l	0.32	0.42	1.5
31.	Chlorine	mg/l	0.22	0.24	---
32.	Phenolic Compound	mg/l	<0.001	<0.001	0.002
33.	Surfactants	mg/l	<0.05	<0.05	---
34.	Phosphate as PO ₄	mg/l	0.25	0.38	---
35.	SAR	mg/l	1.96	10.95	---
36.	Total Coliform	MPN/100ml	1500	3070	50
37.	Fecal Coliform	MPN/100ml	440	1200	---

Source: On-site Water Quality Monitoring in December 2015

187. Chloride and sulphate contents were 31-51 mg/l and 23.2-29 mg/l respectively. While calcium content varied between 35-52 mg/l, magnesium ranged between 60-116 mg/l. Levels of iron was 0.12-0.17 while arsenic, chromium, cadmium, copper, manganese, zinc and mercury are found to be low detectable limit. Both of the samples are found to be high in total and fecal coliforms and therefore not suitable for human use in any manner.

188. The water quality results shows the surface waters in the study area are devoid of any extraneous chemical contamination; there is no toxic or organic constituents are not detected in samples. However, have high coliform count, high BOD levels and low dissolved oxygen indicates discharge of fecal matters and agricultural runoff in the water. Both of the ponds from where surface water have been sampled are surrounded by vast span of agricultural land. Agricultural runoff, exfoliated biomass and animal wastes can be attributed for presence of organic materials in the water, which utilizes dissolved oxygen while decomposing. This has resulted lowering of available DO and high BOD.

M. Ground Water Quality in the Study Area

189. Ground water has been found to be an important source for catering to the local needs of water consumption for various purposes, mainly domestic, in the villages and towns. Therefore, any kind of deterioration in the quality of ground water owing to the developmental activities will pose threat to the village population and attention needs to be paid towards maintaining the quality of water using all possible tools such as monitoring with spontaneous remedial suggestions, if required. 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.

1. Ground Water Quality Monitoring Stations

190. M/s Mantec Environmental Laboratory (A NABL Accredited & MoEF Recognized laboratory) was engaged for collection of ground water samples and analysis. 2 ground water quality monitoring stations (designated as GW1 and GW2) comprising hand operated tube wells (hand-pumps) in the study area were identified for the monitoring and assessment of ground water quality. The details of ground water quality monitoring stations are provided in **Table 64**.

Table 64: Details of Ground Water Quality Monitoring Stations

SN	Station Code	Place	Chainage (Km)	Side	Distance# (m)	Usage
1	GW1	Thadigal Cross	65+100	RHS	65	Drinking & Domestic
2	GW2	Manchineela Kotte	73+250	LHS	95	Drinking & Domestic

Source: On-site Water Quality Monitoring in December 2015

Distance in meter from existing centreline

191. Ground water samples were collected once in the month of December 2015 from both stations and analyzed for physical, chemical and bacteriological parameters as per established standard methods and procedures.

2. Ground Water Quality in the Study Area

192. Salient features of ground water quality monitoring results are presented in **Table 65**. Detailed ground water quality analysis results are provided in **Table 66**.

Table 65: Salient Ground Water Quality Features

SN	Parameter	Range	AM	SD	PTV
1.	pH	6.98-7.35	7.165	0.2	0
2.	TDS (mg/l)	1115-1595	1355	240.0	0
3.	Total hardness (mg/l as CaCO ₃)	769-1253	1011	242.0	100
4.	Chloride (mg/l as Cl ⁻)	221-652	436.5	215.5	0
5.	Iron (mg/l as Fe)	0.24-0.37	0.305	0.1	0

Source: On-site Water Quality Monitoring in December 2015

N- No of measurements, AM- Arithmetic mean, SD- Standard deviation, BDL- Below detection limit

PTV- Percent time violations over permissible limits* (maximum) stipulated for drinking water (IS:10500-2012).

193. All the hand pumps exhibited limited variation of temperature, which are the typical characteristics of ground water. There has been little fluctuation in pH with overall range of 6.98-7.35, marginally below the neutral mark but within the permissible limits of 6.5-8.5 stipulated in drinking water quality standards (IS 10500:2012).

194. Total hardness values for the both samples are observed to high (76901253 mg/l) and higher than the drinking water quality standards for both desirable limits (200 mg/l) and acceptable limits (600 mg/l) in absence of alternative sources.

195. Chloride and sulphate contents were 221-652 mg/l and 84.2-104 mg/l respectively. While calcium content varied between 190-249 mg/l, magnesium ranged between 714-153 mg/l. Heavy metals except Boron remain undetected in the samples. The fluoride levels are also found to be within the stipulated standards. All these parameters were generally within the tolerance limits for drinking water except hardness.

Table 66: Ground Water Quality Monitoring Results

Sl. No.	Parameters	Units of Measurements	GW1	GW2	Indian Standard 10500:2012		WHO Limits
					Desirable	Permissible	
1.	pH	-	6.98	7.35	6.5-8.5	No relaxation	-
2.	Temperature	°C	23	23	-	-	-
3.	Conductivity	µmhos/cm	2453	1716	-	-	-
4.	Turbidity	NTU	4	3	1	5	-
5.	Total Hardness as CaCO ₃	mg/l	1253	769	200	600	-
6.	Total Alkalinity as CaCO ₃	mg/l	317	426	200	600	-
7.	Total Dissolved Solids	mg/l	1595	1115	500	2000	-
8.	Sodium as Na	mg/l	4	14	-	-	-
9.	Potassium as K	mg/l	1	2	-	-	-
10.	Calcium as Ca	mg/l	249	190	75	200	-
11.	Magnesium as Mg	mg/l	153	71.4	30	100	-
12.	Chloride as Cl	mg/l	652	221	250	1000	-
13.	Sulphate as SO ₄	mg/l	84.2	104	200	400	-
14.	Nitrate as NO ₃	mg/l	28.5	12.6	45	No relaxation	50
15.	Iron as Fe	mg/l	0.37	0.24	0.3	No relaxation	-
16.	Manganese as Mn	mg/l	<0.02	<0.02	0.1	0.3	-
17.	Cadmium as Cd	mg/l	<0.001	<0.001	0.003	No relaxation	0.003
18.	Total Arsenic as As	mg/l	<0.01	<0.01	0.01	0.05	0.01
19.	Total Chromium as Cr	mg/l	<0.05	<0.05	0.05	No relaxation	0.05
20.	Copper as Cu	mg/l	<0.01	<0.01	0.05	1.5	2
21.	Mercury as Hg	mg/l	<0.001	<0.001	0.001	No relaxation	0.006
22.	Lead as Pb	mg/l	<0.01	<0.01	0.01	No relaxation	0.01
23.	Zinc as Zn	mg/l	0.19	0.21	5	15	
24.	Boron as B	mg/l	0.57	0.46	0.5	1	2.4
25.	Fluoride as F	mg/l	0.87	0.64	1	1.5	1.5
26.	Total Coliform	MPN/100ml	Absent	Absent	Absent	Absent	Absent

Source: On-site Water Quality Monitoring in December 2015

196. From above it can be concluded that the ground water, in general, is hard in nature and the physico-chemical quality satisfies the permissible limit as stipulated in Drinking Water Standards.

3. Ground Water Availability

197. Ground water plays an important role in the economy of the farmers. Kolar and Chikballapur districts are popularly known as land of Silk and Milk. Agriculture was mainly dependent on irrigation facility by numerable widely distributed tanks during earlier days. Due to drought situations farmers are now mainly depending upon bore-wells for their agriculture needs.

198. There are about 1,22,910 bore wells in the Kolar district and 29,016 bore wells in the Chikballapur district, which reflects the dependency of farmers of both the districts on ground water.

199. All the taluks of the Kolar district are over exploited. On an average over draft of 56,363 hectare meters (ham) per year is occurring in the district which results in continuous lowering of water table. Even though Kolar district stands first in having the maximum number of irrigation

tanks (4488 tanks) in Karnataka, their dependability for irrigation again depends upon rainfall conditions.

200. All the taluks of the Chikballapur district are over exploited except Bagepalli taluk. On an average over draft of 11,634 ham per year is occurring in the district which results in continuous lowering of water table.²

N. Ecology and Biodiversity

1. Introduction

201. The project road traverses through plain land in the starting section and rolling terrain near the end section. The area belongs to semi-arid drought-prone region. The land use along the roadside consist of agriculture, settlements, open scrub and plantations. Trees species abutting the road comprise of *Tamarindus indica* (Tamarind), *Ficus religiosa*, (Peepal), *Ficus benghalensis* (Banyan), *Azadirachta indica* (Neem), *Peltophorum pterocarpum* (Copper pod), *Pongammia pinnata* (Karanj), *Cassia fistula* (Indian Laburnum) *Cassia siamea* (Kassod) and *Eucalyptus teriticornis* (Eucalyptus).



202. Tree species grown in agricultural land comprised of *Mangifera indica* (Mango), *Cocus nucifera* (Coconut), *Psidium guajava* (Guava), *Manilkara zapota* (Sapota), *Musa paradisiaca* (Banana), *Artocarpus heterophyllus* (Jackfruit), *Annona squamosa* (Sitaphai) etc Mango orchards are also located along the project road.



View of Flora along Project Road

203. The major crops grown are *Eleusine coracana* (Ragi), *Sorghum vulgare* (Jowar), *Zea maize* (Maize). Pulses such as *Cajanus indicus* (red gram), *Dolichos lablab* (broad bean) and *Vigna catjang* (Cowpea) are grown. Oilseeds include *Sesamum indicum* (Safed Til) and *Arachis hypogaea* (groundnut). There is no perennial river in the project area, bore-wells are used for irrigation.

2. Road Side Trees

204. The number of roadside trees within existing row is estimated to be **4,945**. Side and girth size wise distribution of existing trees are provided in **Table 51**. Chainage wise detailed survey data is provided in **Annex 4.5**.

² Source: Ground Water Information Booklet – CGWB, Ministry of Water Resources, GoI

Table 67: Number of Trees along the Project Road

Side	No of Trees in Girth Class (in cm)					Total
	<30	31-59	60-119	120-180	>180	
LHS	504	617	449	216	256	2,042
RHS	1,017	935	672	173	106	2,903
	1,521	1,552	1,121	389	362	4,945

3. Green Tunnels and Giant Trees

205. **Green Tunnels:** At some locations Green tunnels are formed along the road. These tunnels provide shade, reduce heat effect, reduce glaring of road and provide overall cooling. Species observed in the green tunnel mainly includes *Tamarindus indica* (Tamarind), *Ficus religiosa*, (Pipal) and *Ficus benghalensis* (Banyan). The stretches will be impacted due to widening activity. The location of green tunnel is given in **Table 68**. Location of Green Tunnel along the project road has been shown on the google image and presented in **Annex-4.6**.



View of Green Tunnel along the Project Road

Table 68: Location of Green Tunnels along the Project Road

Location No.	Existing Ch. Km		Length (m)
	From	To	
1.	49+300	49+580	280
2.	50+270	50+330	60
3.	50+400	50+460	60
4.	54+000	54+700	700
5.	56+620	56+700	80
6.	58+270	58+470	200
7.	60+650	60+750	100
8.	61+160	61+250	90
9.	62+100	62+400	300
10.	62+550	62+800	250
11.	63+600	63+800*	200
12.	66+150	66+200	50
13.	66+530	66+600	70

Location No.	Existing Ch. Km		Length (m)
	From	To	
14.	68+700	68+730	30
15.	69+760	70+000	240
16.	72+000	72+100	100
17.	72+550	72+650	100
18.	73+100	73+160	60
19.	73+380	73+700	320
20.	74+200	74+600	400
21.	74+720	74+800	80
22.	76+600	77+400	800
23.	78+050	79+000	950
24.	81+400	81+520	120
Total Length (Km)			5.640

*Realignment proposed in this section

206. **Giant Trees:** Field survey was conducted to identify the location of giant trees. 27 giant trees are found along the project road, out of which 17 trees are on the left side and 10 trees are on the right side. Details of the giant trees i.e., Chainage, side, distance from existing centerline of the road, species and girth size is presented in **Table 69**.



View of Giant Trees along the Project Road

Table 69: List of Giant Tree along Chintamani to AP Border Road

SL	GPS	Chainage Km	Side	Distance from C/L	Species	Girth Size (m)
1	13°23'26.11"N 78° 6'27.26"E	49+700	LHS	7	Tamarind	3.65
2	13°23'32.00"N 78° 6'41.33"E	50+186	LHS	7	Tamarind	3.84
3	13°23'31.77"N 78° 6'41.50"E	50+186	RHS	7.4	Ficus sp.	5.4
4	13°23'31.30"N 78° 6'40.82"E	50+175	RHS	7.4	Tamarind	6.3

SL	GPS	Chainage Km	Side	Distance from C/L	Species	Girth Size (m)
5	13°23'32.16"N 78° 6'42.48"E	50+200	RHS	7.4	Tamarind	3.9
6	13°24'23.60"N 78° 8'24.04"E	53+670	LHS	6	Tamarind	4.6
7	13°24'52.92"N 78° 9'29.44"E	55+850	LHS	6	Ficus sp.	4.1
8	13°25'10.43"N 78°10'9.66"E	57+160	RHS	8.4	Tamarind	3.3
9	13°26'9.24"N 78°12'10.22"E	61+200	RHS	6.4	Ficus sp.	4.5
10	13°26'9.39"N 78°12'10.66"E	61+210	RHS	6.4	Tamarind	4.3
11	13°26'8.36"N 78°12'46.29"E	62+370	RHS	7.5	Tamarind	3.6
12	13°26'48.07"N 78°14'32.70"E	65+900	LHS	5.5	Tamarind	3.5
13	13°27'21.25"N 78°15'33.38"E	68+200	LHS	6.1	Tamarind	3.6
14	13°27'20.48"N 78°15'31.97"E	68+130	RHS	7.1	Tamarind	3.7
15	13°27'25.62"N 78°15'45.13"E	68+550	LHS	6.9	Tamarind	3.74
16	13°27'29.01"N 78°15'49.91"E	68+735	LHS	6	Tamarind	3.8
17	13°27'36.86"N 78°16'26.05"E	69+900	LHS	6.8	Tamarind	4.1
18	13°28'27.17"N 78°17'30.55"E	72+645	RHS	7.1	Tamarind	5.2
19	13°28'36.89"N 78°17'41.78"E	73+100	LHS	8.4	Tamarind	5.6
20	13°28'37.47"N 78°17'43.28"E	73+140	LHS	5.4	Ficus sp.	5.5
21	13°28'37.80"N 78°17'43.18"E	73+140	RHS	6.6	Ficus sp.	4.6
22	13°28'43.04"N 78°17'50.72"E	73+400	LHS	6.8	Tamarind	7.3
23	13°28'43.63"N 78°17'51.01"E	73+400	LHS	6.8	Tamarind	4.5
24	13°28'45.49"N 78°17'54.49"E	73+560	LHS	6.8	Tamarind	4.0
25	13°29'4.46"N 78°18'23.65"E	74+600	LHS	5.4	Tamarind	4.8
26	13°29'4.64"N 78°18'23.90"E	74+620	LHS	5.4	Tamarind	4.6
27	13°29'4.81"N 78°18'24.17"E	74+640	LHS	5.4	Tamarind	4.6

4. Biodiversity Survey

207. Biodiversity survey was conducted in the month of December, 2015 to **study the flora and fauna** of the project area. Before conducting the assessment work reconnaissance survey of the entire road stretch was made and sampling was done in each vegetation type. In all **five sample plots of 100 m x 10 m were laid** for the purpose of biodiversity assessment. The first sample plot was laid near the starting point, second plot in the mid-section of the road and remaining three plots were laid in the forest area. The plots were laid on either side of the road. The GPS co-ordinates and altitude were recorded for each of the sample plots and presented in **Table 70**.

Table 70: GPS Co-ordinates and Altitude of the Sample Plots

Sample Plots	Latitude	Longitude	Altitude (m)	Vegetation Type & Location
1	13 23'22.4"	78 06'19"	839	Shrubby vegetation – near start point of the Project Road
2	13 28'31.7"	78 17'36.9"	824	Part of the plot is low land – mid section of the Project Road
3	13 30'14.7"	78 20'0.5"	841	Plantation (Part of the plot is low land) – Forest Area
4	13 32'4.0"	78 22'14.2"	844	Plantation (Shrubby vegetation) – Forest Area
5	13 31'38"	78 20'38.9"	821	Plantation (Shrubby vegetation) – Forest Area

Source: Biodiversity Study conducted by ICT Pvt. Ltd.

208. The data collected on the number of individuals present for each species, for both flora and fauna, were subjected to further analysis. Importance Value Index (IVI), Shannon Diversity Index (H) and Simpson's Index (D) were calculated.

a. Floral Composition

209. Primary data on the floral composition was recorded along the proposed project road (Chintamani to Andhra Pradesh Border). In each plot, floral species were botanically identified to the species level by using local flora (Saldanha and Ramesh, 1984, Gurudev, 2002) and other field guides separately for trees, shrubs and herbs; and their scientific names and individual numbers were recorded during field survey for further analysis.

210. **80 floral species** were identified, out of which, 30 were tree species, 29 shrubs and 21 herb species (Plate 1, 2 & 3). The list of floral species along with the status as per International Union for Conservation of Nature (IUCN), red list of threatened species is provided in the **Table 71**.

Table 71: List of Flora recorded during Survey

Sl. No.	Scientific name	Common Name	IUCN Status
1.	<i>Acacia catechu</i>	Black cutch	NE
2.	<i>Acacia mangium</i>	Acacia	NE
3.	<i>Acacia nilotica</i>	Babool	NE
4.	<i>Albizia amara</i>	Chujjulu/ Krishna Siris	NE
5.	<i>Annona squamosa</i>	Custard Apple	NE
6.	<i>Azadirachta indica</i>	Neem	NE
7.	<i>Bauhinia racemosa</i>	Kachnar	NE
8.	<i>Butea monosperma</i>	Palash	NE
9.	<i>Cassia fistula</i>	Golden Shower	NE
10.	<i>Cassia siamea</i>	Kassod	NE
11.	<i>Dalbergia sissoo</i>	Seesham	NE
12.	<i>Eucalyptus tereticornis</i>	Forest Red Gum	NE
13.	<i>Ficus bengalensis</i>	Banyan	NE
14.	<i>Ficus mysorensis</i>	Paras Pipal	NE
15.	<i>Gliricidia maculata</i>	Quick stick	NE
16.	<i>Gmelina arborea</i>	Gamar	NE
17.	<i>Grevillea robusta</i>	Silver Oak	NE
18.	<i>Holoptelea integrifolia</i>	Indian Elm	NE
19.	<i>Leucaena leucocephala</i>	Subabul	NE
20.	<i>Melia dubia</i>	Malabar Neem	NE
21.	<i>Peltophorum pterocarpum</i>	Copper pod	NE
22.	<i>Phoenix sylvestris</i>	Kanjoor	NE
23.	<i>Pongamia pinnata</i>	Karanja	NE
24.	<i>Samanea saman</i>	Rain Tree	NE
25.	<i>Syzigium cumini</i>	Jamoon	NE
26.	<i>Tamarindus indica</i>	Imli	NE
27.	<i>Terminalia bellerica</i>	Bahera	NE
28.	<i>Vitex altissima</i>	Myrole / Peacock Chaste	NE
29.	<i>Wrightia tinctoria</i>	Veppali/ Indrajao	LC
30.	<i>Ziziphus mauritiana</i>	Indian Jujube	NE
Shrubs			
31.	<i>Agave americana</i>	American aloe	LC
32.	<i>Argyreia cuneata</i>	Kallana gida/ Mysore Argyreia	NE
33.	<i>Calotropis procera</i>	French Cotton	NE
34.	<i>Canthium parviflorum</i>	Kadbar	NE
35.	<i>Carissa carandas</i>	Karonda	NE
36.	<i>Cassia auriculata</i>	Anval	NE

Sl. No.	Scientific name	Common Name	IUCN Status
37.	<i>Cassia tora</i>	Coffee Cassia	NE
38.	<i>Chromolaena odorata</i>	Siamweed	NE
39.	<i>Dodonaea viscosa</i>	Hop-bush	NE
40.	<i>Erythroxylum monogynum</i>	Bastard sandal	NE
41.	<i>Grewia hirsuta</i>	Phrongli	NE
42.	<i>Jatropha curcas</i>	Physic nut	NE
43.	<i>Lantana camara</i>	Ghaneri/Lantana	NE
44.	<i>Opuntia dillenii</i>	Nagphani	LC
45.	<i>Prosopis juliflora</i>	Indian Mesquite	NE
46.	<i>Pterolobium hexapetalum</i>	Baadu bakka	NE
47.	<i>Randia dumetorum</i>	Fish poison	NE
48.	<i>Securinega virosa</i>	Dalme	NE
49.	<i>Sida acuta</i>	Blue okra	NE
50.	<i>Sida cordifolia</i>	Bala panchaang	NE
51.	<i>Sida rhombifolia</i>	Queensland hemp	NE
52.	<i>Solanum indicum</i>	Ban Tobacco	NE
53.	<i>Stachytarpheta indica</i>	Kaadu uttarani	NE
54.	<i>Stylosanthes fruticosa</i>	Pencil flower	NE
55.	<i>Tarenna asiatica</i>	Paapatige gida	NE
56.	<i>Tephrosia purpurea</i>	Sarapunkha	LC
57.	<i>Toddalia asiatica</i>	Forest Pepper	NE
58.	<i>Tylophora asthmatica</i>	Antamul	NE
59.	<i>Ziziphus oenoplia</i>	Kakal-ber	NE
Herbs and Grasses			
60.	<i>Achyranthes aspera</i>	Prickly Chaff-flower	NE
61.	<i>Asparagus racemosus</i>	Shathaavari	NE
62.	<i>Commelina benghalensis</i>	Tropical Spider wort	LC
63.	<i>Cynodon dactylon</i>	Bermuda grass	NE
64.	<i>Desmodium triflorum</i>	Matty desmodium	LC
65.	<i>Dolichos falcatus</i>	Kaduhurali	NE
66.	<i>Evolvulus alsinoides</i>	English speedwheel	NE
67.	<i>Hemidesmus indicus</i>	Nannari	NE
68.	<i>Hybanthus enneaspermus</i>	Ratanpurus	NE
69.	<i>Ichnocarpus frutescens</i>	Bakarbel	NE
70.	<i>Leucas aspera</i>	Chhota-halkusa	NE
71.	<i>Mimosa pudica</i>	Touch me not	LC
72.	<i>Mitracarpus verticillatus</i>	Girdlepod	NE
73.	<i>Ocimum americanum</i>	Jangali-tulsi	NE
74.	<i>Parthenium hysterophorus</i>	Congress grass	NE
75.	<i>Phyllanthus amara</i>	Bhumi-amla	NE
76.	<i>Phyllanthus urinaria</i>	Hazarmani	NE
77.	<i>Sopubia delphinifolia</i>	Dudhali	NE
78.	<i>Spilanthes acmella</i>	Toungue cleaner	NE
79.	<i>Tridax procumbens</i>	Coatbuttons	NE
80.	<i>Vernonia cinerea</i>	Ash-coloured fleabane	NE

LC- Least Concern, NE- Not Evaluated, Status as per IUCN Red list

Source: Biodiversity Study conducted by ICT Pvt. Ltd.

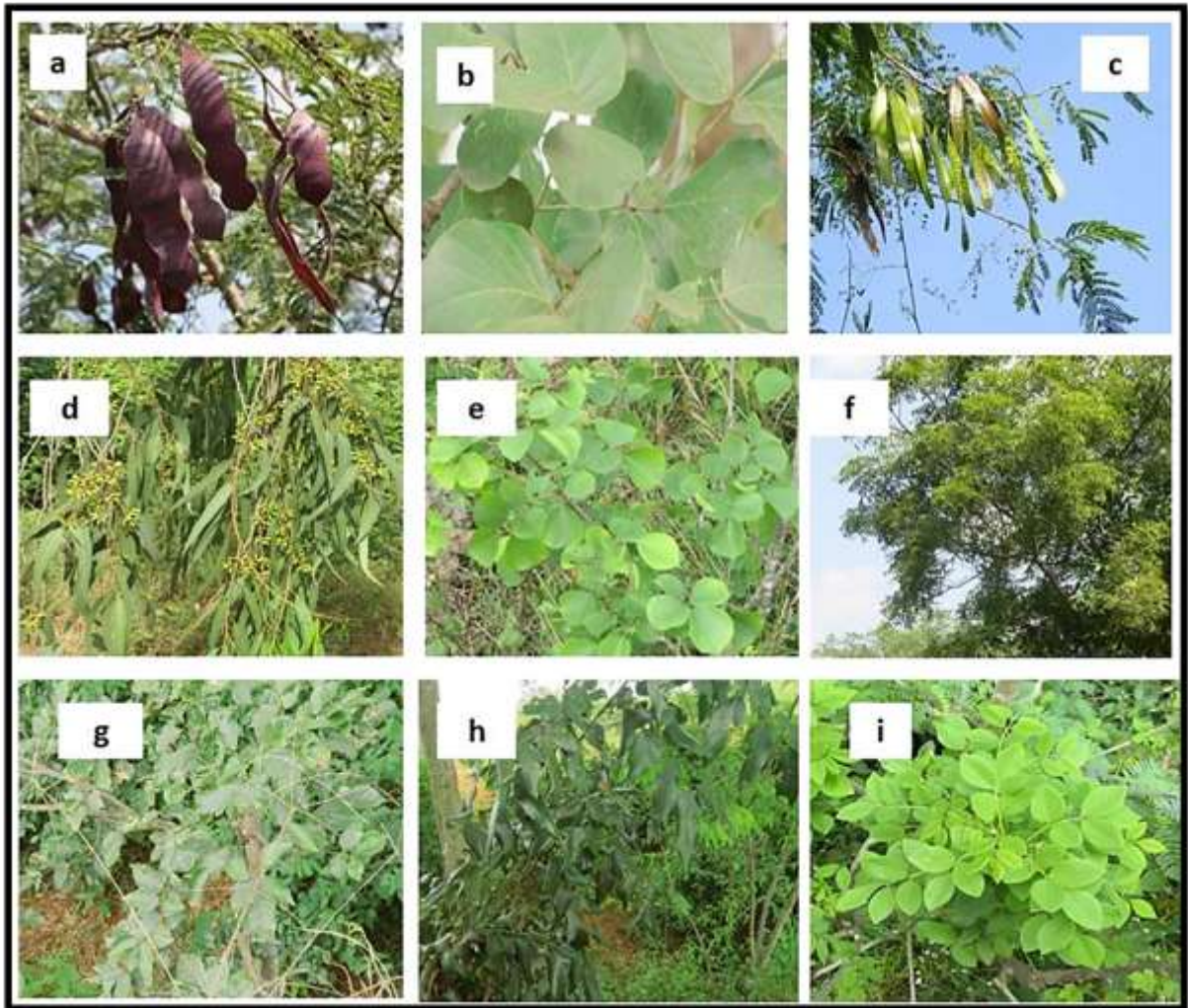


Plate-1 Trees : a. *Acacia catechu*, b. *Butea monosperma*, c. *Leucaena leucocephala*, d. *Eucalyptus tereticornis*, e. *Dalbergia sissoo*, f. *Azadirachta indica*, g. *Pongamia pinnata*, h. *Cassia fistula*, i. *Gliricidia indica*

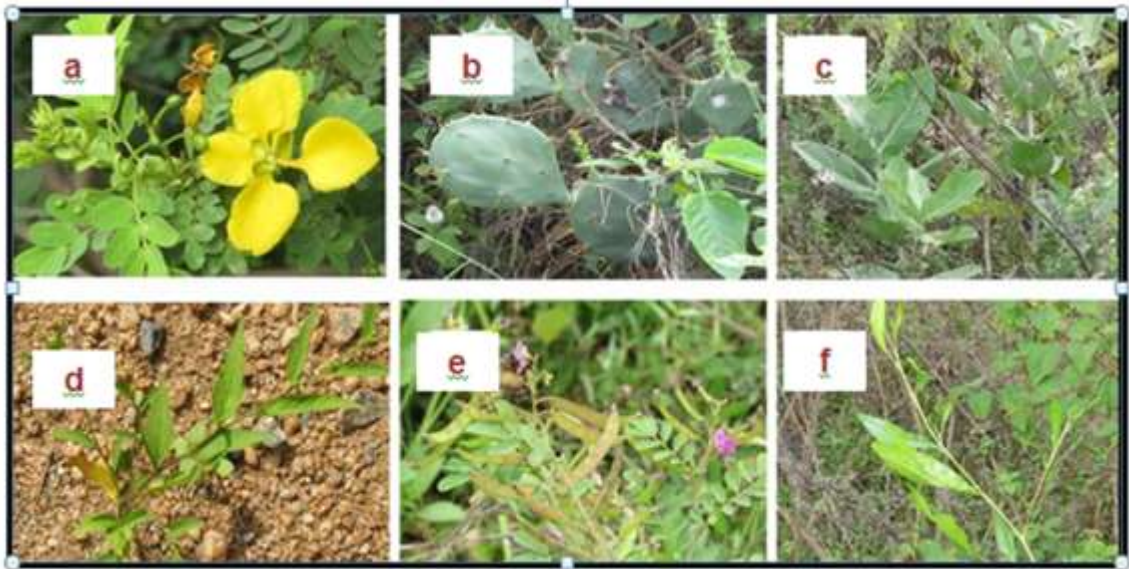


Plate-2 Shrubs: a. *Cassia auriculata*. b. *Opuntia dillenii*, c. *Calotropis procera*
d. *Sida acuta*, e. *Tephrosia purpurea*. f. *Dodonaea viscosa*

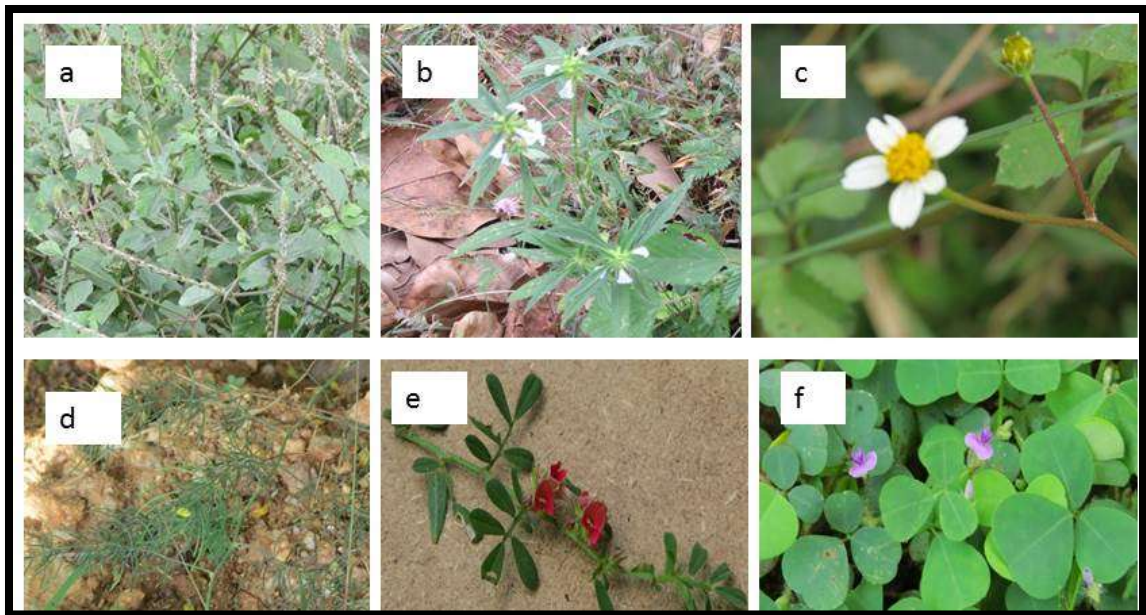


Plate-3 Herbs: a. *Achyranthes aspera*, b. *Leucas aspera*, c. *Tridax procumbens*,
d. *Asparagus racemosus*, e. *Hybanthus enneaspermus*, f. *Desmodium triflorum*

211. Importance Value Index (IVI) : IVI indicates the population structure of species since it takes collective account of structural parameters such as relative density and frequency of the species. The results of biodiversity study are presented in **Annex-4.7** for trees (Table-A.4.7.1), shrubs (Table-A.4.7.2) and herb (Table-A.4.7.3). *Eucalyptus tereticornis* was found to be dominant tree species with 20.0 IVI followed by *Pongamia pinnata*, *Azadirachta indica*, *Cassia fistula*, *Wrightia tinctoria*, *Acacia catechu*, *Holoptelia intigrifolia*, *Gliricidia maculata*, *Acacia catechu*, *Annona squamosa*, *Grevillea robusta* and other species. According to the

species abundance calculated for the tree species, *Gliricidia maculata* exhibited highest value of 9.50 compared to other species. This is mainly because the species though not distributed equally, the number of individual were more. All the tree species recorded were planted along the road and in Forest land

212. The data of shrubs revealed that *Lantana camara* was dominant species with an IVI of 20.22 followed by *Stachytarpheta indica*, *Sida acuta*, *Pterolobium hexapetalum*, *Securinega virosa*, *Agave americana*, *Cromolaena odorata*, *Tephrosia purpuria*, *Sida rhombifolia*, etc. The species abundance for individual shrubs revealed that *Tephrosia purpuria* was having highest abundance value of 45.00.

213. The IVI for the herb species show that *Hybanthus enneaspermus* was found to be dominating with an IVI of 16.19. The species was followed by *Spilanthes acmella*, *Phyllanthus amara*, *Mimosa pudica*, *Parthenium hysterophorus*, *Tridax procumbens*, *Cynodon dactylon*, *Mitracarpus verticillatus*, *Desmodium triflorum*, *Vernonia cinerea*, *Hemidesmus indicus*, etc. The species abundance for herb species show that *Spilanthes acmella* was having highest abundance value of 20.50

214. **Shannon's Diversity index:** Diversity index is used to characterize the species abundance relationship in a community. The simple measure of species diversity is Shannon's diversity index. It is estimated by using the formula:

$$H' = -\sum_{i=1}^S [(ni/N) \ln (ni/N)]$$

Where,

H = the Shannon diversity index

ni = Number of individuals belonging to the ith species,

N= Number of individuals in the sample,

S = Number of species encountered

∑ = sum from species 1 to species S

215. The estimated values of Shannon's diversity index are presented in **Table 72**. In the present assessment, the Shannon's diversity index for tree species was 3.02, for shrubs 2.97 and for herbs 2.89. Sannon's diversity index values obtained was found to be moderate to low when compared to reported values of 3.6 to 5.4 for tropical forests (Knight, 1975) and is nearer to the range (2.557 to 3.375) reported for permanent preservation plots at Western Ghats of Karnataka (Karthik, 2009) and 2.31 to 3.30 for the Western Ghats of Southern Karnataka (Sarkar *et al.*, 2011).

Table 72: Shannon's Diversity Index

S.No	Flora	Shannon's Diversity Index (H)
1	Tree	3.02
2	Shrub	2.97
3	Herb	2.89

216. All species recorded are common in distribution. No threatened species of flora has been reported from the project area

217. **Simpson's index:** It is also called concentration of dominance, was calculated by following formula:

$$D = \sum_{i=1}^s (p_i)^2$$

218. Where, p_i is proportion of important value of the i^{th} species ($p_i = n_i / N$, n_i is the important value index of i^{th} species and N is the important value index of all the species). It is noteworthy that $0 \leq D \leq 1$, with values near zero corresponding to highly diverse or heterogeneous ecosystems and values near one corresponding to more homogenous ecosystems. The calculated Simpson's index indicated that the tree diversity was more compared to shrubs and herbs (**Table 73**).

Table 73: Simpson's Index

S.No	Flora	Simpson's Index (D)
1	Tree	0.05
2	Shrub	0.07
3	Herb	0.06

b. Faunal Composition

219. Primary data on the fauna was collected along proposed project road, SH 82. In each plot, faunal species were identified based on direct sightings and indirect evidences such as call, foot prints if any, nesting etc. The duration of the survey was one day at the site. Based on the identification; scientific name, common name and individual numbers were recorded for further analysis.

220. Total 58 faunal species were identified in the project area during field survey out of which 26 are avian species, 26 insects, 3 (three) mammals, 2 (two) reptiles and 1(one) amphibian species. List of fauna identified is given in the **Table 74**.

Table 74 List of Fauna Species identified in the Project Area

S.No	Scientific Name	Common Name	WLPA Schedule	IUCN Category
Mammals				
1.	<i>Macaca radiata</i>	Bonnet macaque	Schedule II	Least Concern
2.	<i>Pteropus giganteus</i>	Fruit bat	Schedule V	Least Concern
3.	<i>Funambulus palmarum</i>	Three striped squirrel	NA	Least Concern
Aves				
4.	<i>Dicrurus leucophaeus</i>	Ashy drongo	Schedule IV	Least Concern
5.	<i>Muscicapa dauurica</i>	Asian brown flycatcher	Schedule IV	Least Concern
6.	<i>Ictinaetus malayensis</i>	Black eagle	Schedule I	Least Concern
7.	<i>Bubulcus ibis</i>	Cattle egret	Schedule IV	Least Concern
8.	<i>Upupa epops</i>	Common hoopoe	NA	Least Concern
9.	<i>Acridotheres tristis</i>	Common myna	Schedule IV	Least Concern
10.	<i>Actitis hypoleucos</i>	Common sand piper	Schedule IV	Least Concern
11.	<i>Centropus sinensis</i>	Greater coucal	Schedule IV	Least Concern
12.	<i>Apus affinis</i>	House swift	NA	Least Concern
13.	<i>Ardeola grayii</i>	Indian pond heron	Schedule IV	Least Concern
14.	<i>Saxicoloides fulicata</i>	Indian robin	Schedule IV	Least Concern
15.	<i>Turdoides striatus</i>	Jungle babbler	Schedule IV	Least Concern
16.	<i>Casmerodius albus</i>	Large egret	Schedule IV	Least Concern
17.	<i>Egretta garzetta</i>	Little egret	Schedule IV	Least Concern
18.	<i>Saxicola caprata</i>	Pied bushchat	Schedule IV	Least Concern

S.No	Scientific Name	Common Name	WLPA Schedule	IUCN Category
19.	<i>Nectarinia zeylonica</i>	Purple rumper sunbird	Schedule IV	Least Concern
20.	<i>Pycnonotus cafer</i>	Red vented bulbul	Schedule IV	Least Concern
21.	<i>Vanellus indicus</i>	Red wattled lapwing	Schedule IV	Least Concern
22.	<i>Pycnonotus jocosus</i>	Red whiskered bulbul	Schedule IV	Least Concern
23.	<i>Psittacula krameri</i>	Rose ringed parakeet	Schedule IV	Least Concern
24.	<i>Accipiter badius</i>	Shikra	Schedule I	Least Concern
25.	<i>Alcedo atthis</i>	Small blue kingfisher	Schedule IV	Least Concern
26.	<i>Streptopelia chinensis</i>	Spotted dove	Schedule IV	NE
27.	<i>Dicaeum agile</i>	Thick billed flowerpecker	Schedule IV	Least Concern
28.	<i>Dicrurus caerulescens</i>	White billed drongo	Schedule IV	Least Concern
29.	<i>Halcyon smyrnensis</i>	White breasted kingfisher	Schedule IV	Least Concern
Insects				
30.	<i>Tirumala limniace</i>	Blue tiger	NA	NE
31.	<i>Xylocopa violacea</i>	Carpenter bee	NA	NE
32.	<i>Catopsilia pomona</i>	Common emigrants	NA	NE
33.	<i>Eurema hecabe</i>	Common grassy yellow	NA	NE
34.	<i>Euploea core</i>	Common Indian crow	NA	Least Concern
35.	<i>Delias eucharis</i>	Common jezebel	NA	NE
36.	<i>Phalanta phalanta</i>	Common leopard	NA	NE
37.	<i>Papilio polytes</i>	Common mormon	NA	NE
38.	<i>Atrophaneura aristolochiae</i>	Common rose	NA	NE
39.	<i>Sarangesa dasahara</i>	Common small flat	NA	NE
40.	<i>Atrophaneura hector</i>	Crimson rose	NA	NE
41.	<i>Ischnura hecaterostica</i>	Damson fly	NA	NE
42.	<i>Hypolimnas misippus</i>	Dandaidd eggfly	NA	NE
43.	<i>Zizeeria karsandra</i>	Dark grass blue	NA	NE
44.	<i>Sympetrum flavolum</i>	Dragon fly	NA	NE
45.	<i>Psuedocoladenia dan</i>	Fulvous pied flat	NA	NE
46.	<i>Gangara thyrasis</i>	Gaint red eye	NA	NE
47.	<i>Parantica aglea</i>	Glassy tiger	NA	NE
48.	<i>Chorthippus brunneus</i>	Grass hopper	NA	Least Concern
49.	<i>Junonia atlites</i>	Grey pansy	NA	NE
50.	<i>Apis cerana</i>	Indian bee	NA	NE
51.	<i>Zizina otis</i>	Lesser grass blue	NA	NE
52.	<i>Apis dorsata</i>	Rock bee	NA	NE
53.	<i>Coptotermes formosanus</i>	Termite	NA	NE
54.	<i>Vespula vulgaris</i>	Wasp	NA	NE
55.	<i>Ixias pyrene</i>	Yellow orange tip	NA	NE
Reptile				
56.	<i>Calotes versicolor</i>	Garden lizard	NA	Least Concern
57.	<i>Lampropholis guichenoti</i>	Skink	NA	NE
Amphibian				
58.	<i>Duttaphrynus melanostictus</i>	Toad	NA	Least Concern

Source: Biodiversity Study conducted by ICT Pvt. Ltd.

NA- Not Applicable under Wildlife Schedule according to Wildlife Protection Act 1972

NE- Not Evaluated as per the IUCN Red List of Threatened Species

221. *Ictinaetus malayensis* (Black Eagle) and *Accipiter badius* (Shikra) are two avian species which fall under Schedule I as per Wildlife Protection Act, 1972 and amendments. The Act

provides protection to listed species of flora and fauna, prohibits hunting of any wild animal specified in Schedule.

222. Both species *Ictinaetus malayensis* and *Accipiter badius* are under Least Concern as per IUCN Red list. The species have an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion. **None of the species found in the project area fall under the threatened category as per IUCN red list. All the evaluated species are in Least Concern Category.**

223. **Analysis of Primary Data:** Relative Frequency (RF), Relative density (Rd), Importance value index (IVI) and Abundance for overall faunal species were calculated and provided in **Annex 4.7 (Table-A.4.7.4)**. In the present investigation, among the faunal diversity, the insect species were found to be abundant. Biodiversity Index has been calculated, Shannon's Diversity Index and Simpson's Index is presented in **Table 75**.

Table 75: Shannon's and Simpson's Index

Shannon's Diversity Index (H)	Simpson's Index (D)
3.20	0.06



Plate 4. a .Jungle babbler, b. Red wattle lapwing, c. Cattle egret d. Indian pond heron, e. Ashy drongo, f. Rose ringed parakeet, g. Common myna, h. Red vented bulbul, i. Southern grey shrike, j. Oriental magpie robin, k. Common hoopoe, l. Spotted dove, m. Chestnut headed bee eater, n. Indian roller, o. White breasted kingfisher, p. Little and Greater egret

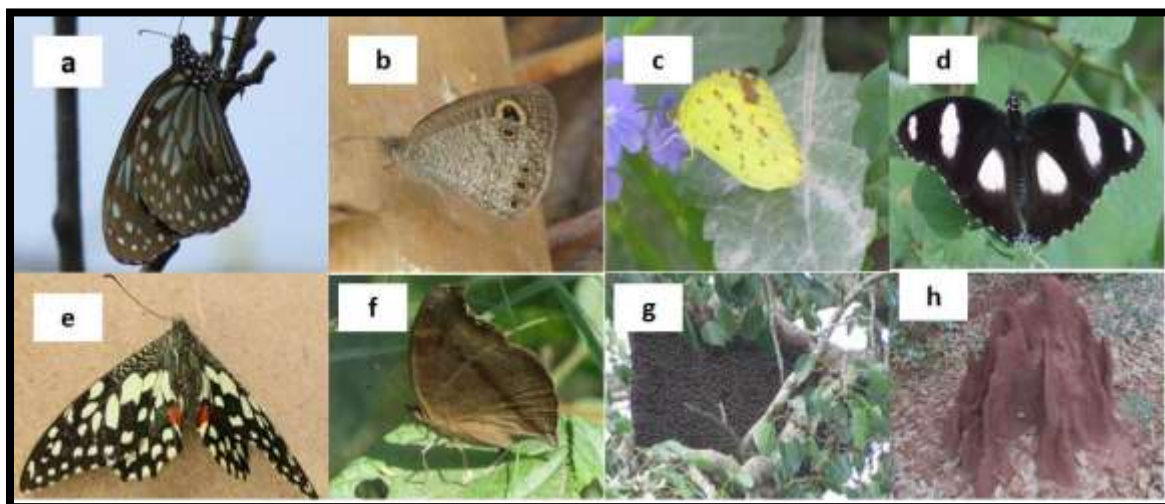


Plate 5. a. Glassy tiger, b. Common four ring, c. Common grass yellow, d. Dandaidd eggfly, e. Lime butterfly, f. Chocolate pansy, g. Rock bee, h. Termite



Plate 6. a. Three striped squirrel, b. Fruit bat, c. Garden lizard d. Toad

O. Protected Areas

224. The project road does not traverse through any National Park, Wildlife Sanctuary or Biosphere Reserve. Rayalpadu Reserve Forest, Addagallunelavanki RF and Attikunte Mallampalli RF are located within 10 Km radius of the road.

P. Forests

225. Two types of forests are reported in the study area namely Dry Deciduous Forest and Scrub & Thorne Forest:

226. **Dry Deciduous Forest:** The common species found are *Azadirachta indica*, *Pongamia pinnata*, *Melia composita*, *Diospyros melanoxylon*, *Diospyros montana* and *Ficus* sps.

227. **Scrub and Thorne Forest:** The vegetation is widely spaced and consists of *Euphorbia royleana* and clumps of wild palms (*Phoenix sylvestris*). Other species occurring are *Pithecellobium dulce*, *Prosopis juliflora*, *Diospyros chloroxylon*, *Carissa carandas*, *Agave americana*, *Dodonaea viscosa*, *Lantana camara* and *Opuntia dillenii*.

1. Rayalpadu Reserve Forest

228. The road is passing through Rayalpadu Reserve Forest in both sides for **3.977 km** and in one side (RHS) for a length of **7.5 km**. Total length of the forest along the project road is 11.477 km. The location of Reserved Forests along the project road is given in **Table 76** and shown in **Figure 19**.

Table 76: Location of Forests along the Project Road

Existing Ch. Km			Design Ch. Km			Side	Name of the Forest
From	To	Length (km)	From	To	Length (km)		
75+600	82+950	7.350	75+320	82+610	7.290	RHS	Rayalpadu Reserved Forest
83+200	83+350	0.150	82+880	83+030	0.150	RHS	
83+353	87+330	3.977	83+030	86+977	3.947	Both	
Total Length (km)		11.477	Total Length (km)		11.387		



Figure 19: Map showing Location of Rayalpadu Reserved Forests along the Project Road

229. As per the ADB's SPS 2009, **Natural Habitats** are the land and water areas where the biological communities are formed largely by native plant and animal species and where human activity has not essentially modified the area's primary ecological functions. The forest areas along the project road have large number of indigenous species, which justifies it to be classified as natural habitats.

230. The vegetation is widely spaced and the common species found are *Azadirachta indica*, *Pongamia pinnata*, *Melia composita*, *Ficus* sps. *Prosopis juliflora*, *Pithecellobium dulce*, *Diospyros chloroxylon*. Clumps of wild Palms (*Phoenix sylvestris*) are common in the area. *Carissa carandas*, *Agave americana*, *Dodonaea viscosa*, *Lantana camara*, *Opuntia dilleni* and *Euphorbia royleana* were the common shrub species observed in the forest area. Poor quality of bamboo is also found in Forest area. The list of flora provided by the Forests Department is presented in **Annex 4.8 (Table – A.4.8.1)**



Royalpadu Reserve Forest



231. The stocking of the Forests is poor. The trees are stunted and branchy with diffused crown with crown density less than 40 percentage. The soil is poor and scanty of rainfall support only stunted growth. The Forests were exploited in past for firewood and charcoal. Large extend of thorny scrubs were cleared to plant mostly *Eucalyptus*. *Eucalyptus teriticornis* plantations were present on Forestland along the roadside.

232. The Forestlands are infested with *Lantana camara* an invasive species. The weed has now become a major source of fuel to the villagers in the area.

233. Royalpadu Forest area consists of hilly terrain with rocky boulders. The slopes are more or less steep and rocky consisting of boulders of varying size almost devoid of vegetation. Patches of *Prosopis juliflora* are located at some places. The ground is broken due to erosion caused by non-perennial streams.

234. On review of Forest working plan it is found that the mammalian species dwelling in the in Forest area comprise of Wild Pig (*Sus scrofa*), Leopard (*Panthera pardus*), Jungle Cat (*Felis chaus*), Bonnet Macaque (*Macaca mulatta*), Fruit bat (*Pteropus giganteus*), Squirrel (*Funambulus palmarum*), Jackal (*Canis aureus*), Indian Fox (*Vulpes bengalensis*), Deer (*Axis axis*), Mongoose (*Herpestes edwardsii*), Indian Hare (*Lepus nigricollis*), Stripped Hyaena (*Hyaena hyaena*), Indian Gerbils (*Tatera indica*), Ratel (*Mellivora capensis*) etc. The list of wildlife provided by the Forest Department is presented in **Annex 4.8 (Table – A.4.8.2)**

235. During Public consultation in the project area the locals informed that Wild Boar, Deer, Jackal and Rabbit were found in the Forest areas. Wild boars were also reported for destroying agricultural crop in the area.

Q. Educational, Medical and religious Properties

236. **Educational Institutions:** Along the project road, there are 10 educational institutions, out of which, 4 are located on the right side and 6 are located on the left side of the project road. Chainage wise list of educational institutions along with distance from the center line of the project road are given in **Table 77**.

Table 77: List of Educational Institutions along the Project Road

S.N.	Description	Village	Existing Ch. km	Design Ch. Km	Side	Distance# (m)
1.	Govt. Higher Primary School	Seegalapallya	61+170	61+170	LHS	8
2.	Govt. Higher Primary School	Thadigol	62+550	62+520	RHS	68.1
3.	Shrunga PU College	Thadigol	62+640	62+600	RHS	55
4.	Bhagwan Buddha ITI	Kamlavarpalli	63+400	63+370	LHS	20
5.	Bhagwan Buddha High Schoo	Kamlavarpalli	63+450	63+430	LHS	23.5
6.	Govt. Higher Primary School	Jodi Kothapalli	68+620	68+400	LHS	8
7.	VSR School	Nelavanki	71+080	70+850	LHS	13
8.	Minarva Vidhya Mandir	Nelavanki	71+300	71+100	RHS	90.6
9.	Govt. Higher Primary School	Manchineelkote	73+410	73+190	RHS	24
10.	Govt. Higher Primary School	Thopalli	74+725	74+500	LHS	16

(Source: Field Survey conducted by ICT Pvt. Ltd.)

Distance in meter from existing centerline



237. **Religious Places:** Along the project road, there are 33 religious places, out of which 13 religious places are located on the right side and 20 are located on the left side of the project road. Chainage wise list of religious places along with distance from the center line of the project road are given in **Table 78**.

Table 78 List of Religious Places along the Project Road

S.N.	Description	Village	Existing Ch. km	Design Ch. Km	Side	Distance# (m)
1.	Narsingha Temple	Medikere	47+300	47+400	RHS	26.10
2.	Kaivara Tataiya Temple	Medikere	47+350	47+400	RHS	70.30
3.	Ramanjenaye Swami Temple	Aimareddihalli	50+760	50+890	LHS	9.10
4.	Hanuman Temple	Alavati	53+350	53+500	LHS	12.60
5.	Road side Mini Worship Place	Alavati	53+590	53+700	RHS	39.20
6.	Road side Mini Worship Place (Navgrah)	Marinayakanhalli	54+655	54+790	LHS	12.80
7.	Sani Mahatma Temple	Marinayakanhalli	54+655	54+794	RHS	8.30
8.	Road side Small Hanuman Temple	Kodivaripally	55+680	55+815	RHS	7.00
9.	Valmiky Temple	Kodivaripally	56+010	56+135	LHS	11.00
10.	Veeranjeneya Temple	Kodivaripally	56+060	56+200	LHS	15.30
11.	Hanuman Temple	Jogyanahalli	57+010	57+140	RHS	12.90
12.	Road side Small Hanuman Temple	Gopalli	58+150	58+275	LHS	10.80
13.	Road side Mini Worship Place	Thadigol	59+880	60+018	RHS	9.00
14.	Vinayak Temple	Thadigol	62+330	62+435	RHS	7.50
15.	Road side Small Hanuman Temple	Kamlavarpalli	63+825	63+800	RHS	16.20
16.	Ganga Maa Gudi Temple	K. Shettihalli	64+885	64+880	LHS	20.80
17.	Navajeevana Church	K. Shettihalli	65+080	65+000	LHS	59.70
18.	Road side Mini Worship Place (Navgrah)	Kossandra	66+920	66+860	LHS	10.00
19.	Ramanjeneya Temple	Kossandra	65+930	66+900	LHS	12.40
20.	Road side Small Hanuman Temple	Jodi Kothapalli	68+150	68+050	LHS	12.50
21.	Road side Mini Worship Place (Ganesh)	Jodi Kothapalli	68+490	68+400	LHS	10.30
22.	Hanuman Temple	Chakapalli	69+200	69+110	RHS	23.80
23.	Road side small Ganga Maa Temple	Nelavanki	70+400	70+310	LHS	67.10
24.	Road side Small Hanuman Temple	Nelavanki	70+450	70+350	LHS	16.80
25.	Mar Thoma Church	Nelavanki	71+500	71+420	RHS	13.30
26.	Road side Small Ankamma Temple	Thopalli	74+800	74+700	LHS	11.00
27.	Road side Mini Worship Place (Hanuman)	Thopalli	75+450	75+280	RHS	7.00
28.	Hanuman Temple	Mandyala	78+450	78+300	LHS	153.70
29.	Mini Worship Place (Nag Dev)	Royalpad	81+600	81+400	LHS	70.30
30.	Small Hanuman Temple	Royalpad	81+700	81+500	LHS	151.60
31.	Hanuman Temple	Gontapalli	82+800	82+635	RHS	43.30
32.	Road side Mini Worship Place (Hanuman)	Gontapalli	84+470	84+247	LHS	7.36
33.	Hanuman Temple	Gontapalli	84+470	84+242	LHS	21.10

(Source: Field Survey conducted by ICT Pvt. Ltd.)

Distance in meter from existing centerline



**Ramanjenaye Swami Temple
at Ch. Km 50+760 (LHS)**



Vinayak Temple at Ch. Km 62+330 (RHS)

238. **Medical Facilities:** No hospital, primary health center or any other medical facilities are located along the project road.

239. **Bore-well and Hand Pump:** 77 bore-wells, 5 hand pumps, 4 overhead water tank and 1 well is located along the side of the project road. Chainage wise list of the hand pumps along with distance from the center line of the project road are given in **Table 79**

Table 79: List of Hand Pumps along the Project Road

S.N.	Description	Design Ch. Km	Existing Ch. Km	Side	Dist. From C/L (m)
1.	Hand Pump	53+690	53+560	RHS	23.2
2.	Hand Pump	63+700	63+600	RHS	135.0
3.	Hand Pump	78+065	78+250	LHS	13.2
4.	Hand Pump	82+865	83+090	LHS	8.9
5.	Hand Pump	84+270	84+490	LHS	29.2

R. Demographic Details of the Population in the Project Area

1. Population

240. The project road falls in two districts namely Chikkballapur and Kolar districts in Karnataka State and it is expected that about 4.57% of the State are likely to be directly or indirectly benefited by the implementation of the project. Details are given in **Table 80**.

Table 80 Total Population in the Study Area

State/Districts	Total Population
Karnataka	61,095,297
Chhikkabalapura	12,54,377
Kolar	15,40,231

Source: Census of India 2011

2. Population Density

241. "Population density of the study area varies considerably. As per the Census Data of 2011, the density of population in Chikkaballapur and Kolar District is 296 persons/ sq. km. and 386 persons/sq. km respectively. Kolar district density of population is greater than the State (319 persons/ sq. km). The population density of the districts is detailed in below **Table 81**.

Table 81: Population density of the affected districts

State/ Districts	Density/km ²	
	2001	2011
Karnataka	276	319
Chhikkabalapura	273	296
Kolar	346	386

Source: Census of India 2011

3. Sex Ratio

242. Sex ratio of the influenced districts presents the same scenario as that of the State. Sex-ratio of Karnataka is 973 males per thousand females. In the project affected districts, it varies from 867 to 962 as detailed in **Table 82**.

Table 82: Sex-ratio in the State and Project Districts

States/ Districts	Overall Sex ratio (Per 1000)	Sex ratio of child population in the age group of 0-6 yrs
Karnataka	973	948
Chhikkabalapura	968	867
Kolar	979	962

Source: Census of India 2011

4. Population Composition of Affected Villages

243. The population composition of any village is important to anticipate the extent of project impact. Keeping this in mind the importance of demographic profile, the population of the villages was computed. The composition of population with respect to male and female population of potential affected villages / settlements is shown in **Table 83**.

Table 83: Distribution of the Population of Affected Villages with Sex Composition

Districts	Village Name	Male	Female	Total
Chikkabalapura	Somasettyhalli	677	710	1387
Chikkabalapura	Kodiganahalli	272	284	556
Chikkabalapura	Rachavaripalli	319	327	646
Chikkabalapura	Cheemanahalli	342	331	673
Chikkabalapura	Kambalapalli	245	245	490
Chikkabalapura	Gollapalli	231	217	448
Chikkabalapura	Dandupalya	157	161	318
Chikkabalapura	Marinaikanahalli	240	230	470
Chikkabalapura	Jogyanaahalli	124	111	235
Chikkabalapura	Goppalli	242	230	472
Chikkabalapura	Gopasandra	354	382	736
Chikkabalapura	Booragamakalahalli	676	624	1300
Chikkabalapura	Oolavadi	826	878	1704

Districts	Village Name	Male	Female	Total
Chikkabalapura	Hebbari	623	588	1211
Chikkabalapura	Imareddihalli	331	315	646
Chikkabalapura	Madikere	882	902	1784
Kolar	Vyapalahalli	173	186	359
Kolar	Rayalpad	1203	1224	2427
Kolar	Mandyala	261	263	524
Kolar	Madarankapalli	94	94	188
Kolar	Yendaguttapalli	65	81	146
Kolar	Guntapalli	389	360	749
Kolar	Kurupalli (K)	210	184	394
Kolar	Manchineellakote	550	508	1058
Kolar	Thoopalli	236	240	476
Kolar	Jinkalavaripalli	273	266	539
Kolar	Subbagundlapalli	114	106	220
Kolar	Nelavanki	385	380	765
Kolar	Chakapalli	157	163	320
Kolar	Kothapalli	202	207	409
Kolar	Doddabandarlahalli	205	213	418
Kolar	Kasettipalli	366	396	762
Kolar	Kamalavaripalli	248	257	505
Kolar	Marepalli	153	141	294
Kolar	Koosandra	368	384	752
Kolar	Bandapalli	374	375	749
Kolar	Gullakunte	142	129	271
Kolar	Thadigol	1214	1155	2369
Kolar	Seegahalli	122	115	237
Kolar	Alavatta	529	530	1059
Kolar	Lakshmisagar	116	113	229
Kolar	Nachagundlahalli	194	196	390
Kolar	Thammiareddihalli	254	269	523

Source: Census of India 2011

5. Social Category

244. In many places, especially in rural India the social category plays a dominant role in determining the accessibility to resources. People from Scheduled Tribes, Scheduled Castes and Other Backward Castes are deprived of their rights. Such section of the society needs special concern while rehabilitating them.

245. The data indicates that majority of PAHs belong to General and OBC category in proposed project. Out of total PAHs, 51.23% belong to General category followed by Other Backward Caste (OBC) 23.36%. There are about 7.58% households belonging to Schedule Tribes (ST) and 6.97% Schedule Caste (SC) and the same have been presented in **Table 84**.

Table 84 Social Stratification of PAHs along the Project Road

Sl. No.	Social Category	No. of PAHs		Total	%
		Left	Right		
1	General	115	135	250	51.23

Sl. No.	Social Category	No. of PAHs		Total	%
		Left	Right		
2	OBC	73	41	114	23.36
3	SC	23	11	34	6.97
4	ST	20	17	37	7.58
5	NA/NR	27	26	53	10.86
Total		258	230	488	100.00

Source: Census Survey, 2015-16

6. Religious Category

246. Social customs and tradition 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 to understand the religious profile of the PAHs within the corridor of impact. Majority of the PAHs belong to Hindu community (88.73%) and (1.23%) population belongs to Muslim community respectively. The trend shows that Hindu communities dominate the project road. **Table 85** delineates the religious category of the project affected households.

Table 85: Religious Categories of PAHs along the Project Road

Sl. No.	Religious Group	No. of PAHs		Total	%
		Left	Right		
1	Hindu	228	205	433	88.73
2	Muslim	4	2	6	1.23
3	NA	26	23	49	10.04
Total		258	230	488	100.00

Source: Census Survey, 2015-16

7. Literacy

247. As per socio-economic survey of 128 households, the literacy indicator shows that percentage of literacy is more in case of female compared to the male. 22.19% of the male are literate where as 36.66% of the female are literate in the project affected area. Details are given in **Table 86**.

Table 86: Literacy Status

Sl. No.	Particulars	Total Male	% Male	Total Female	% Female
1	Literate	75	22.19	114	36.66
2	Illiterate	263	77.81	197	63.34
Total		338	100.00	311	100.00

Source: Socio Economic Survey, 2015-16

8. Income and Poverty Levels

248. Income of the affected households has been grouped into 9 slabs and the number of households falling into a defined slab is detailed below in **Table 87**. This exercise has given a base to determine the number of vulnerable affected families.

Table 87: Annual Income of PAHs

Sl. No.	Annual Income (in Rs.)	No. of PAHs		Total	%
		Left	Right		
1	24001 to 26000	8	14	22	4.51
	26000 to 30000	4	4	8	1.64
2	30001 to 40000	9	11	20	4.10
3	40001 to 50000	7	11	18	3.69
4	50001 to 60000	23	20	43	8.81
5	60001 to 70000	4	0	4	0.82
6	70001 to 80000	21	12	33	6.76
7	80001 to 90000	6	2	8	1.64
8	90001 to 100000	20	10	30	6.15
9	Above 100000	102	82	184	37.70
10	NA/NR	55	63	118	24.18
Total		259	230	488	100

Source: Census Survey, 2015-16

9. Vulnerable Groups along the Project Road

249. The Social Impact Assessment identifies the vulnerable population in order to minimize the adverse impact and provide adequate mitigation measures. An assessment was made to bring out the vulnerable PAPs (BPL, SC, ST, Women-headed Households, Physically handicapped persons and Elderly). Their distribution on the stretch in terms of absolute numbers and percentage are given below.

250. The data reveals that 488 households belong to vulnerable category out of which 56.56% are BPL, 5.74% are SC, 4.92% are Elderly, 4.51% are ST and 2.66% are WHH respectively. Refer **Table 88** for the details of vulnerable groups:

Table 88: Vulnerable Groups along the Project Road

Sl. No.	Vulnerable Category	No. of Households		Total	%
		Left	Right		
1	BPL	148	128	276	56.56
2	WHH	9	4	13	2.66
3	PHH	3	4	7	1.43
4	Elderly	10	14	24	4.92
5	SC	20	8	28	5.74
6	ST	11	11	22	4.51
7	Non - Vulnerable	57	61	118	24.18
Total		258	230	488	100

Source: Census Survey, 2015-16

10. Occupation Pattern

251. The project road is dominated by families involved in agriculture. Out of total 488 affected households about 191 (39.14%) of them are engaged in agriculture for earning their livelihood. 15.37% are engaged as daily wage earner & Labour. The details are provided in **Table 89**.

Table 89: Details of Occupational Pattern of PAHs

Sl. No.	Occupation	No. of PAHs		Total	%
		Left	Right		
1	Agriculture	100	91	191	39.14
2	Agriculture Labour	24	21	45	9.22
3	Daily Wage Earner & Labour	49	26	75	15.37
4	Housewife	2	4	6	1.23
5	Private Employee	20	17	37	7.58
6	Rural Artisan	3	1	4	0.82
7	Salaried Govt.	7	9	16	3.28
8	Unemployed	5	2	7	1.43
9	Business	12	21	33	6.76
10	NA	36	38	74	15.16
Total		258	230	488	100.00

Source: Census Survey, 2015

V. ANALYSIS OF ALTERNATIVES

A. General

252. In the present chapter, development study of existing road (SH-82) has been considered for the improvement keeping in mind the environmental aspects associated. The analysis of alternatives has been carried out 'with the project' and 'without the project' scenarios in terms of potential environmental impacts. The existing road does not pass through any major settlement as it is noted that majority settlement are located away from both sides of the project road. The project road passes through some smaller settlement like Thadigol Cross, Seegalpalya, Nelavanki, Manchineelkote, Royalpad in the district of Kolar and Chikbalpura. The existing ROW is between 20 to 30 m. Due to availability of existing ROW and with no congested major settlement along the project road **no bypasses** have been proposed. However smaller realignment have been considered to improve safer movement of traffic at location with very poor geometry not confirming to codal provisions.

B. "With" and "Without" Project Scenario

253. The existing project road, Chintamani to AP Border occupies a strategic position being an inter-state road. The SH-82 from Hoskote to Chintamani has already been upgraded to 2 lane with paved shoulder in KSHIP-II. Hence improvement of the stretch from Chintamani to AP Border will provide seamless connectivity to the AP Border. Project road forms connectivity to some National Highways and State Highways and also an optional connectivity to Tirupati temple visited by devotees across countries thus forming important link in the region. Keeping this in view, the site conditions and the scope of development of the area, the 'with' and 'without' project scenarios have been compared as shown in **Table 90**. By looking at the table it can be concluded that "with" Project Scenario, with positive / beneficial impacts will greatly enhance social & economic development of the region and improve the environment, when compared to the "without" project scenario, which will further deteriorate the existing environment and quality of life. Hence the "With" project scenario with some reversible impacts is an acceptable option rather than the "Without" project scenario. The implementation of the project therefore will definitely be advantageous to improve the environmental quality of the sub-region besides to achieve an all-round development of the economy and progress of the region.

254. If the project is not implemented, the existing bad pavement of the corridor will deteriorate further. The districts will also find it difficult to generate revenue. Increased air pollution, due to bad road condition, slow moving traffic and congestion will increase. Noise levels will rise due to deterioration of the pavement as well as increased honking. Without the improvement, the traffic would continue to pose a safety risk for the road users.

255. There is little increase in the pollution levels during construction. Dust and particulate matter during construction will affect the air quality on a short-term basis. However, Potential benefits of the proposed road improvements are substantial and far reaching both in terms of the geographical spread and time.

256. Implementation of the project will be a definite advantage to Karnataka State in order to achieve all-round development of its economy and progress for its people. It will provide mitigation not only for air & noise level but will also provide other appropriate mitigative measures such as roadside plantation, arboriculture & landscaping, compensatory afforestation and other short term reversible negative impact on environment.

C. Analysis of Alternatives

257. As mentioned earlier No bypass proposal have been recommended in the improvement proposal for the project road, however few realignments have been considered to improve existing bad geometry for safer movement of traffic.

Table 90: “With” and “Without” Project Scenario

With Project		Without Project	
Impacts		Impacts	
Positive	Negatives	Positive	Negative
<ul style="list-style-type: none"> ▪ With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel and emissions from the vehicles will be reduced reducing air pollution ▪ Improvement in ecology through compensatory afforestation ▪ Enhanced trade and commerce. ▪ The dust clouds associated with vehicles movement on tracks/earth roads will also be eliminated. ▪ Providing better level of service in terms of improved riding quality and smooth traffic flow. ▪ Reduction in accident rate ▪ Reduced transportation costs and increased access to markets ▪ Access to new employment opportunities ▪ Employment to local workers during the execution of the project ▪ Better access to health care centers and other social services ▪ Improved quality of life ▪ Strengthening of local economies and local industries. 	<ul style="list-style-type: none"> ▪ Minor changes in land use pattern ▪ Loss of some properties and livelihood ▪ Removal of vegetative cover along the road ▪ Increase in air pollution due to increased vehicular traffic ▪ Short term increase in dust due to earth work during construction at micro-level ▪ Increase in noise pollution during construction phase ▪ Diversion of minimum reserved forest land for geometric improvement. 	Nil	<ul style="list-style-type: none"> ▪ Increase in travel time ▪ Increase in fuel consumptions ▪ Increase in dust pollution & vehicular emission ▪ Increase in accident rate ▪ Overall economy of the State will be affected. ▪ Further deterioration of the project road ▪ Increased vehicle operation cost ▪ Reduced employment/economic opportunities ▪ Arrest of possible significant enhancement and economic development of the region ▪ Land degradation, dust pollution and damage to agricultural land, contamination in water bodies due to vehicles traveling along multiple tracks on the open ground ▪ In absence of the project, it will be difficult for the state to finance such a massive improvement of the road infrastructure from its own resources.

D. Proposed Realignments

258. The details of the proposed realignments are tabulated below:

Table 91: Details of Proposed Realignment

Sl. No.	Name of Town/Village	Existing Chainage Km		Realignment Chainage		
		Start	End	Start	End	Length (Km)
1	Tadgol Crossing	63+500	64+200	63+470	64+045	0.575
2	Thopalli	75+130	75+600	74+900	75+300	0.400

1. Realignment (Tadgol crossing)

259. The project road turns right ward at km 63+500 before Tadgol crossing with horizontal curve radius of 117m. The SH 99 takes off with Y junction from SH 82 where some small residential and commercial buildings exist along the road. Then the alignment turns leftward with curve radius of about 55m.

260. Further the project road moves rightward at Km 64+200 with radius of 75m. Thus the section from Ch. 63+500 to Ch. 64+200 has very poor horizontal geometry and is a black spot where number of total accidents had happened in the past. Hence, to improve safety of the road users, geometric improvement in form of realignment between Ch. 63+500 to 64+200 has been proposed.



View of Junction of SH 99



View of Sharp curve at Km 63+920



Figure 20: Proposed Thadigol Realignment

261. **Option I:** Improvement proposal along existing alignment is considered in this option. The improvement considered would lead to reduced travel speed due to sharp horizontal curve. Also due to bad geometry this is a black spot with accidents reported in the past. The proposed improvement along existing road would lead to utility relocations including, hand pumps, electrical transformers etc. Few shops at the junction with SH 99 cross road would be impacted in the junction improvement proposal. It was also noted that a Hanuman temple along project road would be impacted along with another small temple near junction with SH 99.

262. **Option II:** Improvement proposal in form of realignment as shown in Figure-5.1 above is considered in realignment. To avoid sharp unsafe curve the project road is connected with straight alignment passing through green virgin land. The improvement proposal has no impact on any existing structures, utilities or any environmental sensitive receptors. The improvement proposal will further improve safer movement of traffic with increased speed. Further due to the realignment, the road length has also been reduced by 125m.

263. Based on above it is noted that alignment improvement proposal in Option I, would lead to unsafe movement of traffic also having impacts on utilities and sensitive receptors. Based on above study realignment on left side as discussed in **Option II, is proposed in the improvement proposal** for the project road.

2. Realignment near Thopalli Settlement

264. There are four continuous substandard horizontal curves within a length of about 470m from km. 75+130 to km. 75+600. The horizontal curve radii are of 40m to 90m. Further the embankment height in this stretch is also about 2.5m. Due to these existing features this stretch is an accident prone area.



S Curve at 75+150



Blind curve at Km 75+600 with cross road



Figure 21: Proposed Realignment near Thopalli settlement

265. **Option I:** Improvement proposal along existing alignment is considered in this option. The improvement considered would lead to reduced travel speed due to three consecutive back to back sharp horizontal curves. In post improvement scenario with increased traffic in future due to bad geometry this would lead to several accidents and would make it a black spot unsafe section. The proposed improvement along existing road would lead to some utility relocation of electric poles. Also a cross road at design Ch. 75.300 improvement proposal of junction would impact an existing small Hanuman temple.

266. **Option II:** Improvement proposal in form of realignment as shown in Figure-5.2 above is considered in realignment. To avoid sharp unsafe curves, the project road is realigned such that alignment passes through greenfield virgin land with geometry of section as dictated in design standards. The improvement proposal has curves with very large radius, and has no impact on any existing structures, utilities or any sensitive receptors. The improvement proposal will further improve safer movement of traffic with increased speed.

267. Based on above it is noted that alignment improvement proposal in Option I, would lead to unsafe movement of traffic also having impacts on utilities and sensitive receptors. Based on the above study **Option II is proposed in the improvement proposal** for the project road.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

268. 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 minimise 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.

B. Land Environment

1. Topography & Geology

a. Construction Phase:

269. The impacts on existing topographical setting originate primarily from embankment preparation and opening up borrow pits to fulfill the requirement of huge quantity 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. Hence the impact on geology of the region is insignificant.

270. Impacts:

- Disfiguration & change in existing profile of the land due to realignment at 2 locations
- 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

271. **Seismological Characteristics of the Area:** The project road is in Zone-II (having low seismic intensity) of the seismic map of India (as per IS:1893, Part-1, 2002), and therefore it will have a low risk of potential damage due to earthquake.

272. **Road Building Materials:** During road construction mainly stone aggregates & bitumen will be required for pavement, while stone aggregates, sand & cement will be required for concrete making for rigid pavement, bridges, culverts, urban drains etc. 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 92**.

Table 92: Raw Materials requirement during Construction

Sl. No.	Item & Unit	Quantity	Mode of Transport	Source
1.	Blue metal (m ³)	4,30,000	Truck	Pre-identified quarry areas
2.	Sand (m ³)	2,90,000	Truck	Pre-identified quarry areas
3.	Cement (MT)	10,800	Truck	Local traders
4.	Bitumen (MT)	6,200	Truck	Refinery
5.	Diesel (liters)	50,00,000	Tanker	Local petrol pumps
6.	Steel (MT)	1,320	Truck	Local traders
7.	Earth (m ³)*	8,15,000	Truck	Identified Borrow areas

273. **Construction of Borrow Areas:** about **8,15,000 cubic meter** of borrow materials is to be used for the project road. This has to be obtained from earth generated through cutting of the road or from the existing borrow areas. Quantity of earth material likely to be generated through cutting operation is **5,90,000 Cum**. Therefore, **2,25,000 Cum** earth will required from the borrow area. The details of proposed borrow areas investigated with their respective locations; corresponding chainage and lead from nearest point to project road are tabulated in **Table 93**.

Table 93: Location of Proposed Borrow Areas

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Village Name	Lead From Nearest Point on Project Road (km)	Existing land Use
1	50+500	LHS	Imareddyhalli	1.30	Barren land
2	55+600	LHS	Nandigenahalli	1.20	Barren land
3	59+600	RHS	Kamatampalli	0.60	Barren land
4	64+800	LHS	Thadigol Cross	0.20	Barren land
5	70+300	RHS	Chakappli	0.20	Barren land
6	75+800	LHS	Thoopalli	0.10	Barren land
7	80+500	LHS	Madarangpalli	0.10	Barren land
8	85+300	RHS	Hakki Pikki Colony	0.50	Barren land

274. If contractor decides to open new borrow area, Environment Clearance and is to be obtained from concerned authority. Opening of new borrow areas could lead to the formation of large depression. If no proper measures are taken, there could be loss of fertile top soil and loss of agriculture crops.

275. **Establishment of Crushers:** Contractor will be required to establish a number of 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.

276. **Mitigation Measures.** All construction works are directly related to the land environment. Therefore, contractor needs to prepare / follow several mitigation / management plan / guidelines for various construction activities. These guidelines are listed below and detailed out in "Part-B Annexes of IEE & EMP".

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

8.4)

- **Guidelines for Siting, Operation and Re-development of Quarrying and Stone Crushing Operations (Annex-8.5)**
- Guidelines for Siting and Management of Debris Disposal Site (Annex-8.7)
- Guidelines for Preparing Comprehensive Waste Management Plan (Annex-8.8)

277. Some of the important provisions are given below:

- Earthquake resistance structures with seismic restrainers are being planned to be constructed under the project. Design of all structures like bridges and CD 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 Independent Engineer (IE). 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 in the forest land.
- Uncontrolled digging of borrow pits will be avoided to prevent water accumulation in abandoned pits which results in breeding ground of vector disease.
- Road building 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 licence 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.

b. Operation Phase

278. During operation phase of the project road, no impact is anticipated on the topography and geology of the area.

2. Soil

279. **Impacts: Soil Erosion:** Erosion of topsoil can be considered a moderate, direct and long term negative impact resulting from construction and maintenance of the road. Erosion problems may occur on newly constructed slopes 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). In the project road, embankment will be raised for a length of 38.339 km, out of which height of embankment is more than 3.0 m for a length of 5.75 km. Slope protection measures (stone pitching or turfing with Coir Geotextile & Vetiver grasses) form part of good engineering practice and therefore, it has been incorporated into the EMP.

280. **Construction of Bridges & Culverts:** Along the corridor reconstruction / widening of a number of minor bridges and culverts is planned. Construction of bridges involves excavation for construction of the foundation and piers. If the residual spoil is not properly disposed of, increased sedimentation may take place during the monsoon. During the construction period, some amount of drainage alteration and downstream

281. **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:

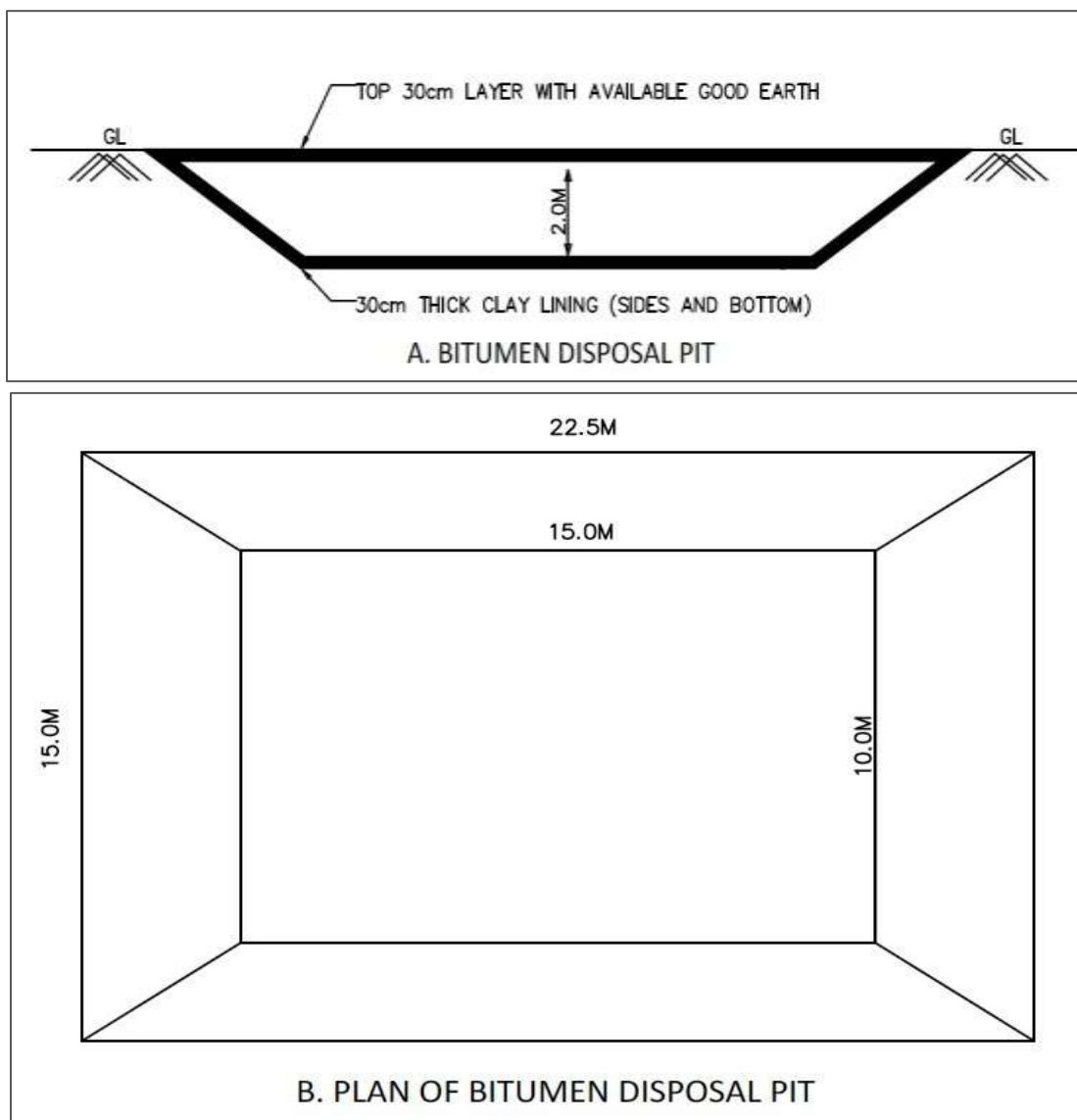
- Scarified bitumen wastes, excess production of bituminous product
- Debris generation due to dismantling of structures
- Maintenance of the machinery and operation of the diesel pumps, diesel generator sets, diesel storage and during transportation
- Operation of hot mix plant
- Storage and stock yards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

282. **Mitigation Measures:** The top soil from all sites including road side widening and working area, cutting areas, quarry sites, 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 Top Soil Conservation and Reuse” as given in **Annex-8.1**.

- **Slope Stabilization:** Adequate measures like adequate drainage, embankment consolidation & slope stabilization will be taken along the road to avoid soil erosion. 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. Environmental uncertainties are prompting engineers to favour bioengineering measures. 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 bios-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. Guideline on Slope Stabilization is given in **Annex-8.3**.
- **Recycling of bituminous surface**
- **Disposal of Bituminous Waste:** Non reusable 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 permission of IE. Details of bituminous waste generated from the proposed project road, number of Bitumen Disposal Pits (of volume 547 Cum) required for the disposal and typical drawing of disposal pit are given below and cost of the pit is covered in the EMP budget.

Table 94: Number of Bitumen Disposal Pits

Name of the Project Road	Chintamani to AP Border
Quantity of Bituminous waste generated (m ³)	23,500 Cum
No. of Bitumen Disposal Pits required	43

**Figure 22: Typical Drawing of Bitumen Disposal Pit**

- 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-8.11**.
- 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.

3. Land Use

a. Construction Phase

283. Widening of existing road will lead to change in land use pattern of areas adjacent to the road that comes under the proposed ROW. The existing land adjacent to the road at present is mainly of agricultural use with some roadside residential & commercial plots which will need to be acquired for widening of the road.

284. Preparatory activities like clearing of ROW, construction of temporary construction camps and godowns, storage of construction materials etc. will be confined within the camp & ROW. This will 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 workforce and supplier who are likely to construct temporary tents in the vicinity.

285. **Impacts:**

- Loss of agricultural land due to land acquisition for the road
- Changes in existing land use pattern of the ROW for construction of the road

286. **Mitigation Measures:**

- Earth material generated from excavation of roadways & drainage will be reused to the maximum possible extent as filling material during site development.
- The small amount of construction debris and surplus excavated material will 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.
- Identification, operation and redevelopment of dumping areas will be as per the Guideline provided in **Annex-8.7**.
- Construction camp will be provided for construction personnel to avoid indiscriminate settlement of construction workers & labourers.
- Regular inspection of haul roads and construction site will be carried out to ensure regular and timely removal of construction debris to the designated dumping sites.
- Construction activities will be kept confined to ROW only.

b. Operation Phase

287. In the operation phase, the temporarily modified land use pattern such as temporary construction camps / tents would be dismantled. The road, after completion of its development, would consist of neat landscape to lead to a pleasing outlook.

288. The existing road passes through mainly agricultural field and some congested stretches of residential / commercial areas. The safe & quicker accessibility would result in increased scope of commercial, industrial and residential development along the project corridor. Squatter settlement and encroachment along the project road is very likely to take place unless proper controlled measures are adopted.

289. **Impacts:**

- Likely change of land use due to squatter / encroachment within ROW

- Likely change of land use due to induced roadside development outside the ROW

290. **Mitigation Measures:**

- 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 project shall be strictly avoided by proper regulation and vigilance.
- Land use control measures will be prepared & administered to avoid occurrence of induced development as far as possible.
- Planning agencies and Collector/ Revenue Officer will be made involved for controlled development and prohibiting squatter / encroachment within ROW.

C. Water Environment

1. Drainage & Hydrological Flow

291. The project road does not experience flood. The project road runs through plain & rolling terrain and there is no river crossing. However, the project road crosses natural drainage channel / stream at seven locations. During heavy rainfall these natural drainage channels carry swift flow. As the existing CD structures and minor bridges will be suitably augmented & additional CD structures will be constructed, it will not obstruct the water flow in the channels. Therefore, no impact on drainage is envisaged.

292. **Impacts:**

- Change in drainage pattern of the land around realignment
- Increased incidence and duration of floods due to obstruction of natural drainage courses by the road embankment
- Chances of filling of existing drainage courses during earth filling
- There may be potential drainage impacts relating to the 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.
- **No road side pond shall be affected**

293. **Mitigation Measures:**

- Adequate roadside drains will be provided along the road to facilitate its better maintenance and increase in the life of the carriageway. This will also help in avoiding soil erosion and land degradation due to water stagnation on the either side of the road.
- Detailed drainage survey and hydrological investigations have been carried out and accordingly capacity of existing drainage works & cross drainage (CD) structures have been duly augmented, wherever necessary, to accommodate high discharges to avoid flooding & formation of water pool
- Adequate new drainage works & cross drainage (CD) structures have been provided for smooth passage of runoff to avoid flooding
- Filling of existing drainage courses will be strictly avoided

- 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 / low lying areas 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 site & camp will be provided to eliminate the chances of formation of stagnant water pools that leads to soil erosion & breeding of mosquitoes

2. Drinking Water Sources

294. **Impacts:** Only 1 hand pump and 11 mini water tank will be impacted.

295. **Mitigation Measures:**

- Affected hand pump and mini water tank shall be relocated in such a manner that it should not hamper the access to drinking water.
- Construction will not be started until all drinking water sources are replaced with new ones.
- Supply water is the main sources of drinking water in the project area. Therefore, no major impact is envisaged on the user.

3. Water Use

296. **Impacts:** 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 95**.

Table 95: Breakup of Fresh Water Requirement during Construction

S N	Purpose	Quantity (KL)
1.	For road construction:	9,85,000
	a) Construction related to earthwork	
	b) Construction of GSB	
	c) Construction of WMM	
	d) Bridges, culverts, retaining walls & other structures	
2.	Dust suppression	5,000
3.	For drinking & other household purpose #	10,000
	Total	10,00,000

297. **Mitigation Measures:**

- Minimum use of water from existing sources for construction purpose will be ensured to minimize likely impacts on other users
- The contractor will arrange water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.

- If new tube-wells are to be bored, due to the non-availability of water required for construction, prior sanctions and approvals by the Ground Water Department has to be obtained by the Contractor
- Wastage of water during the construction should be minimized

4. Water Quality

a. Construction Phase

298. Impacts:

- During construction phase, leakage of POL could lead to an increase in water pollution level of the region. 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 extremely rare.
- Increase of sediment load in the run off from construction sites and increase in turbidity in receiving streams/water bodies
- Water pollution due to sewage from construction camps

299. Mitigation Measures:

- Quality of construction wastewater emanating from the construction site will be controlled through suitable drainage system with silt traps for arresting the silt / sediment load before its disposal into the main natural drainage system around the site
- Proper sanitation facilities will be provided at the construction site to prevent health related problems due water contamination
- 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 during dry seasons only
- 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 drain / 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 unlined roadside drains in rural stretches carrying storm water will be connected to the nearest natural drainage channel, water bodies with silt traps.
-

300. **Enhancement of Water Body:** Enhancement measures have been proposed for roadside pond located at Hebbari village at chainage km 52+800 on the left side of the project road (**Table 96**). Local villagers informed that the pond water is utilized only for post-harvest washing. The pond is located 86 m away from the project road and sufficient space is available for further improvement.

Table 96: Water Body Proposed for Enhancement

SL	Particular	Chainage km	Distance (m)	Side	Village
22.	Pond	52+800	86.3	LHS	Hebbari

301. Followings have been proposed as a part of enhancement:

- a) Deepening of the water body up to 2 m (earth excavation)
- b) Stabilization of the slope using Vetiver Grass
- c) Phyco-Remediation of water using NUALGI
- d) Turfing of surrounding area of the water body
- e) Sitting arrangement with RCC Precast Benches with back support
- f) Pathway with Interlocking Paver Blocks & sand filling
- g) Approach Road
- h) Oil interceptor



View of the Water Body Proposed for Improvement

302. **Phyco-Remediation using NUALGI:** During the site visit, algal growth is observed in the pond and local villagers also informed that the quality of water of the pond is very bad. Therefore, as a part of enhancement measures, Phyco-Remediation using NUALGI is proposed to improve the water quality of the pond. Phyco-remediation 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.

303. 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 CO₂ 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 CO₂ 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.

304. 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 environmentally friendly way of converting the excess nutrients to fish biomass.

305. Guideline on Phyco-Remediation of Water using NUALGI is given in Annex-8.26 and a Typical Enhancement Plan for road side pond / water bodies is given in Annex-8.27. Cost of enhancement is covered in the EMP budget.

306. **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 Plan (Table-8.3 of Chapter-8). The maximum desirable limits as per the water quality standards are given in **Annex-3.1** and the monitored values should correspond with the table. All deviated results shall be reported to Sr. Environmental Specialist of the Independent Engineer for remedial measures. It should be ensured that no construction camps or stockyards are set up near rivers, irrigation canals and water bodies to prevent oil spills.

307. **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 trap at the edge of all water bodies located along the project road and minor bridge locations. Further, silt fence will be mounted in guiding drains at a distance of 3 to 5 m in the upstream direction depending on the gradient of the guiding drains. However 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 Independent Engineer and monitored by PIU. Drawing of typical silt trap is given in **Annex-8.22**.

308. **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 camps. 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. However the number of interceptors shall increase as the situation demands or during the accidental spillages. Actual number will be decided by the Contractor with the consent of Sr. Environmental Specialist of the Independent Engineer. Drawing of typical Oil Interceptor is given in **Annex-8.23**.

309. **Ground Water Recharge Pit/ Rainwater Harvesting Structures** and silt fences has been proposed near natural drainage channel and low lying areas (**Table-6.5**) to improve the water table in this region and conserve water bodies. It has been observed from the past meteorological data of IMD, total number of **rainy days** in the project area is **48.2 days** and total **annual rainfall is 755.4 mm**.

310. Ground Water Recharge Pit has been proposed at 16 locations (**Table 81**). However, the locations of proposed ground water recharge will be reviewed by the Sr. Environmental Specialist of the Independent Engineer and finalized in consultation with EMPIU. These locations should be permanent which shall be handed over to the local civic bodies at the end of the project so that the water shortages can be reduced to a certain extent. Lump sum cost provision has been provided in the EMP. Typical drawing of ground water recharge pit is given in **Annex-8.24**.

Table 97: Proposed Location of Ground Water Recharge Pit

Design Ch. Km	Village	Description
50+000	Hebbari	Natural Drainage Channel
52+800	Hebbari	Low Lying Area
63+775	Kamlavarpalli	Natural Drainage Channel
66+360	Doddabandaralapalli	Low Lying Area
67+750	Jodi Kothapalli	Natural Drainage Channel
70+300	Chakapalli	Natural Drainage Channel
71+600	Nelavanki	Natural Drainage Channel
71+600	Nelavanki	Low Lying Area
72+900	Manchineelkote	Low Lying Area
75+000	Thopalli	Low Lying Area
77+646	Mandyala	Natural Drainage Channel
80+960	Royalpad	Natural Drainage Channel
81+000	Royalpad	Low Lying Area
82+360	Gontapalli	Low Lying Area
63+700	Kamlavarpalli	Low Lying Area
63+700	Kamlavarpalli	Low Lying Area

b. Operation Phase

311. Widening will result in increase of surface run-off due to more paved road surface. It will have adverse impact on ground water recharging if measures are not taken during the design stage.

312. Impacts:

- Increase of surface run-off due to more paved road surface
- Filthy environment due to improper maintenance of drainage
- Chances of contamination of water bodies from road surface run off containing oil

spills due to traffic movement & accidents

313. Mitigation Measures:

- Longitudinal roadside drains of sufficient capacity will be provided on both sides of the 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.

D. Air Environment

1. Construction Phase

314. 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.

315. 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.

316. Impacts:

- 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 construction equipment & vehicular traffic
- Deterioration of air quality due to emission from asphalt and hot mix plants
- Emission of Carbon monoxide, sulfur-di-oxide, nitrogen oxides etc. will be generated from the hot mix plant

317. Mitigation Measures:

(i) Dust Control:

- Proper and prior planning and appropriate sequencing and scheduling of all

major construction activities will be done, and timely availability of infrastructural supports needed for construction will be ensured to shorten the construction period vis a vis reduce pollution.

- Construction materials will be stored in covered godowns or enclosed spaces to prevent the windblown fugitive emissions.
- Truck carrying soil, sand and stone will 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 will be undertaken to control fugitive dust during material handling & hauling activities particularly near habitation especially in the dry seasons.

(ii) Emission Control:

- **Use of Recycled Asphalt Cold Mix Technology:** Most bituminous mixes are produced at a very high temperature (nearly 160°C), mainly because bitumen is very viscous at low temperatures and cannot coat the aggregates, unless heated to high temperatures. Technologies are available, which can facilitate the coating at low temperatures by increasing the surface area of bitumen or by reducing the surface tension at the aggregate bitumen interface with use of certain additives, thereby making the mixing possible at much lower temperature, saving energy and releasing less pollutants in the atmosphere. It is proposed to follow IRC Guideline on the subject.
- 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 Karnataka State Pollution Control Board under Air Act. All vehicles operating for the Contractor, IE and PIU shall obtain Pollution under Control (PUC) certificate.
- All required clearances are to be obtained from the Karnataka State Pollution Control Board and the Mining Department for establishing quarries, borrow areas and crushers. Contractor should submit copy of such clearances to EMPIU & IE before start of activities.
- Asphalt and hot mix plants will be located at least 500 m away from inhabited areas and sensitive receptors such as school, hospital, temple etc. as well as 300 m from the road. A written agreement with the land owner clearly specifying the terms and conditions of opening, operation and closing activities of the Contractor must be part of the management plan
- Pollution control devices such as cyclone separators /scrubbers shall be installed to control emissions from hot mix plants, crushing units and concrete batching plants. Height of the stacks shall be as per the statutory requirements.
- 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.

(iii) 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 (Table-8.3 of Chapter-8). The maximum desirable limits as per the National Ambient Air Quality Standards are given in **Annex-3.1**

and the monitored values should correspond with the table. All deviated results shall be reported to IE for remedial measures.

2. Operation Phase

a. Prediction of Impacts

318. Vehicular emission will be the principle source of pollution during operation stage. Quantitative assessment for predicted level of pollutants concentration has been done using ISC-AERMOD, a recommended model by USEPA for prediction of air quality from point, area and volume sources. AERMOD is a long range dispersion model based on Gaussian dispersion which incorporates the Pasquile-Gifford (P-G) dispersion parameters for estimating horizontal cross wind and vertical dispersion. In ISC-AERMOD software, the line sources are characterized either are area source or volume sources. After drawing the road alignment of particular traffic segment and putting the information related to carriageway width, vertical dimension, source elevation, base elevation and release height, the model converts the road alignment to volume source. The model simulates the effect of emissions from continuous/variable volume sources on neighborhood air quality. The model is an hour-by-hour steady state Gaussian model which takes into account special features like Terrain adjustments, Gradual plume rise, Buoyancy-induced dispersion, Complex terrain treatment, etc.

319. **Emission Rate:** Composite Emission factors were calculated to assess the contribution of the vehicles in air emission based on the emission factors developed for Indian road conditions by "The Automotive Research Association of India (ARAI)", Pune in its study for "Emission Factor Development for Indian Vehicles" as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies under Air Quality Monitoring Project - Indian Clean Air Program (ICAP). Composite Emission Factor (CEF) represent the various vehicular emission pollutant for different types of vehicles (viz. two wheelers, three wheelers, Cars, Commercial vehicle, Buses etc.) used in India as requirement of AERMOD.

320. **Meteorological Data:** The primary factors affecting transport and dispersion of pollutants are wind and stability. The winds are caused by differences in pressure between areas of the atmosphere. Differences in pressure cause air to move from high-pressure areas to low-pressure areas. Wind speed can affect the pollutant concentration in a selected area. In general, the higher the wind speeds, the lower the pollutant concentration. The winds dilute pollutants and rapidly disperse them throughout the near areas. In the present case, **meteorological data of winter season (December 2015)** generated through primary survey has been used for prediction of the impacts.

321. **Homogeneous Traffic Sections:** Based on the traffic surveys conducted by iDeCK during the pre-feasibility study and reconnaissance of the surrounding network, the project road has been divided into two homogeneous traffic sections, as detailed under:

- Homogeneous Traffic Section 1: Ch. 47+203 to 63+626 (Existing Ch. Km)
- Homogeneous Traffic Section 2: Ch. 63+626 to 81+231 (Existing Ch. Km)

322. **Predicted Ground Level Concentrations:** The prediction of maximum ground level concentration on each traffic sections for CO, NO_x and particulate matters have been carried out

using AERMOD for the base year 2015, start year of operation 2020 and design life ending year 2040. The predicted levels are plotted in isopleths and superimposed on a gridded topographical sheet within 10 km radius of the volume source to simulate the dispersion of pollutants. The predicted concentration range is shown in color scale on the right of each isopleths, which are presented in **Figure 23 to 40**.

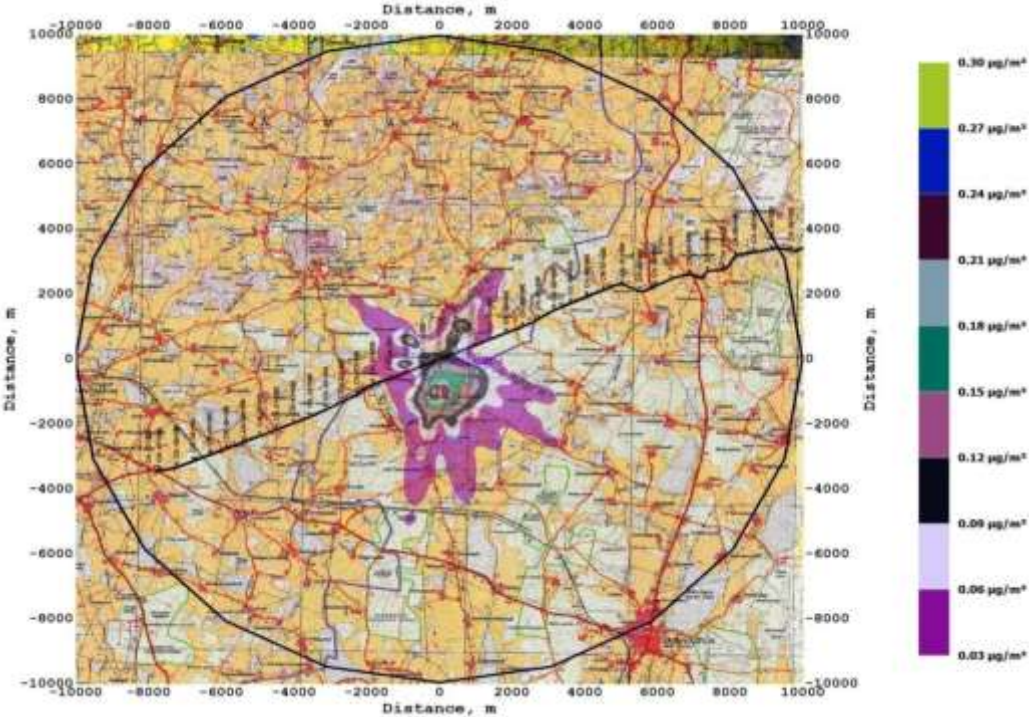


Figure 23: Predicted CO Levels in Traffic Section 1 for the Base Year 2015

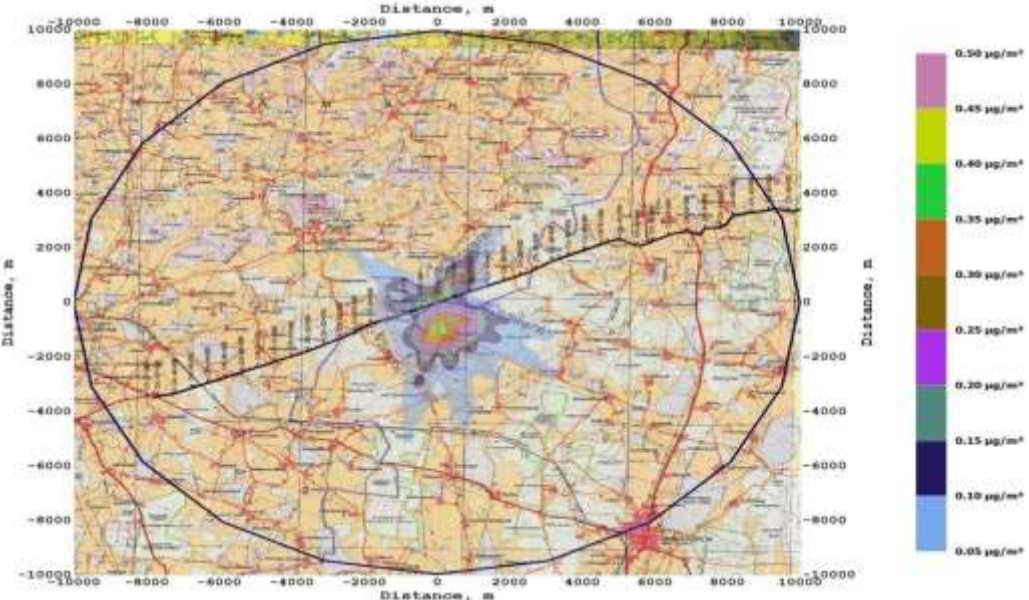


Figure 24: Predicted CO Levels in Traffic Section 1 for the Year of Operation 2020

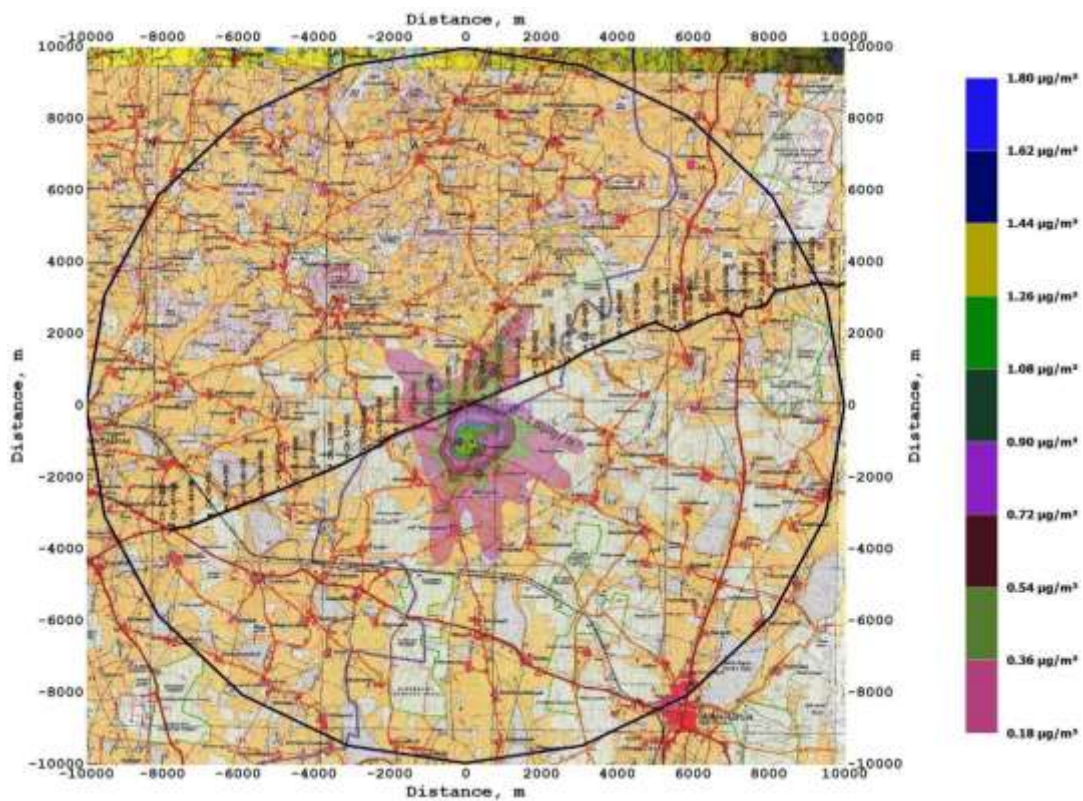


Figure 25: Predicted CO Levels in Traffic Section 1 for the Year 2040

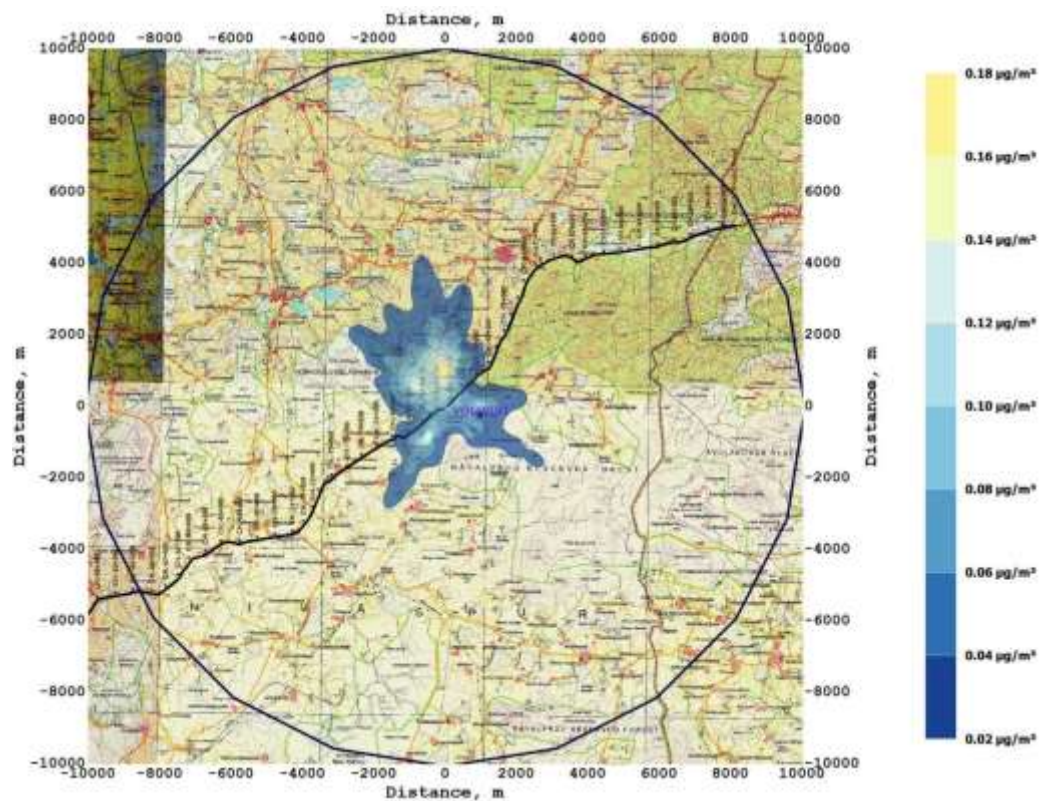


Figure 26: Predicted CO Levels in Traffic Section 2 for the Base Year 2015

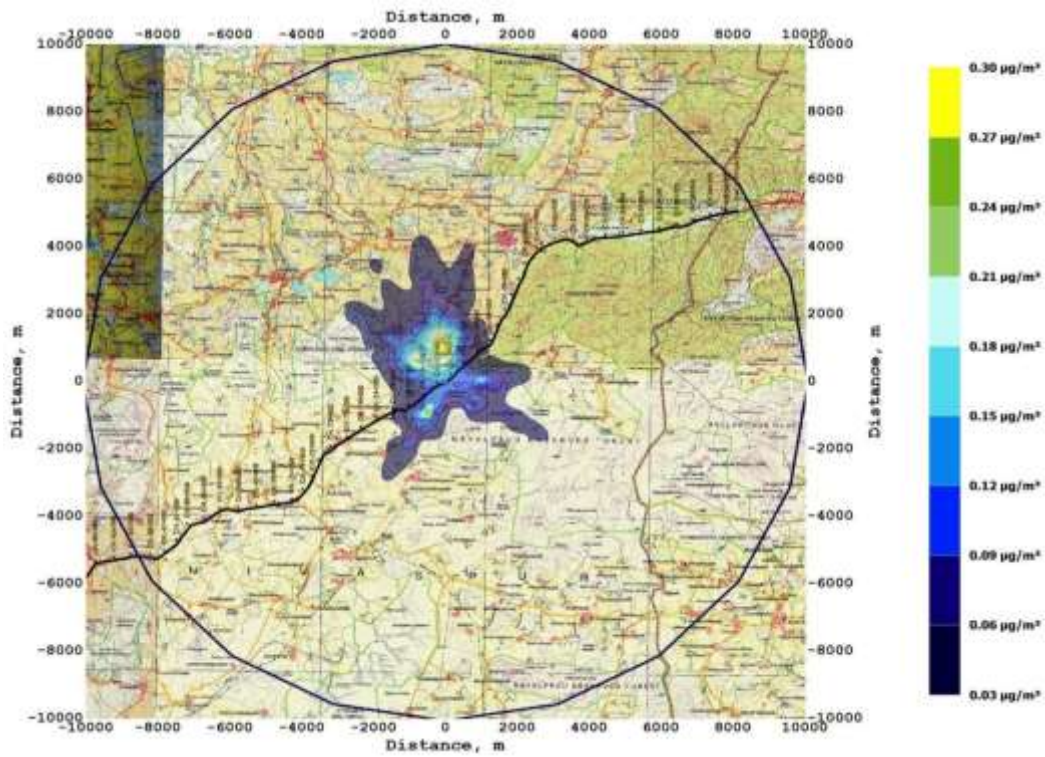


Figure 27: Predicted CO Levels in Traffic Section 2 for the Year of Operation 2020

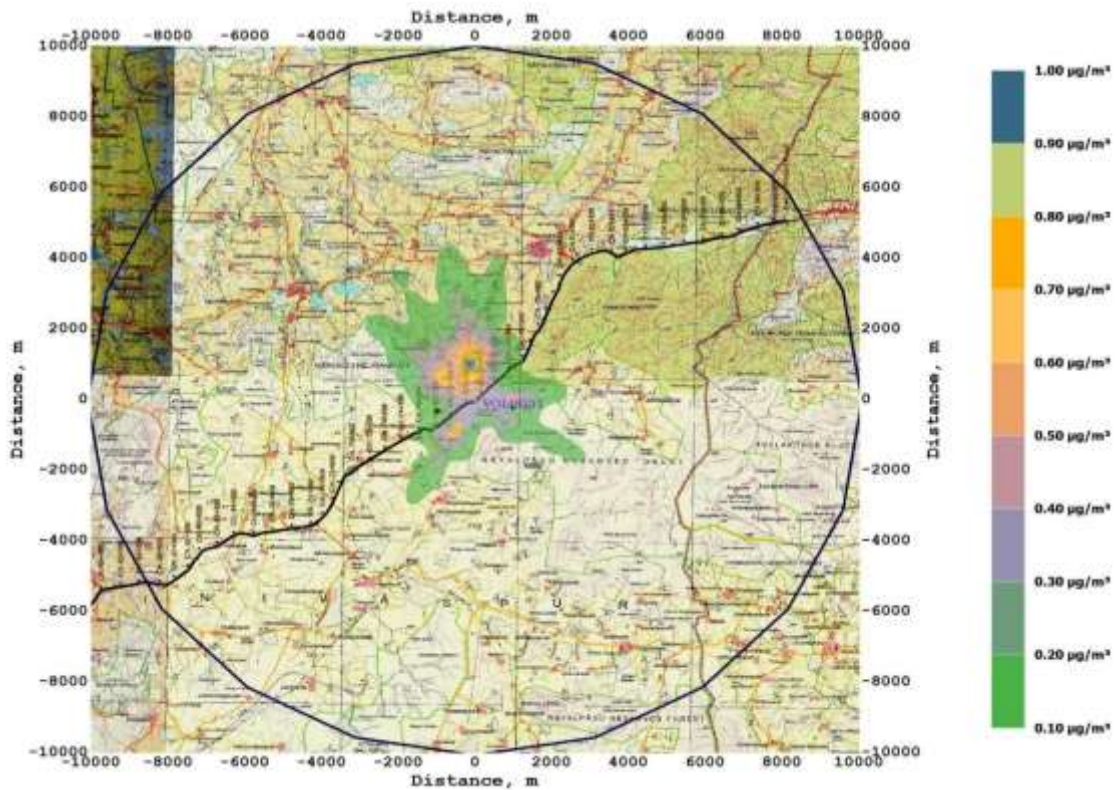


Figure 28: Predicted CO Levels in Traffic Section 2 for the Year 2040

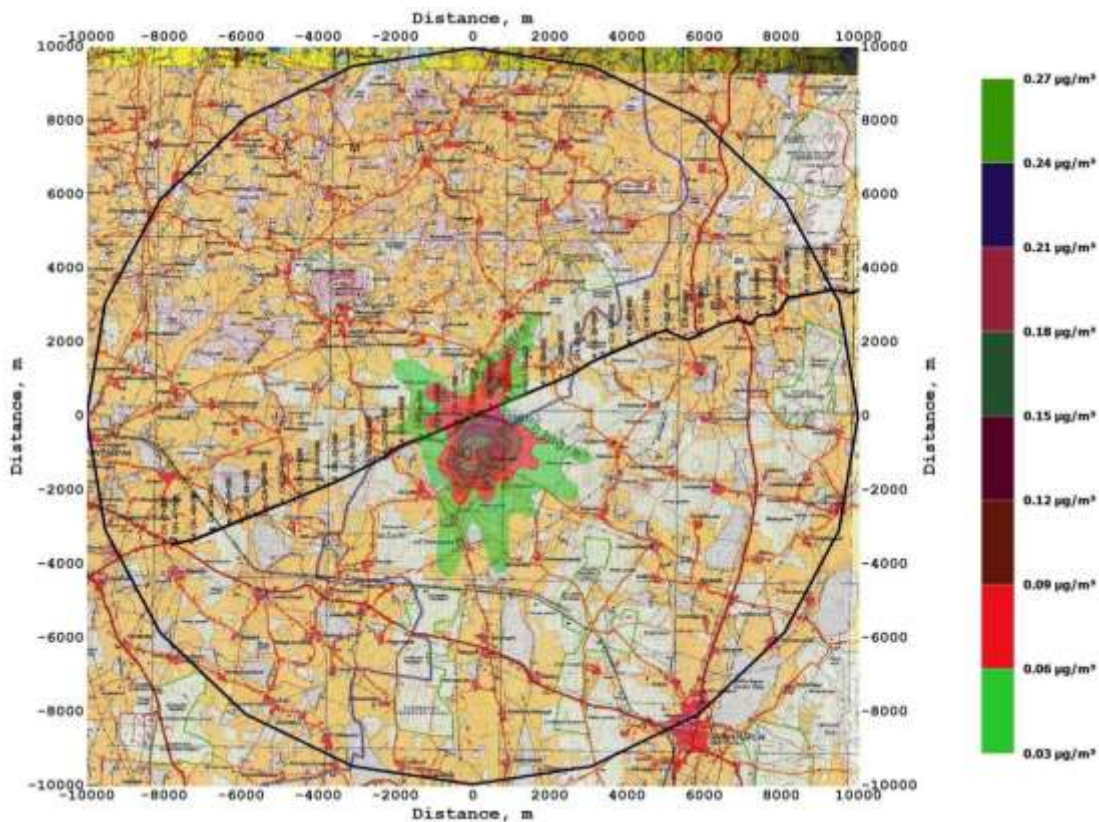


Figure 29'' Predicted NOx Levels in Traffic Section 1 for the Base Year 2015

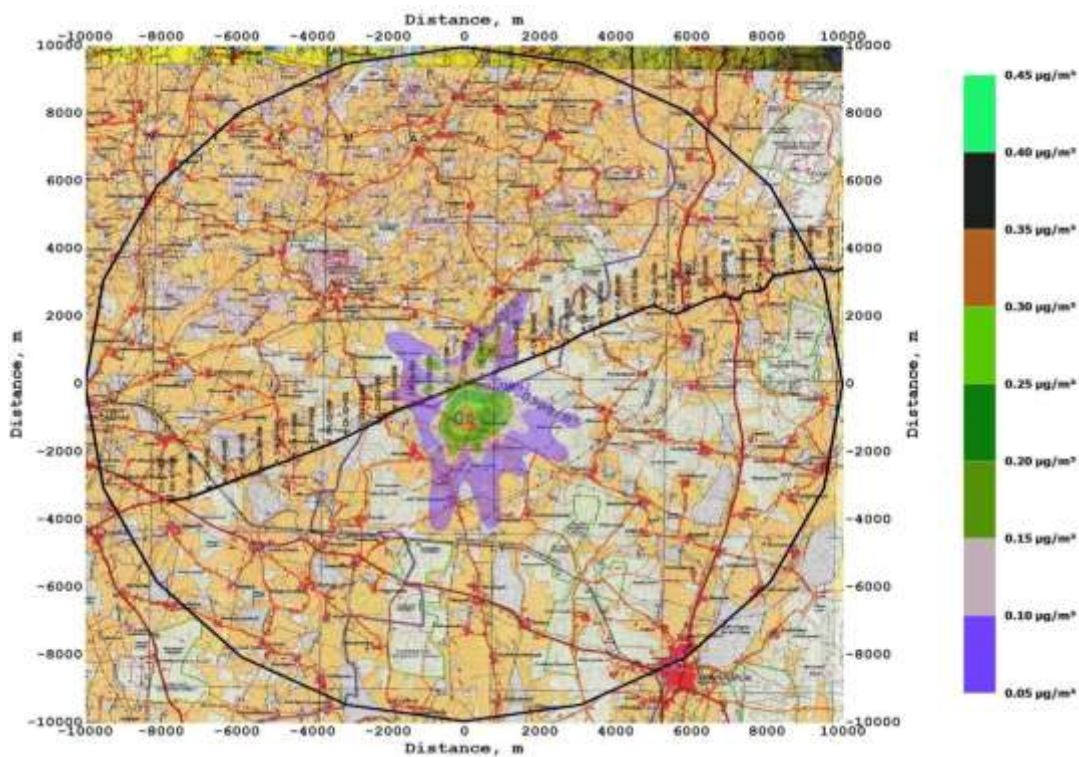


Figure 30: Predicted NOx Levels in Traffic Section 1 for the Year of Operation 2020

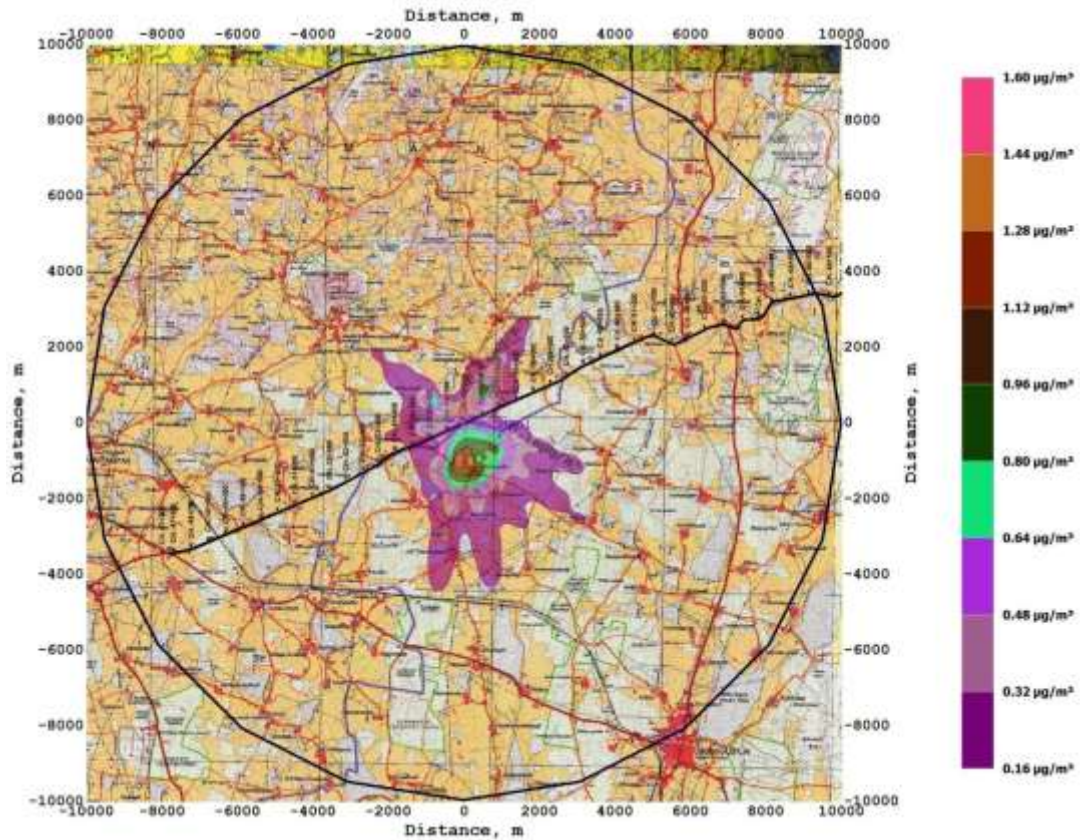


Figure 31: Predicted NOx Levels in Traffic Section 1 for the Year 2040

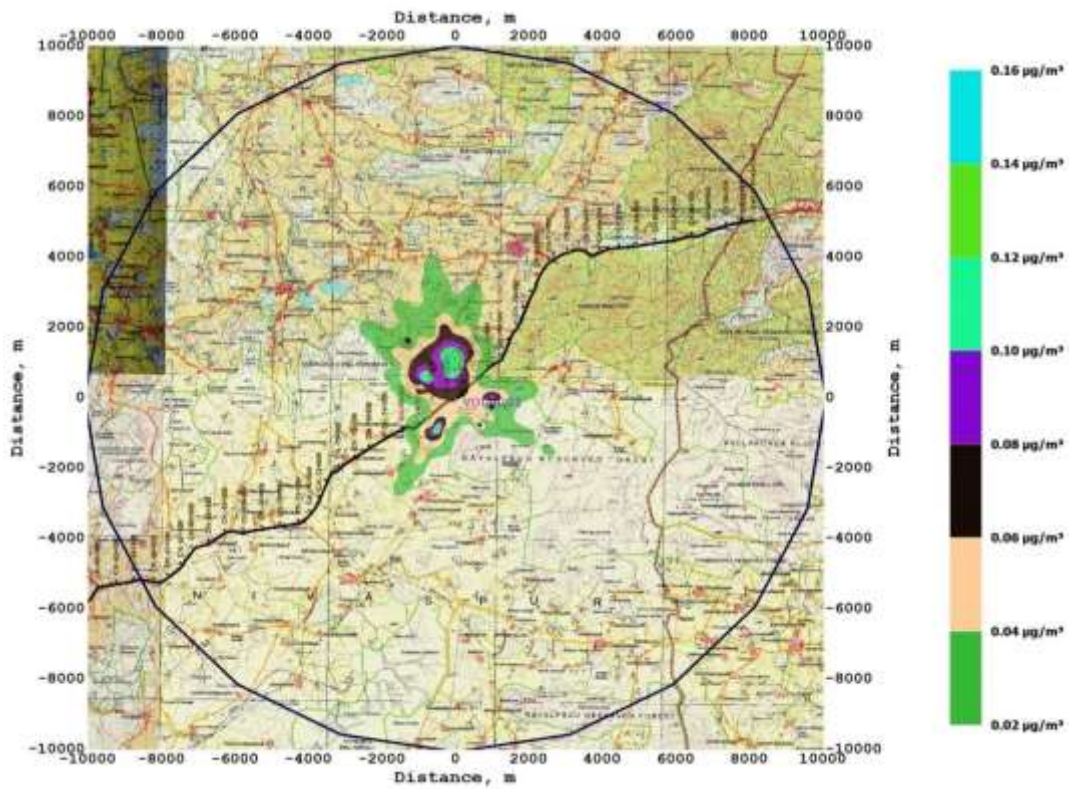


Figure 32: Predicted NOx Levels in Traffic Section 2 for the Base Year 2015

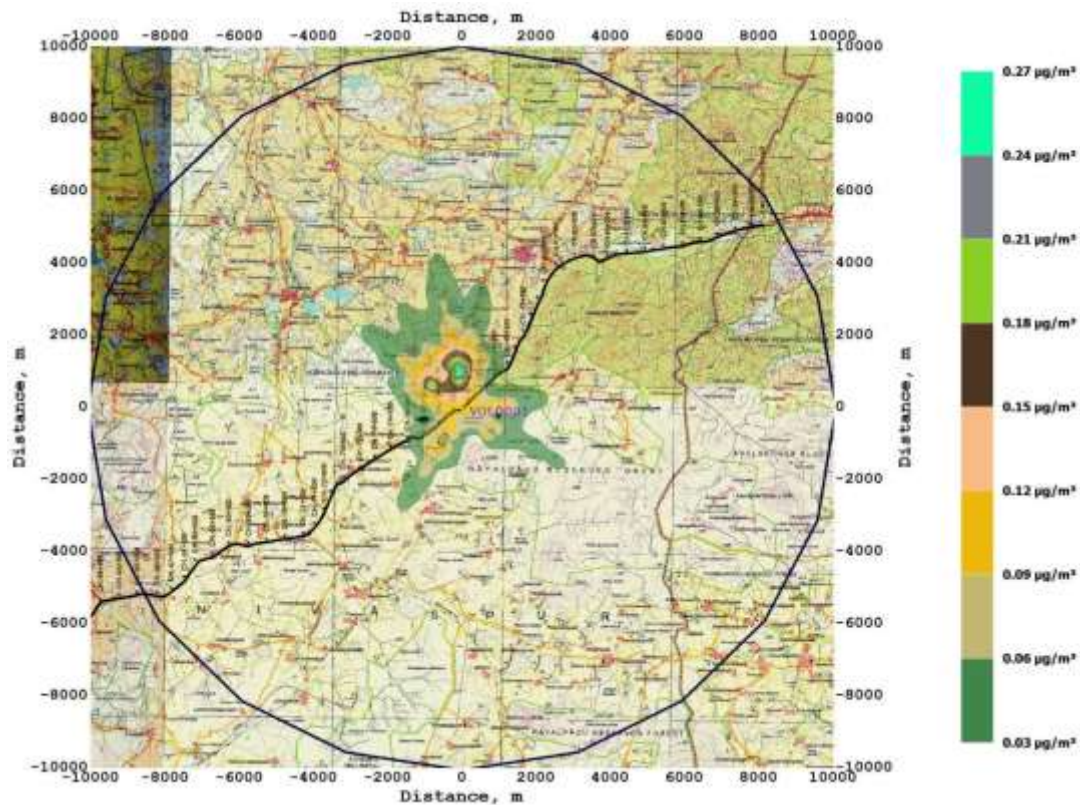


Figure 33: Predicted NOx Levels in Traffic Section 2 for the Year of Operation 2020

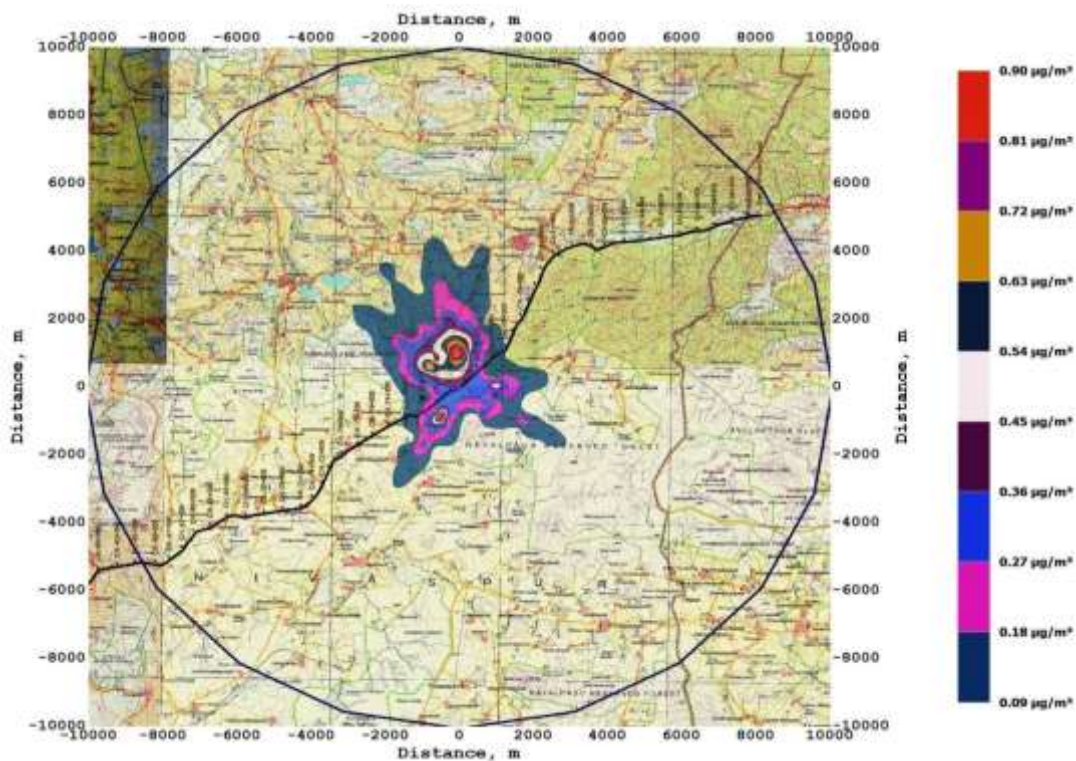


Figure 34: Predicted NOx Levels in Traffic Section 2 for the Year 2040

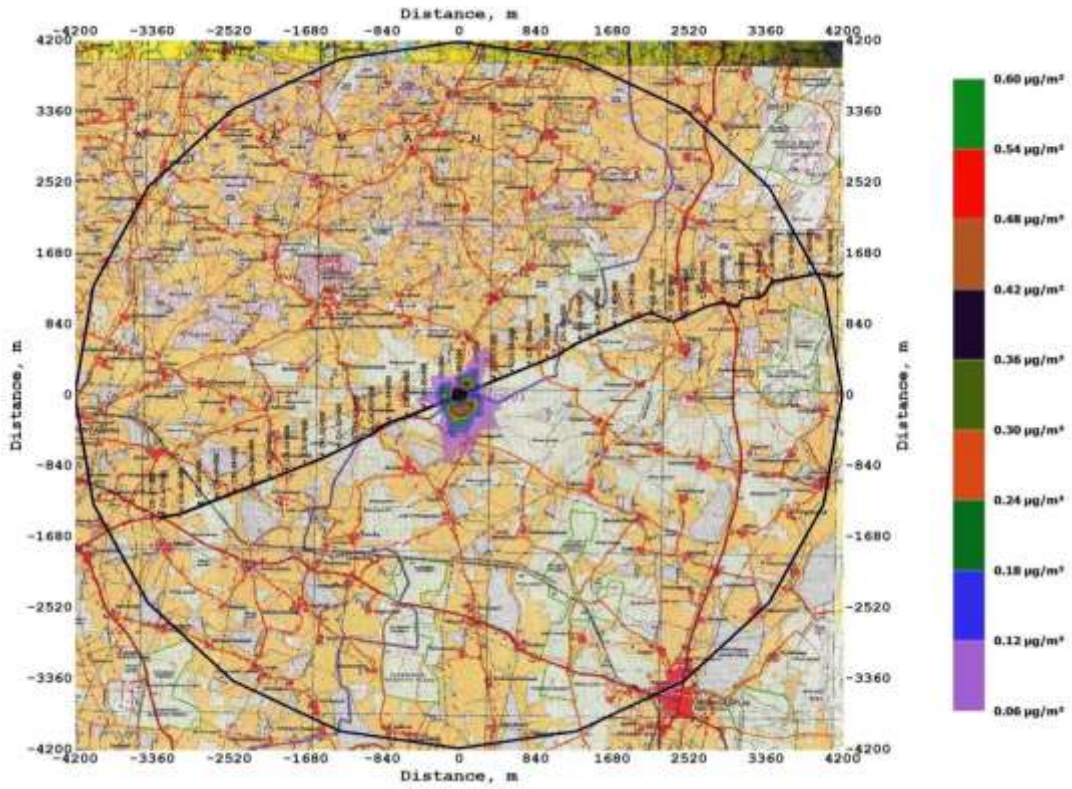


Figure 35: Predicted PM Levels in Traffic Section 1 for the Base Year 2015

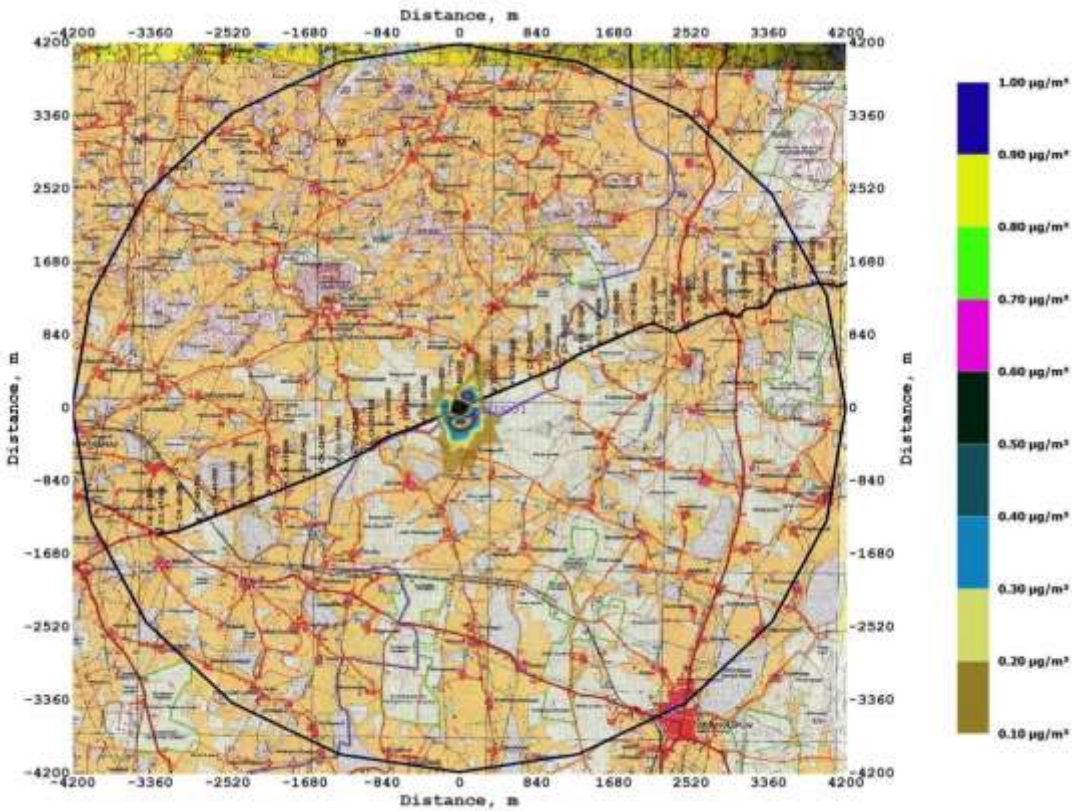


Figure 36: Predicted PM Levels in Traffic Section 1 for the Year of Operation 2020

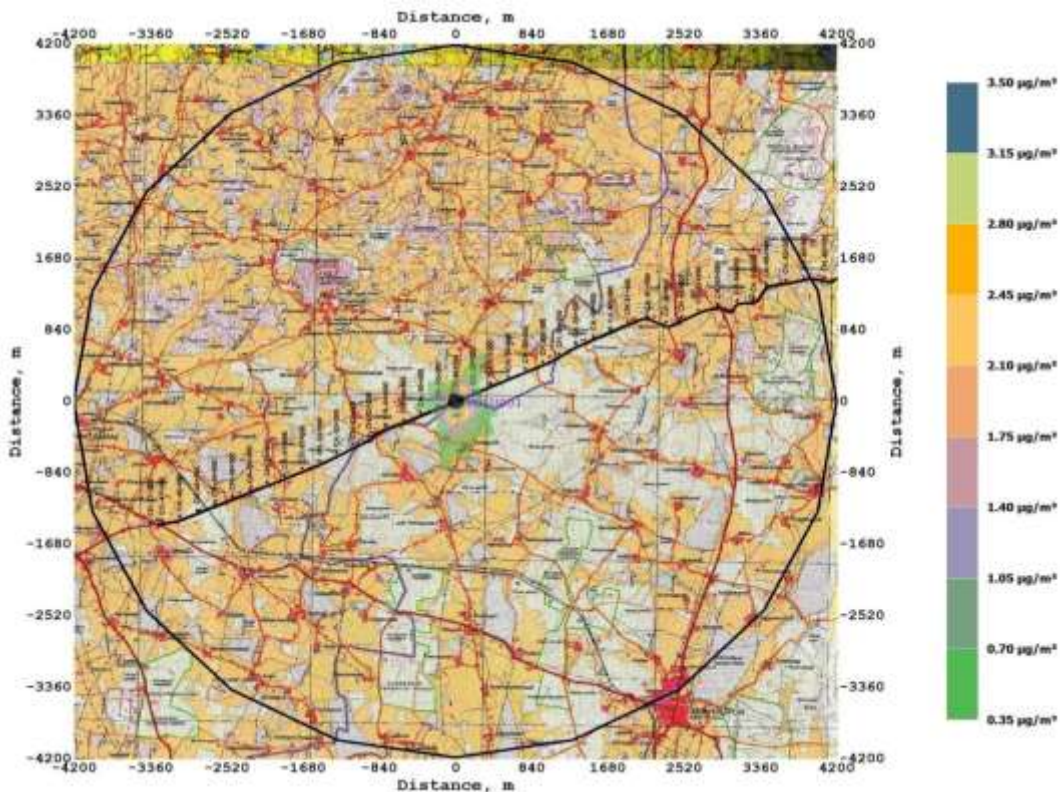


Figure 37: Predicted PM Levels in Traffic Section 1 for the Year 2040

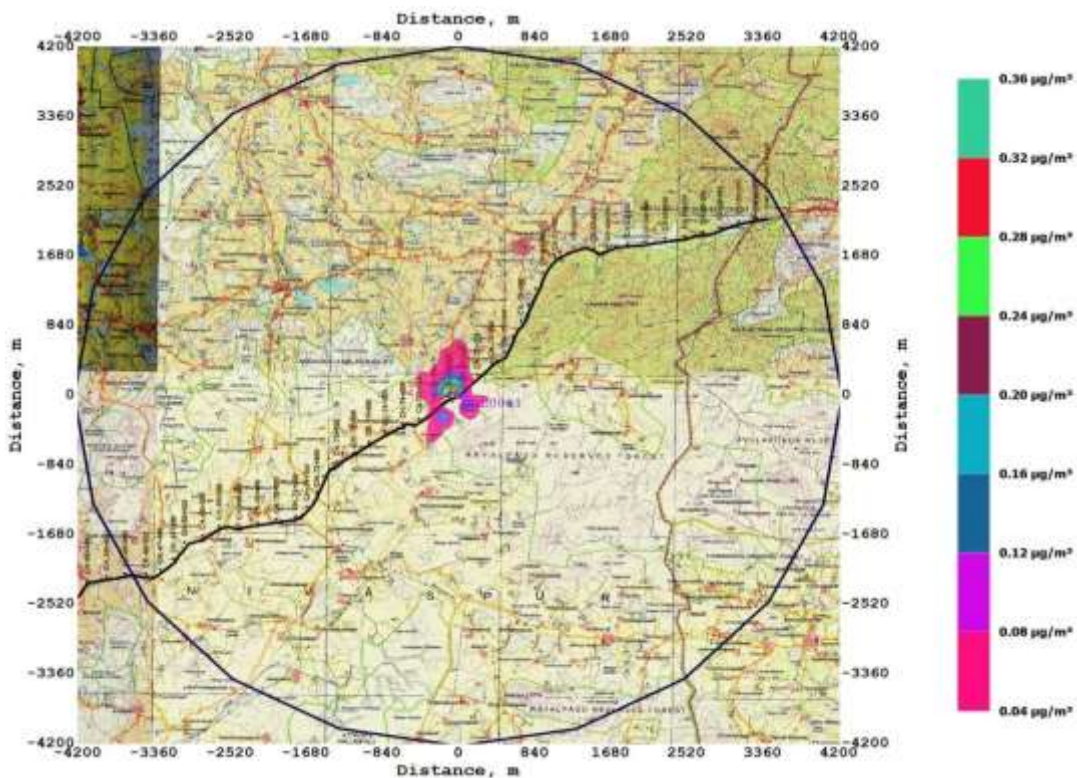


Figure 38: Predicted PM Levels in Traffic Section 2 for the Base Year 2015

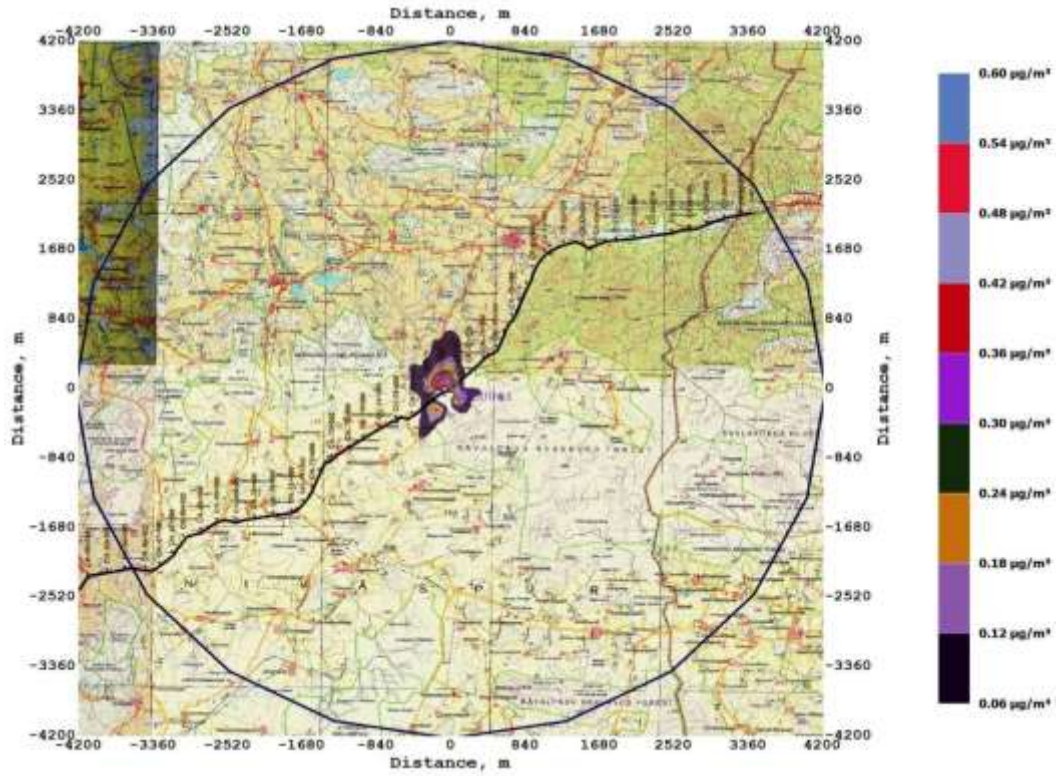


Figure 39: Predicted PM Levels in Traffic Section 2 for the Year of Operation 2020

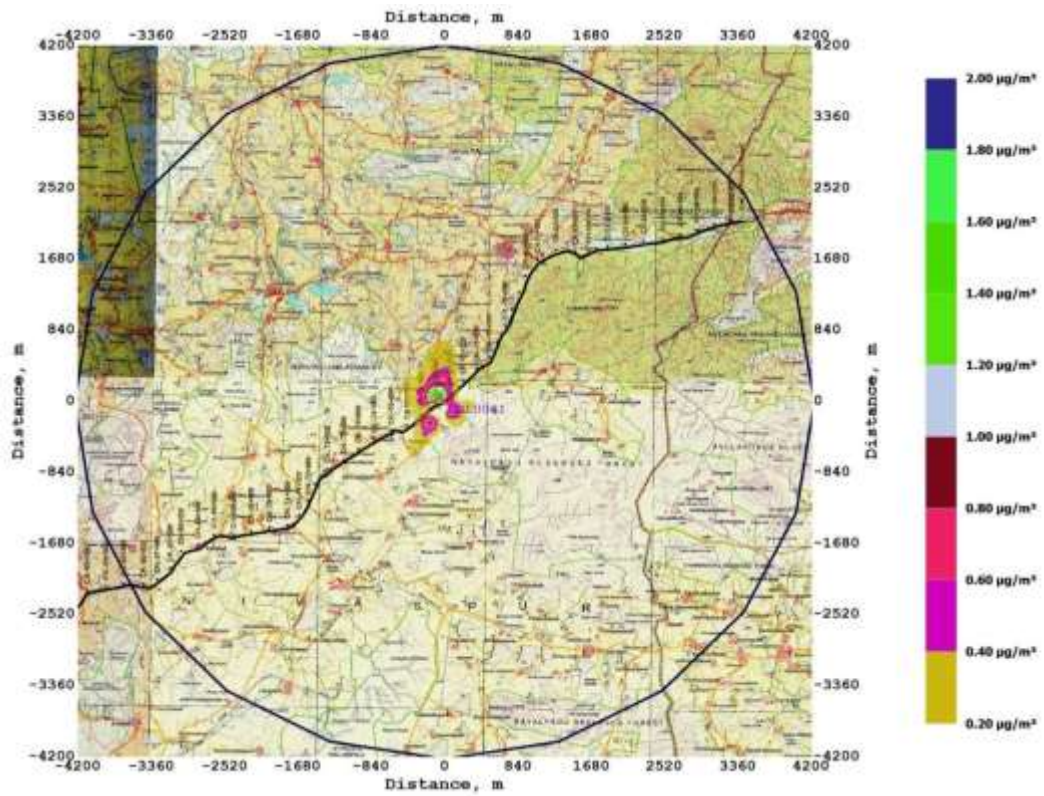


Figure 40: Predicted PM Levels in Traffic Section 2 for the Year 2040

b. Prediction Results

323. Analyses of modeling results ascertain that the predicted level of concentrations for all parameters along the project road in two homogeneous sections are within the prescribed range. However, the pollutant concentrations and its spread (dispersion) increase consistently with the increase in traffic volume. It can be observed from the isopleths that dispersion of gaseous pollutants have wide geographical spread in comparison to the particulate matters, as the it tends to settle down owing to gravitational forces.

c. Caline 4 Model:

324. Caline-4 has high applicability in Indian Scenario and is a recommended model by USEPA for prediction of air quality from line sources like highway projects. Quantitative assessment for predicted level of pollutants concentration has been done using Caline-4 Model Ver. 2011,

325. CALINE4 (Caltrans, 1989) is a fourth-generation line source Gaussian plume dispersion model that predicts carbon monoxide (CO) impacts near roadways. Its purpose is to help planners protect public health from the adverse effects of excessive CO exposure. The Caltrans publication, Transportation Project-Level Carbon Monoxide Protocol (CO Protocol) recommends the use of CALINE4 when a proposed transportation project requires a more detailed analysis than initial screening analysis. The 2011 version of caline-4 can also be used for prediction of NO_x and PM₁₀. Pollution Control Authorities/ Regulatory Agencies in India using CALINE- 4 to predict the future air quality trends along highways/roads from vehicular traffic for regulatory purposes.

326. CALINE-4 model employs a mixing zone concept to characterize pollutant dispersion in the proximity of roadways. The model employs source strength, meteorology, site geometry and site characteristics as input parameters and predicts pollutant concentrations for receptors located within 150 meters either side of the roadways. The CALINE-4 model allows roadways to be broken into multiple links that can vary in traffic volume, emission rates, height, width, etc. CALINE-4 is capable of specifying links at heights above grade ($z = 0$), links as bridges (allowing air to flow above and below the link) and links as parking lots (which should be defined by the user as having a height of zero). Also, unlike CAL3QHCR, CALINE-4 is capable of analyzing the dispersion of pollutants in wind speeds of less than 1 m/s. in CALINE-4 the concentration at a point with coordinates (x,y,z) is calculated based on the following equation:

$$C(x, y, z, H) = \frac{Q}{2\pi u \sigma_z \sigma_y} * \left[\exp\left(-\frac{y^2}{2\sigma_y^2}\right) \right] \left[\exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right) + \exp\left(-\frac{(z+H)^2}{2\sigma_z^2}\right) \right]$$

327. Where:

C = Concentration of the pollutant in air [m/L³]

Q = Rate of chemical emission [m/T]

U = Wind speed in X direction [L/T]

σ_y = Standard deviation in y direction [L]

σ_z = Standard deviation in z direction [L]

y = Distance along a Horizontal axis perpendicular to the wind [L]

z = Distance along a vertical axis.[L]

H = effective stack height [L]

328. Emission Rate, Meteorological Data and Homogeneous Traffic Sections are same with that of ISC=AERMOD model.

329. **Receptors:** The complete road alignment has been drawn with respect to UTM coordinates. A set of link receptors were taken at various receptor locations within each section at a distance of 10 m, 30 m, 50 m, 100 m, 150 and 200 m both sides from edge of the carriageway to know the dispersion of pollutant from the road.

330. **Predicted Ground Level Concentrations:** The prediction of maximum ground level concentration on each road section has been carried out. The prediction for CO was conducted for 8-hourly concentrations, whereas for NO_x, SO₂ and PM₁₀, it was conducted for 24 hourly concentrations. Predicted concentrations on two homogenous section of the Project for CO, NO_x, and PM₁₀ and their spread around the road sections have been presented in **Figure 38** to **Figure 40**.

d. Prediction Results

331. Analyses of modeling results ascertain that the predicted level of concentrations for all parameters along the project road in two homogeneous sections are within the prescribed range. However, the pollutant concentrations are estimated to increase after 2030 within 30 m from the road edge.

332. The tree plantation and habitat improvement activities included in the project scope will help to check air pollution. Road signage at regular intervals to remind motorists to maintain their vehicles and minimize fuel consumption may be posted. Raising awareness amongst drivers on good driving practices to reduce fuel consumption and promote road safety may also be carried out. As part of the routine maintenance works good riding conditions of the road surface will be maintained to reduce dust and vehicular pollution.

333. **Conclusions:** In the existing scenario, due to lesser carriageway width, the average vehicle speed is low, which results in traffic congestions causing more exhaust gas emissions. In the post-project scenario, improved road conditions and congestion free traffic movement will reduce emissions. It is also expected that over the period, the fleet/fuel type will significantly improve contributing significantly in emission reduction.

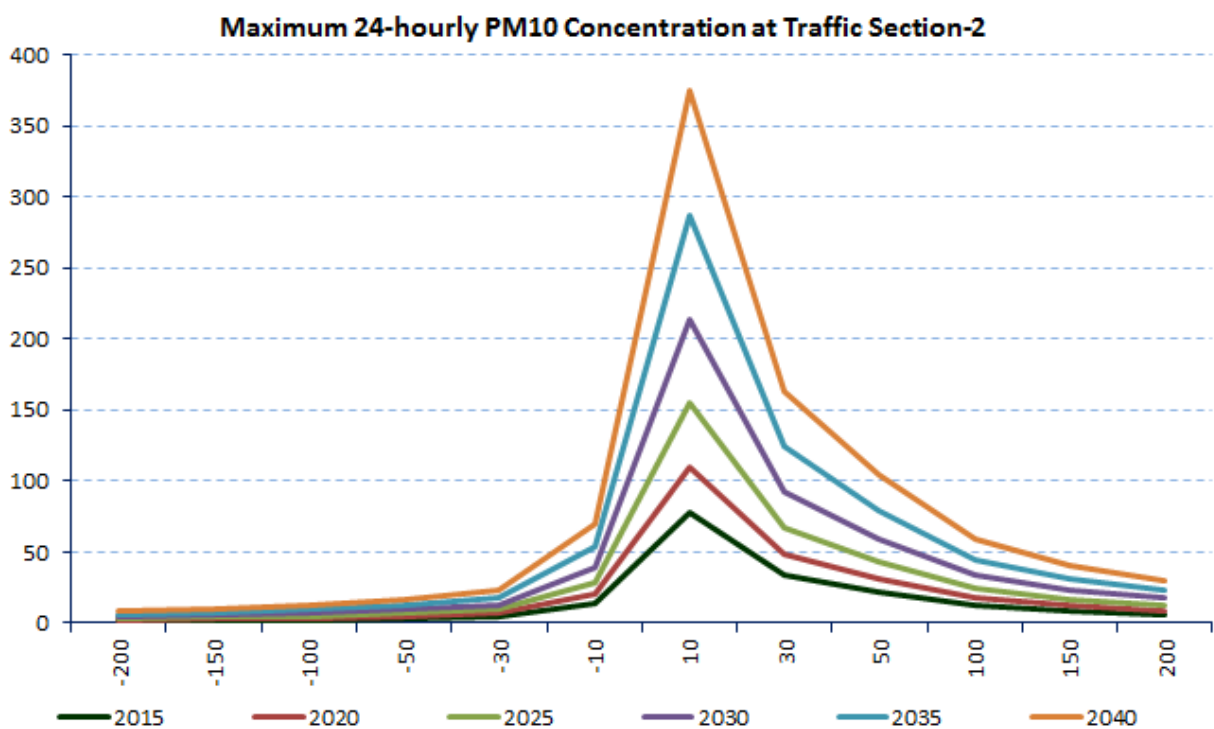
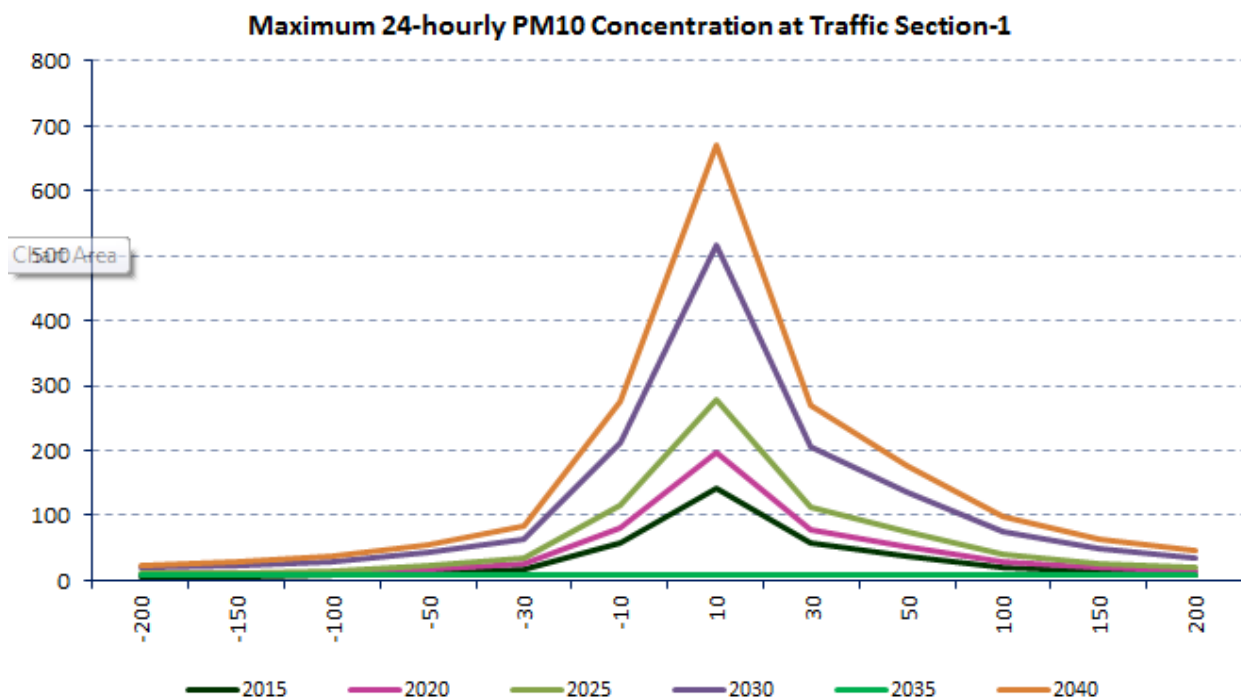


Figure 41: Maximum 24 Hourly PM₁₀ Concentration at Traffic Section-1 and 2

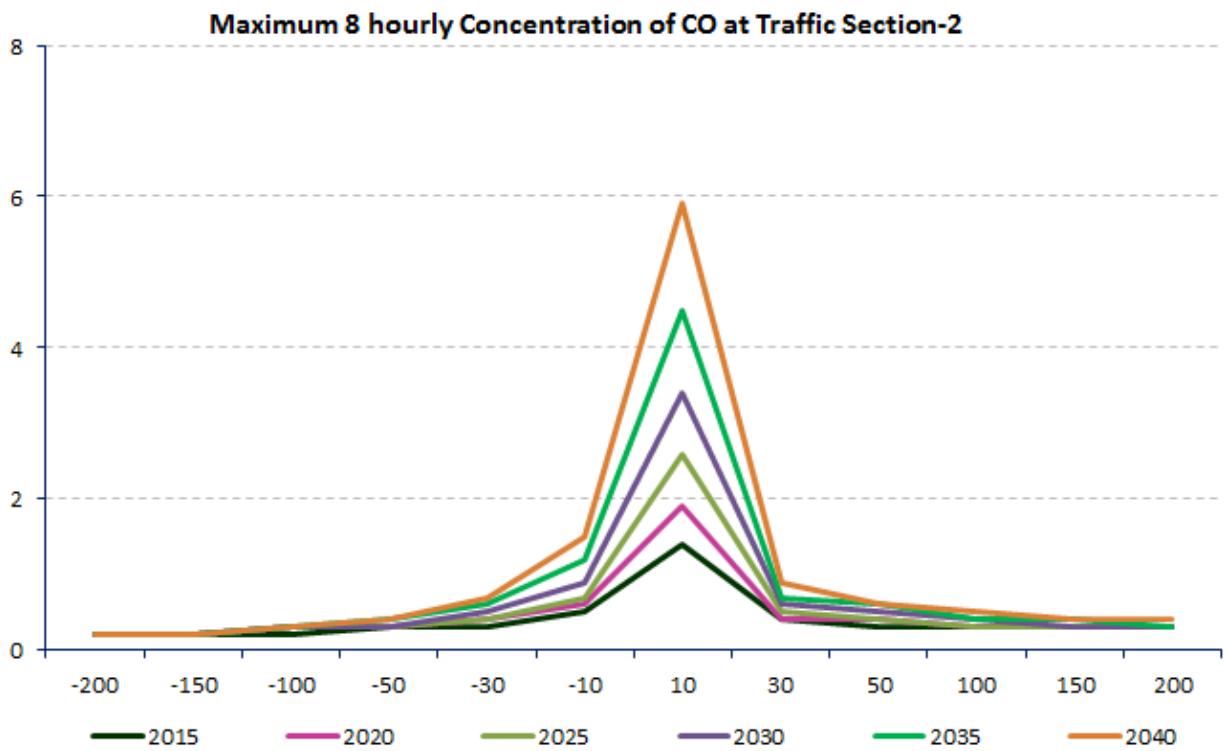
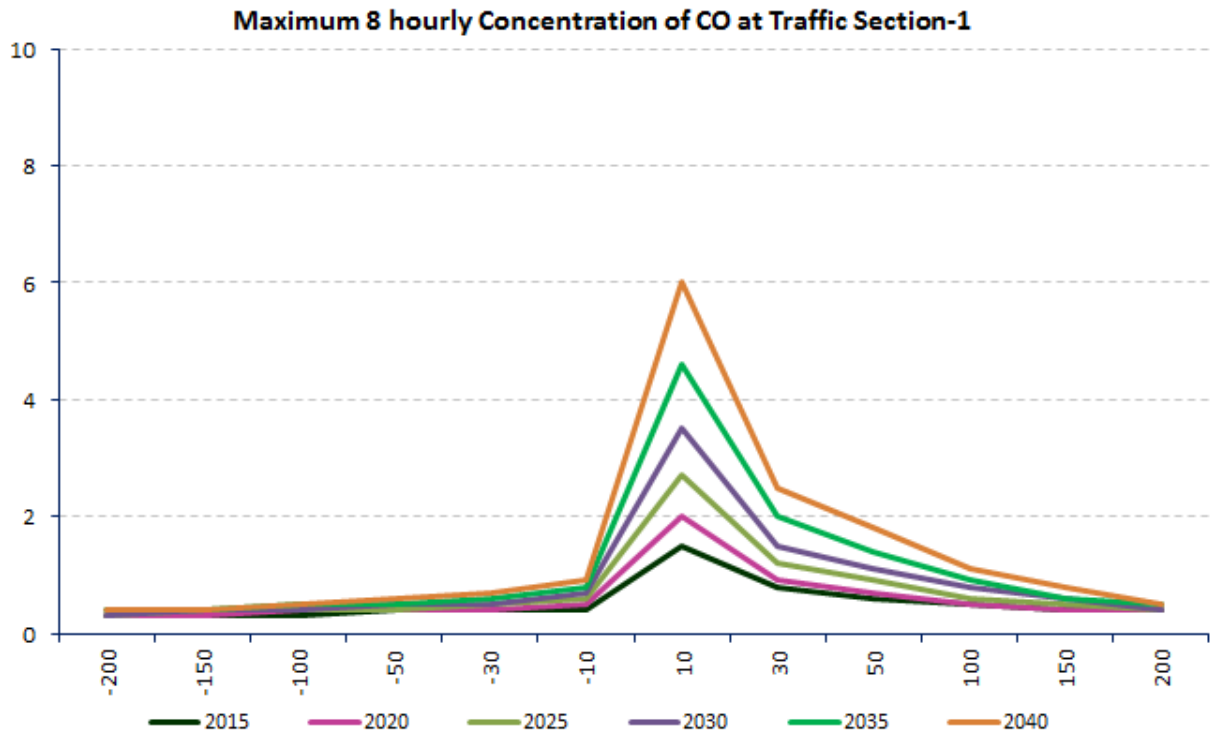


Figure 42: Maximum 24 Hourly CO Concentration at Traffic Section-1 and 2

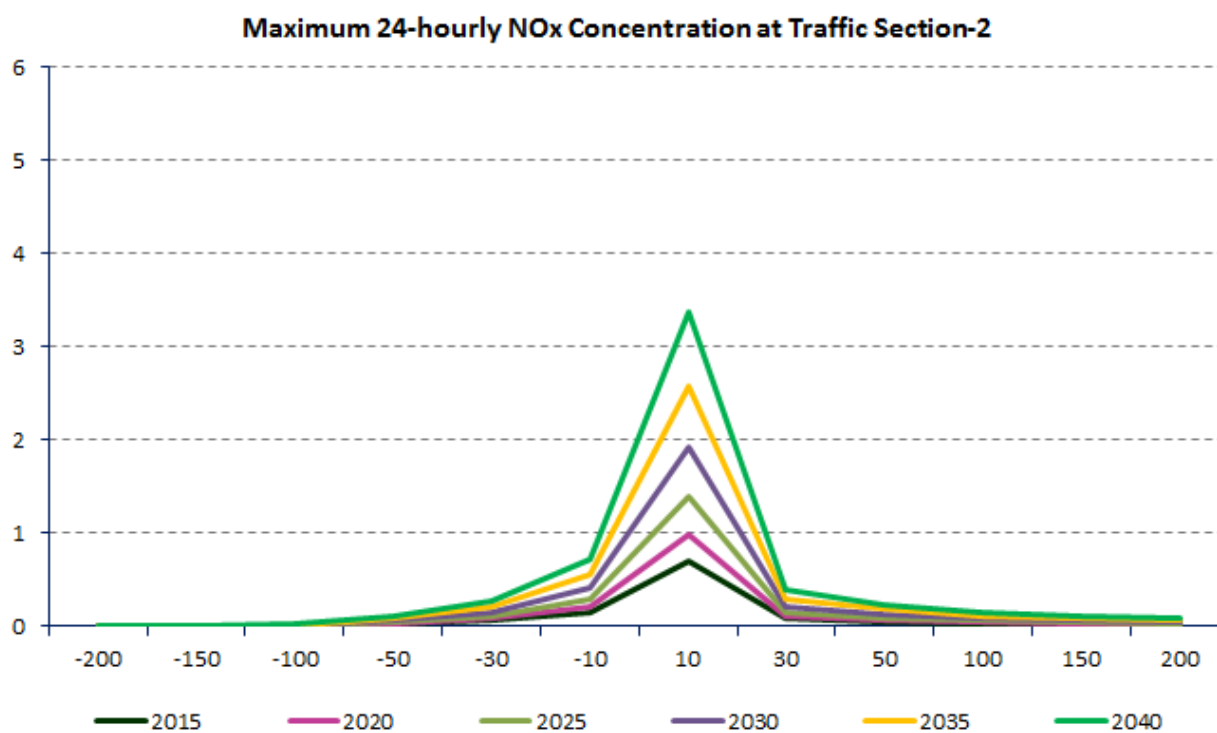
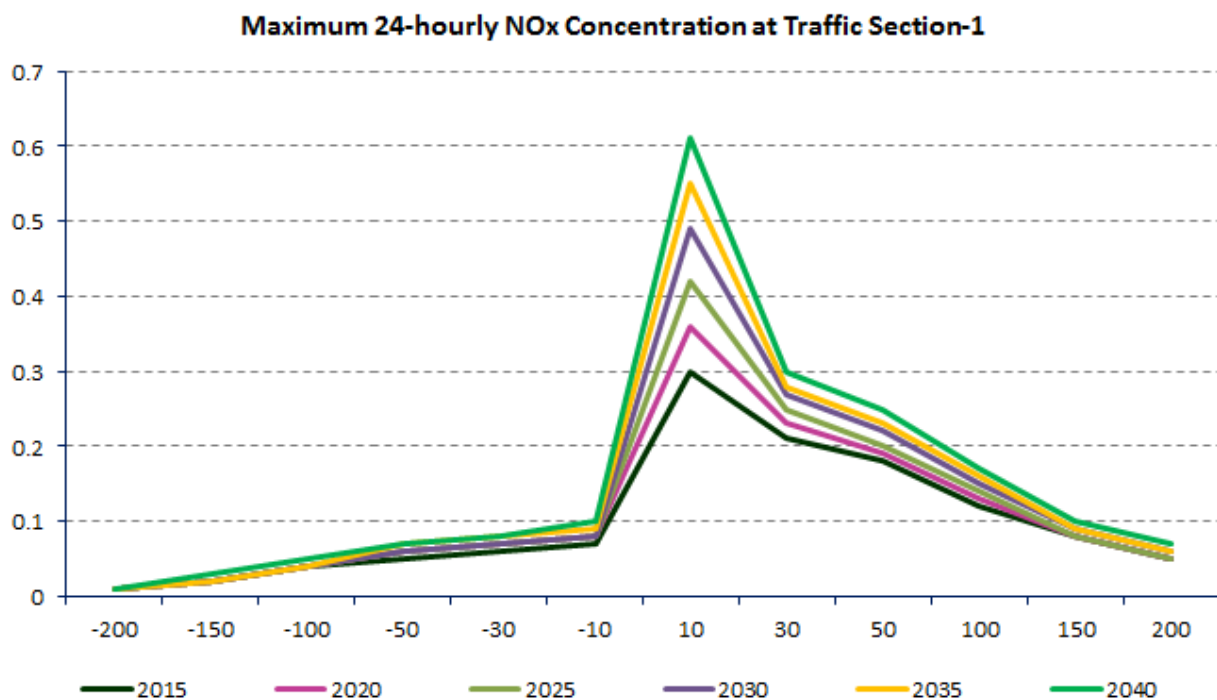


Figure 43: Maximum 24 Hourly NO_x Concentrations at Traffic Section-1 and 2

334. Mitigation Measures

- Vehicular emission will be controlled through enforcement of laws and public awareness. It will be ensured that all the vehicles have vehicular emission within

the permissible limits.

- Truck parking lay-byes and bus bays will be provided at required locations to facilitate smooth traffic flow vis a vis reduce air pollution.
- Regular monitoring of ambient air quality at specified representative locations will be conducted at fixed interval.
- Road side plantation along the road will act as sink of air pollutants. Pollution resistant species, which can grow in high pollutants concentrations and absorb pollutants will be planted as proposed under Greenbelt Development Plan
- The designed road surface will generate lesser dust due to the paved shoulders in settlement areas.
- Improvement in road surface condition and traffic capacity will reduce the local congestion in the built up areas and provide a smooth traffic flow.
- The net air quality impacts during the operation phase would be reduced after widening and improvement of the project.

E. Noise Environment

1. Construction Phase

335. 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.

336. Noise generated from sources mentioned above will be intermittent and mostly during daytime. Moreover, villages / settlements being mostly away from the road, no significant impact on local people is 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.

337. **Impacts:** Increase in noise level due to construction activities like operation of construction equipment & vehicular traffic.

338. 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 associated with highway projects is presented below.

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

339. General conclusion 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.

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

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

340. 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).

$$\text{SPL}_2 = \text{SPL}_1 - 20\text{Log}_{10}(r_2/r_1)$$

Where, SPL1 and SPL2 are the sound pressure levels at distance r_1 and r_2 respectively.

341. 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 stationary source to meet the permissible noise limits during day time for different land use categories are given in **Table 98**.

Table 98: 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

342. From the above table it may be noted that residence within 113m from the 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.

343. **Mitigation Measures:**

- Construction camp and temporary labour sheds will be located away from the

immediate vicinity of the construction sites and major road traffic.

- Protective gears such as ear plugs or ear muffs will be provided to construction personnel exposed to high noise levels as preventive measure (**Annex-8.10**).
- Low noise construction equipment will be used.
- 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.
- 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 i.e. educational institutions, medical amenities and religious places
- 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 barrier will be constructed in all educational institutions to minimize the impact of traffic noise.
- **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 Plan (**Table-8.3** of Chapter-8). Ambient Air Quality Standards with respect of Noise are given in **Annex-3.1** and the monitored values should correspond with the table. All deviated results shall be reported to IE, for remedial measures.

2. Operation Phase

344. The significance of operational noise impacts commensurate with the number of sensitive structures and sensitive areas that exist along the project roads. As stated in chapter IV, the project road is mainly passes through agricultural land (67%) followed by forest area (25%) and built-up (8%). The sensitive structures comprising schools, temples, mosques and health centers located along the project road has been discussed in Section-4.15 of Chapter-IV. After removal and shifting of the directly impacted sensitive structures, the sensitive structures that will be remaining on either side of the road which will be exposed to noise generated by future traffic plying on the improved road.

a. Source of Noise

345. During the operational phase, movement of traffic, traffic congestion, pedestrian interferences and increase in use of horns will be the prime source of noise. The noise levels at nearby schools, religious place may cause nuisance and irritation.

b. Vehicle Noise and Road Surface Influence on Tire/Road Noise³

346. 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

³ U.S. Department of Transportation, Federal Highway Administration

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 44**).

347. There are several pavement 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 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]. Another reason for the increase in noise levels is due to an increase in stiffness from traffic loading. Finally, as the asphalt surface wears over time, the coarse aggregate becomes exposed which causes an increase in noise.

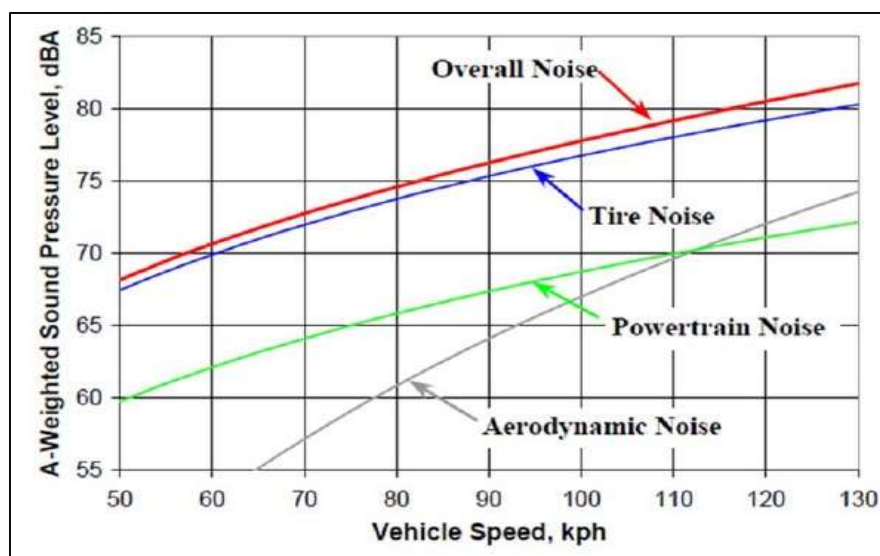


Figure 44: Comparison of Noise Level Separated by Component [Donovan, 2007]

3. Prediction of Impacts

348. Long-term noise level increase was assessed with respect to the sensitive receptors for the years 2015, 2020 and 2040 using the CRTN Model⁴. Noise barrier has been proposed in 8 educational institutions and 2 religious structures. List of sensitive receptors where noise barrier has been proposed is tabulated below:

⁴ CRTN predicts noise in terms of the L_{10} index, for the 18 hours between 06:00 and 24:00. The equation $LA_{eq, 1h} = 0.94 \times L_{A10, 18h} + 0.77$ dB was used to convert L_{10} to L_{Aeq} (Abbot, P. G. and Nelson, P. M. *Converting the UK Traffic Noise Index LA10, 18h to EU Noise Indices for Noise Mapping. Project Report PR/SE/451/02*).

Table 99: Prediction of Noise Results

S.N.	Design Ch. Km	Description	Village	Distance from Existing C/L (m)	Height of Noise Barrier (m)	Length of Noise Barrier (m)
1.	50+890	Ramanjenaye Swami Temple	Aimareddihalli	9.1	3.0	20.0
2.	61+170	Govt. Higher Primary School,	Seegalapallya	8.0	3.0	51.0
3.	62+600	Shanta Shruna PU College,	Thadigol	55.0	3.0	35.5
4.	63+370	Bhagwan Buddha ITI	Kamlavarpalli	20.0	3.0	84.5
5.	63+430	Bhagwan Buddha High School	Kamlavarpalli	23.5	3.0	60.0
6.	66+900	Ramanjeneya Temple	Kossandra	12.4	3.0	40.0
7.	68+400	Govt. Higher Primary School	Jodi Kothapalli	8.0	3.0	34.0
8.	70+850	VSR School	Nelavanki	13.0	3.0	10.0
9.	73+190	Govt. Higher Primary School	Manchineelkote	24.0	3.0	33.0
10.	74+500	Govt. Higher Primary School	Thopalli	16.0	3.0	38.0
Total length of Noise Barrier (m)						406.0

349. **Input Parameters:** Total vehicle flow for the projected period is obtained from the traffic projections. Minimum design speed of 80 km/hr is considered for operation phase. Apart from that, year-wise % of heavy vehicle, gradient, road surface, absorbent ground cover, distance from edge of the carriageway and source / receiver height difference are the other input parameters.

350. **Output:** To reduce traffic induced noise, noise barrier in the form of solid boundary wall is proposed. Height and length of the noise barrier and estimated reduction in noise level after construction of the noise barrier is given in **Table 100** and results of CRTN model is graphically presented (**Figure 45 to 48**) and Noise Contours near the sensitive receptors is shown (**Figure 49 to 52**) for 4 sensitive receptors for the year 2015, 2020 and 2040.

Table 100 Sensitive Receptor Wise Predicted Noise Levels, approximate Length and Height of the Solid Noise Barrier⁵

Year→	2015	2020	2025	2030	2035	2040
Ramanjenaye Swami Temple, Aimareddihalli						
Traffic Noise in dB(A)	71.3	72.6	74.1	75.4	76.4	77.6
Noise at Receptor w/o Noise Barrier dB(A)	70.3	71.6	73.1	74.4	75.4	76.6
Noise at Receptor with Noise Barrier dB(A)	50.9	52.2	53.7	55.0	56.0	57.2
Reduction (dBA)	-19.4	-19.4	-19.4	-19.4	-19.4	-19.4
Govt. Higher Primary School, Seegalapallya						
Traffic Noise in dB(A)	71.0	72.3	73.8	75.1	76.1	77.3
Noise at Receptor w/o Noise Barrier dB(A)	68.7	70.0	71.5	72.8	73.8	75.0
Noise at Receptor with Noise Barrier dB(A)	52.7	54.0	55.5	56.8	57.8	59.0
Reduction (dBA)	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0
Shanta Shruna PU College, Thadigol						
Traffic Noise in dB(A)	71.0	72.3	73.8	75.1	76.1	77.3
Noise at Receptor w/o Noise Barrier dB(A)	62.9	64.2	65.7	67.0	68.0	69.2
Noise at Receptor with Noise Barrier dB(A)	51.7	53.0	54.5	55.8	56.8	58.0
Reduction (dBA)	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
Bhagwan Buddha ITI, Kamlavarpalli						

⁵ Since CRTN Model predicts noise in terms of L_{10} index, the corresponding equation $LA_{eq, 1h} = 0.94 \times LA_{10;1h} + 0.77$ dB to convert L_{10} to LA_{eq} will result to lower values of noise. For example, instead of the 77.6 dB (A) predicted traffic noise (L_{10}) in Ramanjenay Swami Temple in 2040, the $LA_{eq, 1h}$ is only equivalent to 73.7 dB (A).

Year→	2015	2020	2025	2030	2035	2040
Traffic Noise in dB(A)	71.0	72.3	73.8	75.1	76.1	77.3
Noise at Receptor w/o Noise Barrier dB(A)	64.8	66.1	67.6	68.9	69.9	71.1
Noise at Receptor with Noise Barrier dB(A)	51.8	53.1	54.6	55.9	56.9	58.1
Reduction (dBA)	-13.0	-13.0	-13.0	-13.0	-13.0	-13.0
Bhagwan Buddha High School, Kamlavarpalli						
Traffic Noise in dB(A)	71.0	72.3	73.8	75.1	76.1	77.3
Noise at Receptor w/o Noise Barrier dB(A)	63.9	65.2	66.7	68.0	69.0	70.2
Noise at Receptor with Noise Barrier dB(A)	51.9	53.2	54.7	56.0	57.0	58.2
Reduction (dBA)	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0
Ramanjeneya Temple, Kossandra						
Traffic Noise in dB(A)	71.8	73.1	74.5	75.8	77.0	78.1
Noise at Receptor w/o Noise Barrier dB(A)	67.9	69.2	70.6	71.9	73.1	74.2
Noise at Receptor with Noise Barrier dB(A)	53.7	55.0	56.4	57.7	58.9	60.0
Reduction (dBA)	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
Govt. Higher Primary School, Jodi Kothapalli						
Traffic Noise in dB(A)	69.8	71.1	72.5	73.7	75.0	76.1
Noise at Receptor w/o Noise Barrier dB(A)	68.1	69.4	70.8	72.0	73.3	74.4
Noise at Receptor with Noise Barrier dB(A)	51.8	53.1	54.5	55.7	57.0	58.1
Reduction (dBA)	-16.3	-16.3	-16.3	-16.3	-16.3	-16.3
VSR School, Nelavanki						
Traffic Noise in dB(A)	69.7	71.0	72.4	73.6	74.9	76.0
Noise at Receptor w/o Noise Barrier dB(A)	68.9	70.2	71.6	72.8	74.1	75.2
Noise at Receptor with Noise Barrier dB(A)	48.4	49.7	51.1	52.3	53.6	54.7
Reduction (dBA)	-20.5	-20.5	-20.5	-20.5	-20.5	-20.5
Govt. Higher Primary School, Manchineelkote						
Traffic Noise in dB(A)	69.7	71.0	72.4	73.6	74.9	76.0
Noise at Receptor w/o Noise Barrier dB(A)	66.6	67.9	69.3	70.5	71.8	72.9
Noise at Receptor with Noise Barrier dB(A)	51.5	52.8	54.2	55.4	56.7	57.8
Reduction (dBA)	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
Govt. Higher Primary School, Thopalli						
Traffic Noise in dB(A)	69.4	70.7	72.1	73.3	74.6	75.7
Noise at Receptor w/o Noise Barrier dB(A)	68.1	69.4	70.8	72.0	73.3	74.4
Noise at Receptor with Noise Barrier dB(A)	51.3	52.6	54.0	55.2	56.5	57.6
Reduction (dBA)	-16.8	-16.8	-16.8	-16.8	-16.8	-16.8

351. Height of noise barrier has been proposed 3 m. It has been observed that, in the year 2030, the value of noise at the receptor will increase substantially from the base year (2015). However, to maintain the noise level at the receptors, the barrier height should be increased by 0.5 m in the year 2030 (height 3.5 m) and further 0.5 m in 2040 (height 4.0 m). It is recommended that the foundation of the noise barrier should be made in such a way that it can bear the load of incremental heights in future, if required.

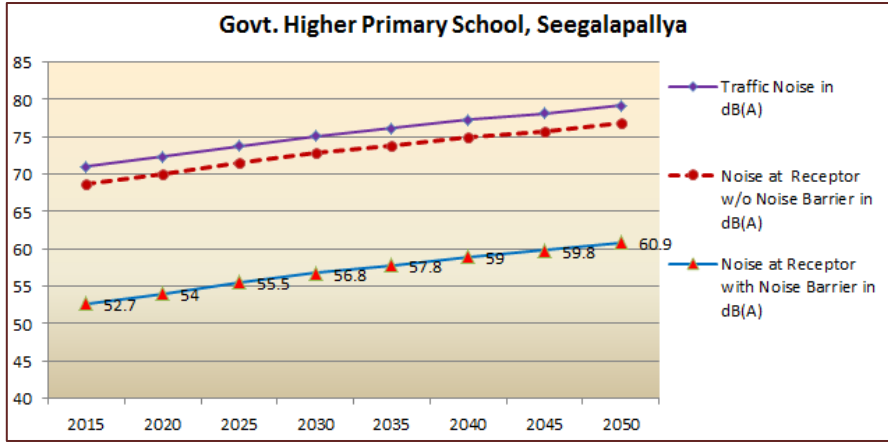


Figure 45: Noise Level at Govt. Higher Primary School, Seegalapallya with & without Noise Barrier

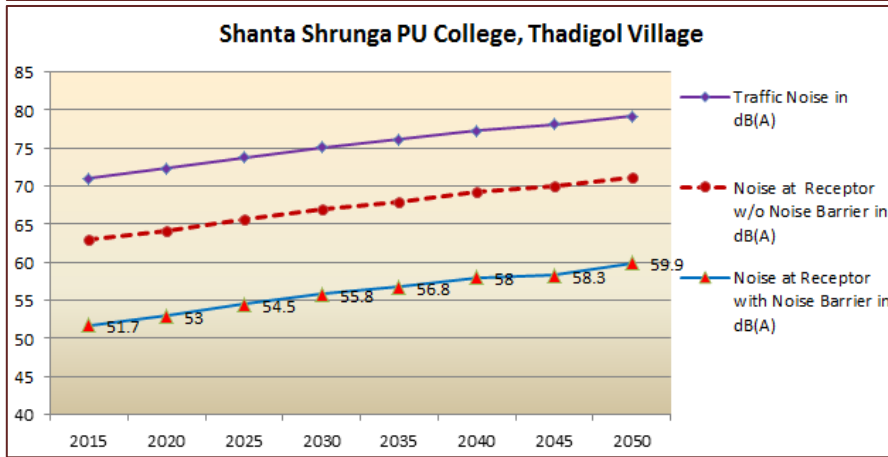


Figure 46: Noise Level at Shanta Shrunga PU College, Thadigol with & without Noise Barrier

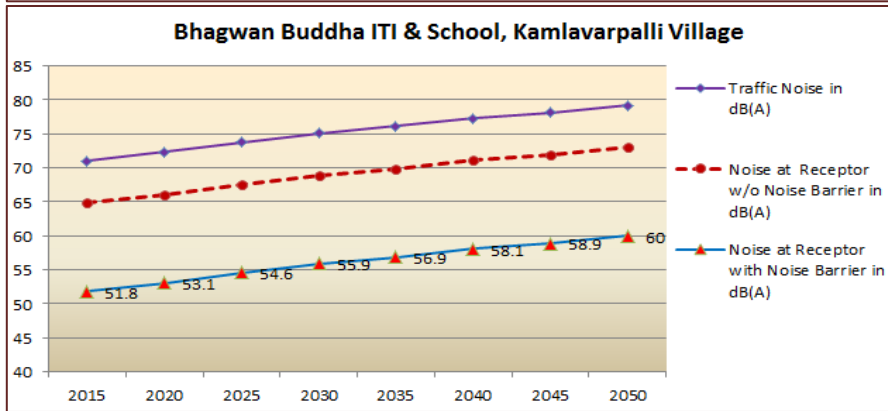


Figure 47: Noise Level at Bhagwan Buddha ITI & School, Kamlavarpalli with & without Noise Barrier

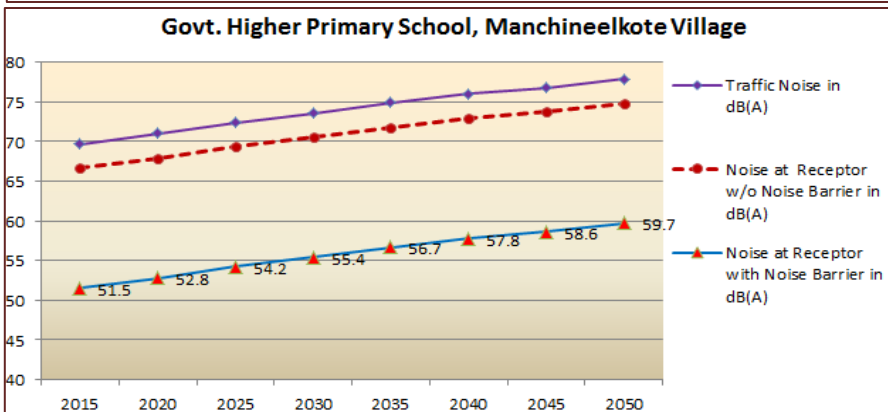


Figure 48: Noise Level at Govt. Higher Primary School, Manchineelkote with & without Noise Barrier

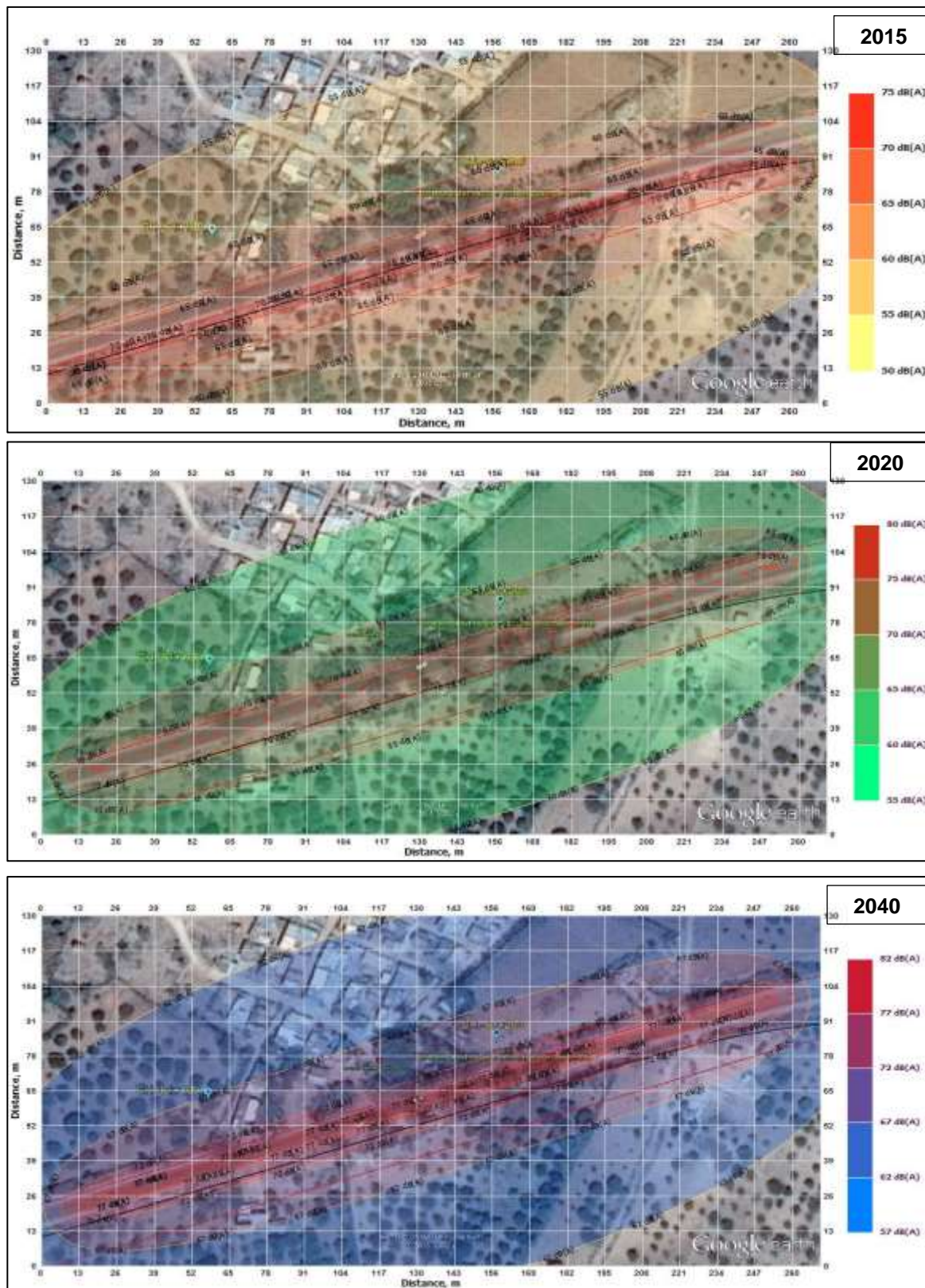


Figure 49: Noise Contour at Govt. Higher Primary School, Seegalapallya

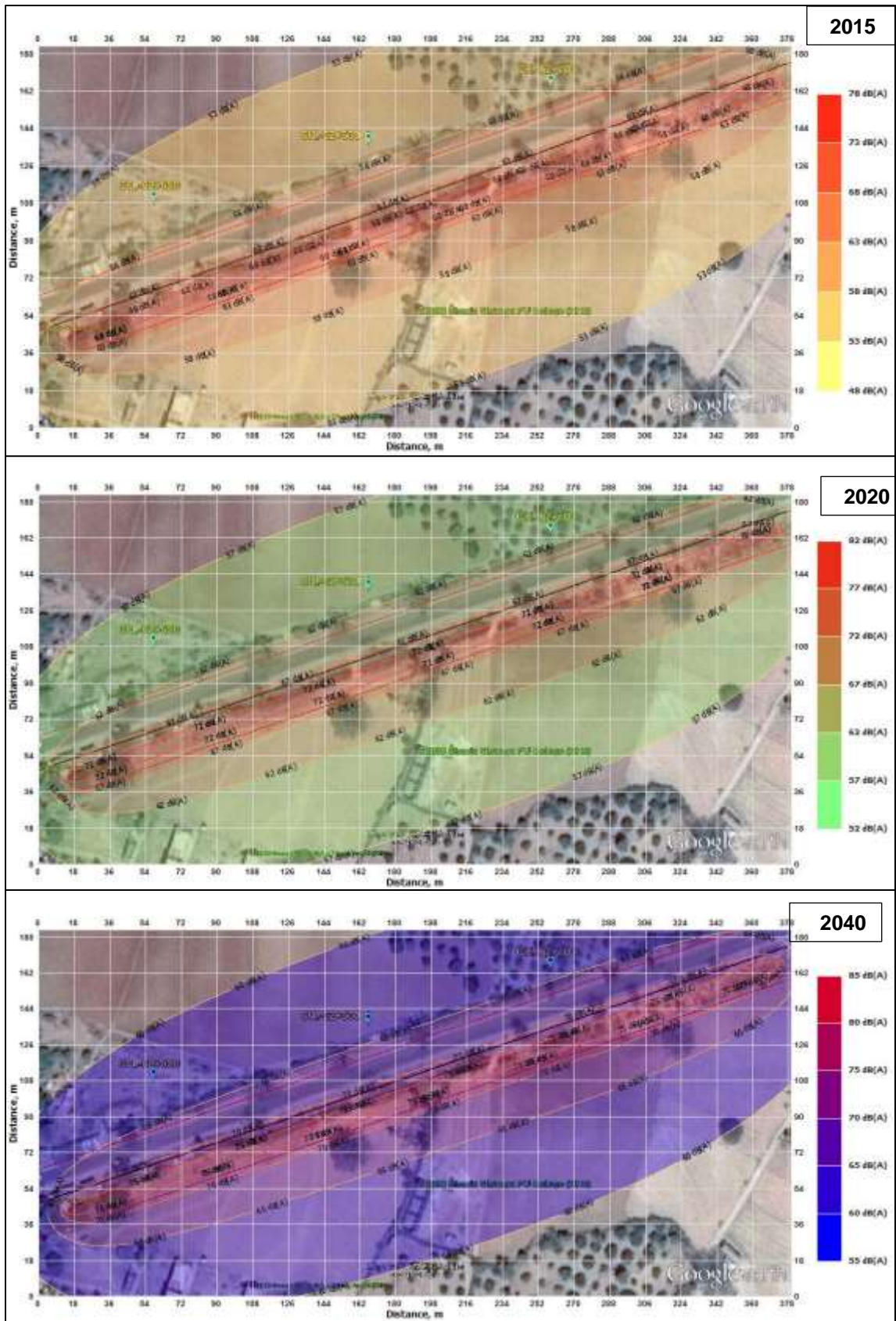


Figure 50: Noise Contour at Shanta Shrunga PU College, Thadigol

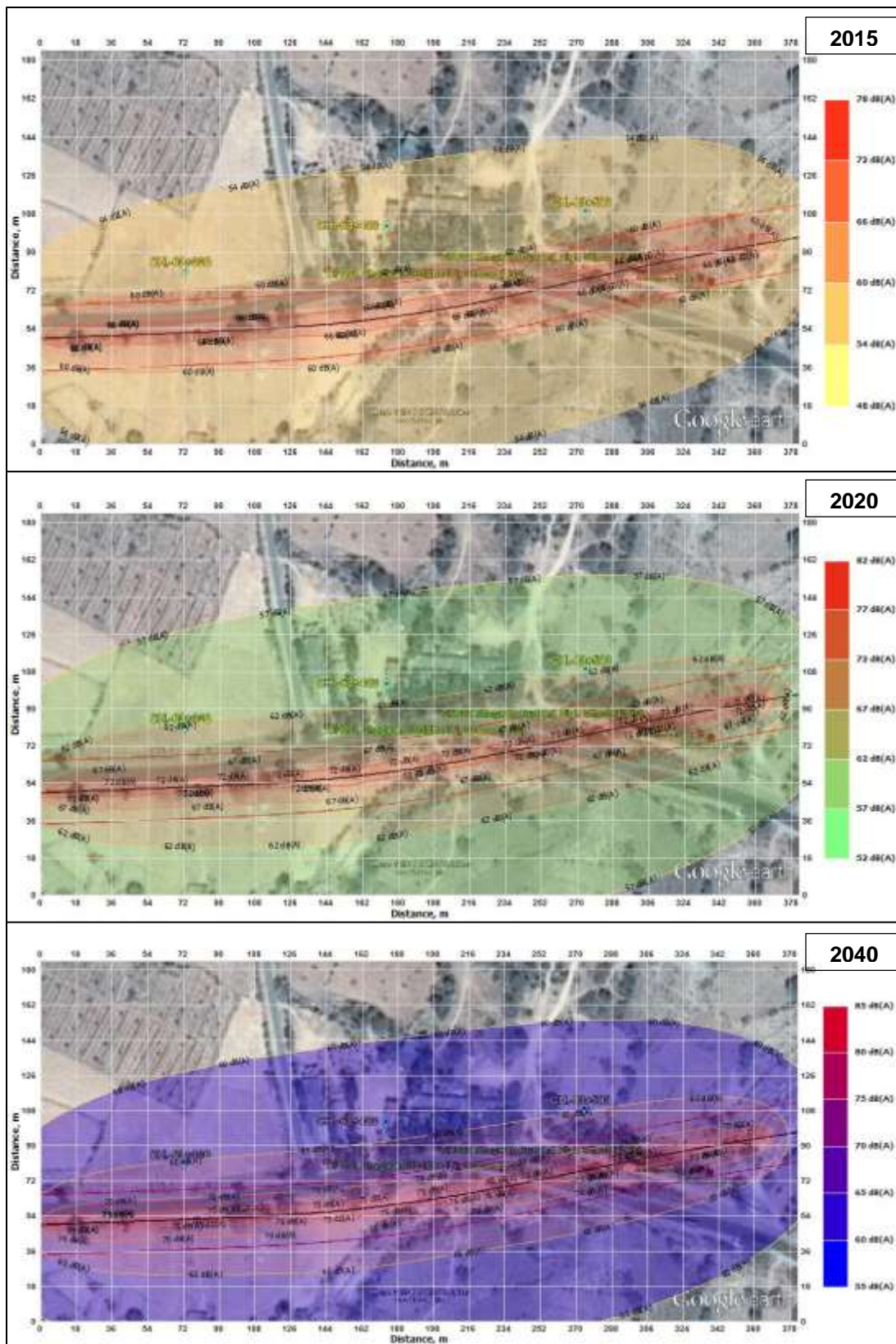


Figure 51: Noise Contour at Bhagwan Buddha ITI & School, Kamlavarpalli

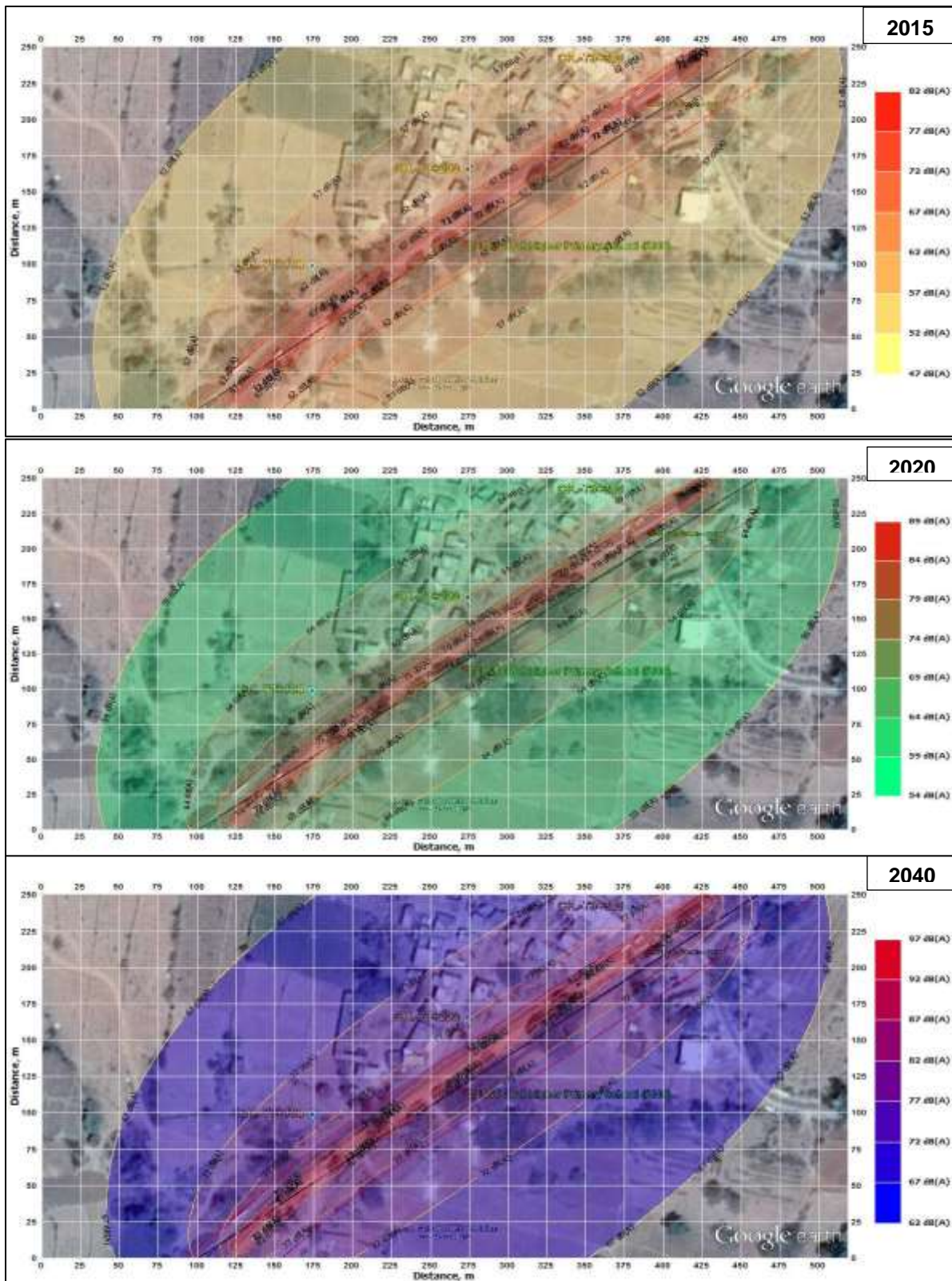


Figure 52: Noise Contour at Govt. Higher Primary School, Manchineelkote

4. Noise Barrier

352. To reduce traffic induced noise, noise barrier in the form of solid boundary wall is proposed for sensitive receptors. The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall, plastering and painting. It is also proposed to plant shade and flowering trees within the boundary of the sensitive receptors, between the building line and the compound wall (**Figure 53**). Creepers may be planted in consultation with the local forest officials to give an aesthetic look. Drawing of typical noise barrier is given in **Annex-8.25**.



Figure 53: View of Solid Boundary Wall with Trees and Creepers

5. Various Noise Barrier Materials

353. Noise barriers are a necessary structure along the highway to protect the sensitive receptors from excessive road noise. There are many different materials from which noise barriers can be constructed such as brick, concrete, plastic, wood, mixed type (existing wall, top up with dense fibre/polyethylene wall) high density fibre/polyethylene etc. Each of the materials used to construct noise barrier has advantages and disadvantages both acoustically and aesthetically.

354. Several studies have been conducted to identify the noise barrier material that produced the greatest noise reduction. It can be concluded from literature review that:

- Absorptive wall materials absorbed more sound energy than a standard reflective material
- Concrete noise abatement walls yields a mean insertion loss of 18.54 dB, which is maximum in comparison to the other materials such as Fiberglass (17.35 dB), Wood (13.60 dB) Acoustic Fabric Fence materials (11.62 dB), Earthen Berms (12.93 dB) etc.

355. However, keeping in view the policy of KSHIP and cost effectiveness, brick has been proposed as a material for construction of noise barrier. In KSHIP – II, brick wall has been constructed as noise barrier and effectiveness of the barrier is discussed in following section. In the year 2035, the noise level at the receptor will increase about 4 dB(A) from the base year (2015). Therefore, to maintain the noise level at the receptors, construction of concrete wall may be considered in the year 2035.

356. Mitigation Measures

- 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.
- Roadside plantation with suitable species near sensitive receptors and inhabited areas will result in partial noise attenuation.
- Maintenance of noise barrier

6. Experience on Noise Barrier installed under KSHIP-II

357. The Karnataka State Highways Improvement Project has taken up improvements of 831 km of State Highways in the state with financial assistance from the World Bank under the Second Karnataka State Highways Improvement Project (KSHIP-II) at a cost of US\$ 350 Million. Under the project, the existing single / intermittent roads are to be strengthened and widened to 2 way carriage way with paved / unpaved shoulders on either side. The civil works were taken up under (i) Engineering Procurement Construction (EPC) contract in five packages for 268.9 Kms of roads and (ii) Engineering Procurement Annuity (EPA) contract in four packages for 562 Kms of roads.

358. As part of the road up-gradation / improvements, KSHIP had constructed noise barriers at selected sensitive receptor locations like schools, colleges, hospitals, temples among others at various chainage along roads under EPC packages.

359. A study was conducted by KSHIP to assess the effectiveness of such constructed noise barriers and accordingly 8 selected sensitive receptor locations, which are either on almost road side or very close to road and have maximum exposure to traffic of the road for most hours of the day were selected.

360. In order to determine the effectiveness of noise barriers, ambient noise levels were recorded on either side of the noise barrier i.e. at the edge of noise barrier towards roadside and at the nearest wall of the sensitive receptor, but away from noise barrier, falling in the same straight line and perpendicular to road. The noise levels monitored at these noise barrier locations were carried out over 8 hours during the daytime (6 a.m. to 10 p.m.) as per the stipulated guidelines.

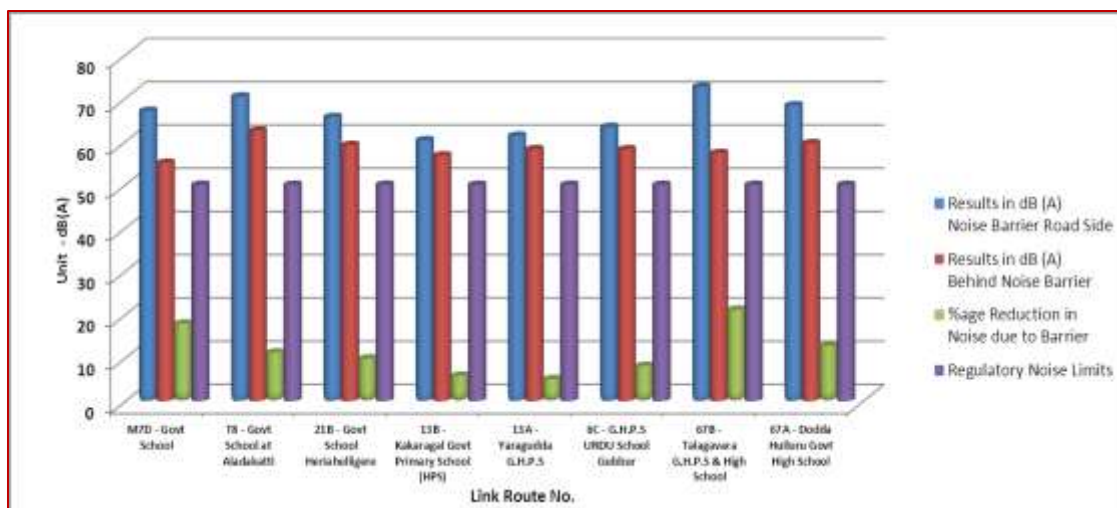
361. The test results of the ambient noise levels monitored at these noise barrier locations along with the minimum, maximum and mean values recorded during the monitoring period are summarized in **Table 85**.

Table 101: Summary of Noise Level Monitoring Results at selected Noise Barriers

Name of Link & Link No	Monitoring Date	Sampling Location	Monitoring Duration	Monitoring in front of Barrier (Road Side)	Monitoring behind Noise Barrier	% Reduction
				Leq* dB (A) (Mean)	Leq* dB (A) (Mean)	
Hangal- Tadasa, M7D	13.03.2012	Govt. School	2.00 to 10.00 p.m.	67.06	55.05	17.91
Haveri(NH4) Hangal, T8	14.03.2012	Govt. School, Aladakatti	10.00 a.m. to 7.00 p.m.	70.41	62.51	11.22
Dharwad-Saundatti, 21B	16.03.2012	Govt. School, Heriahulligere	9.00 a.m. to 5.00 p.m.	65.64	59.18	9.84
Devadurga-Kalmala, 13B	20.03.2012	Govt. Primary School, Kakaragal	9.00 a.m. to 5.00 p.m.	60.31	56.78	5.85
Thinthini-Devadurga, 13A	21.03.2012	Govt. Higher Primary School, Yaragudda	9.00 a.m. to 5.00 p.m.	61.34	58.22	5.09
Chowdapur-Gulbarga, 6C	22.03.2012	Govt. Urdu Higher Primary School, Gubbur	10.00 to 6.00 p.m.	63.36	58.2	8.14
Hindgnala cross-Chintamani pass, 67B	09.04.2012	Govt. Higher Primary School, & High School, Talagavara	9.00 a.m. to 5.00 p.m.	72.64	57.3	21.12
Hoskote Hindgnala Cross,67A	11.04.2012	Govt. High School, Dodda Hulluru	9.00 a.m. to 5.00 p.m.	68.34	59.6	12.79

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

362. An assessment of the recorded noise levels given in Table 85, monitored on either side of the noise barriers as mentioned above indicate **a reduction in noise levels up to 21%**, which can be attributed to the effectiveness of noise barrier. The histograms depicting the ambient noise levels on either side of the noise barriers, monitored along selected roads under EPC packages receptors along with percentage reduction in noise levels due to noise barriers are presented in **Figure 54**.

**Figure 54: Noise Level Monitoring Results at Selected Noise Barrier Locations**

F. Flora

1. Construction Phase

363. Impacts:

- Loss of flora due to felling of trees along the ROW
- No threatened species of flora is falling in the ROW of the project road
- Deposition of fugitive dust on pubescent leaves of nearby vegetation may lead to temporary reduction of photosynthesis. Such impacts will, however, be confined mostly to the initial periods of the construction phase and in the immediate vicinity of the construction area.
- In the long term, compensatory afforestation and Green belt development will enhance environment of the project area.

364. **Felling of Roadside Trees.** Efforts were made to minimize the number of trees to be felled. Approximately 4,802 trees are required to be felled for the improvement of the road out of total 4,945 existing trees. However, this number may reduce and actual number of trees to be felled can be determined only after the completion of joint inspection with the Forest Department. Trees species abutting the project road mainly comprise of *Tamarindus indica* (Tamarind), *Ficus religiosa*, (Peepal), *Ficus benghalensis* (Banyan), *Azadirachta indica* (Neem), *Pongammia pinnata* (Karanj), *Eucalyptus teriticornis* (Eucalyptus) etc. Girth-size wise distribution of trees to be felled along both side of the road is presented in **Table 86**.

Table 102 Girth Size wise distribution of trees to be felled

Side	No of Trees in Girth Class (in cm)					Total
	<30	31-59	60-119	120-180	>180	
RHS	995	914	655	162	105	2,831
LHS	492	597	422	205	255	1,971
	1487	1511	1077	367	360	4,802

365. **Green Tunnel.** Efforts were made to save green tunnel along the project road and this issue was also discussed during public consultation. To minimise the impacts on residential, commercial, religious and educational structures as well as to minimise the acquisition of fertile agricultural land, concentric widening has been proposed. Further, efforts were made to restrict the widening within the existing ROW. Most of the trees along with project road are located within 1-1.5 m from the existing blacktop. Therefore, to minimise the social impacts, green tunnel could not be saved in Chintamani to AP Border road but most of the giant trees will be saved.

366. Mitigation Measures.

- Avoid cutting the giant trees to the extent possible
- The proposed improvement as far as possible is within the existing (ROW) avoiding land acquisition except for locations having inadequate width, realignments with geometric improvements, provision of highway facilities. Out of the total 39.774 km length of project road 36.159 km involves concentric widening, so the land acquisition is minimized and it will require limited vegetation clearing within the ROW only.
- It shall be ensured that trees located outside ROW shall not be felled.
- The trees required to be felled shall be identified, marked and verified by Forest department. Felling of trees shall be done only after obtaining Tree Felling

Permission from competent authority. **No threatened species of flora is reported in the ROW.** The trees planted along the roads are common in distribution and found throughout the region.

- **Roadside Plantations:** To mitigate the adverse impact due to the felling of the roadside trees plantations shall be done. One row of tree shall be planted on both sides of the project road outside drain line where space is available. In urban sections, 16 m to 20 m ROW has been proposed to minimize social impact, where no space is available for plantation. Chainage wise length of the project road, where no space available for plantation is tabulated below:

Table 103: Chainage wise Length where no space available for Plantation

Sl. No.	Design Chainage		Length (km)	Cross Section Type	Description
	From	To			
1.	48+250	48+475	0.225	TCS-6	2 lane (Cutting Section)
2.	48+475	48+910	0.435	TCS-5	RUB
3.	48+910	49+100	0.190	TCS-6	2 lane (Cutting Section)
4.	64+045	64+370	0.325	TCS-7	2 lane (Cutting Section)
5.	64+500	64+830	0.330	TCS-7	2 lane (Cutting Section)
6.	65+260	65+840	0.220	TCS-7	2 lane (Cutting Section)
7.	68+326	68+726	0.400	TCS-4	2 lane (Urban Section)
8.	70+830	71+130	0.300	TCS-3	4 lane (Urban Section)
9.	73+150	73+450	0.300	TCS-3	4 lane (Urban Section)
10.	79+120	79+320	0.200	TCS-7	2 lane (Cutting Section)
11.	80+290	80+530	0.240	TCS-7	2 lane (Cutting Section)
12.	81+990	82+130	0.140	TCS-7	2 lane (Cutting Section)
13.	82+350	82+600	0.250	TCS-7	2 lane (Cutting Section)
14.	85+860	86+100	0.240	TCS-7	2 lane (Cutting Section)
15.	86+510	86+760	0.250	TCS-7	2 lane (Cutting Section)
Total Length (Km)			4.045		

367. Total length of the project road is 39.774 km and effective length available for plantation is **35.729 km**. PIU-KSHIP has an arrangement with the Forest Department to plant the trees. In KSHIP-II, per km 200 trees (10 m interval on either side) were planted and the same system will be followed in KSHIP-III. Therefore, in 35.729 km stretch, **7,145 trees** shall be planted on both sides of the project road.

368. Due to the space constrain, **2,100 trees** are proposed to be planted in local community area, local schools, partnership with participatory forestry schemes or in degraded revenue land. Detail of plantation provided in Tree Plantation Strategy (**Annex-8.12**).

369. **Plantation in Oxbow land** has also been proposed. After the realignment, land of the existing road will be given to the forest department for plantation of trees as per standard tree plantation program approved by the Forest Department, GoK.

Table 104: Location of Oxbow Land

Sl. No.	Name of Town/Village	Existing Chainage Km		Length (km)
		Start	End	
1	Tadgol Crossing	63+500	64+200	0.300
2	Thopalli	75+130	75+600	0.470

370. Total area of the oxbow land is 1.89 ha and as per the arrangement of Forest department with PIU-KSHIP, **378 trees** will be planted in oxbow land (200 trees per ha)

- Total number of trees will be planted : **9,623 trees (1:2)**
- Road side plantation : 7,145 trees
- Plantation in community area, schools etc. : 2,100 trees
- Plantation in oxbow land : 378 trees

371. Compensatory afforestation shall be carried out in the ratio of 1:3. Compensatory Afforestation shall be provided as per the Forest Conservation Act, 1980 and amendment. The amount required for tree cutting and Net Present Value (NPV) for Forest land shall be provided by KSHIP to Forest Department

372. The Karnataka Preservation of Trees Act, 1976 shall be abided. Trees in non-forest/ agriculture land shall be felled only after obtaining permission from competent authority.

373. Therefore, Total Compensatory Plantation will be 1:5 for Chintamani to AP Border

374. Species suggested for plantation are provided in the Table 105.

Table 105: Tree Species suggested for Plantation near Forest

S. No	Species	Value	Visitors*
1.	<i>Tamarindus indica</i>	Nectar, Fruits	I,B,M
2.	<i>Butea monosperma</i>	Nectar, Dust & Pollution Control	I,B,M
3.	<i>Ficus microcarpa</i>	Fruit	I,B,M
4.	<i>Mangifera indica</i>	Nectar, Fruits & Pollution Control	I,B,M
5.	<i>Phoenix sylvestris</i>	Nectar, Fruits	I,B,M
6.	<i>Pongamia pinnata</i>	Nectar, Dust & Pollution Control	I,M
7.	<i>Syzigium cumini</i>	Nectar, Fruits	I,B,M
8.	<i>Ziziphus mauritiana</i>	Fruit	B,M

* I – Insects, B – Birds, M – Mammals

- The plantation shall be maintained for **5 years**. Dead saplings shall be replaced to maintain the survival percentage of 90%.
- To enhance the visual and landscape near water bodies, plantation is suggested. Species such *Terminalia arjuna*, *Syzigium cumini* etc. and flowering plants such as Champa, Jasmine, Rose etc. can be planted.
- Oil seed species / Bio fuel trees species such as *Pongamia Pinnata*, *Azadirachta Indica*, *Simarouba Glauca*, *Madhuca Indica / Latifolia*, *Calophyllum Inophyllum* also suggested for Plantation
- Native indigenous trees species shall be used as far as practicable, strictly avoiding any exotic (but popular) species like *Eucalyptus sp.* that can have far-reaching adverse effects on the ecology and water regime of the area.
- Soil erosion shall be checked by adopting bio-engineering measures.
- Construction camps shall be located away from Forest areas and movement of labours shall be monitored by Independent Engineer and Contractor.
- LPG/ Kerosene shall be provided by the Contractor for cooking.
- The 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.

2. Operation Phase

375. Impacts: Illegal felling of road side plantation.

376. Mitigation Measures:

- Plantation along the ROW will be maintained properly
- Plantation along the ROW will be protected from illegal felling

G. Fauna

1. Construction Phase

377. **Impacts:**

- Wildlife can survive if the landscapes they live in remain intact. The clearing of land and felling of trees will directly cause loss of habitat to avifauna and wildlife dwelling in the area.
- There are no National Parks or Wildlife Sanctuaries within 10 km radius of the proposed road. There will be no direct impact on Protected Areas or wildlife habitat due to the project.
- The project alignment traverses through Rayalpadu Reserve Forest (both side) for 3.9 km. This is an open scrub forest with Eucalyptus plantation. The wildlife mostly avifauna dwelling in the area shall be impacted due to project activities. Two avifauna species *Ictinaetus malayensis* (Black eagle) and *Accipiter badius* (Shikra) belonging to Schedule-I are reported in the project area.
- The construction activities and noise will cause disturbance to wildlife in their movement, feeding, breeding and resting, which is short term reversible impact.
- The labour population may enter Forest area for collecting fire wood.
- The domestic fauna in the area will also face problem in movement due to construction activity.

378. **Mitigation Measures:** The project alignment traverses through Reserve Forest areas. Schedule-I species are dwelling in the area. The development of the project will cause disturbance to the fauna. The construction activity shall be planned in such a manner to minimize impact on fauna.

- The Contractor shall ensure that all the people at construction site abide by the law prohibiting hunting of wildlife. Poaching will be strictly banned and any incidence of poaching of wildlife by workforce shall be reported to the Forest / Wildlife Department
- All the construction workers and staff of the project unit will be made aware and educated about the presence of the Wildlife in the area. Environmental awareness program will be provided to the Contractor, labours and all staff deployed at the site
- All staff / workers will be instructed not to chase or disturb if any wildlife seen near the project area. The incidence of sighting wildlife near project site should be reported to Forest Department.
- The Contractor shall ensure that no open fire is done in construction camp as it may lead to fire to surrounding forest causing injury to wildlife
- Noise will be kept under control by regular maintenance of equipment and

vehicles. No honking board shall be placed near Forest. Noisy activity shall be prohibited during night time.

- To avoid risk of collision of wildlife with vehicles and construction equipment, temporary fencing may be done along the boundary of the diverted forest area (4.295 \cong **4.5 km length**) during construction period.
- Construction camps shall be located away from Forest areas.
- Trees located outside ROW will not be felled. The construction workers will be strictly prohibited from entering Forest Areas.
- Prohibitory Sign boards shall be placed to prevent trespassing in the Forest area. Movement of labour force shall be monitored by the Contractor. Watch tower / check post shall be established near Forest area, if required.
- Construction debris shall not be allowed to dispose in the Forest areas
- Implementing sediment and erosion controls during construction will minimize adverse Impacts of water bodies. Construction activity will be avoided near water bodies during rainy season.
- Existing and proposed culverts and minor bridges along the project stretch will facilitate the movement / crossing of wildlife in the area.
- Plantation of fruit bearing species will support the future demand of the fauna dwelling in the project area. It will provide additional habitats to avifauna dwelling in the area.
- Impact on availability of fodder due to loss of trees and agricultural area shall be negligible on domestic fauna.
- **Overall the impact will be insignificant** on fauna of the project area.

2. Operation Phase

379. Impacts:

- Effect on aquatic fauna in case of accidental oil spill & toxic chemical release find its way into the water bodies.
- Illegal felling of road side plantation

380. Mitigation Measures:

- Contingent actions will be taken for speedy cleaning up of oil spills, fuel and toxic chemicals in the event of accidents
- Plantation along the ROW will be protected from illegal felling

H. Protected Area

381. The project road Chintamani to Andhra Pradesh Border does not pass through any Wildlife Sanctuary/ National Park / Biosphere Reserve. No protected area is located within 10km radius of the project area. Hence, there is **no impact** on protected area.

I. Reserved Forest

382. The road is passing through Rayalpadu Reserve Forest in both sides for **3.977 km** and in one side (RHS) for a length of **7.5 km**. Total length of the forest along the project road is 11.477 km. The location of Reserved Forests along the project road is presented below:

Table 106: Reserved Forests along the Project Road

Existing Ch. Km			Design Ch. Km			Side	Name of the Forest
From	To	Length (km)	From	To	Length (km)		
75+600	82+950	7.350	75+320	82+610	7.290	RHS	Rayalpadu Reserved Forest
83+200	83+350	0.150	82+880	83+030	0.150	RHS	
83+353	87+330	3.977	83+030	86+977	3.947	Both	
Total Length (km)		11.477	Total Length (km)		11.387		

383. Out of **11.477 km**, total length of forest land to be diverted is only **4.295 km**. location of forest land to be diverted is presented in **Table 107**.

Table 107: Location of Forest land to be diverted

From Ch. Km	To Ch. Km	Side	Length (Km)
75+900	76+140	RHS	0.240
76+220	76+350	RHS	0.130
76+450	76+620	RHS	0.170
77+880	77+980	RHS	0.100
78+100	78+300	RHS	0.200
78+700	78+850	RHS	0.150
78+880	79+250	RHS	0.370
81+580	82+280	RHS	0.700
82+280	82+700	RHS	0.420
82+720	82+761	LHS	0.041
82+850	82+950	RHS	0.100
82+900	82+974	LHS	0.074
83+300	83+550	LHS	0.250
84+320	84+390	LHS	0.070
84+350	84+450	RHS	0.100
85+400	85+550	RHS	0.150
85+600	85+750	LHS	0.150
85+700	85+860	RHS	0.160
86+150	86+700	RHS	0.550
86+250	86+420	LHS	0.170
Total Length			4.295

384. Minimum reserved forest land has been proposed for diversion (**3.3526 ha**). The area required is for curve improvement only for the sake of road safety. The acquisition of forest land will be taken up in accordance to the requirements of Government of India. The breakup of the forest land required to be diverted is given in **Table 108**.

Table 108: Details of Forest Land to be Diverted

Sl. No.	Village	Hobli	Taluk	District	Survey Number	Acquisition of land Area (Ha.)
1	Mandyala	Royalpad	Srinivasapur	Kolar	145	0.2149
2	Sunnakal	Royalpad	Srinivasapur	Kolar	68	0.1554
3	Royalpad	Royalpad	Srinivasapur	Kolar	268	0.5935
4	Gontapalli	Royalpad	Srinivasapur	Kolar	16	0.2704
					17	0.6461
					18	0.1046
					110	0.0802
					111	1.2875
Total						3.3526

385. For stretches of the corridor through the forest areas, the contractor and the IE shall ensure that the construction activities shall be limited to the proposed ROW, so as to avoid any impacts on the vegetation within the forest areas. The measures for avoiding / mitigating adverse impacts on the reserve forest stretches are given below:

- No construction camp shall be allowed within the designate limits of the forest areas and within 1km from their boundaries.
- No earthworks or surfacing will be permitted along stretches of road passing through the reserved forest area after 6:30 p.m.
- No workmen shall be allowed to stay within the areas after sundown except with adequate supervision.
- No disposal of debris shall be allowed within these areas except at locations identified during project preparation.

J. Induced and Cumulative Impact

386. 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.

387. 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.

388. 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.

389. For addressing the impacts of air pollution and noise, regular maintenance of the road surface, maintenance and monitoring of newly planted trees, noise barriers have been included in the EMP for implementation during operation stage. 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.

390. Information on other development projects in and around the project area was not available. Hence, it is difficult to assess cumulative impacts from other projects which may get implemented in the project area.

K. Climate Change Impacts and Risks

1. Climate Change Mitigation

391. The Transport Emissions Evaluation Model for Projects (TEEMP)⁶ developed by Clean Air Asia⁷ was utilized to assess the CO₂ 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 2.5 m/km which may deteriorate over a period but not less than 3.5 m/km and widening of roads from 2.0 lane to 2-lane with paved shoulder configuration. These were translated into impacts on traffic speed and hence fuel consumption. 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.

392. Information that was fed into the model for projecting the CO₂ emissions were:

- i) The project will rehabilitate and widen 39.774 km of the SH-82 from Chintamani to AP Border, which will have two different Homogeneous sections: HS-I and HS-II.
- ii) The road configuration will change from 2 lane to 2.0 lane with paved shoulder with carriageway width of 7.0 m and will have an asphalt bituminous surface.
- iii) Existing road roughness varies from 6.120 m/km to 3.6 m/km and will be improved to 2.5 m/km, which may further reach up to 3.5 m/km during 7 years of road operations and hence will be resurfaced after every 7 years.
- iv) Construction will take place over a period of 24 months in 2017-19 and road operations will begin in 2020.
- v) The design life of the road is 20 years (2020 to 2039)
- vi) Other improvements include the repair or reconstruction of damaged culverts, introduction of lined longitudinal and cross drains for the road and removal of irregularities on the existing vertical profile and road safety appurtenances.

393. Traffic forecasts were taken from the detailed project report. Maximum PCU for 2.0 lanes and 2.0 lanes with paved shoulder were considered as 36,000 in consistent to IRC guidelines. The volume / capacity saturation limit was taken at 2.0 for optimum travel speed and fuel consumption. Emission factors were mostly taken from the CBCP / MOEF (2007) Draft Report

⁶ TEEMP is an excel-based, free-of-charge spreadsheet models to evaluate emissions impacts of transport projects.

⁷A 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.

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 109: CO2 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 kg/l

394. 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 average trip distance. Furthermore, 2-wheelers and 3-wheelers constitute 100% and 90%, respectively of the total local traffic.

395. 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 110: Emission Standards of Fleet (%)

Vehicle Type	Current Scenario				Year 2039		
	Pre-Euro	Euro I	Euro II	Euro III	Euro I	Euro II	Euro III
2-Wheel		50%	50%		30%	70%	-
3-Wheel	80%	20%			40%	60%	
Cars/ Jeeps		40%	40%	20%		40%	60%
LCV/Bus/HCV		70%	20%	10%	10%	40%	50%

396. 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 109,600 kg CO₂/km of road construction. ,

2. Estimated Carbon Emissions

397. The proposed road upgrading resulting to surface roughness and road capacity improvements have implications in CO₂ 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.

398. CO₂ emissions will also result from the processing and manufacturing of raw materials needed to upgrade the project road and in the case of project, to upgrade and strengthen the road length of approximately 39.774 km, total CO₂ emissions will be of the order of 4,355.94 tons.

Table 111: Estimated Total CO₂ Emissions during Road Construction

Road Section	Length (km)	Emission Factor (ton CO ₂ /km)	CO ₂ Emission (tons)
HS-I	16.367	109.6	1793.82
HS-II	23.377		2562.12
Total	39.744		4355.94

399. The design life of roads is 20 years. Total CO₂ emission at Business-As-Usual scenario was estimated at 16,714 tons/year and without and with-induced traffic are remains same i.e., 16,736 tons / year. These values are below the 100,000 tons per year threshold⁸ set in the ADB SPS 2009. Therefore it is not necessary to implement options to reduce or offset CO₂ emissions under the project. The project's section-wise CO₂ emission intensity indicators are provided below:

Table 112: Section-wise Project CO₂ Emissions Intensity Indicators

Road Sections	Particular	CO ₂ emission		
		Business-As-Usual	Project (without Induced Traffic)	Project (with Induced Traffic)
HS-I	tons/km	1,634.92	1,725.28	1,725.28
	tons/year	3,248.92	3,428.48	3,428.48
	tons/km/year	81.75	86.26	86.26
	g/t km	96.97	102.33	102.33
	g/tkm	62.73	66.19	66.19
HS-II	tons/km	2,621.54	2,700.68	2,700.68
	tons/year	5,209.52	5,366.80	5,366.80
	tons/km/year	131.08	135.03	135.03
	g/pkm	117.00	120.53	120.53
	g/tkm	55.83	57.52	57.52

400. Overall Project's CO₂ emission intensity indicators are provided below:

Table 113: Project CO₂ Emissions Intensity Indicators

Particular	CO ₂		
	Business-As-Usual	Project (without Induced Traffic)	Project (with Induced Traffic)
tons/km	4,256.46	4,316.28	4,316.28
tons/year	8,458.43	8,577.32	8,577.32
tons/km/year	212.82	215.81	215.81
g/t km	108.40	109.92	109.92
g/tkm	58.29	59.11	59.11

401. The with project scenarios will be have slightly higher CO₂ 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), there will be increase in the CO₂ emission levels over the time due to the increase in the traffic volume, however, the emissions will be controlled by maintaining the road roughness below 3.0 m/km during the entire project life as well as enhanced capacity of the road. This will result in annual CO₂ emissions of the project road much below the threshold limit of 100,000 tons/year.

⁸ Page 38, Appendix I, footnote 10 of SPS 2009

3. Climate Risks and Adaptation needs

402.

403. 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 (CO₂) levels in the atmosphere have risen by 35% since the pre-industrial era. Rising CO₂ concentrations increase the energy retention of Earth's atmosphere, leading to a gradual rise of average temperatures and global warming.

404. 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.

405. **Temperature:** A warming trend in Karnataka for the period June to September was observed by Bangalore Climate Change Initiative – Karnataka (BCCI-K) (2011). As per Karnataka State Action Plan on Climate Change (KSAPCC), districts of northern interior Karnataka (Bidar, Bijapur, Gulbarga, Yadgir and Raichur) experienced an increase of both the minimum and the maximum temperature by $\geq 0.6^{\circ}\text{C}$ over the last 100 years. In terms of magnitude this finding is 0.1°C higher than the 0.5°C annual increase IMD observed over the past 100 years for most parts of the country. The study also projects further warming: 1.7°C to 2.2°C by the 2030s. The projected increase of annual average temperatures for the northern districts is higher than the southern districts.

406. The project road is located in Chikkaballapur and Kolar districts. As per the KSAPCC, projected minimum temperature increases are slightly above those of the maximum temperatures (**Table 114**).

Table 114: Projected change in annual temperature for 2021-50 compared to 1961-90

Districts	Projected change tAVG in $^{\circ}\text{C}$	Projected change tMIN in $^{\circ}\text{C}$	Projected change tMAX in $^{\circ}\text{C}$
Chikkaballapur	1.98	2.06	1.91
Kolar	1.96	2.06	1.87

Source: Karnataka State Action Plan on Climate Change, March 2012

407. **Precipitation:** Out of the average annual rainfall in Karnataka, the state receives 80% during the southwest monsoon period, 12% in the post-monsoon period, 7% in summer and only 1% in winter. The windward side of the Western Ghats, which is the coastal region, records 3,350 mm of rainfall during the southwest monsoon while on the leeward side rainfall drops to 600- 700 mm. BCCI-K (2011) assessed trends based on daily weather data from Indian Meteorology Department (IMD) for the period 1901 to 2008. The study observed a decline in annual rainfall from 1,204 mm during 1901-1950 to 1,140 during 1951-2008. However that IMD Bangalore, who provided the baseline data for the BCCI-K study, disagrees with the conclusion that rainfall in Karnataka has been declining.

408. Increased temperature and precipitation will have following impacts:

- **High Precipitation Impacting Roads /Bridge /Embankment:** Heavy rains can cause disruption of the road networks, decreased accessibility, erosion of roads and embankments, surface water drainage problems, slope failures, landslides, among others. Increased river flow resulting from precipitation and storminess may result in damages to bridges, pavements, and other road structures. Bridge / culvert capacities are reduced or exceeded, causing upstream flooding to occur.
- **High Temperature Impacting Road Stability:** Extreme heat, combined with traffic loading, speed and density can soften asphalt roads, leading to increased wear and tear. It is likely that there would be concerns regarding pavement integrity such as softening, traffic-related rutting, embrittlement, migration of liquid asphalt. Additionally, thermal expansion in bridge expansion joints and paved surfaces may be experienced.

409. **Earthquake:** The project road is situated in the Zone II (having low seismic intensity) of the Seismic Map of India (as per IS: 1893, Part I, 2002) and therefore has a low risk of potential damage due to earthquake. Relevant IS codes have been adopted in designing the structures to sustain the magnitude of earthquake corresponding to Seismic zone II.

410. **Forest Fire:** As per “Karnataka State Action Plan on Climate Change (KSAPCC)”, vast tracts of forest fall victim to forest fires every year. Rising temperatures and reduced top soil moisture due to increased evapotranspiration, the forest fire risk will escalate in the future.

411. **Drought:** As per KSAPCC, Karnataka ranks second in India after Rajasthan. 54% of the geographical area is drought prone, affecting 88 of 176 taluks and 18 of the 30 districts. Srinivasapur taluk is one of the taluk among other taluks having greatest percentage of drought years. The taluks of the northern drought-prone districts have in general, more years of moderate and severe drought than the taluks in the southern districts. Study of BCCI-K (2011) indicates that most northern districts of Karnataka would have 10-80% increased drought incidences.

412. Increased drought frequency may lead to increased susceptibility to consolidation of the substructure with (unequal) settlement, more generation of smog, and unavailability of water for compaction work.

413. **Cyclone:** It can be concluded from the analysis of past meteorological data that cyclone, dust storms are extreme rare in the study area. Impact of cyclone is likely to be low.

414. **Flood:** The study area does not have flood problem. CWC in association with IMD and Ministry of Surface Transport (MOST) has prepared Flood Estimation Reports for small and medium catchments for each hydro meteorologically homogeneous 26 sub-zones. The project area is falling in sub zones 3(h) and 3(i). All structure have been designed for 50 year return period with anticipated risk of rarer flood generally of next higher frequency i.e. 100 year return period flood on the designed structures. Roadside toe drains shall be provided to receive discharge from embankment surface and countryside runoff and carry it safely to the nearest outfall point ensuring safety to the embankment toe, which is the area most vulnerable to erosion / failure.

415. Key engineering measures taken to address flood risks in the design are: i) increase in embankment height, ii) construction of new side and lead away drains, iii) construction of new culverts and widening of existing ones and iv) widening of bridges. As shown in **Table 6-21**,

costs for taking these measures add up to a total of Rs. 24.06 crores. This is approximately 10.63% 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. The detailed list of road with climate risks, specific engineering measures taken and the costs of those measures are provided in **Table 115** 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 115: Details of Climate Adaptation Measures with Cost Implications

Roads/Details		Chintamani to AP Border	
Cross-drainage structures			
Culvert Nos.		73	
Culvert Length (m)	Existing	867.0	
	Proposed	1334.24	
Cost Impact (Rs. Cr)		10.28	
Bridge Nos.		5	
Bridge Length (m)	Existing	58.95	
	Proposed	85.5	
Cost Implication (Rs. Cr)		10.29	
Embankment Raising			
Length raised (m)		38.339	
Cost Implication (Rs. Cr)		1.02	
Roadside drains			
Lined built-up (m)		2,870	
Unlined open (m)		76,678	
Cost Implication (Rs. Cr)		2.47	
Total Cost		24.06	

L. Social Impacts

1. Educational, Medical and Religious Properties

416. **Impacts:** Roadside amenities, religious and cultural properties generally include:

- Educational institutions (schools & colleges)
- Medical amenities (hospitals & health centers)
- Religious properties (temples, mosques, Church etc.)

417. Due to additional land acquisition & widening of the road, there will be some impact on the roadside educational and religious places. In few cases the impacts will be total (e.g. the main structure has to be demolished), and in few cases the impacts will be partial (e.g. only boundary wall and/or part of the structure has to be demolished) depending on the distance of the structure from the road. The impacts on roadside amenities, religious and cultural properties are summarized in **Table 116**.

Table 116: Number of Roadside Educational, Medical and Religious Properties Affected

Items	Number of Educational, Medical and Religious Properties			
	Fully Affected	Partly Affected	Not Affected	Total
Educational Institutions	0	2	8	10
Religious Places	7	0	26	33
Medical Amenities	0	0	0	0

Table 117: List of Affected Educational Institutions

S. N.	Description	Village	Existing Ch. km	Design Ch. Km	Side	Distance# (m)	Affected Status
1.	Govt. Higher Primary School	Seegalapallya	61+170	61+170	LHS	8	Partially Affected
2.	Govt. Higher Primary School	Jodi Kothapalli	68+620	68+400	LHS	8	Partially Affected

Distance in meter from existing centerline

Table 118 List of affected Religious Properties

S. N.	Description	Village	Existing Ch. km	Design Ch. Km	Side	Distance# (m)	Affected Status
3.	Road side Mini Worship Place (Adi Navgrah)	Marinayakanhalli	54+790	54+790	LHS	12.80	Fully Affected
4.	Road side Small Hanuman Temple	Kodivaripally	55+815	55+815	RHS	7.00	Fully Affected
5.	Road side Small Hanuman Temple	Gopalli	58+275	58+275	LHS	10.80	Fully Affected
6.	Road side Mini Worship Place (Hanuman)	Thadigol	60+018	60+018	RHS	9.00	Fully Affected
7.	Vinayak Temple	Thadigol	62+460	62+435	RHS	7.50	Fully Affected
8.	Road side Mini Worship Place (Navgrah)	Gundedu	67+060	66+860	LHS	10.00	Fully Affected
9.	Road side Mini Worship Place (Hanuman)	Gontapalli	84+595	84+247	LHS	7.36	Fully Affected

Distance in meter from existing centerline



Road side Mini Worship Place (Navgrah) at Ch. Km 54+790



Road side Small Hanuman Temple at Ch. Km 55+815



Road side Mini Worship Place (Hanuman) at Ch. Km 60+018



Road side Mini Worship Place (Navgrah) at Ch. Km 67+060



Vinayak Temple at Ch. Km 62+460



Road side Mini Worship Place (Hanuman) at Ch. Km 84+595

Photographs of Affected Religious Structures



Govt. Higher Primary School At Ch. Km 61+170



Govt. Higher Primary School At Ch. Km 68+620

Photographs of Partially Affected Educational Institutions

418. **Mitigation Measures:**

- Fully affected structures will be relocated
- The amount of compensation will be equivalent to the replacement cost for the structures.

2. **Impact on Land**

419. The scope of land acquisition is quite limited in the project because of availability of sufficient RoW. According to the Land Acquisition Plan (LAP) **22.13 Ha** of land will be acquired for the project, out of which 9.79 Ha. is private land. The details of affected land are presented in the **Table 119**.

Table 119 Type of Land Affected

Type of land		No. Ha.
Private	Agriculture/Non-irrigated	5.93
	Irrigated	3.86
	Subtotal	9.78
Public	Forest Department	3.35
	Government	8.99
	Subtotal	12.35
Grand Total		22.13

3. **Ownership of Land being acquired for the Project**

420. Out of total 22.13 Ha of land, which is going to be affected, 9.78 ha (44.19%) land is privately owned, while 8.99 ha (40.62%) and 3.35 ha (15.14%) land belongs to Government / Waste & Forest Land respectively. The details of land acquisition requirement are summarized in the **Table 120**.

Table 120: Details of Land being acquired for the Project

Sl. No.	Land Details	Acquisition of Land Area (Ha.)	Percentage
1	Private Land	9.78	44.19
2	Forest land	3.35	15.14
3	Govt. Land / Waste Land	8.99	40.62
Total		22.13	100.00

Source: Land acquisition Plan, ICT Pvt. Ltd 2015

4. **Impacts on Structure in the Project Area**

421. 187 assets including government and common property resources (CPRs) are likely to be affected. Out of total 187 affected properties, **145 (77.54%) are private structures** owned by 88 titleholders and 57 non-titleholder households, while 30 are government structures, which includes 11 mini water tanks, 10 bus shelters, 2 schools, 1 hand pump, 1 check post, 2 panchayat office, 2 pump house and 1 RTO check post. There are 7 religious structures and 5 community structures. The details of affected properties are presented in the **Table 121**.

Table 121 Details of Affected Structures

Sl. No.	Structure/ properties in the Affected Area	Number of Affected Properties	Fully affected	Percentage
1	Private Structures	145	115	77.54
2	Government Structures	30	28	16.04

Sl. No.	Structure/ properties in the Affected Area	Number of Affected Properties	Fully affected	Percentage
3	Community Structures	5	5	2.67
4	Religious structures	7	7	3.74
	Total	187	155	100

Source: Census Survey 2015-16

5. Impacts on Private Structures

422. As per the census survey, 145 private properties are likely to be affected due to the proposed project. These private properties are residential, commercial and residential-cum-commercial. 115 private structures are fully affected and rest 30 private structures will be partially affected and will remain viable for use. Both partially and fully affected structures are owned by 88 title-holders and 57 non-titled holders. Details on the loss of private assets are presented in Table 122.

Table 122: Impact on Private Structures

Sl. No.	Type of Private Property	Total No. of Affected Structures	Partially affected	Fully affected	No. of affected HHs (including Tenants & Employees)	No. of affected Families (including Tenants & Employees)	No. of affected Persons
1	Residential	35	8	27	38	94	194
2	Commercial	95	18	77	123	278	509
3	Res-Cum-Commercial	13	3	10	18	51	91
4	Boundary wall	2	1	1	3	5	10
	Total	145	30	115	182	428	804

Source: Census Survey 2015-16

6. Legal Ownership of the Properties/ Structures

423. The improvement of the existing road is proposed within proposed Col of minimum 26 m in open section, whereas in 2 lane rural section the Col is customized to 16 m, and in 4 lane urban section the Col is customized to 20 m. The likely impact on Titleholders and Non-Titleholders were assessed through the census survey undertaken within Col of the project road. The details of ownership of properties are presented in **Table 123**.

Table 123: Details of Ownership of Properties

Sl. No.	Type of Properties	No. of Households		Total	Percentage
		Titleholder	Non-Titleholder		
1	Residential	19	16	35	24.14
2	Commercial	58	37	95	65.52
3	Res-cum-commercial	10	3	13	8.97
4	Boundary Wall	1	1	2	1.38
	Total	88	57	145	100.00

Source: Census Survey 2015-16

7. Severity of Impact on Households Losing Structures

424. The analysis of impact on the scale of severity reveals that out of 145 private structures, 30 structures are marginally affected (up to 25%), while 115 structures are significantly affected, leading to physical displacement. The intensity of impact is further classified in the Table 124.

Table 124: Intensity of Impact on Structures

Sl. No.	Scale of Impact	To the scale of 25 %	No. of Household	Percentage
1	Fully Impacted	(More than 25%)	115	79.31
2	Partially Impacted	(Less than 25%)	30	20.69
Total			145	100

Source: Census Survey 2015-16

8. Loss of Livelihoods

425. Out of 144 total households losing their livelihood, 117 are fully affected and 27 are partially affected commercial households. Majority of them are owners and conducting commercial activities in these structures (75%) but some of them are tenants who have taken the premises on rent for commercial purpose (17.36%). The details of economic impact as per the category of affected households are presented in **Table 125**.

Table 125: Loss of Livelihoods

Sl. No.	Loss	Partially affected Households	Fully affected Households	Total affected Households	Percentage
1	Owners of Shop	21	87	108	75.00
2	Artisans	0	3	3	2.08
2	Tenants	5	20	25	17.36
3	Employees	1	7	8	5.56
Total		27	117	144	100

Source: Census Survey 2015-16

9. Impacts on Common Property Resources

426. There are 5 community properties (other than religious structures) affected along the project road which includes 3 aralikatte, 1 ashram and 1 statue. Out of 28 affected government properties (other than educational institution) 11 are mini water tanks, 10 bus shelters, 2 panchayats, 2 pump houses, 1 RTO check post, 1 check post and 1 hand pump. The summary list of CPRs affected along the project is presented in **Table 126**.

Table 126: Types of CPRs and Government Properties likely to be affected

Sl. No.	Types of Properties	Items	Total	Percentage
1	A. The Other Community Properties (CPRs)	Aralikatte	3	9.1
2		Ashram	1	3.0
3		Statue	1	3.0
4	B. Government Properties	Bus Stand (BS)	10	30.4
5		Hand Pump (HP)	1	3.0
6		Mini water tank	11	33.3
7		Check post	1	3.0
9		Panachayat	2	6.1
10		Pump house	2	6.1
11		RTO check post	1	3.0
Total			33	100

Source: Census Survey 2015-16

M. Steps for Minimizing Adverse Impacts

427. Social impacts were minimized to the extent possible. The following steps were followed to minimize social impacts and in particular impacts on very congested areas and sensitive structures (i.e. clusters, community and religious structures). The Social team working in the field, weighed up the alternative alignment options proposed by the Survey and Engineering team and this field information were shared and discussed with engineering design team, to avoid or minimize adverse impact on large number of households. Moreover, local level consultations regarding the impact of widening of the road and in particular its impacts on sensitive sites were conducted and alternative suggestions offered by road residents were considered. In response, the engineering team considered various options. These minimization efforts resulted in:

- Potential displacement avoided by modifying the alignment;
- Fixing the speed in the built up areas including schools and hospitals as per local needs and problems of the people;
- Deciding the rural and settlement location road cross-sections based on field surveys and likely impact on the people; and
- Evolving Community consensus on shifting the existing community properties and religious structures.

428. More specifically, a total of 6.32 ha of private land and 124 structures were avoided, as described in **Table 127** below:

Table 127: Mitigation Measures Taken

Sl. No.	As per codal provision		As per measures adopted to minimize impact		Remarks
	Structures Affected	Land Required (Ha.)	Structures Affected	Land Required (Ha.)	
1	311	25.80	187	22.13	This process saved 124 structures and 3.67 Ha of land

429. At some instances, the alignment has been modified to avoid certain sensitive structures. Few key examples are at Aimareddihalli (km. 50.000) and Marinaikanahalli (km. 54.000) in Chikkabalapura district temples were saved. At Aimareddihalli one temple was saved by providing retaining wall in front of the temple. Similarly, at Marinaikanahalli one big temple of Shani Mahatma was saved by shifting the alignment to LHS (eccentric widening).

N. Rehabilitation and Resettlement

430. The resettlement cost estimate for the RP includes compensation for structure at replacement cost without depreciation, compensation for livelihood loss, resettlement assistances and cost of RP implementation. The total resettlement cost for the project is INR 24.17 Crores. The EA will provide the necessary funds for compensation for land and structures and R&R assistance. The EA will ensure timely availability of funds for smooth implementation of the RP.

O. Employment and Trading Opportunities

431. 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.

432. 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.

433. Mitigation Measures:

- Most of the unskilled construction labourers will be recruited from the local areas to create some employment opportunities and sense of wellbeing among local people. This will also reduce social tension of migration.
- Some of the construction materials like stone chips & sand will be procured locally. Thus there is a possibility of generation of local trading opportunities, though temporary.

P. Migration

434. 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.

Q. Construction Camp

435. Impacts:

- 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

436. Mitigation Measures:

- 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.
- Most of the construction work is labour intensive. As most of the job will be done by contractors, it will be ensured that the contractor's workers are provided with adequate amenities, health & sanitation facilities in the camp by the contractor. Such facilities shall include potable water supply, sanitary facilities, solid waste collection & disposal system, primary health facilities, day care facilities and temporary electrification (if possible). (**Annex-8.2**)
- It will be ensured through contract agreement that the construction workers are

provided fuel for cooking to avoid cutting of trees for fuel wood from the adjoining areas.

- Domestic as well as the sanitary wastes from construction camp will be cleared regularly

437. **Waste Management**

- The Contractor should provide separate garbage bins in the camps for bio-degradable, non-biodegradable waste and ensure that these are regularly emptied and disposed-off in safe and scientific manner.
- The disposal of kitchen waste and other biodegradable matter will be disposed in approved landfills through arrangement with local civic bodies
- Non-biodegradable waste like discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, metal containers, strips and scraps of metal etc. and other such materials will be sold /given out for recycling or disposed in approved landfills through arrangement with local civic bodies.
 - **No incineration or burning of wastes should be carried out.**
- Effluent treatment system like septic tank with soak pits provided for toilets should be sited, designed, built and operated in such a way that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place.
- Soak pits must be provided to collect waste water from bathrooms and kitchen.
- Septic tank must be provided for toilets and the sludge should be cleared by municipal exhausters.

R. **Occupational Health and Safety**

438. **Impacts:** Health & safety related problems to construction workers due to inadequate health & safety measures

439. **Mitigation Measures:**

- Adequate safety measures complying with the occupational safety manuals will be adopted by the contractor to prevent accidents/hazards to the construction workers
- A road safety, traffic management and accident management plan is to be prepared by the Contractor prior to the start of the construction activity
- Periodic health check-up of construction workers will be done by the contractor
- Personal protective equipment will be provided to the construction workers (**Annex-8.10**)

S. **Road Safety**

1. **Construction Phase**

440. **Impacts:** Increase on incidence of road accidents due to disruptions caused in existing traffic movements

441. **Mitigation Measures:**

- Proper traffic diversion and management will be ensured during construction at the intersections and construction areas. Proper warning signs will be displayed at the construction sites (**Annex-8.9**)

- Reduction of speed through construction zones

2. Operation Phase

442. Impacts:

- Impacts on human health due to accidents
- Damage of road due to wear & tear

443. Mitigation Measures:

- 40 nos. of Bus Shelters shall be provided along the project road conforming to design standards.
- Semi-rigid type / rigid type / flexible type safety barriers shall be provided on the high Embankment Section (where the height of embankment is more than 3.0 m) and along the horizontal curve having radius up to 450m for complete length including transition and 20m further before and after.
- Rigid Type such as Concrete Crash Barriers shall be provided on the bridges, isolated structures and its approaches.
- Three types of Road signs shall generally be provided (such as Mandatory / Regulatory, Cautionary / Warnings, and informative signs).
- Locations of Signs shall conform to IRC:67-2012 and Section 800 of MoRT&H Specifications.
- Periodical inspection of the road will be conducted to detect anomalies in pavement
- Disposal of solid waste/ municipal waste along the side of the road should be avoided. The accumulated wastes should be disposed at approved landfill sites. Where such sites are not available within reasonable lead distance, KSHIP should encourage the local municipal / panchayat authorities to identify and develop new landfill sites away from the project for disposal of solid wastes
- The ambulance services to transport serious cases to the district hospital will be introduced and maintained so that serious accident cases can be transported immediately to the nearest district hospital

T. Positive and Beneficial Impacts

1. Construction Phase

- Employment opportunities due to recruitment of local labourers
- Trading opportunities due to procurement of some construction materials locally
- Clean up operations, landscaping and plantations

2. Operation Phase

- Increase in road traffic & transportation activities due to faster accessibility
- Time saving due to faster movement of traffic
- Fuel saving due to faster movement of traffic
- Reduction of air pollution
- Reduction of number of accidents
- Reduction of vehicle operating cost
- Better facilities to road users e.g. bus bay, truck lay-byes etc.

VII. PUBLIC CONSULTATION

A. Approach of Public Consultation Meeting

444. 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 is held open to all general public who are concerned with the project during the initial stage.

445. 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

1. Arrangement

446. Major settlements located close to project roads were selected for conducting public consultation. Venue for the meeting was fixed at local schools in agreement with the school administration. Affected communities and potential stakeholders such as local residents, panchayat members, school 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 is prevented from entering and /or leaving the PCM as he / she shall so desire.

2. Discussions, Questions and Answers

447. 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.

3. Collection of Feedback

448. A feedback questionnaire in local language (Kanada) 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. 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

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

4. Record of the Meeting

449. 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

450. The public consultation meeting schedule for the project road is provided in **Table 128**.

Table 128: Public Consultation Meeting Schedule

SI	Date	Time	Venue	Location Coordinates
PCM-1	8 Dec 2015 Tuesday	10:30 a.m.	Govt. Primary School, Seegalapallya Village	13°26'9.51"N 78°12'8.15"E
PCM-2	8 Dec 2015 Tuesday	11:50 a.m.	Shanta Shrunga P U College, Thadigol Village	13°26'10.56"N 78°12'54.51"E
PCM-3	8 Dec 2015 Tuesday	01:30 p.m.	Bhagwan Buddha High School & ITI College, Kamlavarpalli Village	13°26'22.68"N 78°13'17.94"E
PCM-4	8 Dec 2015 Tuesday	3:00 p.m.	Govt. Lower Primary School, Manchineelkote Village	13°28'37.87"N 78°17'44.17"E



D. Analysis of Collected Feedback\

1. Stakeholders and women participants

451. A total of 167 stakeholders participated in 4 public consultation meetings. Meeting at Bhagwan Budda High School had the highest number of participants (79). Women participants were nearly 50%; highest women participation was observed in kamlavarpalli Village. Gender-wise breakup of participants is provided in **Table 129**.

Table 129: Gender-wise Distribution of Participants in PCMs

SL	Location	Female	Male	Total
PCM-1	Govt. Primary School, Seegalapallya Village	14	30	44
PCM-2	Shanta Shrunga P U College, Thadigol Village	10	11	21
PCM-3	Bhagwan Buddha High School & ITI College, Kamlavarpalli Village	47	32	79
PCM-4	Govt. Lower Primary School, Manchineelkote Village	11	12	23
Total		82	85	167

452. 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 130**. Overall, about 60% of women and 35% of men responded with written response.

Table 130: Gender wise Distribution of Respondents given written feedback

SL	Location	No of responses			% of response w.r.t. total participants		
		Female	Male	Total	Female	Male	Total
PCM-1	Govt. Primary School, Seegalapallya Village	2	11	13	14.3%	36.7%	29.5%
PCM-2	Shanta Shrunga P U College, Thadigol Village	9	7	16	90.0%	63.6%	76.2%
PCM-3	Bhagwan Buddha High School & ITI College, Kamlavarpalli Village	30	9	39	63.8%	28.1%	49.4%
PCM-4	Govt. Lower Primary School, Manchineelkote Village	8	3	11	72.7%	25.0%	47.8%
Total		49	30	79	59.8%	35.3%	47.3%

2. Perception of Participants on Noise Pollution Issues

453. About 72% respondents felt that traffic induced noise pollution could be disturbing. 37% respondents scaled present traffic noise as highly disturbing while another 24% viewed it as moderately disturbing. About 57% of the respondents expected the traffic volume to increase after project implementation. About 40% of the respondents anticipated increased noise level to be high or moderate after project implementation. It may be interesting to note that the anticipation on noise menace due to honking remains more or less same among the respondents in present and future traffic scenarios. The perception of the respondents with respect to noise pollution is detailed in **Table 131**.

Table 131: Perception of Respondents on Noise Pollution due to Traffic

1 Do you feel disturbed due to traffic noise	Yes 72.2%				No 27.8%	
If yes, then Degree of Impact	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Insignificant</i>	<i>Can't Say</i>	<i>Not Applicable</i>
Disturbance from Noise of present traffic	36.7%	24.1%	5.1%	3.8%	2.5%	27.8%
Disturbance from Honking of present traffic	30.4%	27.8%	6.3%	2.5%	5.1%	27.8%
2 Increase in traffic volume after project implementation	41.8%	16.5%	12.7%	7.6%	21.5%	-
3 Do you anticipate change in noise level due to the project?	Increase	51.9%	Decrease	44.3%	No Change	3.8%
If anticipated increase, then Degree of Impact	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Insignificant</i>	<i>Can't Say</i>	<i>Not Applicable</i>
Increase in noise after project implementation	34.2%	6.3%	5.1%	3.8%	2.5%	48.1%
Increase in honking after project implementation	31.6%	7.6%	3.8%	1.3%	7.6%	48.1%
Disturbance due to construction machinery & vehicles	24.1%	19.0%	3.8%	1.3%	3.8%	48.1%

454. PCM wise variation of response on noise pollution is presented in **Table 132**. It may be observed that about high disturbance due to traffic noise and honking has been reported by respondents of Kamlavarpalli Village (PCM-3). The respondents at large, has also expressed concern on the honking noise of the vehicles.

Table 132: PCM wise Variation of Response on Noise Pollution

Parameters➤	Disturbance from traffic noise	Annoyance from existing traffic noise	Annoyance due to honking	Anticipated increase in Traffic Volume	Anticipated annoyance from future traffic noise
Category➤	Disturbed	High	High	High	High
PCM-1	16.5	7.6	5.1	3.8	3.8
PCM-2	15.2	3.8	1.3	19.0	13.9
PCM-3	26.6	16.5	17.7	11.4	11.4
PCM-4	0.0	8.9	6.3	7.6	5.1
Overall	27.8	36.7	30.4	41.8	34.2

3. Perception of Participants on Air Pollution Issues

455. About 73% of the respondents felt that traffic induced air pollution could be disturbing. However, only 29% respondents scaled present air pollution and dust levels due to traffic as highly disturbing while another 23% and 19% respondents viewed the same as moderately disturbing respectively. About 57% respondents expected the traffic volume to increase after project implementation. 85% of them could not identify any other sources of air pollution in vicinity.

456. It is noteworthy that about 46% respondents anticipated improved air quality after project implementation due to better road conditions while 5% of them could not anticipate any change in air quality in future with respect to the present condition. However, 49% 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 more or

less same among the respondents in present and future traffic scenarios. The perception of the respondents with respect to air pollution is detailed in **Table 133**.

Table 133: Perception of Respondents on Air Pollution due to Traffic

4 Do you feel disturbed due to air pollution	Yes 73.4%				No 26.6%	
If yes, then Degree of Impact	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Insignificant</i>	<i>Can't Say</i>	<i>Not Applicable</i>
Disturbance due to air emissions from present traffic	29.1%	22.8%	10.1%	6.3%	5.1%	26.6%
Disturbance due to dust due to present traffic	29.1%	19.0%	7.6%	11.4%	6.3%	26.6%
5 Any other sources of Air Pollution other than traffic	5.1%	2.5%	5.1%	2.5%	84.8%	-
6 Change in air quality due to the project?	Deteriorate 49.4%		Improve 45.6%		No Change	5.1%
If anticipated increase, then Degree of Impact Ø	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Insignificant</i>	<i>Can't Say</i>	<i>Not Applicable</i>
Increase in air pollution due to increased traffic	25.3%	17.7%	2.5%	2.5%	1.3%	50.6%
Increase in dust due to increased traffic	29.1%	7.6%	8.9%	1.3%	2.5%	50.6%
Increase in dust due to construction activity	36.7%	2.5%	3.8%	5.1%	1.3%	50.6%

457. PCM wise variation of response on air pollution is presented in **Table 134**. Highest disturbance (by %) due to present traffic emission has been reported by 15% of the respondents in PCM 3 at Kamlavarpalli village. As evident from the table below, the anticipated air emission and dust pollution in the construction and operation phase has vary to a considerable extent among respondents across all PCMs.

Table 134: PCM wise Variation of Response on Air Pollution

Parameters ➤	Emission from present Traffic	Dust from Traffic Movement	Emission from Future Traffic	Dust due Future Traffic Movement	Emission from Construction machinery
Category ➤	High	High	High	High	High
PCM-1	6.3	6.3	6.3	11.4	10.1
PCM-2	0.0	0.0	0.0	0.0	1.3
PCM-3	15.2	13.9	10.1	10.1	17.7
PCM-4	7.6	8.9	8.9	7.6	7.6
Overall	29.1	29.1	25.3	29.1	36.7

4. Perception of Respondents on Road Safety Issues

458. Respondents were almost unanimous (99%) that the road at the present condition is accident prone and requested to take immediate steps for its improvement. 38% of the respondents feared that construction period may lead to further increase of accidents and adequate safety measures must be enforced.

459. 81% of the respondents wanted pedestrian crossings at important junctions and popular movement locations like schools, hospitals and temples etc. while 62% of them felt speed breakers 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 (75%). 33% respondents viewed regular police petrol can also curb the accident rate while another 41% 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 65% respondents opined that regular road safety education camps and Driver Awareness Programs can also bring down accident rates. The perception of the respondents regarding safety issues is detailed in **Table 135**.

Table 135: Perception of Respondents on Road Safety Issues

Perception on Road Accidents	%
Is the road accident prone?	98.7
Anticipation of increased road accidents in construction phase?	38.0
Choice of People on Road Safety Measures	
Speed Breaker	62.0
Pedestrian crossing	81.0
Road signage	74.7
Improved emergency services	44.3
Police Petrol	32.9
Speed Cameras	40.5
Road safety education camps	67.1
Driver Awareness Programs	64.6

5. Perception of Respondents on Ecology and Biodiversity Issues

460. Only 24% respondents reported sighting of wild animals in the project area. Out of them only 3.8% said prevalence of sighting is high, while 16.5% respondents ranked the sighting prevalence as moderate. 19% of the respondents reported that they experienced crop damage by some time or other by wild animals. Accidents involving wildlife is reported by 5% respondents while injury to human life by wild animals are reported to be very rare event. No wildlife accident spots were identified by the respondents.

461. Respondents reported that major wildlife observed in the project area involves fox, deer, rabbit and wild boars. They opined that flowering and fruit bearing trees like mango should be selected for median plantations. The perception of the respondents regarding ecology and biodiversity issues is detailed in **Table 136**.

Table 136 Perception of Respondents on Ecology & Biodiversity Issues

Indicators	%
Are wild animals sighted in your area?	24.1%
Frequency of Sighting wild animals	<i>High – 3.8%</i> <i>Moderate – 16.5%</i> <i>Low - 3.8%</i>
Crop damage by wild animals	19.0%
Accident involving wildlife	5.1%
Incident on man wildlife conflict	1.3%
Poaching / wildlife trafficking incident in nearby locality	No
Frequently sighted wild animals	Fox, Deer, Rabbit & Wild boar
Frequent Wildlife accident spots, if any	Nil
Preferred tree species in agricultural land boundaries	Mango, Tamarind and Blackberry
Preferred species for roadside plantation	Neem, flowering trees and Mango

E. Outcome of the Public Consultation Meeting

462. The following are the major points of concern of the participants of PCM:

- (i) Stakeholders are concerned about the existing traffic noise and anticipate that increase of traffic flow may lead to increased noise level after project implementation.
- (ii) Majority of the stakeholder are concerned with the existing air emission by the present traffic but their opinion in post project scenario is fragmented to a considerable extent.
- (iii) Stakeholders are unanimously agreed that the road is accident prone and needs immediate improvement.
- (iv) Pedestrian crossing, proper road signage and speed control measures are the most sought after road safety measures by the stakeholders.
- (v) Accident involving wildlife and man-animal conflicts are reported to be rare, though incidents of crop damage by wild boars and deer are moderately reported.
- (vi) Though school authorities and citizens at large are in favour of introducing speed restriction near the schools.
- (vii) Boundary wall acting as noise barriers along the school premises are welcomed by most of the participants, while a few felt high boundary walls should may result obstructed vision and reduced illumination.

F. Consultation in Religious Places

463. To assess the requirement of noise barrier in the religious places along the project road, consultations with stakeholders were carried out. Local devotees, temple owner or trustees and devotees visiting the temples were informed about the impending development.

464. Four temples, as detailed in **Table 137** were selected for such consultation based on its local importance and relative proximity with the proposed alignment.

Table 137: List of Temples Identified for Consultation

S.N.	Description	Village	Existing Ch. km	Design Ch. Km	Side	Distance# (m)
34.	Ramanjenaye Swami Temple	Aimareddihalli	50+760	50+890	LHS	9.10
35.	Sani Mahatma Temple	Marinayakanhalli	54+655	54+794	RHS	8.30
36.	Veeranjeneya Temple	Kodivaripally	56+060	56+200	LHS	15.30
37.	Ramanjeneya Temple	Kossandra	65+930	66+900	LHS	12.40

Distance in meter from existing centerline



Location of Consultations at Religious Places along Chintamani AP Border road

1. Outcome of Consultation at Religious Places

465. The response of the participants varied widely regarding installation of noise barrier, as detailed in **Table 138** below. While participants at Sani Mahatma Temple unanimously ruled out any requirement of boundary wall for mitigating traffic noise, stakeholders at Ramanjeneya temple welcomed the move. This divided opinion was again observed at two other venues as evident from the Table.

466. Some participants showed reservation against construction of boundary wall due to temple aesthetics and accessibility, while those supported the concept were delighted to get a wall constructed around their property at government's expenses as a part of big ticket public expenditure.

Table 138: Outcome of the Consultation at Religious Places

S. N.	Description	No. of participants	Type of Participants	Response of Participants regarding Noise Barrier			
				Yes	%	No	%
1.	Ramanjenaye Swami Temple	13	Devotees, Trustee	6	46	7	54
2.	Sani Mahatma Temple	10	Priest, Devotees, Trustee	0	0	10	100
3.	Veeranjeneya Temple	5	Priest, Devotees	1	20	4	80
4.	Ramanjeneya Temple	8	Priest, Devotees, Trustee	8	100 %	0	0
Overall Response				15	41.7	21	58.3



Photographs of Consultation at Religious Places

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

467. 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. Stage Wise Environmental Management Measures

468. 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. Stage wise management measures are tabulated below:

Table 139: 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 inadequate drainage provisions in habitat areas	<ul style="list-style-type: none"> ▪ Soaked CBR value of sub grade is recommended to be 12 % except for a small stretch (design Ch. Km 78+000 to 86+977) where recommended CBR is 10%. ▪ Overloading to be checked ▪ Raised embankment and provision of roadside drainage to prevent damage to pavement due to water logging on the road and also inconvenience caused to ▪ Provision of adequate no. of cross drainage structures. ▪ Increase (vent and height) in waterway of existing structures. ▪ Roadside drains have been 	Design requirement IRC:37-2012 IRC: 58-2015	Entire stretch Embankment raised for a length of 38.339 km Roadside drains Roadside drains shall be provided on both sides of the embankment. In urban sections lined drains with footpath has been proposed for safety reasons. For rural areas, the drains	<u>MI</u> : Design and number of cross and side drains, slab/box culverts, and Hume pipes <u>PT</u> : Design and numbers are in accordance with site needs	Review of detail design documents & drawings and comparison with site conditions	Design Consultant	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>proposed with suitable outfalls. The Length of lined drain along the project is 1,435m on either side (i.e. 2 x 1,435 = 2,870m) and the length of unlined drain is 38,339m on either side (i.e. 2 x 38,339 = 76,678m).</p> <ul style="list-style-type: none"> Considering the adequacy and hydrological requirements, some additional culverts and replacement of some culverts have been proposed. There are 44 hume Pipe, 27 RCC box and 2 slab culvert have been proposed. In addition to the above there are 46 hume pipe culvert proposed for cross drainage at proposed junctions. 		<p>have been proposed as open and trapezoidal with 2(H):1(V) side slope as per IRC: SP: 73-2015 (Clause 6.2.4). The minimum bed width and depth of flow at starting section shall be 500 mm and 300 mm respectively.</p> <p>For list of bridges, Please refer Table-12 of Chapter-2 of IEE Report</p>				
1.2 Safety along the proposed alignment	<ul style="list-style-type: none"> The project road is having substandard horizontal geometry in some sections. There are about 27 nos. Horizontal curve having radius less than 200m with a design speed of less than the minimum 80 kmph stipulated in code along the project road. To improve safety of road users, realignment have been considered at two locations as part of geometric improvement Safety barriers shall be provided on the high Embankment Section (where the height of embankment is more than 3.0 m) Provision of retro-reflective warning sign boards near school, hospital, religious places and forests Highway lightings including high masts will be provided at intersections in order to improve the night time visibility. All the built up 	<p>Design requirement</p> <p>Vertical geometry will be based on IRC-SP:73-2015</p> <p>IRC:SP:84-2014 IRC SP 87 2013 IRC: 37-2012</p>	<p>Entire stretch</p> <p>At embankment height >3.0 m total length = 5.75 km</p> <p><u>Horizontal Curve:</u> Please refer Annexure-1.2 of Volume-II Design Report</p> <p><u>Vertical Alignment:</u> Please refer Annexure-1.3 of Volume-II Design Report</p>	<p><u>MI:</u> number and location of Semi-rigid type / rigid type / flexible type safety barriers, warning sign boards</p> <p><u>PT:</u> numbers and location are in accordance with site needs</p>	Review of design documents and drawings and comparison with site conditions	Design Consultant	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	locations as well Underpasses has been proposed lighting arrangements. <ul style="list-style-type: none"> Signs and marking viz., cat's eyes, delineators, object markers, hazard markers, safety barriers at hazardous locations Horizontal and vertical geometry as per IRC Specification 						
2. Natural Hazards							
2.1 Flooding / Water-Logging	<ul style="list-style-type: none"> Provision of adequate number of CD structures. Additional culverts have been proposed. All CD structures designed for 50year HFL return period and bridges designed for 100 year HFL return period Water ways of bridges and culverts have been increased. Roadside drains also provided Embankment height raised along low lying/ potential water logged areas Improvement in existing culverts/ Bridges to increase their carrying capacity. 	Design requirement	Entire stretch	MI: Design and numbers of cross & side drains, slab/box culverts Hume pipes, road embankment height, design and number of bridges PT: Design and numbers are in accordance with site needs	Review of design documents and drawings and comparison with site conditions	Design Consultant	KSHIP
3. Loss of Land and Assets							
3.1 livelihood loss to affected persons	<ul style="list-style-type: none"> Road improvement work to be accommodated within available ROW to the extent possible. 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. 	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. and	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	Check LA records; design drawings vs land plans; Interview with affected persons Check status of employment	KSHIP & implementing NGO	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<ul style="list-style-type: none"> ▪ Adhere to the Land Acquisition procedures in accordance to Entitlement Framework. ▪ Compensation and assistance as per project 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 	<p>ADB's Involuntary Resettlement Policy.</p> <p>Contract Clause for preference to local people during employment.</p>		of complaints / grievances. All cases of resettlement and rehabilitation if any are resolved at GRC level. No case referred to arbitrator or court.	given to local people during construction		
4. Felling of Trees and Diversion of Forest Land							
4.1 Loss of trees 4.2 Loss of habitat of avifauna	<ul style="list-style-type: none"> ▪ Geometric adjustments made to minimize tree felling ▪ Tree clearing within ROW would be only those required for enabling construction or to reduce accident. Trees to be felled shall be clearly marked. ▪ Obtain tree felling permission from State Forest Department ▪ Provision of mandatory compensatory afforestation through 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. 	<ul style="list-style-type: none"> ▪ Forest Conservation Act, 1980 ▪ The Karnataka Preservation of Trees Act, 1976 ▪ Environmental Policy of KSHIP 	Throughout the corridor Total number of affected trees= 4802 LHS: 1,971 RHS: 2,831	<p><u>MI:</u> Number and location of geometric adjustments made to avoid forestland and tree cutting, budget amount allocated for compensatory afforestation and additional plantation</p> <p><u>PT:</u> Unnecessary tree felling along the project road avoided; Budget allocation is adequate</p>	Review final design. Check budget provision for compensatory afforestation and additional plantation.	<ul style="list-style-type: none"> - Design Consultant (incorporated in DPR), - Contractor (joint inspection, marking of trees, follow up for clearance) - KSHIP & - Forest Department 	KSHIP & Forest Department
4.3 Diversion of	▪ Diversion of forest land has	Forest	Royalpadu Reserved	<u>MI:</u> Geometric	Review final	- Design	KSHIP &

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
Forest Land	<p>minimized to the extent possible by Geometric adjustments and reducing the RoW or by adopting eccentric widening where forest land is located only on one side of the road.</p> <ul style="list-style-type: none"> Forest area to be diverted is to be marked on ground through a joint inspection with Forest Officials. NoC is to be obtained (FRA Certificate) under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. 	Conservation Act, 1980; Environmental Policy of KSHIP	<p>Forest</p> <p>For location of Reserved forest along the project road, please refer Table No.60 of Chapter-4 of IEE and Section-6.9 of Chapter-6 of IEE</p> <p>Forest land to be diverted : 3.3526 ha</p>	<p>adjustments made to avoid forestland, budget amount for diversion of forest land</p> <p>PT: Unnecessary tree felling on forest land avoided. Budget allocation is adequate,</p>	design. Check budget provision for compensatory afforestation and additional plantation.	<p>Consultant (incorporated in DPR, Preparation of Application for Forest Clearance),</p> <ul style="list-style-type: none"> - Contractor (follow up for Forest clearance) - KSHIP & - Forest Department 	Forest Department

5. Shifting of Utilities

5.1 Disruption of utility services to local community	<ul style="list-style-type: none"> All telephone and electrical poles/wires and underground cables should be shifted before start of construction in any construction zone Bore wells, water supply pipelines and hand pumps located within the proposed RoW should be shifted before start of construction in any construction zone 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 	Project requirement	Throughout the corridor	<p>MI: Number of complaints from local people, number, timing and type of notifications issued to local people, time taken to shift utilities</p> <p>PT: No. of complaints should be 0. Effective and timely notification. Minimal time for utility shifting</p>	Interaction with concerned utility authorities and local public	Contractor/ KSHIP / Utility company	KSHIP / IE
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B. CONSTRUCTION STAGE

1. Air Quality

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
1.1 Dust Generation due to construction activities and transport, storage and handling of construction materials	<ul style="list-style-type: none"> ▪ Transport, loading and unloading of loose and fine materials through covered vehicles. ▪ Paved approach roads. ▪ Storage areas to be located downwind of the habitation area. ▪ Water spraying on the unpaved haulage roads and other dust prone areas. ▪ Provision of PPEs to workers. 	<ul style="list-style-type: none"> - MORT&H Specifications for Road and Bridge works - The Air (Prevention and Control of Pollution) Act, 1981 and - Central Motor and Vehicle Act 1988 - Environmental Policy of KSHIP 	Throughout project corridor	<p><u>MI</u>: PM10 level measurements Complaints from locals due to dust</p> <p><u>PT</u>: PM10 level < 100 µg/m³; Number of complaints should be 0.</p>	Standards CPCB methods; Observations; Public consultation; Review of monitoring data maintained by contractor	Contractor	KSHIP / IE
1.2 Emission of air pollutants (HC, SO ₂ , NO ₂ , CO etc.) from vehicles and use of equipment and machinery	<ul style="list-style-type: none"> ▪ 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 SPCB ▪ Only Crushers licensed by the SPCB shall be used ▪ Hot mix plant should be fitted with dust extraction unit ▪ SPM value at a distance of 40m from a unit located in a cluster should be less than 500 g/m³. 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 	<p>The Air (Prevention and Control of Pollution) Act, 1981 (Amended 1987) and Rules 1982;</p> <p>Environmental Policy of KSHIP</p>	Batching & Asphalt Mixing Plants, Hot Mix Plant, Crushers, DG sets locations	<p><u>MI</u>: Levels of HC, SO₂, NO_x, and CO. Status of PUC certificates</p> <p><u>PT</u>: To keep SO₂ and NO_x levels less than 80ug/m³. PUC certificate of equipment and machinery is up to date</p>	Standards CPCB methods Review of monitoring data maintained by the Contractor	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	source in construction camps instead of wood <ul style="list-style-type: none"> Air quality monitoring as per Environmental Monitoring Program Contractor to prepare traffic management and dust suppression plan duly approved by IE & KSHIP 						
2. Noise							
2.1 Disturbance to local residents and sensitive receptors due to excessive noise from construction activities and operation of equipment and machinery	<ul style="list-style-type: none"> 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 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 Manage smooth traffic flow to avoid traffic jams and honking. Restrict construction near residential, built up and forest areas to daylight hours. Construction of noise barrier at sensitive receptors Initiation of multi-layered plantation, to serve as mitigation option for operation phase 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 	Legal requirement Noise Pollution (Regulation and Control) Rules, 2000 and amendments Thereof; Environmental Policy of KSHIP	Throughout project section especially at construction sites, residential and identified sensitive locations. Refer Table No. 61 and 62 of Chapter-4 of IEE for information on sensitive receptors.	MI: day and night Noise levels. Number of complaints from local people 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	As per Noise rule, 2000 Consultation with local people Review of noise level monitoring data maintained by contractor Observation of construction site	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<ul style="list-style-type: none"> Noise monitoring as per Environmental Monitoring Program 						
3. Land & Soil							
3.1 Land use Change and Loss of productive / topsoil	<ul style="list-style-type: none"> Non-agricultural areas to be used as borrow areas 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-8.1 Hot-mix plants, batching plants, construction camps shall be located at least 500m away from habitation and 1000 m away from forest & wildlife area Land for temporary facilities like construction camp, storage areas etc. shall be brought back to its original land use Detailed site selection criteria for Construction Camp given in Annex-8.2 should be followed. Details of sites identified for Construction Camp should be reported to the Sr. Environmental Specialist of IE for approval in the format as given in Annex-8.13 and format for setting up Construction Camp is given in Annex-8.14 Details of sites identified for establishment of Hot-mix/ Batch mix Plants should be reported to the Sr. Environmental Specialist of IE for approval in the format as given in Annex-8.15 	<p>Project requirement</p> <p>Annex-8.1 Guidelines on Top Soil Conservation and Reuse</p> <p>Annex-8.2 Guidelines for Siting and Layout of Construction Camp</p>	<p>Throughout the project section</p> <p>Land identified for construction camp, storage areas, hot-mix plant, batching plant etc.</p>	<p><u>MI</u>: Location of Construction Camp, Storage Areas, Hot-mix Plant, Batching Plant</p> <p>Top soil storage area</p> <p><u>PT</u>: Zero complaints or disputes registered against contractor by land owner</p>	<p>Visit of construction camp, plant sites; review of the reports submitted by the contractor</p>	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
3.2 Slope failure and Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	<ul style="list-style-type: none"> ▪ 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. ▪ Please refer Annex-8.3 regarding Guideline on Soil Stabilization 	<p>IRC: 56 -1974 recommended practice for treatment of embankment slopes for erosion control Clause No. 306 and 305.2.2 MORT&H</p> <p>Annex-8.3 Guidelines on Soil Stabilization</p>	Throughout the project road	<p><u>MI</u>: Occurrence of slope failure or erosion issues</p> <p><u>PT</u>: No slope failures. Minimal erosion issues</p>	Review of design documents and site observation	Contractor	KSHIP / IE
3.3 Borrow Area Management	<ul style="list-style-type: none"> ▪ Obtain EC from SEIAA before opening any new borrow area. ▪ Comply to EC conditions ▪ 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 habitated 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 	<p>IRC Guidelines on Borrow Areas; Environmental Protection Act and Rules,1986; Water Act 1974; Air Act 1981</p> <p>Annex-8.4 Guidelines on Siting, Operation and Re-development of Borrow Area</p> <p>Environmental Policy of KSHIP</p>	Borrow sites location	<p><u>MI</u>: Existence of borrow areas in inappropriate unauthorized locations. Poor borrow area management practices. Number of accidents. Complaints from local people.</p> <p><u>PT</u>: No case of non-compliance to conditions stipulated by SEIAA in clearance letter. Zero accidents. Zero complaints.</p>	Review of design documents and site observations Compare site conditions with EC conditions by SEIAA	Design Consultant and Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>shall be kept for stockpiling of fertile topsoil. The piles shall be covered with gunny bags / tarpaulin.</p> <ul style="list-style-type: none"> ▪ Slope of stockpile shall not exceed 1:2 (V:H) and edge of pile shall be protected by silt fencing ▪ 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-8.4. ▪ Details of identified sites should be reported to the Sr. Environmental Specialist of IE for approval in the Format given in Annex-8.16 and reporting format for establishment of borrow area given in Annex-8.17 						
3.4 Quarry Operations	<ul style="list-style-type: none"> ▪ 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 Sr. Environmental Specialist of IE & KSHIP. ▪ 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 case of opening new quarry ▪ Quarrying shall be done only after 	<p>IRC Guidelines on Quarry Areas; Environmental Protection Act and Rules,1986; Water Act 1974; Air Act 1981</p> <p>Annex-8.5 Guidelines on Siting, Operation and Re-development of Quarry Area</p> <p>Environmental</p>	Quarry area locations	<p><u>MI:</u> Existence of licenses for all quarry areas from which materials are being sourced</p> <p>Existence of a Quarry Redevelopment Plan</p> <p><u>PT:</u> Quarry license is valid; No case of non-compliance to consent /permit conditions and \ Air quality meets the prescribed limit</p>	Review of design documents, contractor documents and site observation; Compliance to EC conditions in case of opening new quarries	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>obtaining proper permit or license from the Department of Mining and quarrying operation shall comply with the requirements of the State Pollution Control Board.</p> <ul style="list-style-type: none"> ▪ Detailed site selection criteria, operation of quarry area and redevelopment plan given in Annex-8.5. ▪ Details of identified sites should be reported to the Sr. Environmental Specialist of IE for approval in the Format given in Annex-8.18 	Policy of KSHIP					
3.5 Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	<ul style="list-style-type: none"> ▪ 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 and tear to the village /minor roads. ▪ Land taken for construction camp and other temporary facility shall be restored to its original conditions 	Design requirement	Parking areas, Haulage roads and construction yards.	<p><u>MI</u>: Location of approach and haulage roads; Presence of destroyed / compacted agricultural land or land which has not be restored to its original condition</p> <p><u>PT</u>: Zero occurrence of destroyed / compacted land and undestroyed land</p>	Site observation	Contractor	KSHIP / IE
3.6 Contamination of soil due to leakage / spillage of oil, bituminous and non-bituminous debris generated from demolition and road construction	<ul style="list-style-type: none"> ▪ 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. ▪ Unusable debris shall be 	Design requirement	Fuelling station, construction sites, and construction camps and disposal location.	<p><u>MI</u>: Quality of soil near storage area Presence of spilled oil or bitumen in project area</p> <p><u>PT</u>: Soil test conforming to no – contamination;</p>	Site observation	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>dumped in ditches and low lying areas.</p> <ul style="list-style-type: none"> ▪ 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' and 'Hazardous' sold off to MoEF / SPCB authorized vendors ▪ Non-bituminous wastes to be dumped in borrow pits with the concurrence of landowner and covered with a layer of topsoil conserved from opening the pit. ▪ Bituminous wastes will be disposed-off in an identified dumping site approved by the State Pollution Control Board 			No sighting of spilled oil or bitumen in construction site or camp site			
4. Water Resources							
4.1 Sourcing of water during Construction	<ul style="list-style-type: none"> ▪ Requisite permission shall be obtained for abstraction of groundwater from Central Groundwater Authority. ▪ 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 ponds, tanks or wells, specially created tanks or ponds nearby perennial rivers subject to approval of village & local administration. ▪ Water intensive activities not to be undertaken during summer season. ▪ Provision of water harvesting structure to augment groundwater 	CGWA Guidelines	Throughout the Project section	<p><u>MI</u>: Approval from competent authority; Complaints from local people on water availability</p> <p><u>PT</u>: Valid approval from Competent Authority. Zero complaints from local people.</p>	Checking of documentation; Talk to local people	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	condition in the area						
4.2 Disposal of water during construction	<ul style="list-style-type: none"> Provisions shall be made to connect roadside drains with existing nearby natural drains. 	Design requirement	Throughout the Project section	<p><u>MI</u>: Condition of drainage system in construction site; Presence / absence of water logging in project area.</p> <p><u>PT</u>: Existence of proper drainage system. No water logging in project area</p>	Standards methods; Site observation and review of documents	Contractor	KSHIP / IE
4.3 Alteration in Surface Water Hydrology	<ul style="list-style-type: none"> Existing drainage system to be maintained and further enhanced. Provision shall be made for adequate size and number of cross drainage structures especially in the areas where land is sloping towards road alignment. Road level shall be raised above HFL level wherever road level is lesser than HFL. Culverts reconstruction shall be done during lean flow period. In some cases these minor channels may be diverted for a very short period (15-30 days) and will be bring back to its original course immediately after construction. 	Design requirement,	Near all drainage channels, River /Nallah crossings etc.	<p><u>MI</u>: Proper flow of water in existing streams and rivers</p> <p><u>PT</u>: No complain of water shortage by downstream communities. No record of overtopping / water logging</p>	Review of design documents Site observation	Contractor	KSHIP / IE
4.4 Siltation in Water Bodies due to construction activities / earthwork	<ul style="list-style-type: none"> Embankment slopes to be modified suitably to restrict the soil debris entering water bodies. Silt fencing shall be provided along ponds within the direct impact zone intercepting highway to prevent siltation in water bodies. Sediment / silt should be collected 	Design requirement; Worldwide Best Practices; Annex-8.6 Guideline for Sediment Control	Near all water bodies/ waterway Refer Table No. 44 of Chapter-4 of IEE for information on Water Bodies / low lying areas along the project road	<u>MI</u> : Presence/absence of siltation in rivers, streams, nala, ponds and other water bodies in project area; water quality monitoring	Field observation	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>and stockpiled for possible reuse as surfacing of slopes where they have to be re-vegetated.</p> <ul style="list-style-type: none"> ▪ 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-8.6 			<p>PT: No records of siltation due to project activities. Surface water quality tests confirm to turbidity and TSS limit</p>			
<p>4.5 Deterioration in Surface water quality due to leakage from vehicles and equipment and waste from construction camps.</p>	<ul style="list-style-type: none"> ▪ 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 language emergency response procedure, including reporting, will be provided by the contractors ▪ Construction camp to be sited away from water bodies. ▪ Wastes must be collected, stored and taken to approve disposal site only. ▪ Water quality shall be monitored 	<p>The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof;</p> <p>Environmental Policy of KSHIP</p>	<p>Water bodies; refueling stations; construction camps.</p>	<p>MI: Water quality of ponds, streams, rivers and other water bodies in project</p> <p>Presence of oil floating in water bodies in project area</p> <p>PT: Surface water quality meets freshwater quality standards (IS:2296)</p>	<p>Conduction of water quality tests as per the Environmental Monitoring Plan</p> <p>Field observation</p>	<p>Contractor</p>	<p>KSHIP / IE</p>
5. Flora and Fauna							

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
5.1 Vegetation loss due to site preparation and construction activities	<ul style="list-style-type: none"> ▪ Restrict tree cutting up to toe line considering safety to road users. ▪ Roadside trees to be removed with prior approval of competent authority. ▪ 7,145 trees shall be planted on both sides of the project road ▪ 2,100 trees are proposed to be planted in local community area, local schools, partnership with participatory forestry schemes or in degraded revenue land. ▪ 378 trees will be planted in oxbow land ▪ Trees will be planted as per the Tree Plantation Strategy given in Annex-8.12 ▪ Mandatory compensatory plantation is to be done by Forestry Department (1:3) ▪ Total Compensatory Plantation will be 1:5 ▪ Local villagers to be employed for afforestation activities. Employment preference to be given to women ▪ Regular maintenance of all trees planted. ▪ Provision of LPG in construction camp as fuel source to avoid tree cutting. ▪ Plantation of trees on both sides of the road where technically feasible. ▪ Integrate vegetation management (IVM) with the carriage way completely clear of vegetation. ▪ Additional plantation near sensitive receptors, river banks to minimize noise & air pollution and to check erosion. 	<p>Forest Conservation Act 1980; IRCSP:21 and IRCSP:66</p> <p>Environmental Policy of KSHIP</p>	<p>Throughout project corridor</p> <p>Additional Plantation near Sensitive receptors, river banks, borrow areas, quarry area etc.</p>	<p><u>MI</u>: ROW width; Number of trees for felling; Compensatory plantation plan and Number of trees replanted.</p> <p><u>PT</u>: Additional compensatory afforestation done by contractor. Number of trees planted. Tree survival rate is at least 70%.</p>	<p>Review of relevant documents; Tree cutting permit; Compensatory plantation plan; Meeting with villagers; Field Observations</p>	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<ul style="list-style-type: none"> Controlled use of pesticides / fertilizers 						
6. Construction Camp							
6.1 Impact associated with location	All camps should be established with prior permission from SPCB. Camps to maintain minimum distance from following: # 500 m from habitation # 1000 m from forest areas where possible # 500 m from water bodies where possible # 500 m from through traffic route	Design Requirement The Water (Prevention and Control of Pollution) Act, 1974 and its amendments thereof Annex-8.2 Guidelines for Siting and Layout of Construction Camp	All construction camps	<u>MI</u> : Location of camp sites and distance from habitation, forest areas, water bodies and through traffic <u>PT</u> : Distance of camp site is less than 500m from listed locations	On site observation Interaction with workers and local community	Contractor and EO	KSHIP / IE
6.2 Worker's Health in construction camp	<ul style="list-style-type: none"> The location, layout and basic facility provision of each labor camp will be submitted to IE and approved by EA. The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner. Adequate water and sanitary latrines with septic tanks with soak pits 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 Contractor shall conduct monthly health check-ups of all his laborers in his camps through registered medical practitioner 	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	All construction camps	<u>MI</u> : Camp health records. Existence of proper first aid kit in camp site. Complaints from workers. <u>PT</u> : 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	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<ul style="list-style-type: none"> ▪ 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. ▪ No alcoholic liquor or prohibited drugs will be imported to, 	Environmental Policy of KSHIP and provision of ISO:14001:2004					
7. Management of Construction Waste / Debris							
7.1 Selection of Debris Disposal Sites	<ul style="list-style-type: none"> ▪ 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-8.7 ▪ Details of identified debris disposal site should be reported to the Sr. Environmental Specialist of IE for approval in the Format given in Annex-8.19 	Design Requirement; Annex-8.7: Guideline for Siting and Management of Debris Disposal Site, Environmental Policy of KSHIP	At all Dumping Sites	MI: Location of dumping sites of 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	KSHIP / IE
7.2 Reuse and disposal of construction and dismantled waste	<ul style="list-style-type: none"> ▪ The existing bitumen surface shall be utilized for paving of cross roads, access roads, and paving works in construction sites and camps, temporary traffic diversions and haulage routes. 	Design Requirement; Annex-8.8: Guideline for Preparing	Throughout the project corridor	MI: Percentage of reuse of existing surface material Method and location of disposal site of	Contractor records Field observation	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<ul style="list-style-type: none"> ▪ All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. ▪ Unusable and non-bituminous debris materials should be suitably disposed-off at pre-designated disposal locations, with approval of the concerned authority. The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. ▪ Unusable and surplus materials, as determined by the Project Engineer, will be removed and disposed off-site. ▪ Guideline for Preparing Comprehensive Waste Management Plan is given in Annex-8.8 	Comprehensive Waste Management Plan		<p>construction debris</p> <p><u>PT:</u> No public complaint and consent letters for all dumping sites available with contractor or IE</p>	Interaction with local people		
8. Traffic Management and Safety							
8.1 Management of existing traffic and safety	<ul style="list-style-type: none"> ▪ 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 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 	<p>Design requirement and</p> <p>IRC: SP: 27 -1984;</p> <p>IRC:SP: 32 -1988 Road Safety for Children (5-12 Years Old);</p> <p>IRC:SP: 44 -1994 Highway Safety Code</p> <p>IRC: SP: 55 -2001; Guidelines for Safety in Construction Zones;</p>	Throughout the project corridor especially at intersections.	<p><u>MI:</u> Traffic Management Plan. Presence/ absence of safety signs, clear traffic demarcations, flag men etc. on site. Complaints from road users. Number of traffic accidents</p> <p><u>PT:</u> No complaints. No accidents due to poor traffic management. Traffic signs, demarcation lines etc. present in appropriate locations on site</p>	<p>Review Traffic Management Plan;</p> <p>Field observation of traffic management and safety system</p> <p>Interaction with people in vehicles using the road</p>	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed.</p> <ul style="list-style-type: none"> ▪ 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. ▪ Guideline for Preparing of Traffic Management Plan is given in Annex-8.9 	<p>IRC:53:2012 Road Accident recording</p> <p>The Building and other Construction workers Act 1996 and Factories Act 1948</p> <p>Annex-8.9 Guideline for Preparing of Traffic Management Plan</p>					
8.2 Pedestrians, animal movement	<ul style="list-style-type: none"> ▪ Temporary access and diversion, with proper drainage facilities. ▪ Access to the schools, temples and other public places must be maintained when construction takes place near them. ▪ All structures having vertical clearance above 3m and not catering to perennial flow of water may serve as underpass for animals 	Same as above	<p>Near habitation on both sides of schools, temples, hospitals, graveyards,</p> <p>Construction Sites,</p> <p>Haulage roads and diversion sites.</p>	<p>MI: Presence/ absence of access routes for pedestrians. Road signage. Number of complaints from local people</p> <p>PT: Easy access to schools, temples and public places. Zero complaints</p>	Field observation Interaction with local people	Contractor	KSHIP / IE
8.3 Safety of Workers and accident risk from construction activities	<ul style="list-style-type: none"> ▪ Contractors to adopt and maintain safe working practices. ▪ Usage of fluorescent and retro refractory 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, 	<p>Same as above</p> <p>Annex-8.10 Guideline to Ensure Worker’s Safety during Construction</p> <p>Environmental Policy of KSHIP and provision of ISO:14001:2004</p>	Construction sites	<p>MI: Availability of Safety gears to workers</p> <p>Safety signage Training records on safety</p> <p>Number of safety related accidents</p> <p>PT: Zero fatal</p>	<p>Site observation</p> <p>Review records on safety training and accidents</p> <p>Interact with construction workers</p>	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>excavations, trenches and safe means of entry and egress shall be complied with.</p> <ul style="list-style-type: none"> ▪ 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. ▪ Other provisions to ensure Worker's Safety during Construction should be followed as per Annex-8.10. ▪ Guidelines for Storage, Handling, Use and Emergency Response for Hazardous Substances is given in Annex-8.11. ▪ The Safety Checklist given in Annex-8.20 should be submitted to Sr. Environmental Specialist of IE on monthly basis ▪ Reporting format for road safety measures during Construction given in Annex-8.21 should be submitted to IE before start of construction. ▪ On occurrence of any accident or injury, the safety officer should submit an accident report to the IE as per the format given in IRC:53-2012 "Road Accident Reporting" 			accidents. Zero or minor non-fatal accidents.			
8.4 Accident risk to local community	<ul style="list-style-type: none"> ▪ Restrict access to construction sites only to authorized personnel. ▪ Physical separation must be provided for movement of vehicular 	Same as above	Construction sites	MI: Safety signs and their location; Incidents of accidents; Complaints from local	Site inspection Consultation with local	Contractor	KSHIP / IE

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	and human traffic. <ul style="list-style-type: none"> Adequate signage must be provided for safe traffic movement Provision of temporary diversions and awareness to locals before opening new construction fronts. 			people PT: Zero incident of accidents. Zero complaints.	people		
9. Site Restoration and Rehabilitation							
9.1 Clean-up Operations, Restoration and Rehabilitation	<ul style="list-style-type: none"> 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 Environmental officer. All the opened borrow areas will be rehabilitated and 'Engineer' will certify 	Project requirement Annex-8.2 Annex-8.4 Annex-8.5 Annex-8.7 Environmental Policy of KSHIP and provision of ISO:14001:2004	Throughout the project corridor, construction camp sites and borrow areas	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	KSHIP / IE
C. OPERATION AND MAINTENANCE STAGE							
1. Air Quality							
2.1 Air pollution due to due to vehicular movement	<ul style="list-style-type: none"> Roadside tree plantations shall be maintained. Regular maintenance of the road 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 	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981 Environmental Policy of KSHIP	Throughout the Corridor	MI: Air quality monitoring as per post project Environmental Monitoring Program PT: Levels are equal to or below baseline levels given in the IEE report	As per CPCB requirements Site inspection	PIU / Pollution Monitoring Agency	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>consumption.</p> <ul style="list-style-type: none"> Enforcement of vehicle emission rules in coordination with transport department or installing emission checking equipment 						
2. Noise							
2.1 Noise due to movement of traffic	<ul style="list-style-type: none"> Effective traffic management and good riding conditions shall be maintained Speed limitation to 20 km/hour and honking restrictions near sensitive receptors HORN PROHIBITED sign to be placed near educational institutions and medical facilities Noise monitoring. If monitored value exceeds prescribed limit, suitable control measures must be taken. Maintenance of noise barriers near sensitive receptors with the help of local community The effectiveness of multilayered plantation should be monitored. Create awareness amongst the residents about likely noise levels from road operation at different distances, the safe noise limits and easy to implement noise reduction measures while constructing a building near road 	<p>Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof</p> <p>Environmental Policy of KSHIP</p>	Sensitive receptors as identified in the IEE Report	<p>MI: Noise monitoring as per post project Environmental Monitoring Program</p> <p>PT: Levels are equal to or below baseline levels given in the IEE report</p>	<p>Noise monitoring as per noise rules , 2000</p> <p>Discussion with people at sensitive receptor sites</p>	PIU / Pollution Monitoring Agency	KSHIP
3. Land & Soil							
3.1 Soil erosion at embankment during heavy rainfall.	<ul style="list-style-type: none"> Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching etc. Soil quality monitoring. If monitored parameters exceeds prescribed limit, 	Project requirement	At bridge locations and embankment slopes and other probable soil erosion areas.	<p>MI: Existence of soil erosion sites; Number of soil erosion sites</p> <p>soil quality monitoring</p>	<p>On site observation</p> <p>As per CPCB</p>	PIU	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
	<p>suitable control measures must be taken.</p> <ul style="list-style-type: none"> Necessary measures to be followed wherever there are failures 		Soil quality monitoring from different land use area along the project road such as agricultural area, residential area, forest land and low lying areas	<p>as per post project Environmental Monitoring Program</p> <p>PT: Zero or minimal occurrences of soil erosion</p>	requirements		
4. Water Resources / Flooding and Inundation							
4.1 Siltation	<ul style="list-style-type: none"> Regular checks shall be made for soil erosion and turfing conditions for its effective maintenance. 	Project requirement	Near surface Water bodies	<p>MI: Water quality monitoring as per post project Environmental Monitoring Program</p> <p>PT: No turbidity of surface water bodies due to the road</p>	Site observation	PIU	KSHIP
4.2 Water logging due to blockage of drains, culverts or streams	<ul style="list-style-type: none"> 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	<p>MI: Presence/ absence of water logging along the road</p> <p>PT: No record of overtopping/ Water logging</p>	Site observation	PIU	KSHIP
5. Flora							
5.1 Vegetation	<ul style="list-style-type: none"> Planted trees, shrubs and grasses to be properly maintained. The tree survival audit to be conducted at least once in a year to assess the effectiveness 	<p>Forest Conservation Act 1980</p> <p>Environmental Policy of KSHIP</p>	Project tree plantation sites	<p>MI: Tree/plants survival rate</p> <p>PT: Minimum rate of 70% tree survival</p>	<p>Records and field observations.</p> <p>Information from Forestry Department</p>	Forest Department / PIU	KSHIP
6. Maintenance of Right of Way and Safety							
6.1 Accident Risk due to uncontrolled	<ul style="list-style-type: none"> Efforts shall be made to make shoulder completely clear of 	Project requirement	Throughout the Project route	<p>MI: Presence and extent of vegetation</p>	Visual inspection	PIU	KSHIP

Environmental Issues/ Component	Remedial Measures	Reference to laws/ guidelines	Location	Monitoring Indicators (MI) / Performance Target (PT)	Monitoring Methods	Institutional Responsibility	
						Implementation	Supervision
growth of vegetation	vegetation. <ul style="list-style-type: none"> ▪ Regular maintenance of plantation along the roadside ▪ No invasive plantation near the road. 			growth on either side of road. Number of accidents. <u>PT</u> : No accidents due to vegetation growth	Check accident records		
6.2 Accident risks associated with traffic movement.	<ul style="list-style-type: none"> ▪ Traffic control measures, including speed limits, will be forced strictly. ▪ Further 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 ▪ Highway patrol unit (s) for round the clock patrolling. Phone booth for accidental reporting and ambulance services with minimum response time for rescue of any accident victims, if possible. ▪ Tow-way facility for the breakdown vehicles if possible 	IRC:SP:55	Throughout the Project route	<u>MI</u> : Number of accidents and existence of safety signs, rumble strips etc. on the road Presence/absence of sensitive receptor structures inside the stipulated planning line as per relevant local law <u>PT</u> : Fatal and non-fatal accident rate is reduced after improvement	Review accident records Site observations	PIU	KSHIP
6.3.Transport of Dangerous Goods	<ul style="list-style-type: none"> ▪ Existence of spill prevention and control and emergency responsive system ▪ Emergency plan for vehicles carrying hazardous material 	-	Throughout the project stretch	<u>MI</u> : Status of emergency system – whether operational or not <u>PT</u> : Fully functional emergency system	Review of spill prevention and emergency response plan Spill accident records	PIU	KSHIP

EA: Executing Agency, KSHIP: Karnataka State Highways Improvement Authority, EO: Environmental Officer, IRC: Indian Road Congress, IE: Independent Engineer, SPCB: State Pollution Control Board,

The “Project engineer” or “the engineer” is the team of Independent Engineer (IE) responsible for approving the plans, engineering drawing, release of payments to contractor etc. on behalf of the employer (KSHIP). It is usually the team leader of the IE that takes the responsibility of signing approval documents on behalf of the IE team. The “environmental officer” is the environmental specialist under the IE who is responsible for providing recommendations to the IE team leader for approving activities specific to environment safeguards on behalf of “the engineer”.

C. Environmental Policy of KSHIP

469. **The Karnataka State Highways Improvement Project (KSHIP)**, a unit of KPWD, Government of Karnataka, implements improvement in the State's road network to provide safe and efficient road access, that will enhance community livelihood and support economic prosperity in the State.

470. KSHIP seeks to achieve balanced and sustainable outcomes with responsible environmental leadership in all the projects it implements. For achieving the above, KSHIP aims to:

- Comply with all applicable environmental legislation and other requirements
- Protecting & conserving natural resources and enhancing the environmental values while preventing pollution and minimizing the impact on the natural environment
- Implement, maintain and continually improve an effective environmental management system
- Apply an approach of "avoid, minimize and mitigate", to the management of environmental impacts associated with road improvement for its Stakeholders
- Develop awareness of environmental management processes, standards and responsibilities among KSHIP employees, consultants, contractor partners etc.
- Be responsive to community and stakeholder views on environmental issues
- Set specific environmental objectives and targets relating to the key environmental aspects of KSHIP activities; measure and report progress in achieving these targets

471. This policy is established in line with the Vision and Environmental Policy of the KPWD, Government of Karnataka.

D. Emergency Response Plan

472. 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

E. Grievance Redressal Mechanism

473. A project-specific grievance redress mechanism (GRM) will 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.

474. Project area-wide 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.

475. **Grievance Redress Process:** KSHIP PIU has a well-established and functioning grievance redress system. The same system will be followed for this project.

476. **Registering complaints:** Complainants will have the flexibility of conveying grievances/suggestions by registering in the compliant registers placed at contract site offices, SDO & DO offices or by e-mail, or by post, or by registering online of KSHIP website. PIU established a public response centre (PRC) helpline specifically addresses the issues arising out of project implementation. Compliant can be registered via any of the following means:

- (i) Through Public Response Center Help Line 24/7: °
 - Land Line Number: 080-23205995
 - Cell No: 9482079947
 - Skype ID: Kshipprc
 - WhatsApp: 9482079947
 - Email: kshipprc@vindhyainfo.com
- (ii) Through Facebook: www.facebook.com/pwd.KSHIP
- (iii) register online at (<http://www.kship.in/pms/Pub/CHM/frmComplaintNewEn.aspx>)

477. The complaint received at PRC helpline is recorded and transferred to concerned official based on the nature of complaint. Environmental related complaints/grievances are forwarded to the Environmental Specialist of the PIU. ES will review the complaint and forward to the concerned DO for redress. DO will take necessary action on the complaint and if the corrective action is to be taken by the contractor, DO will instruct the contractor to do so. It is required to address the complaint in 28 days, and inform the complainant about redress and the action taken.

478. Following process is followed for the complaints received at the site offices. Careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location and nature of the problem will be undertaken. In case of grievances that are immediate and urgent in the perception of the complainant, the contractor's EHS officer and the Project Manager, and personnel from the PIU engineers on-site will provide the most easily accessible or first level of contact for the quick resolution of grievances. Contact information of responsible officers and contractor staff will be posted at all construction sites in visible locations. The grievance redress process will have following levels:

- **1st Level Grievance:** The complaint will be reviewed by concerned AEE and forwarded to the contractor for immediate resolution of the issue on-site and will be required resolve the issue within 7 days of receipt of a complaint/grievance.

IEs Environmental Management Specialist (EMS) will provide guidance as required by site staff.

- **2nd Level Grievance:** All grievances that cannot be redressed within 7 days at the 1st level will be dealt by at Executive Engineer, DO, with the assistance of IE EMS. If the issue is not resolved in 7 days at EE level, will be brought to the notice of the PIU head office. The Environmental Specialist of PIU will resolve the grievance within 14 days of receipt of a complaint/grievance.
- **3rd Level Grievance:** If the grievance is not resolved at above two levels within 28 days will be referred to the District Grievance Redress Committee (DGRC) headed by the Deputy Commissioner. DGRC will have following members: Assistant Commissioner, independent member from any reputed institution appointed by DC and EE of concerned DO (as member secretary). DGRC meets at the district headquarter as required, and resolve the matter within 30 days of receipt at DGRC.

479. The PIU Environmental Officer (EO) will have the overall responsibility for timely grievance redressal on environmental issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

480. The project GRM notwithstanding, an aggrieved person shall have access to the country's legal system at any stage. That is the choice of the complainant, and can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM

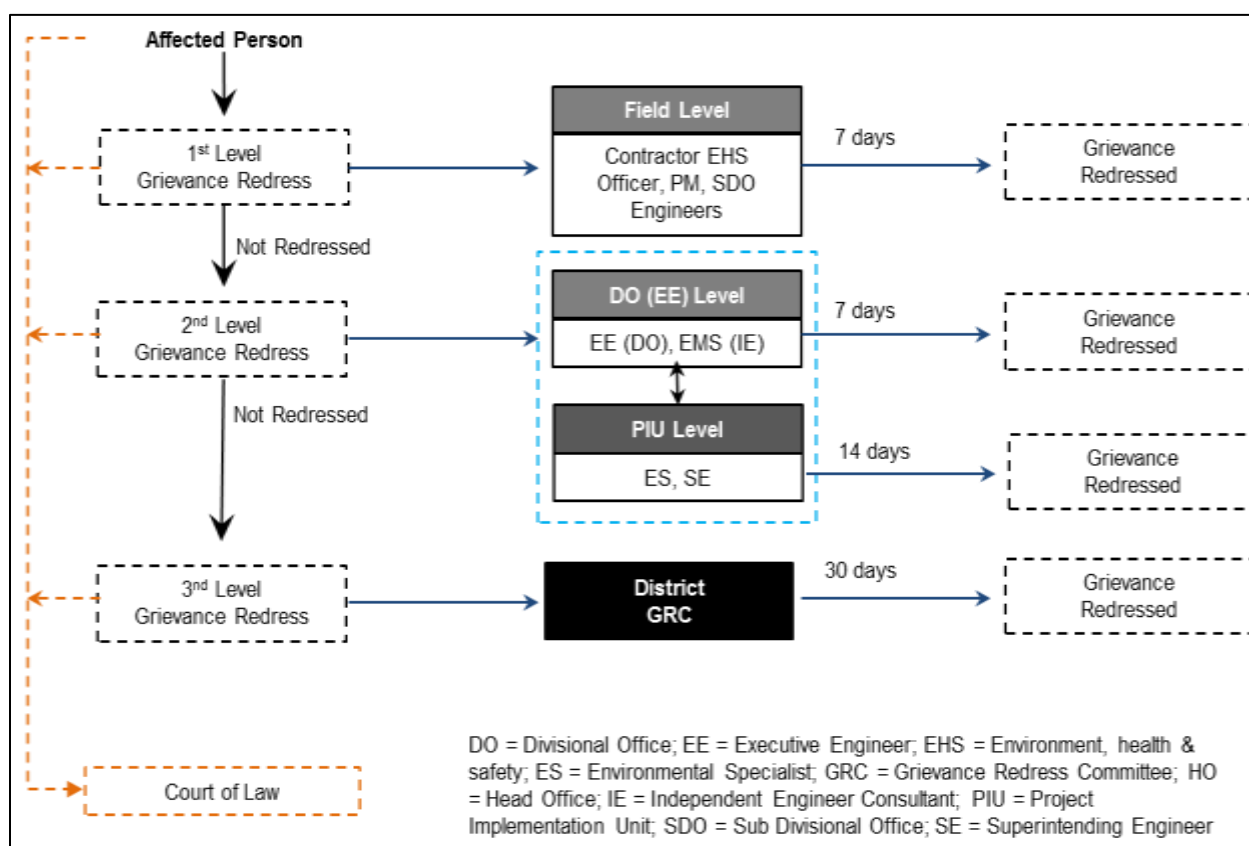


Figure 55: Grievance Redress Process

481. In the event that the established 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. The complaint can be submitted in any of the official languages of ADB's Developing Member Countries. The ADB Accountability Mechanism information will be included in the Project Information Document to be distributed to the affected communities, as part of the project GRM.

482. **Record-keeping:** The PIU will keep records of grievances received, including contact details of the complainant, the date the complaint was received, the nature of the grievance, agreed corrective actions 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 PIU website, as well as reported in monitoring reports submitted to ADB on a semi-annual basis.

483. **Periodic Review and Documentation of Lessons Learned:** The Project Director will 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.

484. **Costs:** All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the PIU.

F. Environmental Monitoring Program

485. 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

486. The environmental monitoring plan contains:

- Performance Indicators
- Environmental Monitoring Program
- Reporting Formats
- Necessary Budgetary Provisions

1. Performance Indicators

487. 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

488. The Performance Indicators and monitoring plans prepared are presented in **Table 140**.

Table 140: 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-8.16	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-8.18	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-8.19	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-8.3)	Air quality	Construction	Contractor through NABL approved monitoring agency
		Noise level	Construction	Contractor through NABL approved monitoring 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.	Progress of measures suggested as part of the strategy is to be reported	Tree plantation	Construction	Contractor
3.	Contractor shall report implementation of the measures suggested for topsoil conservation to Sr. Environmental Specialist of IE	Top Soil Conservation	Construction	Contractor
4.	Contractor shall report implementation of the measures suggested for slope stabilization and sediment control to Sr. Environmental Specialist of IE	Slope Stabilization and Sediment Control	Construction	Contractor

S.N	Details	Indicators	Stage	Responsibility
5.	Contractor shall report implementation of the measures suggested for waste management to Sr. Environmental Specialist of IE	Waste Management Plan	Construction	Contractor
6.	Contractor shall report implementation of the guideline to ensure worker's safety during construction to Sr. Environmental Specialist of IE	Worker's Safety during Construction	Construction	Contractor
C. Operation Stage: Management & Operational Performance Indicators				
1.	The number of trees surviving during each visit will be compared with the number of saplings planted	Survival rates of trees	Operation	Sr. Environmental Specialist of IE up to construction period, and then Environmental Cell of PIU, KSHIP over a period of 5 years
2.	Sr. Environmental Specialist of 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 IE and PIU / KSHIP
3.	The PIU will visit sensitive locations along with the environmental monitoring agency (responsible for monitoring of noise levels during operation stage) to check the efficiency of the noise barriers	Utility of noise barriers for sensitive receptors	Operation	PIU / KSHIP

2. Monitoring Schedule

489. The detail monitoring schedule during construction and operation stages are presented in **Table-8.3**. 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 141: Environmental Monitoring Program

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
Air Quality	Construction ⁹	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO, HC	At 2 locations: Wherever the contractor decides to locate the Batching & Asphalt Mixing Plants, Hot Mix Plant, Crushers, DG sets locations	Twice in a season at one day interval for 3 seasons (except monsoon) Construction work should	Contractor through NABL approved monitoring agency	IE / PIU

⁹ Construction period is 24 months

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
				be in full swing during monitoring <u>Duration:</u> 24 hours		
		PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO,	At 3 locations: Chintamani, Thadigal Cross and Manchineela Kotte	Twice in a season at one day interval for 3 seasons (except monsoon) Construction work should be in full swing during monitoring <u>Duration:</u> 24 hours	Contractor through NABL approved monitoring agency	IE / PIU
	Operation ¹⁰	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO,	At 3 locations: Chintamani, Thadigal Cross and Manchineela Kotte	Once in a season for 3 seasons (except monsoon) <u>Duration:</u> 24 hours	PIU through NABL approved monitoring agency	PIU/KSHIP
Noise Level	Construction	Noise level in dB(A)	At equipment yard and Stone Crusher Unit	4 times a year (in each season) <u>Duration:</u> 24 hours	Contractor through NABL approved monitoring agency	IE / PIU
		Noise level in dB(A)	At 6 locations: - Seegalpalya, - Thadigol Cross, - Kamlavarpalli, - Nelavanki, - Manchineela Kotte - Thopalli	4 times a year (in each season) <u>Duration:</u> 24 hours	Contractor through NABL approved monitoring agency	IE / PIU
	Operation	Noise level in dB(A)	At 4 locations: - Seegalpalya, - Thadigol Cross - Nelavanki, - Manchineela Kotte	Once in every three years <u>Duration:</u> 24 hours	PIU through NABL approved monitoring agency	PIU/KSHIP
Ground Water Quality	Construction	Physical, Chemical & Biological parameters as per IS 10500:2012	At 4 locations: - Seegalpalya, - Thadigol Cross - Nelavanki, - Manchineela Kotte	4 times a year (in each season)	Contractor through NABL approved monitoring agency	IE / PIU

¹⁰ Monitoring in Operation Phase will be conducted in every 3 years for 10 years

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility		
		Parameters	Location	Frequency	Implementation	Supervision	
		However, IE may include additional parameters					
	Operation	Physical, Chemical & Biological parameters as per IS 10500:2012	At 4 locations: - Seegalpalya, - Thadigol Cross - Nelavanki, - Manchineela Kotte	Twice in every three years (Pre-monsoon & post-monsoon)	PIU through NABL approved monitoring agency	PIU / KSHIP	
Surface Water Quality	Construction	Physical, Chemical & Biological parameters as per IS:2296	At 5 locations:	4 times a year (in each season)	Contractor through NABL approved monitoring agency	IE / PIU	
			Design Ch. Km				Village
			65+100				K. Shettihalli
			67+300				Jodi Kothapalli
			78+600				Mandyala
			80+200				Yendaguttapalli
85+750	Gontapalli						
	Operation	Physical, Chemical & Biological parameters as per IS:2296	At 3 locations: Design Ch. Km	Twice in every three years (Pre-monsoon & post-monsoon)	PIU through NABL approved monitoring agency	PIU / KSHIP	
			Village				
			65+100				K. Shettihalli
			67+300				Jodi Kothapalli
			85+750				Gontapalli
Soil	Construction	pH, Conductivity, Organic matter, N, P, Na, K, Pb	At 6 locations: Wherever the contractor decides to locate the Hot Mix Plant; construction camp; remaining 4 will be from different land use area along the project road such as agricultural area, residential area, forest land and low lying areas ¹¹	Once in a year	Contractor through NABL approved monitoring agency	IE / PIU	
	Operation	pH, Conductivity, Organic matter, N, P, Na, K, Pb	4 will be from different land use area along the project road such as agricultural area, residential area, forest land and low lying areas	Once in every three years	PIU through NABL approved monitoring agency	PIU / KSHIP	
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 IE & Contractor	IE / PIU	
Haul Road	Construction	Maintenance of haul roads,	Haul roads & hauling mode	At least twice a day i.e. midday and	Contractor	IE / PIU	

¹¹ Low-lying area means area situated below the normal height or altitude / close to water or ground level

Environment Component	Project Stage	Environmental Monitoring Program			Institutional Responsibility	
		Parameters	Location	Frequency	Implementation	Supervision
		generation of dust.		evening		
Plantation	Construction	Plantation	- Side of the carriageway - Along boundary wall of the schools – Noise Barrier	Once in fortnightly; Comparison should be done for every six months	State Forest Department / PIU	PIU / KSHIP
	Operation	Growth of plantation	- Side of the carriageway - Along boundary wall of the schools – Noise Barrier	Assess growth every year for initial five years	PIU	PIU / KSHIP

Note: 1) Construction period is 24 months

2) Monitoring in Operation Phase will be conducted every 3 years for 10 years.

Note: Karnataka has the following four seasons in the year:

- Winter Season : January to February
- Summer Season : March to May
- Monsoon Season : May to September
- Post-monsoon : October to December

3. Reporting System

490. Reporting system for the suggested monitoring program operates at two levels:

- Reporting of environmental management indicators
- Reporting for operational performance indicators at the PIU level

491. Environmental monitoring involves regular checking of the environmental management issues detailed in the EMP and to ascertain whether the mitigation measures are achieving their objectives, according to the EMP, with the progress of the works. It provides the necessary feedback for project management to keep the program on schedule will still achieving the expected outcomes.

492. The contractor, IE and PIU are three components of the reporting system for environmental conditions and management indicators. The reporting system to be followed in **construction phase** is presented in **Table 126**.

- 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 IE who in turn shall report to the PIU. The Contractor will submit monthly and quarterly environmental compliance reports along with formal monthly and quarterly reporting to the IE.
- The IE will submit separate quarterly environmental monitoring reports to PIU in addition to submission of the summary of the activities of the month in the formal monthly report including any deviations and corrective actions.
- PIU will be responsible for preparation of the targets for identified non-compliances

- A full record of construction activities will be kept as a part of normal contract monitoring system. Reporting and Monitoring Systems for various stages of construction and related activities have been proposed are to ensure timely and effective implementation of the EMP.

493. During the operation phase, the supervision as well as reporting responsibilities will lie with the KSHIP site offices and overall supervision will be the responsibility of Environmental Specialist at KSHIP head office in Bengaluru.

Table 142 Reporting System during Construction Phase

Item	Contractor	Independent Engineer		PIU to oversee compliance monitoring
		Supervision	Reporting to PIU	
Construction Stage				
Monitoring of construction site and construction camp	Before start of Work	Regular	Quarterly	Regular
Pollution Monitoring	As per Environmental Monitoring Program	As per the Schedule	Quarterly	Quarterly
Debris Disposal Area	Weekly	As required	Quarterly	Quarterly
Monitoring of Enhancement Activities	Regular	Regular	Quarterly	Quarterly
Top Soil Conservation & Slope Stabilization	Weekly	Weekly	Monthly	Quarterly
Borrow Area /Quarry Area / Debris Disposal Area	Regular	Weekly	Monthly	Quarterly
Tree felling	Weekly	Weekly	Monthly	Quarterly
Tree Plantation	Monthly	Monthly	Monthly	Quarterly

G. Institutional/Implementation Arrangements

1. Institutional Arrangement

494. Project Implementation Unit (PIU) is responsible for implementation of all the mitigation and management measures suggested in EMP and also make sure that the statutory requirements are not violated during the pre-construction, construction and operation stages of the project. Organizational setup of for PIU is illustrated in the **Figure 56**.

495. The CPO heads KSHIP. He will be responsible for the successful implementation of the Project. The Chief Engineer is also the Project Director in the KSHIP set up for the implementation of the project. The PD is assisted by PIU, Environmental and LAQ wings at the head office. Various wings are functioning under PIU such as Technical, Environment, LAQ, Administration and Accounts.

496. An Environmental Management Plan Implementation Unit (EMPIU) has been created in Project Implementation Unit (PIU) and an Environment Engineer and Assistant Conservator of Forests have ben positioned with support staff to monitor implementation of Environment Management Plan.

497. Project Director will be heading the overall functioning of the PIU. The Executive Engineers (EEs) and supporting staff as employer's representatives nominated for the project

will be responsible for the implementation of the project under the divisions. The Environmental Specialist of the EMPIU will look after the environmental issues during the project preparation, implementation and operation with the assistance of the Sr. Environmental Specialist of the Independent Engineer (IE). The contractor will be responsible for implementation of the EMP in the field. The "Contractors" herein mean the agency hired for execution of the construction works for the respective packages.

2. Implementation Arrangements

498. The KSHIP is responsible for the implementation of the provisions made within the EMP through Independent Engineer (IE) with the help of project offices. The services of Independent Engineer will be procured to assist the site offices for monitoring the environmental aspects of the project during implementation. The IE 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 packages). This team will ensure compliances of mitigation measures and all statutory requirements during implementation and operation of project.

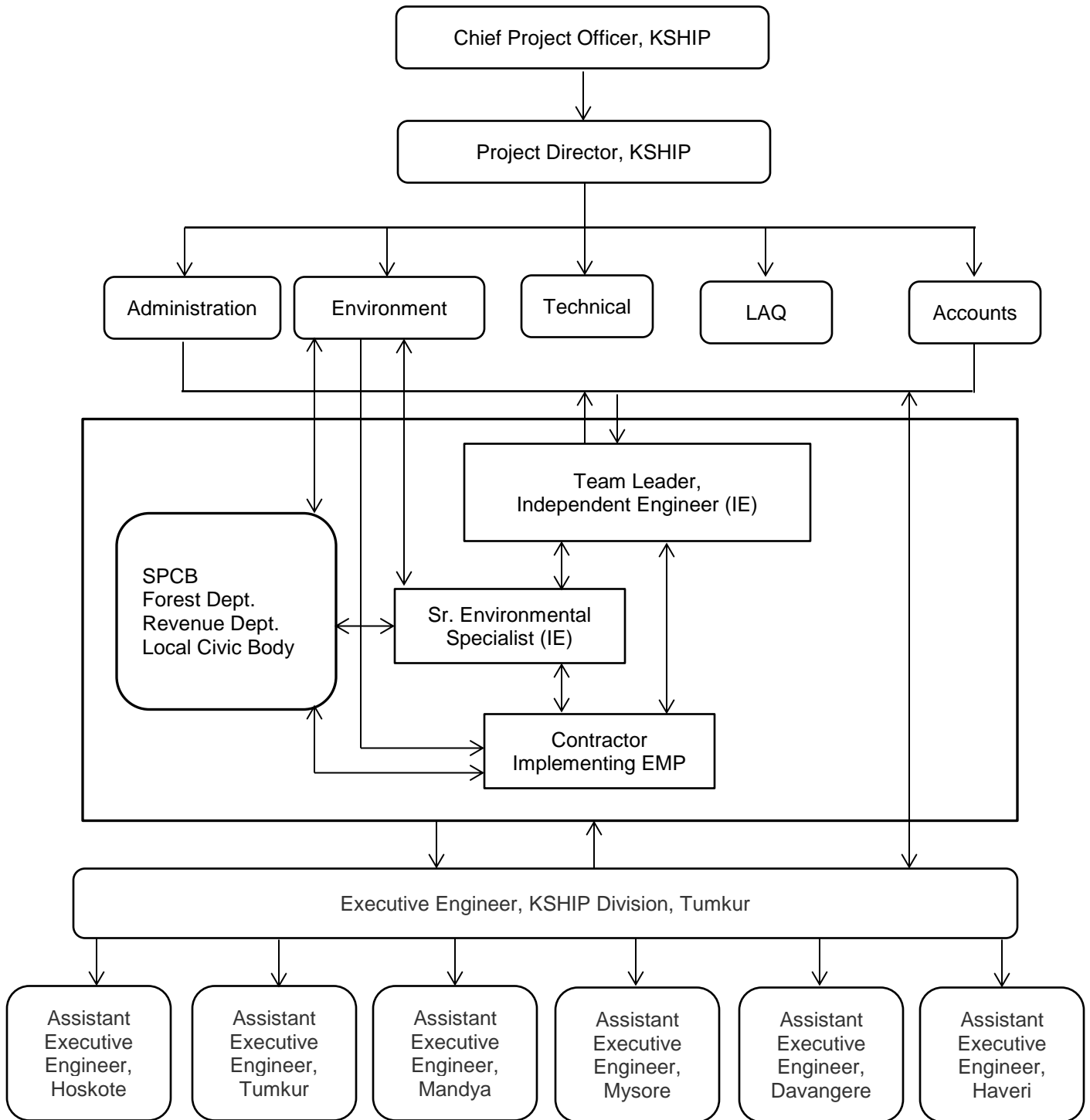


Figure 56: Implementation Arrangement

a. Independent Engineer (IE)

499. The Independent Engineer, to be procured through ICB shall assist the KSHIP with the implementation of project, once the project documents are ready. The Environmental Specialist of the IE shall be the key personnel to ensure the successful implementation of EMP provisions. Since ICB procurement is envisaged, the selected IEs 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 Independent Engineer will be a key position, which can be leveraged to ensure that the Contractor complies with the various EMP requirements.

500. 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.

b. Qualification and Responsibilities of Senior Environmental Specialist of IE:

• ***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 KSHIP 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 KSHIP regarding the progress of environmental works
- Prepare and submit Monthly, Quarterly, Semi-annual and Annual Environmental report to KSHIP
- Develop and organise environmental training programmes to upgrade the skills within the staff of the environmental cell and Contractors
- Document and develop good practices during project implementation for wider dissemination

501. The project will require continuous environmental supervision from the IE's side. Since the **Sr. Environmental Specialist for IE projects 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.

c. Qualification and Responsibilities of Junior Environmental Specialist of IE (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 IE 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's Environmental Officers in implementation of the EMP
 - Assist the Key Environmental Specialist in preparation of monthly, Quarterly, Semi-annual and Annual Environmental reports
 - 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

d. Contractor

502. Execution of works will be the responsibility of the PBDPS Contractor (Performance based Deferred Payment System 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 contractor (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:

e. Qualification and Responsibilities of Environmental Officer 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 IE.
- 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 IE 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 and Quarry Management and other safety, health and environment related Plans for approval of the IE.
- 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 IE.
- Detail out site-specific environmental mitigation and enhancement measures and obtain approval of the IE 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 IE.

- 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

3. Penalty Clause:

- For not employing a full time Environmental Officer (EO), the contractor shall be levied a fine of Rs. 2,000/ every day from his invoice
- The EO shall be approved by the Client
- In case of non-notified absence of the EO (absence to be notified to the authority in writing) for more than 15 days from site, a fine of Rs. 2,000 per day to be levied on the contractor. Eligibility of leave due to the EO shall be as per standard guidelines of the organization.

503. 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.

- **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.
- **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
- **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.
- **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.

H. Institutional Capacity Building

504. 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.

505. 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 / Engineers at PIU and Independent Engineer 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.

1. Training Components

506. The environmental training should encompass the following:

- Understanding of the relevant environmental regulations and their application to the project;
- Environmental & Social Issues in Highway Projects
- Road Safety and Road Safety Audit for Highways
- 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
- Green Highways & Green Infrastructure
- Use of Waste Plastic in Road Construction
- ISO 14001:2004 Environmental Management System

2. Training Program

507. A training program needs to be worked out incorporating the project needs as well as the intermediate-term capacity building needs of the PIU, IE 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.

508. Given below is a list of Training Institutes (**Table 143**) which can be contacted for providing training in various issues related to environmental management as identified in Section H.

Table 143: 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)

Sl. No.	Name of Training Institute
	Email: jahe.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 (CRRRI) P.O. CRRRI, Delhi-Mathura Institute, New Delhi – 110 025 Shri. T. K. Amla, Chief Scientist, Head & Course Organizer Phone: 011 26921939 Email: tkamla.crrri@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.	Kerala Forest Research Institute An Institute of Kerala State Council for Science, Technology and Environment Peechi P.O, Thrissur District - 680653 Kerala Phone: 0487 2690100; Fax: 0487-2690111
6.	National Environmental Engineering Research Institute (NEERI) Nehru Marg, Nagpur – 440020, Maharashtra Phone: 0712 2249885-88; 2249970-72 URL: http://www.neeri.res.in
7.	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: 011 26811833 Email: envirotech@vsnl.com
8.	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
9.	TUV India PVT Ltd 801, Raheja Plaza 1, L.B.S. Marg, Ghatkopar (West) Mumbai – 400086 Phone: +91 22 66477096/ 98, +91 22 66477009 Email: infoindia@tuv-nord.com
10.	SGS India - South 28B/1, 28B/2, 2nd Main Road, Ambattur Industrial Estate Chennai, Tamil Nadu, 600 058 Phone: +91 (0) 44 6608 1600 /1700 / 1800, +91 (0) 87 54 44 6594 (Regional Branch Manager)

I. Environmental Budget

509. 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 KHSIP

510. A capital cost provision of about **Rs. 4.1 Crore** has been kept towards implementation of environmental management plan. Summary of environmental budget is presented in **Table 144**.

Table 144: Environmental Management Plan: Works to be implemented by the Contractor under Civil Works Contracts (Bill of Quantities)

A. Mitigation / Enhancement Budget

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Topography & Geology	Construction	Establishment of Construction Camp	Sq. ft	Area required 100 Sq.ft/ labour; No. of labours: 100 Total area required = (100 x 100) = 10,000 sq.ft	300	3,000,000
Soil	Construction	Bitumen disposal pit for disposal of Bituminous waste generated (23,500 Cum) as per specification given in Figure-6.1 of Chapter-6	No.	43	58,800	2,528,400
Soil	Construction	Slope stabilization	Covered under Engineering Cost			
Air	Construction	Dust suppression with sprinkling of water;	Trip	3 trips per day x 300 days in a year for 2 years = 1,800 trips	500	900,000
Water	Construction	Provision of potable water supply facilities for the construction camps	Month	24	10,000	240,000
Water	Construction	Provision of sewage and sanitation facilities for the construction camps, including maintenance for 2 years	Month	24	10,000	240,000
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.	1 units in a construction yard x 2 locations = 2	10,000	20,000

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Water	Construction	Construction of Sedimentation Tanks in construction yard near to 1) Concrete mix plant and 2) Hot mix plant	No.	1 units in a construction yard x 2 locations = 2	50,000	100,000
Water	Construction	Silt fencing near water bodies, low lying areas and areas identified by the IE	Meter.	445.5	850	378,675
Water	Construction	Rainwater Harvesting Structures	No.	16	62,800	1,004,800
Water	Construction	Enhancement of water body at 1 location as per specification given in the Pond Enhancement Plan (Annex-8.27) and described in Section-6.3.4 of Chapter-6	No.	1	34,11,000	3,411,000
Water	Construction	Phyco-Remediation of water body using NUALGI as per details provided in Annex-8.26	Liter	22.5	9,000	202,500
Noise	Construction	Construction of noise barrier at sensitive receptors along the project road (for details please refer Section 6.5.2 of Chapter-6)	Meter	406	7,500	3,045,000
Vegetation loss	Construction	Provision of fuel in the construction camp	No.	4 commercial LPG Cylinder per month x 24 months = 96 cylinders	1,500	144,000
Fauna	Construction	Bird Wire Fencing along the side of diverted forest land including labour cost	Km	4.5	1,68,000	756,000
Solid Waste Management	Construction	Clearing garbage from construction camp and construction site	Month	24	4,000	96,000
Safety of Workers	Construction	Providing PPE to the labours during the construction	Cost/ person	100	1,200	120,000
Health Checkup	Construction	Provision for biannual health checkups	No.	100 persons x 4 checkups = 400	2,000	800,000
Resettlement & Rehabilitation	Construction	Compensation for structure including affected religious structures, livelihood loss, resettlement assistances & RP implementation	Covered under Engineering Cost			
					Total	16,986,375

Note: 1) Construction period is 24 months/ 2 years

basis of unit cost is the Consultant's past experience in similar projects

B. 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)	5	60	4,000	240,000
	Operation	Once in a season for 3 seasons (except monsoon)	3	27	4,000	108,000
Noise Level	Construction	4 times a year (preferably in each season)	8	64	2,000	128,000
	Operation	Once in every three years	4	12	2,000	24,000
Ground Water Quality	Construction	4 times a year (preferably in each season)	4	32	7,000	224,000
	Operation	Twice in every three years (Pre-monsoon & post-monsoon)	4	24	7,000	168,000
Surface Water Quality	Construction	4 times a year (preferably in each season)	5	40	7,000	280,000
	Operation	Twice in every three years (Pre-monsoon & post-monsoon)	3	18	7,000	126,000
Soil Quality	Construction	Once in a year	6	12	5,000	60,000
	Operation	once in every three years	4	12	5,000	60,000
Transportation of samples to the laboratory	Construction	Immediately after sampling	-	-	Lump sum	200,000
	Operation	Immediately after sampling	-	-	Lump sum	300,000
Grand Total						1,918,000

Note: 1) Construction period is 24 months/ 2 years

2) Monitoring in Operation Phase will be conducted every 3 years for 10 years.

basis of unit cost is the Consultant's past experience in similar projects

Table 145: Environmental Management Plan: Works to be implemented by the KHSIP

C. Forestry Budget

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Forest Land Diversion						
Net Present Value (NPV)	Pre-construction	Diversion of Reserved Forest Land	Ha	3.3526	6,26,000	2,098,728
Compensatory Afforestation	Pre-construction	Mandatory Compensatory Afforestation for diversion of forest land	Ha	3.3526	2,34,000	784,508
Plantation in Oxbow land	Construction	Plantation (378 trees) in realignment section in non-forest stretches as per standard tree plantation program approved by the Forest Department, GoK (location of oxbow plantation is given in Section-6.6.1 of	Ha	1.89	2,34,000	442,260

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
		Chapter-6)				
		Fencing	m	550	168	92,400
Avenue Plantation	Construction	Plantation of trees (one row) on either side of the project road at 10 m interval & its maintenance for 5 years (200 trees / km on both sides) <ul style="list-style-type: none"> ▪ Road side plantation 7,145 trees ▪ Plantation in community area, schools etc.: 2,100 trees 	Nos.	9245	1,911	17,667,195
Total						21,085,091

D. Training & Mobilization Budget

Component	Stage	Item	Unit	Quantity	Cost# (Rs.)	Total Cost (Rs.)
Training and Mobilization	Construction & Operation	Training of Environmental staff of KSHIP involved in the project, staff of IE, contractor, and collaborating Government agencies	Training cost per person	4 persons @ 2 trainings per year	40,000 per training	640,000
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	400,000
Total						1,040,000

basis of unit cost is the Consultant's past experience in similar projects

Table 146: Summary of Environmental Budget

Component	Description	To be implemented by	Amount (Rs.)
A.	Mitigation / Enhancement	Contractor	16,986,375
B.	Environmental Monitoring		1,918,000
Subtotal			18,904,375
C.	Forestry	KSHIP	21,085,091
D.	Training & Mobilization		1,040,000
Subtotal			22,125,091
Grand Total			41,029,466

IX. CONCLUSION & RECOMMENDATIONS

A. Conclusion

511. The proposed project (Chintamani to Andhra Pradesh Border) includes strengthening and widening of existing State Highway (SH-82). No new bypass is proposed, and instead realignments at two locations (total 0.975 km) for improving the road geometrics and meet the project objectives. The length of the project road is **39.774 km**. Project road predominately traverses through plain terrain except small sections which traverses through rolling terrain.

512. The existing road is to be widened to standard 2-lane with paved shoulder configuration based on the traffic projection. To address the safety issue in the built up sections en-route and as per applicable standards, 4-lane divided carriageway with raised median has been proposed at two locations totaling to a length of 600 m. The proposed improvements as far as possible are kept within the existing right of way to avoid / minimize land acquisition.

513. As per ADB Safeguard Policy Statement 2009, proposed project is “**Category B**” project. The Initial Environmental Examination (IEE) Report attempts to identify significant 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. **3.3526 ha** Reserved Forest land is to be diverted for curve improvements for the sake of improved road safety.

514. 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.

515. As per the Government of India regulation, Environmental Clearance is not required for the proposed project. NOC from SPCB is also not required for the proposed project. However, Forest Clearance and Tree Felling Permission from State Forest Department will be required before start of construction.

B. Recommendations

516. Conservation and **Ecosystem Management** has vital role to minimize the impact of highway construction. Maintaining natural flows of rivers, streams etc. without changing the gorge of flow at highway site also contribute to conservation of ecosystem.

517. The use of **Recycled Asphalt Cold Mix** in lieu of Hot Mix Asphalt (HMA) is one of the practices to reduce the lifecycle energy in highway construction. Recycled Asphalt Pavement (RAP) materials generated out of the existing distressed bituminous layers are proposed to be used as the base layer. The single most important justification for use of this technology is that it reduces the emission of greenhouse gases and controls thereby global warming. This would earn tradable carbon credit. Secondly, the technology is quite compatible with Reclaimed Asphalt Pavement technology, which saves the requirement of fresh aggregates and reduces

the environmental hazard associated with dumping of damaged pavement materials. The fumes from Hot Mix Asphalt are known to be potential health hazards, especially for the construction workers. Construction at normal air temperature of the mix avoids this health hazard.

518. **Bio-engineering** is the technique of utilizing vegetation in addressing geotechnical problems, which is the only environment friendly and sustainable technology to control soil erosion and slope stabilization in highway project.

519. **Waste plastic** creates problem to the environment. The best way of disposal of waste plastic is its recycling to the maximum extent and waste plastic has great potential for use in bituminous construction. Plastics increase the melting point of the bitumen as well as its addition in small dose helps in substantially improving Marshall Properties, fatigue life and other properties. Use of this technology can not only strengthens the road construction but also increases the road life, and also help to improve the environment.

520. As discussed above, the Environmental Management Plan has been prepared incorporating various modern technologies and guidelines to reduce the environmental impacts of highway construction to make it a Green Highway. Therefore, it is recommended to strictly follow the EMP and associated Guidelines during construction phase and operation phase of the project.

Green Highway considerations at Construction Stage

- Use of Waste Plastic in Road Construction
- Use of Recycled Asphalt Cold Mix Technology
- Slope stabilization using Coir Geotextile and Vetiver Grass
- Phyco-Remediation of water using NUALGI
- Native indigenous trees species with large canopy cover shall be planted. One sq. m. of green canopy absorb 0.2 kg of CO₂ and other waste gases.
- Preservation of fertile top soil
- Adequate number to cross drainage structures proposed to maintain natural flows of streams without changing the gorge of flow at highway site
- Rainwater Harvesting Structures to improve ground water level
- Provision of LPG in construction camp as fuel source
- Utilization of low electrical equipment viz. CFL, LED etc. in construction camp
- Utilization of solar panels in camps, offices and execution sites
- Disposal of hazardous and non-hazardous waste from construction site and reporting its environmental compliances to concerned authorities
- Use of CNG vehicles
- Reduction in fuel consumption & lower down fuel demand in machinery & vehicles